Our Plan for Customers & Communities

Water Resources Management Plan, 2015-2020

November 2013

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Asset Management document control sheet

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Document approval

Document title	Draft Water Resources Management Plan			
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CEO Foreword

We are pleased to present our Water Resources Management Plan that has been revised following extensive consultation with our customers and stakeholders.

Our vision is to be the leading community-focused water company in the UK, understanding the local needs of the communities we serve in our three regions and ensuring that our service reflects the priorities of our customers.

This Plan is being published following consultation with our customers on our water resources planning strategy and investment for the next 25 years. We will deliver a range of measures across our eight water resource zones to ensure the security of water supplies is maintained into the future whilst reducing the environmental impact of our operations and improving the resilience of our infrastructure to cope with climate variations.

A key challenge for our business will be how we adapt to the reduction in our abstractions from a number of our groundwater sources to improve flows and environmental habitats in local chalk streams. We have agreed sustainability reductions of 70Ml/d with the Environment Agency in our Central and Southeast regions. These reductions represent nearly 6% of our resource base. This Plan is substantially different from our previous plans as we no longer have a surplus of resources and it means we have to replace lost resources by reducing leakage and working with customers to reduce consumption through metering and promoting water efficiency or developing new resources and bringing in new supplies.

We have been proactive in engaging with the water industry regulators to ensure that there is consistency between this WRMP and our Business Plan that will be submitted to the price regulator, Ofwat, in December 2013. Incorporation of customer views is fundamental to both plans so we have consulted in a variety of ways during the spring and summer of 2013.

We have also worked closely with other water companies in the South East of England to explore the potential for sharing regional water resources in the interests of resilience, sustainability, cost and energy efficiency. This work has been valuable and we have used the outcomes of collective modelling work to inform our Plan. We have worked closely with neighbouring companies to ensure our respective Plans agree with regard to water trading.

Our Plan will result in substantial changes to our operations and carries additional risk which means it is essential we work in partnership with our customers to reduce water consumption through universal metering of most households by 2025, water efficiency initiatives and leakage reduction. We will also continue to make best use of existing resources whilst improving resilience to severe drought following the experience of the 'wettest drought on record' in 2012; the unprecedented summer rainfall averted what could have been the worst drought in living memory.

We are committed to providing high quality customer service and take this opportunity to ask our customers and stakeholders to let us know if they agree with our Plan and support the level of service offered. Please let us have your views.

Richard Bienfait
Chief Executive Officer, Affinity Water Ltd.

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Our Plan for Customers & Communities

Summary

We **sought the views of our customers and stakeholders** on our draft Water Resources Management Plan (WRMP) and investment proposals between May and August 2013. In our Statement of Response, we have shown how we have considered each response together with other feedback we received on our Business Plan proposals.

We have **revised our WRMP in response to customer and stakeholder views**, including feedback on our technical analysis from the Environment Agency, Ofwat and the Consumer Council for Water. We have also taken account of the latest data of population and housing growth forecasts, which has altered the scope, scale and timing of investments. Our overall strategy of leakage reduction and, in our Central region, universal metering coupled with enhanced water efficiency activities, together with making best use of our existing supplies and sharing resources with other water companies in the South East of England remains consistent with our draft WRMP. We are confident that our revised WRMP balances the needs of customers and stakeholders as well as those of the environment within a cost envelope that is acceptable.

Our Plan **aligns with the outcomes our customers have told us they want** but in particular with “making sure you have enough water” and “supplying high quality water you can trust”, and all measures needed to implement our WRMP are included in our Business Plan.

As we have a supply / demand deficit in five of our eight zones at the beginning of the planning period and in seven zones by 2040, we have considered a wide range of options to rebalance supply and demand which results in a **substantial investment programme for our Central region**. Our **Southeast region has deficits from 2020**, so we have developed options to address this. Our **East region, WRZ8, remains in surplus throughout the planning period** and no water resources investment is required.

We are pleased to note that **customers generally support our proposals**. The situation in our Southeast region, WRZ7, has also improved since the publication of our draft WRMP. Sustainability reductions in the Little Stour are not now required and therefore water resources investment to 2020 is significantly lower and the only scheme required is flow augmentation on the Little Stour. This investment is included in our Business Plan.

Our Preferred Plan provides for sustainable development of resources, **minimal impact on the environment** and best value to customers. We believe our Preferred Plan represents **good value for money** and **equity for customers** as we work together with our communities to ensure there is enough water for our customers and the environment, now and in the future.

We recognise the **importance of flexibility and resilience** in preparing our Plan and in addressing the significant challenges and uncertainties we face.

We considered the sensitivity of our plan to a number of factors and have chosen a Preferred Plan that is a **balance of demand management and supply side measures**, and therefore risk. In this way, we have further options available in reserve should the preferred strategy options fail to deliver their designed benefits.

We have also reviewed our options in light of the requirements set out by the **Water Framework Directive** and the need to prevent deterioration in ecological status arising from our proposals. We have included provision in our Business Plan under our proposals for a change protocol for further sustainability reductions that are currently classified as 'uncertain' should new obligations arise from the River Basin Management Plans due by the end of 2015.

We will **develop a non-technical summary document** to accompany our WRMP, as suggested by the Consumer Council for Water, to aid customer and stakeholder understanding. We will follow the style of our Business Plan consultation document, which was generally well received. We will publish our non-technical summary together with our final WRMP.

Stakeholder consultation

We received a wide range of views from 81 respondents and the key themes arising from our draft WRMP consultation responses were:

- Support for our plans to reduce leakage beyond the economic level together with a preference for a greater response to leakage management in times of water scarcity;
- Support for our plans to reduce abstraction where environmental damage is occurring, and acceptance for the impact on bills;
- Calls for commitments to fully assess the natural environment, built environment, heritage and archaeological aspects prior to the delivery of the projects in our Preferred Plan;
- A desire to see Affinity take a greater role in championing the protection of rare chalk stream habitats across the South East of England;
- Support for our plans to deliver a programme of universal metering, coupled with water efficiency awareness, to help customers reduce their consumption and save money, but seeking assurance that we have enough flexibility in our WRMP to accommodate variance in our forecast of 13.6% demand reduction;
- However, more information is needed to show that we will be able to support vulnerable customers via transitional arrangements and social tariffs and for the logic underpinning the order of implementation by WRZ;
- Support for drought resilience proposals, and a number of consultees asked us to explain why we had not included reservoirs, desalination and grey water use in the options in our Preferred Plan;
- Requests from third parties for additional clarity about how we had considered options from outside our operating area to manage the supply / demand balance;
- Further explanation about the water use and future needs of non-domestic customers, including the percentage that are metered and consideration for agricultural requirements;
- The need to agree and align bulk transfers between donor and recipient companies.

How our Plan has changed

- We have **carried out a substantial amount of customer and stakeholder consultation** using a variety of methods to establish support for the proposals in our draft WRMP. Generally, our plans were supported. A number of consultees asked for our abstractions to be reduced further, even when not cost beneficial. We have agreed with the Agency where sustainability reductions are to be undertaken where they are found to be cost beneficial and our WRMP remains compliant with the latest information from the Agency (NEP3, August 2013). In our Business Plan, investment is included under our National Environment Programme to implement the confirmed sustainability reductions and continue the investigation of the impact of our abstractions on the environment. We will investigate the potential for further sustainability reductions from the 'uncertain' classification of sources and we have included provision through our Business Plan change protocol for the implementation of these measures, should they be confirmed to us as an outcome of the forthcoming River Basin Management Plans.

– We have also carried out **willingness to pay and bill acceptability studies**. Customers have demonstrated clear preferences for demand management measures (leakage and water efficiency) over increasing abstraction from rivers. Customers that we have engaged with as part of our wider consultation share generally the same views as the consultees responding to our draft WRMP consultation.

– We have **slowed our universal metering programme**, in response to the Consumer Council for Water's comments, so that metering will be delivered approximately equally over two AMPs. We have been developing our communications campaign, taking account of reports such as the Consumer Council for Water's report *The Customer Impact of Universal Metering Programmes (May 2013)*.

– We have continued to work on our **delivery programme for household metering and water efficiency** as well as the introduction of social tariffs and the transition plan to support our customers, as requested by the Consumer Council for Water. We have considered the impact of transitional arrangements on achieving demand savings and to compensate for this, we have enhanced our communications and water efficiency provisions. In this way, we have managed the risk such that it does change the options in our Preferred Plan.

– We have improved our water efficiency programme to **include more educational awareness** and expand the future role of our Education Centre team in Bushey, as many of our customers would like to see us working more with local schools to educate the next generation. We have been able to do this without increasing costs by changing the balance of components of our overall water efficiency programme; this does not have an effect on the options chosen in our Plan.

– We have thoroughly **reviewed our levels of service analysis**, in response to comments from both the Agency and Ofwat, and provided further evidence in support of our assessment. This does not have an impact on the options selected in our Preferred Plan.

  - We plan to introduce a **delay to the implementation of temporary use restrictions for economically vulnerable non-household customers**, such that they receive a slightly higher level of service.
  - We will explain that **emergency drought orders for additional abstraction** where it harms the environment would be at **no greater frequency than 1 in 118 years**.
  - We will clarify that we consider **emergency drought orders for the use of standpipes are unacceptable** and we are not planning for their use in anything other than civil emergency conditions.
  - We will update our Drought Management Plan in 2014 with these changes.

– We have undertaken additional detailed analysis as to how we can continue to supply customers after the **implementation of sustainability reductions**, without affecting their levels of service. There is an additional cost associated with this work that we highlighted in our draft Plan. We have concluded our investigations and are able to explain where we need to make changes to our infrastructure to preserve resilience and the quality of water supplied to our customers for the sustainability reductions to be delivered in AMP6. We have defined all individual project investments to implement what we need to do and how much it will cost, and are pleased to inform our customers that this will cost less than we identified in our draft WRMP.

- We have taken account of the **latest Census data** (2011) in our revised demand forecast. As population is projected to grow at a faster rate than we expected in our draft WRMP, and that our base population was greater than we had planned for in our draft WRMP, we have had to introduce new options to meet the deficits, particularly towards the end of the planning period.
- We have reviewed our **headroom assessment** for our baseline demand forecast to ensure we had fully considered all of the uncertainties around our supply / demand balance. We have responded to feedback on our Plan from Anglian Water and allowed for uncertainties in our supply from our shared resource, Grafham Water. Details of this change are included in our revised WRMP.
- We have **removed a third party licence groundwater option from our feasible options list** in response to the Agency's concerns that there was no existing licence at this location. This option was selected in our draft WRMP but is no longer available for our revised WRMP.
- We have accounted for the **impacts of climate change on our options** in our modelling, as requested by the Agency. This affects a small number of groundwater schemes, and results in these options being less cost-beneficial later in the planning period and so less likely to be selected.
- We have **concluded our negotiations with regard to bulk transfers of water from our neighbouring water companies and other third party suppliers** so that our respective Plans are consistent with WRSE, as requested by the Agency, Ofwat and the Consumer Council for Water. We show our proposed utilisation of the agreed bulk transfers in section 11.4 of our revised WRMP. We have continued to participate in the concluding phase of work of the WRSE project and are pleased with the alignment between our proposals and the outcomes of the WRSE modelling.
- We have **run additional scenarios** to address customers' views, for example offering reservoirs and desalination options taking account of their significant impact on the environment. We have also run scenarios where all options that have been classified as high and medium risk with respect to the environment are not available, to show the impact on costs.
- We have reflected the **uncertainty of our Preferred Plan in our headroom assessment**, as required by the Agency, and discussed its impact on our WRMP. Some consultees were concerned we had insufficient headroom and that we were over reliant on our proposed universal metering programme and bulk transfers from other water companies, who, during drought may be unable to meet our needs. We have also considered contingency options that we may need to develop should our Preferred Plan fail to deliver the benefits projected.
- We have **continued to assess the environmental impact of our options** as part of our SEA, as requested by the Agency and Natural England. Our assessment is that the options in the first ten years of our Preferred Plan will not cause deterioration in ecological status in accordance with the Water Framework Directive and that the options in the remainder of the planning period are very unlikely to cause deterioration. We will continue to review our future projects as part of our annual review of our WRMP, and will investigate potential deterioration effects as necessary so that we are able to draw firm conclusions to ensure no deterioration through adoption of alternative solutions well before any option is included in subsequent WRMPs. This approach does not affect the selection of options in our modelling.

Delivering our Plan in the next five years

In the **immediate five years**, from 2015 to 2020, our Preferred Plan derives:

- A saving of **20Ml/d** in distribution leakage through a number of methods;
- Over **29Ml/d** from universal metering by AMR in four of our six water resource zones in the Central region (with the remaining two WRZ delivered in the following five-year period). This includes 7Ml/d from the repair of leaking customer supply pipes, and around 4Ml/d from the distribution of water efficient devices and in-home water efficiency audits;
- Approximately **2Ml/d** from water efficiency, targeted at our non-domestic customers to help them identify ways to use less water in the operation of their businesses;
- An extra **2Ml/d** from our existing licences, by increasing the amount we abstract without causing damage to the environment. These options also give us an extra 11Ml/d during peak conditions;
- That we buy **17Ml/d** of water from our neighbouring water companies as a bulk transfer of water to make sure we have enough capacity to meet the needs of our customers.

The table below shows the breakdown of total cost by component of our revised WRMP investment programme. The costs are shown in the five-year period in which they are incurred, and are presented in 2011/12 prices. The costs shown include capital investment, operational expenditure, capital maintenance, and environmental, social and carbon costs.

Total Expenditure, £ millions	**AMP6** 2015-20	**AMP7** 2020-25	**AMP8** 2025-30	**AMP9** 2030-35	**AMP10** 2035-40	**TOTAL** 2015-40
Leakage	19.08	14.71	18.22	31.85	44.01	127.87
Metering	57.85	51.29	3.76	35.21	31.23	179.34
Water efficiency	3.16	2.20	0.28	1.07	2.57	9.28
Demand Management schemes	**80.09**	**68.20**	**22.26**	**68.13**	**77.81**	**316.49**
Supply (ground & surface water)	5.26	1.96	0.71	5.52	26.90	40.35
Bulk transfers	0.59	0.60	0.45	2.10	2.90	6.64
Network improvements	0.00	6.73	5.97	2.18	7.67	22.55
Supply side schemes	**5.85**	**9.29**	**7.13**	**9.80**	**37.47**	**69.54**
Total per AMP for Supply and Demand	**85.94**	**77.49**	**29.39**	**77.93**	**115.28**	**386.03**
WFD no deterioration investigative works	0.25	0.25	0.25	0.25	0.25	1.25
Delivery of Sustainability Reductions **	13.54	0.00	0.00	0.00	0.00	13.54
TOTAL	**99.73**	**77.74**	**29.64**	**78.18**	**115.53**	**400.82**

** *The estimated costs to mitigate sustainability reductions beyond AMP7 has not been determined. Our change protocol will apply to ensure that we meet our obligations.*

As a result of discussions with the Environment Agency in November 2013, we have included provision for an early start on the implementation of sustainability reductions measures as part of transitional expenditure in 2014/15 and we have included a change process in our Business Plan to make provision for the implementation of new obligations in AMP6.

We will continue to work closely with our key stakeholders, including the Environment Agency in particular, with regard to the implementation and monitoring of our Plan. The substantial changes we are proposing to our operations to be able to reduce our abstractions will be a challenge but our Plan preserves resilience of supplies to customers at all times.

Table of Contents

Table of Figures

List of Tables

1 Introduction

1.1 Need for a Water Resources Management Plan

Water companies in England and Wales are required by law to produce a Water Resources Management Plan (WRMP) every five years. The Plan must set out how a water company intends to maintain the balance between water supply and demand over a 25-year period. The Plan must been compiled in accordance with the Water Resources Planning (WRP) Guideline developed by Government and water industry regulators. It also takes account of and supports Government policy and aspirations for providing secure, sustainable and affordable water supplies to customers.

This revised draft WRMP has been developed following the consultation on our draft WRMP with our customers, statutory consultees and other stakeholders. It is the first WRMP produced by Affinity Water and covers our entire company water supply area; in the past, as three individual companies, we produced separate Plans for each of our three geographic regions.

The implementation of solutions required in our WRMP will underpin our next regulatory Business Plan, which will submitted to the economic regulator Ofwat in December 2013, who will determine our future water charging price limits.

Alongside compliance with water industry regulations, we are adhering to the following objectives within our WRMP:

– To meet the water supply needs of our customers over the next 25 years;
– To work closely with other water companies in our region to share water resources;
– To ensure that our water abstractions are sustainable and do not damage the environment;
– To reduce leakage from underground water pipes where the savings justify the expenditure and to meet customer expectations;
– To promote water efficiency to support customers and as an aid to reducing demand;
– To extend customer water metering, where cost beneficial, in the interests of fair charging and reducing demand;
– To take account of potential future uncertainties including climate change and higher environmental standards;
– To make best use of existing resources whilst maintaining water quality at all times.

To meet our WRMP objectives, we have:

– Consulted with customers and stakeholders to ensure that our plan takes account of their views;
– Engaged with water industry regulators and statutory consultees.

We aim to compile a balanced plan including a range of option types to provide flexibility and to avoid concentration of risk – we aim to reduce leakage, work with customers to reduce their domestic consumption of water and promote metering as a fair method of charging which reduces demand, whilst balancing the needs of our customers and stakeholders with those of the environment.

1.2 Plan structure

This Plan explains how we have estimated the quantity of water available for supply over the next 25 years and how we have forecasted demand from our customers over the same period. We have then compared the supply and demand figures and, where we do not have enough capacity to meet our customers' needs, investigated options for meeting the future deficit.

Our Plan comprises a summary, the main Plan document, data tables and a series of supporting Technical Reports. Figure 1 describes how we have developed our strategy.

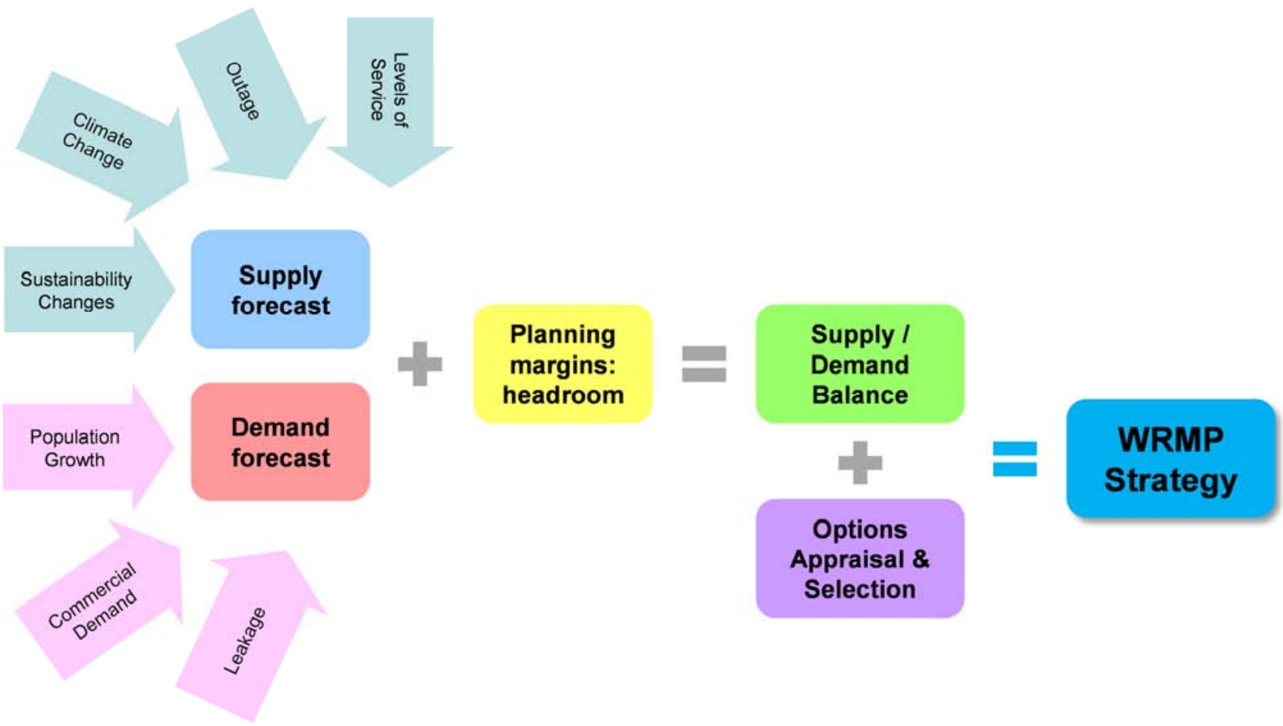

Figure 1: The development of our water resources strategy

We have included allowances in our Plan for reductions in abstractions from some existing groundwater sources where investigations indicate that such abstractions are unsustainable as they are considered to cause a reduction in summer river flows with a consequent negative environmental impact on local water habitats. These are known as **sustainability reductions**.

We have calculated the likely impact of **climate change** on our sources and how it might affect the way our customers use water in the future, and considered it in our Plan.

We have considered **future demand for water** by considering local authority growth projections for domestic housing and the potential for change from our non-domestic customers.

We have considered the uncertainty in all elements of our supply and demand forecasts to establish the risk allowance we need to have in order to manage change. This is our **headroom**.

As we do not have enough water to meet demand in all of our operating areas, we are required to undertake an **options appraisal** to consider ways to resolve the deficits.

Our feasible options to balance supply and demand include schemes to **reduce leakage**, **install more customer meters** and encourage **better use of water** with minimal wastage. These are consistent with Government aspirations to reduce per capita water consumption.

We have also identified possible schemes to provide **additional water resources** from groundwater, surface water and transfers from neighbouring water companies and third parties within and in close proximity to our boundaries. Each of these options has been defined and priced in accordance with the methodology set out in the WRPG.

For each option we have undertaken a **Strategic Environmental Assessment** (SEA) and, where necessary, a **Habitats Regulation Assessment** (HRA), in order to consider whether the option remains feasible should there be environmental concerns.

We have taken an active role in the **Water Resources in the Southeast** (WRSE) project working with the Environment Agency and five other water companies to assess strategic water supply opportunities across the region. The WRSE supply / demand modelling process, encompassing potential options and cross border supplies from all the water companies, has been a crucial component in the development of our plan.

This Plan also describes the **customer and stakeholder consultation** process that has been fundamental to our decision making in setting our water resources strategy and in developing our Business Plan. Feedback from customers has influenced where we target expenditure.

Figure 1 describes the components of our WRMP and their relationships with each other.

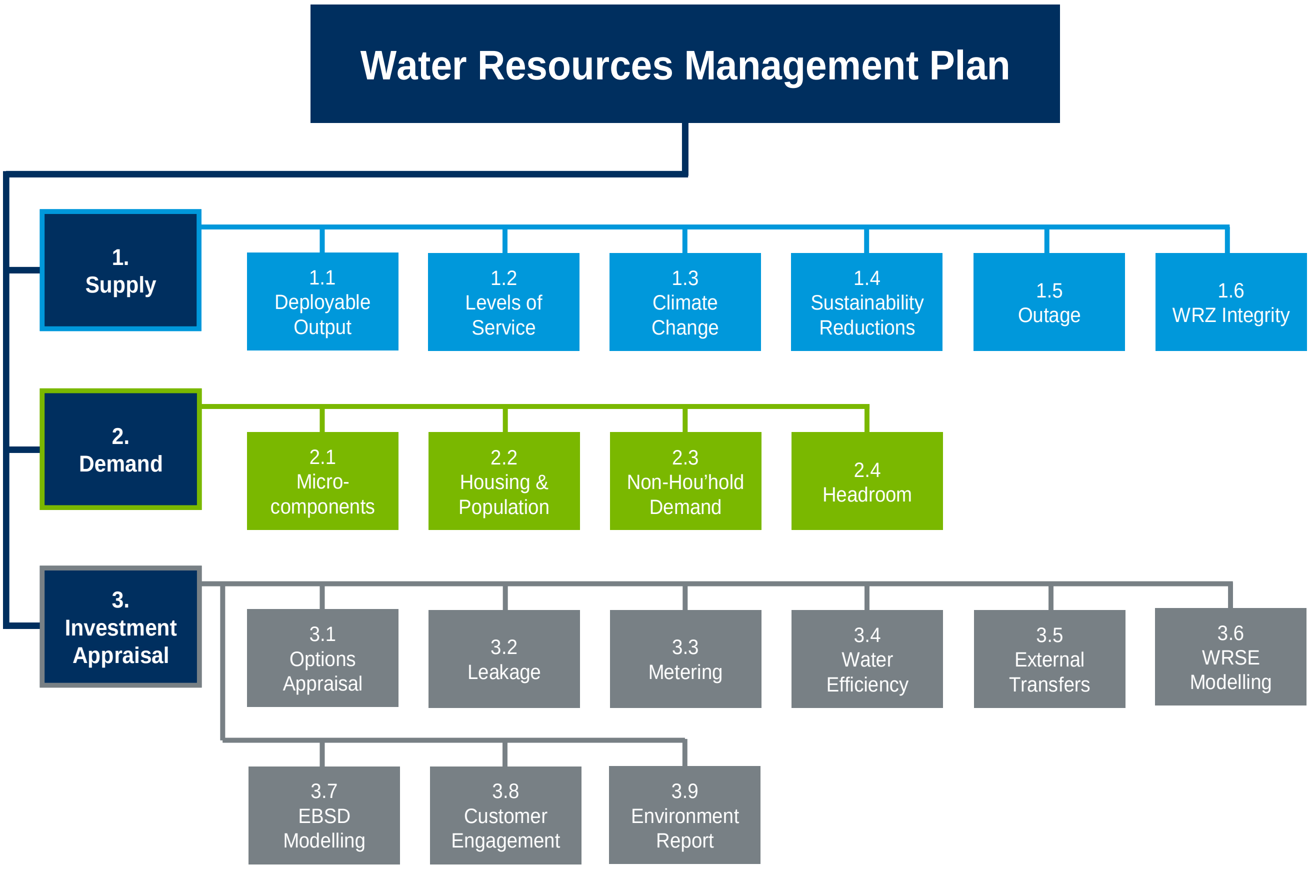

Figure 2: Components of our WRMP

Our WRMP is supported by:

- An Environmental Report describing the Strategic Environmental Assessment and Habitats Regulation Assessment undertaken to assess the impacts of our development options;
- Full results and conclusions from the detailed studies undertaken to produce this plan. These are compiled into separate Technical Reports as listed in this Plan's Appendix A. Reference is made to each Technical Report in relevant sections of this Plan;
- Tables submitted to the Environment Agency with full Plan data;
- The published WRSE Reports (February 2013).

1.3 Timeline

The timeline for our main WRMP activities is shown in Figure 2.

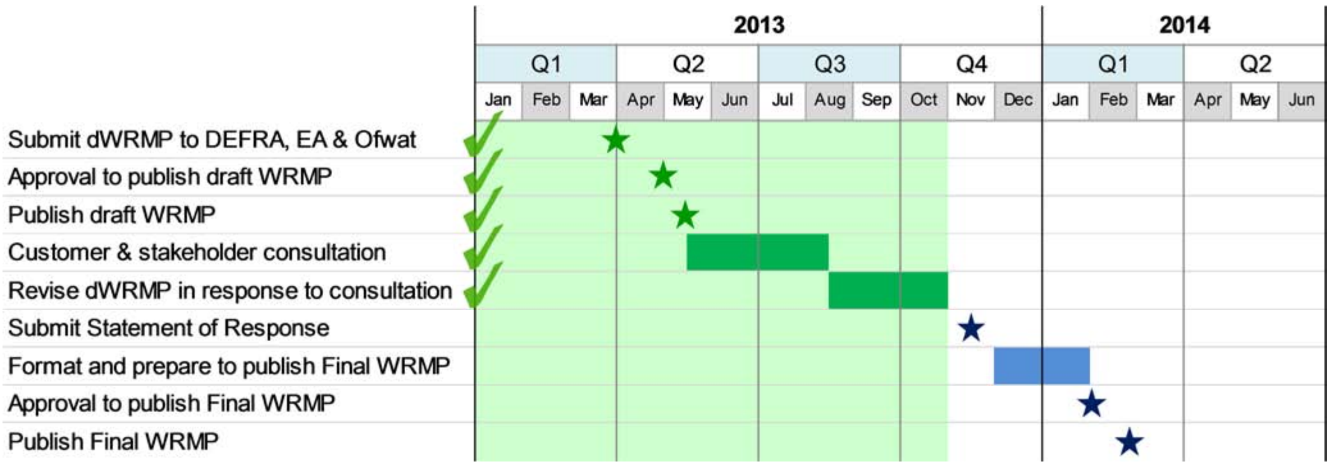

Figure 3: Timeline for WRMP process

We published our draft WRMP on 17th May 2013 following direction from DEFRA and the consultation period remained open for 12 weeks until 12th August 2013.

We are required to submit our Statement of Response by 17th November 2013, and prepared our revised WRMP to support it.

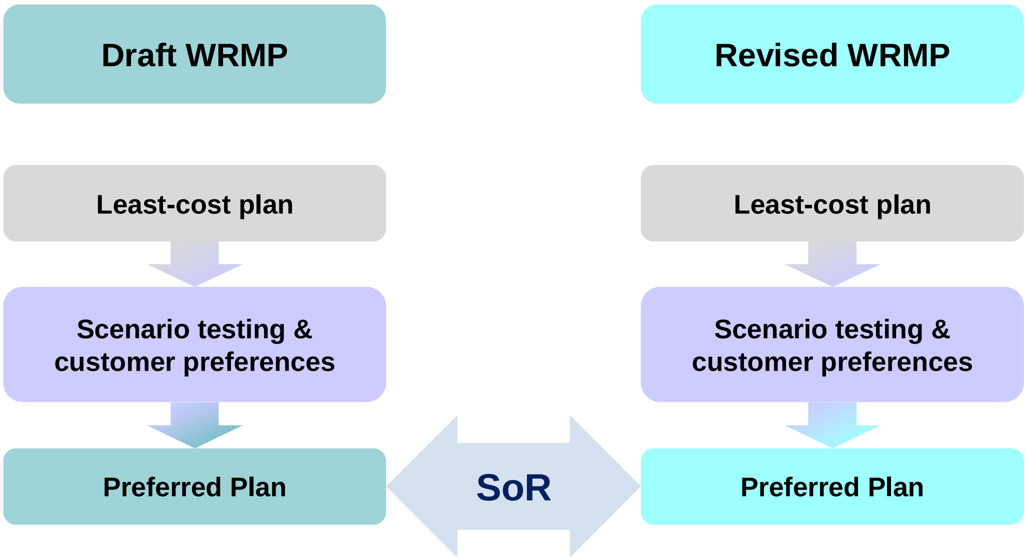

Figure 4: Where our SoR sits between our draft WRMP and revised WRMP

Subject to approval by the Secretary of State, we will publish our final WRMP early in 2014.

1.4 Communicating with our consultees

We invited our customers to submit comments on any aspect of our draft WRMP.

We notified a wide range of key stakeholders and interest groups that our Plan had been published for consultation, as listed in Appendix B: *List of Stakeholders and Consultees* of our draft WRMP. We also contacted these organisations during our pre-consultation stage in 2012, and we advised them again on submission of our SoR.

We will publish our Statement of Response on our website, and we will formally notify all consultees identified in Appendix B of our draft WRMP together with all individuals and organisations who commented on our Plan during the consultation phase. Printed copies of our Statement of Response will be provided on request.

Upon direction from the Secretary of State, we will publish our final WRMP on our website in spring 2014.

Please note that, for security and commercial confidentiality, our technical reports will be restricted and will not be released into the public domain. We will ensure that a copy of our Plan with all associated Technical Reports and tables is available to review in hard copy at our offices in Hatfield.

1.5 Changes that have influenced our revised WRMP

1.5.1 Our consultation

We received **81 responses** from a variety of stakeholders, including the **Environment Agency**, **Ofwat**, **the Consumer Council for Water**, **Natural England**, **English Heritage**, and the **Canal & River Trust** as well as **local authorities** and **parish councils**. We received six responses after the closure of our consultation period, but have chosen to include them in our analysis. We are pleased to have received a considerable number of responses from **residents** living in our area.

> "Please let me know what the follow-ups to your plans are. I would be interested in hearing about them"

1.5.2 Further engagement during the consultation period

The audience for a draft WRMP consultation is self-selecting, such that those who are obliged or feel minded to respond are more likely to give us feedback than customers and stakeholders who have little reason to contact a water company. As responses to consultation of any type tend to reflect the vested interests of the respondents, it is likely that the views expressed in the themes arising from our draft WRMP consultation are biased to their particular views and interests.

We have prepared a new Technical Report, 3.8: *Engaging Customers in Future Planning*, that provides the results of our consultation. Appended to this report is a suite of documents providing detailed results of our engagement programme that we have used to justify the proposals in our revised WRMP. We have prepared this report for submission with our SoR and revised WRMP.

We felt it was important to gather feedback that was **statistically representative of our customer base** as part of our overall business planning engagement programme to compare with the consultees who responded to our draft WRMP consultation to better understand any bias or conflicts between the consultation required by the WRPG and other avenues of engagement.

We have received over 10,000 individual pieces of feedback from customers as part of our Business Plan engagement activity, which includes our draft WRMP consultation. The type, quality and quantity of responses are important for us to consider in assessing all feedback. We developed robust criteria to evaluate the feedback we received in order to understand how responses should **influence**, **inform** and **provide insight** to our Plan.

The additional engagement activities we have undertaken include:

- Questionnaires to our statistically representative online panel;
- A large-scale questionnaire on general water topics called "Let's Talk Water" that received over 3,500 responses;
- Environmental forums with local interest groups and environmental regulators; and
- Deliberative forums with our customers.

We have also carried out **willingness to pay** and **bill acceptability studies** in conjunction with our Business Plan consultation programme. The challenges that our WRMP must address has an impact on our business strategy and it was essential for us to understand customer preferences on all elements of their service, not just having enough water for their needs.

All of the additional engagement that we have carried out during the consultation period is described in detail in Technical Report, 3.8: *Engaging Customers in Future Planning*.

1.5.3 Our Data & Models

Since the submission of our draft WRMP to DEFRA on 30th March 2013, we have updated our models and the data used by those models in light of new information.

- **Updated household and population forecasts** provided by consultants Experian in May 2013, accounting for the Census in 2011, which changes our demand forecast. Not only is our base population greater, population is projected to increase by 17% by 2040, compared to 14% in our draft WRMP;
- Changes to the **volumes of sustainability reductions** following discussions with the Agency, confirmed to us in August 2013, as to how the changes will be implemented at a detailed hydraulic demand zone level and to avoid the wider use of water with elevated levels of metaldehyde to maintain high quality drinking water. Our Southeast region no longer has sustainability reductions, reducing the supply / demand deficit;
- Analysis of the **impacts of the sustainability reductions** in much more detail, within our water resource zones, to ensure that we do not have deficits. We have been able to design the schemes that need to be delivered prior to the implementation of the sustainability reductions to ensure we can supply water to all areas of our Central region, maintain our customers' security of supply and preserve levels of service;
- Further analysis of our **levels of service calculations** and ongoing dialogue with the Agency to ensure that they are satisfied with our rigour. We have clarified how these relate to the levels of service provided to customers;
- Modifications to our **micro-component and demand forecast models** to map directly to the Environment Agency's Water Resource Planning tables to improve quality assurance;
- Reviews of our **headroom assessment** following feedback from our consultees, our auditors and neighbouring water companies to ensure that our assessment of uncertainty and the associated 'buffer' between supply and demand was appropriate and robust. We have agreed with Anglian Water to include the uncertainty associated with the bulk supply we receive from Grafham Water and so our headroom in the early years is higher for our revised WRMP than for our draft WRMP, but lower at the end of the planning period. Our risk profile remains the same;
- Refinement of our **leakage cost curves**, making best use of our leakage management data to ensure that the costs to deliver our leakage options are more accurate. This has resulted in a higher level of background leakage, and a steeper curve for the greater levels of leakage reduction. This change means we have increased the long-term availability of leakage options in our economic modelling;
- Reviewing our **customer supply pipe leakage repair costs**, which we found to be less (on average) than what we had assumed in our draft WRMP. Conversely, evidence from Southern Water's universal metering programme suggests a higher percentage of supply

pipes needed repair than we had assumed in our draft WRMP. Combining these changes meant we increased the forecast of repairs in our metering options, resulting in a higher yield without increasing the total costs. This change improves the cost benefit of metering;

- Checking that **water trading options from neighbouring companies and third parties remained feasible**, updating with latest pricing data where provided. Where companies have entered into heads of terms for bulk supplies, those supplies are no longer available to us as feasible options. We remain consistent with the outcomes of the Water Resources in the South East project;
- Improvements to our **Economics of Balancing Supply and Demand model** to determine more discrete changes in leakage management at Water Resource Zone level. This means our model is able to choose any value for leakage reduction within a given range where it is economic;
- Review of our feasible options costs in light of the **unit cost** work being carried out as part of our Business Plan submission to ensure that the cost build-up from two different methods are comparable;
- Integrating the outcomes of **willingness to pay, bill acceptability** and **customer preference** studies as constraints in our modelling;
- Developing our **community engagement programme** to support universal metering and water efficiency campaigns underpinning our WRMP;
- Reviewing and updating our **Strategic Environment Assessment** of our feasible options to be able to show, as far as reasonably practicable, no deterioration in ecological status as required by the Water Framework Directive.

1.5.4 Governance and assurance

As a result of our draft WRMP consultation period, we have received feedback from the Environment Agency, Ofwat and the Consumer Council for Water. Details of how we have taken account of this feedback is given in Appendices A, B and C respectively.

Following the consultation period, we have received a number of challenges on particular subjects from our Customer Challenge Group. We have responded to these challenges to explain our rationale and justify our proposals.

In September 2013, we were invited to provide additional information on our WRMP and Business Plan to the Environment Agency in order that they would be able to provide their view of the robustness of our Plan to our Customer Challenge Group and to DEFRA. A copy of the information we have provided is included in Appendix B2, including our letter of assurance that we have included all requirements to deliver our WRMP in our Business Plan.

Our Directors and Board have closely monitored the development of our water resources strategy, our WRMP and our supply / demand investment proposals for our Business Plan. Our Board has endorsed our revised WRMP for submission to DEFRA.

At various points in the development of our WRMP, we have been subject to third party audits and assurance of our methods, data, modelling and interpretation. We have taken appropriate action to address areas for improvement, which are addressed by the points described in section 1.5.3.

1.5.5 Our Plan

We have undertaken the work described in sections 1.5.1 to 1.5.4 inclusive in order to present our draft Final WRMP with our Statement of Response, showing how our Plan has changed in response to our customer and stakeholder consultation.

> "It is balancing act between not harming the environment, cost to customers and ensuring we have the water we require"

The Technical Reports in support of our draft Final WRMP have been updated with our latest analysis and have been submitted with our updated Plan.

Our Business Plan has been built on the outcomes of our draft Final WRMP, addressing the outcomes that we agreed with customers as part of our pre-consultation in 2012.

2 Affinity Water Supply Area

2.1 Summary

We supply drinking water to approximately 3.5 million people and 1.4 million properties in the South East of England.

Our supply area comprises three distinct geographic regions, as shown in Figure 3:

– ***Central*** provides water to north London and extends into rural parts of Essex, Hertfordshire and Buckinghamshire, with a population of 3.2 million people;

– ***Southeast*** provides water to the towns of Folkestone and Dover, together with surrounding rural areas including Romney Marsh and Dungeness, with a population of 160,000 people;

– ***East*** provides water to north east Essex including the towns of Harwich and Clacton on Sea, with a population of 156,000 people.

Figure 5: Map of Affinity Water supply area

2.2 Water resources

We currently have 130 groundwater sources, four river intakes on the River Thames, one impounding reservoir and 12 bulk supply imports from neighbouring water companies.

Approximately 65% of our water is from groundwater sources and the rest from surface water. We also provide bulk supply exports to three water companies (reference Technical Report 3.5: *Water Company & Third Party Bulk Transfers*).

Our major water sources and trunk mains for transferring water across our regions are shown in Figure 4, Figure 5 and Figure 6. These maps represent the transfers between our WRZ and Hydraulic Demand Zones (HDZs) and the connections we have with our neighbouring water companies. As a result, our customers benefit from a highly integrated and resilient network. The key to our HDZs is not publicly available for security reasons.

One megalitre, or 1,000,000 litres, is approximately 40% of an Olympic-sized swimming pool

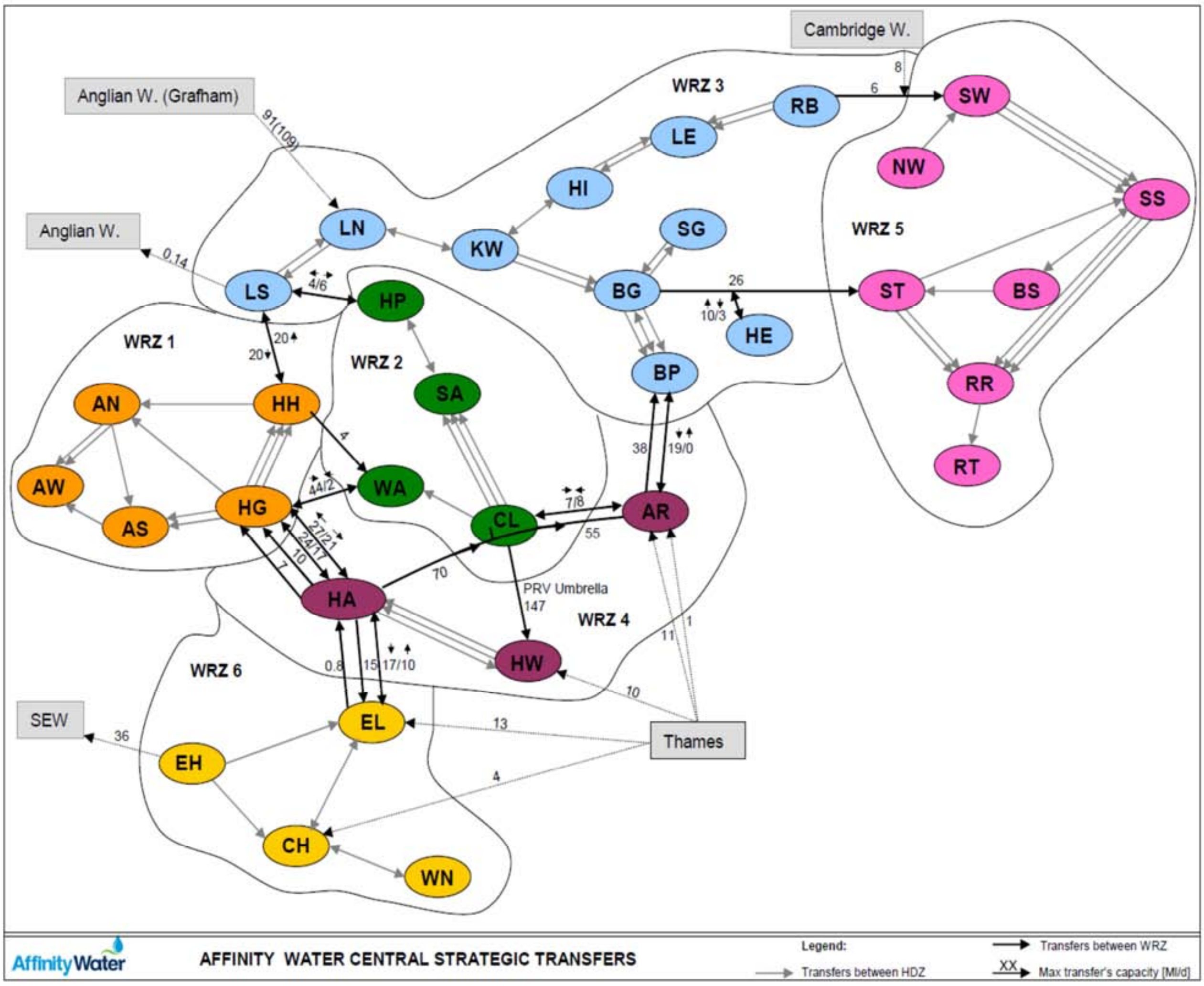

Figure 6: Map of sources and transfers in our Central region

Our Central region abstracts 60% of its water supply from groundwater sources with boreholes abstracting from chalk and gravel aquifers, 40% from surface water sources and imports from neighbouring water companies: Thames Water, Anglian Water and Cambridge Water. We also export water to South East Water and Cambridge Water.

Central:
Average Distribution Input of 875Ml/d

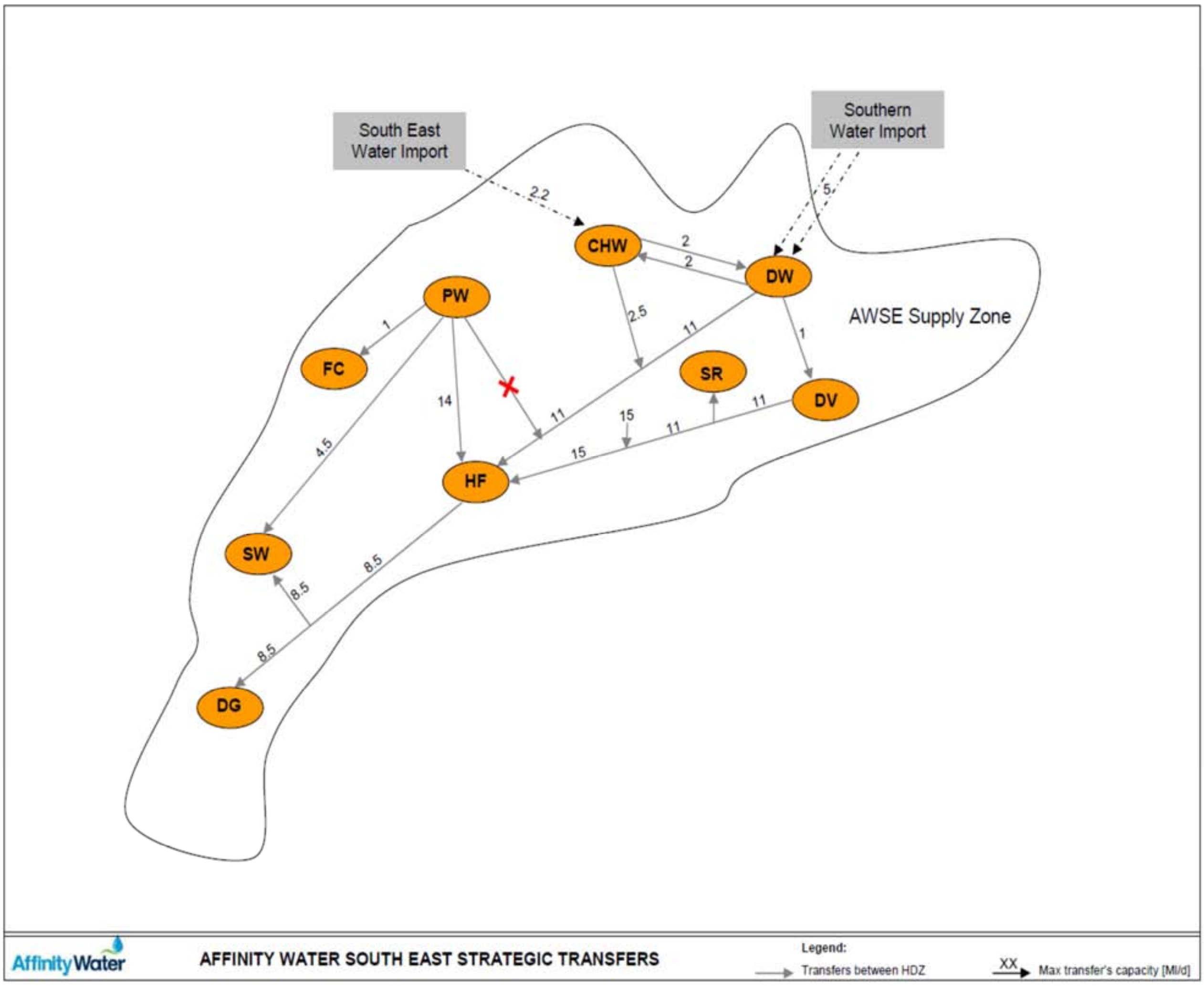

Figure 7: Map of sources and transfers in our Southeast region

Our Southeast region abstracts 90% of its water from chalk and greensand groundwater boreholes with a minor component from the Denge gravels; small amounts of water are also imported from South East Water and Southern Water.

Southeast:
Average Distribution Input of 42Ml/d

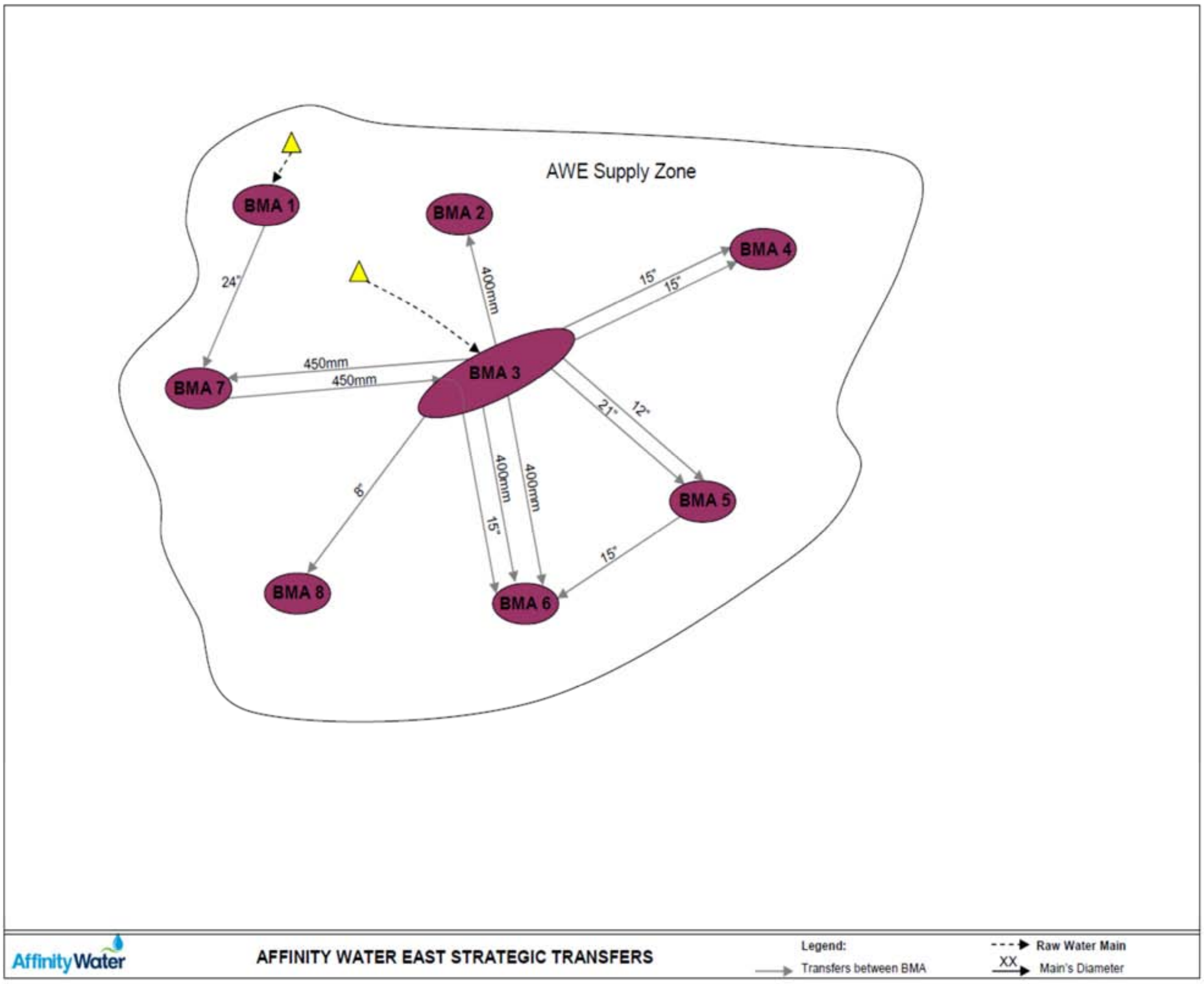

Figure 8: Map of sources and transfers in our East region

East:
Average Distribution Input of 29Ml/d

Our East region normally takes 100% of its water supply from groundwater sources but can also import water from our nearby reservoir, which is jointly owned with Anglian Water.

Although we operate all water supply facilities in our area, other providers can be granted licences by the regulator, Ofwat. Currently there are no other parties who hold licences to abstract and provide drinking water. Sewerage services are provided by other companies, although we bill some of our customers for those services on their behalf.

- *In **Central***, sewerage services are provided by Thames Water and Anglian Water;
- *In **Southeast***, sewerage services are provided by Southern Water, and billed separately;
- *In **East***, sewerage services are provided by Anglian Water.

An indicative diagram showing how water is transferred from source to our customers' taps is shown in Figure 9.

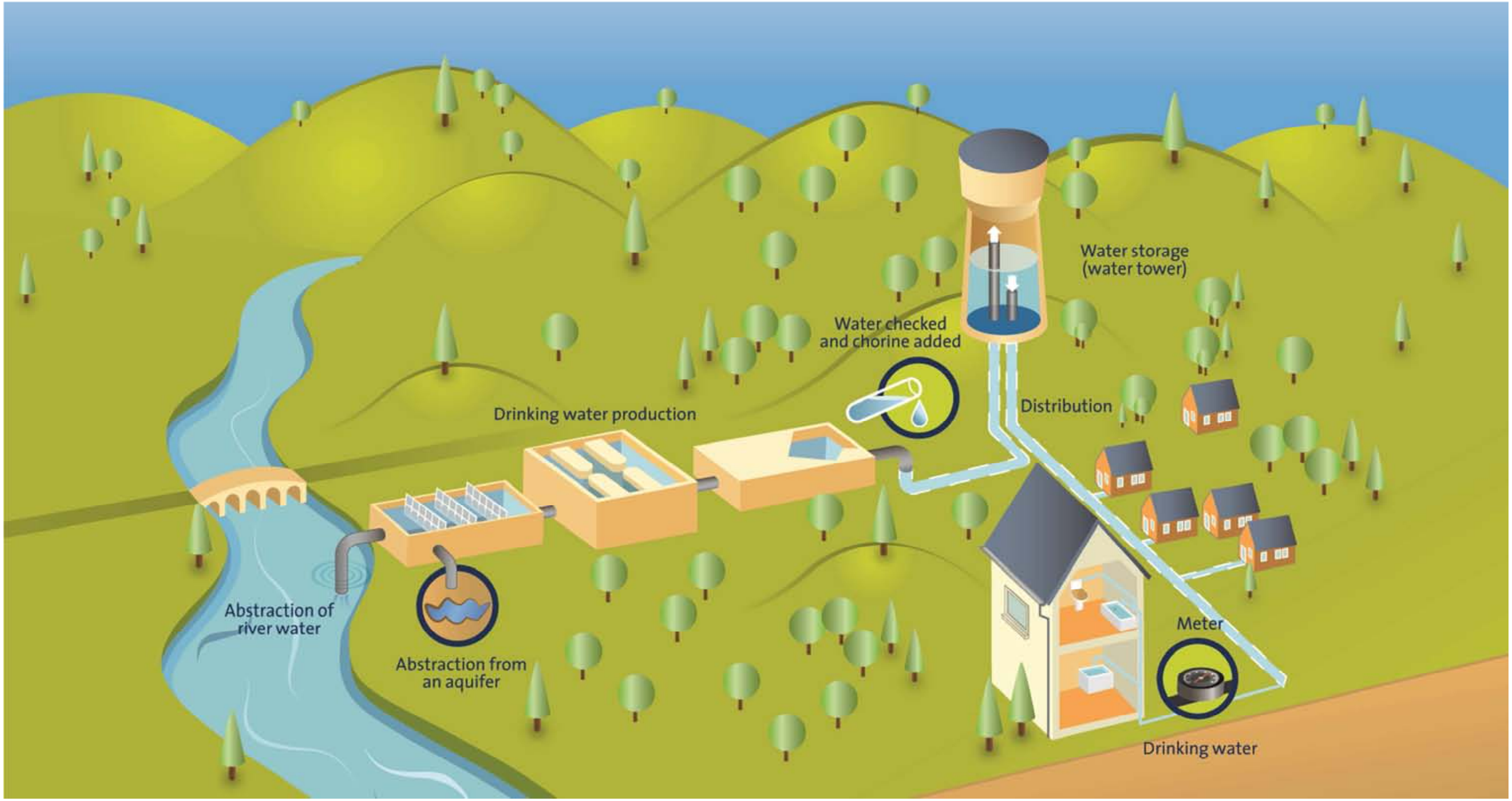

Figure 9: Supplying water to our customers

3 Our planning approach

3.1 Water resource zones

Our supply area is divided into eight water resource zones (WRZs) that are broadly integrated areas in which customers are supplied by a common pipe network from a number of local water sources. We also have the capacity to transfer water between zones to permit operational flexibility. WRZs are created to facilitate assessment of the supply / demand balance. We may not be able to transfer water from every source to all parts of our operating area due to limitations on pipe work, pumping stations or other infrastructure. Pumping water over longer distances is also very energy intensive so it is not cost effective to create fully integrated water networks over a large area. We do, however, have a well-connected network that is made more resilient as a result of a number of connections that we have with neighbouring water companies, facilitating the bulk transfer of water.

We assess our supply / demand balance at WRZ level as well as at the integrated regional and company-wide areas. The WRPG defines a water resource zone as 'the largest possible zone in which all resources, including external transfers, can be shared and, hence, the zone in which all customers will experience the same risk of supply failure from a resource shortfall'. We have undertaken a review of our networks to ensure that our zones meet this definition. Our zones are shown in Figure 10.

Figure 10: Map of water resource zones

Each of our two smaller regions, East and Southeast, operates as an independent resource zone.

Our Central region is divided into six water resource zones. In our previous WRMP, we split the Central region into three zones but we have reverted to six to facilitate assessment of likely sustainability reductions; these are reductions in source outputs agreed with the Environment Agency where water abstractions are considered to be having an impact on environmental habitats.

Sustainability reductions will result in closure of or reduction in abstraction at local water sources so investment will be required in those areas to ensure we continue to meet demand. We explain our approach to planning for sustainability reductions in section 3.3.2, and the investment required to maintain the levels of service to customers in section 11.9. Our work is detailed in Technical Report 1.4: *Sustainability Reductions*.

Our water resource zones also define our communities. These community links were established to ensure that we continue to provide effective delivery of services at a local level. In particular, we want to ensure that the two outlying zones (East and Southeast regions) retain their identities within the unified company. The community-facing elements of our consultation were key to us understanding what customers and stakeholders needed from their local water supplier, so that we could produce a WRMP that reflected their views.

In our draft WRMP consultation, we invited all customers and stakeholders to comment on our proposals from their own local perspective so we could take account of their views in our future plans.

3.2 Affinity Water policies

3.2.1 Levels of service

3.2.1.1 *Introduction*

Water supply **levels of service** are a measure of the likelihood of applying restrictions on customers during drought conditions. Our current target values are:

– Temporary use restrictions – **1 in 10 years**;

– Drought permits for additional abstraction and Drought Orders to reduce essential use – **no more frequent than 1 in 40 years**;

– Emergency Drought Order (rota cuts and deployment of standpipes) – **considered unacceptable**.

“Environmental issues are becoming very important with more frequent drought spells and flooding”

We reviewed our levels of service return periods to determine our ability to achieve these targets using a hindcasting approach. We explain our analysis in detail in the Technical Report 1.2: *Levels of Service Hindcasting*.

As part of the WRMP process, we consulted with customers to consider whether we should change our current target levels of service. Reducing the likelihood of supply restrictions would require us to develop options to make more water available in drought periods so would incur development costs. We explain the outcomes of our consultation in section 10.5.3.

Table 1 summarises our analysis of the calculated **return period** for each of our levels of service, and compares it with our actual level of service provided to our customers. A return period is a statistical measure of the average frequency of an event occurring, and is usually given as a certain “event”; for example, a drought with an average frequency of 1 in 10 years would have a 10-year return period. Our calculations are described in the following sections.

	Drought Zone Trigger Level	Action Level	Action	Customer Level of Service in our draft WRMP	Calculated Return Period (confidence interval)	Revised Customer Level of Service
Increasing Drought Severity	3	3a	Domestic Temporary Use Restrictions	1 in 10	**1 in 10** (1 in 7 to 1 in 17)	**1 in 10**
		3b	Vulnerable non-household Temporary Use Restrictions	~	~	< 1 in 20 *
	4	4a	Drought Orders for non-essential use	1 in 20	**1 in 65** (1 in 50 to 1 in 100)	**< 1 in 40 ***
		4b	Drought Permits for Additional Abstraction	~	~	1 in 75 **
		4c	Drought Orders for restrictions on essential use	~	~	1 in 90 **
	5	5a	Emergency Drought Orders for abstraction causing Environmental Damage	~	**1 in 120** (1 in 100 to 1 in 150)	1 in 120
		5b	Emergency Drought Orders for standpipes and rota cuts	1 in 50	~	**Considered Unacceptable**

Table 1: Our Levels of Service, calculated and actual

** Estimated forecast for implementation of restrictions as these are required in advance of the actual hydrological conditions occurring.*

*** Interpolated return periods for different types of drought orders.*

Restrictions are put in place to reduce demand and increase water availability in times of water stress. As drought severity increases, the measures implemented are more extensive. The timing of these restrictions reflects a change from measures to improve river flows and groundwater storage to those that increase water availability to meet customer demand.

Under drought zone trigger 3, the implementation of temporary use bans restricts demand, which allows reductions on abstractions to conserve storage and improve environmental flows. Under more severe droughts (drought trigger 4), borehole source performance becomes restricted and thus drought orders to reduce water demand and permits for additional abstraction allow increased water availability are required. It must be noted that restrictions under drought zones 4 and 5 (emergency drought orders) are likely to be highly localised where network and borehole performance are restricted.

The frequency of implementation of drought measures may also be greater than the return period of the corresponding groundwater level trigger, as measures must be put in place before the drought event occurs. There may be occasions when the implementation of restriction measures is required because the trigger level is being approached, but groundwater levels subsequently begin to rise, reducing restrictions on our operations, so the level trigger is not reached.

3.2.1.2 Temporary use restrictions

We applied three temporary use restrictions (often referred to as hosepipe bans) across our regions in the last 30 years: in 1991, 2006 and 2012. Our hindcasting analysis confirms that the return period for temporary use bans is between 1 in 7 years and 1 in 17 years. As a result, we consider that our level of service at **1 in 10 years** is validated.

> “We need to be more careful how we use water so if we have to have temporary hosepipe bans to achieve this I find it acceptable”

Following the drought in 2012, in light of the representations from customers and trade associations we received and the revision of the industry Code of Practice on Implementation of Restrictions in Drought, we have reviewed the implementation of temporary use restrictions for non-household customers whose livelihoods may be significantly adversely affected by restrictions. As a result, we have introduced a ‘new’ level of service for our economically vulnerable non-household customers, in that we defer the implementation of temporary use restrictions on them. Consequently, our non-household customers benefit from a higher level of service with less frequent restrictions. However, there is a point at which we would need to ask non-household customers to restrict their use, even if it had an impact on their business, as this must precede any application for a drought order. We estimate the return period for temporary use restrictions for our economically vulnerable non-household customers to be no more frequent than 1 in 20 years. We are proposing to introduce these changes in our Drought Management Plan in the next update.

3.2.1.3 Drought permits

We have only once applied restrictions on non-essential use of non-households, in 1991; therefore, we conclude that the frequency of application of drought orders is better than 1 in 20, which is the stated level of service in our current Drought Management Plan (published in February 2013).

Following our draft WRMP consultation, the Agency highlighted a concern that our levels of service in our Drought Management Plan were stated differently to those in our draft WRMP; the former stated “no more frequent than 1 in 20 years”, whilst the latter stated “1 in 20 years”. Consequently, we have consulted with the Agency and reviewed our analysis together to ensure a more complete understanding of our position.

Our hindcasting assessment considered the frequency of groundwater levels below the relevant drought trigger (zone 4) for this level of service from 1920 onwards. This resulted in a calculated return period of 1 in 65 years. Modelled groundwater levels in our trigger observation wells are very sensitive to small variances in rainfall records. Allowing a standard error of 3% gives a confidence range of 1 in 47 to 1 in 100.

We propose to update our Drought Management Plan with a stated level of service for drought permits of **no more frequent than 1 in 40 years**. Whilst this appears conservative in comparison to our calculated return period, there will be occasions where we will need to impose restrictions in order to be able to prepare for the next level of drought, should that event occur. There will also be occasions when we impose restrictions but do not proceed to the next level of drought preparedness as our groundwater stocks recover.

> “The importance of water supply cannot be overstated and it is reasonable for there to be restrictions when there is a drought”

3.2.1.4 Emergency drought orders for additional abstraction

It should be noted that drought groundwater levels associated with an emergency drought order are lower than previously recorded and consequently it is not possible to predict the actual behaviour of the chalk and abstraction at levels lower than this.

The Agency highlighted a concern that our levels of service in our Drought Management Plan were stated differently to those in our draft WRMP; the former stated “considered unacceptable”, whilst the latter stated “1 in 50 years”. On reflection, we feel that our draft WRMP was unduly cautious and we have reviewed our position. We have consulted with the Agency and reviewed the outcomes of our analysis together.

In order to estimate a possible level of service for emergency drought orders, a decrease in water level of one metre below the lowest recorded groundwater level, drought zone 4 (Drought Orders for Additional Abstraction) was applied. This resulted in a calculated return period of 1 in 118 years. It must be noted that this return period is highly uncertain and should be considered with a broad confidence range (i.e. 1 in 120 +/- 30 years).

We are of the opinion that the use of standpipes is no longer an appropriate drought response as it is not compatible with regulatory water quality requirements. Our initial customer feedback is also strongly opposed to the use of standpipes; the majority of customers believe that standpipes are unacceptable in a modern civilised society. As a result, the level of service for emergency drought orders as stated in our Drought Management Plan remains correct, in that we **consider them unacceptable**.

> “Standpipes are not an option in the 21st century”

Regrettably, in today’s world with emerging threats such as terrorism, we feel that it would be inappropriate to state that we are certain in the resilience of our system such that we would *never* use standpipes. As a result, we consider that standpipes would only ever be deployed as a last resort in the event of a civil emergency and more than likely at a very local level for a short period of time to deal with a significant threat.

3.2.1.5 *Assessing the Impact of Level of Service Restrictions and Sustainability Reductions on Deployable Output*

The WRPG and the Environment Agency have indicated that we should test the impact of three sets of levels of service restrictions on deployable output. We discuss this work in detail in Technical Report 1.2: Level of Service Hindcasting. 12% of our normal year average groundwater DO is affected by low groundwater levels. Our levels of service are equivalent to the Industry Standard Levels of Service (1 in 10 years for temporary use bans, 1 in 40 years for non-essential use bans). To test the impact of these restrictions, we undertook lumped parameter groundwater modelling for two scenarios:

1. A nine month period of restrictions, covering 6 months of temporary use bans and three months of temporary use and non-essential use bans.
   - This has been equated to a reduction in abstraction of 30Ml/day in the first six months and 50Ml/d in the last six months.
2. A continuous reduction of 70 Ml/day representing the sustainability reductions

Run 1 resulted in a groundwater level rise of 0.16m. These changes in levels are insignificant in the context of natural recharge/discharge processes and would not materially affect DO. The groundwater system continues to drain as temporary restrictions are implemented, resulting in rapid dissipation of level increases through increased discharge and environmental flows. It should also be noted that the reduction in demand and abstraction modelled for this period of restrictions is likely to be a very optimistic reduction. It may be that measures to reduce demand do not achieve such reduction in output. Consequently, the increases in level of up to 0.16m are likely to be an upper limit on the groundwater recovery caused by reductions in demand and abstraction. Moreover, shorter periods of demand restrictions may take place in peak periods (July), whereas groundwater levels are at their lowest in September to October. In peak demand periods, level increases are highly unlikely to impact DO as borehole pumping water levels are likely to be higher than the Deepest Advisable Pumping Water Levels at this time of year.

Run 2 resulted in groundwater level rises of 0.54m. It is recognised that, on a local scale, level rises from constant sustainability reductions may be greater, and in such situations DO may be affected. We will continue to monitor the actual impact of restrictions and sustainability reductions on groundwater DO and environmental flows as these are implemented. This will be achieved through a programme of environmental and borehole monitoring, recording:

- Abstraction borehole groundwater levels and flows
- River flows
- Macroinvertebrate and Macrophyte sampling

Monitoring of these parameters have been included in Affinity Water's Business Plan submission for drought monitoring and sustainability reductions.

3.2.1.6 *Our analysis of the 2012 drought and resilience proposals in our draft WRMP*

In April 2012, after much consideration and dialogue with neighbouring water companies, we decided to impose a temporary use ban as our groundwater levels had reached very low levels after a third consecutive dry winter, where rainfall had been less than 60% of the long term average. In some cases, the borehole levels were lower than previously recorded, giving rise to unprecedented conditions. We took the decision to ask customers to reduce their water demand by imposing temporary use restrictions (often referred to as a hosepipe ban) in our Central and Southeast regions to help prevent further restrictions in future, should our groundwater levels continue to decline.

"I've seen the devastation of drought and, long term, will cause problems for everyone"

Within weeks of imposing the restrictions, the South East of England saw extraordinary levels of rainfall throughout the summer of 2012; we estimate that the likelihood of three dry winters followed by substantial summer rainfall was 1 in 200 years. At a time that groundwater levels are typically in recession, we saw unparalleled levels of recharge. In just six months, our groundwater levels went from some of the lowest ever recorded back to the long-term average, and beyond.

Figure 11 shows the measured groundwater levels at one of our key monitoring boreholes in the Central region. Passing 'Drought zone 3' represents the point at which we would need to apply for drought permits to restrict non-essential use due to the time it takes to secure such permits from the Agency; we came very close to this point in April 2012.

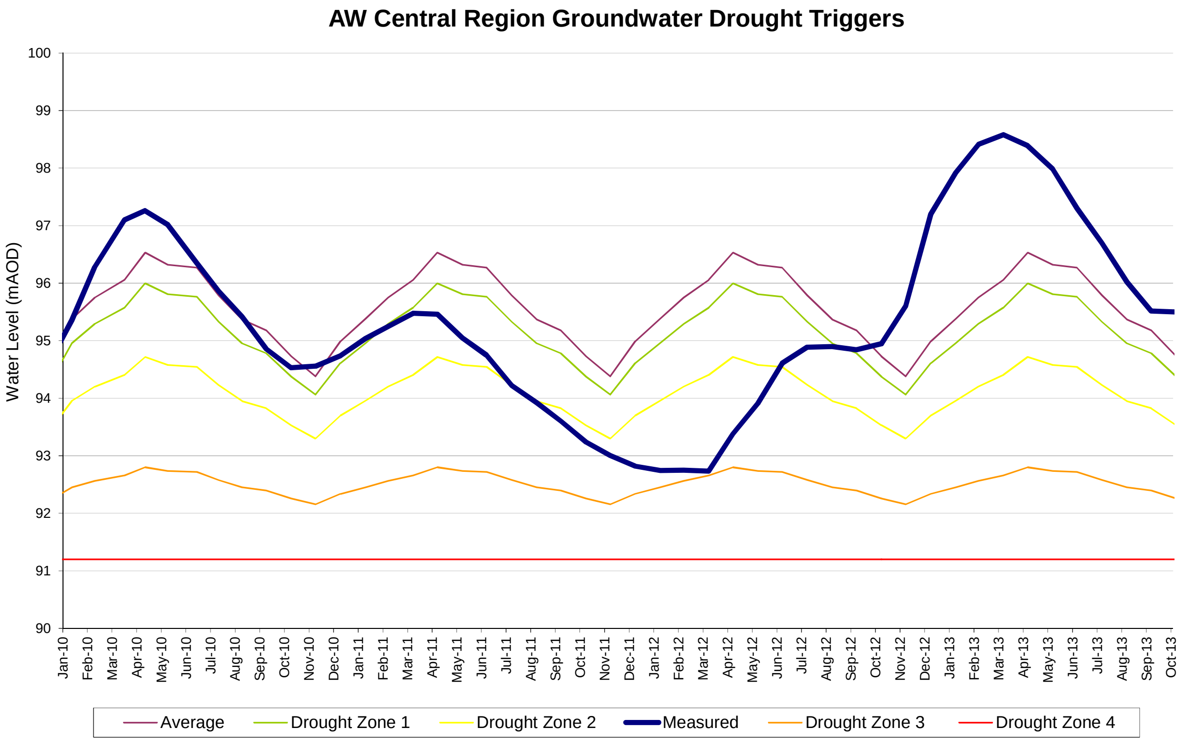

Figure 11: Groundwater levels in our Central region from January 2010 – October 2013

A similar picture arises for our Southeast region, shown in Figure 12, with the impact of the three consecutive dry winters clearly seen on the measured groundwater level.

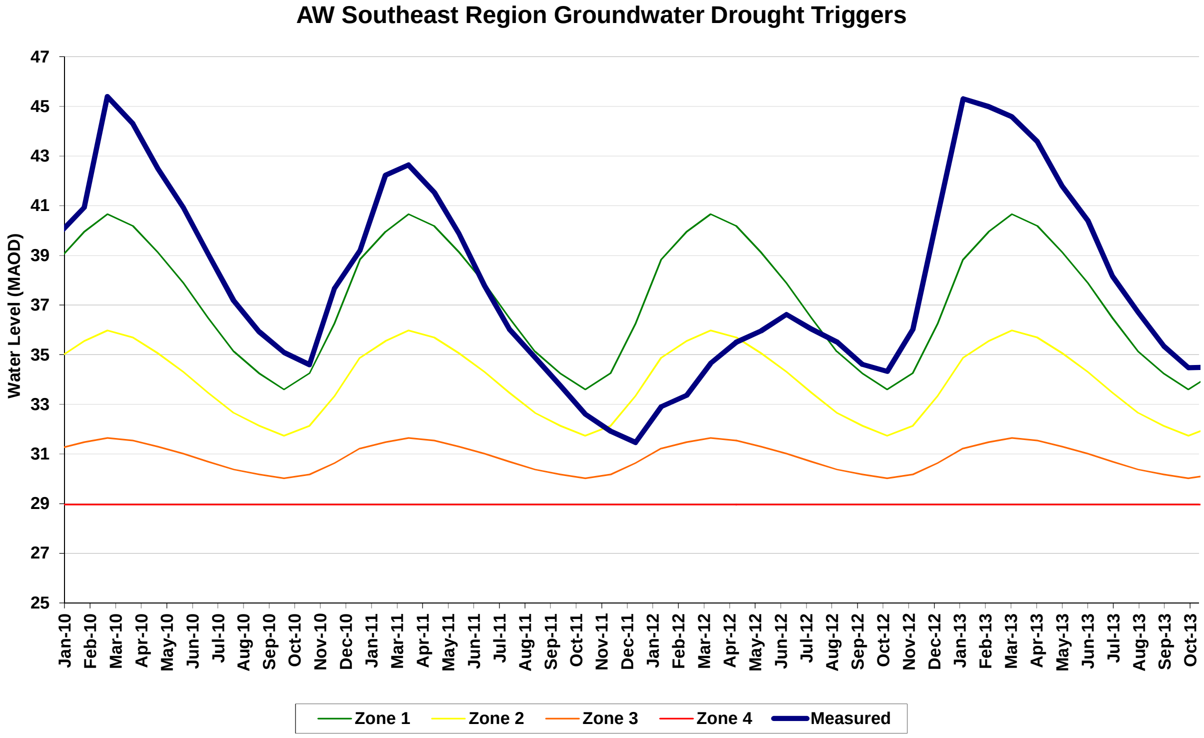

Figure 12: Groundwater levels in our Southeast region from January 2010 – October 2013

The drought in 2012 highlighted two issues: firstly, concern about the impact of the new temporary use ban restrictions on non-households and the livelihood of small businesses in particular; secondly, we were facing the prospect of unprecedented drought if we saw a third dry winter.

We have listened to our customers and their views on these two issues. Customers supported a change in the way restrictions were implemented, and we have been working with our fellow water companies to review the industry Code of Practice on the implementation of restrictions. We plan to introduce a difference in timing of restrictions such that non-household (commercial) customers are affected later than our domestic customers, as explained in 3.2.1.2. This will help small businesses in particular, and give them more time to prepare for restrictions if they are eventually imposed. Our Drought Management Plan will be updated in 2014 and we will ensure it takes account of this change.

In our pre-consultation on this Plan, we asked customers if they wanted us to invest more to reduce the potential impact of severe drought. We have investigated what this would mean in terms of improvements to our sources and the ability to transfer water from areas that will be less affected by severe drought to areas that will be more affected. We have made improvements in the flexibility and resilience of our transfer system in recent years; this is reflected in increases in deployable output for this Plan.

We continued our analysis after the publication of our draft WRMP for consultation. We have determined that the implementation of sustainability reductions is predicated on the delivery of new infrastructure to allow us to move water from areas of surplus to those with areas of deficit. In our draft Plan, drought resilience expenditure was assumed to be separate from sustainability reductions mitigation. Our modelling has determined that the delivery of the sustainability reductions infrastructure serves to improve our resilience to a third dry winter. We explain this work in sections 11.9 and 11.10.

Please refer to Technical Report 1.2: *Levels of Service Hindcasting*.

3.2.2 Leakage

3.2.2.1 Introduction

At the start of the next planning period, we will have a supply deficit in five of our eight WRZs. This rises to deficits in seven of our eight WRZs by 2040, and as such, we will therefore commit more resource to managing leakage levels.

Setting a leakage strategy is a complicated matter as we have some zones with a surplus of water, and some with deficits. A true economic approach would suggest we should let leakage rise in some of our WRZ; however, our regulators have indicated that leakage should not be allowed to rise[1]. We have assumed that this statement applies at company level and WRZ level.

> "I had not previously given much thought to the problems of leakage, which are obviously serious"

Customers have told us that leakage remains a priority for us to address. As we have undertaken consultation in a variety of methods, the feedback we receive is sometimes contradictory. For example:

– We asked customers if we should continue to search for and fix all leaks, both visible and hidden, even if it costs more than the value of water that is lost. 78% said yes[2]. However, we asked our statistically representative online panel if we should spend more money to reduce leakage further, beyond the economic level, only 41% said yes, whilst 32% said no[3].

– We also wanted to know if customers felt our average time to repair a leak of five days was acceptable, as responding faster would cost more whilst increasing the response time would allow us to plan our work more efficiently, resulting in savings. 50% of customers felt we should respond faster, whilst 45% thought our response was about right[4].

One of the key factors in managing leakage in the most economic way is the establishment of the **background level of leakage**. This is the leakage level at which costs to detect and repair are regarded as infinite as collectively the leaks are too small to be detected by modern technology . The closer we are to the background level of leakage, the more difficult it is to detect the leaks that we can repair. An added factor is the cost of working in the public highway, as we are required to pay additional charges that are set by the local authorities; the busier the road, the more expensive it is to work in to undertake repairs.

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[1] Water resources planning guideline, the guiding principles, June 2012.Government policy, section iv. Reducing demand for water.
[2] Let's Talk Water survey, August 2013. 78% said yes, 16% said no, 6% said don't know.
[3] Results of leakage online panel, July 2013. Question: Do you think we should spend more money to reduce leakage further, beyond the economic level? 41% said yes, 32% said no, 27% said don't know.
[4] Results of leakage online panel, July 2013. Question: On average, we repair leaks around 5 days after they have been found or notified to us. We generally react if it's a large leak or affecting customers' supplies. Is this level of performance right? 50% said no do it faster, 45% said yes, 1% said big leaks shouldn't be prioritised and 4% said don't know.

We asked our customers if our leakage targets should change in response to weather conditions. The majority of customers, 76%, would like us to increase our activity at times of water shortage[5]. Further, our regulators appreciate that maintaining levels of leakage in all weather conditions is neither possible nor sensible, so, in practice, a temporal rise in leakage as a result of severe weather is taken account of in our strategy.

> "Reading about the difficulties due to adverse weather etc makes it easier to understand the water leakage problem"

We continued to engage with customers during the draft WRMP consultation period to ensure that our plans addressed the needs of our customers, whilst balancing the aspirations of our regulators with the benefits to the environment. This section of our WRMP explains our approach to managing leakage, whilst in sections 10 and 11 we identify how we have taken account of customer and stakeholder preferences.

3.2.2.2 *Leakage target setting*

We set ourselves leakage targets for each of our three regions, which were agreed with Ofwat, for the maximum amount of water that can be lost from our network. This volume target includes water lost from our network and from supply pipes that are owned by our customers. To set this target, we consider all of the costs involved, including those of fixing leaks and the cost of producing more water. The final decision on our target is based on what would be the lowest cost for customers – we call this the **economic level of leakage**. Operating at this level of leakage means that the total cost of supplying water is minimised and we are operating efficiently.

When our leakage targets were set at the last price review in 2009, when we existed as three separate water companies, we were forecasting a surplus of water in all of our WRZs. Now that we are forecasting deficits, we must consider the cost benefit of reducing leakage further against other measures to increase supply and reduce demand. This is the **long-run economic level of leakage**, and, as we have deficits in the supply / demand balance, it is derived by our water resources planning modelling.

In order to remain below a maximum level of leakage in all conditions, we will need to control leakage to much lower levels during benign weather periods to allow for potentially severe winters, when freezing and thawing give rise to an increase in leakage. Equally, our customers have indicated a strong preference for an increased response to leakage during times of drought. Under both of these transient conditions, leakage operations may be sub-economic.

> "More work in the dry seasons before pipes burst in the cold and wet, a better form of prevention is better than a cure"

Having a flexible approach to leakage may also conflict with DEFRA's aspiration that leakage should not rise; however, we consider this will be necessary at times to be able to adapt to seasonal and annual weather conditions, whilst seeking to be as efficient as we can in our operations.

[5] Results of leakage online panel, July 2013. Question: Does the speed at which we repair leaks become more important to you when water is more scarce, such as during times of drought? 76% said yes, 22% said no, 3% said don't know.

It is important that we have a balanced investment programme to manage the supply / demand deficit. Relying solely on high levels of leakage reduction presents significant risks to our customers if these cannot be achieved in a sustainable and cost beneficial manner.

We will ensure a continually reducing leakage level through the careful monitoring and response to leakage outbreaks and the natural rate of rise of leakage encountered together with controlled implementation of leakage reduction measures from one leakage level to another.

3.2.2.3 Leakage management and control

Management and control of leakage is primarily achieved by active leakage control (ALC), which is the detection of non-visible leaks, as well as optimised pressure control to reduce the flow from any live leaks and reduction in bursts and the early repair of leaks. This is combined with accurate reporting of our performance to ensure efficient delivery of regulatory targets.

Over 800 District Metered Areas (DMAs), covering in excess of 80% of our network and customers, are monitored on a daily basis in order to review performance and identify potential leakage.

Software tools are used to assess flow and pressure in these areas and significant changes identified. Minimum night flows, the means by which leakage is quantified, are assessed and leakage levels are calculated daily.

> “I didn't know how much care went into leakage, I thought repairs were purely reactive”

3.2.2.4 Continuous improvement of our leakage programme

Over the last five years, we have made significant improvements to the way we manage leakage. Some of these are immediately visible to our customers, such as increasing our response to weather conditions, whilst others are internal, such as developing new procedures and analytical techniques. We explain some of these improvements here.

– **Increased programme of monitoring for large users.** For our largest non-household (business) customers, we measure their consumption by monthly reads of their meters. Our other business customers have their meters read every three to six months, depending on the amount of water they use. We review the bills of our largest customers regularly to identify potential leaks at the earliest opportunity, and we provide a similar service for our other business customers.

– **Comparison of consumption for domestic customers using the bi-annual billing cycle.** We have developed a tool that automatically identifies if any of our metered household (domestic) customers have bills generated that are more than 50% higher than their previous bills in the same period last year. We contact those customers before their payments are due to discuss what might have caused the increased bill and whether we can provide guidance in finding internal plumbing leaks.

> “There should be a clear way of reporting leaks, maybe a action line to help people to sort leaks in their own home without being ripped off”

- **Increased response during severe weather conditions.** In the drought of 2012, we increased our response rate to leaks, reducing the average time to repair from five working days down to two working days. Customers were encouraged to report leaks to us via a special telephone line. This resulted in a sharp drop in our leakage levels, at significant cost to us. Similarly, during the severe winter of 2011, we increased our rate of response as we suffered a significant increase in pipe bursts on our network. Such bursts, particularly those on our largest pipes, can cause damage to property and significant disruption to our customers.

> "Sometimes the shortage of water is due to leaks which are not fixed quickly enough"

- **Benefits from our Automated Meter Reading (AMR) programme in Southeast.** We have around 6,000 AMR units installed in our Southeast region. As consumption data is taken more frequently, we have been able to determine areas of likely customer side supply pipe leakage. We are able to support customers in repairing the leaking pipe, which also results in lower bills for those customers. Similarly, when combined with our bill analysis, we can also help find internal plumbing leaks that are verified by the AMR device recording consumption when there is no water use in the property.
- **Improved accuracy of costs for budgeting.** We have introduced various processes to improve the accuracy of our data, such as hourly timesheets for our community teams and the provision of additional information on completion of a pipe repair to trace the root cause. These improvements allow us to improve our cost forecasting for leakage management, and, should we increase the rate at which we reduce leakage, establish budgets that are more robust.
- **New works management system.** We are developing a new works management system that we expect to be implemented by the end of this AMP. The new system will fully integrate detection and repair activities and together with more detailed activity cost information provided by the timesheets and quicker reporting. We believe this will improve the efficiency of our leakage management programme.
- **Improving our analysis.** We have reviewed our analytical techniques in accordance with best practice and have improved the rigour of our calculations.

3.2.2.5 *Customer support for our leakage programme*

We are acutely aware that many of our customers and stakeholders react adversely to leakage and we will improve our understanding of this.

We received over 900 responses to our draft Water Resources Management Plan (draft WRMP) pre-consultation, which was a mix of qualitative comments and quantitative data. Our dialogue with customers tells us that a majority of 75% feel we should increase the rate at which leaks are fixed on our network but when asked about willingness to pay for this to happen the majority, 69% are not prepared to see an increase in their water bill to address this[6].

> "Leaks should be fixed immediately"

[6] Draft Strategic Direction Statement and draft WRMP consultation, October 2012.

We evaluated the responses we have received and taken account of stakeholder views in the preparation of our WRMP. Where the majority of customers expressed a preference on leakage in support of our plans (according to the pre-consultation feedback), we maintained that position in our forward planning. Our draft WRMP included a significant programme of leakage reduction, beyond the economic level of leakage, which was one of our key consultation questions on which we were keen to seek customers' and stakeholders' views.

Our regulators have aspirations to reduce leakage, and we explore the cost benefit assessment in section 8.4.2.

As we explain in section 10, we have undertaken a significant programme of customer and stakeholder engagement to be able to develop a WRMP that satisfies their needs and those of the environment.

> “I didn't really understand much about any of it to begin with. I now understand how much of a complex situation it can be”

The results of our Preferred Plan in section 11 explain how we have balanced the responses to our draft WRMP consultation with our engagement programme outcomes in the development of our proposed strategy for leakage management from 2015.

3.2.3 Metering

3.2.3.1 Introduction

Our three operating regions have implemented metering in accordance with local conditions, where we had the necessary approvals.

- Our **Southeast** region was designated an area of water scarcity in 2006 and we have now completed our programme of compulsory metering with 93% of properties being fitted with a meter. Where possible, we will try to fit meters where customers ask.
- In our **East** region optant meter take-up has been high and we now have 72% of households metered. We continue to offer to fit meters on an optant basis.
- In our **Central** region, we have a current policy of optant metering following a period of metering on change of ownership between 2005 and 2010; we now have 42% of households metered.

We also require all new properties to have a meter.

The proportion of households with meters in each of our three regions is shown in Figure 13.

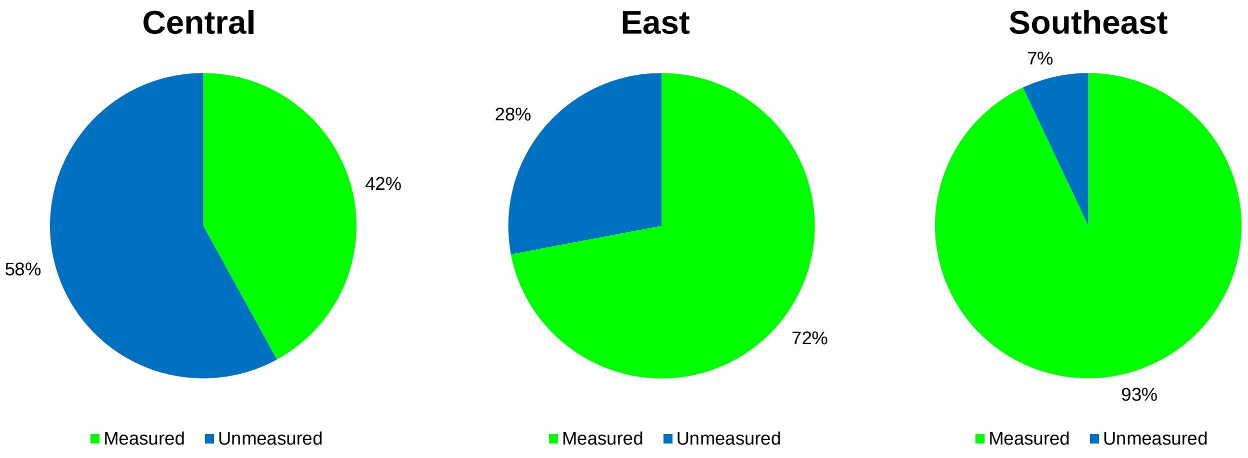

Figure 13: Household metering in Affinity Water's three regions

All three of our regions remain designated as 'serious water stress' areas so we have considered the cost benefit of universal metering as part of our modelling and development of our draft WRMP as directed by DEFRA.

With sustainability reductions and the effects of climate change further diminishing water supplies, there is a substantial requirement to reduce abstraction to achieve the balance between supply and demand.

> "We are running out of water so something needs to be done. Water meters is a good start"

Against this backdrop, demand is on the rise, in part due to a growing population predicted to rise by an average of 17% within the next 25 years. This is in addition to our customers currently having one of the UK's highest per capita consumption (PCC) figures.

We received over 900 responses to our draft WRMP pre-consultation. The majority of customers agreed:

- That having a meter installed would affect the amount of water they use (67%).
- They consider meters as the fairest way to pay for water (75%).
- The concept of a volumetric stepped tariff is majority supported (67%).
- While opinion was divided on the likelihood of a meter saving them money, nonetheless 77% believe a compulsory metering programme should be universal rather than limited to areas of severe water scarcity only.

There have been a number of different tariff trials carried out across our regions, aiming to encourage a reduction in consumption. Generally, customers have not responded positively to these trials. At this time, we do not propose to implement any specific new tariffs for measured household customers but we remain committed to trying to develop new tariffs that will incentivise our customers to reduce their demand for water.

The compulsory metering activity we carried out in our Southeast region over the last seven years has provided a wealth of experience in metering at both the strategic and on-site levels. Although it is accepted that there are significant differences between our three separate regions, the knowledge we gained still provides a good foundation for our Plan, as set out in this document, for metering of the wider Affinity Water area and the Central region in particular.

> "Unless people are shown how effective metering is and make more of an effort to conserve water proactively then not much will change"

Analysis carried out by industry specialist consultants Tynemarch shows a reduction of more than 16% in consumption was achieved as a direct result of the compulsory metering programme in our Southeast region. Given the caveats surrounding this achievement, we have used a slightly lower figure of 13.6% reduction as the basis for modelling purposes for our Central region, although we have used different values in our sensitivity testing. Further detail is given in section 3.2.3.4, whilst the Tynemarch report is appended to our Technical Report 3.3: *Metering and Cost Benefit Analysis*.

Affinity Water has chaired the Water UK Metering Strategy Network for the last two years and is therefore at the forefront of metering know how in the UK. This involvement adds further to the knowledge base that has been used in developing this strategy. The metering costs and savings entered into our Economics of Balancing Supply and Demand (EBSD) model have been derived using the latest UKWIR metering cost benefit analysis (CBA) optimisation software, an output of the Water UK group, described in section 8.4.3 and in detail in Technical Report 3.3: *Metering and Cost Benefit Analysis*.

> "People should be trying to cut down their water usage to help the long term environment"

3.2.3.2 *Compulsory metering experience in Southeast region*

Our Southeast region started the AMP4 period in 2005 in a resource deficit position and it was this that supported the proposal to carry out a significant metering programme in the region.

The programme commenced with optant and change of hands metering in April 2005. This, as expected, was found to be inefficient and far more costly than a focused street-by-street approach.

In March 2006, our Southeast region achieved water scarcity designation and this allowed us to begin a selective and compulsory metering programme that planned to achieve in excess of 90% domestic meter penetration within ten years. The current meter penetration is 93% and the programme is considered to be complete. The meters installed were all dumb meters although some have subsequently been equipped with an AMR unit to enable remote reading. Internal and difficult to read meters in particular will all be equipped with a remote read AMR unit before the end of AMP5.

The metering programme has provided significant experience from strategic level through to on-site practices that have been used in our AMP6 planning for metering in our Central and East regions.

3.2.3.3 Southeast region metering trials

During the compulsory meter installation programme in our Southeast region, we carried out a number of trials. We summarise the trials and the impacts on our customers' demand for water.

1. Smart Communications

We have trialled the use of regular personalised consumption information on water use in the town of Lydd. A quarterly information sheet was included with customers' bills, personalised for each property, giving information on their water use, average water use for similarly occupied properties, costs of typical water usage including wastewater and energy costs. The information sheets received praise from the industry and regulators and generally positive comments from customers, but the impact on demand was small. Our post-trial analysis suggests that Lydd's population were already relatively low volume users, hence why the impact on demand was small and the trial was not as directly successful as we had hoped. However, we believe there is merit to investing in our network and information systems to be able to provide customers with better data about their usage, particularly in areas where consumption is higher than average, to assist customers in reducing their demand.

2. Stepped Tariff

A two-tier stepped tariff was trialled in two areas, Lydd and Cheriton, with approximately 980 properties in each area being put onto the tariff. The remaining properties in each area remained on the standard measured tariff. An initial base volume of water was calculated for each property individually, based on occupancy, to derive the 'essential' water cost. Subsequent water use was then charged at a different rate. Despite a significant step between the 'essential' water cost (75% of the standard measured tariff) and the 'discretionary' cost (double the standard measured tariff), there was no measureable reduction in demand.

3. Retrofit

We undertook the retrofit trial to gain a better understanding of our customers' attitudes and behaviour towards water efficiency. 250 customers volunteered for the trial with a high proportion being elderly customers. All trial customers received a full water audit and free installation of water efficiency devices. Questionnaires where used to capture the pre and post trial customer appetite for water savings and whether they considered the outcome positive.

The devices included:

- Eco-beta toilet siphon break;
- Hippo bags;
- Save-a-flush bag;
- Tap Magic spray;
- Aerated low flow showerheads.

The trial was successful with a relatively high level of engagement (15% of contacted customers volunteered) and demonstrated a positive appetite for water savings advice and devices, although customers may have been influenced by the presence of the ongoing universal metering programme and tariff trials in the area. The volumetric savings were lower than we had anticipated but the overall customer response was that they were 'pleased' & 'very pleased' with the outcome.

4. Deferred meter

This two-year trial was set up to measure the change in water consumption that takes place when a meter is installed onto an unmeasured property, but before the property is transferred to the standard metered tariff. One thousand unmeasured properties had a meter fitted although they were left on unmeasured charges. Consumption was then recorded regularly over the first year and paid in accordance with our unmeasured tariff, before they were all transferred onto a measured tariff for a further year of recording.

The difference in customer consumption between the first year and second year resulted in an average overall reduction in consumption of 10.7%. We consider that this is the impact on demand of customers transitioning from unmeasured to measured billing for these properties.

5. Small area metering

The purpose of this trial was similar to the 'Deferred Metering trial' i.e. to identify the change that occurs when an unmeasured property is metered. This trial involved installing loggers on small DMA meters where downstream properties were approximately 50% metered. Midway through the two-year trial the remaining unmeasured properties in each of the zones were to be metered, making the zone as fully metered as possible for the second year.

This trial was less successful than the deferred metering trial in identifying a variation in consumption before and after metering. Technical problems with the logging of the DMA data sets occurred, the background leakage in the areas varied significantly over the two years and the customer meter data was also found to contain inconsistencies. The outcome of this trial has failed to provide statistically valid results so no conclusions around demand savings can be drawn.

3.2.3.4 *Impact of metering on Southeast's distribution input*

As the universal metering programme drew to a close, we engaged industry specialist consultants Tynemarch to carry out a study to investigate the impact of the meter installations on the demand for water in the region.

Their report states:

> *The analysis comparing the measured consumption of selective meters to the estimate of unmeasured consumption shows a reduction of 26%. The calculations use post-maximum likelihood estimates (MLE) where the balance error has been reconciled. Confidence limits have not been developed for this estimate. There is*

significant uncertainty in the actual reduction given the limited data regarding unmeasured consumption.

This estimate is higher than reported in similar studies regarding the impact of metering; a recent estimate of 15% was obtained from the extensive tariff trials at Wessex Water.

An alternative view can be obtained by constructing a water balance which progressively separates the components of consumption until the consumption can be identified of a set of properties which begin as unmeasured in 2005 and are now measured. This approach uses pre-MLE data.

The results from this analysis indicate a consumption reduction with a central estimate of 33% and a range of 16% to 50% assumed to be to a 95% confidence interval.

We consider it reasonable to conclude that the reduction in consumption for properties metered between 2005 and 2011 is at least 1.8 Ml/d or 16% of corresponding 2005 consumption based on the available data.

3.2.3.5 *Fixed Network AMR trial in Folkestone*

A fixed network trial on 6,000 domestic properties has been set up in one of the DMAs in Folkestone, using Homerider AMR technology. The existing dumb meters have all been retrofitted with an AMR 'TRAK' unit that transmits 15-minute water use data via Repeaters fitted onto nearby lampposts to Data Collectors for onward transmission to web based servers.

This data frequency provides an excellent opportunity to identify leakage both on supply pipes and on our distribution assets as well as being of day to day operational use. At this time the data is only being used for our own internal purposes, but it is possible that a future phase of the trial may share the data with customers as part of a water efficiency initiative.

3.2.4 Water efficiency

3.2.4.1 *Introduction*

Our water efficiency programme will be a pivotal part of that will help to reduce overall customer consumption in accordance with the WRPG Guiding Principles[7].

We recognise that some of our communities have the highest unmeasured per capita consumption (PCC) in the country and we face a major challenge to support our customers in reducing demand. We consider this to be the right approach in addressing the supply deficits we face over the next 25 years, as well as meeting Government aspirations for companies with above average consumption to fall to below national average levels.

[7] Water resources planning guideline, the guiding principles for developing a water resources management plan, June 2012. Government policy, for water companies in England, section iv. Reducing demand for water: "*Where a company is in an area designated as water stressed, or where it has demand that is above the national average (147 litres per head per day), Government expects the demand trend to be significantly downwards.*"

Our customers have indicated support for movement towards reducing the demand for water as part of a coherent demand management programme that will include metering, water efficiency, leakage reduction and pressure management to achieve our goal.

A key factor to be taken into account in developing our water resources management strategy is our customer's future demand for water, and to what level this can be influenced by water efficiency activities. Prior to 2010, there was a realisation that while water companies were delivering ad-hoc activity to encourage customers to save water, there was a perception that there was no underlying strategy to influence customer consumption. This coincided with a lengthy sustained period of increasing PCC, driven by the increasing availability of water using appliances (such as dishwashers, pressure washers, pumped power showers) and the changing behaviours of customers.

The unchecked increases in PCC led central Government to review the situation and a water efficiency target (WET) was introduced for the first time. This activity-based target began in April 2010 and set the goal for water companies to achieve a one litre per day reduction in consumption for each household.

We have achieved our WET each year since the target began.

3.2.4.2 *Our Education Services*

We provide services to primary and secondary schools as part of our Education Centre. Our Education Team aims to support teachers in our communities by providing a stimulating hands-on learning experience about the importance of water and the environment, such that it can enrich the curriculum. Our award winning Education Team:

- Welcomes more than 6,000 visitors a year to our Education Centre in Bushey;
- Visits over 7,000 pupils each year by attending their schools;
- Has been accredited with the Learning Outside the Classroom Quality Badge;
- Has received eight Green Apple awards between 2000 and 2012 in numerous educational and environmental categories;
- Is accredited with the BCE Engagement Premiership Award 2012.

3.2.4.3 *Customer feedback on Water Efficiency*

During the first phase of our stakeholder engagement programme, we received over 900 responses to our draft WRMP pre-consultation: a mix of qualitative comment and quantitative data. When asked to respond to our plans for water efficiency, customers gave this feedback:

- That while customer views are divided about the value in receiving more frequent bills (only 47% value this), a majority of 69% believe access to more information about their water use would be of value and 59% believe this would influence their behaviour.
- That their behaviour in water use would be affected by the installation of a meter (67% agreed).

- The majority of respondents (87%) agreed they would use water saving devices were they supplied with them.
- There was a high degree of interest in the supply of discounted water efficient white goods (72%).

As the majority of customers have expressed a preference in support of our water efficiency activity plans, we have maintained this position in our forward planning.

Beyond 2015, we propose to step up our plans to reduce water demand in response to customer feedback and in line with Government aspirations to do so. The need for this is acute, as in our Central region we currently have a high weighted average PCC of 166 litres / person / day (compared to the national average of 147 PCC) and we want to demonstrate a long term commitment to reducing PCC. In our East and Southeast regions we have seen the benefit of a higher penetration of metering as weighted average PCCs are 114 and 134 respectively.

The benefits of reducing PCC for our long term supply / demand balance, the communities we serve and environments we operate within mean that our plans will require a more coherent approach in terms of bringing the focus of our different demand options (metering, water efficiency, leakage and pressure management) together.

> “People need incentives to make small changes”

3.3 Future challenges

3.3.1 Population and housing growth

Our population has increased by approximately 150,000 over the past four years up to the current total of 3.6 million. It is forecast to grow by over 600,000 (an average of 17%) over the next 25 years to 4.2 million in 2040.

The corresponding growth forecast in housing indicates that we will have 288,000 additional houses by 2040 (a rise of 22% on average) to give a total of 1.62 million. Clearly, additional population results in additional demand for water. New developments are governed by legislation that requires developers to build water efficient properties such that occupants use a maximum of 125 litres per person per day[8]. All new build properties are metered. This helps new build properties have one of the lowest per household consumption figures in the country.

Whilst the cost of additional infrastructure to deliver water to the new properties is borne by the developer, it is the responsibility of the water company to ensure there is enough water for everyone.

> “There should be control of all the new housing estates being built in our area without due care for the amount of water they will use”

We describe the impact of the increase in population and housing growth in section 5.2.6, and in detail in Technical Report 2.2: *Household Demand Forecast*.

[8] Part G of the Building Regulations, updated in April 2010, 125 litres per person per day for domestic dwellings. This comprises internal water use of 120 litres per person per day, and in that respect is in line with Code Levels 1 and 2, plus an allowance of 5 litres per person per day for outdoor water use.

3.3.2 Sustainability reductions in source outputs

3.3.2.1 Legislation

The Environment Agency is responsible for issuing licences for water abstractions from both groundwater and surface water. It also has the power to amend existing licences or to enter into operating agreements to limit abstraction where it is having a negative effect on the environment.

In the last 25 years, there has been greater awareness of the benefits of protecting the environment and ensuring that our rivers and other water habitats are maintained in good condition.

In response to European and national legislation, the Agency introduced the National Environment Programme (NEP) to ensure that water companies meet European and national targets related to water. The NEP is a list of environmental improvement schemes which water companies include in their five-yearly Business Plans. The NEP includes requirements for water companies to undertake improvement schemes, or where more evidence is required, to investigate a particular problem.

> “I think it's important that people start to realize that water comes from somewhere - it's not literately ON TAP as we would like to believe”

The European Water Framework Directive (WFD) includes measures to control abstraction pressures and promote efficient and sustainable water use. The implementation of the WFD created new requirements for the protection of water resources. The Agency, in consultation with Natural England, currently has an ongoing programme of review of water abstractions in relation to impacts on:

- Sites protected by the EU Habitats and Wild Birds Directive;
- Sites of special scientific interest (SSSI);
- Biodiversity Action Plan sites;
- Sites of local importance;
- Water bodies that are failing to meet the environmental objectives set by the WFD.

> “I think we should care more about the environment and save water.”

From its reviews, the Agency publishes lists of possible reductions of water abstraction termed **sustainability reductions**.

3.3.2.2 EA sustainability reductions

For our water supply area, the Agency has issued a list of potential sustainability reductions under three headings: ‘confirmed’, ‘likely’ and ‘unknown’. The ‘confirmed’ and ‘likely’ reductions have been agreed for inclusion in our Plan, in accordance with the WRPG. This results in a loss of almost 70 Ml/d from our existing groundwater sources under average conditions (over 6% of our available deployable output). The ‘unknown values’ are in excess of 300 Ml/d at peak. There are also further potential reductions relating to river catchments not yet reviewed by the Agency. A summary of the reductions notified to date is given in Table 1.

Sustainability reductions	Average DO Ml/d	Peak DO Ml/d
Planned ('confirmed' & 'likely')	69.80	51.55
Possible ('unknown' value)	215.52	254.85
Grand Total	285.32	306.40

Table 2: Sustainability reductions in our operating area

It can be seen that sustainability reductions are the biggest challenge in our water resource planning. (Refer to Technical Report 1.4: *Sustainability Reductions*.)

3.3.2.3 *Our investigations*

Our supply area is home to many chalk streams which flow through areas of importance including the Chilterns AONB, Dedham Vale AONB and the North Downs. Chalk streams are a globally rare habitat, confined to North-west Europe and notably the UK. These streams are an integral part of our landscape and communities, providing valuable habitat for plants and animals. We have been actively working with the Environment Agency, Wildlife Trusts, Conservation Boards and other stakeholders over the last 20 years to improve and conserve these habitats. The inclusion in our Plan of Sustainability Reductions, combined with work our National Environment Programme and Catchment Management activities will help protect the future of these important rare habitats.

We have been working with the Agency for more than 20 years on numerous low river flow investigations. In our Business Planning period 2005-2010, under the National Environment Programme (NEP), we investigated sites potentially affecting 66.4Ml/d of water abstractions and the conclusions of the studies resulted in an agreed loss of 14.83Ml/d of licensed abstraction (some 22% of the amount investigated). Our investigations have continued and this reduction is included in the 70Ml/d described above.

"We need to protect our environment and the ecology, it supports flora and fauna. The countryside is very important for my family and myself"

For the 2010-2015 period, under the current NEP, we are required to investigate five river catchments in our Central region (see Figure 10) where our groundwater sources have a combined water abstraction capacity of 388 Ml/d, compared to a total groundwater resource base of 597Ml/d.

During the same period, we have been investigating sustainability reductions in the Little Stour catchment in conjunction with Southern Water and South East Water. Figure 11 shows where our investigation is taking place. The total capacity of this catchment is 17Ml/d, compared to a total groundwater base of 53.8Ml/d.

"Helpful to understand environmental impact on river and streams"

Progress to date on each catchment is described below.

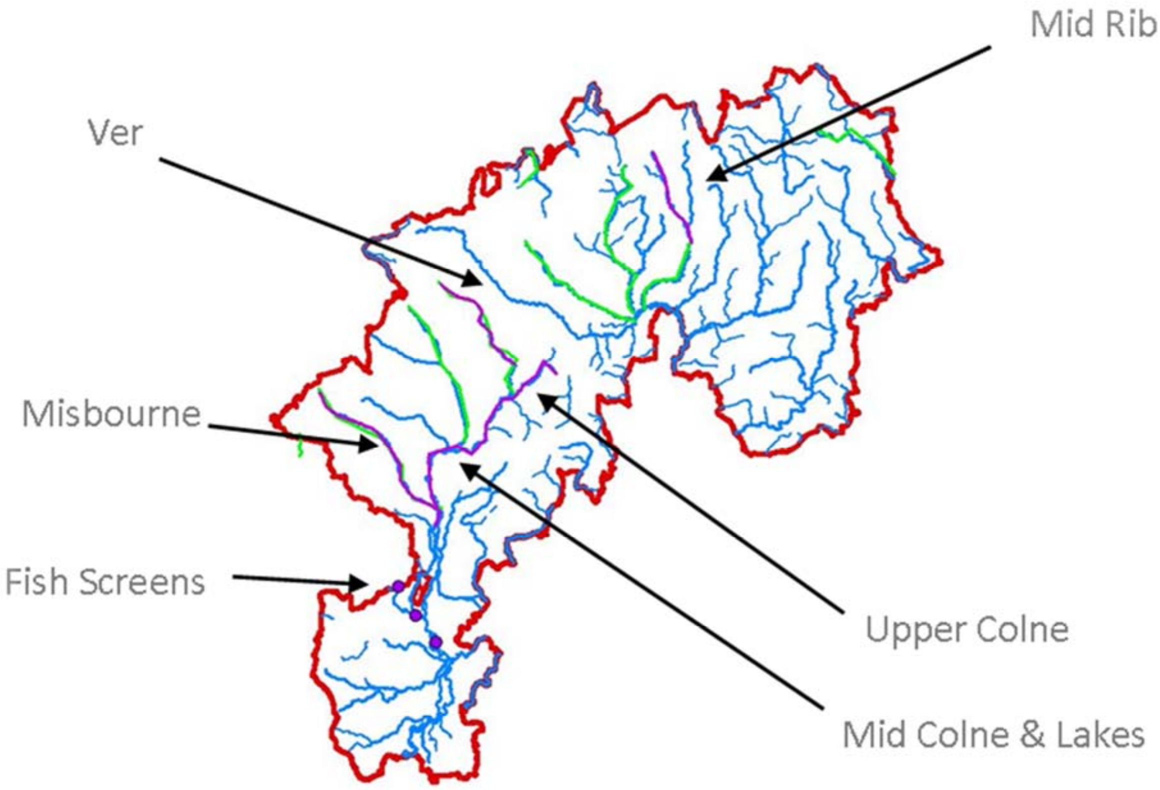

Figure 14: River catchment investigations 2010 – 2015, Central region

1. Upper River Colne

The River Colne rises in Colney Heath and flows southwest through rural areas before entering the urban area of Watford. It receives a significant proportion of its flow from chalk groundwater and is defined as a chalk stream / river. It is also influenced by surface water inflows from tributaries and run-off from urban areas.

The study required investigation into 13 sources. We have carried out various field investigations and monitoring, with the final report due to be submitted to the Agency by March 2014. Possible abstraction reductions in the Agency's 'unknown' category amount to 118Ml/d.

2. Middle Colne and Lakes

This study area covers 8km of the River Colne between the Gade and Denham Green; it includes the Mid Colne Lakes, which are a series of 18 lakes formed following gravel extraction. Parts of the area are designated as Sites of Special Scientific Interest (SSSIs). Initial investigations undertaken by the Agency had identified a number of abstractions that were suspected of impacting on river flows and lake levels.

Field investigations are being undertaken on the effects of nine sources and new observation boreholes are being drilled and monitored. The final report will be submitted to the Agency in March 2014. Possible abstraction reductions in the Agency's 'unknown' category amount to 88Ml/d.

3. River Ver

The River Ver is a groundwater-fed chalk stream located within the Upper Colne catchment in Hertfordshire. It has a high conservation value, as well as recreation values and a record of cultural history in the landscape. The study area covers a 13.2km length of the river and includes seven of our groundwater sources. There was an abstraction reduction from one source implemented in 1993.

Four of our sources have been shown to affect river flows. We are appraising the options available and completion is scheduled for March 2014. Planned abstraction reductions of 14.66Ml/d at average have been agreed with the Agency, as well as the requirement for morphological mitigation work.

4. Mid Rib

The River Rib is predominantly a groundwater-fed chalk stream characterised by narrow, steep sided shallow channels with a history of low flows during dry summer months. The study area includes a 12.3km length of the river and covers three of our groundwater abstraction sites.

From the detailed monitoring that we have undertaken, it has been concluded that there is a minimal impact of our groundwater abstraction on low flows and on the ecology of the river. Our final assessment report will be reviewed by the Agency following the presentation of additional data and analysis from our autumn 2013 Signal Tests. There are currently no planned abstraction reductions.

5. River Misbourne

The River Misbourne is a chalk stream, rising at Mobwell and joining the River Colne at Denham, a distance of 28km. It is flanked by locally and nationally important sites and throughout its course has varied and valuable habitats. Previous studies concluded that abstractions in the upper catchment were lowering the groundwater table and water levels in Great Missenden Abbey Park lakes. Although abstractions were reduced, there were further concerns raised about effects on the conservation and amenity value of the river.

Planned abstraction reductions of 5.0Ml/d have been agreed with the Agency, as well as morphological mitigation work and a provision for river support, should it be required.

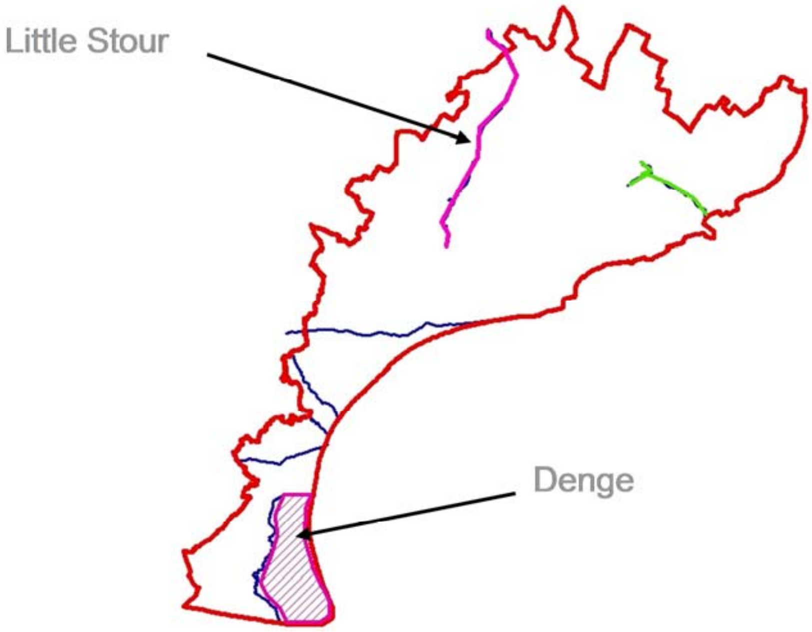

Figure 15: River catchment investigations 2010 – 2015, Southeast region

6. Little Stour

The Little Stour options appraisal scheme was to evaluate options to mitigate groundwater abstraction related low flow impacts that were identified in our previous investigations. This is a joint project between ourselves, Southern Water and South East Water. For our draft Plan, we had included reductions of 4.9Ml/d at average and 5.69Ml/d at peak in the absence of notification from the Agency. This alone drove the deficits in the first five years of the planning period in our Southeast region.

We have continued to work with the Agency and they have concluded that the options appraisal was not cost beneficial, and therefore no sustainability reductions are proposed for this catchment. A scheme for morphological mitigation work and river augmentation has been agreed with the Agency as the most cost beneficial way forward, and work will be implemented in conjunction with Southern Water and South East Water.

7. Fish Screens

Following our AMP4 investigations into the entrainment of fish fry on the Lower Thames, we are installing fish screening of our river intakes in AMP5. Hydrolox screens have now been installed at one of our intakes in summer 2013 and screens will be installed at a further two locations in 2014.

Further details on each of our investigations can be found in the Technical Report 1.4.1: *AMP5 NEP Progress and Summary of PR14 Schemes*.

8. Dungeness

Dungeness is the UK's largest shingle structure and is designated as a Special Protection Area (SPA), Special Area of Conservation (SAC) and a Site of Special Scientific Interest (SSSI) in recognition of its national importance as a distinctive habitat for unusual flora and fauna and as an important landfall for migrating birds.

As part of our options appraisal work on the Dungeness peninsular we have changed our abstraction pattern and reported on the impacts.

The current level of abstraction is significantly lower than historic and this appears to minimise the abstraction impact on these key areas. A future licence change to restrict our future daily and peak abstraction capability, without impacting on our current Deployable Output is proposed for implementation in AMP6, in conjunction with relocating two disused wells to maintain security of supply.

3.3.2.4 *Morphological Mitigation Measures*

Many of the chalk streams within our supply area are failing to meet Good Ecological Status (GES) under the Water Framework Directive (WFD). We have been working in partnership with the Environment Agency since 1990 to understand the affect of our abstractions on stream flow.

Through our NEP investigations and options appraisals we have identified that some of our groundwater abstractions exacerbate periods of low flows in these local chalk rivers. Where it has been confirmed that our abstractions are having adverse environmental impacts, we have agreed sustainability reductions on our licences. In addition to this, by undertaking channel modification and enhancement work there is often potential to offset the environmental impact of our abstraction, subsequently reducing the volume of licence that will be subject to sustainability reductions.

As a result, channel modification and enhancement work has been identified in certain cases as a cost effective or cost beneficial option, rather than having to replace large volumes of water for public supply as a result of further sustainability reductions.

In January 2013, we were notified that a morphological mitigation scheme would be included in the NEP for AMP6. We have therefore made a provision for funding in our PR14 submission for works within the Depleted Water Areas (as defined by the EA) on the Mimram, Beane, Ver, Gade, Upper Lee, Misbourne and Little Stour. This work will help improve in-channel habitats and contribute to meeting the target of GES.

We will be working closely with the EA and other key stakeholders in these catchments to help ensure the success of these projects. Where these rivers also flow through our landholdings there are links with our Biodiversity project to meet our duties under the Natural Environment and Rural Communities (NERC) Act.

We will also be undertaking implementation works on two lakes which are designated as Heavily Modified Water Bodies (HMWB) so that they achieve Good Ecological Potential (GEP) by 2027, as well as installing fish screening and eel passes. Further replacement fish screens, to meet the Eels Regulations, will also be installed at Ardleigh.

3.3.2.5 Further sustainability reductions

In addition to the changes proposed as part of our current investigations, further sustainability reductions have been discussed with the Agency in relation to environmental studies that we are proposing for inclusion in the next Business Planning period (2015-20) as follows:

- River Beane – Planned reduction of 16.18Ml/d;
- River Mimram – Planned reduction of 15.47Ml/d;
- River Ver – Planned Reduction of 14.66Ml/d
- River Misbourne – Planned reduction of 5Ml/d
- Upper River Lee – Planned reduction of 10.49Ml/d;
- River Gade – Planned reduction of 6.4Ml/d;
- Hughenden Stream – Planned reduction of 1.6Ml/d.

Details of proposals can be found in Technical Report 1.4: *Sustainability Reductions*.

3.3.2.6 AMP6 Schemes

Our programme of work under the NEP for AMP6 has been developed based on information from and discussions with the Environment Agency. We have also included biodiversity enhancement works to meet our duties under the NERC Act.

- Investigations and Options Appraisals

The EA has identified four schemes for investigation and options appraisal and a further ten schemes for implementation in our Central and Southeast regions. This includes further investigations and options appraisal on the Upper River Ver and new investigations/options appraisals on the River Cam and Purwell.

We will also be monitoring the effectiveness of fish screens at one of our river intakes to ensure compliance with the Eels Regulations. This work has both Biodiversity and Water Framework Directive drivers.

- River Support/Augmentation on the Little Stour and Misbourne

Following our AMP5 options appraisal a solution for the Little Stour was agreed by the Little Stour Steering Group in July 2013. The outcome of the options appraisal identified that any solution centre on Sustainability Reductions was not cost beneficial.

The preferred option promotes the installation of a new augmentation borehole to provide water for refuge augmentation. In addition to a sustainability reduction in the Misbourne catchment, a provision for river support to help maintain flows in the middle reaches of the river has been included in our PR14 submission. Morphological mitigation and habitat enhancement is also proposed to improve the resilience of these river under low flow conditions.

3.3.3 Climate variability

There has been much publicity in recent years about climate variability with awareness that more extremes in rainfall and drought have occurred. Over the past 13 years, we have experienced:

- The second wettest year since records began in the UK (2012);
- The wettest winter for 120 years (2000);
- The driest winter for 140 years (2010/11).

Climate variability has a major impact on forecasting water supply availability and an additional impact on forecasting water demand, as customers' use changes. We have evaluated and taken account of both aspects in our draft WRMP.

> "You need to take more water from rivers at flood times than you do, and provide storage to fill on these occasions."

The impact of climate change on supply is considered in Technical Report 1.3: *Assessment of Climate Change Impacts on Deployable Output*), whilst the impacts of climate change on demand are discussed in Technical Report 2.0: *Demand Forecast*.

The latest national climate projections were published by DEFRA in 2009. Those projections are used as a basis for the assessment of potential impacts on water resources in accordance with the WRPG. The projections include a large number of scenarios covering a range of values for rainfall and temperature changes. This enables us to study the potential impact of the scenarios on our water supply availability and on demand forecasts.

3.3.4 Pollution of water sources and catchment management

In the past, we have experienced pollution of some of our sources from urban, industrial and agricultural supplies. We have undertaken pollution risk assessments of our groundwater catchments and incorporated the results into Drinking Water Safety Plans on which monitoring requirements and risk mitigation are based. In some catchments, we have also detected herbicides and pesticides in some water samples (especially metaldehyde, which is the active ingredient in slug pellets used by farmers to protect crops).

We employ catchment management officers who undertake catchment monitoring and pollution prevention tasks for both groundwater and surface water catchments.

Our catchment management officers are also active members of the Metaldehyde Stewardship Group. An article published in the Farmer's Guardian in 2013 highlighted our involvement in this group, where, together with Severn Trent Water, we are targeting 'high risk' fields in catchments in our region with the intent of demonstrating the impact on the environment when metaldehyde is not used to control slugs. One of the expected outputs of the three-year study is a recommendation for increased control on the sale and use of metaldehyde. We are working with local landowners and

> "We welcome the inclusion of catchment management approaches to protect and improve raw water quality of sources"
>
> *WWF-UK*

growers to identify suitable sites for the studies, and we plan to commence the study in early 2014 ready for the autumn application of pesticides. We will continue to sample all of the rivers and tributaries in the catchment to monitor changes in concentrations of metaldehyde getting into the water.

We will continue our catchment management programme into our next five-year Business Plan and, as a result, we are not forecasting any permanent reduction of source deployable outputs from pollution. We include allowances for temporary loss of supply based on historic assessment of actual incidents over the past five years in our outage and headroom assessments. We have additional safeguards against loss of water supply from our River Thames sources due to river pollution incidents. Our agreement with Thames Water allows us to take emergency supplies from two Thames Water reservoirs (up to 3,650 million litres per annum) in the event of River Thames contamination.

3.3.5 Major infrastructure projects

The nature of our regions and their proximity to London means that development is inevitable and we must be positioned to cope with changes to the way we deliver water to our customers, whilst maintaining their security of supply.

- Over the past few years, we have had to divert sections of our trunk main network to enable the **widening of the M25**.
- The western section of the **Crossrail** surface line extends from Ealing Broadway to Maidenhead with a leg to Heathrow airport, through our Central region.
- The **High Speed 2** rail link between London and the North traverses our Central region. We are actively engaging in the early stages of the route planning, as it passes very close to a number of our sources, which could need to be moved or protected against damage. This has the potential to affect our sustainability reductions programme.
- A new **western rail link from Slough to Heathrow** is proposed, reducing journey times for passengers as they no longer need to go via London Paddington.
- The investigation of shale gas fields in the South East of England and the associated development of hydraulic fracturing ("**fracking**") as a way to meet our growing demand for energy. This currently particularly affects our Southeast region.

3.4 Planning forecasts

3.4.1 Introduction

Our base year for supply and demand data is 2011/12, which is the most recent full year for which data is available prior to preparation of this WRMP.

In accordance with the WRPG, we have calculated the following planning forecasts:

- **Dry year annual average**;
- **Dry year critical period**.

We have reviewed our supply / demand balance under average climate conditions in order to prepare the forecast of a normal year. The normal year is used as the base and is adjusted for a dry year, for both annual average and critical period scenarios. We have also assessed our Minimum Deployable Output as an additional scenario, which is when water levels are at their lowest, generally after summer, while demand is still generally high.

The planning scenarios are consistent with those used in the Water Resources in the South East (WRSE) modelling which was undertaken with the Environment Agency for ourselves and the five other water companies operating in the South East of England (see section 3.5.3).

3.4.2 Determining the critical period

For the dry year, we calculate average daily demand values and peak daily demand values; the peak values are typically for the 7-day period with the highest demand during the dry year. This normally occurs in the summer when temperatures are at their highest. Water companies find that demand in the peak week is often 25% to 35% higher than the annual average, although the additional abstraction required to meet our peak demand is temporal and has very limited direct environmental impact.

We have examined a range of time steps to assess our critical period. In operational terms, the most significant event occurred in 2003 when a long, hot, dry summer generated high demands over an eight-week period. The resource situation at that time was satisfactory and demand was unrestricted, i.e. no temporary use bans were in place. This demand period has been used as our benchmark for the dry year demand forecast with average day peak week taken as the critical period occurring at any point within an eight-week window (56 days). Daily peak conditions are not used for water resource planning purposes as extreme peaks in demand and short-term extreme outages are accommodated using our limited service reservoir storage.

We have considered each of our WRZ and have analysed dry year annual average and dry year peak week to determine the critical period.

At the outset of our Plan, dry year peak week is the key driver of investment in most of our WRZ, although dry year annual average is the driver of investment in some of our zones. In developing our options for our supply / demand balance analysis, we have explored opportunities for increasing connectivity and licence changes to alter the balance between dry year annual average and dry year peak week scenarios in order to achieve an optimal economic solution. Ultimately, dry year annual average and dry year peak week become mutually critical through the planning period.

3.5 Engagement programme: pre-consultation phase

3.5.1 Introduction

During 2012 and early 2013, we carried out a number of activities as part of the pre-consultation phase in order to understand customers’ views in the development of our draft WRMP.

More detail about the various methods of stakeholder engagement are provided in Technical Report 3.8: *Engaging Customers in Future Planning*.

3.5.2 Methods

3.5.2.1 Investing for your community

During 2012 we published a consultation document *Investing for your Community (October 2012)* which introduced the key aspects of our thinking in terms of our future plans. The document set out the primary elements that inform our Strategic Direction Statement, our Strategic Environmental Assessment Scoping Report and our draft Water Resources Management Plan. It sought the views of our customers on four customer expectations. We also asked five specific questions and offered a choice of answers asking how we should respond to the challenges we face.

The publication described these challenges; the levels of service available and the implications for customer bills and invited comment on the options available to us.

3.5.2.2 Have your say

A new web channel 'Have Your Say' was set up to capture feedback on our plans. Customers were offered the option to complete an interactive online questionnaire posing specific questions about the impact of our operations.

The channel offered access to a number of primary documents including *Investing for your Community (October 2012)* and our *Strategic Environmental Assessment Scoping Report (September 2012).*

3.5.2.3 Postal surveys

In October 2012 we wrote to our statutory consultees, our regulators, as well as to a further 900 representative bodies to consult them on *Investing for your Community (October 2012)*. This included local environmental interest groups, MPs, MEPs, parish councils, local and district councils, social welfare bodies, commercial organisations and other representative public interest groups.

A further 200 letters went out inviting feedback on our *Strategic Environmental Assessment Scoping Report (September 2012)*.

3.5.2.4 Drop-in events

We arranged ten drop-in events which took place between October and December 2012 in our local communities across our regions. The events offered customers the opportunity to drop in on an ad hoc basis to talk with us about any aspect of our plans. The drop-in events were promoted widely through local press advertising, news events and our website.

3.5.2.5 Qualitative focus groups

Between October and December 2012 we conducted ten independently run focus groups with customers looking for qualitative feedback on our plans. In one group, we consulted small- to medium-sized enterprises in the sports and leisure sector and the remainder were domestic customer groups across the demographic and geographic range of our customer profile.

3.5.2.6 Online customer panel

We set up an online panel (independently run by research body ResearchNow) made up of 2000 customers. The sample group was profiled to ensure it was a geo-demographic reflection of our customer groups across our regions. We scheduled panel surveys throughout 2013 and this provided us with a statistically significant number of quantitative responses to key issues posed to the panel.

> “Interesting to be asked by my water supplier for my opinion”

During this pre-consultation, we ran two panels:

- **December 2012:** a generic fact-finding questionnaire, to enable us to focus in on issues of most concern to our customers, covering topics such as contact, metering principles, water efficiency, planned work, waste water, difficulty paying bills, restrictions, and service values.
- **February 2013:** a survey designed to inform the development of our draft WRMP, including questions on metering, bill frequency, quality of information, stepped tariffs, water saving devices, leakage fix rates, and the importance of the environment.

3.5.2.7 Billing booklet

We send out over 900,000 accompanying pamphlets with water bills each year. During 2013, we included information prompting for feedback on our plans. We will continue to use this as an avenue of engagement in the future.

3.5.2.8 Environmental forum

During November 2012 we launched an environmental forum to give voice to the views of environmental groups representative of customers affected by our operations. A second meeting took place during February 2013 to debate key issues and options and gain meaningful input to our plans.

3.5.3 Results of the pre-consultation phase

3.5.3.1 Quantitative feedback

Across our online panel of 2,000 members, a total of 949 responses were received from the two customer surveys delivered in December 2012 and February 2013. The profile of responses maps the geo-demographic spread of customers across our WRZ. For each survey, customers were asked to respond to a multiple choice questionnaire. Customers were also invited to leave comments at the end of each survey.

We received 448 completed responses to our generic fact-finding questionnaire from December 2012[9]. The results included:

- Regarding the household's use of water, 5% consider themselves 'high' users, with 57% 'medium' and 38% 'low' users.
- When asked to rate their water efficiency on a scale of 1 to 10 where 1 was "I don't think about water efficiency – I use as much as I want" and 10 was "I actively reduce my use of water by taking actions, e.g. short showers, only doing full loads of washing etc", 17% selected 5 or lower, 54% selected a number between 6 and 8 inclusive, whilst 29% selected 9 or above.

> "It's time we all worked together to save water and the environment, we must think of the future and what we are leaving our children"

- When asked how effective metering is in saving water, with a scale of 1 (very ineffective) to 5 (very effective), 67% selected 4 or above, with 2% selecting 1.
- When asked whether all customers should be metered, 36% said no, customers should be able to choose, with the remaining responses selecting either yes, it's the fairest way to pay for what you use or yes, as it helps to encourage water efficiency.
- When asked if their use of water was restricted in the last year, 43% said no. Of the 57% that said yes, 85% cited that they were affected by the hosepipe ban. Most customers (69%) felt the restrictions they faced was a minor inconvenience.
- When asked if additional support should be provided to customers who have difficulty in paying for their water bill, 21% felt that sufficient safe guards already existed, whilst 14% did not know. 38% felt that personalised payment plans should be provided, 29% felt that targeting specific groups and working with support agencies would help, whilst 17% felt that a lower tariff should be offered, funded by customers.

We received 501 completed responses to our water resources questionnaire from February 2013[10]. The results included:

- When asked if meters are the fairest way for everyone to pay for the water they use, 75% said yes, 15% said no, whilst 10% didn't know.
- 55% of customers felt that a household water meter would save them money on their water bill, whilst 27% disagreed and 18% didn't know.
- 69% of customers would like to receive more information about their water use with their water bill. 23% did not want to receive more information, whilst 8% didn't know.
- When asked about a compulsory metering programme, 77% of respondents felt that everyone should have a meter whilst 14% felt they should only be installed in areas of short supply. A further 9% didn't know.
- 87% of customers said they would use water saving devices such as water butts and toilet cistern devices if we supplied them. 5% of customers said they would not use them, and 8% didn't know.

[9] Office for Public Management, Panel Survey Findings report, September 2013: survey 1
[10] Office for Public Management, Panel Survey Findings report, September 2013: survey 2

- 75% of respondents felt we should increase the rate at which we fix leaks on our network. 11% disagreed, and 14% didn't know.
- However, 69% of customers would not be prepared to see an increase in their water bill to allow leaks to be fixed at a faster rate; 15% said they would pay more, with another 15% saying they didn't know.
- 87% of respondents agreed that the local environment was important to them, whilst 8% disagreed. 75% of customers would like us to carry out more evaluations at our water sources in order to understand the impact on the local environment.

> "Good survey, however not in favour of increased bills as everything is already so expensive"

- However, 31% of customers felt that having as much tap water as they wanted / needed was more important to them than the local environment. 44% of customers felt that the environment was more important, whilst 25% didn't know.
- 65% of customers would be prepared to reduce the amount of water they used to keep local rivers and streams flowing, whilst 13% would not.
- 59% of customers would not be prepared to see an increase in their water bill to avoid harm to the environment; 23% said they would pay more, with another 18% saying they didn't know.

Detailed analysis of all quantitative feedback has been undertaken by a third party and is appended to Technical Report 3.8: *Engaging Customers in Future Planning*.

3.5.3.2 *Qualitative feedback*

The first phase researched the views of domestic and small commercial customers as well as environmental stakeholders on the four customer expectations published in our Business Plan consultation document *Investing for Your Community (October 2012)*:

- Making sure our customers have enough water;
- Supplying high quality water you can trust;
- Minimising disruption in your community;
- Providing a value for money service.

The aim of the study was to collect information about attitudes, opinions and preferences that would assist us in understanding customer issues, including those related to the WRMP. The first stage of the study used focus groups to gain the views of domestic customers and small and medium commercial customers, whilst stakeholder views were captured from a workshop.

We achieved over 180 responses to the pre-consultation phase via *Investing for your Community (October 2012)*. A further 80 individuals attended our focus groups and around 50 fed their thoughts back through their attendance at an Environmental Forum. These responses, coupled with views gathered from over 100 ad-hoc emails and letters, make up the qualitative response to our pre-consultation exercise.

Key responses relating to the WRMP were that customers wanted us to:

- Stop abstraction where damage is occurring;
- Act to reduce consumption, provide free water efficient appliance fittings and advice to customers;
- Reduce leakage;
- Install meters systematically in water stressed areas provided it is cost-beneficial.

There was a divided response over increasing bills to reduce the frequency of applying restrictions between 'under all conditions' and 'no change'. We sought to explore this during the draft WRMP consultation period and present our findings later in this document.

3.5.3.3 Customer Challenge Group

Recent changes to policy set out by our regulator Ofwat, provide for a new body to be created. Our Customer Challenge Group (CCG) was set up in 2012 to provide us with a means for our plans to be constructively challenged to ensure that they are accepted by customers.

The role of the CCG is to operate independently of the company to review our customer engagement process. The CCG has considered the emerging evidence to ensure that customers' views are properly taken into account as we develop our plans. The CCG has a mandate to challenge the phasing, scope and scale of work required to deliver outcomes and the degree to which it is socially, economically and environmentally sustainable. The CCG advises Ofwat on the effectiveness of our engagement and whether it considers that our Business Plan reflects a sound understanding and reasonable balance of customers' views.

Throughout our engagement programme we have welcomed the feedback and active participation of our CCG in all aspects of our activities from review and comment on our proposed online panel surveys to attendance at focus groups.

Our CCG was formed in July 2012, is independently chaired and meets regularly.

The Chair of our CCG has provided the following feedback in March 2013:

> *"The Customer Challenge Group (CCG) has taken a keen interest in the draft WRMP, as it underpins the Business Plan that Affinity Water will submit to Ofwat. Affinity Water colleagues have provided several briefings to the CCG, and CCG members provided their thoughts on the consultation process. The CCG has been presented with the results of the pre-consultation engagement and looks forward to seeing the views expressed in those results carried forward into the draft WRMP consultation."*

3.5.4 Other consultation

3.5.4.1 Water Resources in the South East

The Water Resources in the South East Group (WRSE) was set up to review how the six regional water companies should utilise the strategic water resource in the most efficient and effective way. Along with the five other water companies, we provided data on our water availability and our forecast customer demand to facilitate modelling of regional resource needs in the next 25 years. We also provided details of all options for meeting any water deficits. The cost data from all water companies and the modelling approach to date has been subject to independent review.

"Enough rain falls in this country to provide for everyone's needs; it just needs capturing"

Our input to the WRSE process has included engagement with the Environment Agency, Ofwat, DEFRA, the Consumer Council for Water and Natural England, as well as with other companies to explore options for best use of resources across the South East.

Companies are expected to explain how their WRMPs are influenced by the outcomes of the WRSE project.

We describe the WRSE modelling and how we have used the outcomes to inform the development of our Plan in section 9.2.

3.5.4.2 *Water Resources East Anglia*

Our East region, in East Anglia, is not part of the area covered by the WRSE project; however, we are participating in the Water Resources East Anglia (WREA) project, which has similar objectives to WRSE, although it did not have any outputs to inform this round of Plans. Our Central and East regions are part of WREA and we expect to have results to inform our WRMP in 2019.

The following is an extract from Anglian Water's summary of WREA:

> *In response to the challenge of climate change, population growth and the reductions in deployable output that are needed to restore abstraction to sustainable levels, the water companies in East Anglia have been working to develop a robust, long-term water resources strategy. This work is being progressed through the Water Resources East Anglia (WREA) project.*
>
> *The WREA builds on previous work that led to the "Trading Theory for Practice" paper published in 2010 by Anglian Water, Cambridge Water and Essex and Suffolk Water. Key points about the WREA include:*
>
> - *It is a multi-company, multi-sector strategic water resource planning project for mitigating long-term supply-demand risk in East Anglia*
> - *It will focus on the strategic challenges of growth, climate change, sustainability reductions and intergenerational equity, and*
> - *It will look at the business case for winter storage reservoirs, strategic transfers and trading, aquifer storage and recovery, water reuse, desalination and a step-change in leakage reduction and water efficiency*
>
> *The area covered by the WREA includes the supply areas for Affinity Water (East and Central), Anglian Water, Cambridge Water and Essex and Suffolk Water. In view of the significance of the Trent for the future supply-demand strategy of East Anglia, Severn Trent Water will also be involved in the future development of the project.*

Success for the WREA is a flexible and adaptive plan for delivering a reliable, affordable and sustainable system of supply; which also needs to be resilient to the effects of population growth, climate change and future possible sustainability reductions.

The AMP6 work builds on an existing AMP5 pilot project. This has established a framework for collaborative technical work on strategic water resource issues and is based on application of Robust Decision Making (RDM) and multi-criteria optimisation. As part of this, a new regional water resource model has been developed. Using the new model, over 180 climate change, growth and sustainability reduction scenarios have been evaluated and future strategies based on reservoirs, water reuse and desalination tested.

The WREA project differs from existing regional planning efforts in several important respects:

- *It is long-term and multi-sector and recognises that success is based on effective decision making*
- *It will use an innovative approach to the economics of balancing supply and demand. Currently, a cost-effectiveness approach is favoured by the industry. The WREA will use a scenario based cost-benefit approach which is based on RDM and multi-criteria optimisation*
- *Through the RDM approach, the impact of abstraction on the environment will be explicitly modelled, and*
- *The WREA will provide a framework for the development of company-only WRMPs; it will not replace them, or the process by which these are developed.*

Through the WREA, water companies in East Anglia will be able to deliver the outcomes described in the Governments "Water for Life" white paper. These include promoting growth and protecting the environment. To enable this, the WREA project will:

- *Take a long-term view;*
- *Take better account of the value of water;*
- *Consider all options for maintaining the supply-demand balance, including trades;*
- *Reduce the demand for water; and*
- *Take customer views into account.*

This approach is fully aligned with current water resource planning guidelines from the EA, Ofwat, Defra and the Welsh Government, as described in the recently published "Guiding Principles" of water resource planning.

3.5.4.3 *Other water companies and third parties*

We have held discussions with all of our neighbouring water companies with respect to water trading opportunities.

These discussions explored the potential to create new cross-border supplies between companies as well as opportunities to vary existing agreements for water supply imports and exports from or to our operating area. Such water trading can offer the most efficient way of sharing regional resources for the benefit of all customers. Our discussions with Anglian Water also considered the use of our shared assets and existing transfer arrangements.

Following the publication of the draft WRMP, we have continued to hold discussions with neighbouring companies to ensure that the bulk supply options remained feasible, and to establish outline agreements and prices. The Agency identified this as a potential weakness in both the donor and recipient companies' Plans and asked that we ensure our revised Plans matched. We explain the development of water trading options in section 8.2.2, and set out which options we have agreed to proceed with in section 11.7.

Further details of these discussions can be found in Technical Report 3.5: *Water Company & Third Party Bulk Transfers*.

3.5.4.4 *Water industry regulators*

We have worked closely with all of our regulators, and in particular the Environment Agency, in the development of our Plan. Detailed discussions have taken place with regard to sustainability reductions and during the various stages of development of our potential options for meeting supply / demand deficits.

When we published our previous Water Resources Management Plan in 2010, we considered the effect of future sustainability reductions but, as they were not agreed with the Environment Agency at that time, we were unable to plan investment to replace the lost resource and this also meant we could not justify a compulsory metering programme.

Since then, we have worked closely with DEFRA, the Environment Agency and our fellow water companies, particularly as an active participant in the WRSE project, to agree how we can plan properly for this risk in our Plan. DEFRA and the Agency in particular have supported and challenged our desire to ensure our Plan takes proper account of potential sustainability reductions.

As a result, we have included sustainability reductions in the baseline supply / demand forecast of our Plan, which have been updated since the publication of our draft WRMP following further discussions with the Agency. This means we are able to identify investment needs and consult with our customers on the cost impact.

3.5.4.5 *Local interest groups and other stakeholders*

We included local interest groups and community organisations in our customer consultation programme described in Section 3.5.1 above.

We are often invited to present at local interest group meetings and to participate in group discussions. Many are keen to receive an update on the progress of sustainability reductions that could impact on the status of their local rivers. We have received a number of responses from local interest groups in response to our consultation on our draft WRMP, and many have told us that they participated in the Let's Talk Water campaign.

> "We have been involved in the WRMP consultation workshops and are very pleased with the degree they consulted local users and user groups"
>
> *Friends of the Mimram*

Consultation has also taken place as part of the Strategic Environmental Assessment (SEA) work (see section 3.7). We engaged with the three statutory environmental consultation bodies (English Heritage, the Environment Agency and Natural England) together with a number of non-statutory consultees including county and district councils, wildlife trusts, and recreation and amenity groups.

3.5.5 How our draft WRMP was influenced by pre-consultation

As described above, we engaged with customers as part of the pre-consultation phase to understand their key concerns and preferences.

Feedback to date has shown a strong signal that most customers believe that **metering is the fairest way to charge for water used**, but customers are less supportive of a universal metering programme that did not apply to the whole company area.

> "Metered water is much fairer - why should I subsidise big families?"

Our customers are very aware that **water meters help to reduce consumption** and that, for many, their water bills reduce as a result.

However, there is recognition that for some customers a water meter may not be the cheapest option (for example, large families or customers with specific medical needs), and that they would like us to explore an appropriate **transition programme** before universal metering is rolled out. This could include different types of tariffs to assist customers in need.

> "We save 200 gallons of rain water in water butts; the overflow tops up my garden pond"

Customers have also told us that **the environment is important to them**, but so is **having the water they need, at the right quality and quantity**. There is support for water efficiency programmes to help reduce consumption, which might include the provision of water butts for the garden.

Customers believe that **more should be done to address leakage**. Our customers acknowledge that a meter might help them identify internal plumbing leaks or leaks on their supply pipe, but it would be important for customers to be rewarded for swift action as opposed to being penalised for leaked water.

We used this feedback to develop our Preferred Plan in our draft WRMP for consultation.

3.6 Engagement programme: consultation phase

3.6.1 Introduction

As described in section 3.5, we undertook various forms of engagement and consultation to inform the development of our draft WRMP. We have continued to engage with customers and stakeholders to ensure that our revised WRMP provides the best balance between their preferences, the protection of the environment, Government aspirations and value for money.

This section provides a broad description of the activities we carried out during the consultation phase. We explain our assessment of the results of the consultation in section 10 and how the outcomes of the consultation phase have influenced and informed our revised Plan in section 11.2.

Further details of the outcome of each of the following elements of consultation and how we have considered these are appended to our Technical Report 3.8: *Engaging Customers in Future Planning* as follows:

- Technical Report 3.8.1: *Engagement Planning Phases*
- Technical Report 3.8.2: *Panel Survey Findings*
- Technical Report 3.8.3: *Environmental Forum Report*
- Technical Report 3.8.4: *A Review of our Plan Following Feedback from our Regulators*
- Technical Report 3.8.5: *draft WRMP Response Log*
- Technical Report 3.8.6: *Let's Talk Water*
- Technical Report 3.8.7: *Willingness to Pay Study*
- Technical Report 3.8.8: *Bill Acceptability Study*
- Technical Report 3.8.9: *Deliberative Forum Report*
- Technical Report 3.8.10: *Customer Challenge Group Briefing Pack*

3.6.2 Draft Water Resources Management Plan consultation

3.6.2.1 Introduction

Consultees were invited to share their views on how well the proposals set out in our draft WRMP balanced the challenges that we face now and in the future. We were particularly keen to understand their views on five key issues, as outlined below.

3.6.2.2 Leakage

Our draft Plan proposed to spend more on repairing pipes than is cost effective for the volume of water saved. We asked customers and stakeholders to consider two questions:

- *Do you agree with this approach?*
- *Weather conditions can have a significant impact on the level of leakage, should our targets be altered to reflect this?*

3.6.2.3 Sustainability Reductions

To enable local river environments to improve we propose replacing or reducing abstraction from those sources likely to be impacting on them. Our initial analysis suggested this could increase customers' water bills by around £10. We asked customers:

– *Are you willing for bills to rise to enable this to be achieved?*

3.6.2.4 Water Efficiency and Metering

We think metering is the fairest way to pay for water. We also think we need to do more ourselves and to help everyone else in being more efficient in the use of water. To do this, we proposed a universal metering programme in our draft WRMP. The cheapest way to meter is achieved via street-by-street installation, fitting a meter to every property that does not currently have one, whilst promoting water efficiency. We asked customers:

– *Do you agree?*

3.6.2.5 Drought resilience

Our experience of the 2012 drought highlighted the need for us to invest around £15.5M to improve the security of water supplies in the case of future severe water shortage in South East of England. We included this investment in our draft WRMP. We asked customers:

– *Should this investment be made?*

3.6.2.6 Online panels

During the consultation phase, we made use of our independent online panel to run further surveys providing robust quantitative responses to key issues. The panels we ran during the consultation phase of our engagement programme are listed below.

– **May 2013:** testing to seek support for a proposal to include environmental measures within our four proposed outcomes, including questions on environmental impacts and associated investment.

– **July 2013:** a leakage survey to establish if customers believe we manage leakage appropriately, preferences for how to report leakage, options for leakage repair rates, willingness to pay to reduce leakage beyond the economic level, relationship between restrictions and leakage fix rates, management of customers' supply pipes and leakage targets.

– **August 2013:** a survey investigating views on abstraction, bill levels linked to sustainability measures, our strategy on demand management, investment in drought resilience, and temporary use restriction (hosepipe ban) rates.

– **August 2013:** a survey seeking customer views on the principle of providing social tariffs for vulnerable customers.

Learning from the earlier panel surveys of the pre-consultation phase, we worked harder on the format and delivery of the surveys for this phase to provide customers with simply stated and meaningful information about complex issues against which they could feel better able to respond. We grouped questions by topic and for each group provided an initial statement in plain language about the issue.

We also added a final question to surveys to gauge the success of this approach, their comprehension of the issues and the effect this had on customer support of our plans.

3.6.2.7 Let's talk water

As part of the Business Plan consultation, we ran a campaign to gather feedback from the public on our plans. The campaign was publicised widely in local press to promote a substantial response. The survey was accessible as an interactive form on our website and paper versions were promoted and made available at events throughout our regions.

LET'S TALK WATER
Your community, your say, our future
www.talkwater.co.uk

We also ran the same survey with our customer profiled online panel during the consultation period to validate the findings of the self-selecting audience that completed the web and paper versions.

The 'Let's Talk Water' survey asked 19 closed questions about customer perceptions of their water use, metering, leakage, water saving devices, abstraction, water quality and affordability.

3.6.2.8 Environmental forum

We commissioned an agency to undertake a series of workshop forums to elicit feedback from stakeholders representing the views of customers with an interest in the environment. Our aim was to explore the views of participants around our four customer expectations. We sought to understand their perspective on key issues of resource planning including the relationship between the impact of abstraction and managing demand and the key themes and objectives set out in our Strategic Environmental Assessment (SEA).

We undertook four workshops across our regions in November 2012, February 2013 and July 2013.

3.6.2.9 Willingness to pay

As part of our business planning process we asked consultants ICS Consulting and Eftec (Economics for the Environment Consultancy) to undertake a series of customer stated preference studies to ascertain customer preferences for different service improvements. The value customers place on differing service measures was examined in a 'willingness to pay' study. As well as a main study, phase two of the work focused on water resources.

A number of key water service attributes formed the basis of the study – our Service Measure Framework is set out below:

- Drinking water notices (combined boil and do not drink);
- Water hardness;
- Discolouration;

- Taste and odour;
- Low pressure;
- 6-12 hour supply interruption;
- Water flooding to properties;
- Water restrictions (temporary use bans and non-essential use bans);
- Low flow rivers;
- Leakage.

The willingness to pay study was commissioned to provide quantitative evidence for use in investment optimisation.

3.6.2.10 *Bill acceptability*

We tested our Preferred Plan to see whether the bill associated with that plan would be acceptable to customers. This piece of work was jointly undertaken by consultants ICS Consulting and Eftec. Our Preferred Plan was tested against several other possible options to determine whether this plan or another was the most acceptable plan in the view of customers.

We used this piece of work to determine the best service-bill combination for customers.

3.6.2.11 *Deliberative forum*

We asked consultancy Office for Public Management (OPM) to facilitate four deliberative forums for us across our regions in Clacton, Harrow, Folkestone and Bishops Stortford. The purpose of these events was to drill down in greater detail with customers to understand whether they felt we have the balance right between the service they receive and the bill they pay.

Discussion was qualitative in nature during the event though some quantitative data was obtained when participants were asked to vote on three topics at the beginning and again at the end of the day:

- The extent to which they felt well informed.
- Their trust of Affinity Water and their satisfaction of service levels.
- The value for money they perceive for their water service.

Around 50 domestic customers attended each event (approximately 200 in total). The audience was selected to broadly reflect the population in the geographic location in which each event was held, based on national census data.

3.6.2.12 *Customer Challenge Group*

Our CCG has included the following statement in their report on our Business Plan:

"Since its formation in July 2012, the Customer Challenge Group (CCG) has advised and challenged Affinity Water during each stage of the creation of its Business Plan for 2015-2020.

We are completely independent of the company and our members comprise of both household and business customers, as well as representatives from regulators, local authorities, community and environmental groups. We meet regularly to examine Affinity Water's customer engagement programme and to consider whether the company is taking its customers' views into account when preparing its Business Pan for 2015 -2020. I also meet the Affinity Water Board to advise them on our work and to share any concerns that have been raised about the company's plans.

We have ensured that the company has undertaken a comprehensive consultation, with a broad cross section of customers and stakeholders. We have closely examined how it has interpreted the results to ensure it is a fair and accurate reflection of customers' views.

We are submitting our own report of our findings to Ofwat at the same time that this plan is presented."

Further, the CCG report states:

"The CCG believes that throughout its customer engagement programme Affinity Water has followed the guidance recommended by Ofwat and UKWIR on Willingness to Pay. We believe the company used best practice on designing and delivering the other surveys. The company used external consultants with good reputations for expertise in this area. The engagement programmes were peer reviewed by experts. The outcomes from each stage were robust. Where necessary, the results were statistically significant."

3.6.3 Results of the consultation phase

The results of the consultation phase have influenced the development of our revised WRMP. We describe the results of our consultation in section 10.3, and how our Plan has changed in section 11.2. Further detail about the various methods of stakeholder engagement and the results are provided in Technical Report 3.8: *Engaging Customers in Future Planning*.

3.7 Strategic Environmental Assessment

As we are planning to accommodate both an increasing population and source sustainability reductions, our Plan demonstrates investment is needed to overcome a supply demand deficit and therefore assesses development options. A Strategic Environmental Assessment (SEA) is required, which must adhere to a regulatory assessment and consultation process.

We undertook a baseline assessment to identify the key receptors that could be affected by the implementation of potential options. The receptors include people, habitats and species, water bodies including rivers, landscape character and heritage features.

The baseline assessment was used to assess the environmental impacts that would be expected to occur on the unconstrained options. Options with a greater environmental risk were screened out as part of the assessment, alongside options that had high technical risks. The output matrix used a traffic light coding system, where the highest risk options (red) were removed from further assessment. The green (low) and amber (moderate) options were taken forward onto the feasible options list.

A summary of the baseline environment was presented in the Scoping Report, along with the proposed methodology for the SEA. The Scoping Report was issued to statutory and other consultees with comments on the proposed SEA approach being returned in December 2012.

The SEA was undertaken on all of the feasible options. The baseline was assessed in terms of the sensitivity to an option. We then assessed the potential impacts that could be expected to occur during the construction and operation of each option. An environmental risk level was assigned to each option based on the sensitivity of the environment and the scale of the potential effects likely to occur. This environmental risk level was used within the model to allow the selection of alternative environmental scenarios as part of selecting the Preferred Plan.

Further environmental assessment was undertaken on the least cost plan to identify whether there were cumulative effects between the individual options and whether further model iterations or mitigation would be required to reduce the risk of significant effects from the Plan. The Environmental Report provides the results of the SEA, together with recommendations to improve the environmental outcomes and monitor the effects of the plan. A Habitats Regulation Assessment (HRA) has also been completed for the Preferred Plan.

Both the Environmental Report and HRA report have been updated in the preparation of our final Plan.

Details of the SEA inputs to the development options assessment are described in Section 8.7.3. Full details of the SEA, which includes consideration for cumulative effects of options and neighbouring companies' Plans, are described in Technical Report 3.9: *Environmental Report*.

4 Water available for supply

4.1 Introduction

Each of our three regions has its own sources of supply as indicated in Figure 6, Section 2.2. As described earlier, our Central region is divided into six water resource zones that have their own water sources and are supported by inter-zone transfers. Our East and Southeast regions each comprise a single water resource zone.

The majority of our water comes from groundwater and the Chalk aquifer (approximately 60%), which provides large amounts of natural storage. The remainder comes from surface water, but we have limited storage with only about 10% of total resources from surface water reservoirs.

Although the three regions are geographically separated, there is potential to establish links by cascading water transfers via neighbouring water companies' pipe networks. Such an approach has been explored in our future options assessment particularly in the context of the WRSE work (linking our Central and Southeast regions) and in discussions with Anglian Water (linking our Central and East regions).

> "We need a "National Grid" for water, and I would very much like to see this come into play. It would help balance water supply throughout the UK"

Water availability from our sources is limited to the volumes specified in abstraction licences and by the capacity of our networks, pumping stations and treatment works. However, it will also potentially vary depending on climatic conditions.

After prolonged periods of rainfall, river and groundwater levels will typically be high allowing maximum water abstraction; under drought conditions, water levels will be at their lowest and may limit abstraction.

For planning purposes, our source outputs are assessed in relation to two climate scenarios as follows:

- **Normal year** – how much water is available under average climate conditions;
- **Dry year** – how much water is available in a year with low annual rainfall.

Outputs under dry year conditions are assessed as three values:

- An **average daily amount** for the whole year;
- A **peak daily amount** over a critical period when demand is at its highest (typically the peak seven day period);
- A **minimum daily amount** when water sources are at their most stressed condition (this would normally be when natural water levels are at their lowest at the end of a dry summer).

Our supply demand planning assessment is based on the dry year scenario in accordance with the WRPG[11].

[11] WRPG, section 2.6.1. "The dry year, a period of low rainfall and unconstrained demand, is the basis of a company's water resources management plan."

4.2 Deployable output of existing sources

Deployable output (DO) is the term used to define how much water can be abstracted reliably from a source during a dry year and delivered into supply. It is measured in mega litres per day (Ml/d). We evaluate DO as an average over the whole year (known as average DO or ADO) and during critical periods (typically a seven-day period) when demands are at their highest (known as peak DO or PDO).

Our surface water sources in Central region comprise four intakes (one supplying WRZ4 and three supplying WRZ6) on the River Thames operated under the Lower Thames Operating Agreement; the Agreement stipulates that Thames Water, who abstract much greater quantities of water than us, have to maintain minimum river flows. Our abstractions therefore have no river flow constraints affecting DO. We have made operational changes and improvement in treatment capacity at these four works with a consequent increase in DO values.

We also jointly own with Anglian Water one surface water reservoir source that supplies our East region (WRZ8). This source of water is governed by the Ardleigh Reservoir Order of 1967. The DO of this source has been reduced due to water treatment constraints. As joint owners, we are entitled to 50% of the output but, under a short-term agreement, we currently take 30% of the total output, allowing Anglian to take 70% under a ten-year rolling Bulk Reservation Agreement that we signed in 2010.

We have a further arrangement with Anglian Water for a shared supply from another surface water reservoir to our Central region (WRZ3). This source of water is governed by the Great Ouse Water Act of 1961 and provides a supply of 91Ml/d at average and 109Ml/d at peak. We share the cost of operating and maintaining the reservoir, treatment works and pipeline that brings water from Huntingdonshire into our operating area, to the north-east of Luton. We have reviewed the reliability of our supply from Grafham Water following publication of our dWRMP and further discussion with Anglian Water. Taking account of recent correspondence with the Environment Agency regarding a change in river flow gauging on the Bedford Ouse and Anglian's reassessment of deployable output from the reservoir and water treatment works we have agreed to include for a potential reduction in deployable output in drought conditions to ensure our plans are consistent. We have made allowance for this additional uncertainty by updating our headroom assessment (see Technical Report 2.4: *Headroom*).

Our groundwater source DO assessment is based on review of pumped outputs against long term hydrological records (observing, for example, how groundwater levels have varied and how much water could be abstracted under such varied conditions). We have records of groundwater levels back to the 1960s and have estimated levels for key aquifers back to pre-1900 by using rainfall data as an input to a groundwater recharge computer model. (Refer to Technical Report 1.1: *Deployable Output Assessment*.)

In our previous WRMP, we reported on our assessment of groundwater DO values based on groundwater levels, which were at their lowest during the dry year 2005/06. We have now experienced another dry year in 2011/12 following which we have assessed groundwater level data to see whether 2011/12 represents a more extreme case. In general across our aquifers, the 2005/06 water levels were more extreme although at a few sources, 2011/12 levels were lower. At these sources, we have reviewed and, where appropriate, modified the DO values. We have also re-assessed groundwater source DOs where there have been new works undertaken or operational changes made.

In summary, our average and peak DO values for our own sources within each water resource zone are shown in Table 3. Changes in outputs since the previous WRMP are also shown and are fully explained in the Technical Report 1.1: *Deployable Output*.

The values in Table 3 *exclude* bulk transfer imports from other water companies.

WRZ	Average deployable output (ADO) Ml/d	Peak deployable output (PDO) Ml/d	Change in ADO (Ml/d) from WRMP 2009	Change in PDO (Ml/d) from WRMP 2009	Key Reasons for Changes
1	136.78	172.25	-2.00	-9.19	Reduced availability from aquifer
2	180.36	213.47	-4.23	-0.39	Termination of temporary abstraction licences
3	171.93	188.52	-2.03	5.87	New abstraction licences and adjustments in source performance
4	241.00	245.00	36.00	5.36	Net increase in output at surface water sites
5	70.77	73.38	-0.45	-4.37	Net reduction in abstraction licences
6	201.70	262.20	10.01	39.38	Net increase in output at surface water sites
Sub-total (Central region)	1002.54	1154.82	37.30	36.66	
7 (Southeast region)	52.30	60.93	1.15	-4.16	Adjustments in source performance and sustainability reductions
8 (East region)	38.55	52.75	-2.14	-3.6	Amendments to loan agreement with Anglian Water
Company Total	**1093.39**	**1268.50**	**36.31**	**28.90**	

Table 3: Zonal deployable output values

4.3 Existing water transfers

We have arrangements with six neighbouring water companies for the bulk supply import of treated water to our water resource zones (WRZs) and with four of the companies for bulk supply exports in different locations (reference Technical Report 3.5: *Water Company & Third Party Bulk Transfers*); details are listed in Table 4. The volumes represent the available capacity, not our actual utilisation, which varies from year to year.

ID	Donating Company	Receiving Company	Average Ml/d (max)	Peak Ml/d (max)
1	Anglian Water	Affinity WRZ3	91.0	109.0
2	Thames Water *	Affinity WRZ4	10.0	10.0
3	Thames Water	Affinity WRZ4	0.2	0.2
4	Thames Water	Affinity WRZ4	2.0	2.0
5	Thames Water	Affinity WRZ6	2.27	2.27
6	Cambridge Water	Affinity WRZ5	0.31	0.31
7	Affinity WRZ3	Cambridge Water	0.04	0.04
8	Affinity WRZ3	Anglian Water	0.14	0.14
9	Essex & Suffolk Water	Affinity WRZ5	0.03	0.03
10	Affinity WRZ6	South East Water	36.0	36.0
11	Affinity WRZ7	Southern Water	0.1	0.1
12	Affinity WRZ8	Anglian Water	8.1	8.1

Table 4: Existing water import and export arrangements

* *The statutory instrument governing this bulk import from Thames Water is for 27Ml/d, and the connection capacity was enhanced from 10Ml/d to 27Ml/d under our security and emergency measures directive programme for PR09, and therefore we agreed with Thames Water that the DO would remain at 10Ml/d for AMP5.*

We also have infrastructure in our Southeast region that we have used in the past to receive bulk imports from South East Water and Southern Water. Those agreements expired recently and have been replaced by new agreements that represent good value for our customers, as they have previously carried high annual charges regardless of the volume used. We have represented these bulk imports as feasible options for our WRMP, as described in section 8.2.2.6 and 8.2.2.7.

Figure 16 gives the indicative locations of these existing import and export arrangements.

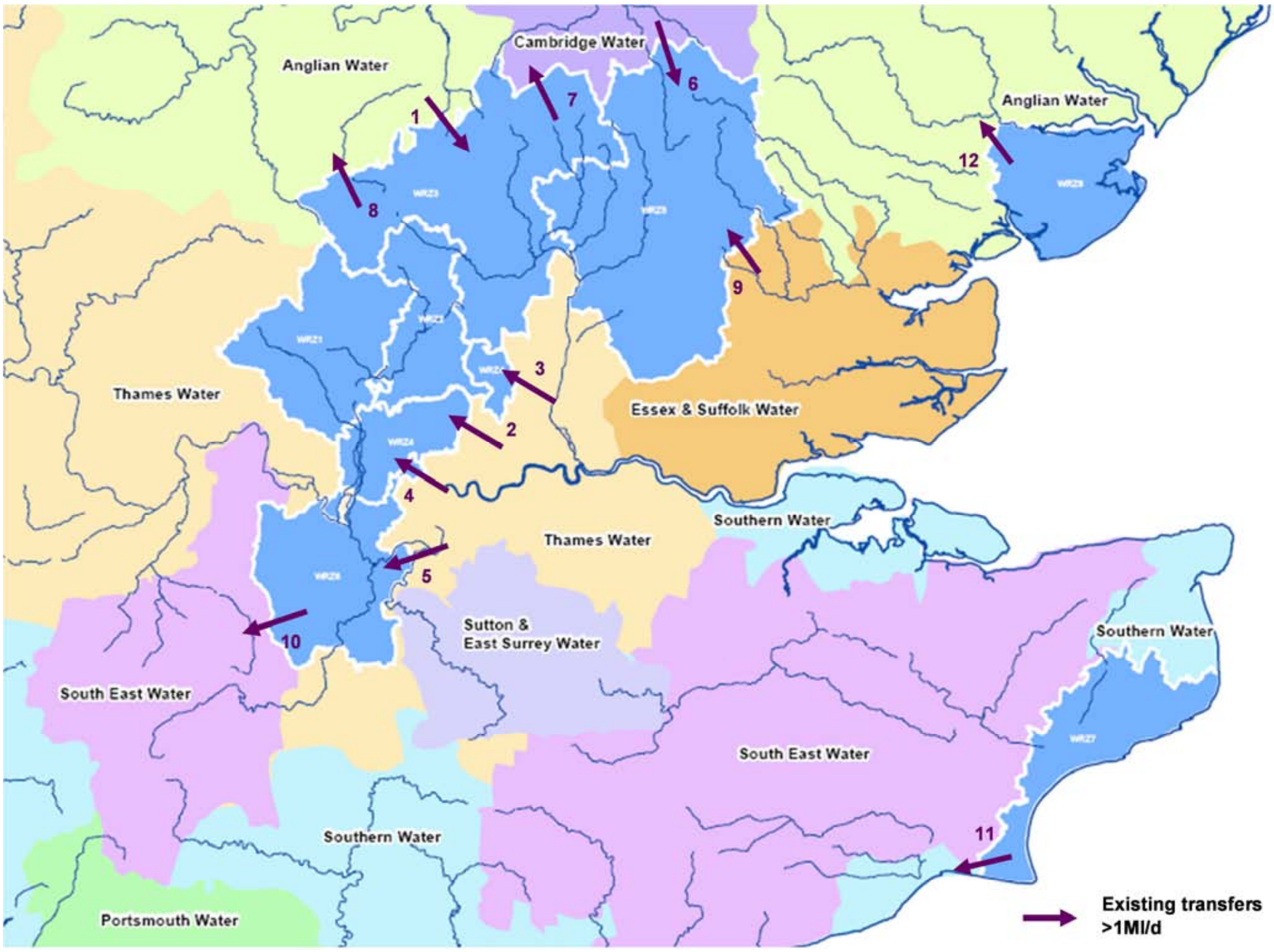

Figure 16: Locations of existing import and export arrangements

We also have 36 emergency cross-border transfer connections with neighbouring water companies. Although these are not used routinely and thus do not contribute to deployable output assessments, they do provide additional resilience to our water supply network in the event of emergencies.

4.4 Future reductions in deployable output

4.4.1 Sustainability reductions

As described in section 3.3.2, we have agreed with the Environment Agency the following sustainability reductions that apply to our groundwater abstraction sources in three of our eight zones. Table 5 shows the average and peak sustainability reductions by water resource zone.

Water Resource Zone	Reduction Average DO Ml/d		Reduction Peak DO Ml/d	
	AMP6	AMP7	AMP6	AMP7
1	11.00	2.00	6.15	2
2	5.82	8.84	5.82	0
3	25.27	16.87	27.09	10.49
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
Sub-total (Central region)	**42.09**	**27.71**	**39.06**	**12.49**
7 (Southeast region)	0	0	0	.0
8 (East region)	0	0	0	0
Company Total	**69.80**		**51.55**	

Table 5: Groundwater abstraction sustainability reductions

The reductions affect 13 of our sources, with five sources being shut down and eight having reduced outputs. We are planning to achieve reductions of 42Ml/d under average conditions in the first five years of the period, with the remainder to be completed by 2025.

Further possible reductions of 217Ml/d have been listed in the Agency's 'unknown' category and could affect future WRMPs. We will continue to work closely with the Agency to explore their future requirements.

4.4.2 Other reductions

We do not forecast any future reductions to our DO associated with pollution incidents.

4.5 The impact of climate change on supply

4.5.1 Assessment for our draft WRMP

Our assessment of the impact of climate change on source outputs has been based on the latest climate change projections published by DEFRA (UKCP09 scenarios). We employed specialist consultants to take samples from the 10,000 UKCP09 scenarios and to forecast the range of impacts on groundwater levels (reference Technical Report 1.3: *Assessment of Climate Change Impacts on Deployable Output*). A vulnerability assessment was undertaken to assess which sources were vulnerable to climate change. An appraisal was then made of the impact of the varied groundwater levels on the quantity of water that could be abstracted from those sites vulnerable to climate change.

In our Central region, mid-range climate change values for groundwater sources resulted in a reduction in output at 19 of our sources. Our surface water abstraction licences from the River Thames do not include any flow or other constraints as Thames Water is responsible for maintaining minimum flows in the river; there are therefore no climate change impacts on our abstractions.

In the East region, climate change impacts have been assessed for the surface water reservoir we share with Anglian, concluding that there would be no impact on the water available. Groundwater sources in the area are not considered to be sensitive to climate change due to groundwater levels being significantly higher than borehole pump levels in the confined chalk aquifer. Nominal allowances, as used for the previous WRMP, of 1% reduction in output have been made for our chalk sources.

> “It's made me think more about the balance between water extraction and the environment”

In the Southeast region, climate change impacts have been assessed using the East Kent groundwater model resulting in reductions at seven of our sources.

For all of our water resource zones, the 50th percentile estimate of climate change impacts has been used for our DO assessment and the range from the worst case to a best case has been used in the headroom analysis to evaluate the uncertainty. Table 6 identifies the reduction in Average and Peak DOs in each of our WRZ that will be realised by 2035 as a result of climate change.

Water Resource Zone	Reduction in Average DO Ml/d	Reduction in Peak DO Ml/d
1	-2.54	-6.94
2	-4.49	-4.34
3	-4.61	-4.38
4	0	0
5	-0.40	-0.95
6	-8.50	-9.10
Sub-total (Central region)	-20.54	-25.71
7 (Southeast region)	-5.10	-6.18
8 (East region)	-0.30	-0.42
Company Total	**-25.94**	**-32.31**

Table 6: Climate change reductions

4.5.2 Latest analysis for our final WRMP

In order to ensure our assessment of the impacts of climate change in our draft WRMP is suitable, for our final WRMP we re-assessed the vulnerability of our sources to climate change by reviewing previous estimates of climate change impacts on Deployable Output from PR09. This is detailed in Technical Report 1.3: *Assessment of Climate Change Impacts on Deployable Output.* On the basis of this assessment, our Central and East regions are considered to be at low vulnerability to climate change whilst our Southeast region is considered to be at high vulnerability to climate change. On this basis, the level of analyses undertaken for our Central, Southeast and East regions in our draft WRMP and discussed in section 4.5.1 is considered to be appropriate.

The WRPG suggests that water companies may wish to consider the impacts of climate change beyond the 25-year planning period. We have decided not to analyse climate change impacts beyond 2040 due to the very large uncertainties associated with climate predictions, downscaling, recharge modelling and relating groundwater levels with deployable output in drought conditions. As we have low vulnerability to climate change, we consider that our analysis is sufficiently robust for the 25-year planning period and will continue to review our assessments as part of the annual review process.

> "Climate change is affecting every one of us, and playing a major role in lower availability of water"

The outcome of our latest analysis is that there is no change to our assessment of the impact of climate change on our sources for our final WRMP.

4.6 Outage allowances

4.6.1 Assessment for our draft WRMP

Outage is a measure of the temporary loss of output from a source due to planned events such as equipment maintenance or due to unplanned events such as power failure or raw water quality deterioration. Applying an outage allowance to source outputs ensures a realistic assessment of overall water supply capability.

We have made significant improvements in outage reduction as a result of our current programme of investment to prevent flooding at 29 sites. Our programme will be completed in 2014. We have reflected these improvements in our outage assessment.

Since our last WRMP, we have improved routine logging of source downtime to gain detailed records of the type and duration of outage events. These records (available since 2009 for WRZ1-6 and since 2011 for WRZ7 and WRZ8) have been used in our statistical models to forecast future outage.

Outage records for all groundwater and surface water sources and for transfers into each zone were applied to a probability model using specialist risk assessment computer software. Distributions were assigned to each event and then summed to give an outage forecast for each source works. A model was created for each resource zone, with source outages being summed to give a total outage value for the resource zone.

Table 7 summarises the outage allowances for each water resource zone. The full analysis can be found in Technical Report 1.5: *Outage*.

Water Resource Zone	Average DO Outage Ml/d	Peak DO Outage Ml/d
1	5.82	7.36
2	6.31	4.83
3	14.59	13.77
4	6.28	4.56
5	2.76	2.6
6	6.05	6.7
Sub-total (Central region)	41.81	39.82
7 (Southeast region)	2.02	1.58
8 (East region)	0.99	0.85
Company Total	**44.82**	**42.25**

Table 7: Outage figures by Water Resource Zone

4.6.2 Latest analysis for our final WRMP

We have reviewed outage in 2012/13 in the preparation of our Annual Return and publication of our risk and compliance statement as required by Ofwat.

2012/13 was an unusual year, with temporary use restrictions put in place after three dry winters, only to be succeeded by the second wettest summer on record, which, with the lower temperatures, significantly suppressed demand.

As the aquifer was recharging during the summer of 2012, we took the opportunity presented by these weather conditions to bring forward various planned outages that had already been delayed as a result of the three dry winters, as our system was able to cope with such outages during a period of low demand. This operational flexibility allowed us to undertake essential maintenance to ensure we continued to supply high quality drinking water to our customers.

We consider that 2011/12 represents a normal year in terms of outage and we have not adjusted our supply / demand balance to account for the outage reported in our 2013 Annual Return.

4.7 Treatment works losses

4.7.1 Introduction

Feedback on our draft WRMP from the Environment Agency included a recommendation that we clarify how we have taken account of treatment works losses. We review our assessment of losses annually and confirm any changes in configuration in each treatment plant with our operational colleagues. We have abstraction and distribution input meters with varying configuration depending on the specific requirements of each treatment works and pumping station. All meters are calibrated in accordance with the Environment Agency's best practice guidance and operate continuously. Instantaneous and integrated readings are collected both on site and through our telemetry system. We have assessed each site for losses and summarise how we take these into account below.

Our deployable output values take account of treatment works losses so no further deductions are required. We have explained our analysis in the Technical Report 1.1.1: *Surface Water Deployable Output Assessment*.

4.7.2 Surface water treatment works

At our surface water treatment works, we have both abstraction meters and output meters. We use abstraction meters primarily to monitor compliance with abstraction licences and use output meters to measure distribution input. We also measure significant waste flows, such as water discharged to waste. We have progressively reduced treatment works losses by adding secondary treatment in many cases with supernatant returning to the head of the works after abstraction metering, therefore total losses are small. Only the waste from small water quality monitors such as residual chlorine or turbidity instruments are unmetered. The majority of these monitors operate continuously at constant flow rate and we include an assessment for this element under an adjustment for minor losses in our water balance.

4.7.3 Groundwater sites: Karstic and sites subject to raw water pollution and two-stage pumping

We have a small number of groundwater treatment sites that are subject to the influence of surface water and therefore these have complex treatment. These sites are configured in the same way as our surface water sites.

4.7.4 Groundwater sites: non-karstic

We have a large number of groundwater sites where raw water quality is generally good such that it requires minimal treatment. These sites have single stage pumping and continuous treatment such as disinfection. In this case there are one set of flowmeters at the point of abstraction. These meter readings are monitored continuously through our telemetry system. Waste at these sites has only two elements: pumping to waste at start up or as a result of maintenance and continuous water quality monitoring instruments. Records are kept at each site for periods of pumping to waste and copied to our control room who record adjustments to daily integrated flow reports. An assessment has been made of the waste from sampling instruments and included in the water balance minor losses volume adjustment.

4.8 Abstraction Incentive Mechanism

As part of our PR14 Business Plan submission, we are required to complete table W7 – Abstraction Incentive Mechanism. An Abstraction Incentive Mechanism (AIM) has been proposed by OFWAT as a way to incentivise reductions in abstraction from environmentally damaging sites. In principle, these reductions would be offset by increases in abstraction from less environmentally impacting sites. This mechanism has been proposed to operate under the current abstraction licencing regime, until abstraction reform has been completed.

In 2013, we supported an UKWIR pilot project testing AIM. This pilot project tested a financial incentive of £50 per mega litre to reduce abstraction from environmentally damaging sites. The mechanism was tested using our water resource optimisation model, MISER. With this financial incentive, our MISER modelling suggested that abstraction could be reduced at a few specific AIM sites, and water replaced by transfers from our surface sites on the River Thames. During sensitivity testing, increasing the financial incentive showed that imports from our Anglian Water supply could also be used. It should be noted, however, that no groundwater replacements from within our operating area were selected by the model. This is because groundwater sites represent the cheapest source of water and are used as base load stations with full utilisation under all demand scenarios. As such. there is very limited capability to increase groundwater sources at the expense of reductions at environmentally damaging sites. Consequently, it was concluded that a financial AIM for our sites would only operate if the incentive was greater than the marginal cost of water between groundwater sites and imports and transfers. This was not the original goal of the AIM.

AIM is a reputational target for AMP6 and this is helpful as it will reflect the substantial progress we are planning to make with sustainability reductions. Provided the AIM is balanced, it should reflect an overall gain for the environment where substantial volumes of abstraction are curtailed and only partially replaced by water from alternative existing sources and new imports as the greater portion will be addressed through demand reductions.

A list of 92 of our sites have been selected by Ofwat as being suitable for AIM. These are all groundwater sites affecting Band 1, 2 and 3 Water Bodies under the Environment Agency’s assessment of ecological effects under the Water Framework Directive. This is a national scale assessment of abstraction impacts, with very limited site-specific understanding used. The total volume from the 92 sites constitutes 490 Ml/d, approximately half of our total supply. If only Band 3 or Bands 2 and 3 water bodies were to be selected, a proportionally lower number of sites and volumes would result. With limited spare groundwater resource capability and no economic incentive to reduce abstraction by increasing imports and transfers, the full benefits of sustainability reductions will be masked by partial increases at sites where there is limited or no ecological impacts if all 92 sites are adopted for AIM. We have therefore adopted a screening process based on our understanding of actual abstraction impacts at the site scale and developed a revised schedule of all sites that have any significant environmental sensitivity such that this gives a more effective measure of abstraction reductions where this is likely to benefit the environment.

Details of how we have addressed AIM in our business plan are included a commentary in our Business Plan Table W7.

5 Water demand

5.1 Our approach

As set out in the WRPG, demand for water includes:

– Household consumption;
– Non-household consumption;
– Leakage;
– Other minor components of demand; and
– Calculation of target headroom (please refer to section 6).

We measure the quantity of water supplied from all our treatment works using flow meters; this is known as **distribution input** (DI). We are also able to measure flows within our pipe networks at the entry points to district meter areas (DMAs), which are local zones covering urban areas, towns and villages, generally covering a few thousand homes. These flows are monitored continuously and enable us to constantly assess changes in demand at a detailed level and the need to vary our source outputs. DMAs are primarily used to monitor consumption to identify leaks on our network so we can arrange to repair them, but they also provide useful information on consumption.

Customer demand comprises water use by **households** and **non-households** (commercial and industrial). A further split is undertaken between **measured** (metered) properties and **unmeasured**; the split is relevant because we know the consumption of measured customers from meter readings. We also know from experience that metered households use, on average, less water than unmeasured; this is due to a greater awareness of minimising wastage, as well as having greater control over water and energy bills.

For household customers with meters, cumulative flows are taken from meter readings that are typically taken every 6 months, coinciding with our bi-annual billing cycle. For our household customers who do not have a meter, we determine unmeasured demand with our consumption monitor, which we summarise in section 5.2.3.

For larger commercial customers, meter readings are taken more frequently and, in the case of our largest customers, flows are logged continuously. For other elements of demand, including unmeasured non-household customers (those without a meter), we have to estimate demand. As the vast majority of our non-household customers are metered, the unmeasured component is very small; non-household demand is explained in section 5.3.

We are required to account for **leakage** in our demand forecast, considering the impact of any current or future baseline leakage reduction programmes.

Other **minor components of demand** include elements such as builders' temporary supplies from standpipes, water for fire fighting purposes and operational use such as flushing of hydrants. We describe these components in section 5.4.2.

We create our 'water balance' by assessing how closely the water we put into supply (our DI) matches the sum of household consumption, non-household consumption and the other components of demand. We seek to close the water balance to within a few per cent and we report this as part of our Annual Return.

We are required to assess how water demand may change over the next 25 years. Our base year for the assessment is 2011/12. Whilst we have more recent billing data from 2012/13, it was an unusual year in terms of weather patterns, with the wettest drought on record suppressing summer demand in particular.

The WRPG requires water companies to balance supply and demand at **dry year annual average** (DYAA) and **dry year critical period** (DYCP), where applicable, in their WRMPs. We build our normal year forecast based on the demand in a recent 'normal' year before applying factors to generate our DYAA and DYCP demands. Our analysis identifies 2011/12 as the most recent normal year in terms of weather and demand.

We estimate **future demand** by reviewing how each component of demand in the base year may change in future years: this is our baseline demand forecast. For household consumption, we use a micro-component approach: assessing how much water a customer uses for each purpose, e.g. clothes washing, personal washing, and how such usage may change in the future. This is then multiplied by the forecast change in population. We also consider how climate change might affect our customers' demand for water. Our baseline demand forecast is used to build the supply / demand balance over the next 25 years to enable us to determine if any of our zones are in surplus or deficit.

Details of our assessment approach are described below and in detail in Technical Report 2.0: Demand Forecast.

5.2 Household customer consumption

5.2.1 Introduction

Figure 17 explains how we calculate the household consumption component of our demand forecast in any given year.

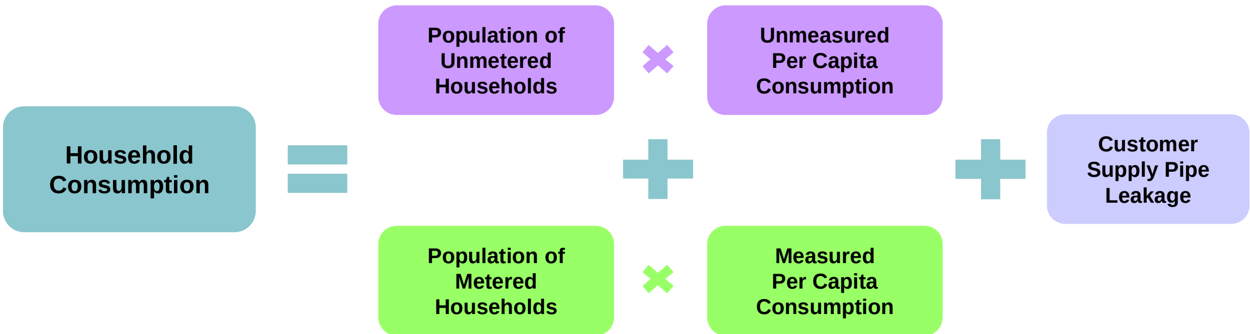

Figure 17: Calculation of household consumption

We can estimate the future household demand for any given year by forecasting the per capita consumption for measured and unmeasured customers, and multiplying it by the number of metered and unmetered properties respectively.

Our household demand forecast for the 25-year planning period is the summation of each year's household consumption, as calculated in accordance with Figure 17.

5.2.2 Derivation of measured Per Capita Consumption

We calculate the annual consumption of measured households from meter readings logged on our billing system. We measure the volume used over a period of time (usually a year) to reveal each household's use and to calculate average property consumption. As we read domestic customers' meters twice each year and have a robust meter age replacement programme, we are confident in our consumption data for our measured households.

We convert the average household consumption to a quantity per person by using an average household occupancy value. The average occupancy value was derived from a survey we undertook in summer 2012 and benchmarked against the overall occupancy we received from Experian. Demand is quoted as the litres per person (or per head) per day; this is **per capita consumption** (PCC).

PCC is important to derive for our base year as we use it to forecast future household demand by multiplying by the population forecast over the planning period.

5.2.3 Derivation of unmeasured PCC using our unmeasured consumption monitor

We also produce estimates of current average unmeasured household consumption for each of our water resource zones using our unmeasured consumption monitor; this comprises a group of around 1,500 customers in our Central region who have had meters installed for our survey purposes but which are not used for charging. As the meter penetration in our Southeast and East regions is much higher than that of our Central region, we do not have an unmeasured consumption monitor in those regions.

Our unmeasured consumption monitor has been in operation since 1995. We selected a wide range of property types (flats / apartments, terraced houses, semi-detached and detached properties) across the region to better understand how water use differs for different properties. For example, we would expect to see garden watering to be lower for those living in flats than for those living in detached properties.

We read the meters of our unmeasured consumption monitor four times each year. The approximate locations of our monitor households are shown in Figure 18.

The key objective of our unmeasured consumption monitor is to produce auditable and consistent figures to estimate unmeasured per capita consumption, in particular for our Annual Return regulatory submission to Ofwat and the Agency.

Periodically, we run a survey where we ask the customers on our unmeasured consumption monitor to share information about the number of people living at their property, whether any are transient (e.g. students returning home outside of term-time), and whether they have recently upgraded to more water efficient devices. We incentivise the return of survey forms by running a competition with a number of small cash prizes. We ran our most recent survey in July 2012 to inform our draft WRMP.

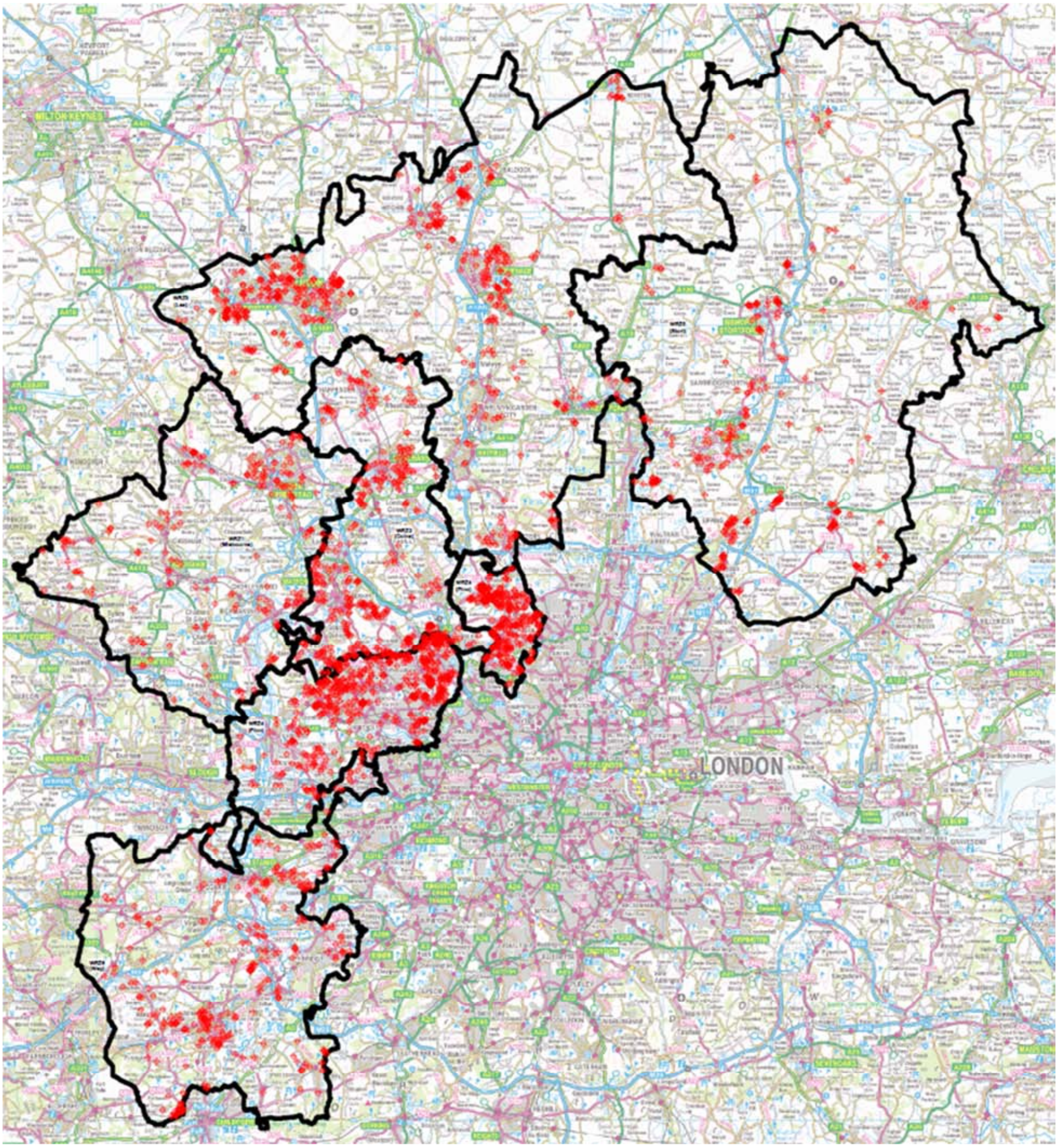

Figure 18: Unmeasured consumption monitor households in our Central region

As a result of our investment in the consumption monitor, we are confident in the accuracy of data reported. In addition, a third party consultant independently verifies the outputs. We intend for the study to remain at the forefront of "best practice" and updates to underlying data are undertaken at appropriate intervals to ensure continued precision. The quality of data is paramount and we take care to eliminate incorrect readings and outliers through our assessment process.

We convert the average unmeasured property consumption to a quantity per person by using an average household occupancy value (the average number of people occupying each property).

Demand is then quoted as litres per person (or per head) per day; this is termed per capita consumption (PCC).

Our customers' demand for water is very variable. The range of consumption values for the customers from our unmeasured domestic consumption monitor is given in Figure 19, showing the frequency of per capita consumption (PCC) for each step of consumption, to the nearest ten litres. The distribution profile around the mean PCC for our East and Southeast regions is also similar. This demonstrates that there is considerable variation in actual consumption across households.

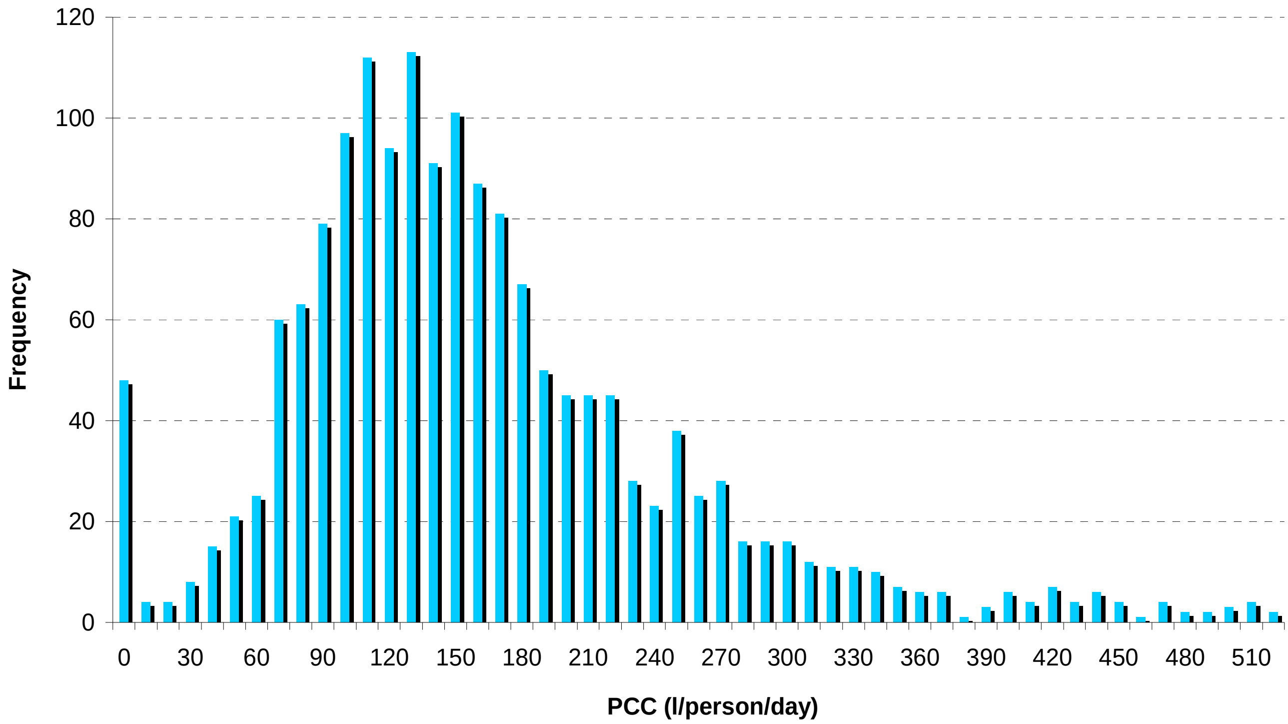

Figure 19: Variation in household consumption, Central region (2011/12)

We must also consider the PCC of new properties that are connected to our network. Part G of the Building Regulations specifies that new properties must not have a PCC in excess of 125l/h/d. The PCC of new properties varies slightly in different zones but the average PCC for new properties in our operating area is 122l/h/d.

5.2.4 Baseline per capita consumption

The weighted average PCC for our baseline demand forecast at DYAA and DYCP are presented in Table 9 and Table 10 respectively.

Water resource zone	2012 l/h/d	AMP5 2014/15 l/h/d	AMP6 2019/20 l/h/d	AMP7 2024/25 l/h/d	AMP8 2029/30 l/h/d	AMP9 2034/35 l/h/d	AMP10 2039/40 l/h/d
1	170.42	168.42	164.84	160.99	158.52	157.00	156.22
2	163.23	161.76	159.27	156.33	154.45	153.32	152.68
3	153.71	151.98	148.61	144.69	141.75	139.61	138.11
4	165.06	163.32	160.27	157.18	155.33	154.26	153.65
5	163.72	161.95	158.66	154.96	152.46	150.82	149.78
6	166.04	164.71	162.51	159.98	158.45	157.60	157.34
Central region weighted average PCC	162.94	161.27	158.28	154.97	152.78	151.37	150.54
7 (Southeast region)	130.35	126.19	124.06	122.23	121.42	121.15	121.21
8 (East region)	123.14	121.92	120.32	118.56	117.69	117.40	117.59
Company weighted average PCC	**159.59**	**157.97**	**155.07**	**151.92**	**149.91**	**148.67**	**147.97**

Table 8: NYAA weighted average PCC at the end of each AMP in our baseline demand forecast

Water resource zone	2012 l/h/d	AMP5 2014/15 l/h/d	AMP6 2019/20 l/h/d	AMP7 2024/25 l/h/d	AMP8 2029/30 l/h/d	AMP9 2034/35 l/h/d	AMP10 2039/40 l/h/d
1	190.46	187.04	183.08	178.80	176.05	174.36	173.50
2	174.54	171.95	169.30	166.17	164.18	162.97	162.29
3	160.69	157.94	154.44	150.36	147.30	145.08	143.53
4	181.24	178.25	174.93	171.55	169.53	168.36	167.70
5	174.17	171.24	167.77	163.85	161.20	159.47	158.38
6	184.84	182.32	179.56	176.45	174.45	173.20	172.62
Central region weighted average PCC	176.77	173.92	170.63	167.01	164.59	163.02	162.07
7 (Southeast region)	142.98	138.41	136.07	134.07	133.18	132.88	132.95
8 (East region)	135.44	133.73	131.97	130.04	129.09	128.77	128.98
Company weighted average PCC	**173.45**	**170.57**	**167.38**	**163.93**	**161.71**	**160.31**	**159.51**

Table 9: DYAA weighted average PCC at the end of each AMP in our baseline demand forecast

Water resource zone	2012 l/h/d	AMP5 2014/15 l/h/d	AMP6 2019/20 l/h/d	AMP7 2024/25 l/h/d	AMP8 2029/30 l/h/d	AMP9 2034/35 l/h/d	AMP10 2039/40 l/h/d
1	243.52	239.73	235.65	231.15	228.61	227.48	227.42
2	233.17	230.25	227.68	224.44	222.74	222.15	222.28
3	224.21	220.90	216.93	212.13	208.75	206.58	205.35
4	235.80	232.45	229.08	225.62	223.96	223.47	223.66
5	235.55	232.16	228.46	224.12	221.52	220.21	219.76
6	251.87	249.32	247.07	244.31	243.07	242.93	243.73
Central region weighted average PCC	236.29	233.08	229.73	225.91	223.72	222.73	222.56
7 (Southeast region)	187.71	182.25	180.08	178.32	178.02	178.52	179.49
8 (East region)	177.82	176.05	174.57	172.86	172.44	172.90	174.05
Company weighted average PCC	**231.55**	**228.30**	**225.07**	**221.48**	**219.55**	**218.77**	**218.79**

Table 10: DYCP weighted average PCC at the end of each AMP in our baseline demand forecast

5.2.5 Micro-components

To assist in forecasting future changes in PCC, we use a standard water industry approach called micro-component analysis. The WRPG requires consumption to be assessed under the following micro-components:

- Toilet flushing;
- Clothes washing;
- Dishwashing;
- Personal washing (baths and showers);
- External use;
- Miscellaneous (cooking, cleaning, drinking, hand washing and teeth brushing).

Our micro-component analysis goes beyond the requirements of the WRPG, with 14 individual components assessed. For example, we have split personal bathing into the following micro-components:

- Baths;
- Normal showers;
- Power showers.

In the development of our household demand forecast, we must account for the fact that the frequencies of some micro-components are related to household use (for example, the frequency of washing machine use and garden watering) whilst others are specific to the household's occupancy (for example, the frequency of showering and toilet flushing). Quantities used under the headings above depend on customer water usage so we undertook a survey of a sample of customers to ask them about device ownership and the approximate frequency of use so we could link to individual micro-components.

We sent out over 20,000 questionnaires across our three regions. The results from over 5,250 customer responses were assessed against five property categories using the ACORN system, which assigns properties to socio-economic categories based on property type and location. The volumes used for each device are taken from published industry data.

The final assessment stage is to forecast how water usage will change over the next 25 years. We make predictions about future changes, such as an increase in the proportion of metered customers as a result of our optant metering programme and increased installation and use of more efficient dishwashers, washing machines and WCs.

We have included an allowance in our forecast demand for the impact on demand from climate change in accordance with the WRPG and DEFRA's *Climate Change and the Demand for Water* report 2003.

The plots in Figure 20 and Figure 21 show the change in water consumption for each micro-component of water use for measured and unmeasured customers respectively. The figures reflect the fact that our metered (measured) customers use less water than our unmeasured customers do.

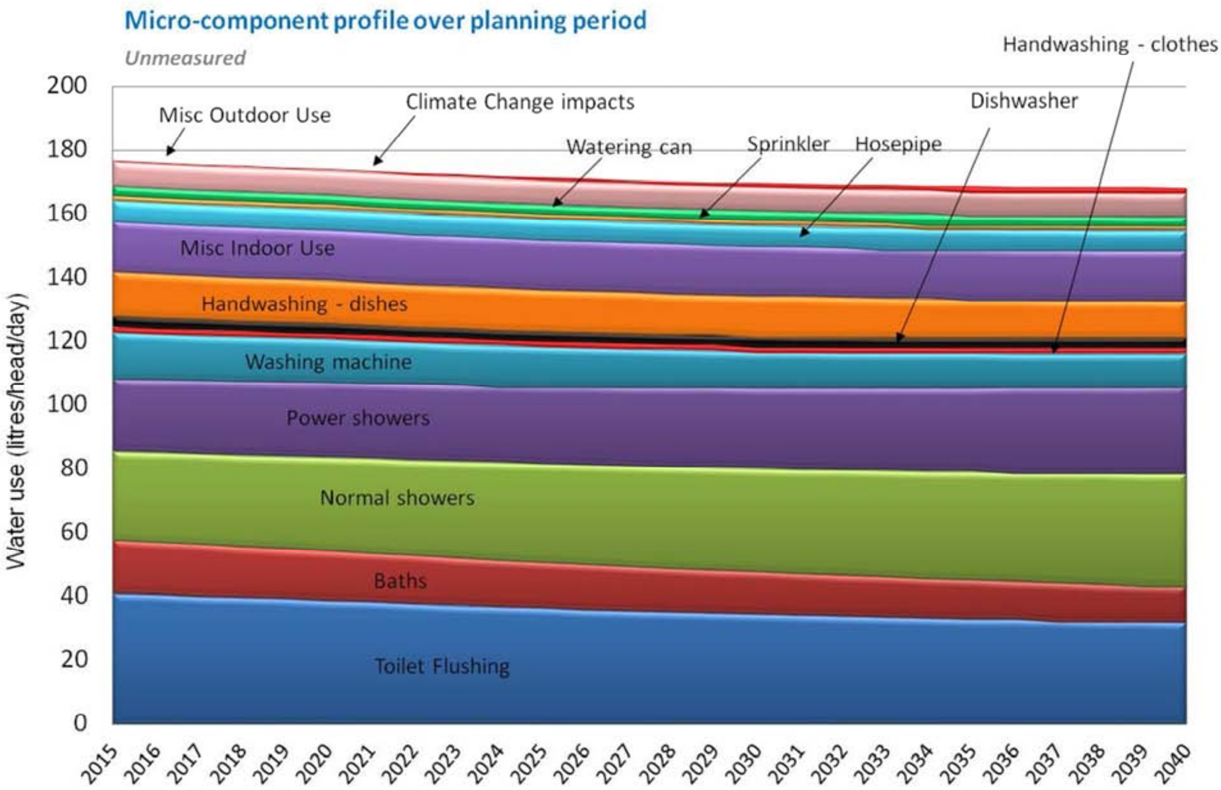

Figure 20: Baseline micro-component profile (unmeasured households)

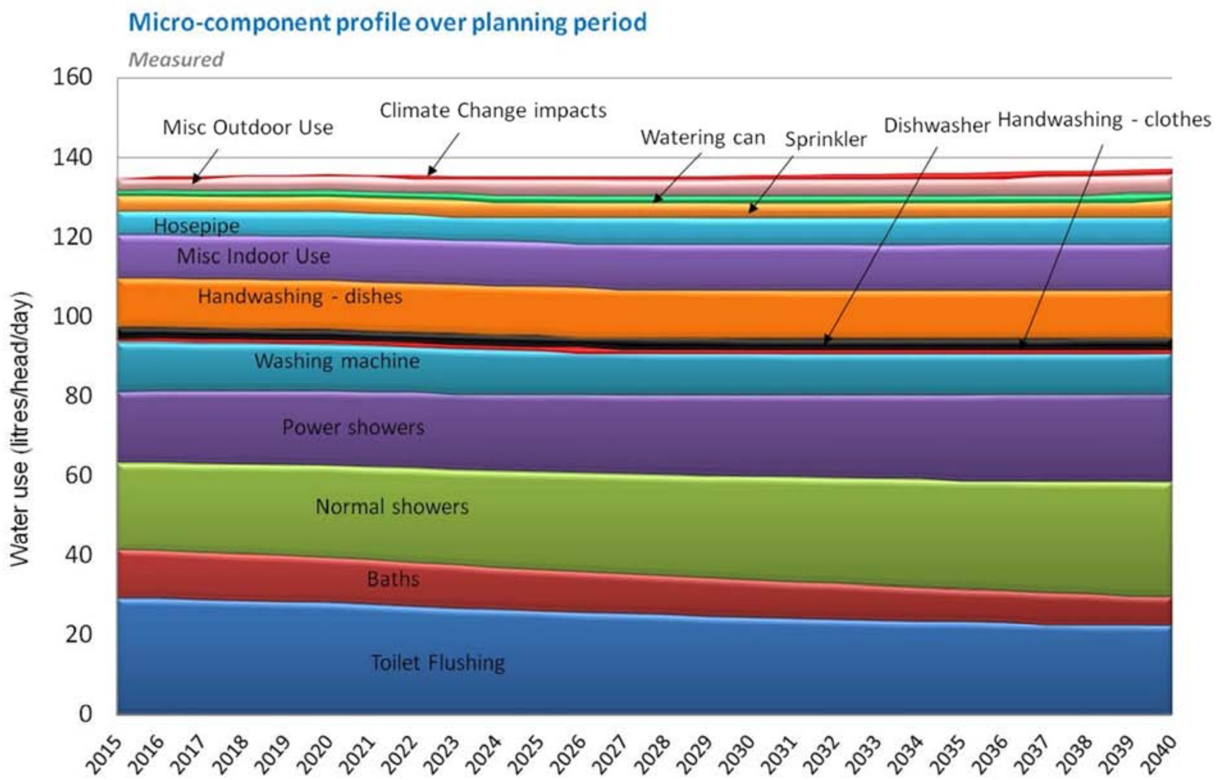

Figure 21: Baseline micro-component profile (measured households)

Key reasons for the change in each micro-component over the planning period are as follows:

- Toilet flushing (frequency 4.71 flushes / person / day from DEFRA research): reduction in average cistern size as new houses use smaller cisterns and customers replace old cisterns with new, more efficient devices.
- Personal washing (showers and baths): reduction in use of baths, increase in use and frequency of showers; increased installation and use of power showers.
- Clothes washing: reduction in washing machine water demand as new machines use less water (some clothes washing by hand continues).
- Dishwashing: reduction in dishwashing machine water demand as new machines use less water (some dishwashing by hand continues).
- Outdoor water use (includes hosepipes, sprinklers, watering cans, pressure washers): small increased ownership and use of certain devices as a result of drier, warmer summers brought about by climate change.
- Miscellaneous indoor use (includes cooking, cleaning, drinking, hand washing, teeth brushing): no change forecast from base year.

Full details of our micro-component analysis can be found in Technical Report 2.1: *Micro-component Analysis*.

5.2.6 Population and households

Population and household forecasts were produced by Experian for us and eight other water companies. For our draft WRMP, Experian obtained data from local authorities on planned housing projections, from the Office for National Statistics (ONS) on population estimates and from analysis of the population Census 2001. The forecasts included:

– Total population;

– Household population;

– Communal population (e.g. care home residents);

– Households;

– Household occupancy.

Experian derived three sets of forecasts for each of our eight water resource zones as follows:

– Trend-based projections – based on a combination of ONS population projections (2010) and Department for Communities and Local Government (DCLG) household projections;

– Local authority plan-based projections;

– Most-likely projections – Experian's view of the most-likely scenario that concludes that the trend-based population forecast will be achieved but with reduced levels of house building.

Experian updated their forecasts in light of the publication of Census 2011 data together with additional responses from local authorities, and released them in May 2013.

We reviewed the Experian results to determine which of the three sets of forecasts should be used for our draft WRMP. Our review comprised a comparison of the forecasts with projections undertaken for the previous WRMP (2009) and with actual numbers of new properties connected for water supply over the past six years. We also re-based the household property figures to our actual household numbers for all three regions from our billing records for 2012, to adjust for unoccupied and multi-occupancy properties, as well as special supplies such as building water, cattle troughs and garages. We then applied the annual increase in property numbers from the Experian report.

It is important that we consider the growth of population in our regions as well as the number of new properties that we expect to be built during the planning period. This is necessary as elements of our micro-component analysis relate to the frequency of use per household, such as the use of dishwashers and washing machines, while others relate to the frequency of use per person, such as personal washing and toilet flushing. We have not made any adjustments to the population forecasts produced by Experian. During the development of our population forecasts, we considered the risks of underestimating the current population by not taking account of communities not recorded in the official statistics and the risk of overestimating by not making a downward adjustment for populations with private water supplies. With no clear evidence as to the population either of these would account for, we mitigated this risk through our headroom allowance which accounts for uncertainty in the growth forecast.

We concluded that the updated local authority **plan-based** housing and population projections from Experian remained the most appropriate to be used for our demand forecasting. This approach is consistent with the WRPG and reconciles with our actual numbers of new housing connections over the past six years. A sensitivity check on the potential effect of using the trend-based figures was also undertaken as part our scenario testing.

The population forecast for each water resource zone is shown in Table 11.

Water Resource Zone	Current Population (2012/13)	Total Population forecast by 2020	Total Population forecast by 2040	% Increase (by 2040)
1	324,720	336,288	363,552	12%
2	435,936	452,462	498,945	14%
3	699,253	732,431	845,584	21%
4	969,315	1,012,742	1,145,982	18%
5	289,142	307,418	362,351	25%
6	526,614	545,207	604,945	15%
Sub-total (Central region)	3,244,980	3,386,547	3,821,360	18%
7 (Southeast region)	169,008	180,275	188,462	12%
8 (East region)	150,708	155,402	161,426	7%
Company total	**3,564,696**	**3,722,225**	**4,171,248**	**17%**

Table 11: Current and forecast population numbers

The household forecast for each water resource zone is shown in Table 12.

Water Resource Zone	Current Number of Properties (2012/13)	Total Number of Properties forecast by 2020	Total Number of Properties forecast by 2040	% Increase (by 2040)
1	129,148	133,873	144,982	12%
2	164,349	171,231	191,837	17%
3	263,385	278,431	329,472	25%
4	331,358	351,313	417,198	26%
5	111,813	120,200	144,883	30%
6	192,458	201,030	230,256	20%
Sub-total (Central region)	1,192,512	1,256,079	1,458,627	22%
7 (Southeast region)	69,436	76,089	83,719	21%
8 (East region)	69,010	72,126	76,928	11%
Company Total	**1,330,958**	**1,404,294**	**1,619,274**	**22%**

Table 12: Current and forecast number of households

Further details of our analysis can be found in the Technical Report 2.2: *Domestic Housing and Population Forecast*.

5.3 Non-household customer consumption

In total, over 90% of our non-household (business, commercial and industrial) customers are metered and pay for the volume of water they use. The remaining businesses are not cost effective to meter and pay a rateable value.

Figure 22 shows the proportion of non-household customers that are metered in each of our regions.

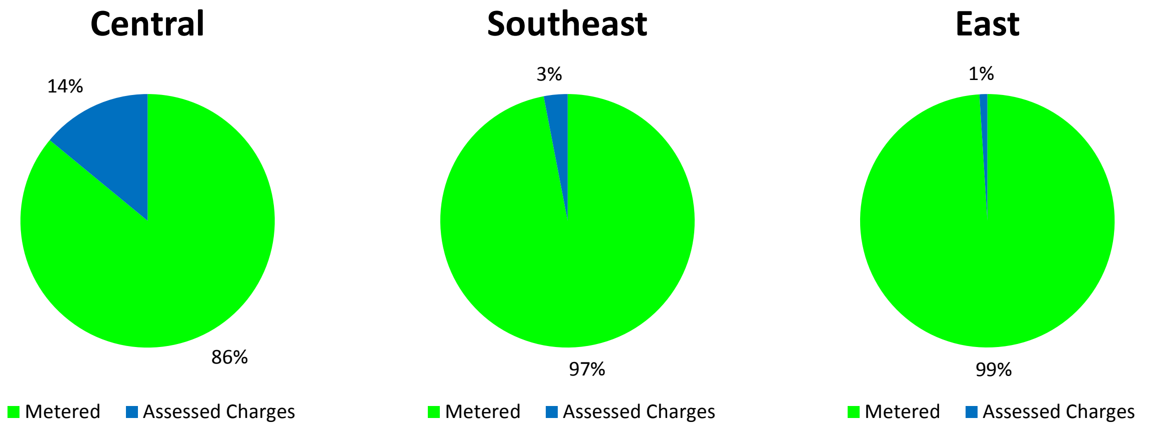

Figure 22: Proportion of non-domestic customers metered in each of our regions

In our WRMP published in 2010, we assessed non-household demand in relation to regional gross value-added (GVA) output, which is a measure of productivity forming part of the national gross domestic product calculation; we also compared demand with historic employment figures. The forecast at that time indicated a slight decrease in future non-household demand. For this WRMP, we have repeated the analysis with actual data to 2011/12.

Having reviewed the historic demand against actual GVA and employment data, we have established that there is no significant correlation between economic activity and water demand.

We are also aware that in recent years many non-household customers have implemented schemes to make significant reductions in water use, both in response to our water efficiency advice and to economic conditions in particular. There is now less scope for future reductions on such a scale as indicated by recent demand, which has remained stable. We maintain a dialogue with our larger use customers but, with the continuing uncertainty over economic conditions, there is no clear picture emerging of future changing non-household demand.

Agriculture use makes up approximately 4% of non-household water use and this percentage has remained fairly constant since 2005. Historic data indicates no shift in agricultural water use and we have assumed that it will remain flat over the planning period.

In light of the above, we conclude that non-household demand will remain unchanged over the 25-year planning period. This allows for potential increased population, increased employment and increased economic activity to be balanced by further improved water efficiency across industry so that demand remains broadly stable.

Figure 23 illustrates the forecast in relation to historic demand since 1998/99 for our Central region (reference Technical Report 2.3: *Non-household Demand Forecast*).

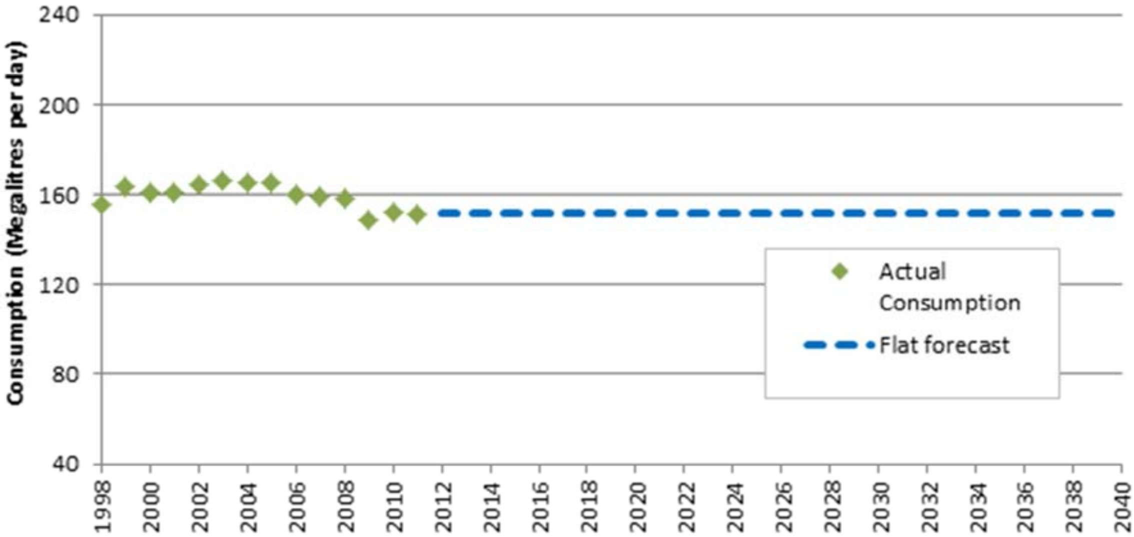

Figure 23: Non-household consumption forecast

As part of our assurance processes, we reviewed our approach to the development of the non-household consumption forecast with our auditors, Atkins. They were satisfied that our approach was robust and concurred that there was insufficient evidence to forecast anything other than flat demand throughout the planning period.

This does not mean that there will be no change between the sectors, just that the total non-household demand will not change. For example, an increase in agricultural use could be offset by increasing water efficiency drives in office buildings.

The various industrial sectors that comprise our non-household customers as logged on our billing system are shown in Figure 24.

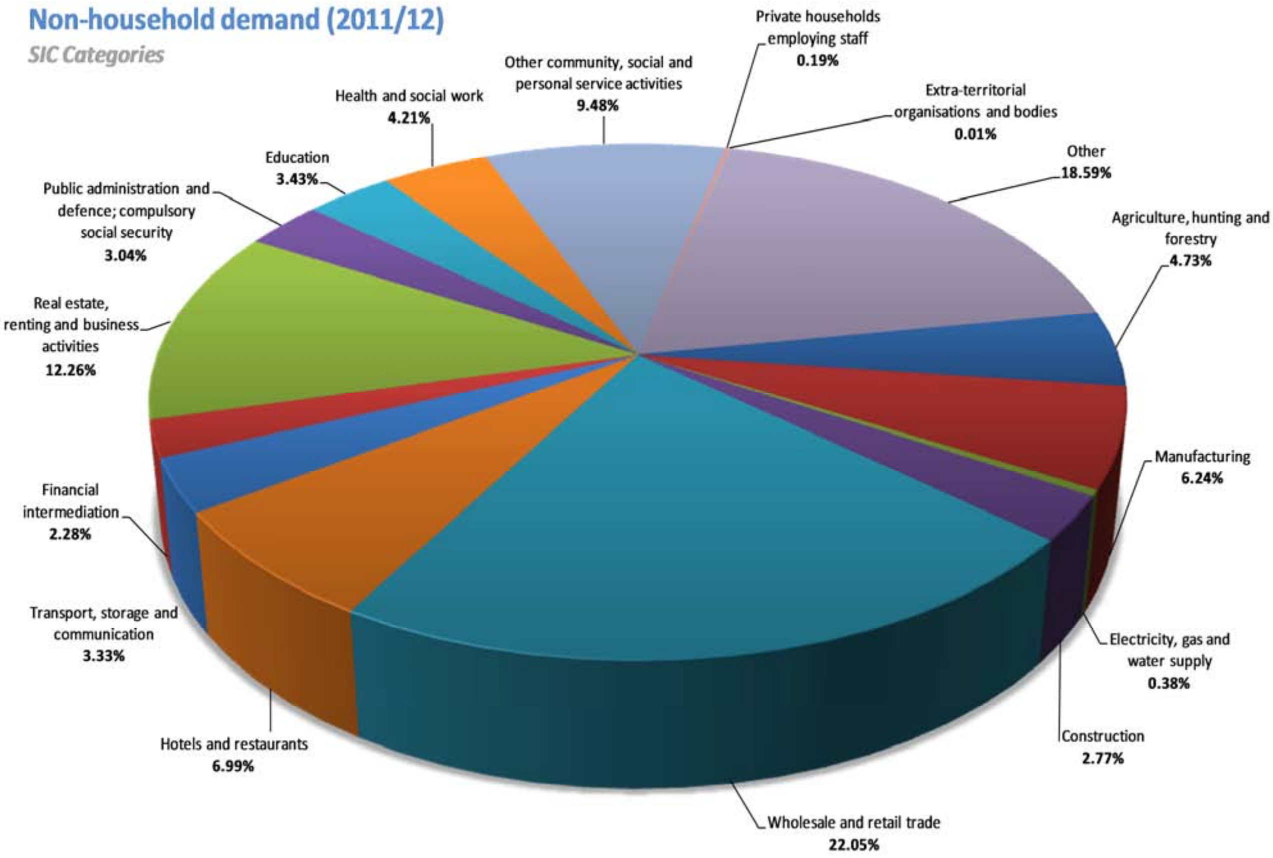

Figure 24: Categories of non-household demand (2011/12)

5.4 Leakage and other components of demand

5.4.1 Leakage

5.4.1.1 Introduction

We have used the recent UKWIR publication *Managing Leakage* (2011) as a reference guide in the determination of our level of leakage. We provide further explanation in our Technical Report 3.2: *Leakage*.

Leakage in the base year (2011/12) for the whole company area was 170Ml/d. We consider that 2011/12 was a benign normal year in terms of climate with no extremes, such as prolonged hot dry weather or prolonged freezing conditions, causing ground movement and a consequent high incidence of pipe bursts. We therefore need to adjust our 2011/12 leakage value to produce an appropriate base year value for our dry year supply / demand balance.

Table 13 shows our actual measured leakage in 2011/12, our current target and our baseline values for the planning period. We also show our leakage as reported in our Annual Return in 2012/13 and our latest estimated result for 2013/14.

We have included options for reducing leakage as part of managing the supply / demand balance.

Region	Leakage 2011/12 Ml/d	AMP5 Leakage Target Ml/d	Baseline leakage for final WRMP planning Ml/d	Leakage 2012/13 Ml/d	Latest Estimated Result 2013/14 Ml/d
Central	158.45	185.00	185.00	178.01	184.97
East	4.29	5.10	4.29	4.18	4.35
Southeast	7.45	7.70	6.78	7.09	6.76
Company	**170.19**	**197.8**	**196.07**	**189.28**	**196.08**

Table 13: Leakage performance by region

Our zonal leakage figures are given in Section 5.7.3, Table 16.

5.4.2 Other components of demand

Our assessment of other components of demand, comprising operational use (such as hydrant and mains flushing) and water taken unbilled (which includes water taken legally for fire fighting purposes and water that is taken illegally), reflects the last assessment carried out for our Annual Return in 2013.

Region	Operational Use Ml/d	Water taken, legally unbilled Ml/d	Water taken, illegally unbilled Ml/d	Total Ml/d
Central	0.64	8.75	1.23	10.62
East	0.02	0.01	0.00	0.03
Southeast	0.06	0.20	0.01	0.27
Company	**0.72**	**8.96**	**1.24**	**10.91**

Table 14: Other components of demand

5.5 The impact of climate change on demand

We have updated our demand forecast to account for the recent publication of UKWIR's *Impact of Climate Change on Demand* (2013). Our latest analysis identifies that the impact of climate change on demand is lower than it was assessed to be in our previous WRMP, despite recent evidence that suggests our climate is changing to warmer, drier summers and milder, wetter winters.

We have included a baseline level of the impact of climate change on demand in our demand forecast, and have accounted for the uncertainty of that forecast in our headroom assessment as described in section 6.

Our assessment of the small increase in demand as a result of climate change shows that the increase largely applies to garden watering, which has been verified by the micro-component study we undertook in the summer of 2013; see section 5.7.2.6.

5.6 Demand forecast scenarios

5.6.1 Planning scenarios

The starting point for our demand forecast is the base year that is represented by our most recent outturn data. This ensures that the current metered and unmeasured household numbers and commercial customer numbers are up to date.

The base year for our assessment is 2011/12, as our analysis indicates it is a normal year. Our base year demand is then adjusted to simulate dry year demand as described in section 5.7.2.

The key scenarios used in our demand forecasting are:

– Normal year annual average (NYAA);
– Dry year annual average (DYAA);
– Dry year critical period (DYCP).

5.6.2 Weighted average annual demand

Companies are required to report their weighted average annual demand (WAAD) forecast to Ofwat for use in the price review process.[12] WAAD will not be used for any other purpose.[13]

Whilst companies' WRMPs are required to meet the DYAA planning scenario in all years, and DYCP where it exists, the demand that we are likely to face in the planning period will, on average, reflect a mix of dry years, normal years and 'wet' years. Planning on the basis of DYAA throughout the 25-year period would overstate demand, whilst planning on the basis of NYAA could understate demand, with the corresponding effects on revenue. WAAD represents our view of the demand that we are most likely to face over the planning period, on average.

WAAD is built up from the following components:

– Water delivered;
– Water taken unbilled;
– Distribution system use;
– Leakage.

[12] WRPG, section 2.6.2, Weighted annual average demand forecast.
[13] WRPG, Appendix 3 – Weighted annual average demand.

WAAD is not used in the preparation of our WRMP, but it is derived from our consideration of historic occurrence of different types of years (normal, wet and dry). Over the last 10 years, we have established that there were eight normal years, one dry year when demand was significantly high (2003/04), and one wet year (2012/13). Since our draft WRMP, we have considered the wet year of 2012/13 on our calculation of WAAD. The distribution input in that year was 819Ml/d in our Central region. We adjusted this figure to ensure that leakage matched our target figure (as we did for our Annual Return in 2012) and calculated that the wet year demand would be 831Ml/d.

The WAAD for our Central region in the base year 2011/12 was 876.51Ml/d. This compares to an actual distribution input in 2011/12 (a normal year) of 876.17Ml/d. Given the very small difference between WAAD and Normal Year demand, we have adopted the normal year as our WAAD such that our WAAD is our forecast of normal year demands.

We have completed the Agency's WRP2b Weighted Baseline Demand table and the WRP6b Weighted Final Planning Demand table as required by the WRPG.

The details of our WAAD calculation are given in Technical Report 2.0: *Demand Forecast*.

5.7 Base year assessment

5.7.1 Normal and dry year forecasts

For the base year 2011/12, we have records from our billing system of the number of customers supplied, the water delivered to metered customers and the overall quantity of water supplied from all our sources. We have compared this to the property forecast data provided by Experian and have confirmed a good match.

We calculate the quantity of water delivered to unmeasured customers using our water monitors extrapolated from samples of unmeasured customers who have meters installed to allow us to monitor their consumption but who are not charged on the basis of those meter readings.

We also identify other components of water use, such as flushing of mains or building water supplies from standpipes and calculate that the balance is leakage.

We have amended our estimated household occupancy rates by using the latest estimate of population from the studies described in Section 5.2. We have separate occupancy rates for the following household types: unmeasured; measured (new properties), measured (optants) and measured (excluding new properties and optants). Optants are those customers who have been fitted with a meter at their request and tend to have a lower than average occupancy.

The numbers of household and non-household properties for the base year exclude empty properties, also referred to as 'voids', which have had no demand for water.

2011/12 represents a normal year in terms of demand. The forecast dry year demand has been estimated by using factors applied to the actual 2011/12 data, described in section 5.7.2. Although our groundwater levels were very low following two dry winters, there were no prolonged periods of hot dry weather triggering high water use by customers and consequently there were no demand restrictions applied.

5.7.2 Peak forecasts

5.7.2.1 Introduction

As we have deficits in our supply / demand balance that are driven by the DYCP planning scenario, we are required to submit baseline and final planning forecasts of critical period demand[14]. The WRPG requires us to:

- Describe the type and duration of the critical period demand, including when this demand typically occurs;
- Describe the operational constraints that occur in the resource zone and how they affect managing the critical period demands;
- Detail the assumptions made in developing the critical period scenario.

Our peak factors are used in the following calculations:

- In our micro component model to derive overall household demands for normal, dry year and critical periods;
- In our demand forecast to predict changes in distribution input over time;
- And to ensure that our micro-component model is correctly allocating peak demands across the various micro-components.

5.7.2.2 Methodology

We have followed best practice in the derivation of our peak factors by using UKWIR's *Peak Water Demand Forecasting methodology* (2006), and describe our approach in detail in Technical Report 2.0: *Demand Forecast*.

We have used 2003/04 as our design year for our peak factor analysis. 2003 was the warmest summer in recent times for which we have a complete dataset, with a peak DI in our Central region of 1136Ml/d. In 2003/04, our Central region operated as three WRZ; our analysis therefore had to account for the fact we now operate with six WRZ.

We split both the average and peak DI into the various components of demand so that we can better predict how demand will change in the future as the proportion of the components changes. The components of demand are:

- Household consumption;
- Non-household consumption;
- Leakage; and
- Other minor components of demand.

We have also accounted for the changes to our demand data since 2003 in our analysis, such as the changes in population and household numbers, the change in leakage over time and relatively small reductions in commercial demand.

[14] WRPG, August 2013. Section 4.2.1, Peak forecasting.

5.7.2.3 Peak factors results – household

Household consumption is the component that will cause the biggest changes in demand over the planning period, and consequently significant investment.

We have calculated the peak factors for household demand for a 1 in 10 year event (a 'design dry year') for different return periods in accordance with the best practice peak factors methodology, and present the results of our analysis in Table 15. Peak demands for other return periods (such as a 1 in 20 dry year) have been developed and are given in Technical Report 2.0: *Demand Forecast*.

		Household Peak Factor for a 1 in 10 year event						
PR09	**PR14**	**Daily**	**Avg. day peak week**	**30 day**	**56 day**	**90 day**	**DYAA**	**Normal Year**
Central WRZ	WRZ1	1.44	1.41	1.32	1.29	1.25	1.11	1.00
	WRZ2	1.41	1.38	1.29	1.25	1.22	1.06	1.00
	WRZ4	1.42	1.39	1.30	1.26	1.23	1.09	1.00
Northern WRZ	WRZ3	1.43	1.40	1.25	1.19	1.15	1.04	1.00
	WRZ5	1.50	1.45	1.29	1.23	1.18	1.06	1.00
Southern WRZ	WRZ6	1.74	1.50	1.32	1.30	1.31	1.11	1.00
Central region		**1.50**	**1.43**	**1.31**	**1.27**	**1.24**	**1.10**	**1.00**
Southeast region		**1.59**	**1.42**	**1.35**	**1.33**	**1.31**	**1.07**	**1.00**
East region		**1.56**	**1.41**	**1.36**	**1.30**	**1.27**	**1.04**	**1.00**

Table 15: Household peak factors for different durations of the 1 in 10 year event

The peak factors given in Table 15 represent the overall increase in demand when compared to a normal year. For our draft WRMP, we applied these factors to a single micro-component, which gave rise to some unusual PCC figures in our WRP Tables. For our final Plan, we have represented the increase in demand from a normal year to both the dry year annual average and dry year critical period buy applying different factors to different micro-components, as we believe that some micro-components are more sensitive to dry and peak conditions than others.

5.7.2.4 Peak factors results – non-household

We have analysed our non-household demand from large users over the last three years and have established that the peak factor for our commercial customers is 1.1. The details of our analysis are presented in Technical Report 2.0: *Demand Forecast*.

5.7.2.5 *Peak factors results – leakage and other minor components*

There are no peak factors associated with leakage and the other minor components of demand.

5.7.2.6 *Micro-component level monitoring in summer 2013*

We undertook a study in summer 2013 of around 20 properties from our unmeasured consumption monitor in the north-west London area (WRZ4 in our Central region) using WRc's Identiflow system. Identiflow is capable of determining household consumption by individual micro-components by analysing the volume of water taken through a property's supply pipe together with the duration of the water use 'event'. After post-processing the data, it is also possible to establish if there is a leak at the property, whether on the customer's supply pipe or within their property's plumbing.

We had a number of objectives for this study:

- To assure our assessment of micro-components for our unmeasured customers;
- To establish links between household occupancy and overall per household consumption, and therefore PCC;
- To assure our peak factors analysis, subject to weather conditions.

We selected a range of property types with varying occupancies; all of the properties selected had responded to our most recent survey. The trial commenced in early June and was intended to last for six weeks, although we opted to extend the trial to eight weeks after experiencing some valuable weather conditions in the first month of the trial. The weather extremes during the trial included:

- Minimum average temperature of 12.0°C, and maximum recorded temperature of 32.8°C (compared to the average temperature of 22.5°C in July);
- Maximum rainfall of 12.2mm in one day (approximately one-quarter of the average rainfall in July).

We were fortunate to have Identiflow deployed during the hot, dry spell in July when we saw sustained average temperatures of over 22°C and peaks of over 32°C, which allowed us to use the data to achieve our third objective in assuring our peak factors.

Figure 25 shows the weather data we recorded for the duration of the trial, together with the total demand (DI) in mega litres per day. Note that the DI is the total volume of water put into supply for our Central region.

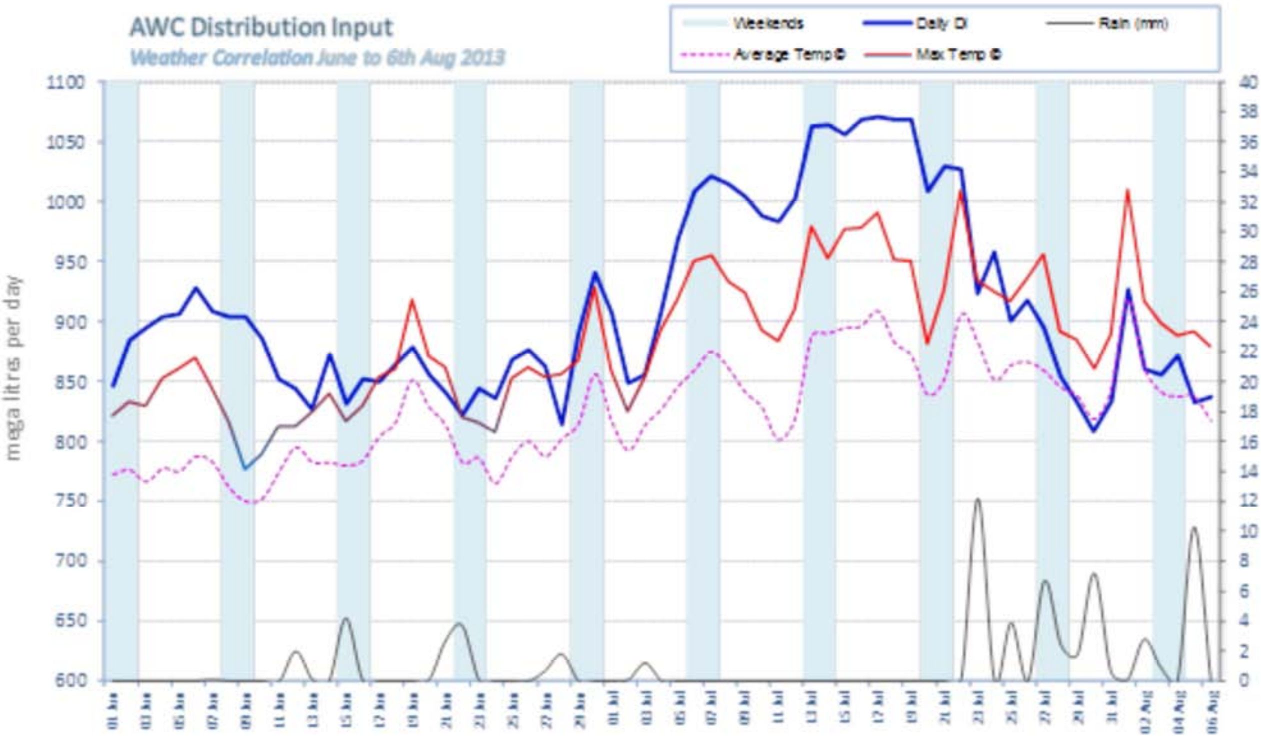

Figure 25: Distribution input, temperature and rainfall during the Identiflow study

Throughout the study, as demonstrated by Figure 25, it can be seen that DI tracked temperature very closely. Our maximum DI of 1070Ml/d coincided with the maximum temperature of 31.2°C on Wednesday 17th July, although we recorded 11 consecutive days when DI was in excess of 1000Ml/d. Our minimum DI of 809Ml/d was recorded on Tuesday 30th July, a day that saw a sharp drop in average temperature to 17.5°C with 7.2mm of rainfall.

We plan to undertake more detailed analysis of the datasets from the study, but we have been able to draw the following conclusions:

- Peak demand was driven by **a small number of households using considerably more water in hot periods than they do under normal weather conditions**.
- The majority of this change in use between average and peak demand was **driven by garden watering**.
- Households with higher than average occupancy have lower PCCs than households with less than average occupancy, who use more water per person.
- Our unmeasured customers are less likely to take action against leaks on their supply pipes or internal plumbing than our measured customers.
- The change in demand between 'normal' and hot, dry periods supports our peak factors analysis for domestic households.

We are aware that our datasets will be of considerable interest to other water companies, particularly those in the South East of England. We will seek to publish our research such that others can benefit.

Further details of our analysis of the Identiflow study can be found in in Technical Report 2.0: *Demand Forecast*.

5.7.3 Stable components of our demand forecast

Demand components that remain stable over the planning period are summarised in Table 16.

Water Resource Zone	Non-household consumption Ml/d	Leakage Ml/d	Minor components Ml/d
1	12.03	23.92	1.35
2	18.65	34.59	1.30
3	31.42	36.91	2.34
4	45.68	45.18	2.84
5	17.52	18.40	1.14
6	34.07	26.01	1.65
Sub-total (Central region)	159.36	185.01	10.62
7 (Southeast region)	11.50	6.78	0.27
8 (East region)	6.22	4.29	0.03
Company Total	**177.08**	**196.08**	**10.91**

Table 16: Summary of base year stable components for each WRZ

5.8 Demand forecasts

The demand forecasts for each water resource zone are presented in the following tables:

- Table 17 gives our base year demand forecast data;
- Table 18 shows our baseline demand forecast for NYAA;
- Table 19 shows our baseline demand forecast for DYAA; and
- Table 20 shows our baseline demand forecast for DYCP.

2011/12	Base Year				
WRZ	Annual Return 2012 *(Post MLE)*	Annual Return 2012 *(Revised)*	NYAA	DYAA	DYCP
1	107.95	92.01	92.01	98.59	116.04
2	120.66	124.93	124.93	130.23	156.22
3	173.97	176.89	176.89	182.54	227.67
4	252.50	251.17	251.17	267.69	321.55
5	90.23	83.76	83.76	87.29	105.53
6	136.91	147.41	147.41	158.33	194.41
Sub-total (Central region)	882.23	876.17	876.17	924.66	1121.43
7 (Southeast region)	40.26	40.05	40.05	42.56	50.52
8 (East region)	28.51	28.54	28.54	30.59	37.08
Company total	**951.00**	**944.77**	**944.77**	**997.82**	**1209.02**

Table 17: Base year demand forecast data

NYAA	Baseline			
WRZ	2011/12	2014/15	2019/20	2039/40
1	92.01	91.84	91.93	92.89
2	124.93	125.06	125.70	129.42
3	176.89	177.03	178.16	186.05
4	251.17	252.21	253.78	267.21
5	83.76	84.21	85.38	90.95
6	147.41	147.67	148.55	154.83
Sub-total (Central region)	876.17	878.03	883.50	921.36
7 (Southeast region)	40.05	39.82	40.60	41.12
8 (East region)	28.54	28.66	28.68	28.76
Company total	**944.77**	**946.51**	**952.78**	**991.24**

Table 18: Normal Year Annual Average demand forecast

DYAA	Baseline			
WRZ	2011/12	2014/15	2019/20	2039/40
1	98.59	98.41	98.51	99.61
2	130.23	130.37	131.05	135.02
3	182.54	182.69	183.86	192.06
4	267.69	268.81	270.53	285.20
5	87.29	87.76	88.99	94.87
6	158.33	158.52	159.31	165.53
Sub-total (Central region)	924.66	926.55	932.26	972.29
7 (Southeast region)	42.56	42.31	43.15	43.72
8 (East region)	30.59	30.72	30.74	30.84
Company total	**997.82**	**999.58**	**1006.15**	**1046.85**

Table 19: Dry Year Annual Average demand forecast

DYCP	Baseline			
WRZ	2011/12	2014/15	2019/20	2039/40
1	116.04	116.01	116.48	119.45
2	156.22	156.66	158.01	165.44
3	227.67	228.24	230.56	245.16
4	321.55	323.53	326.74	350.54
5	105.53	106.34	108.30	117.72
6	194.41	195.13	197.03	209.30
Sub-total (Central region)	1121.43	1125.91	1137.11	1207.62
7 (Southeast region)	50.52	50.27	51.50	52.87
8 (East region)	37.08	37.31	37.47	38.16
Company total	**1209.02**	**1213.49**	**1226.09**	**1298.65**

Table 20: Dry Year Critical Period demand forecast

Figure 26 and Figure 27 show the percentage change in demand at DYAA and DYCP respectively.

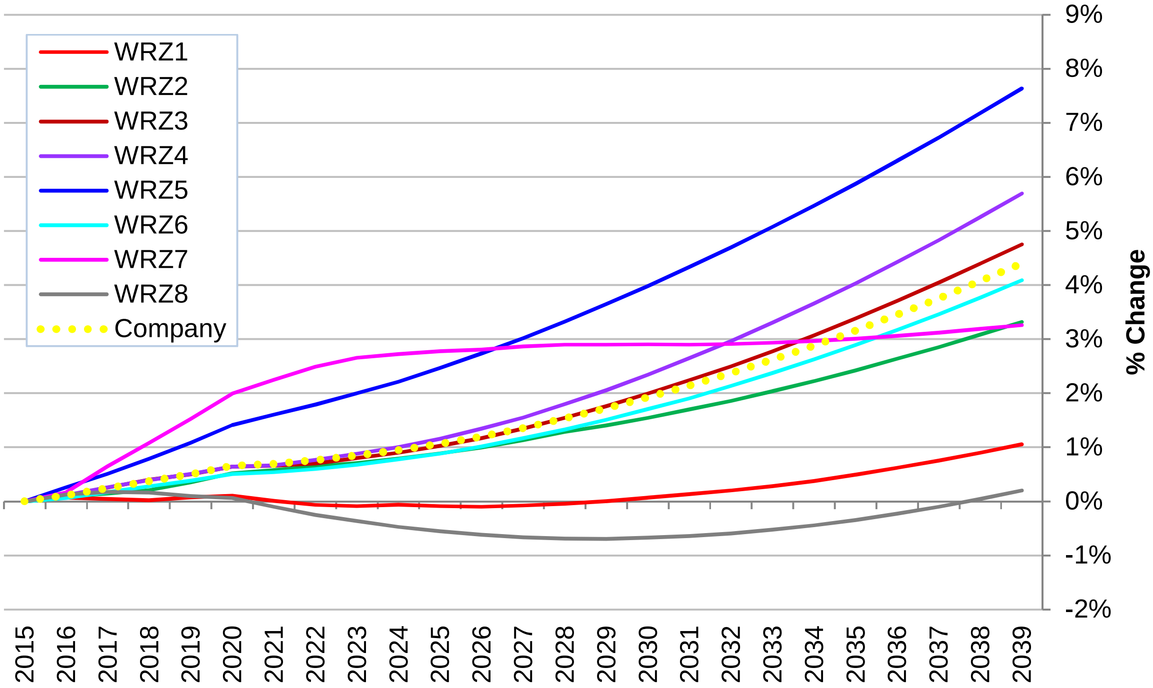

Figure 26: Change in average demand per WRZ, DYAA

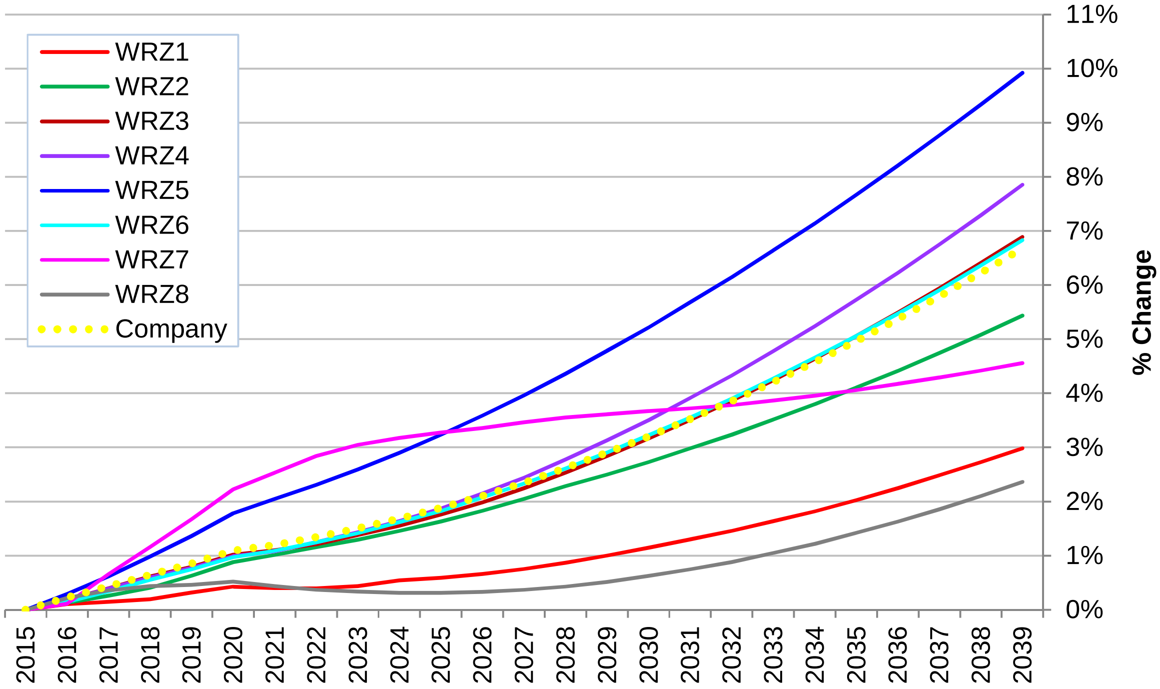

Figure 27: Change in peak demand per WRZ, DYCP

6 Headroom

6.1 General

There are inevitably uncertainties in forecasting supply and demand values over a 25-year period. Actual demands could exceed our assumptions or water supply availability could be reduced by more extreme climate variability or changes in environmental standards. We therefore include an allowance known as **target headroom** to act as a buffer between our forecast demand and our supply capability to cater for specified uncertainties.

There are two methods for the calculation of target headroom uncertainty:

- The 1998 methodology: *A Practical Method for Converting Uncertainty into Headroom* (UKWIR, 1998)
- The 2003 methodology: *An Improved Methodology for Assessing Headroom – Final Report* (UKWIR, 2002)

The 2003 methodology determines headroom through probabilistic simulation. The uncertainties of each headroom component are defined as probability distributions and then combined using Monte Carlo techniques. The 1998 methodology is appropriate only when no supply / demand balance deficit exists over the planning period. Where there is a supply demand deficit, it is recommended that the more comprehensive 2003 methodology is used.

6.2 Assessment of Uncertainties

6.2.1 Introduction

Our target headroom assessment uses the **2003 methodology**. The key components of the headroom calculation in this methodology are:

- S1 Vulnerable surface water licences
- S2 Vulnerable groundwater licences
- S3 Time limited licences
- S4 Bulk transfers
- S5 Gradual pollution causing a reduction in abstraction
- S6 Accuracy of supply side data
- S7 Single source dominance and critical periods (old method only)
- S8 Uncertainty of climate change on yield
- S9 Uncertain output from new resource developments (new method only)
- D1 Accuracy of sub component data
- D2 Demand forecast variation
- D3 Uncertainty of climate change on demand
- D4 Uncertain outcome from demand management methods (new method only)

6.2.2 Distribution types

The uncertainties for each component are defined as probability distributions and combined via a computer model (using proprietary computer software). Uncertainties can change over time, for example, there will be a greater uncertainty about how many more people and houses there will be in 2040 than in 2020.

Of the categories described above, S1, S2 and S3 are identified by the Agency as being not required for the assessment of headroom uncertainty as these elements are addressed in the NEP programme and covered under the presumption of licence renewal respectively. S7 does not apply as we are using the new methodology. S9 and D4 are not considered in the target headroom assessment for our baseline supply / demand balance, and are considered in the assessment of our Preferred Plan uncertainty, described in section 11.12.

Table 21 describes the components of uncertainty in our target headroom assessment, together with the distribution type and an explanation.

Components	Distribution	Explanation
S1: Vulnerable surface water licences	*N/A*	*Not included in our assessment*
S2: Vulnerable groundwater sources	*N/A*	*Not included in our assessment*
S3: Time-limited licences	*N/A*	*Not included in our assessment*
S4: Bulk Imports	Triangular	A triangular distribution is used based on understanding of the bulk imports. The distribution is defined by minimum, most likely and maximum reductions from the agreed transfer volume. A 10% reduction in transfer volumes is assumed for maximum and 5% for most likely reduction in transfer volumes and zero for minimum.
S5: Gradual pollution of sources causing a reduction in abstraction	Exponential	An exponential function is used to model this uncertainty. It is assumed that no source will be completely lost due to this component and the headroom risk has been related to the process losses associated with the additional treatment required as a result of pollution. The risk of contamination has been quantified based on the historic pattern of incidents.
S6: Accuracy of supply side data	Triangular	The DO assessments of sources have been graded as good, fair or poor based on the constraints that affect the DO value. This grading has been linked to the constraints affecting the DO, which in turn is then converted into a percentage uncertainty of the DO. The most likely impact on the DO is assumed to be zero where as max reduction in DO is either 1, 5, 10 or 20% based on the constraint affecting the DO and max gain in DO is either 0.5%, 2.5%, 5% or 10%.
S7: Single source dominance	*N/A*	*Not included in our assessment*
S8: Uncertainty of Impact of Climate Change on source yield	Triangular	UKCP09 projections for the Medium Emissions scenario 2030s (2020-2049) for the Thames basin was used to determine the impact of climate change on DO. The values produced by the climate change analysis are applicable to the 2030s, so these were interpolated and extrapolated across the planning horizon using the scaling factors specified in the Environment Agency's WRPG (section 3.3.6, stage 3). This was repeated for both the Dry Year Annual Average and Dry Year Peak Week planning scenarios. The mean values were applied

Components	Distribution	Explanation
		to the baseline supply / demand balance as the projected change in deployable output over the planning horizon, for each planning scenario. The difference of the minimum below the mean and the maximum above the mean is taken as the range of uncertainty to incorporate within the headroom allowance under factor S8 (as triangular distributions).
S9: Uncertain output from new resource development	*N/A*	*Used to assess supply side uncertainties associated with the Preferred Plan; not included in our baseline assessment. See section 11.12.*
D1: Accuracy of sub-component data	Normal	A small allowance is included to represent the uncertainty in the accuracy of distribution input (DI) meters. A percentage uncertainty of +2.1% & -2.0% for Normal and +4.1% & -4.0% for peak has been used to represent the accuracy of sub-components demand data.
D2: Demand forecast variations	Triangular	Three demand forecast scenarios have been used for this uncertainty: a medium demand forecast based on Experian's plan-based population growth forecast, a high demand forecast based on Experian's trend-based population forecast and a low demand forecast based on Experian's plan based population growth forecast and a weighted average PCC of 143l/h/d in the year 2040 when the PCC is higher than 143l/h/d. For resource zones where the weighted average PCC is less than 143l/h/d in the year 2040, a reduction of 5% has been assumed. The difference of the medium and low, medium and medium, and high and medium are taken as the range of uncertainty.
D3: Uncertainty of impact of climate change on demand	Triangular	We have made an allowance for this uncertainty based on Technical Report 1.3.2: *the Impact of Climate Change on Demand*. The report suggests that that the projected changes on demand as a result of the impact of climate change will be in the following ranges for the 2030s: • Lower = 0.7% of DI • Mid = 1.3% of DI • Upper = 2.2% of DI
D4: Uncertain outcome from demand management measures	*N/A*	*Used to assess demand side uncertainties associated with the Preferred Plan; not included in our baseline assessment. See section 11.12.*

Table 21: Components of uncertainty for target headroom with distribution types

The outputs from the assessment are in the form of Ml/d values for each water resource zone corresponding to different probabilities of occurrence.

6.2.3 Risk profiles

We have maintained the same risk profile as our draft WRMP.

We selected an increasing level of risk over time on the basis that, for the current year, we have no time available to respond to uncertainty so the certainty should be 99%; in future, we can accept a lower level of risk as the uncertainties for which headroom allows will become smaller.

This means that, over time, we allow the percentile to reduce to 75%, which results in a lower Target Headroom.

6.3 Our Target Headroom

Our analysis is detailed in Technical Report 2.4: Headroom.

Table 22 presents our headroom provision at DYAA per WRZ in Ml/d at the end of each quinquennium throughout the planning period. Table 23 presents our headroom provision at DYCP per WRZ in Ml/d at the end of each quinquennium throughout the planning period.

WRZ	2015/16	2019/20	2024/25	2029/30	2034/35	2039/40
1	8.47	8.40	8.31	8.22	8.12	8.03
2	13.05	13.00	12.93	12.86	12.80	12.73
3	27.27	28.22	29.40	30.59	31.78	32.97
4	11.82	11.34	10.75	10.15	9.56	8.97
5	4.99	4.68	4.30	3.92	3.53	3.15
6	8.58	8.44	8.27	8.09	7.92	7.74
Sub-total (Central region)	74.18	74.08	73.96	73.83	73.71	73.59
7 (Southeast region)	4.05	4.10	4.15	4.21	4.26	4.32
8 (East region)	1.40	1.62	1.90	2.18	2.46	2.74
Company total	**79.63**	**79.80**	**80.01**	**80.22**	**80.43**	**80.65**

Table 22: Headroom provision in Ml/d per WRZ for DYAA at the end of each quinquennium

WRZ	2015/16	2019/20	2024/25	2029/30	2034/35	2039/40
1	14.21	14.23	14.25	14.28	14.30	14.32
2	17.81	17.27	16.60	15.93	15.26	14.59
3	21.56	21.77	22.04	22.31	22.58	22.85
4	19.32	18.53	17.54	16.54	15.55	14.56
5	7.34	6.80	6.13	5.47	4.80	4.13
6	25.72	24.26	22.43	20.60	18.77	16.94
Sub-total (Central region)	105.96	102.86	98.99	95.13	91.26	87.39
7 (Southeast region)	4.24	4.58	5.02	5.45	5.89	6.32
8 (East region)	4.17	4.12	4.05	3.99	3.92	3.85
Company total	114.37	111.56	108.06	104.57	101.07	97.56

Table 23: Headroom provision in Ml/d per WRZ for DYCP at the end of each quinquennium

The final target headroom profiles for our company at Dry Year Annual Average and Dry Year Critical Period are shown in Figure 28 and Figure 29 respectively. We have used the values labelled 'linear' in our modelling in order to prevent peaks and troughs in the demand plus target headroom forecast.

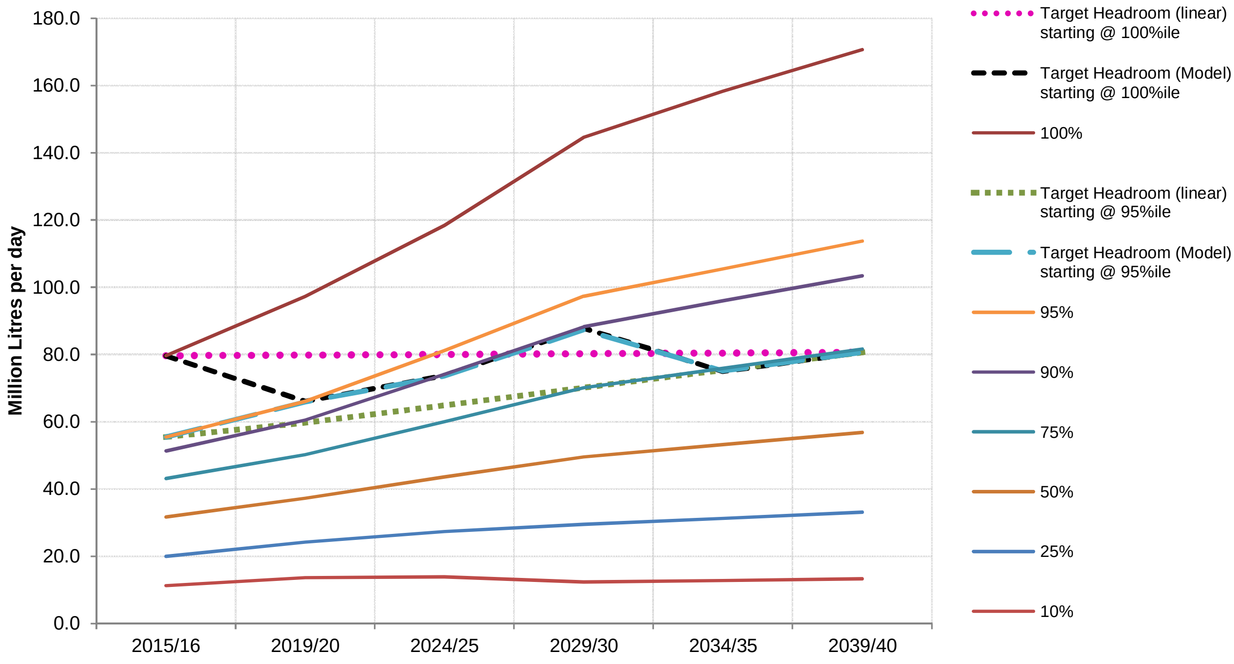

Figure 28: Company target headroom profile for dry year annual average

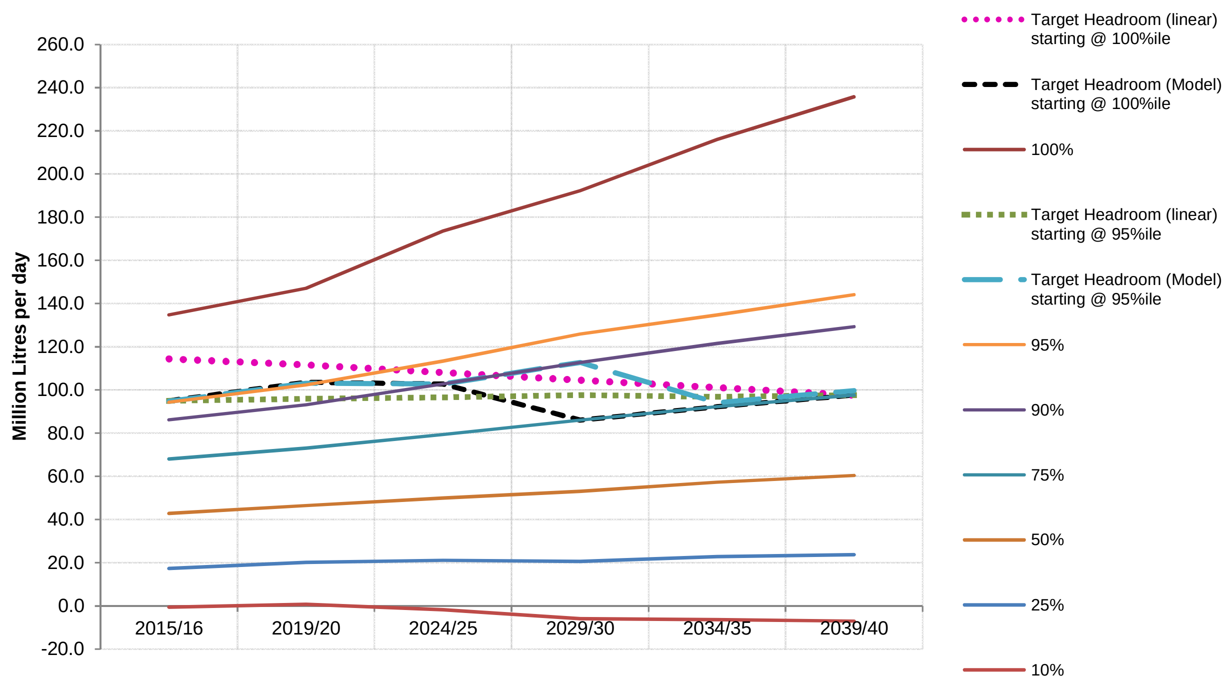

Figure 29: Company target headroom profile for dry year critical period

Figure 30 and Figure 31 express headroom as a percentage of our total distribution input at DYAA and DYCP respectively.

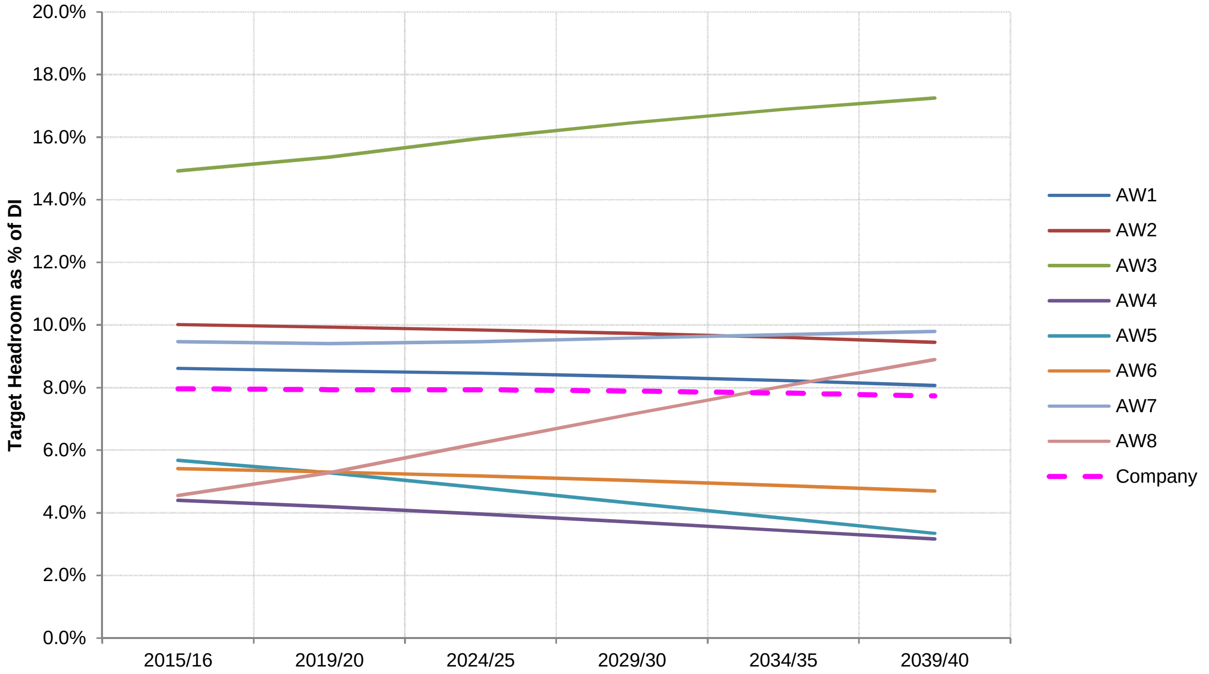

Figure 30: Target headroom as % of dry year annual average

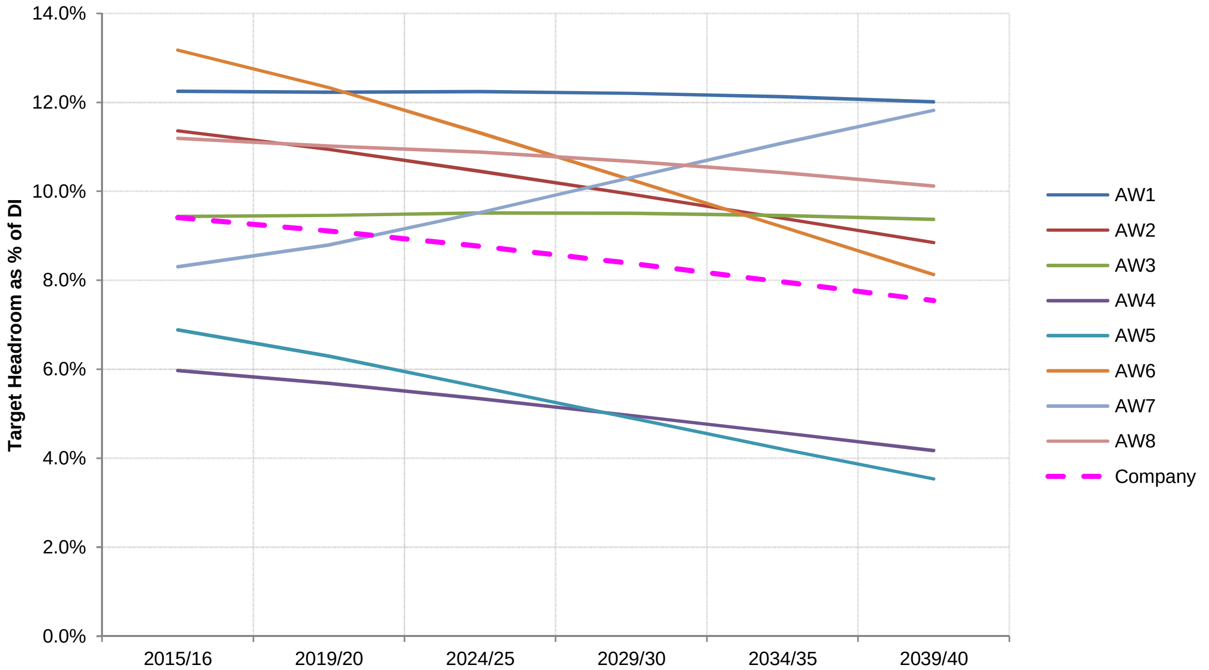

Figure 31: Target headroom as % of dry year critical period

7 Supply / demand balance

7.1 Approach

We compare our water available for supply with the forecast demand and include the planning allowance known as target headroom to give flexibility in case actual demand exceeds our forecast.

Our supply / demand balance is calculated by:

	Deployable output (DO)[15]
Minus	**Climate change impacts**
Minus	**Sustainability reductions** (SR)
Minus	**Outage and process losses** (water available for use, WAFU)
Minus	**Water demand** (distribution input, DI)
Minus	**Target headroom** (THR)

Where **supply** is less than **demand**, there is a **deficit** that must be overcome by developing options to reduce demand or increase supply.

We must ensure that there are no deficits in any year of the planning period, for all planning conditions.

7.2 Constrained and unconstrained balances

7.2.1 Introduction

We show the supply / demand balances at Dry Year Critical Period for each of our three regions in the following graphs:

– Figure 24 shows WRZ1 – 6, our Central region;
– Figure 25 shows WRZ7, our Southeast region;
– Figure 26 shows WRZ8, our East region.

We have illustrated the supply / demand balances with sustainability reductions (the ‘constrained’ balance) and without sustainability reductions (the ‘unconstrained’ balance) to demonstrate the major impact of those reductions that apply in our Central and Southeast regions.

[15] Our deployable output represents the water that is available to supply to our customers, and accounts for the bulk imports and bulk exports of water that are in place in 2015. For example, our bulk export to South East Water (36Ml/d) from WRZ6 and our bulk import from Anglian Water (91Ml/d at average) to WRZ3.

7.2.2 Our Central region supply / demand balance

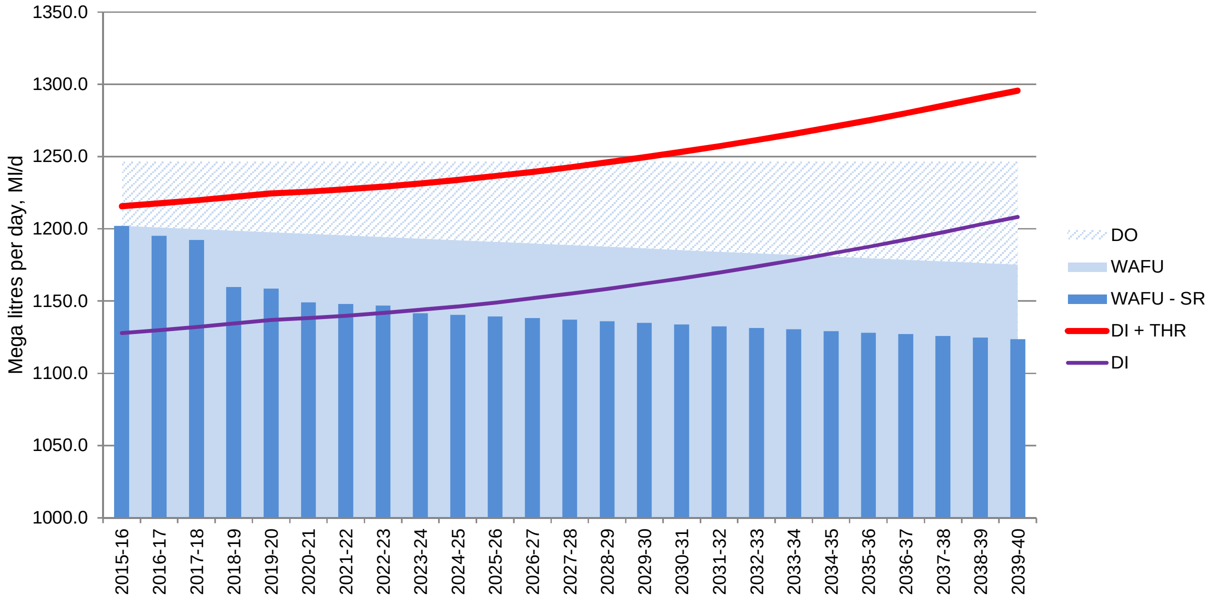

Figure 32: Supply / demand balance graph for Central, WRZ1-6, DYCP

7.2.3 Our Southeast region supply / demand balance

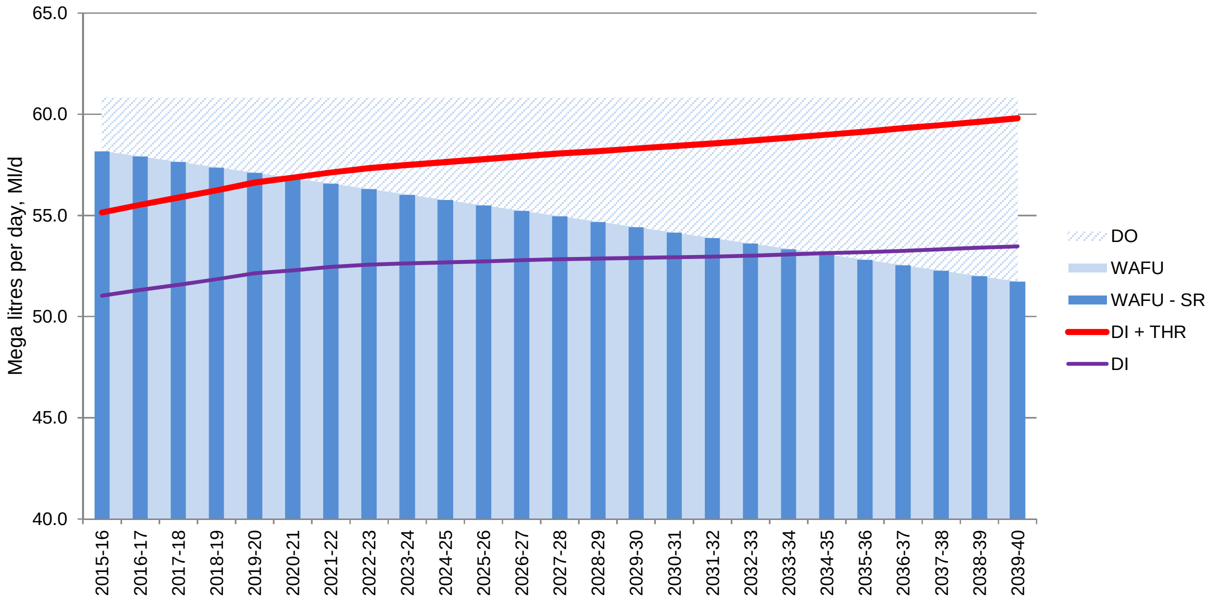

Figure 33: Supply / demand balance graph for Southeast, WRZ7, DYCP

7.2.4 Our East region supply / demand balance

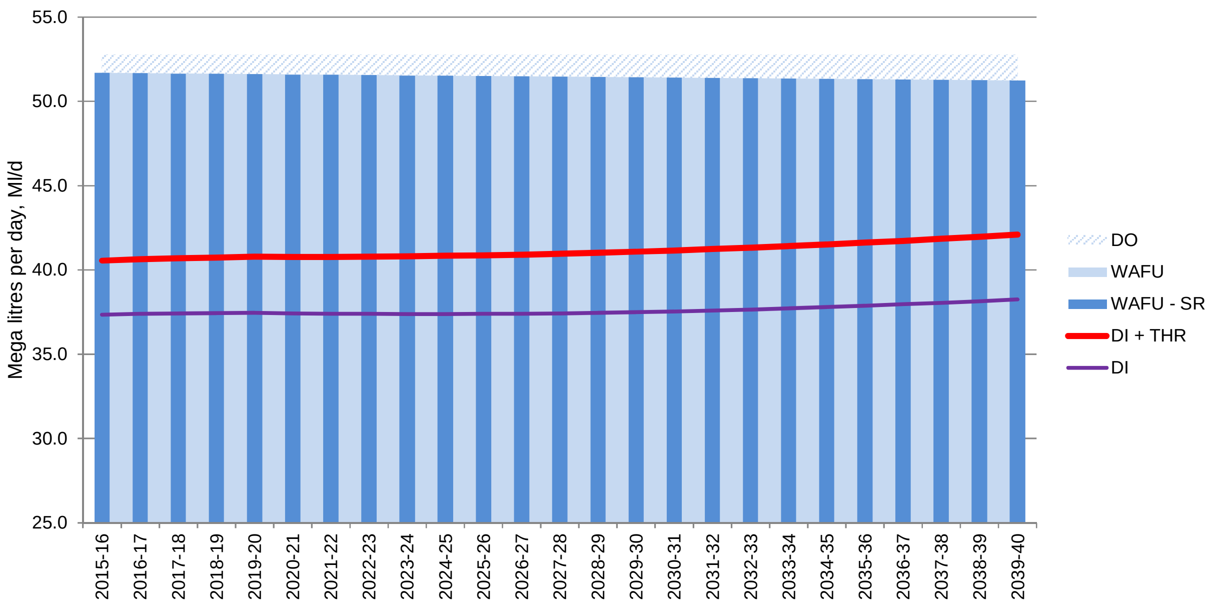

Figure 34: Supply / demand balance graph for East, WRZ8, DYCP

7.3 Baseline supply / demand balance 2015 – 2040

7.3.1 Overview

Our assessment of water available identifies that our Central and Southeast regions do not have sufficient water for the whole of the 25-year planning period to meet our customers' need for water.

Figure 35 shows the supply / demand balance for Affinity Water as a whole, combining the regional balances to give the overall position that this WRMP must resolve at a zonal level for the 25-year planning period. The deficit is between the blue 'Water Available For Use with Sustainability Reductions' bars and the red 'Distribution Input plus Target Headroom' line.

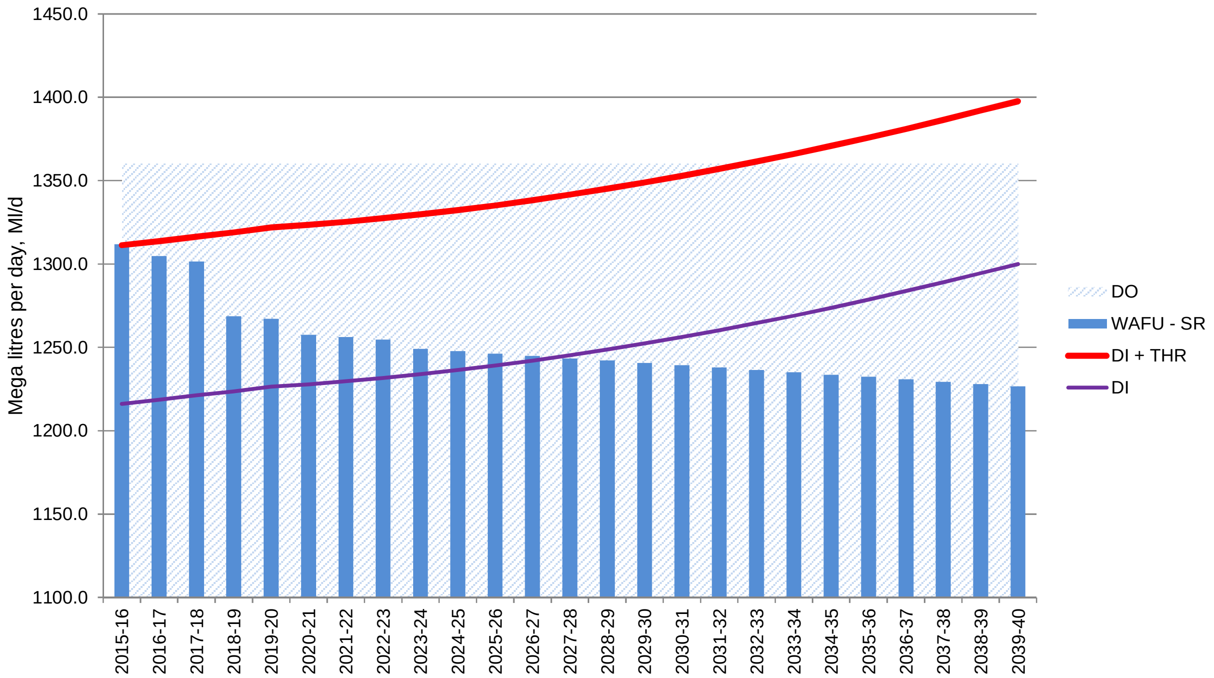

Figure 35: Final supply / demand balance for Affinity Water

Our baseline supply and demand assessments show that without the planned sustainability reductions, we have deficits in four water resource zones. The total deficit at the end of the planning period (2040) without sustainability reductions for the whole company is forecast to be **111.20Ml/d**.

However, with the planned sustainability reductions, our analysis shows that we have deficits in five of our eight water resource zones; our East region, WRZ8, does not have a supply deficit. At the end of the planning period, the total deficit for the whole company is **170.04Ml/d**.

In accordance with section 6 of the WRPG, we must take action to remove the deficits, as there is not enough supply to meet demand, including target headroom. The figures in sections 7.3.2, 7.3.3, and 7.3.4 show the zonal balances between supply and demand in 2015, 2020 and 2040 at DYAA and DYCP.

Our options appraisal is described in section 8. Our approach to modelling and scenario testing is explained in section 9.

Sustainability reductions remain a key element of our Plan and we discussed the impacts and subsequent options with our customers during the consultation period, addressed in section 10.

The following sections of our Plan explain our approach to the resolution of supply deficits in our Central and Southeast regions. As our East region remains in surplus throughout the planning period, we explain the service offering for our customers in WRZ 8 in section 11.4.8.

7.3.2 WRZ surplus and deficits in 2015

The plots in Figure 36 and Figure 37 show the surplus or deficit available to each of our WRZ in 2015, for average and peak respectively.

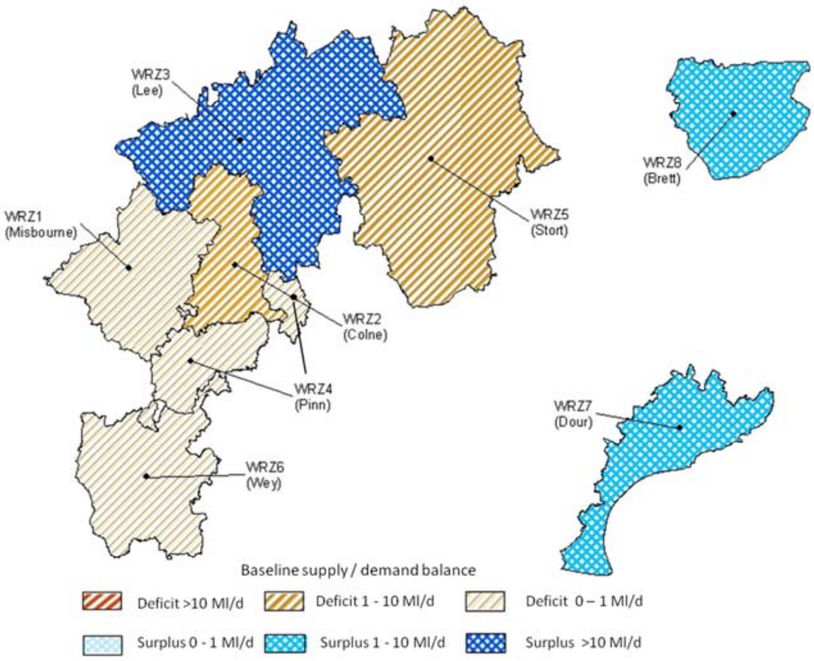

Figure 36: Water available at DYAA in 2015

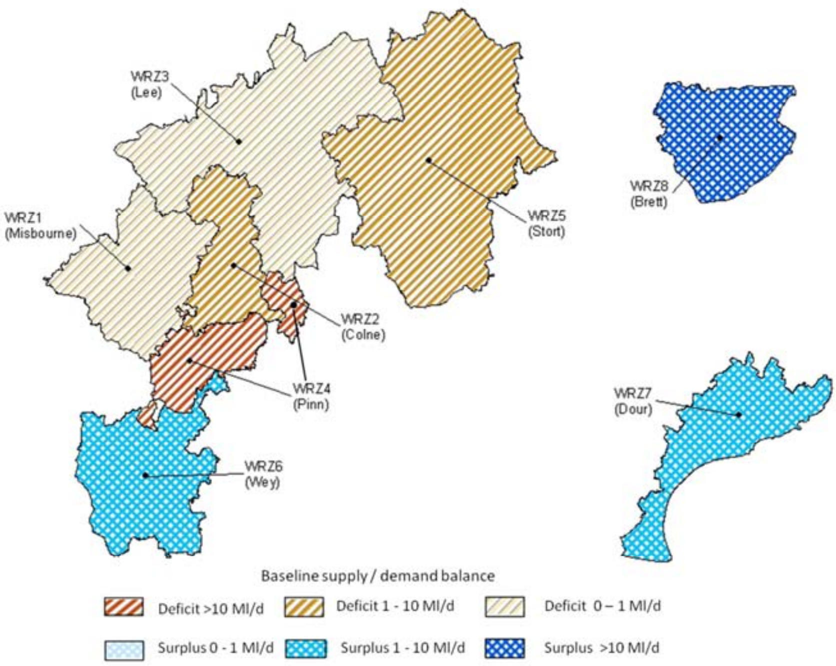

Figure 37: Water available at DYCP in 2015

7.3.3 Surplus and deficits in 2020

The plots in Figure 38 and Figure 39 show the surplus or deficit available to each of our WRZ in 2020, for average and peak respectively.

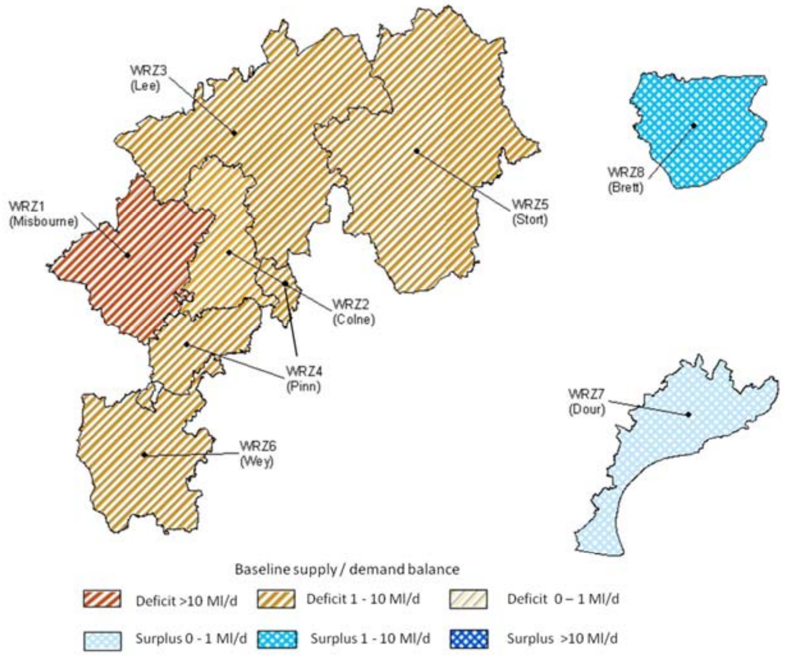

Figure 38: Water available at DYAA in 2020

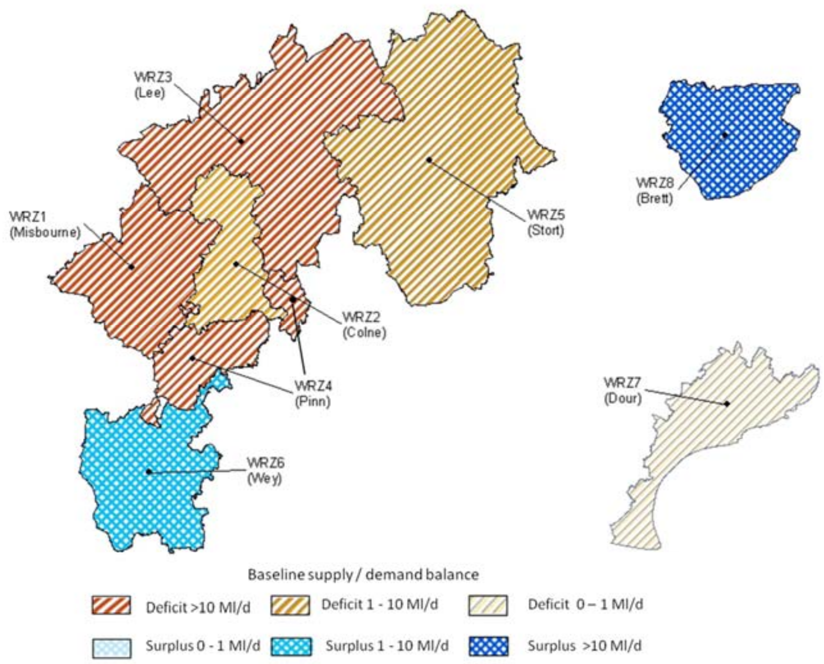

Figure 39: Water available at DYCP in 2020

7.3.4 Surplus and deficits in 2040

The plots in Figure 40 and Figure 41 show the surplus or deficit available to each of our WRZ in 2040, for average and peak respectively.

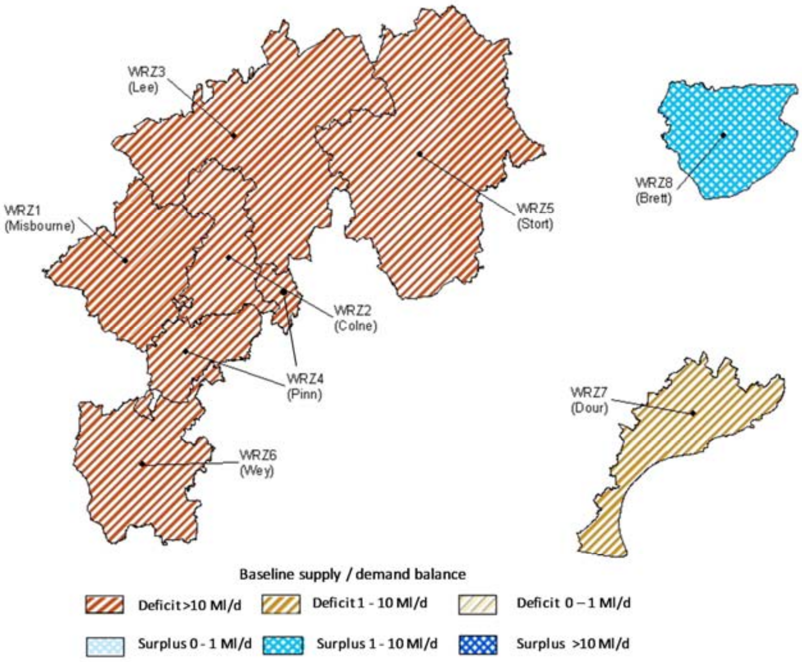

Figure 40: Water available at DYAA in 2040

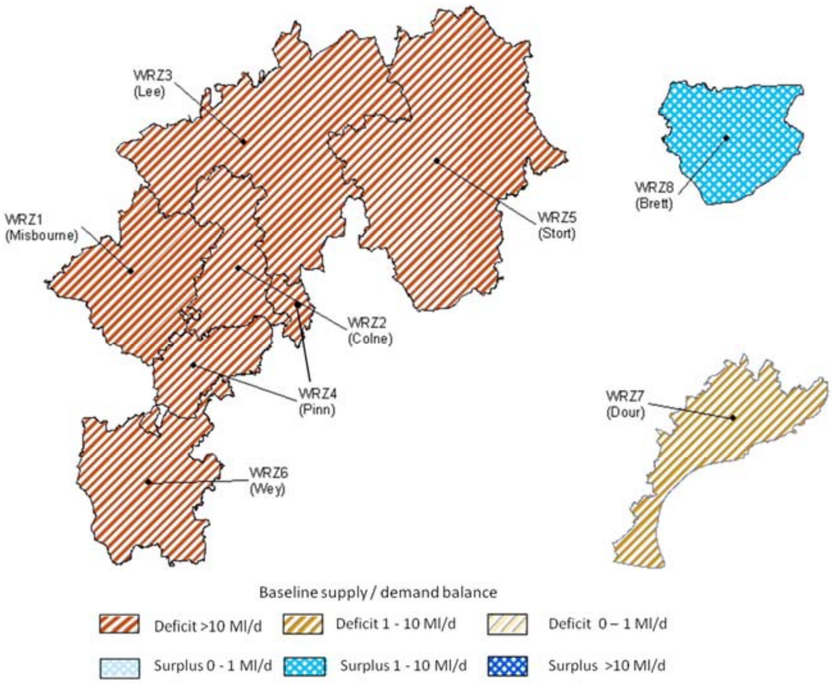

Figure 41: Water available at DYCP in 2040

8 Options appraisal

8.1 Approach

There is an established approach in the water industry for identifying, evaluating and selecting options for meeting water resource needs. Our approach is based on current best practice guidance, shown in Figure 42, which is divided into the following stages:

- **Stage 1 Unconstrained options** – compile a list of possible options which are technically credible but which have not been assessed for any constraints on development. This is termed the unconstrained options list.
- **Stage 2 Feasible options** – undertake a screening process on the list of unconstrained options and create a shorter list of feasible options which are studied in more detail and compared in terms of environmental impact, development and operational costs and long-term value, involving an economic assessment to establish the least-cost options.
- **Stage 3 Programme appraisal and environmental assessment** – assess alternative combinations of options against the requirements of Strategic Environmental Assessment (SEA) and Habitats Regulation Assessment (HRA).
- **Stage 4 Preferred programme and final supply / demand balance** – select the preferred programme of options for the company's water resources strategy.

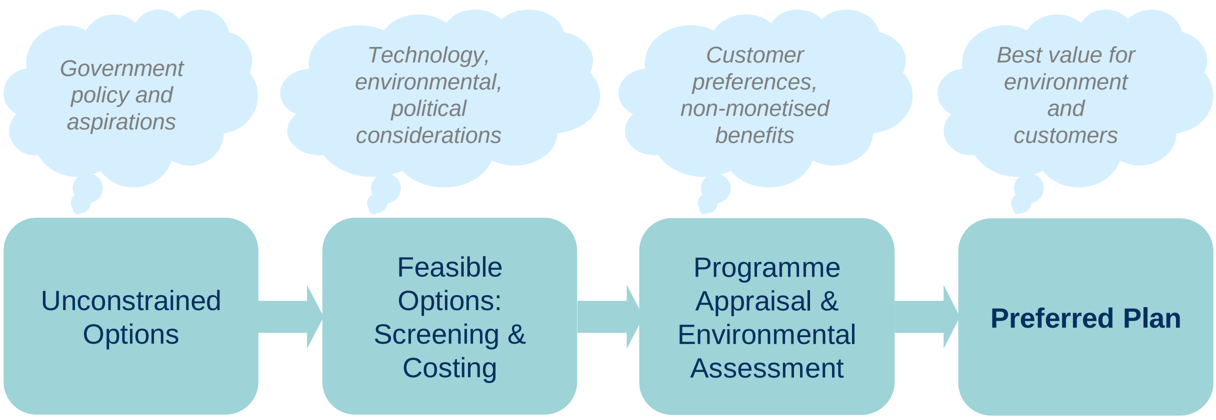

Figure 42: Components of our options appraisal

As our East region is in surplus for the whole planning period, we have not undertaken an options appraisal as we do not need to increase water availability or reduce consumption to maintain the supply / demand balance. Our East customers have a low PCC and therefore further reductions in consumption are unlikely.

The following sections of this draft Plan therefore apply to our Central and Southeast regions, both of which have supply deficits.

Our work to address Stages 1 and 2 is explored in Technical Report 3.1: *Options Appraisal*. Stage 3 is explored in our Technical Report 3.9: *Environment Report*, while our Preferred Plan is explained in Section 11 of this Plan.

8.2 Stage 1 – Unconstrained options

8.2.1 Option types

The unconstrained options list was created for our Central and Southeast regions by considering the full range of potential demand reduction methods and all realistic ways of providing increased water availability. The final list of options can be identified as options that either reduce demand or increase the availability of supply.

We started by considering the unconstrained options list from our previous WRMP (published in 2010), before holding a series of workshops to develop these options further and to build new options for a more detailed review. After an initial review of the viability of the schemes, the outcome was a new unconstrained options list, comprising demand side options (to reduce the amount of water 'needed') and supply side options (to increase the amount of water available).

As our regions remain classified as in 'serious water stress', we are directed to consider compulsory metering as part of the options appraisal[16].

Demand side options include:

– Leakage reduction;
– Water efficiency for both household and non-household customers;
– Metering;
– New tariffs;
– Local water reuse (grey water reuse, rainwater harvesting, etc.).

Supply side options include:

– Bulk transfer imports from other water companies or third party licence holders, whether neighbouring or not;
– Abstraction licence trading and other third party options;
– Transfers between our water resource zones (giving rise to greater connectivity and extra capacity to move water from areas of surplus to areas of deficit);
– Surface water, including increased river abstractions and new reservoirs, as well as considerations for making use of reservoirs owned by third parties;
– Groundwater, including increasing output from existing sources, developing new boreholes and enhancing aquifer storage;
– Treated water storage;
– Catchment management (to reduce water quality constraints on existing sources);
– Effluent reuse and desalination.

The WRPG asks companies to consider a change in levels of service as an option to resolve a supply demand deficit. Changing our levels of service will not materially affect our DO as temporary use bans (hosepipe bans) and non-essential use bans do not materially increase

16 Water resources planning guideline: the guiding principles for developing a water resources management plan, June 2012. Government policy, section iv: reducing demand for water.

water available for use in further droughts as, unlike a reservoir, our groundwater system is continually draining. Restrictions do allow for some improvements in environmental flows during droughts, but consultation responses indicate that customers do not support changes in the levels of service. Further, we do not want to offer our customers different levels of service in different regions, as East remains in surplus. As a result, we have not developed any options related to a change in our levels of service as a means to resolve our supply / demand deficits.

The number of options of each type presented at the unconstrained stage is shown in Table 24.

Option types	Number of unconstrained options	Unconstrained option details
Water efficiency	110	Provision of water saving devices such as dual flush toilets and water efficient showers, water audits, campaigns
Local water reuse	8	Harvesting rainwater locally at major airports and sports grounds. Immediate grey water reuse in the home
Leakage	97	Active leakage control, changing the boundaries of DMAs, installing PRVs, distribution network replacement
Metering	43	Installing universal or voluntary meters over different periods of time, both to unmeasured customers and the retro-fit of newer technology to existing metered customers
Tariffs	22	Linking volumetric charges to water consumption, varying charges for different types of customers
Transfers: bulk transfer imports / exports, inter-zone transfers & network reinforcement	77	Options to donate and receive bulk supplies of water from third parties outside of our operating region, whether the infrastructure exists or not, moving water between WRZs, options to remove capacity constraints in the network to release trapped DO
Surface water	42	New reservoirs, extending existing reservoirs, non-reservoir surface water (treatment)
Groundwater	98	Closing the gap to licence, increasing licence, licence variation, borehole recommissioning, new borehole, artificial storage and recovery in the aquifer
Effluent reuse	7	Treating waste water effluent to be able to supply it as potable water
Desalination	12	Taking water from the sea (sea intakes, deep chalk wells, shallow beach wells) and treating it. Restricted to regions with a coastline
Treated water storage	2	Expanding storage at existing Affinity sites
Catchment management	2	Working with landowners to reduce pollution in the catchment to allow an increase in DO of local sources
TOTAL	**520**	

Table 24: Summary of unconstrained option types at draft

The unconstrained options process is further explored in the Technical Report 3.1.1: *Unconstrained Options Study*. Details of all of the unconstrained options are provided in an appendix to this report.

8.2.2 Options from third parties: water trading

8.2.2.1 Introduction

Increasing the volumes of water traded between organisations is a key Government initiative, designed to increase flexibility in supply systems and the efficiency with which available resources are used. Overall, this has the potential to delay costly supply side schemes, which could provide better value for money for customers and for the environment. It was also a key principle of the Water Resources in the South East (WRSE) project, which sought to provide a regional solution for the South East of England where the available resources were shared for the benefit of all customers.

The existing transfers and cross-border connections between our neighbouring companies and us are explained in section 4.3.

We engaged with many of our neighbouring water companies to develop options for water trading as part of or participation in WRSE. We also spoke with water companies further away from our operating regions to determine the viability of bulk supplies of water that could utilise an intermediate transfer capability. We liaised with organisations that have a private water network, such as the Canal & River Trust, to develop options. In addition, we researched licence holders in and near to our operating region to establish the likelihood of water trading.

All of the water trading options have been considered equally with the other available options in our EBSD modelling, with no bias towards or against supplies from third parties.

This section summarises our discussions with these organisations, and how they have influenced the screening process to develop our feasible options.

8.2.2.2 Anglian Water

We share boundaries with Anglian Water in our Central region, at WRZ3 and WRZ5.

Anglian Water is forecasting supply deficits in some of its WRZ in the planning period.

We share a resource with Anglian Water to the north of our WRZ3. We discussed options to vary our entitlement, but as Anglian is also in deficit in the neighbouring WRZ, a formal amendment to the DO is not feasible. We have agreed to keep the possibility of water trading of our shared resource open, and continue to meet regularly with Anglian Water to ensure that the assets are appropriately managed and maintained.

The viability of new water trading options to support our customers is highly dependent on Anglian Water being able to release surplus from the north of their operating region or receiving a significant bulk transfer of water from a third party. As a result of continued discussions and further analysis of our supply demand balances, some options could not be progressed through screening as Anglian Water could not replace the water transferred to us.

The viability of our effluent reuse schemes for certain areas of our Central region is dependent on us being able to gain access to the effluent in their region as the waste water undertaker.

For our East region, where we maintain a small surplus throughout the planning period, we have agreed to explore opportunities for flexible water trading of our shared resource. Any proposals would need to be agreed by the Committee that controls the management of the resource.

8.2.2.3 Cambridge Water

We share boundaries with Cambridge Water in our Central region, at WRZ3 and WRZ5.

We have infrastructure in place in WRZ3 to facilitate access to a source in Cambridge Water's operating region for emergency use.

Cambridge Water's supply / demand balance shows a small surplus throughout the planning period. We made contact to explore the availability of this surplus as a potential option for our WRMP.

Cambridge Water will consider entering in to a bulk supply agreement with us for year-round take of the licence volume, although high levels of nitrate are currently present as a result of the 2012 drought and subsequent unprecedented rainfall, for which there is no treatment at the site. Consequently, we would need to blend the supply with low nitrate water in our region, of which some sources are subject to sustainability reductions, giving rise to water quality concerns.

We plan to continue our discussions with Cambridge Water about the best use of this resource, which, despite the high nitrate levels, could offer a degree of resilience to our customers in WRZ3 and WRZ5.

8.2.2.4 Essex & Suffolk Water

We share a boundary with Essex & Suffolk Water in our Central region, at WRZ5.

Essex and Suffolk has declared they have a surplus volume available for water trading in their statement for need and availability of water. We made contact to express our interest and obtained an approximate volumetric cost and annual charge for this supply.

As there is insufficient infrastructure between our companies to accommodate large volumes, the options we developed had significant capital cost to lay the necessary pipelines and infrastructure to pump the water. The shortest distance pipeline routes to deliver the available surplus usually involved mains laying in sensitive environmental areas.

We understand that Essex and Suffolk Water has agreed to sell their surplus to Thames Water; therefore, there is no water available to trade with us.

8.2.2.5 Severn Trent Water

We do not share any boundaries with Severn Trent Water.

We have discussed the potential scope and scale of bulk transfer options with Severn Trent Water. In view of the absence of a direct transfer link, we concluded that any transfer would depend on a cascade through Anglian Water's region or the canal system. Consequently, we have supported Anglian Water's Water Resources in East Anglia modelling project to evaluate this potential and discussed options with the Canal Trust (see section 3.5.4.2). We have not been able to identify alternative feasible options for our revised plan, however we plan to continue to participate in this project through AMP6.

8.2.2.6 South East Water

We share boundaries with South East Water in our Central region, at WRZ6, and our Southeast region, at WRZ7.

South East Water is forecasting supply deficits in the planning period.

We have an existing bulk supply agreement with South East Water to support our customers in our Southeast region, WRZ7. Together, we developed options for the WRSE modelling, which included both a continuation and an increase in take of the existing bulk supply (using the existing infrastructure with no additional capital cost), and new bulk supplies dependent on the development of a reservoir in South East Water's operating area. The new bulk supplies would require new infrastructure at significant capital cost.

We agreed to model all bulk supply options with the annual fixed and volumetric charges specified in the current contract between our respective companies as South East Water confirmed any new bulk supply would have similar charges to the existing supply.

The availability of the additional water is dependent on South East Water being able to replace the volume transferred to us. This, together with the difference between marginal and opportunity costs, could give rise to differences between our respective Plans and the outputs of the WRSE modelling, which could suggest a different set of solutions to solve the regional supply / demand balance.

In addition, the existing bulk supply is capable of being bi-directional, meaning that we can supply a bulk supply to South East Water should we have the ability to assist them. However, as we have supply deficits from AMP7 in WRZ7, it is unlikely that we could provide a consistent volume, although we will endeavour to provide water for operational support on an ad-hoc basis.

It is our understanding that South East Water do not plan to undertake works at the reservoir, voiding the options that were dependent on it.

We have shared the outcomes of our modelling with South East Water to ensure that our proposals are agreeable and that the options selected in our Preferred Plan can be reflected in South East Water's WRMP.

8.2.2.7 Southern Water

We share boundaries with Southern Water in our Southeast region, at WRZ7.

Southern Water is forecasting supply deficits in the planning period.

As with South East Water, we developed options with Southern Water as part of WRSE, which included continuing the current bulk supply and increasing the volume as the existing infrastructure is capable of transferring larger volumes. These options utilise the existing infrastructure and there is no additional capital cost.

We agreed to model all bulk supply options with the annual fixed and volumetric charges specified in the current contract between our respective companies.

The availability of the additional water is dependent on Southern Water being able to replace the volume transferred to us. This, together with the difference between marginal and opportunity costs, could give rise to differences between our respective Plans and the outputs of the WRSE modelling, which could suggest a different set of solutions to solve the regional supply / demand balance.

The viability of our effluent reuse schemes for our Southeast region is dependent on us being able to gain access to the effluent in their region as the waste water undertaker.

We have shared the outcomes of our modelling with Southern Water to ensure that our proposals are agreeable and that the options selected in our Preferred Plan can be reflected in Southern Water's WRMP.

8.2.2.8 *Sutton & East Surrey Water*

We share a small boundary with Sutton & East Surrey Water in our Central region, at WRZ6.

Sutton & East Surrey Water is forecasting supply deficits in the planning period.

We do not have any existing connections with Sutton & East Surrey Water. In the development of options for WRSE, we discussed a number of options. Ultimately, the high capital cost associated with the infrastructure needed to facilitate a bulk supply rendered the options infeasible as we both have numerous connections with other neighbouring companies to ensure a resilient supply to our customers.

We wish to continue dialogue with Sutton & East Surrey Water to ensure we do not miss opportunities for water trading.

8.2.2.9 *Thames Water*

We share boundaries with Thames Water throughout our Central region, WRZ1 – 6.

Thames Water is forecasting supply deficits in the planning period.

We have a number of existing connections and bulk supplies with Thames Water. We built various options for WRSE modelling that included increasing the capacity of existing transfers and developing new bulk supplies with associated infrastructure.

We held various discussions with Thames Water regarding the viability of schemes and used annual fixed and volumetric charges specified in existing agreements.

A number of these options are dependent on Thames Water developing upstream supply side options, such as reservoirs, to enable them to reduce their abstraction from the River Thames and leave more in the river for others to abstract. We understand that there are no current plans for Thames to build a reservoir or to reduce their abstraction, rendering a number of options unavailable for our modelling. This, together with the difference between marginal and opportunity costs, could give rise to differences between the WRSE modelling outcomes and our respective plans, as some WRSE scenarios could determine that an upper Thames reservoir is cost beneficial.

The viability of our effluent reuse schemes for certain areas of our Central region is dependent on us being able to gain access to the effluent in their region as the waste water undertaker.

We have shared the outcomes of our modelling with Thames Water to ensure that our proposals are agreeable and that the options selected in our Preferred Plan can be reflected in Thames Water's WRMP.

8.2.2.10 Canal & River Trust

The Canal & River Trust (CRT) operate canals that link rivers in our area to potential sources of supply. In Figure 29, we show the rivers, canals and other infrastructure that CRT operates in and near to our Central operating region (green outline, black dots represent locks).

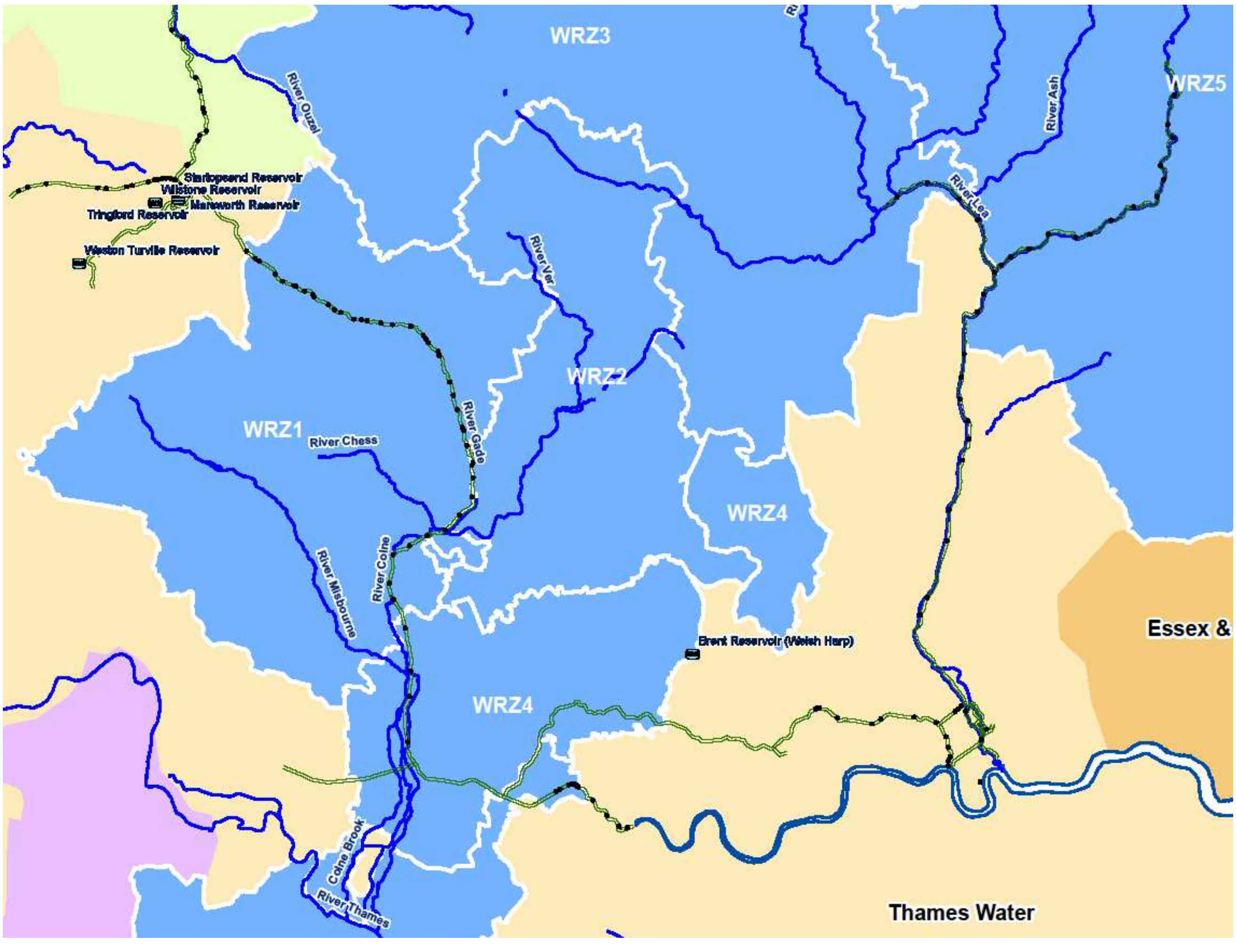

Figure 43: Overlay of Canal & River Trust infrastructure in the Central region

In our assessment of the potential options, we noted that the quality of the water produced from the canals was likely to be poor and that as a consequence, the EA would be unlikely to give consent for it to be discharged, untreated, into any river. Resolving this issue is likely to drive significant cost for all of the canal related options. Further, the costs to pump the water in our region over long distances are considerable and could result in CRT options being less cost effective than others.

However, since we are forecasting significant deficits in our region throughout the planning period, we remain interested in this option. On this basis, we have developed preliminary Capex and Opex estimates for the options and have included these in our EBSD model. Discussions with the CRT and other interested parties are on-going, so we are able to understand how water for public consumption would be supplied when the canal network is under stress.

8.2.2.11 Private Water Supplies

The Agency provided us with a list of all licence holders that had licences of greater than 1Ml/d in our Central and Southeast operating regions.

Our review of these licences suggested we might be able to enter into an agreement with the licence holder to lease all or part of their licence, whether raw or treated water, either throughout the year or at times when they do not use their full licence entitlement.

The availability of significant volumes to make such a scheme cost effective varied from WRZ to WRZ. Such options would require significant investigation to determine genuine feasibility and to ensure that any water quality concerns were addressed. We would also need to discuss any licence changes with the Agency. The nature of the licences tended to mean that they were some distance from our existing infrastructure, e.g. on farmland, so pipeline costs would need to be included in the Capex costs.

8.3 Stage 2 – Feasible options

8.3.1 Screening process

A detailed screening process was applied to the unconstrained options to create the feasible options list, which was discussed with the Agency in the summer of 2012

Acceptable options were reviewed against each of three risk categories (technical, environmental and political) to identify potential constraints to development. Each option was marked as having no major concerns, some potential major constraints or significant issues likely to prevent successful development.

The screening eliminated certain water supply options where increased abstractions from rivers or groundwater aquifers were likely to have a detrimental environmental impact. Such impacts included unacceptable reduction in river flows, aquifers already deemed to be over-abstracted, existing river water quality concerns and other effects on water-reliant habitats.

Table 25 identifies the number of unconstrained options that were removed from the feasible options list as a result of our screening process.

Option types	Number of options screened out	Justification for the screening out of these options
Water efficiency	80	Review of validity of options, e.g. whether they had already been delivered or the technology had become obsolete. Some combining of options to deliver better yields for a lower total cost. Some reliance on external parties (e.g. national media campaign) could not be relied upon to reduce demand.
Local water reuse	8	Support of airport authority unknown to install rainwater harvesting. Installation in homes could give rise to water quality concerns / cross-contamination of potable supply.
Leakage	55	Small benefits in water saved for comparatively large expenditure (e.g. extension of DMA metering, trunk main monitoring). Ability to achieve large ALC reductions a concern, hence screened out. Overlap with other options. Options to allow leakage to rise unacceptable (even if below ELL).
Metering	19	Historic performance / difficulties in deliver of some options and reduced demand e.g. change of hands metering. Dumb meters and fixed networks not cost beneficial. Overlap with current company policy, e.g. AMR on difficult to read / access properties.
Tariffs	22	Justification of demand savings difficult, quantities will be very variable and affected by weather, Special tariffs relies on our ability to identify homeowners with swimming pools, outside taps etc. Experience of tariff trials in both Central and Southeast regions show no significant difference in water consumed.
Transfers: bulk transfer imports / exports, inter-zone transfers & network reinforcement	34	Bulk exports to other companies screened out as they are addressed in their options appraisal (accounted for in loss of our WAFU). Consideration for technical feasibility / overlap with schemes being delivered in AMP5. Cost of new infrastructure to supply water compared with existing infrastcture that is capable of delivering a similar capacity. Availability of water from neighbouring companies / third parties. Transfers within zones do not provide additional capacity for EBSD modeling.
Surface water	34	No upstream resource availability to feed reservoirs, e.g. low flowing rivers. Consideration for environmental impacts, e.g. loss of ancient woodland. Technical challenges resulting in high costs therefore infeasible.
Groundwater	72	Review of validity of options, e.g. whether they had already been delivered or will be delivered by the end of AMP5. Agency veto / “red list”. Consideration for catchment designation – likelihood of licence being granted when over-abstracted / over-licenced, and for environmental consequences Cost of plant to treat abstracted water has rendered some options infeasible.
Effluent reuse	4	WFD concerns – water bodies in poor status. We have no right to the effluent, as we are not a wastewater undertaker. Conflict with other water companies’ plans for effluent reuse schemes. Technical feasibility when compared with bulk supply options.
Desalination	10	Unconstrained options were similar, varying in location and how water would be developed (from the sea, deep chalk wells or shallow beach wells). Deep chalk wells opposed by the Agency due to saline intrusion to the aquifer. Disposal of concentrated brine and long sea intakes increase the capital and operating costs.
Treated water storage	2	Schemes provide additional capacity at peak for a very short period of time and would be unable to cope with concurrent peak events (no time to refill). Water quality concerns with the retention of treated volumes for long periods, generating additional cost for treatment.
Catchment management	2	Cannot be relied upon to deliver yield as it relies on large numbers of farmers to work together. Difficult to plan for the consequences of alternative treatment methods. However our Business Plan for 2015-20 proposes a significant programme for catchment management and we hope we will be able to reduce the uncertainty around the loss of DO as a result of pollution in future.
TOTAL	**342**	

Table 25: Reasons for screening options out of the feasible options list

The constrained options screening process is further explored in Technical Report 3.1.2: *Option Screening and Constrained Options Methodology*. Appended to the report is a matrix giving details of the reasons for the decision to screen options in or out of the feasible options list.

8.3.2 Option development

Each feasible option was developed further by producing an outline design and undertaking appraisal of:

- Water supply yield;
- High level environmental assessment, including potential environmental impacts during construction and operation as well as mitigation requirements and opportunities for environmental enhancement;
- Development (capital) and running (operational) costs;
- Social and environmental costs;
- Carbon emissions;
- Potential development constraints;
- Interdependencies with other options (mutually exclusive, mutually inclusive, sequential);
- Programme for implementation.

The Environment Agency was consulted during the derivation of our unconstrained options and the development of our constrained options and provided useful feedback to assist the process. Particular assistance was given on the likelihood of additional water being available for abstraction from groundwater aquifers and rivers.

The incremental costs of each option are based on 2014/15 as the base year. Any planned infrastructure developments or improvements that will deliver additional DO or transfer capacity have been taken into consideration when developing the starting position for the supply demand balance.

A range of supply, transfer and demand management options were originally developed for the WRSE modelling using the 2011/12 price data and in our modelling are discounted back to this starting point. Option prices have been reviewed during the period between the publication of our draft WRMP and our Statement of Response and we believe the option costs are still to a degree of accuracy within the bounds of uncertainty around the options.

The average incremental cost (AIC) of each option is calculated as the Net Present Value (NPV) of Option Costs / NPV of Option Capacity or output. Where the costs included an environmental and social cost, the result was an average incremental social cost (AISC) score. These scores were not used to inform the modelling on the basis that we have used an optimisation model to select the option set.

The discount rate used in our modelling is 4.5%.

In order to comply with the WRPG, we present AICs and AISCs in our WRP tables (3a, 3b and 3c), using the in-built methodology.

8.3.3 The impact of Climate Change on our Options

Of our feasible groundwater options, the majority are not sensitive to climate change as they involve construction of new boreholes or installation of new borehole pumps. We plan for these schemes to be designed to effectively 'engineer out' any climate change impacts, such as lowering pumps and deepening boreholes to account for possible climate change impacts.

Our analysis suggests two of our feasible groundwater options are likely to be affected by climate change. Both options (ID005 in WRZ6 and ID070 in WRZ1) deliver very small yields (less than 1Ml/d at average) and involve recommissioning and optimising within licences. We have accounted for the reduction in yield over time for these options in our modelling.

For our surface water schemes, we will engineer out the impacts of climate change as we develop the new capability.

All of our bulk transfer options are capacity based and are not affected by climate change.

Effluent reuse and desalination schemes are not affected by climate change.

None of our demand management options (leakage, metering and water efficiency) are sensitive to climate change.

8.4 Economic appraisal of demand management options

8.4.1 Introduction

In order to develop options for leakage and metering for use in our EBSD modelling, it has been necessary to carry out a separate economic appraisal.

The detail of this work is summarised in sections 8.4.2 and 8.4.3, and further detailed in Technical Report 3.2: *Leakage Strategy Report* and Technical Report 3.3: *Metering Strategy & Cost Benefit Analysis*.

8.4.2 Leakage

8.4.2.1 Short Run Economic Level of Leakage

There are two aspects of leakage: the mathematical calculation of the economics of leakage, and our customers' views about our leakage policy. This section addresses the former, whilst section 10 addresses the latter.

The method of calculating the short run Economic Level of Leakage (ELL) and sustainable ELL (SELL), where environmental and social costs pertaining to maintaining leakage volumes and leakage management activities are taken into account, follows Ofwat guidelines and industry best practice.

Table 26 sets out the results of the short run ELL and SELL analysis for each region when compared to the current leakage targets. The current company target is 5% and 8% below the short run ELL and short run SELL respectively.

Area	Private ELL (Ml/d)	Sustainable ELL (Ml/d)	Base year target
Central	200.8	207.8	185.0
East	5.5	5.5	5.1
South East	6.8	7.7	7.7
Company	**213.1**	**221.0**	**197.8**

Table 26: Regional ELL and SELL results

8.4.2.2 *Consideration of risk*

The recent tripartite *Review of the calculation of sustainable economic level of leakage and its integration with water resource management planning* (Environment Agency, 2012) recommends that companies consider the level of risk associated with their SR SELL forecasts.

The principal risk factors associated with the SR SELL are considered to be weather related and, in particular, frequent repeats of the very severe winters experienced in 2010 and 2011. The SR SELL parameter most affected by this is the natural rate of rise (NRR) since this dictates the costs required to maintain a given leakage level. The recommended SR SELL is based on an NRR analysis and observed costs from the single year 2011/12, which in leakage terms may be considered as fairly benign. There is a risk therefore that without considering the range around the SR SELL that the resulting AMP6 leakage budget could be insufficient if there were to be an increased frequency of severe winter events during this period.

In order to explore more fully the sensitivity of NRR and SR SELL to weather effects the last 7 years of data has been used to determine benign and extreme values of NRR. The lowest and highest NRR values resulted from 2007/08 and 2005/06 respectively. Table 27 shows the resulting impacts on SELL, based on Central only.

Central	Use of Benign Year NRR	Use of 2011/12 NRR	Use of Extreme NRR
SR SELL (Ml/d)	187.2	195.7	202.6

Table 27: Impacts on SELL

The results indicate that the recommended SR SELL values are approximately mid-way between benign and extreme conditions and therefore represent a “pragmatic” view regarding the frequency of both benign and extreme scenarios.

8.4.2.3 Developing the costs for our leakage options

WRZ-level leakage~cost relationships have been developed based on District Meter Area (DMA) marginal cost analysis for 2011/12, in accordance with the Method B best practice approach. The cost curves define the relationship between the marginal unit cost of active leakage control and the full range of leakage levels down to background leakage.

The leakage detection and repair costs used to derive the cost relationships were averaged across each region before application to District Meter Areas (DMA) and Water Resource Zones (WRZ). Mathematically, there is a lower confidence when comparing local WRZ ELL and SELL values and water resource zone leakage levels than at the regional level.

Our SR SELL assessment includes a quantitative assessment within each WRZ of the full range of social, environmental and carbon costs and benefits, based on best practice guidance published by Ofwat (2008) and the Environment Agency (2011).

The approach to cost curve development is consistent with the latest thinking on the development of leakage cost curves as reported in a recent UKWIR best practice report[17]. This UKWIR study advocates increased granularity of cost~leakage relationships at the level of DMA.

The consultants that undertook this work for us produced a report, which we have appended to Technical Report 3.2: *Leakage Strategy*.

8.4.2.4 Leakage options available to the model

There are four types of leakage options offered to our EBSD model:

- **Active Leakage Control (ALC).** Proactive work to detect and repair leaks in the network, whether visible or not. Costs include delivering the leakage saving and ongoing costs to maintain leakage at the new level. Costs are derived from the non-linear leakage cost curves described in 8.4.2.3. Available in all WRZ.
- **Savings arising from reducing District Meter Area (DMA) size.** Creating smaller DMAs (less than 2,000 domestic properties) gives us better control of leakage in that area, delivering a degree of efficiency that we account for as additional yield. As we have reduced DMA size in three of our eight WRZ, we have developed options for the four WRZ that are in deficit during the planning period (our East region, WRZ8, is in surplus).
- **Savings arising from installing Pressure Reducing Valves (PRVs).** Installing more PRVs gives a similar benefit to the DMA option, allowing us to manage the pressure in DMAs more discretely. Where it is possible for us to reduce pressure in a DMA whilst maintaining the levels of service our customers expect, we will reduce the volume of leakage. Available in all WRZ.
- **Leakage reduction by replacing distribution mains.** Establishing the pipes with the greatest volume of leaks and replacing significant lengths. This is a very expensive option for limited benefit; generally, local repairs will be most cost effective and much less disruptive to the local community. Available in all WRZ.

[17] Best practice for the derivation of cost curves in economic level of leakage analysis 11/WM/08/46

We were conscious that in deriving leakage options for our draft WRMP, we chose a range of discrete leakage reductions which meant our economic model was limited in the choice of leakage solutions. This was because the cost associated with leakage reduction is a non-linear function, but our economic model is linear. In addition, it is important that options selected are valid and therefore reflect a reasonable extrapolation of the cost function at any point in time.

We have calculated our 'background level of leakage' for each WRZ. This is the level of leakage that we believe is the lowest possible leakage we could achieve.

We have compared it to the current level of leakage in each WRZ and factored in the savings from customer supply pipe repairs as a result of universal metering to derive the 'available' leakage for each WRZ; refer to Table 28. The total available leakage can be achieved by various combinations of the four leakage option types, but ALC provides the most yield.

	A	B	C	D	
WRZ	Total leakage	Background level of leakage	Reduction in leakage by CSPL repairs from metering	Consequential leakage (arising from meter installs)	Available leakage A - B - C + D
1	27.97	11.58	2.15	0.78	15.02
2	38.73	14.24	2.92	1.05	22.62
3	31.91	16.28	4.1	1.48	13.01
4	38.65	22.21	6.32	2.27	12.39
5	16.52	9.67	1.59	0.57	5.83
6	19.07	10.87	3.08	1.11	6.23
7	7.01	5.39	0	0	1.62
TOTAL	**179.86**	**90.24**	**20.16**	**7.26**	**76.72**

Table 28: Derivation of leakage available in each WRZ

8.4.3 Metering

8.4.3.1 Introduction

As explained in section 3.2.3, the meter penetrations for household and non-household properties vary across our regions. With household meter penetration in our Southeast region at 93%, there are very few properties left that could be metered in a cost effective way; further, our recent universal metering programme has succeeded in reducing the average PCC. 97% of our non-household customers are metered. As a result, we consider that there are no remaining metering options that are feasible to address the supply / demand imbalance.

Our East region has a relatively high household meter penetration at 72% and 99% of our non-household customers are metered. The average PCC in our East region is significantly below the UK average. As we are in surplus throughout the planning period, we are not required to consider options beyond our baseline programme of optant metering.

We have considered different types of metering options in the development of our feasible options list as a way to reduce consumption in order to balance supply and demand in our Central region, as household meter penetration of 42% presents opportunities. In addition, two other factors encourage companies to consider a more aggressive metering strategy:

– DEFRA requires companies with above average consumption to reduce consumption.
– The Water Industry (Prescribed Conditions) Regulation 1999 requires companies in water stressed areas to consider compulsory (universal) metering.

We have undertaken a study to determine the most cost beneficial solution for our feasible metering options that we will offer to our EBSD model.

8.4.3.2 Metering Cost Benefit Analysis: Central Region

A cost benefit analysis (CBA) has been carried out using the latest UKWIR methodology to determine the optimal metering solution for a universal metering programme in our Central region.

The base case against which these options are compared is a continuation of the current 'dumb' meter optant programme. The CBA model is run for 40 years from 2015 to 2055 and the model results are 40-year net present values.

The model has been developed specifically to meet the latest regulatory requirements and a sensitivity analysis of all the parameters in the model was performed. We were also able to determine the tipping points for the marginal cost of water. The model includes analysis of the following elements:

– Meter and data capture procurement
– Meter replacement
– Meter installation
– Meter reading
– AMR communications, Capex and Opex
– Back office system
– Programme costs
– Leakage
  • Internal leakage
  • Supply pipe leakage
  • Network leakage
– Level of demand and diurnal demand profile
– Dealing with customers

– Carbon
  • Direct
  • Embedded

Further details about our modelling approach are included in our Technical Report 3.3: *Metering Strategy & Cost Benefit Analysis*.

8.4.3.3 Results

Our CBA was completed after the publication of the draft WRMP, although sufficient detail was available to us to be able to establish which options would be most cost beneficial. The most valuable result from the CBA modelling is the identification of the most beneficial option. For a universal metering programme aiming to achieve 90% penetration in our Central region, the modelling identified:

A 5-year Automatic Meter Reading (AMR) metering programme, without retrofitting existing meters with AMR, is the most beneficial option when the Long Run Marginal Cost of water (LRMC) is higher than £690/Ml.

The Cost Benefit Analysis also shows the following results:

– Compulsory metering programs are cost beneficial if the long run marginal cost (LRMC) of water is used and it is higher than approximately £690/Ml.
– That both Dumb and AMR compulsory metering programs are cost beneficial if the LRMC of water is higher than £750/Ml.
– That the 5-year program is more cost beneficial than the 10-year program.
– That retrofitting existing metered properties with AMR meters is not cost beneficial.
– The overall costs are approximately 80% Capex, 10% Opex and 10% customer interface costs.
– The benefits with the short run marginal cost comprise 40% carbon and 60% water saving and with the long run marginal cost comprise 15% carbon and 85% water saving.
– The LRMC should be established and used in the business case for the WRMP and PR14 Business Plan.
– The model is most sensitive to:
  • The marginal cost of water.
  • Value of carbon – non-traded sector only (gas and other fuels);
  • Hot water carbon emissions (other);
  • Hot water –energy demands to heat water (other);
  • Average volume of water demanded.

The results of the CBA analysis for the eight options compared are summarised in the following tables.

- Table 29 summarises the total NPVs for all options by WRZ over 40 years.
- Table 30 compares each option by WRZ with the base case over 40 years.
- Table 31 categorises the costs and benefits for each option into Capex, Opex, Water savings, Carbon costs and Customer interface costs.

These tables are repeated from the Technical Report 3.3: *Metering Strategy & Cost Benefit Analysis*.

Summary of option costs
SRMC - Short Run Marginal Cost
LRMC - Long Run Marginal Cost

		5 year				10 year		
WRZ	Base	COH	Dumb	AMR	AMR+Retro	Dumb	AMR	AMR+Retro
SRMC - £127.14								
1	159	164	165	166	177	166	167	173
2	202	209	211	213	221	212	214	221
3	322	332	336	337	361	337	339	353
4	408	423	428	431	452	430	434	447
5	136	140	141	142	153	142	143	149
6	236	243	246	247	264	247	249	259
TOTAL	1,463	1,511	1,528	1,536	1,628	1,535	1,545	1,602
LRMC - £1000								
1	228	227	226	224	233	228	226	229
2	292	290	289	286	293	292	289	293
3	463	460	459	454	474	462	458	466
4	592	588	586	579	598	591	586	593
5	195	194	193	192	201	195	193	197
6	339	337	336	333	347	339	336	342
TOTAL	2,109	2,096	2,090	2,068	2,146	2,107	2,089	2,120

Table 29: Summary of 40 year NPVs for all Options

Table 29 shows the cost benefit balance of each scheme in £millions when looking at a 40-year period (taking into account NPV).

The most preferable scheme is the one with the lowest cost. So with the Short Run Marginal Cost of water of £127.14 our Base case option (dumb meter optants) is selected.

With the Long Run Marginal Cost of water of £1000, our 5-year AMR compulsory option is selected.

Summary of option cost differences

Comparing Dumb meter scenarios (5/10 years) and AMR meter scenarios (5/10 years) against the Base Case by W

	5 year				10 year		
WRZ	Base case vs COH	Base case vs DUMB	Base case vs AMR	Base case vs AMR+Retro	Base case vs DUMB	Base case vs AMR	Base case vs AMR+Retro
SRMC - £127.14							
1	-5	-7	-8	-19	-8	-8	-15
2	-7	-9	-10	-19	-10	-12	-19
3	-10	-13	-15	-38	-15	-16	-31
4	-15	-20	-23	-44	-22	-26	-39
5	-4	-5	-6	-17	-6	-7	-13
6	-7	-10	-11	-28	-11	-13	-23
TOTAL	-48	-65	-73	-164	-72	-82	-139
LRMC - £1000							
1	1	2	4	-5	0	2	-1
2	2	3	6	-1	0	3	-1
3	3	4	8	-11	0	5	-3
4	4	6	12	-6	1	6	-1
5	1	1	3	-6	0	2	-2
6	2	3	6	-8	0	3	-3
TOTAL	13	18	40	-37	2	20	-11

Table 30: Comparison of 40 year NPVs against the Base Case by WRZ

Table 30 shows that, with a Short Run Marginal Cost (SRMC) of water of £127.14, out of all the metering options that go beyond the base case of Optant Dumb metering only, the most cost beneficial option is ‘5 year Change of Hands including optants’ because it is only £48M (using 40-year NPV) less than the base case, where as all other options are much worse.

The Change of Hands option has a negative result because, as shown in Table 29, with an SRMC of £127.14 the base option is the most cost beneficial solution.

With a Long Run Marginal Cost of water of £1000, the data presented in Table 30 concludes that, out of all the metering options that go beyond the base case of Optant Dumb metering only, the most cost beneficial option is ‘5 year compulsory AMR’ and that it is £40M better (using 40-year NPV) than the base case.

Summary of option cost differences

Comparing Dumb meter scenarios (5/10 years) and AMR meter scenarios (5/10 years) against the Base Case by cost/benefit element

	5 year				10 year		
Cost	Base case vs COH	Base case vs DUMB	Base case vs AMR	Base case vs AMR+Retro	Base case vs DUMB	Base case vs AMR	Base case vs AMR+Retro
SRMC - £127.14							
Capex £M	-78	-106	-122	-182	-108	-125	-187
Opex £M	-12	-17	-13	-11	-15	-12	-9
Water £M	25	35	39	26	31	35	38
Carbon £M	23	31	31	12	27	27	26
Customers £M	-6	-8	-8	-9	-7	-7	-7
TOTAL	-48	-65	-73	-164	-72	-82	-139
LRMC - £1000							
Capex £M	-78	-106	-122	-182	-108	-125	-187
Opex £M	-12	-17	-13	-11	-15	-12	-9
Water £M	86	118	153	153	105	136	166
Carbon £M	23	31	31	12	27	27	26
Customers £M	-6	-8	-8	-9	-7	-7	-7
TOTAL	13	18	40	-37	2	20	-11

Table 31: Option cost differences by cost/benefit element

Table 31 provides the same total results as in Table 30 by comparing each metering option against the base case option. In Table 31, instead of expressing the differences by water resource zone, it shows them by different cost and benefit categories. This table helps to understand the gains and losses in costs and benefits between each option and the base case.

8.4.3.4 Justification for the AMR option

As described in section 7.3, our baseline supply / demand balance forecasts that we will have a deficit in our Central region at the start of the planning period. We therefore need to consider a range of options including both supply and demand management options to provide the best plan for our customers. Metering is one type of feasible option available to our model.

We modelled various scenarios in the development of our Preferred Plan, describing them in detail in section 9.6. In our least-cost plan, metering was selected in all zones during the planning period. This shows that in order to balance supply and demand, metering was an economic solution compared to the other options offered.

In iterating towards our Preferred Plan, we ran a scenario that prevented any metering and water efficiency options from being selected (see section 9.6.3.4). Under this scenario, the model was not able to solve without a deficit, which results in a plan which does comply with the WRPG.

However, from this we were able to derive the LRMC of this solution which can be compared to the LRMC of our Preferred Plan, as seen in Table 32.

Scenario	NPV of the WAFU (Ml/d)	NPV of the solution costs (£K)	40-year LRMC of the solution (£/Ml)
S3	886.36	252,723.02	781.16
Preferred Plan	1147.28	190,464.10	454.83

Table 32: LRMC of scenario S3 and our Preferred Plan

The LRMC of scenario S3 was £781.16/Ml. As the LRMC of scenario S3 is greater than £750/Ml, metering is a cost beneficial solution. This correlates with the WRMP modelling which selects metering as part of a programme of options to meet our supply / demand balance.

8.4.3.5 Metering options available to our model

Our company policy is to read household meters twice per year. For dumb meters, this is a labour intensive exercise and carries a considerable cost premium over reading AMR devices (whether walk-by, drive-by or fixed network).

Regardless of the type of technology, meters have a life of around 15 years before they need to be replaced.

Although an AMR device is more expensive than a dumb meter, the total cost of the device with twice-yearly meter reading over the life of the meter is roughly cost neutral. This supports the results of our cost-benefit analysis using the UKWIR model, in that we are offering walk-by AMR metering as the technology for all types of options.

There are two types of metering options that we have developed to offer to our EBSD model:

– **Universal metering – AMR.** Fitting AMR devices to unmeasured domestic properties and moving customers to measured charging. Our updated EBSD model is capable of modelling the delivery of these options over any time period (e.g. five years). This option is available to all WRZ in our Central region. If all WRZ are selected, we will achieve 90% meter penetration of domestic customers.

– **Community integrated demand management.** Fitting AMR devices to unmeasured domestic properties to enable them to be moved to measured charging. At the same time as the meter is installed, testing the customer's pipework to determine whether they have a leaking supply pipe and repairing it when determined to be cost beneficial. Also offering to provide free water efficient devices and providing advice on ways to save water. Our updated EBSD model is capable of modelling the delivery of these options over any time period (e.g. five years). This option is available to all WRZ in our Central region. If all WRZ are selected, we will achieve 90% meter penetration of domestic customers.

8.4.3.6 Justification for demand savings

We have used 13.6% as the demand reduction per WRZ associated with a universal metering programme in our WRMP. This is based on taking account a range of supporting data as there is no singular piece of evidence defining the precise savings.

The key pieces of evidence we considered are described below.

- The National Metering Trials that completed in 1991 had ten studies around the country. The largest study was the Isle of White (achieving savings of 22%), and we had two studies in our area at Chorleywood (achieving 8% savings) and Brookmans Park (with savings of 11%). These studies were documented by the Water Research Centre and published in 1991, although to our knowledge these documents are not available electronically.
- The difference between unmeasured and measured consumption in our water balance varies slightly from year to year but has typically been in the range of 12 to 20%. These values have an uncertainty linked to assumptions of occupancy and population studies that are taken account of in assessing reported values. The reported difference in PCC for our Annual Return in 2012 was 13.6%.
- UKWIR have carried out two notable industry studies on the effect of metering on demand in 1996 and 2005. The latter report by Professor Paul Herrington, *Critical Review of Relevant Research Concerning the Effects of Charging and Collection Methods on Water Demand, Different Customer Groups and Debt*, was a systematic review of both national and international research into the subject including recent trial data from the UK and shared through the EA/WUK working group on metering outcomes. The outcomes are complex, however the headline conclusions were that the overall effect of metering from UK studies was between 10 and 15% with the Isle of Wight remaining an outlier, of between 9 and 21% for optants and a range of between 10 and 45% for peak periods depending on weather conditions, including 10 to 20% in wet summers. The international evidence suggests savings consistent with a 10 to 20% range but studies in France from metering of apartments showed a range of between 5 and 60%.
- Further, studies from European tariff changes show demand elasticity of between -10 and -20% and some international studies have been higher. In comparison, our evaluation of the effect of a volume block tariff in our Southeast region controlled study did not show a significant effect on consumption. We have shared the outcomes of our metering trials with the Environment Agency and UKWIR. (Refer to section 3.2.3.3.)
- The recent Tynemarch study from the universal metering programme in our Southeast region concluded evidence of firm savings of 16% but, when uncertainty is accounted for, the savings could be as high as 55%. (Refer to section 3.2.3.2.)
- The results from the AMR trial in our Southeast region remain at a very early stage and, although the initial signs are positive, we have not yet been able to consider the outcomes from that work on our proposals as the trial period is not yet sufficient. We will report our findings in our WRMP Annual Review. (Refer to section 3.2.3.5.)

8.5 Feasible options for our draft Plan

The number of options of each type presented at the end of the options development stage is shown in Table 33.

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Option types	Number of feasible options (draft)	Notes
Water efficiency	30	Water efficiency for businesses includes airport water efficiency and audits of processes. Domestic water efficiency includes distribution of devices, although some are mutually exclusive with the community integrated metering schemes.
Local water reuse	0	No feasible options.
Leakage	46	Note we developed one additional leakage option per WRZ for AMP7, but removed 3 DMA options (they had been optimized in AMP4) prior to submission of the draft plan (previously 42).
Metering	24	Four different options for the six WRZ in Central: 5-year AMR, 10-year AMR, 5-year community integrated AMR and 5-year community integrated AMR with retro-upgrade.
Tariffs	0	No feasible options.
Transfers: Bulk transfer imports	29	Schemes as per options provided to WRSE, largely from neighbouring water companies.
Transfers: Inter-zone transfer	11	All options in Central to provide additional capacity between neighbouring WRZs.
Transfers: Network reinforcement	4	All options in Southeast to remove pipework size constraint to release full DO into the network. We developed one new option for WRZ7 prior to submission of the draft plan that was not developed at the unconstrained stage (previously 3).
Surface water	8	7 reservoirs (across Central and Southeast) and 1 surface water development scheme (in Central) remain.
Groundwater	21	Options across Central and Southeast to provide additional yield via licence optimization and / or new licences where no deterioration is expected. Note five options screened out prior to submission of draft plan (previously 26).
Effluent reuse	3	1 option in Central, 2 options in Southeast.
Desalination	2	2 options in our Southeast region.
Treated water storage	0	No feasible options.
Catchment management	0	No feasible options.
TOTAL	**178**	

Table 33: Summary of feasible options for our draft Plan

Full details of each feasible option are recorded in our option dossiers; refer to Technical Report 3.1.3: *Constrained Option Dossiers*.

8.6 Feasible options for our final Plan

After we published our draft Plan in May 2013, we continued to work on our options and how they could be modelled as realistically as possible. As a result, there have been some minor changes in the number of options, which we summarise in Table 34.

Option types	Number of feasible options (final)	Reasons for changes to number of draft options
Water efficiency	30	No changes.
Local water reuse	0	No changes.
Leakage	53	Change in EBSD modeling approach and increase in available leakage throughout the planning period. One ALC option per WRZ per AMP (7 WRZs and 5 AMPs), plus 7 PRVs, 7 mains renewals and 4 DMAs.
Metering	12	Change in EBSD modeling approach renders time-limited options obsolete. Two different options for the six WRZ in Central: metering only or integrated demand management. Five- and ten-year implementation options irrelevant. UKWIR CBA and our own modelling for the draft WRMP establishes that retro-upgrade of existing dumb meters to AMR is not cost beneficial, so no longer offered to our EBSD model.
Tariffs	0	No changes.
Bulk transfer imports	18	Confirmation by donor companies that options were no available due to their own deficits and / or lack of available water (e.g. because a strategic resource has not been selected by their own modelling). Removal of options as a result of the EA's view of licence availability.
Inter-zone transfer	11	No changes.
Network reinforcement	4	No changes.
Surface water	8	No changes.
Groundwater	19	Removal of two options.
Effluent reuse	3	No changes.
Desalination	2	No changes.
Treated water storage	0	No changes.
Catchment management	0	No changes.
TOTAL	**160**	

Table 34: Summary of feasible options for our final Plan

It is at this point that we have the options set to be able to run our model and determine the least cost plan to meet the supply / demand balance. The least cost plan is described in section 9.3.

8.7 Stage 3 – Programme Appraisal & Environmental Assessment

8.7.1 Introduction

We are required to assess alternative combinations of options that may help meet wider objectives for our WRMP identified by our Strategic Environmental Assessment or arising from sensitivity testing in accordance with the WRPG.

We explain our process of scenario testing from our least cost plan to our Preferred Plan in section 9.5.

8.7.2 Programme Appraisal

The WRPG explains that the optimum programme of options may not necessarily be the combination of the least cost options requires to match the supply / demand deficit at the company level. The Guideline also recommends that the least cost programme be reviewed and, where appropriate, reiterated to consider:

– Any significant non-monetised impacts identified by our Strategic Environmental Assessment;

– Any significant additional risks that have not been captured by the options appraisal process;

– Any uncertainties that have not been captured by the options appraisal process.

In our Central region we have some WRZ in surplus whilst others are in deficit. Our supply / demand balance at the regional level is complex as we seek to move our available surplus to areas in deficit, balancing the costs of pumping against alternative options. This is further complicated by the range of potential growth in our WRZs, from as little as 12% increase in population in our southerly zones to as much as 25% in the north.

“Forward planning is essential. The population is increasing and the weather is more unpredictable.”

In our Southeast region, we retain a small surplus in AMP6 before moving into deficit. Our neighbouring companies are also in deficit and we must balance the costs of bulk imports of water against the potential for a regional solution such as a reservoir or a desalination plant.

In all modelling scenarios, every available option has been compared equally with no bias towards or against particular options. We have sought to use the best available cost data for options from third parties, which would only be confirmed should a contract be drawn up.

The costs presented in our scenario modelling are derived from the planned utilisation of the options. For each option, the Capex and Fixed Opex will be applied irrespective of utilisation; however the variable Opex will be costed as per the volumetric use (utilisation) of each option selected by the model for any given scenario.

8.7.3 Strategic Environmental Assessment

The WRPG recognises the need to include a Strategic Environmental Assessment (SEA) in formulating the Preferred Plan together with cost, risk and other deliverability issues. We produced an SEA scoping report in October 2012, which we sent to a wide range of stakeholders. A number of comments were received and we incorporated them in our ongoing analysis.

As part of the options appraisal process, we undertook a detailed SEA of all feasible options. The process we have followed is described below:

- Individual options have been appraised against SEA objectives and specific criteria covering magnitude and extent, short and long-term impacts, without and with mitigation. The results are recorded in a summary matrix.
- An overall SEA risk category for each option is provided for modelling input (excluding consideration of the carbon footprint objective that is fully covered in environmental costs). Three simple categories: ‘high’, ‘moderate’ and ‘low’ have been developed. An option might be graded ‘high’ risk if it presents significant impacts on a designated site or feature.
- This list has been compared to the Agency’s “red list” to consider whether further amendments to the risk level were required.
- It is recognised that stakeholders are likely to ask if a viable plan be formed without including the ‘high’ risk options. We have run a scenario in our model excluding the ‘high’ risk options to determine the impact on overall cost (see Section 9.5). The results have been assessed in terms of meeting other Plan objectives.
- Our Base Case, other scenarios and the Preferred Plan have been assessed within the SEA using both the individual options matrices and cumulative impact assessments. The results have been used to identify specific options that should be removed from our economic modelling to see if alternative options would be better. The first level of cumulative assessment has looked at in-combination effects within the company options selected and the second level of cumulative assessment includes sources outside our area where they provide supplies to us.
- We have also undertaken a Habitats Regulation Assessment (HRA) for our feasible options.

> “It’s important that Affinity Water always considers the impact on the environment for any action undertaken by the company”

It is important that we show how the SEA has influenced the development of our Preferred Plan. We have explained how this is the case in Section 11.8.

Full details of the SEA and HRA work are described in Technical Report 3.9: *Environmental Report*.

8.8 Stage 4 – Our Preferred Plan

We describe our Preferred Plan in section 11, which we derived after thorough sensitivity testing to ensure that our Plan met the needs of customers, stakeholders and the environment. Our scenario analysis is explained in section 9.5.

9 Our modelling and scenario testing

9.1 Our approach

There are four key components in building our Preferred Plan:

– Undertake economic analysis, initially using the WRSE model and then using our own optimisation model, to find the costs of alternative planning scenarios and to compare results from the WRSE modelling with our Base Case plan;
– Understand the risks and uncertainties of selected options and check that they meet the objectives of our plan;
– Ensure that customer preferences and willingness to pay are accounted for to ensure that selected options are consistent with customer views;
– Ensure that the Preferred Plan meets the SEA objectives.

In developing our Preferred Plan, we have sought to:

– Work with our customers to reduce household consumption in line with DEFRA's Guiding Principles for water resources management planning;
– Reduce abstraction from existing sources where it is considered to be damaging the environment and has been found cost beneficial;
– Share resources with neighbouring companies and third party licence holders, in accordance with the principles of the WRSE modelling in developing a potential regional strategy;
– Derive a flexible approach to option development to maintain the principles of a least cost investment programme;
– Promote resilience by having a balanced programme of investment that does not rely on a single option type.

9.2 WRSE least cost modelling: Phases 1, 2A and 2B

Least cost modelling was undertaken by the WRSE group to cover all water resource zones operated by the six water companies in the South East of England (reference Technical Report 3.6: *Water Resources in the South East Modelling*). In parallel with the WRSE assessment, we undertook our own least cost modelling to enable us to investigate options in more detail, to include customer preferences and to understand the risks in the Preferred Plan. We explain our approach in Section 9.3.

Key aspects outside of the scope of the WRSE modelling were assessments of:

– Customer views or preferences;
– The views and preferences of local interest groups;
– Commercial (opportunity) costs of water transfers between water companies;
– Non-monetary environmental impacts of options;

- Secondary company-specific benefits of options, such as water supply resilience;
- Whether least cost options represented best value for our customers.

The WRSE regional modelling provided results on strategic options for eliminating the regional supply demand deficit. The WRSE model used data from the six regional water companies on existing water resource outputs and forecast water demand to produce a supply / demand balance for the South East of England. For water resource zones with a supply demand deficit, it then utilised data on a range of scheme options to eliminate the deficit; options included water supply and demand management schemes able to provide more water or to reduce demand. The model was also able to modify quantities taken from existing sources and quantities transferred between water resource zones to produce a least cost combination of options over the 25-year planning period. The WRSE modelling software operates in a similar way to our own modelling software.

The WRSE modelling compared 10 initial scenarios with a range of forecasts for future water demand, sustainability reductions and other variables. These scenarios used data supplied by the participating water companies that was submitted at the end of 2012. Some of the scenarios excluded potential water resource options that the Environment Agency considered as high risk because of possible environmental impacts (which may prevent particular new resources from being developed).

Further scenarios with local changes were then run at the request of water companies; results from the additional runs are not included in the current WRSE report. A core set of options was selected from the initial modelling results as being important to a South East Strategy. Further alternative options were then proposed by some of the project's participants based on their own experience and judgment.

Details of the WRSE modelling can be viewed on the project's website at www.wrse.org.uk. The WRSE report published in February 2013 is available at:

http://www.wrse.org.uk/sites/default/files/WRSE_report_19Feb2013.pdf

A summary of outputs relating to Affinity Water and how the WRSE outputs have influenced our draft Plan are included in our Technical Report 3.6: *Water Resources in the South East Modelling*.

9.3 Our least cost modelling

9.3.1 About our EBSD model

9.3.1.1 General

We undertook an optimisation of the feasible options using a least-cost computer model based on specialist software. Our Economics of Balancing Supply and Demand (EBSD) model is programmed to read our water supply availability and water demand forecasts for each of the 25 years from 2015 and to assess whether there is a deficit between supply and demand in each of our eight water resource zones for both DYAA and DYCP. The model then selects the least-cost approach in each of the zones with a supply / demand deficit (for both annual average and peak periods).

Details of each option, including capital development costs and operational running costs, are included in the model. The variable Opex is calculated based on a weighting of the 3 planning scenarios. We have assumed that throughout the planning period that 80% of the time will be NYAA conditions, 15% will be DYAA and 5% will be DYCP.

The function of both the WRSE model and our model is to identify the least cost solution to ensure that any deficit is met in every planning scenario in every year of the assessment period. The model determines on an annual basis whether an option should be implemented and, in the case of supply schemes, how much of the available water is utilised. The cost is optimised using the capital and fixed operational costs and the variable operational costs calculated from the amount of water supplied. The model also accounts for environmental, social and carbon costs to derive the least cost solution for the whole life costs of the options.

Our model and its functionality is explained in detail in Technical Report 3.7: *Economics of Balancing Supply and Demand Model Development, Commissioning & Use*.

9.3.1.2 *Utilisation of options*

The primary objective of our model is to minimise the total cost of the solution whilst solving the supply demand balance in all zones, in all years of the planning period, under all planning conditions. The cost components it considers are the net present values (NPV) of:

- Annual Capex;
- Fixed annual Opex;
- Variable Opex;
- One-off environmental and social costs;
- Fixed annual environmental and social costs;
- One-off carbon costs; and
- Fixed annual carbon Opex.

Each feasible scheme has a predefined cost for each of these components, with the exception of the Annual Capex that is calculated through the method explained in Appendix E of Technical Report 3.7: *Economics of Balancing Supply and Demand Model Development, Commissioning & Use*. If an option is selected, all costs except the variable Opex will be incurred at a fixed rate. The variable Opex is a cost that depends on the utilisation of the scheme.

Each option has a defined capacity for the amount of water it can supply; the model can then choose whether or not to fully utilise the solution depending on the variable Opex. The greater the utilisation of the option, the higher the cost incurred. Therefore, when choosing the optimal solution, the model also needs to consider the optimum utilisation of each option.

The model also considers the variable Opex associated with the use of existing supplies from our own sources and from existing bulk supply arrangements from other water companies. During the optimisation process, the model will consider how it utilises these sources of water. It may choose to build and utilise a new source and reduce the take from existing bulk supplies if this is a cheaper way to meet the supply / demand balance.

9.3.1.3 The optimal solution

The globally optimal solution is the combination of options, utilisations and start years that meets the supply / demand balance, taking into consideration any given requirements or constraints imposed in the modelling run in the most economical way compared to all other possible combinations. In any optimisation problem, close to the optimal solution there are several near-optimal solutions. It can be very time consuming to identify the global optimal; therefore in optimisation models a tolerance is set so that the model is able to identify the minimum cost solution within a percentage % of the global optimum. For our Plan, we have set the model tolerance to a maximum of 2%. It will therefore stop searching further option combinations and start years when it finds a solution within this tolerance.

9.3.2 Aligning our model with WRSE for our draft WRMP

The modelling for our draft WRMP included updated information from that used in the WRSE modelling as follows:

– Changes in the availability of bulk supply transfers from neighbouring water companies as agreed with each of those companies;

– The opportunity to assign realistic costs to bulk supply options (the WRSE modelling did not take account of commercial payments to be made between water companies);

– Refinement of minimum deployable output values to differentiate between the dry year annual average scenario and a more severe drought event (known as the “third dry winter”);

– Offering more leakage options to explore our customers’ views of the “emotional level of leakage”;

– Changes to the metering option costs based on refinements of our data;

We asked the WRSE to undertake a model run based on our latest data refinements to compare with and validate our base case model results to determine consistency (WRSE reference K13). In March 2013, the WRSE team ran this model scenario at our request that closely represented the options that were available for our draft WRMP, after the conclusion of detailed discussions with our neighbouring water companies about the bulk transfer options. We felt this was necessary as the WRSE modelling programme took longer than envisaged due to the number of scenarios and complexity of the problem the model was solving. During that time, companies were iterating towards their Preferred Plan so the availability of transfers had changed as heads of terms agreements were drawn up between potential donor and recipient companies.

As explained above, and in more detail in the Technical Report 3.7: *Economics of Balancing Supply and Demand Model Development, Commissioning & Use*, we have identified the parameters that are different in our model but sought to replicate the investment programme of K13 as our ‘Base Case’ to show how the WRSE has influenced the decisions in our Plan. We have analysed the investment programme generated by our EBSD modelling and compared it with WRSE’s K13 scenario. Table 35 shows the number of options selected by type in the WRSE K13 scenario and our Base Case. 75% of the options selected within the WRSE K13 case are also selected with in our base case scenario. There are a further 6 options which are variations of the same option type (for example, 5 year universal metering and 5 year community integrated metering with demand management). If these are included then there is an 84% alignment of chosen options. Table 35 refers.

Option type	Selected by K13	Selected by our draft WRMP Base Case
Leakage Schemes	18	18
Water Efficiency	18	20
Metering	5	4
Groundwater	16	16
Network Constraint Removal	2	4
Inter Company Transfers	1	1
Reservoirs	0	1
Regional Transfers	8	7

Table 35: Comparison of WRSE K13 and our draft WRMP Base Case

9.4 WRSE least cost modelling: Phase 3

9.4.1.1 Introduction

Phase 3 of the WRSE project commenced in summer 2013, after the submission of companies' draft WRMPs, and concluded in November 2013.

The intention of the Phase 3 modelling was to allow water companies to assess the consistency of the WRSE results with their draft WRMPs, to understand the causes of any significant differences and to support water companies in the submission of their final Plans. Phase 3 was not intended to replace companies' final WRMPs, but to inform them.

In Phase 3, there were three main modelling runs:

– Run 1: all feasible options are allowed in the model with earliest their start dates.
– Run 2a: only companies' preferred options with their preferred start dates are allowed.
– Run 2b: all feasible options are allowed, with preferred options assigned their preferred start dates instead of earliest start dates.

Phase 3 takes into account the discussions we have had with other companies regarding the bulk transfer of water that took place after the publication of the WRSE Phase 2B report in February 2013. Phase 3 uses the supply / demand data from our draft WRMP, as it would not be consistent to test the outcomes of our draft Plan with an updated supply / demand balance.

In exploring the significance of the Phase 3 results, the WRSE paper refers back to two specific model runs from Phase 2B, these are:

– Scenario A: the 'base case' scenario in Phase 2B (and reported in the February 2013 WRSE report).
– Scenario K13: a subsequent scenario that was intended to model the transfer options that donor companies confirmed were available.

The results from Scenario K13 and Run 2a were expected to most closely match the water companies' draft WRMPs.

9.4.1.2 Results

We are pleased to note a high degree of consistency between our draft WRMP and the outcomes of the Phase 3 Run 2a. Table 36 compares the results of the WRSE Phase 3 Run 2a against our draft WRMP Preferred Plan options.

Water Resource Zone	Comparison between WRSE Phase 3 Run 2a results and our draft WRMP
1	No differences
2	A single commercial water efficiency scheme is delayed by one year (within the same AMP), everything else as per our draft WRMP
3	A single transfer option was not selected; however, that option was never utilised in our draft WRMP
4	Leakage reduction option and airport water efficiency delayed by two years (within the same AMP), everything else as per our draft WRMP
5	Leakage reduction option and one water efficiency scheme delayed by one year (within the same AMP), whilst a bulk supply import from Cambridge Water is delayed by two years
6	Leakage reduction option delayed by one year (within the same AMP), with one water efficiency scheme delayed by 20 years, everything else as per our draft WRMP
7 (Southeast region)	A single commercial water efficiency scheme is delayed by eight years, everything else as per our draft WRMP

Table 36: Comparison of WRSE Phase 3 Run 2a and our draft WRMP

Other results of note include:

- The WRSE model concurred with our own modelling in the selection of universal metering. The delivery years for each WRZ matched exactly.
- The WRSE model selected the same bulk transfers of water from neighbouring companies as our draft WRMP, with the same start years.
- The WRSE model identifies demand management (leakage, metering and water efficiency) as a significant proportion of the solution for Affinity Water's operating area, particularly in the first five years. This aligns with the proposals we set out in our draft WRMP.
- The WRSE model also selects a small number of groundwater schemes with low average yields and higher peak yields, in accordance with our draft WRMP.
- There are no deficits at any point during the 25-year planning period for the planning conditions.

The results of the WRSE Phase 3 Run 2a confirm that our draft WRMP Preferred Plan is a viable plan and that it solves the supply / demand balance for our regions.

A report has been prepared by the WRSE's technical authors, which states:

- WRSE modelling has shown that the options selected in water companies' draft WRMPs can provide the best solutions for customers and the environment in the South East. The modelling has demonstrated that the overall cost of the options in the draft WRMPs is consistent with that of the other WRSE scenarios modelled. Importantly, the [water companies'] draft WRMPs include options that provide greater resilience and mitigation of risk than in other scenarios.
- The WRSE Group has validated that the water companies' draft WRMPs are consistent with the scenarios modelled by WRSE.
- It was important to take account of many potential uncertainties such as the impacts of further sustainability reductions (through changes in abstraction licences), feasibility of novel solutions, impacts of climate change and customer acceptance of options. The WRSE Group has investigated the solutions that might be required for a wide range of scenarios, in order to understand how to mitigate the risks to future water supply and identify contingency options. Water companies have considered these issues in determining their mix of options to ensure their plans are robust and water supply resilience can be maintained.
- A significant reduction in demand is planned in South East England over the first five years as a result of [proposed] demand management programmes, comprising a large number of water efficiency, leakage reduction, and metering options. This demand reduction satisfies one of the Government's key aspirations for water supply. The modelling has identified some small-scale contingency options that can be implemented quickly by water companies in case demand management programmes are unable to deliver the expected water savings.
- The strategy includes enhanced sharing of available water between companies, by increasing inter-company and within-company transfers throughout the planning period. When preparing their draft WRMPs, the water companies worked together to investigate the feasibility and effectiveness of possible transfer schemes, including discarding some options and introducing new options. Therefore the transfer schemes now included are considered to be more robust than those identified in the previous WRSE work before production of the draft WRMPs. Water transfers are necessary to maintain the supply demand balance across the region and will also help to provide an increased level of resilience. A number of barriers still need to be overcome before implementation including the agreement of appropriate commercial agreements and costs, and resolving any water quality issues that exist.
- New water resource schemes (water reuse, groundwater, surface water, aquifer recharge and storage solutions) will make an important contribution to the provision of new water capacity, particularly during the 2020s when some major schemes will be required. The extent of each type of water resource option that is appropriate varies across different parts of the region.
- Water companies have taken the WRSE results into account in developing their WRMPs. In considering the options arising from the latest WRSE modelling, water companies will need to take account of new information, for example recently revised population forecasts. Where a water company's final WRMP departs significantly from the solutions identified by the WRSE work, the company will explain and justify in their WRMPs the reasons for any variations to the WRSE options.
- The WRSE Group will continue to work together to determine the best way to implement a regional strategy. There are opportunities for the Group to plan joint customer communications and activities to promote water efficiency, to work together to establish the best approach for contractual arrangements for new water transfers, to examine the

feasibility of the main strategic option types (storage, re-use, inter-basin transfers, aquifer storage recharge), and to co-ordinate phased investigation, testing and implementation of water reuse. Also, the Group intends to jointly consider the long-term sustainability of water resources schemes, and the potential impact of abstraction licence reform, climate change and other environmental pressures on water resources available in the South East.

– The variation in selected options between scenarios emphasizes the current uncertainty around the potential selection of any one, or combination of, strategic schemes and the need for companies to undertake further work over the next 5 years to clarify those options that will best meet the range of future risks and uncertainties in supply-demand.

Further details can be found in the report *A shared water resources strategy for the South East of England (November 2013)*, currently in preparation, which will be published at wrse.org.uk.

9.5 Further data and model refinements for our Final WRMP

9.5.1 General

We continued to work on our WRMP after the submission of our draft Plan in March 2013. Some of the changes we have made are significant and will increase the differences between our proposals and those of WRSE, although we have worked hard to be able to explain why such differences arise.

The changes include:

– An updated demand forecast to account for the latest Census data (2011);

– The latest sustainability reductions as notified to us by the Agency in August 2013, changing the water available for use

– A full review of all components of our headroom analysis;

– Accounting for the impacts of climate change on affected options;

– Development of an options database to act as the single source of the truth for all options data, from which the EBSD model draws its information prior to optimisation;

– Significant improvements to the way our EBSD model handles leakage options to enable it to derive the ‘true’ economic level (see section 9.5.2);

– Improvements to the display of modelling outputs in the EBSD model, reducing post-processing time; and

– Auto-population of the WRP tables 3a, 3b, 3c and 4 from our EBSD model to enhance quality assurance and reduce errors.

Note that these changes do not consider the outcomes of our consultation, where customers explained their preferences and willingness to pay for particular programmes of investment. We explain this aspect of our WRMP in section 10 and how they have influenced our WRMP in section 11.2.

Further details on the enhancements we have made to our modelling practices can be found in Technical Report 3.7: *Economics of Balancing Supply and Demand Model Development, Commissioning & Use*.

9.5.2 Leakage

9.5.2.1 Introduction

The most significant improvement in our EBSD modelling capability was the incorporation of our leakage cost curves into the model. We felt that offering our model discrete leakage options, as we did for our draft WRMP, artificially constrained the outcomes, but developing a suite of leakage options at 0.1Ml/d increments was unsustainable.

We worked with our modelling consultants to develop a method to allow the model to select leakage from a continuous range, but as a single option. The continuous range was derived from the leakage cost curves that were developed by a specialist leakage consultant and the methodology for that work can be found in Technical Report 3.2: *Leakage Strategy*.

9.5.2.2 Leakage Calculations

The cost of reducing leakage depends upon the amount of leakage occurring (the higher the level of leakage, the cheaper it is to detect and fix) and the background level of leakage. The background level of leakage is the asymptote of the marginal cost curve and is the leakage level at which costs are regarded as infinite.

As we approach the level of background leakage through repeated leakage sweeps, the reductions in leakage get smaller until they quickly stop being cost effective. Figure 44 illustrates a standard leakage curve.

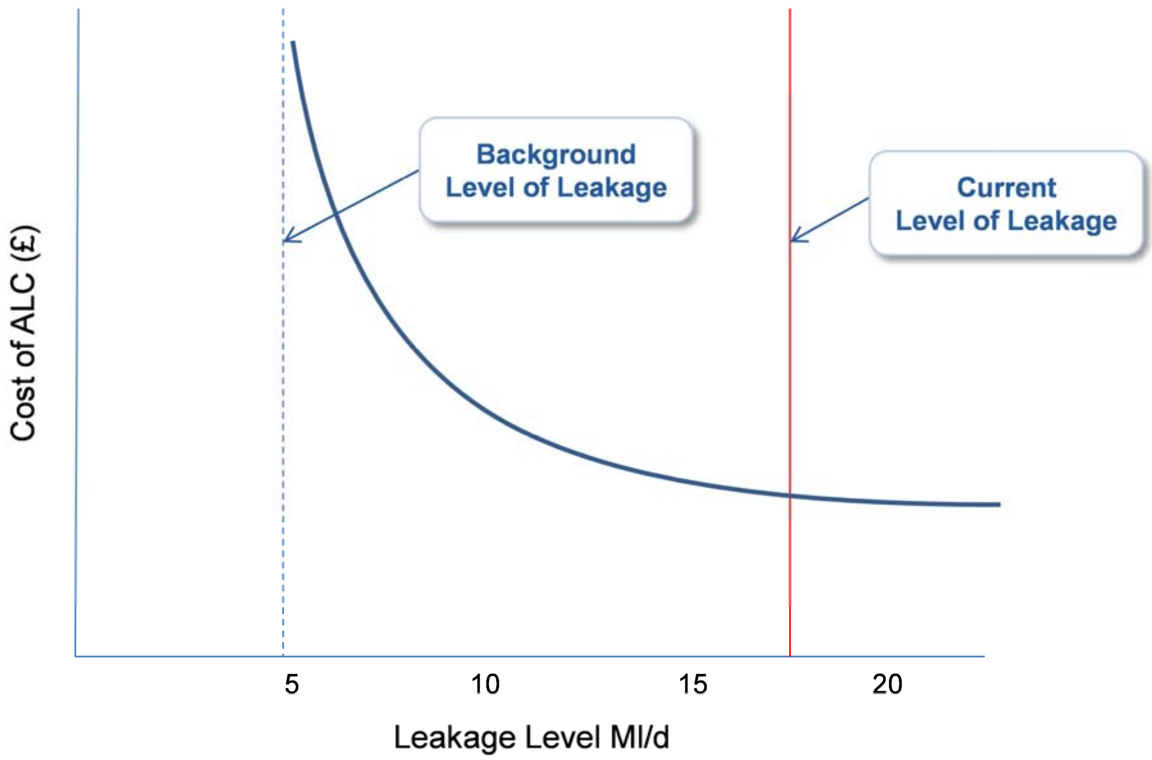


Figure 44: An illustration of a generic leakage cost curve

Our EBSD model incorporates the leakage cost curves of moving from one leakage level to another and optimises the amount of leakage reduction needed against the cost of other supply and demand schemes. Using a starting leakage position and the assessment of the supply / demand imbalance year-by-year through the planning period, any deficits that occur at some point in the future are satisfied through either additional water into supply or a reduction in demand, or a combination of the two. The least cost scenario then identifies the optimal mix of supply and demand options and their timing in order to achieve the objective of meeting demand in all conditions, in every year of the planning period. Leakage reduction below the short-run SELL (or base-line leakage assumption) will be one such intervention option that is a result of the modelling process.

As the EBSD model uses mixed integer linear programming to optimise, the options it is offered need to be in a linear form. The equations derived from the leakage cost curves are non-linear and therefore a method to turn them into a linear format needed to be derived. The method chosen had to be able to ensure that there was enough accuracy that the detail of the curve was not lost but that the model was not being offered an infinite number of solutions to consider, which would reduce the efficiency and usability of the model.

To resolve the problem, the leakage cost curves for each zone were split into a number of equal sections that can be defined by the user; we have typically used six sections for our modelling, although the schematic in figure 10 shows ten points. The left-most point on the curve is slightly above the background level of leakage such that the cost for that level of leakage is not infinite. The right-most point on the curve is slightly beyond the current level of leakage, such that the model knows the cost of allowing leakage to rise. The other points are spread evenly between the two extreme points. This is illustrated in Figure 45.

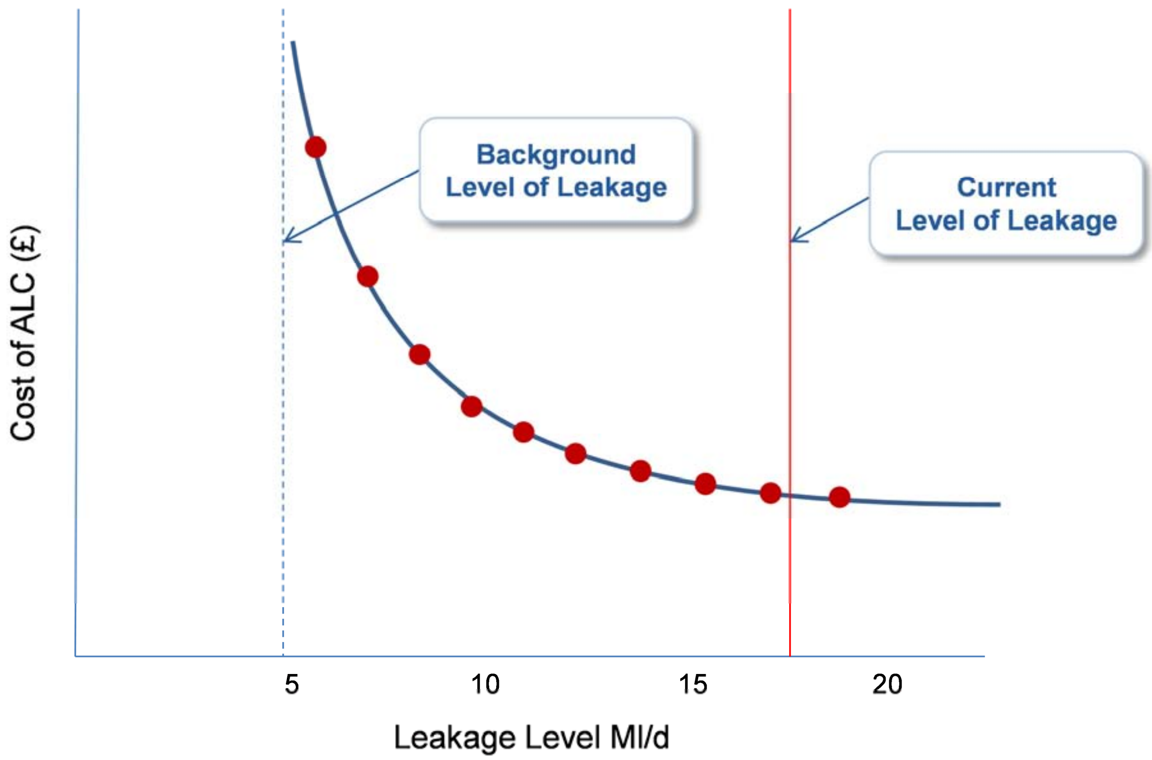


Figure 45: The division of a generic leakage curve into 10 even sections

Using these points on the curve, a straight line is drawn to connect each set of neighbouring points (as illustrated in Figure 46). The equations of these straight lines are then used to offer the model a linear option to consider during the optimisation. The model can choose any value of leakage reduction along these straight lines and, given the changing gradients and line equations of the approximated leakage cost curve, is able to optimise on the most economical level of leakage.

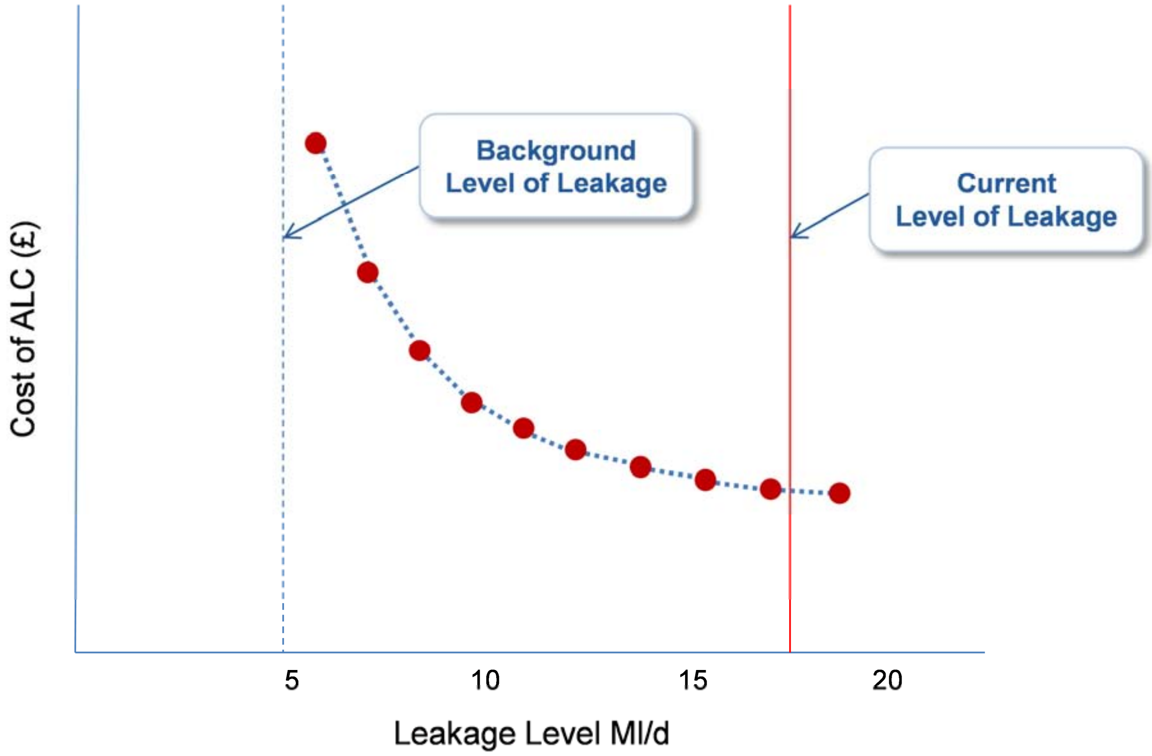


Figure 46: Straight lines drawn between each division on the leakage curve to develop a linear problem

The leakage cost curve used by our EBSD model can also be changed, should our view of the costs change as a result of actual work. We would simply need to present a different leakage cost curve to the model.

9.5.2.3 Model performance

Compared to the discrete 0.2, 0.8 and 2 ML/d active leakage control (ALC) options offered to the model for our draft WRMP, the model now has a greatly increased number of leakage options to select from. This has affected the performance of the model and has made the run-time too long for it to be used in day-to-day business planning.

As a result, we have offered our model a maximum volume of leakage per AMP to ensure that we do not have an over-optimistic programme and to ensure we keep disruption to the community at a minimum. We have skewed the profile to offer more leakage in the early years of the planning period; please refer to Table 37. In addition, we have constrained our model to ensure leakage is not permitted to rise, even if it is more cost effective, in accordance with Government aspirations.

WRZ	Maximum Available Leakage per AMP					Total Available Leakage in the Planning Period
	2015-20	2020-25	2025-30	2030-35	2035-40	
1	3.5	3.5	3	3	2.02	15.02
2	5	4.5	4.5	4.5	4.12	22.62
3	3	3	2.5	2.5	2.01	13.01
4	3	2.5	2.5	2.4	1.99	12.39
5	1.5	1.5	1	1	0.83	5.83
6	1.5	1.5	1.5	1	0.73	6.23
7	1	0.62	0	0	0	0.54
Total	**18.5**	**17.12**	**15**	**14.4**	**11.7**	**76.72**

Table 37: Leakage available per WRZ in each five-year period

The way in which the model receives the benefit from this leakage work was carefully considered. We decided that the model should select the level at the beginning of the AMP, with the Capex costs applied. However, the benefit is release gradually over the 5 years with 20% being achieved in each year of the AMP. Therefore if the model selects 2.5Ml/d of ALC in an AMP, 0.5 Ml/d will be delivered in year 1, 1Ml/d in year 2, 1.5Ml/d in year 3, 2 Ml/d in year 4, achieving 2.5Ml/d in year 5.

9.5.2.4 Additional leakage control settings

The model is now aware of the cost impacts of allowing leakage to rise in each of our water resource zones. In some zones, where the model believes we are currently working below our SELL, it can choose to reduce the amount of ALC, letting leakage rise. During the planning period, this has the potential to allow the model to select a high-risk plan that puts too much reliance on leakage control. As well as being risky, such a plan would be much less likely to select measures to achieve Government's aspirations to reduce household demand, such as universal metering and water efficiency.

We have therefore designed a constraint that prevents the model from allowing leakage to rise that will be used in most of our scenarios, including our Preferred Plan. This constraint identifies the maximum amount of leakage that can take place in each zone during each AMP, and is user-defined. Similarly, we wish to explore the cost impact of going beyond our SELL. Our draft WRMP consultation suggested that our customers support leakage control and would be willing to pay a premium to reduce leakage beyond the economic level. As such, we designed a constraint that allows us to force the model to select additional ALC, beyond what it believes is most economic.

We are also able to operate the model to optimise with 'unconstrained leakage', allowing the model to select as much leakage as it wants in each AMP whilst allowing leakage to rise where it is most economic to do so. This demonstrates the full functionality of our model. Such a scenario gives rise to the 'true' economic level of leakage but would not meet Government aspirations in that it can let leakage increase.

9.5.2.5 *Assuring our modelling of the leakage options*

We have developed an innovative approach to the management of leakage, by approximating a non-linear cost curve into our linear EBSD model. Our modelling consultants undertook a full testing regime prior to its release and we participated in numerous validation exercises. We have shared our work with our auditors, who were satisfied that the model incorporated the cost curves faithfully.

The updates to our model together with its testing and validation is explained in detail in Technical Report 3.7: *Economics of Balancing Supply and Demand Model Development, Commissioning & Use*.

9.6 Scenario Testing

9.6.1 Introduction

In accordance with Section 8.0 of the Water Resources Planning Guideline, we are required to test the robustness of our Plan. We are directed to consider changes to supply and demand forecasts, the main risks (for example, sustainability reductions) and to demonstrate that a very risk adverse Preferred Plan has not been selected.

With the exception of the least cost plan to demonstrate alignment with WRSE, our EBSD modelling has been conducted using a 25-year planning period and a 50-year assessment period. The planning period is the period of time that the model is solving the supply demand balance for. For PR14, our planning period is 2015 to 2040. The assessment period is the period of time that the model takes into account the cost of this solution. This allows the model to consider the whole life costing of the options preventing a bias that would allow more expensive option to be selected near the end of the planning period. A full worked example of this can be found in Appendix E of Technical Report 3.7: *Economics of Balancing Supply and Demand Model Development, Commissioning & Use*.

Our least cost plan is unconstrained, allowing our model to freely choose the options to manage the deficits throughout the planning period.

We have modelled a large number of sensitivities in developing our Preferred Plan. The scenarios described here is not an exhaustive list, as we have improved our data and modelling processes and used sensitivity testing to validate our options.

We believe the scenarios listed in our Plan are the most relevant to show how we have tested the flexibility and resilience of our proposals. We have developed our Preferred Plan as a result of this scenario testing, and we consulted with customers on the components of investment during the summer of 2013.

Figure 47 identifies the scenarios we have analysed in the iteration of the Preferred Plan, whilst considering customer preferences and environmental impacts. Section 9.5.4 discusses the results of these scenarios.

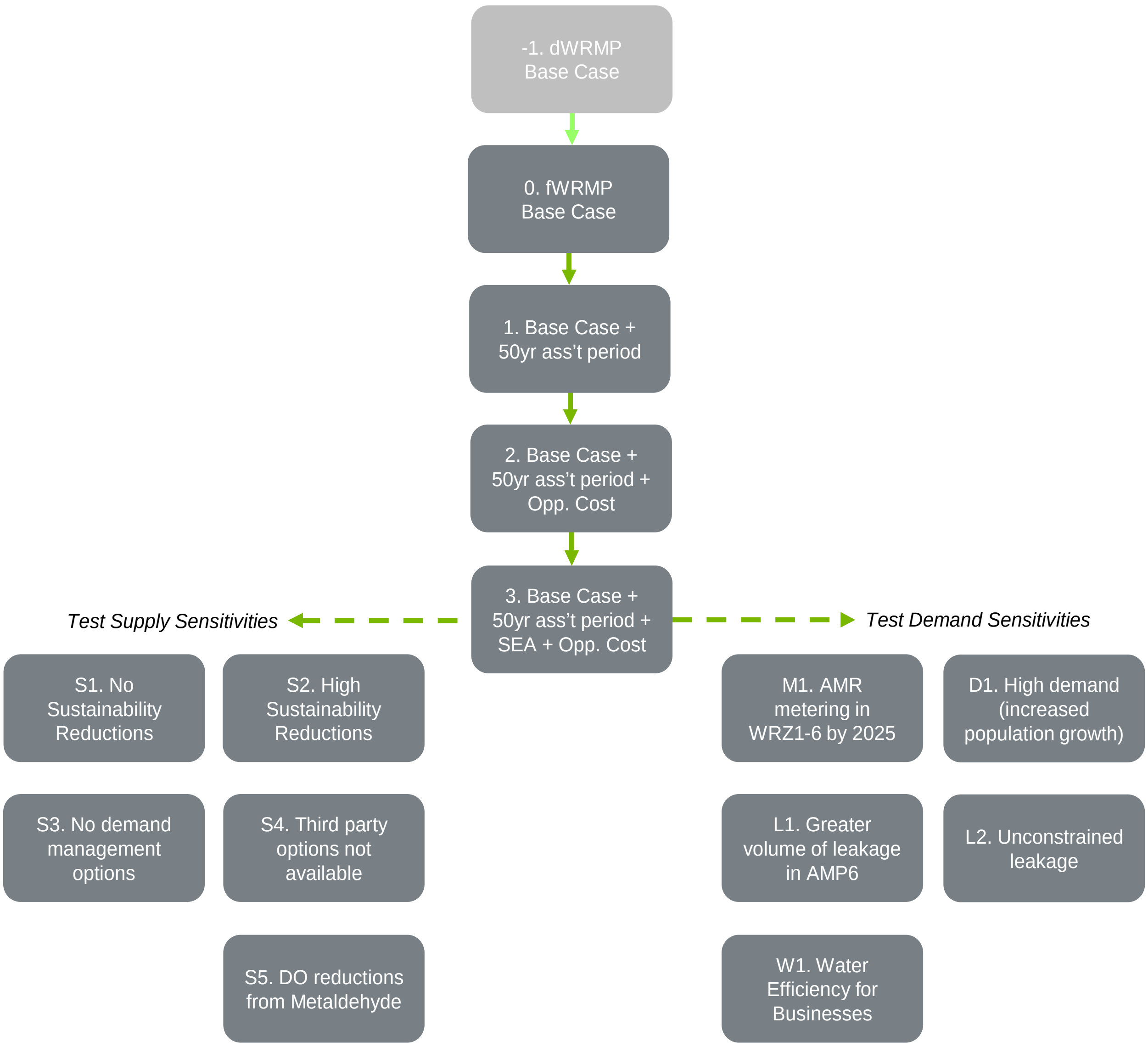


Figure 47: Scenario testing of our Plan

We have not considered a sensitivity with respect to climate change. Our assessment of climate change concludes that it has an impact of around 2% on our water availability. Our surface water sites are not affected by climate change (the River Thames). We also consider that our target headroom adequately covers the risk of climate change within the planning period.

Further details and analysis of our scenario testing are provided in Technical Report 3.7: *Economics of Balancing Supply and Demand Model Development, Commissioning & Use*.

9.6.2 Description of the core scenarios we have tested

9.6.2.1 Scenario -1: draft WRMP Base Case

The Base Case for our draft WRMP attempted to replicate the WRSE model K13 run, although we did not receive a validated and correct output until April 2013. Earlier WRSE cases had not been re-run with the latest company data, which could derive alternative investment plans. K13 used the most up-to-date information and accounted for the most recent bulk transfer discussions that had taken place between us and our neighbouring water companies prior to the publication of our draft WRMP.

The WRSE model was operated with both the planning period and assessment period set at 25 years; we have reflected this in our model setup. Critically, we have also decided to estimate the marginal cost of water from the “donor” for bulk transfers from neighbouring water companies, in an attempt to show alignment with the WRSE model. Due to commercial confidentiality, we do not know the exact marginal costs of the donating company, so we have used the marginal cost of our bulk supply import from Anglian Water because this water is our most expensive source that can be transferred readily in large volumes to most of our zones, either directly or by substitution. We believe this is consistent with the approach taken in WRSE where up to 20% of zonal capacity is treated as variable.

Our model is therefore free to choose the least-cost investment plan to satisfy the supply / demand deficits in our operating area, although it is not a “real world” least-cost plan as it does not account for the commercial arrangements for bulk transfers that would entitle the donor to a degree of profit, increasing the marginal cost to an “opportunity” cost.

9.6.2.2 Scenario 0: fWRMP Base Case

As explained in section 9.5, since April 2013 when the WRSE K13 model run was finalised and the submission of our draft WRMP, we have made refinements to both our supply side and demand forecast data, we have updated to some of our options data, and we have made improvements to the way that the model considers leakage options. Notably our demand forecast is higher as a result of the latest Census data and so the solutions of our draft WRMP base case and our final WRMP base case are not comparable.

We have implemented these changes for this ‘new’ base case run for our final Plan and all further scenarios have been based on this updated data set. Our new base case attempts to replicate the principles of the WRSE modelling, as did our draft WRMP base case. To do this we have modelled with 25-year planning and assessment periods as used in the WRSE modelling, and we have taken the same approach to modelling the marginal costs of bulk supplies as we did with our draft WRMP base case, explained in section 9.6.2.1.

As with our draft WRMP base case our model is free to choose the least-cost investment plan to satisfy the supply / demand balance in our operating area, again recognising that it will not produce a “real world” least-cost solution.

9.6.2.3 Scenario 1: Base Case + Longer Assessment Period

The next step in iterating towards our Preferred Plan is to run the our new base case with a longer assessment period. Running with a 50-year assessment period ensures that costs that are incurred after the end of the planning period are accounted for in the investment programme. Our EBSD model uses annuitised costs, which divide the total cost of a scheme by its asset life. A typical option has a 60-year life span, therefore in the modelling the costs are divided by sixty, and one sixtieth is applied each year. If a scheme is selected in 2039, only one sixtieth of the total costs will be applied. By increasing the assessment period to 50 years, 26 60^{ths} will be incurred, which reduces the bias of the model selecting an expensive scheme towards the end of the planning period. As a result of the longer assessment period, different options could be selected to derive the true least-cost investment plan.

As with the original Base Case, our model is free to choose the least-cost investment plan, although it is not a "real world" solution.

9.6.2.4 *Scenario 2: Base Case + Longer Assessment Period + Opportunity Cost*

We are supportive of the principles of the WRSE approach to marginal cost of transfers. The existing transfer arrangements we have in place with neighbouring water companies suggests that there is a degree of opportunity cost that the receiving company pays. The commercial arrangements differ from transfer to transfer, with the commercial cost being set by the donor company. Where we have existing commercial arrangements, we have assumed they will continue at the same charging rate. Options that increase capacity of an existing transfer are assumed to cost the same per unit of water as the existing commercial arrangements. For new options, we have used the commercial rates offered by the donating company. In the absence of any rates proposed by the donor, we have assumed an inclusive opportunity cost of 60% of the donating company's Large User Tariff.

Our model will optimise the least-cost investment plan in this sensitivity. This is the true **least-cost plan**, and we have used the outcomes of this scenario to populate WRP Table 3b.

9.6.2.5 *Scenario 3: Base Case + Longer Assessment Period + Opportunity Cost + SEA*

A number of our customers responded to our draft WRMP consultation expressing their wishes to see greater storage options (such as reservoirs) and other uses of water (such as desalination plants) in our Plan. These options have significant environmental impacts and have been assessed as 'high' risk under our Strategic Environmental Assessment (details are provided in Technical Report 3.9: *Environmental Report*). We wanted to understand the cost impact of preventing our model from selecting the options that had high levels of environmental risk.

> "How water is stored and collected from the environment will be critical over the next decades"

Some of the options classified as 'medium' or 'low' risk under the SEA were bulk transfers from other companies. As we consider that the opportunity cost of bulk transfers is a more realistic outcome than an assumed marginal cost, we tested the sensitivity of the investment plan to this environmental bias by running our model with the 'high' SEA risk options excluded together with the opportunity cost approach as described in scenario 2.

With the exception of the 'high' SEA risk options, the model was otherwise free to select the least-cost plan.

9.6.3 Description of the additional scenarios we have tested

9.6.3.1 Introduction

Scenario 3 represents the case on which we have tested other sensitivities. We applied different factors affecting the supply / demand balance and the availability / timing of both supply and demand management options to determine the impact on the investment programme.

9.6.3.2 Scenario S1: No Sustainability Reductions

Whilst we have agreed the volume of sustainability changes ('confirmed' and 'likely') with the Environment Agency for inclusion in our WRMP, we wanted to share with our customers the effect of having no sustainability reductions. The expected result is a much smaller investment programme, as we would not need to replace the agreed abstraction reductions in our Central region of 69.8Ml/d under average conditions (around 6% of our DO).

9.6.3.3 Scenario S2: High Sustainability Reductions

We have debated a higher level of sustainability reductions with the Environment Agency, which remain 'unknown'; however, we could be notified of further sustainability changes. In the absence of confirmation from the Agency about the specific details of the 'unknown' reductions, we assumed a 50Ml/d reduction in the Colne catchment in our WRZ2 to be delivered in AMP7 (by 2025). We also moved all 'confirmed' and 'likely' sustainability reductions such that they would all be delivered in AMP6 (by 2020). We wanted to run our model to show the cost impact of this higher volume of reductions. It was also important to exclude the 'high' environmental risk options, as we needed to exclude options where potential sustainability reductions would render the options invalid. As demonstrated in the equivalent WRSE scenario, this is likely to significantly increase the investment required to manage the supply / demand deficit.

9.6.3.4 Scenario S3: No demand management options

The WRPG asks companies to identify which supply side options are avoided by the implementation of demand management measures[18]. This scenario attempts to close the balance between supply and demand using only supply side measures, in order to identify which options are delayed or avoided when compared to scenario 3.

9.6.3.5 Scenario S4: Third party options not available

Many of our water trading options have been approved in principle as a result of our ongoing dialogue with potential donors. However, some options have less certainty for trading. We have used this scenario to test the impact on costs if we were only able to trade water with other water companies.

[18] WRPG, July 2013. Section 4.2.5.2, "The company must explain and highlight where supply-side resource options have been offset or avoided as a result of water efficiency measures."

9.6.3.6 Scenario S5: DO reductions from metaldehyde

The requirement to ensure metaldehyde (the active ingredient in standard slug pellets) exists only in low quantities in drinking water presents a challenge to many water companies, as there is no effective treatment to remove it. Companies with metaldehyde issues can blend the water with other sources to dilute the concentration of the pesticide prior to putting it into supply. However, our shared resource with Anglian Water has high quantities of metaldehyde due to extensive use of the product by farmers in the catchment, and, unlike the River Thames, it is not transient and remains at high concentrations all year round. We have used this scenario to test the impact on our WRMP should we be unable to fully utilise our entitlement to our shared resource as a result of such long-term pollution, pertinent as we have less water available for blending due to sustainability reductions. We have assumed a nominal 25% reduction in volumes available at both average and peak from 2015.

9.6.3.7 Scenario M1: Community Integrated AMR metering in WRZ1-6 by 2025

Our Base Case scenarios can freely select between the available metering options. Customers have also told us that they believe metering is the fairest way to charge for water, but they wish for it to be equitable so that all customers have a meter installed. We believe that we will derive efficiency in a universal metering programme if we install meters on a street-by-street basis. We have therefore constrained our model by forcing it to select the community integrated automated meter reading (AMR) option in all of our Central WRZs by 2025. It was free to choose when to start each WRZ, but must finish (i.e. the full benefit must be delivered) by 2025.

> “I am already on a water meter and it has helped me save money and water, everyone should have one”

9.6.3.8 Scenario D1: High demand

Our baseline demand assumes plan-based population growth of 17%. We have run this sensitivity to test the impact of trend-based population growth on the investment plan – this is population growth of 30%. Due to this significant increase, we have also re-run our headroom model to derive a new lower target headroom for this sensitivity. This is likely to increase the investment required, although there may be no impact on bills as there will be more people paying bills.

9.6.3.9 Scenario L1: Greater volume of leakage in AMP6

There is a level at which it costs more to manage leakage than it does to provide the equivalent volume of water through other means: this is called the sustainable economic level of leakage (SELL). As we go beyond this SELL, we get closer to our ‘background level of leakage’ and the costs start to increase rapidly. However, customers think we should do more to reduce leakage, so we have developed this sensitivity to show the impact of undertaking more leakage in AMP6.

9.6.3.10 Scenario L2: Unconstrained leakage

Expanding on the sensitivity described in Section 9.5.3.12, we wanted to offer the model a more flexible approach to leakage management. All other model runs were set to prevent leakage from rising in any WRZ in accordance with DEFRA's aspirations. For this scenario, we removed this constraint to allow leakage to rise where it was most economic to do so, and allowed the model to freely choose as much leakage as it wanted in all years of the planning cycle, up to a maximum value equivalent to the background level of leakage in each WRZ. This scenario demonstrates the capability of our modelling, in that it can derive the true ELL for our company.

9.6.3.11 Scenario W1: Water Efficiency for Businesses

DEFRA's Guiding Principles ask water companies to consider implementing demand reduction measures where the costs may outweigh the benefits. We wanted to share with our customers and stakeholders the impact of a programme that requires water efficiency schemes to be selected, specifically for our non-household customers.

9.6.4 Results of Scenario Testing

We have run the scenarios and sensitivities described in sections 9.6.2 and 9.6.3. As described in section 9.3, our model seeks to derive the least-cost programme of options that will meet the supply / demand deficit within the given constraints.

Our model also considers the cost of abstracting, treating and distributing water from our own sources and compares that with new options, as it may be cheaper to deliver an option than to supply water from an existing source. Our water available for use (WAFU) is calculated from our baseline deployable output (DO), which includes bulk transfers from neighbouring companies, less the impacts of climate change, sustainability reductions and outage. The costs over and above WAFU represent the investment programme of options that we need to resolve the deficit in the supply / demand balance.

The total investment programme comprises three main components of cost of the options:

- Capital expenditure, or **Capex**. This generally relates to money spent to deliver a project, such as constructing a new pipeline, building a reservoir or installing meters, and includes the purchasing of all materials, goods and services.
- Fixed Operational expenditure, **Fixed Opex**. This is the fixed part of the cost of operating and maintaining the assets that are built or installed with Capex, such as local authority business rates. It is a fixed amount of money each year.
- Variable Operational expenditure, or **Variable Opex**. These are costs that change dependent on usage, for example unit power costs to operate treatment works or charges to purchase water from a neighbouring water company to deliver to our customers. Our model determines how much water to use from different sources or from bulk transfer imports to maintain least-cost and then calculates the Variable Opex. The costs presented relate to the utilisation of each option.

It should be noted that other costs must be taken into account over the planning period, and we have included them in our model:

- **Capital maintenance costs:** these are the costs that are incurred in order to maintain the assets installed with the initial capital expenditure. One example is the replacement of meters, where the initial installation would be accounted for under capital expenditure, while the replacement at the end of their life (typically 15 years) would be classified as capital maintenance. Other examples include the proactive maintenance of pumps and treatment plant.
- **Environmental, Social and Carbon costs:** these costs are calculated for different types of options and account for the environmental and social impact of the option, together with the carbon costs. An example is traffic disruption to local residents as a result of leakage repairs. These costs can be negative (because they have a positive effects on the environment, i.e. reducing the total cost of the option) or positive (because they have a negative effect on the environment i.e. increasing the total cost).

Figure 48 shows the total comparative cost of each of the scenarios, including the cost of abstracting, treating and distributing water from our existing sources and external transfers, presented in ascending order.

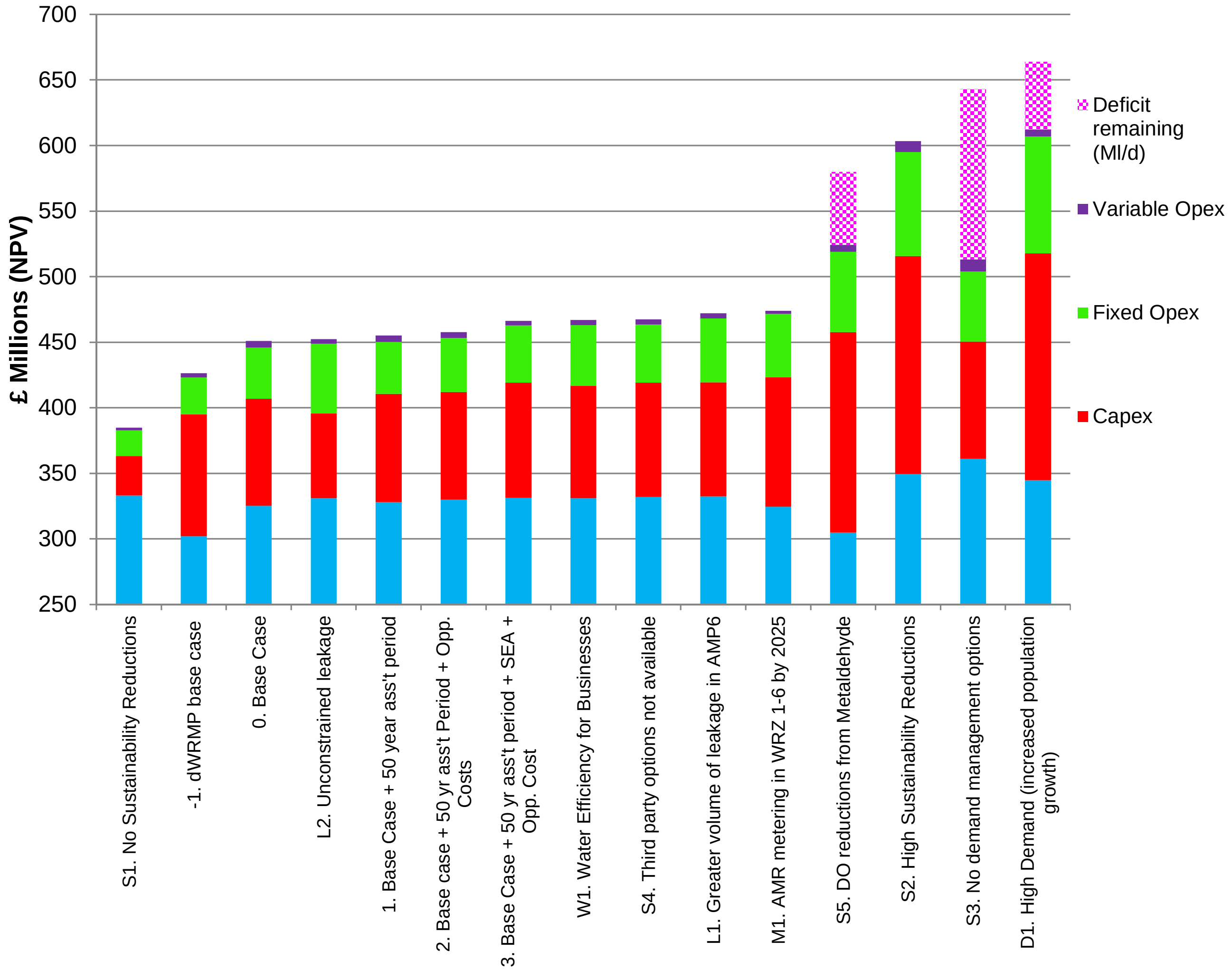


Figure 48: Comparative Total Cost of Scenarios over the 25 year planning-period

Figure 48 shows the NPV costs for the 25-year planning period; note that all except scenarios -1 and 0 are run with a 50-year assessment period, but, to be able to show comparative costs, we have only presented 25 years' worth of costs.

Three of the scenarios could not fully resolve the supply / demand balance:

- S5: DO reductions from Metaldehyde;
- S3: No demand management options; and
- D1: High demand (increased population growth).

The resulting deficits are presented as a nominal £1M per Ml/d, to show the volume of imbalance. Note that the deficits would cost significantly more than £1M per Ml/d to resolve. The deficits presented are not NPV figures.

Figure 49 shows the value of the investment programme, excluding existing supply and transfer costs. The scenarios are presented in the same order as in Figure 48; generally, the investment cost increases with each scenario.

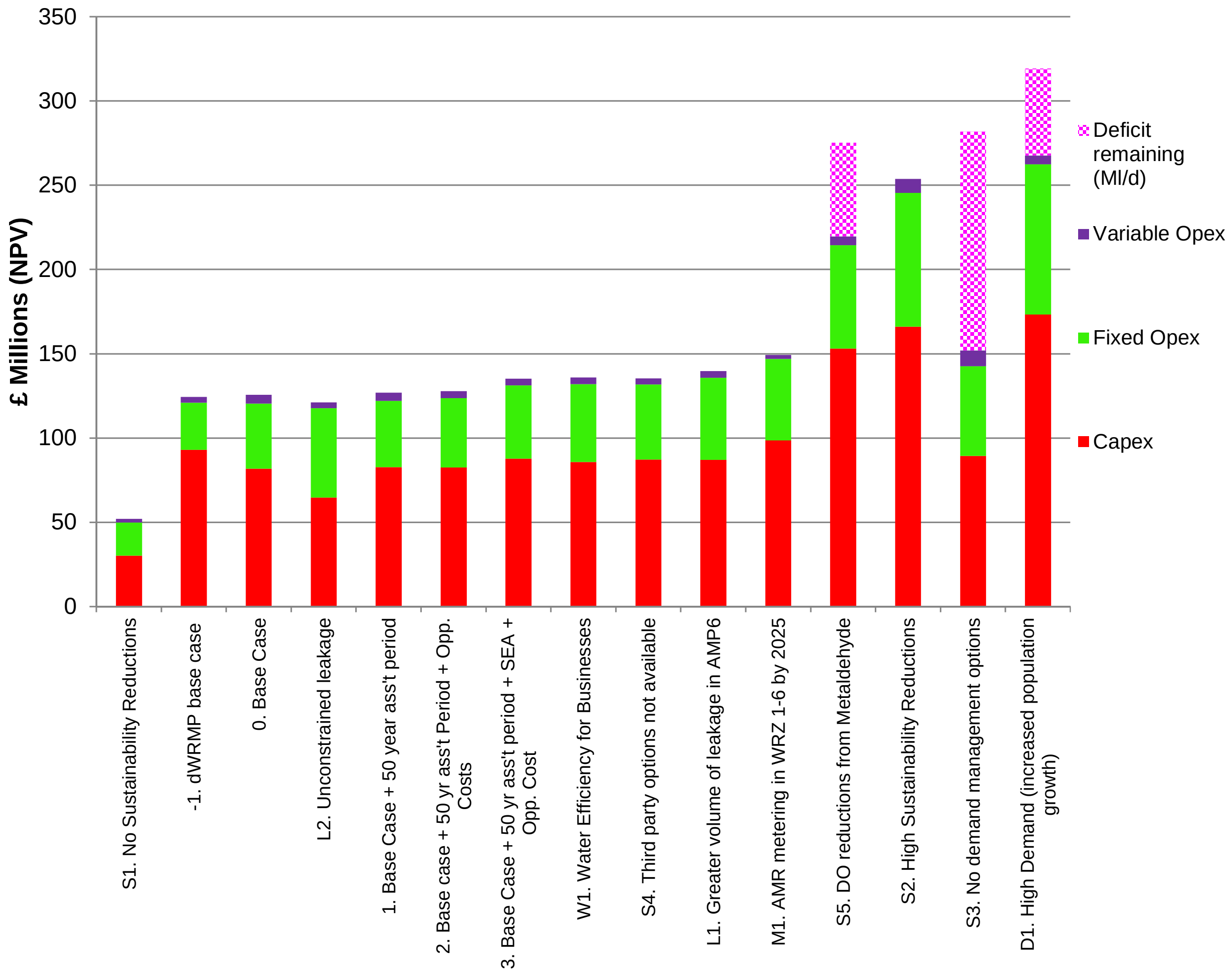


Figure 49: Comparative Investment Cost of Scenarios

It is important to note that the cost of the investment should not be assessed separately from the cost of existing WAFU, as there will be some instances where it is cheaper to develop new schemes than use existing sources. An example of this is bulk supplies from a neighbouring water company, where we pay a higher unit price for a given volume of water as well as the costs associated with moving that water to where it is needed.

9.7 Analysis of Scenarios

9.7.1 Compliance with the WRPG

9.7.1.1 Scenarios with deficits

Three of our scenarios result in deficits that cannot be solved with the available feasible options:

- S3: No demand management options;
- S5: DO reductions from Metaldehyde; and
- D1: High demand (increased population growth).

Presenting a solution in a WRMP that includes deficits is not compliant with the WRPG.

As we are required to show which supply side schemes are delayed or offset by demand management measures, specifically water efficiency, we did not expect scenario S3 to solve without deficits. This scenario used all available supply-side options before 'selecting' the deficit option.

Whilst we will not consider them in the development of our Preferred Plan, scenarios S5 and D1 do highlight areas of concern that warrant close monitoring over the planning period. We will work with Anglian Water to control the pesticide concentrations at our shared resource and we will continue to plan for strategic resources to manage growth.

9.7.1.2 Sustainability reductions

Water companies must plan for 'confirmed' and 'likely' sustainability reductions, but are not permitted to plan for 'unknown' sustainability reductions.

We felt it was important to show the cost impact to our customers of a scenario where no sustainability reductions were implemented at any point during the 25-year planning period. This is presented in scenario S1. We understand the Agency also wishes to use the outcomes of this scenario in their cost benefit analysis of sustainability reductions.

Equally, whilst we are not permitted to plan for a higher level of reductions, we remain concerned about the volumes indicated by the Agency in the Colne catchment and the significant cost impact this would have to our customers. Scenario S2 highlights the costs required to maintain the balance between supply and demand with these higher reductions.

> "I think that society as a whole has to take on more responsibility with environmental factors"

The cost benefit of these sustainability reductions must be concluded by the Agency prior to formal notification and our ability to plan for changes to our operations. Therefore, scenarios S1 and S2 are not viable considerations in the development of our Preferred Plan.

9.7.2 Compliance with Government aspirations and other legislation

9.7.2.1 Leakage

Table 38 compares the yields and costs of the least-cost plan with the two leakage scenarios.

Option Type	Period	Yield in least-cost plan (Ml/d)	Yield in scenario L1 (Ml/d)	Yield in scenario L2 (Ml/d)
Leakage	2015-20	16.86	20.00	28.12
	2020-25	29.36	29.68	45.86
	2025-30	30.95	32.80	45.86
	2030-35	31.60	45.16	47.66
	2035-40	32.12	46.34	48.90
	Cost, £M NPV	**£457.45**	**£471.92**	**£452.07**

Table 38: Comparing the leakage reduction selected in our scenarios

Water companies are asked not to let leakage rise in accordance with DEFRA's aspirations.

The leakage programme selected by our L2 scenario of unconstrained leakage is shown in Table 39, with the leakage changes per WRZ in each AMP of the planning period.

WRZ	Leakage reduction selected per AMP					Total Leakage Reduction
	2015-20	2020-25	2025-30	2030-35	2035-40	
1	9.96	0	0	0	1.20	11.16
2	17.73	0	0	0	0	17.73
3	0	6.91	0	0	0	6.91
4	0	6.65	0	0	0	6.65
5	3.53	0	0	0	0	3.53
6	-3.10	4.18	0	1.80	0	2.88
7	0	0	0	0	0.04	0.04
Total	**28.12**	**17.74**	**0**	**1.80**	**1.25**	**48.90**

Table 39: Leakage selected per WRZ in each five-year period by the L2 unconstrained leakage scenario

Scenario L2 demonstrates the capability of our EBSD model in that it has allowed leakage to rise in WRZ6, whilst others reduce significantly and in some zones there is no leakage selected at all. In WRZ7, there is no leakage selected until the last AMP, when the model chooses the option to reduce the size of district meter areas.

Regardless of the fact that we would have concerns about the deliverability of such significant changes in leakage in some of our WRZ, allowing leakage to rise in others would not be in accordance with DEFRA's aspirations.

As a result, scenario L2 is not a viable consideration in the development of our Preferred Plan, but does identify the total level of leakage reduction at the end of the planning period that is considered most economic, where no other constraints are applied to the model.

9.7.2.2 Reducing demand

Water companies with an average household PCC of greater than 147l/h/d are directed to reduce consumption. Scenarios M1 and W1 both reduce demand and have no deficits.

9.7.3 Viable scenarios

As our draft WRMP Base Case (scenario -1) was modelled with a different supply / demand balance, this scenario has been removed from the viable scenarios comparison. We have also removed the updated Base Case (scenario 0) and the Base Case with the 50-year assessment period (scenario 1) as both assume unrealistic marginal costs for bulk transfers of water.

Table 40 gives the cost components of the remaining viable scenarios.

Scenario	Description	WAFU, £M NPV	Investment, £M NPV	Total, £M NPV
2	Base Case with 50-year assessment period and opportunity cost: least-cost	329.58	127.88	457.45
3	Base Case with 50-year assessment period, opportunity cost and high risk SEA excluded	331.28	135.07	466.35
W1	As scenario 3, with additional water efficiency for non-households	330.92	135.91	466.83
L1	As scenario 3, with a higher volume of leakage reduction in AMP6	332.27	139.65	471.92
M1	As scenario 3, with all Central WRZ metered by 2025	324.54	149.28	473.82

Table 40: Cost components of viable scenarios

The graph in Figure 50 shows the cost components of the remaining viable scenarios. We have considered these in the development of our Preferred Plan, described in section 11.

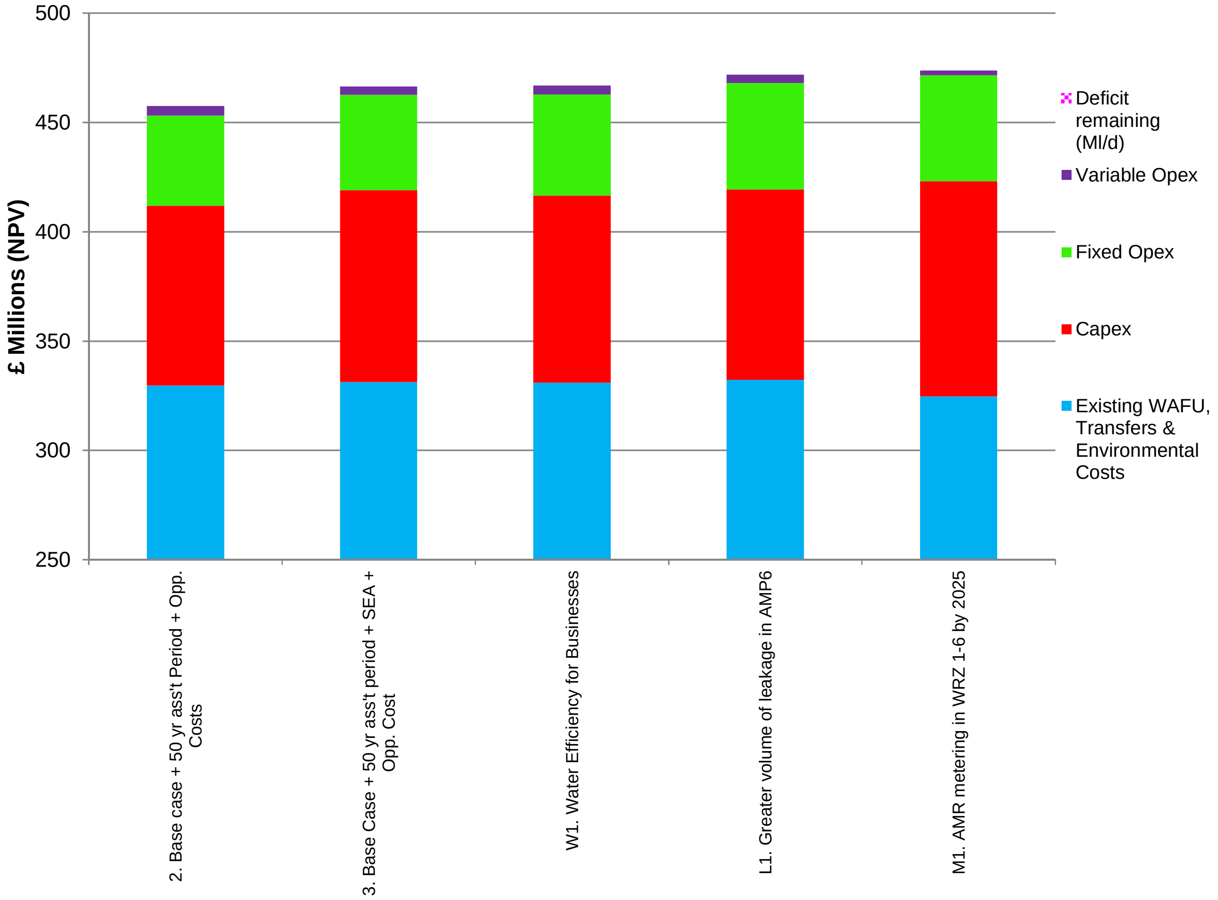


Figure 50: Comparative Total Investment Costs of Viable Scenarios

Further analysis of the scenarios and the details of scheme selection can be found in the Technical Report 3.7: *Economics of Balancing Supply and Demand Model Development, Commissioning & Use*.

10 Customer Consultation & Willingness to Pay

10.1 Introduction

In the development of our draft WRMP, we carried out consultation on our strategic environmental assessment report and general water resources items that we used to shape our Plan for wider consultation.

In following the statutory process for consultation on the WRMP, we recognise that respondents are self-selecting, such that those who are obliged or feel minded to respond are more likely to give us feedback than customers and stakeholders who have little reason to contact a water company. As responses to consultation of any type tend to reflect the vested interests of the respondents, it is likely that the views expressed in the themes arising from our draft WRMP consultation are biased to their particular views and interests.

Consequently, we felt it was important to gather feedback that was **statistically representative of our customer base** to compare with the consultees who responded to our draft WRMP consultation to better understand any bias or conflicts between the consultation required by the WRPG and other avenues of engagement.

We carried out this additional engagement activity after the publication of our draft Plan in May 2013, including further questionnaires to our online panel, environmental forums with local interest groups, deliberative forums with customers, as well as work to understand customer and stakeholder preferences for programmes of investment, their willingness to pay and bill level acceptability in addition to our Business Plan consultation.

We have received over **12,000 individual pieces of feedback** from customers as part of our Business Plan engagement activity, which includes our draft WRMP consultation.

The type, quality and quantity of responses are important for us to consider in assessing all feedback. We developed robust criteria to evaluate the feedback we received in order to understand how responses should **influence**, **inform** and **provide insight** to our Plan.

In this section, we describe the consultation work that we have carried out and how the responses to our various avenues of consultation have informed and shaped our Preferred Plan for customers, communities and stakeholders.

10.2 Our draft WRMP consultation

10.2.1 Introduction

We submitted our draft WRMP to DEFRA in March 2013. On 30th April, we were directed to publish our Plan, which we did on 17th May 2013. We closed the consultation period on 12th August 2013. We invited consultees to share their views on our Preferred Plan and how well it balanced the challenges we face now and in the future.

Our key consultation questions concerned leakage, sustainability reductions, water efficiency, metering, and drought resilience.

10.2.2 Leakage

Our draft Plan proposed to spend more on repairing pipes than is cost effective for the volume of water saved. We asked customers and stakeholders to consider two questions:

– *Do you agree with this approach?*

– *Weather conditions can have a significant impact on the level of leakage, should our targets be altered to reflect this?*

10.2.3 Sustainability Reductions

To enable local river environments to improve we propose replacing or reducing abstraction from those sources likely to be impacting on them. Our initial analysis suggested this could increase customers' water bills by around £10. We asked customers:

– *Are you willing for bills to rise to enable this to be achieved?*

10.2.4 Water Efficiency and Metering

We think metering is the fairest way to pay for water. We also think we need to do more ourselves and to help everyone else in being more efficient in the use of water. To do this, we proposed a universal metering programme in our draft WRMP. The cheapest way to meter is achieved via street-by-street installation, fitting a meter to every property that does not currently have one, whilst promoting water efficiency. We asked customers:

– *Do you agree?*

10.2.5 Drought resilience

Our experience of the 2012 drought highlighted the need for us to invest around £15.5M to improve the security of water supplies in the case of future severe water shortage in South East of England. We included this investment in our draft WRMP. We asked customers:

– *Should this investment be made?*

10.3 Response to our draft WRMP consultation

10.3.1 General

DEFRA advised us of **81 responses** to our consultation, six of which were received after it formally closed. The responses were from a wide range of organisations, including the Environment Agency, Ofwat, Natural England, English Heritage, the Canal & River Trust and the Consumer Council for Water, as well as local interest groups and local councils.

The breakdown of responses by type is given in Table 41.

Contact Type	Count
Borough Council	3
Charity	1
County Council	5
District Council	3
Local Interest Group	14
National Group	3
Non-government organisation	4
Parish Council	6
Regulator	3
Resident	36
Town Council	2
Water Company	1
TOTAL	81

Table 41: Number of organisations responding to our draft WRMP consultation

As we are required to show how we have changed our WRMP in response to the consultation, we have considered each comment in detail. We have put all of the responses in a table together with a statement about what we have done to address each comment from our customers and stakeholders. We have also identified where in our WRMP and / or supporting Technical Reports we have changed our plans as a result of careful consideration of this feedback. The table of consultation responses is presented in Technical Report 3.8.5: *Draft WRMP Consultee Response Log*.

The key themes arising from the consultation responses were:

- Support for our plans to reduce leakage beyond the economic level together with a preference for a greater response to leakage management in times of water scarcity;
- Support for our plans to reduce abstraction where environmental damage is occurring, and acceptance for the impact on bills;
- Calls for commitments to fully assess the natural environment, built environment, heritage and archaeological aspects prior to the delivery of the projects in our Preferred Plan;
- A desire to see Affinity take a greater role in championing the protection of rare chalk stream habitats across the South East of England;
- Support for our plans to deliver a programme of universal metering, coupled with water efficiency awareness, to help customers reduce their consumption and save money, but seeking assurance that we have enough flexibility in our WRMP to accommodate variance in our forecast of 13.6% demand reduction;

- However, more information is needed to show that we will be able to support vulnerable customers via transitional arrangements and social tariffs and for the logic underpinning the order of implementation by WRZ;
- Support for drought resilience proposals, although a number of consultees asked us to explain why we had not included reservoirs, desalination and grey water use in the options in our Preferred Plan;
- Requests from third parties for additional clarity about how we had considered options from outside our operating area to manage the supply / demand balance;
- Further explanation about the water use and future needs of non-domestic customers, including the percentage that are metered and consideration for agricultural requirements;
- The need to agree and align bulk transfers between donor and recipient companies.

These themes were verified by a third party consultant, OPM.

10.3.2 Consultee comments

We also analysed the comments from our consultees to determine which topics were most often mentioned.

Figure 51 is a ‘word cloud’ of topics commented on, where the size of the text is representative of the number of times key words or phrases linked to a given topic is mentioned; the more frequent the topic, the larger the size of text.

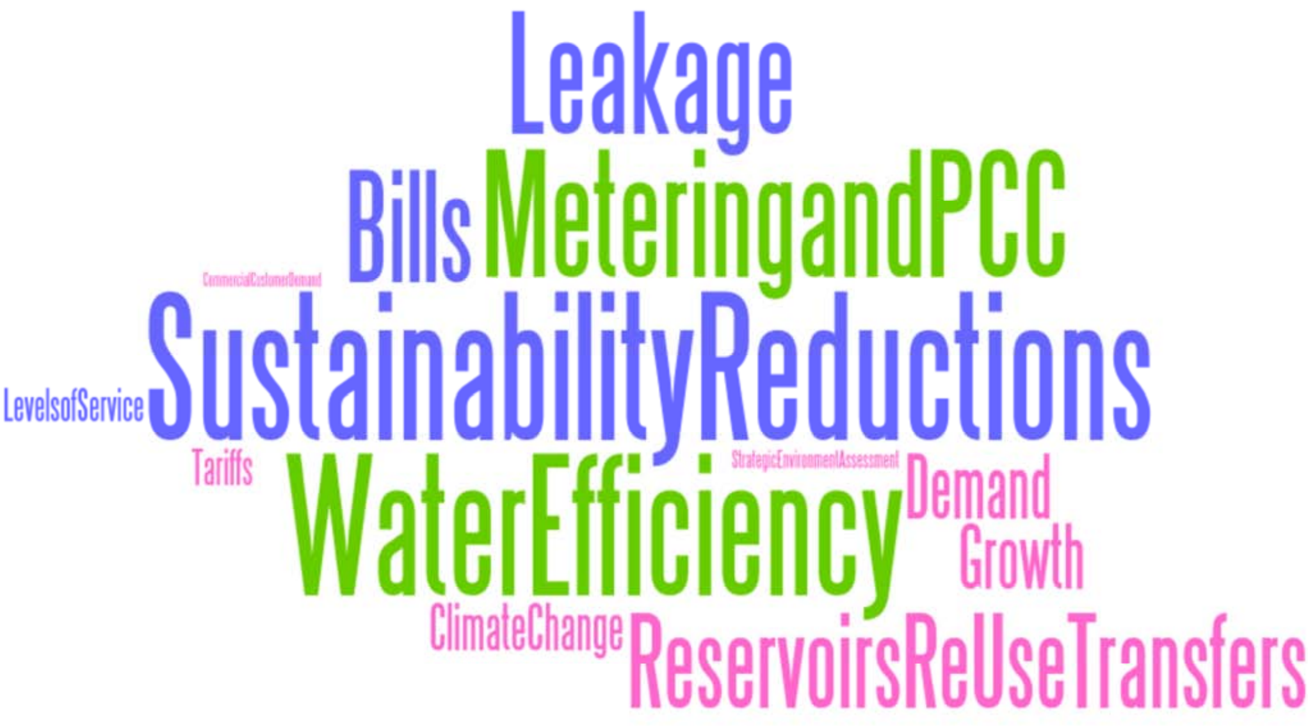


Figure 51: Word cloud of key topics identified by customers in our consultation

We note that environmental themes continue to be raised by both customers and stakeholders, including the need to reduce leakage, promote sustainable abstraction, and ensure that vulnerable customers are supported in the delivery of our universal metering programme.

A number of consultees asked us why our plans did not include new reservoirs and, for our Southeast region, desalination.

Some consultees suggested water companies should be given a greater say in future growth proposals, as it was unsustainable to continue increasing the population in an area of water scarcity.

There was strong support for encouraging water efficiency, with consultees proposing that we undertake more work to engage with and educate the next generation.

Some consultees felt we should take a greater role in championing the habitats of globally rare chalk streams.

10.3.3 Response to consultation questions

Some of the responses we received did not make a specific reference to the consultation questions. We analysed each of the responses we received and have assessed them as one of the following four categories:

- Yes: supportive of the proposal
- Part: some support for the proposal, but with comments
- No: disagrees with the proposal
- No response: no discernible response to the question

The responses to our consultation questions are given in Table 42.

	Balance of draft WRMP	Leakage below ELL	Leakage target linked to weather	Sustainability Reductions	Metering & Water Efficiency	Drought Resilience
	% response	% response	% response	% response	% response	% response
Yes	45.7%	42.0%	16.0%	50.6%	58.0%	38.3%
Part	14.8%	14.8%	0.0%	17.3%	7.4%	12.3%
No	0.0%	2.5%	8.6%	2.5%	0.0%	2.5%
no response	39.5%	40.7%	75.3%	29.6%	34.6%	46.9%

Table 42: draft WRMP consultation responses to key questions

Table 43 shows the response to our consultation questions with the 'no response' category excluded.

	Balance of draft WRMP	Leakage below ELL	Leakage target linked to weather	Sustainability Reductions	Metering & Water Efficiency	Drought Resilience
	% response	% response	% response	% response	% response	% response
Yes	75.5%	70.8%	65.0%	71.9%	88.7%	72.1%
Part	24.5%	25.0%	0.0%	24.6%	11.3%	23.3%
No	0.0%	4.2%	35.0%	3.5%	0.0%	4.7%
no response	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 43: draft WRMP consultation responses to key questions – no responses excluded

Generally, there was support for all of our proposals. However, there are also a number of very insightful and useful suggestions and queries from our consultees. We explain how our revised Plan has been influenced by our consultees in section 11.2.

10.4 Complimentary structured consultation

10.4.1 Summary of themes arising from other consultation

Our draft WRMP was circulated to statutory consultees as well as other persons and organisations with a stated interest in our plans. In addition, it was published on our website and made publicly available to any person wishing to review it.

Respondents to the consultation document responses are self-selecting, i.e. those who are obliged to respond or feel minded to respond. As responses to consultation of any type tend to reflect the vested interests of respondents, it is possible that the views expressed in the themes set out for our draft WRMP in section 10.3.1 are biased to their particular views and interests. To assess this, we also conducted complimentary stakeholder consultation using a range of structured and representative samples.

The majority of views from the draft WRMP consultee responses were largely supported by the outcomes of the other engagement activities, many of which utilised a controlled sample to ensure our customer population was properly reflected.

This section describes the results of the additional engagement we have undertaken during the period of consultation on our draft WRMP. The key themes overall are presented in Table 44.

Expectation	Key themes
Making sure our customers have enough water	– Customers tend to take water for granted and rarely think about what is involved in the delivery of water services. – While most customers support metering, some are reluctant to have one installed. – Customers want to see Affinity Water do more to reduce leakage and ensure water is not wasted. – Most customers perceive they are water efficient and would like to know how their consumption compared to others and how they can save water. – Customers support proposals to leave more water in the environment and make water resources more resilience but are reluctant to pay for improved environmental protection.
Supplying high quality water you can trust	– Customers are concerned about the hardness of their water, but are unwilling to pay more to reduce hardness. – Customers see the provision of high quality water as a core duty for Affinity Water and want investment maintained to protect and maintain high quality water to their taps.
Minimising disruption to you and your community	– Customers want to see the standards of service maintained, and are willing to pay slightly more to see this happen. – Only a small proportion of customers experience disruptions, however, those that do are very concerned when prolonged disruptions occur.
Providing a value for money service	– Customers are content with the bills they currently pay for Affinity Waters' service, although they are concerned about any significant rise in their bills. – Many customers are concerned that some people struggle to pay their bills and want them helped; however, their views on social tariffs are mixed. – Customers support investment in assets to maintain the levels of service they want.
Communication	– Customers want more information about the challenges faced, and the actions and expenditure undertaken. This should be multi-channel and personalised to meet customer needs and preferences. – Customers are generally positive about Affinity Water staff and rarely have cause for concern about customer service.

Table 44: Key themes of customer priorities across all consultation channels

10.4.2 Neighbouring water companies

Following the publication of our draft WRMP, we have continued to hold discussions with neighbouring companies to ensure that the bulk supply options remained feasible, were consistent between our respective plans and to establish outline agreements and prices. The Agency identified this as a potential weakness in both the donor and recipient companies' Plans and asked that we ensure our revised Plans matched.

We explain the development of water trading options in section 8.2.2 of our revised WRMP, and set out which options we have agreed to proceed with in section 11.4 of our revised WRMP.

As part of the consultation process, we have engaged in particular with Thames Water, Anglian Water, South East Water and Southern Water.

– We have concluded our discussions with Thames Water about our bulk transfer volumes, which were previously not included in Thames Water's draft WRMP.
– We have accounted for the uncertainty in the available deployable output at Grafham Water, a resource we share with Anglian Water in our headroom assessment.
– We have an agreement in place between ourselves and South East Water regarding a bulk import of water for our Southeast region.
– We have also exchanged heads of terms for a small bulk import from Southern Water that is capable of delivering larger volumes for a short period in the event of planned outage.

10.5 Additional questionnaires to our online panel

10.5.1 Introduction

We described our online panel in section 3.5.1.9.

The questionnaires we asked prior to the publication of our draft WRMP helped inform our high level strategy, such as whether metering should be universal and whether leakage continues to be a priority for customers.

We were keen to explore aspects of our proposals in more detail during the consultation period. We felt that customers' views about our management of leakage and our ability to maintain a resilient supply would help us ensure that our Preferred Plan met the requirements of customers, stakeholders and the environment. We improved the style of questionnaire by setting out a statement before asking related questions.

> "I think its important to use less water and this survey has made me understand Affinity Water a little better"

As with the first questionnaires, we asked our CCG to review the questions to ensure we were asking the right questions for customers without being leading in the way we worded them.

Further details about the responses are given in Technical Report 3.8: *Engaging Customers in Future Planning*.

10.5.2 Leakage

We are aware that managing leakage remains a priority for our customers. Previous surveys have established that customers want us to reduce leakage beyond the economic level.

> "Leakage information is not at the forefront of information produced for customers and this survey was enlightening"

As leakage can be a complex subject, we structured the questionnaire with introductory statements that needed to be read before our online panel respondents were presented with questions related to each statement. We saw this as an opportunity to help some of our customers understand more about the way our business operates, potentially as a pilot for future awareness campaigns.

We wanted to know more about our customers' preferences for the way we went about delivering this enhanced programme of leakage reduction.

We asked customers:

- Do you think we manage leakage appropriately? 78% said yes.
- Should we try explain leakage and its importance to our operations better than we currently do to customers? 73% said yes.
- What concerns you most about leakage? (Multiple options could be selected) 82% don't like seeing water wasted, 82% are concerned about the cost of controlling leakage, whilst 68% worry about the effect on their bill.
- Typically we repair leaks within five days. Is a five day repair rate right? 45% said yes, it's about right whilst 50% said no, we should do it faster.
- Should we spend more money to reduce leakage beyond ELL? 41% said yes, 32% said no whilst 27% didn't know.
- Is the rate at which we repair leaks more important during droughts? 76% said yes, we should respond faster in a drought.
- Should we do more to reduce pressure as method of leakage management? 68% said yes, but without affecting appliances and/or at low demand times.
- Should we continue to offer free repair of customer supply pipes when we find them leaking? 60% said yes to a free repair or subsidised replacement regardless of the size of leak, with the cost spread across all customers.
- Do you believe metering will encourage householders to take responsibility for own leakage if they know how much is being wasted and at what cost? 76% said yes.

We added a question at the end of the questionnaire to gauge comprehension of the complex issues being presented to understand the extent to which customers felt enabled to respond meaningfully and to assess the effect this had on customer support of our plans. The example for our leakage survey is set out below:

> *Question 16 (a):*
>
> *'We wanted to explain more about leakage and help our customers understand the challenges we face to strike the right balance between finding and fixing leaks and spending money wisely. Now you have finished the questionnaire, we would like to know if your view of our leakage management strategy has changed. Which of these statements is closest to how you feel now?'*

The response to this question is presented in Figure 52.

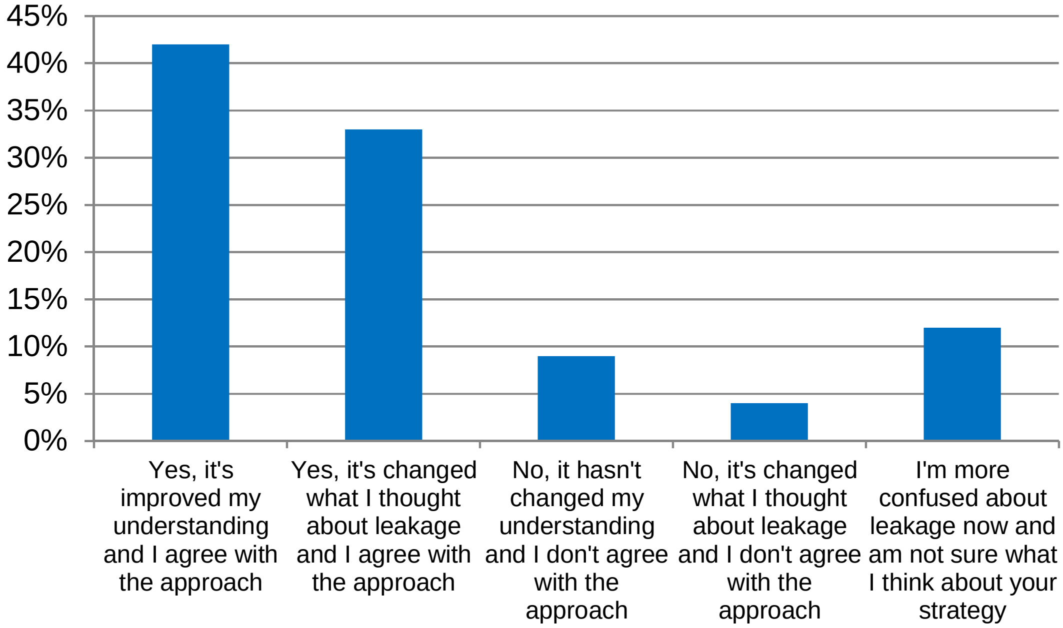


Figure 52: Response to final question of our leakage online panel, July 2013

As shown in Figure 52, 75% of respondents confirmed that it had either improved their understanding (42%) or changed what they thought about leakage (33%) and in all of those cases, agreed with our approach.

> "Fantastic survey - probably the best I've ever done. Informative and very thoughtful"

We are satisfied that the quality of our dialogue with customers is moving in the right direction. However, as we continue with our engagement plans in the future, our intention is to focus greater attention on simplifying the complex issues to enable customers to make meaningful contributions to our future planning.

10.5.3 Levels of Service, Sustainability Reductions & Drought Resilience

As the delivery of planned sustainability reductions would have an impact on the security of supply to our customers, we proposed to replace that lost resilience with additional investment. It was important to gain responses from a statistically representative sample of our customer base, rather than the self-selecting group that responded to our draft WRMP consultation. It was also important to establish if customers felt abstraction should resume in certain situations, or whether unsustainable abstractions should cease at all costs.

We also wanted to test the acceptability of restrictions, particularly the application of temporary use bans (TUBs), and whether additional investment should be made to protect customers against severe drought, such as the third successive dry winter that the South East of England suffered in 2011/12 that led many companies to apply TUBs.

As with the leakage questionnaire, we asked customers to read brief statements before answering related questions.

"I thought I was well informed about water usage and proposals but the questionnaire has increased my understanding"

The outcomes of this online panel included:

- 72% agree to reducing abstraction to save drying rivers;
- 72% say a 1 in 10 year hosepipe ban (TUBs) is agreeable;
- 78% would pay an average extra £5.50 over 5 years to help adapt to sustainability reductions (refer to section 10.9);
- 69% agree with our demand management strategy to help deliver sustainability reductions (programme of leakage reduction, water efficiency and metering);
- 55% support the £15m investment to improve drought resilience.
- 68% support for resuming abstraction of sources subject to sustainability reductions under certain circumstances/conditions.

And when asked what they thought about our survey:

- 67% believed our survey was understandable and agreed with our approach.

10.6 Willingness to Pay

We appointed specialist consultants to carry out both willingness to pay and bill acceptability studies. The studies aimed to deliver results that would support both our WRMP and the Business Plan.

During October, our consultants reported on the outcomes of this study to estimate customer preferences for different service improvements.

The pilot survey tested the study framework with 100 household customers using an online survey.

The main survey took place between July 2013 and August 2013 and targeted 700 household customers via an online survey (350) and computer-aided personal interview (350), a technique in which the interview took place in the respondent's home and was conducted by an interviewer using a computer programmed with the survey.

The target survey group was recruited as a representative household sample from within our supply area. Business customers (508) were recruited by telephone and completed an online survey.

Participants were asked to complete tasks that highlighted their preferences for different attributes relating to water resources. The experiment involved presenting participants with trade-off choices between attributes and asking them to choose their most and least preferred options.

The work resulted in a set of customer preference weights that demonstrate the relative preference for different options and programmes of investment. The weights relative to a base case of maintaining service at the current level and those in addition to a base case are presented in Table 45.

	Computer-aided personal interview (CAPI)		Online survey	
Water resource option	Weights	Weights in addition to base case	Weights	Weights in addition to base case
Base case: maintaining service	1.00	0.00	1.00	0.00
Take more from rivers	1.00	0.00	0.97	-0.03
Take more from the sea	3.08	2.08	2.63	1.63
Take more water from underground	2.69	1.69	1.96	0.96
Fix more leaks	2.55	1.55	6.23	5.23
Transfer more water	2.73	1.73	2.14	1.14
More water meters	1.82	0.82	3.21	2.21
More water efficiency	3.38	2.38	4.33	3.33

Table 45: Customer weightings for water resource options

Interpreted in terms of water resources options, the data highlighted the customer priorities given in Table 46.

Option	Online order of preference	CAPI order of preference	Combined order of preference
Fix more leaks	1	5	**1**
More water efficiency	2	1	**2**
Take more from the sea	4	2	**3**
More water meters	3	6	**4**
Transfer more water	5	3	**5**
Take more water from underground	6	4	**6**
Take more from rivers	7	7	**7**

Table 46: Customer priorities for water resource options

In the case of water restrictions, the data highlighted respondents' views on the perceived impact of a three-month ban on a household's day-to-day use, presented in Table 47.

	No impact	Slight impact	Moderate impact	Large impact	Very large impact
Hosepipe ban chance	39	34	19	6	1
Non Essential Use Ban chance	50	27	18	4	1

Table 47: Perceived impact of a water ban lasting three months

A full report on the water resources willingness to pay study and how it will be utilised is available in Technical Report 3.8.7: *Willingness to Pay Study.*

10.7 Bill Acceptability

We directly engaged with our customers during the bill acceptability element of our willingness to pay study to identify the most acceptable set of choices: their view of the best combination of service and bill level. We used the survey to determine the strength of feeling on attitudes to risk, the pace of changes to service level, the profile of bill increases and specific investment options.

The draft survey was tested in cognitive interviews with household and business customers during June 2013 to gauge comprehension of the survey framework. This progressed to a pilot study with 139 households, conducted online. The results of the pilot study indicated a reasonable match between proposed investments and customers' priorities so the main acceptability survey was able to proceed largely unchanged.

During the main phase of work, 900 households (made up of 500 computer-aided personal interviews and 400 online respondents) along with 300 business customers were engaged in the study. This was split 400 per investment plan reviewed (300 domestic and 100 business), covering three plans in total.

The results from the study enabled us to establish customer preferences expressed as relative weights. These can be utilised as part of the willingness to pay study as estimates for water resource planning options over and above any environmental and social costs that are assessed separately in the WRMP. They also allow us to estimate customer relative values for different water use restrictions including hosepipe bans, non-essential use bans, frequency and duration.

> "I agree with the approach in theory but I don't think people can afford higher bills to pay for it"

A full report on the bill acceptability study is available in Technical Report 3.8.8: *Bill Acceptability Study*.

10.8 Environmental Forum

During July 2013, we ran two further forums in Hatfield, Hertfordshire (14 participants) and Hythe, Kent (11 participants). The events took place as a half-day workshop. Participants were sent a copy of the draft WRMP in advance of the day in preparation for discussion.

Delegates were invited to represent local interests within our three regions. Those accepting the invitation to attend included representations from town, district, county and borough councils, environmental groups, local common interest societies, wildlife trusts, housing associations; the Consumer Council for Water and members of our Customer Challenge Group.

We delivered presentations providing an introduction to the draft WRMP and our proposals to balance supply and demand, including detail of sustainability reductions and our approach to the consultation process. We also presented on our catchment management programme. Questions and answers followed the presentations and were largely focused on household metering and managing demand, the regulatory process, the reliability of sources, strategic direction from government and the relationship between pollution events and water quality standards in relation to catchment management.

> "Affinity Water has both an ethical and legal duty to the community to manage environmental impact responsibly"

The second half of the workshops consisted of a group facilitated discussion on how to balance both social and environmental needs in terms of supply and demand. Participants were asked to map the social impacts of restricted use against a scale of sustainability reductions in abstraction levels. Results were similar in both sessions:

- Participants generally shifted social impacts towards the beginning of the scale indicating that restrictions should come in earlier in their view to protect the environment.
- It was agreed that some activities should never be banned.
- We should raise awareness of drought as early as possible
- Advice on reducing domestic usage should happen under normal circumstances
- Businesses should be informed in advance about how and when different restrictions could impact them so that they are better prepared should these restrictions come into place.
- Use of grey water or non-potable water should be considered to enable some activities to continue after mains use has been restricted.

Reports on all our environmental forums are available in Technical Report 3.8.3: Environmental Forum Reports.

10.9 PR14 Business Plan consultation

In July 2013, we published our Business Plan consultation.

We asked customers to review our proposals for achieving four outcomes:

- Making sure you have enough water;

- Supplying high quality water you can trust;
- Minimising disruption to you and your community;
- Providing a value for money service.

We presented three different options for customers to consider, each with a different bill impact over the five-year period from 2015 to 2020. The three options identified the changes in service and to the bill against the average water-only annual bill of £165. The options offered were:

- Our Slower Plan, reducing customers' bills by £2.50;
- Our Proposed Plan, adding £3.70 to customers' bills; and
- Our Faster Plan, adding £13.70 to customer's bills.

Our water resources management proposals fall largely into the outcome 'making sure you have enough water'. The Proposed Plan identified in the Business Plan consultation document reflects the sustainability reductions in accordance with our draft WRMP, whilst the Slower Plan delays their delivery and the Faster Plan delivers more sooner. The Slower Plan reduces customers' bills as we do not have as large a deficit between supply and demand, whilst the Faster Plan increases bills as the deficit is much larger than that in the Proposed Plan.

In addition, Ofwat requires us to consider the measures of success for our Business Plan, together with proposals for incentives and penalties linked to our performance. We determined that, for 'making sure you have enough water', our measures of success would be to reduce leakage, help customers use less water and to reduce the amount of water we abstract in order to meet supply, leaving more water in the environment.

During the summer of 2013, specialist consultancy Office for Public Management facilitated four deliberative forums for us that took place across our regions in Clacton, Harrow, Folkestone and Bishops Stortford. The purpose of these events was to gain insight about the range and diversity of customers' views and in particular on the subject of acceptance for the draft Business Plan.

We wanted to understand whether they felt we proposed the right balance between the service they receive and the bill they pay. We asked customers their views on our proposed measures of success and whether these adequately enable them to judge our performance. We also tested the style, content and language of our Business Plan consultation document.

A total of 200 customers attended the deliberative forums. Engagement was qualitative via discussions in small groups at tables. Some of the key messages captured on the day were:

- Customers hold mainly positive views about us, but they know very little about us.
- The more they learn, they more they feel they are receiving value for money.
- We compare favourably to other utility companies in other industries.
- Water meters are a good way of changing behaviour and improving water efficiency.

- Some issues of concern to delegates included water meters leading to higher bills for some vulnerable groups, water pressure, hardness, appearance and taste. In addition, some concern over our ownership.
- For most, the proposed rate of investment and increase to bills is acceptable.
- Most agree with the proposed measures and in the case of disruptions, would like to see the disruption time of 12 hours decreased.
- Customers would like us to make it easier for them to contact us by providing more contact channels.
- Our Business Plan document was considered accessible and easy to understand, though a shorter summary might be an attractive option.

10.10 Let’s Talk Water

10.10.1 Introduction

Throughout the summer of 2013, we ran our ‘Let’s Talk Water’ campaign. We developed a series of questions with discrete answers (yes or no, or a number between 1 and 10) to help us understand customer views on a wide range of aspects of their water service. Some of the questions related to water resources planning, and we felt it was important to highlight those in our WRMP. The full report is appended to Technical Report 3.8: *Engaging Customers in Future Planning*.

We received over 3,600 responses from customers across our operating area:

- 84% were from customers in our Central region;
- 9% were from customers in our East region;
- 6% were from our Southeast region;
- Whilst 1% did not tell us which region they lived in.

Survey respondents also advised us whether they had a meter and age grouping, allowing us to cross-cut the responses to check for trends in these sub-groups of customers.

Customers were also invited to leave comments on completion of the survey.

It is worth noting that the response to Let’s Talk Water was entirely self-selecting, and that it is not necessarily statistically representative of the demographics in our regions. As such, the response to Let’s Talk Water provides insight to our customers’ preferences, but is less representative than other avenues of engagement that will influence our WRMP, such as the questionnaires put to our online panel.

10.10.1.1 Leakage

We asked customers: should we continue to search for and fix all leaks – both visible and hidden – even if it costs more than the value of water that is lost?

A large proportion of survey respondents, 78%, would like us to find and repair leaks even if it is more expensive than other ways to supply water. This correlates well with our other consultation feedback, with a majority supporting leakage reduction beyond the economic level.

The results are shown in Figure 53.

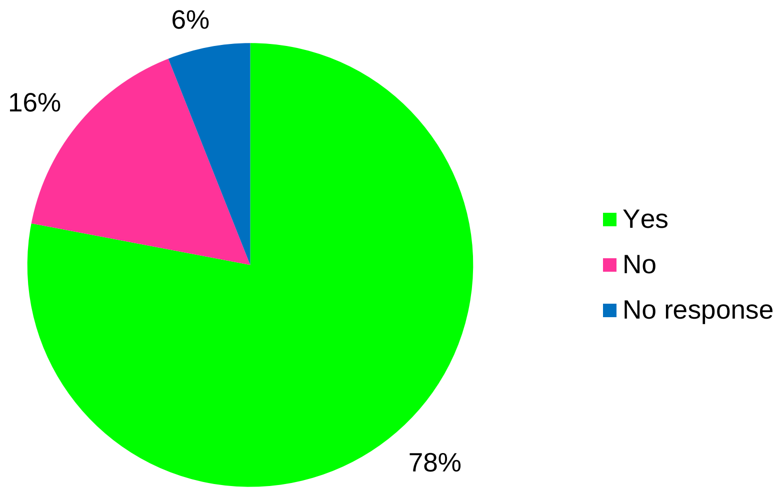


Figure 53: Let's Talk Water: should we fix leaks beyond the economic level?

10.10.1.2 Water efficiency

We asked customers: how important is it to you to use water carefully?

Survey respondents were asked to select a number between 0 and 10, where 0 indicates "don't really care" and 10 indicates "very important".

The response to this question is given in Figure 54, and shows that a significant majority think that it is important to use water carefully.

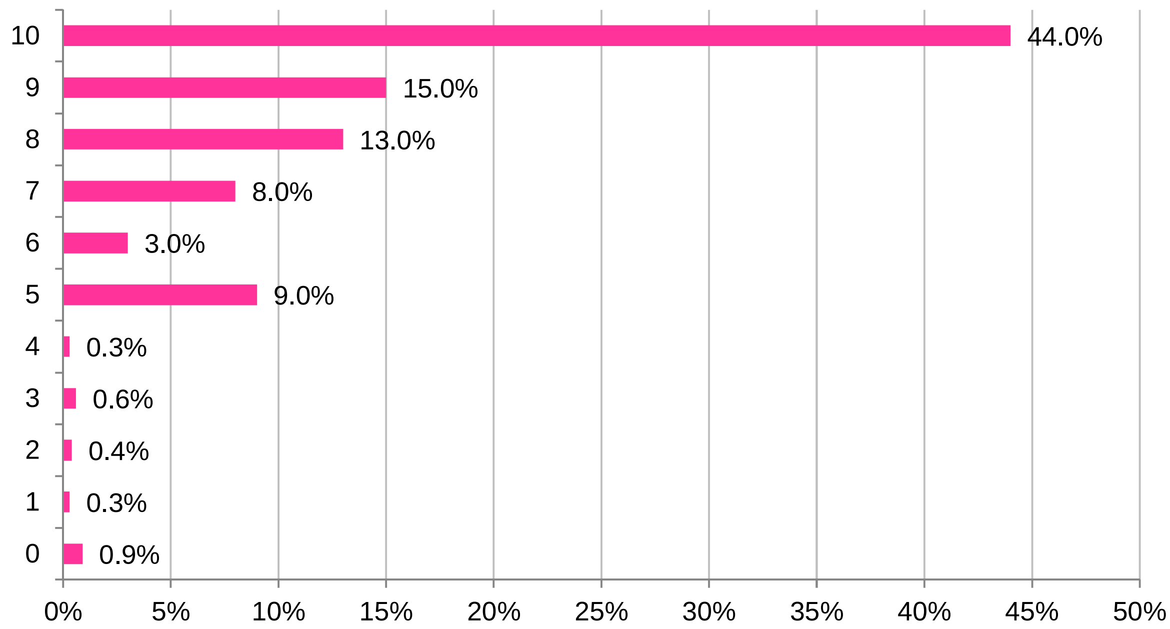


Figure 54: Let's Talk Water: how important is it to use water carefully?

10.10.1.3 *Metering*

We asked customers: do you think that a water meter is the fairest way to charge for supplying water?

The results are show in Figure 55.

79% of customers agreed that water meters are the fairest way to charge for water. This correlates well with the responses we received when asking the same question from other avenues of engagement, such as our online panel.

Further analysis of the responses identified that customers who already had a meter believed water meters were the fairest way to pay for water (93%) compared to unmeasured customers (60%).

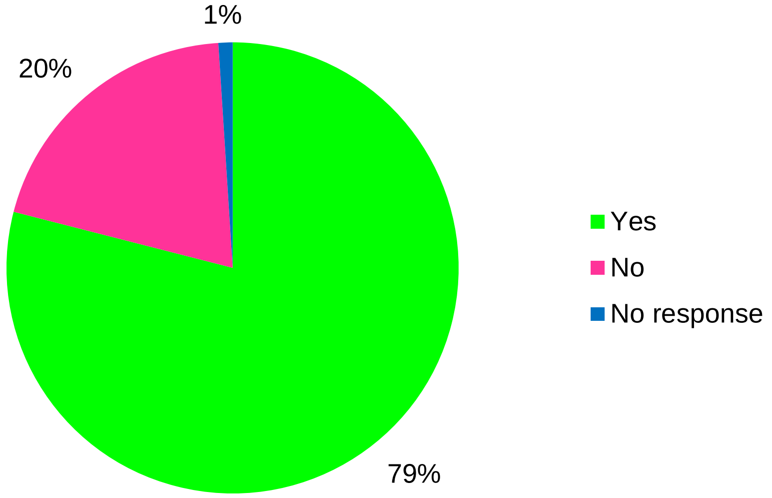


Figure 55: Let's Talk Water: is metering the fairest way to pay?

10.10.1.4 *Sustainability & Abstraction*

We asked customers: what priority should we place on reducing the amount of water we take from underground sources to leave more water for rivers?

Survey respondents were asked to select a number between 0 and 10, where 0 indicates "don't really care" and 10 indicates "very important".

The results are shown in Figure 56.

Whilst a large proportion believes reducing our groundwater abstraction to improve river flows is important, there are also a significant number of respondents who do not have a strong opinion.

It is also interesting to note that 9% of respondents do not care whether more water is left for rivers.

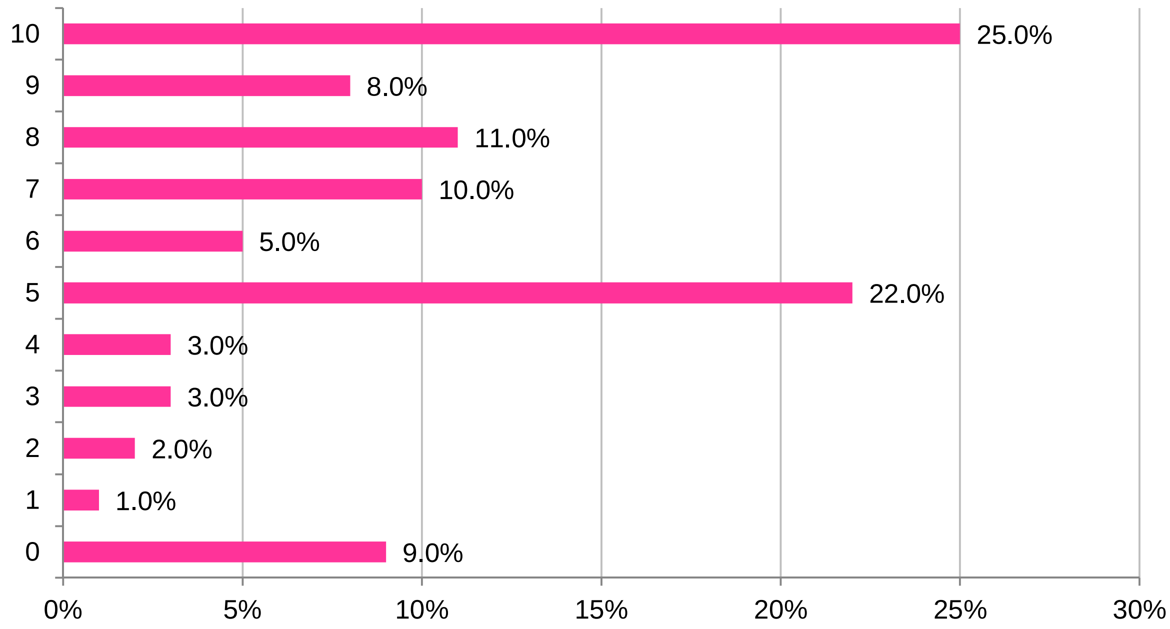


Figure 56: Let’s Talk Water: what priority to place on reducing groundwater abstraction to leave more water for rivers?

10.11 Assurance

To ensure that we had correctly interpreted the responses to our draft WRMP consultation and the other avenues of engagement, we commissioned independent studies to review our analysis and identify the key themes that we needed to address in our Statement of Response.

The details of the third party assurance and analysis are given in the appendices to Technical Report 3.8: *Engaging Customers in Future Planning*.

11 Our Preferred Plan for Customers & Communities

11.1 Introduction

As we set out in Section 1, our objectives in the development of our water resources strategy were:

- To meet the water supply needs of our customers over the next 25 years;
- To ensure that our water abstractions are sustainable and do not damage the environment;
- To reduce leakage from underground water pipes where the savings justify the expenditure;
- To extend customer water metering, where economic, in the interests of fair charging and demand management;
- To promote water efficiency as an aid to reducing demand;
- To take account of potential future uncertainties including climate change and higher environmental standards;
- To work closely with other water companies in our region to share water resources.

To meet our WRMP objectives, we have shown that we have:

- Consulted with customers and stakeholders to ensure that our plan takes account of their views;
- Engaged with water industry regulators and statutory consultees.

We have changed our WRMP in response to the consultation as detailed below and this has altered the scope, scale and timing of investments, however **our overall strategy** of leakage reduction and, in our Central region, universal metering coupled with enhanced water efficiency activities, making best use of existing resources and bulk imports **remains consistent with our draft WRMP**.

11.2 How we have changed our WRMP in response to the consultation

We have made the following amendments to our WRMP as a result of the representations we received from consultees responding to our draft WRMP consultation.

- We have **carried out a substantial amount of customer and stakeholder consultation** using a variety of methods to establish support for the proposals in our draft WRMP. Generally, our plans were supported. A number of consultees asked for our abstractions to be reduced further, even when not cost beneficial. We have agreed with the Agency where sustainability reductions are to be undertaken where they are found to be cost beneficial and our WRMP remains compliant with the latest information from the Agency (NEP3, August 2013). In our Business Plan, investment is included under our National Environment Programme to implement the confirmed sustainability reductions and continue the investigation of the impact of our abstractions on the environment.

- We have also carried out **willingness to pay and bill acceptability studies**. Customers have demonstrated clear preferences for demand management measures (leakage and water efficiency) over increasing abstraction from rivers. Customers that we have engaged with as part of our wider consultation share generally the same views as the consultees responding to our draft WRMP consultation.
- We have **slowed our universal metering programme**, in response to the Consumer Council for Water's comments, so that metering will be delivered approximately equally over two AMPs. We have been developing our communications campaign, taking account of reports such as the Consumer Council for Water's report *The Customer Impact of Universal Metering Programmes (May 2013)*.
- We have continued to work on our **delivery programme for household metering and water efficiency** as well as the introduction of social tariffs and the transition plan to support our customers, as requested by the Consumer Council for Water. We have considered the impact of transitional arrangements on achieving demand savings and to compensate for this, we have enhanced our communications and water efficiency provisions. In this way, we have managed the risk such that it does change the options in our Preferred Plan.
- We have improved our water efficiency programme to **include more educational awareness** and expand the future role of our Education Centre team in Bushey, as many of our customers would like to see us working more with local schools to educate the next generation. We have been able to do this without increasing costs by changing the balance of components of our overall water efficiency programme; this does not have an effect on the options chosen in our Plan.
- We have thoroughly **reviewed our levels of service analysis**, in response to comments from both the Agency and Ofwat, and provided further evidence in support of our assessment. This does not have an impact on the options selected in our Preferred Plan. We will update our Drought Management Plan in 2014 with these changes.
  - We plan to introduce a **delay to the implementation of temporary use restrictions for economically vulnerable non-household customers**, such that they receive a slightly higher level of service.
  - We will explain that **emergency drought orders for additional abstraction** where it harms the environment would be at **no greater frequency than 1 in 118 years**.
  - We will clarify that we consider **emergency drought orders for the use of standpipes are unacceptable** and we are not planning for their use in anything other than civil emergency conditions.
- We have undertaken additional detailed analysis as to how we can continue to supply customers after the **implementation of sustainability reductions**, without affecting their levels of service. There is an additional cost associated with this work that we highlighted in our draft Plan. We have concluded our investigations and are able to explain where we need to make changes to our infrastructure to preserve resilience and the quality of water supplied to our customers for the sustainability reductions to be delivered in AMP6. We have defined all individual project investments to implement what we need to do and how much it will cost, and are pleased to inform our customers that this will cost less than we identified in our draft WRMP. Any infrastructure changes that arise from notification of sustainability reductions under the next round of River Basin Management Plans will be considered at the same time as our AMP7 considerations.
- We have taken account of the **latest Census data** (2011) in our revised demand forecast. As population is projected to grow at a faster rate than we expected in our draft WRMP, and that our base population was greater than we had planned for in our draft WRMP, we have

had to introduce new options to meet the deficits, particularly towards the end of the planning period.

- We have reviewed our **headroom assessment** for our baseline demand forecast to ensure we had fully considered all of the uncertainties around our supply / demand balance. We have responded to feedback on our Plan from Anglian Water and allowed for uncertainties in our supply from our shared resource, Grafham Water. Details of this change are included in our revised WRMP.
- We have accounted for the **impacts of climate change on our options** in our modelling, as requested by the Agency. This affects a small number of groundwater schemes, and results in these options being less cost-beneficial later in the planning period and so less likely to be selected.
- We have **concluded our negotiations with regard to bulk transfers of water from our neighbouring water companies and other third party suppliers** so that our respective Plans are consistent with WRSE, as requested by the Agency, Ofwat and the Consumer Council for Water. We show our proposed utilisation of the agreed bulk transfers in section 11.4 of our revised WRMP. We have continued to participate in the concluding phase of work of the WRSE project and are pleased with the alignment between our proposals and the outcomes of the WRSE modelling.
- We have **removed a third party licence groundwater option from our feasible options list** in response to the Agency's concerns that there was no existing licence at this location. This option was selected in our draft WRMP but is no longer available for our revised WRMP.
- We have **run additional scenarios** to address customers' views, for example offering reservoirs and desalination options taking account of their significant impact on the environment. We have also run scenarios where all options that have been classified as high and medium risk with respect to the environment are not available, to show the impact on costs.
- We have reflected the **uncertainty of our Preferred Plan in our headroom assessment**, as required by the Agency, and discussed its impact on our WRMP. Some consultees were concerned we had insufficient headroom and that we were overly reliant on our proposed universal metering programme and bulk transfers from other water companies, who may be unable to meet our needs if they are experiencing a drought. We have also considered contingency options that we may need to develop should our Preferred Plan fail to deliver the benefits projected.
- We have **continued to assess the environmental impact of our options** as part of our SEA, as requested by the Agency and Natural England. Our assessment is that the options in the first ten years of our Preferred Plan will not cause deterioration in ecological status in accordance with the Water Framework Directive and that the options in the remainder of the planning period are very unlikely to cause deterioration. We will continue to review our future projects as part of our annual review of our WRMP, and will investigate potential deterioration effects as necessary so that we are able to draw firm conclusions to ensure no deterioration through adoption of alternative solutions well before any option is included in subsequent WRMPs. This approach does not affect the selection of options in our modelling.
- We will **develop a non-technical summary document** to accompany our WRMP, as suggested by the Consumer Council for Water, to aid customer and stakeholder understanding. We will follow the style of our Business Plan consultation document, which was generally well received. We will publish our non-technical summary together with our final WRMP.

11.3 Preferred Plan Summary

11.3.1 Overview

As we have a supply / demand deficit in five of our eight zones at the beginning of the planning period and in seven zones by 2040, we have revised our Preferred Plan as a result of our consultation to account for customer and stakeholder views and in light of the refinement of data and improvements to our modelling. Our **East region, WRZ8, remains in surplus throughout the planning period** and no water resources investment is required.

We are pleased to note that **customers generally support our proposals**. The situation in our Southeast region, WRZ7, has also improved since the publication of our draft WRMP. Sustainability reductions in the Little Stour are not now required and therefore water resources investment to 2020 is significantly lower and the only scheme required is flow augmentation on the Little Stour. This investment is included in our Business Plan.

As such, **the strategy of our draft WRMP** with its focus on demand management, leakage reduction and sharing water across the South East of England **remains valid for our revised WRMP**. We have made a number of refinements to our proposals to account for the feedback we received during the consultation period.

Our Preferred Plan provides for sustainable development of resources, **minimal impact on the environment** and best value to customers. We believe our Preferred Plan represents **good value for money** and **equity for customers** as we work together with our communities to ensure there is enough water for our customers and the environment, now and in the future.

In the **immediate five years**, from 2015 to 2020, our Preferred Plan derives:

- A saving of **20Ml/d** in distribution leakage through a number of methods;
- Over **29Ml/d** from universal metering by AMR in four of our six water resource zones in the Central region (with the remaining two WRZ delivered in the following five-year period). This includes 7Ml/d from the repair of leaking customer supply pipes, and around 4Ml/d from the distribution of water efficient devices and in-home water efficiency audits;
- Approximately **2Ml/d** from water efficiency, targeted at our non-domestic customers to help them identify ways to use less water in the operation of their businesses;
- An extra **2Ml/d** from our existing licences, by increasing the amount we abstract without causing damage to the environment. These options also give us an extra 11Ml/d during peak conditions;
- That we buy **17Ml/d** of water from our neighbouring water companies as a bulk transfer of water to make sure we have enough capacity to meet the needs of our customers.

We have reviewed our options in light of the requirements set out by the **Water Framework Directive** and the need to prevent deterioration in ecological status arising from our proposals. We discuss our approach in section 11.8.

Our WRMP includes a small provision for investigative works on options scheduled for delivery beyond AMP7 so that we may continue our assessment, and, should the risk of causing deterioration be high, consider alternative options. We will continue to review our future projects as part of our annual review of our WRMP, and will **investigate potential deterioration effects** as necessary so that we are able to draw firm conclusions to ensure no deterioration through adoption of alternative solutions well before any option is included in subsequent WRMPs.

We have also balanced the challenge of **implementing the sustainability reductions** described in section 4.4.1 with the need to maintain a resilient network and security of supply to our customers. Whist our Preferred Plan ensures that there is enough water for everyone in all of our WRZ, at a more granular level of detail we need to invest to remove constraints in our network. We describe our work to assess the investment required in section 11.9.

We recognise the **importance of flexibility and resilience** in preparing our Plan and in addressing the significant challenges and uncertainties we face. We have prepared a change protocol to be able to react flexibly to requirements that are made outside of the price review process. We summarise how our revised WRMP provides for this flexibility in section 11.10

We have considered the sensitivity of our proposals to a number of factors and have chosen a Preferred Plan that is a **balance of demand management and supply side measures**, and therefore risk. As our Plan includes an ambitious but achievable demand management programme, we have further supply-side options available in reserve should the preferred strategy options fail to deliver their designed benefits. Section 11.12 discusses the uncertainty of our Preferred Plan and our contingency options.

The modelling constraints we applied beyond the least-cost plan to determine our Preferred Plan were:

- The exclusion of high environmental risk options.
- Additional leakage, beyond the economic level.
- The selection of water efficiency for our non-household customers in all of our WRZ.
- Universal metering in our Central region, such that all six WRZ were selected by 2025 to achieve 90% meter penetration of our household customers, although at a slower rate than we proposed in our draft WRMP.

We describe the development of our Preferred Plan options in Figure 57, by highlighting the scenarios that we have used to build our Preferred Plan.

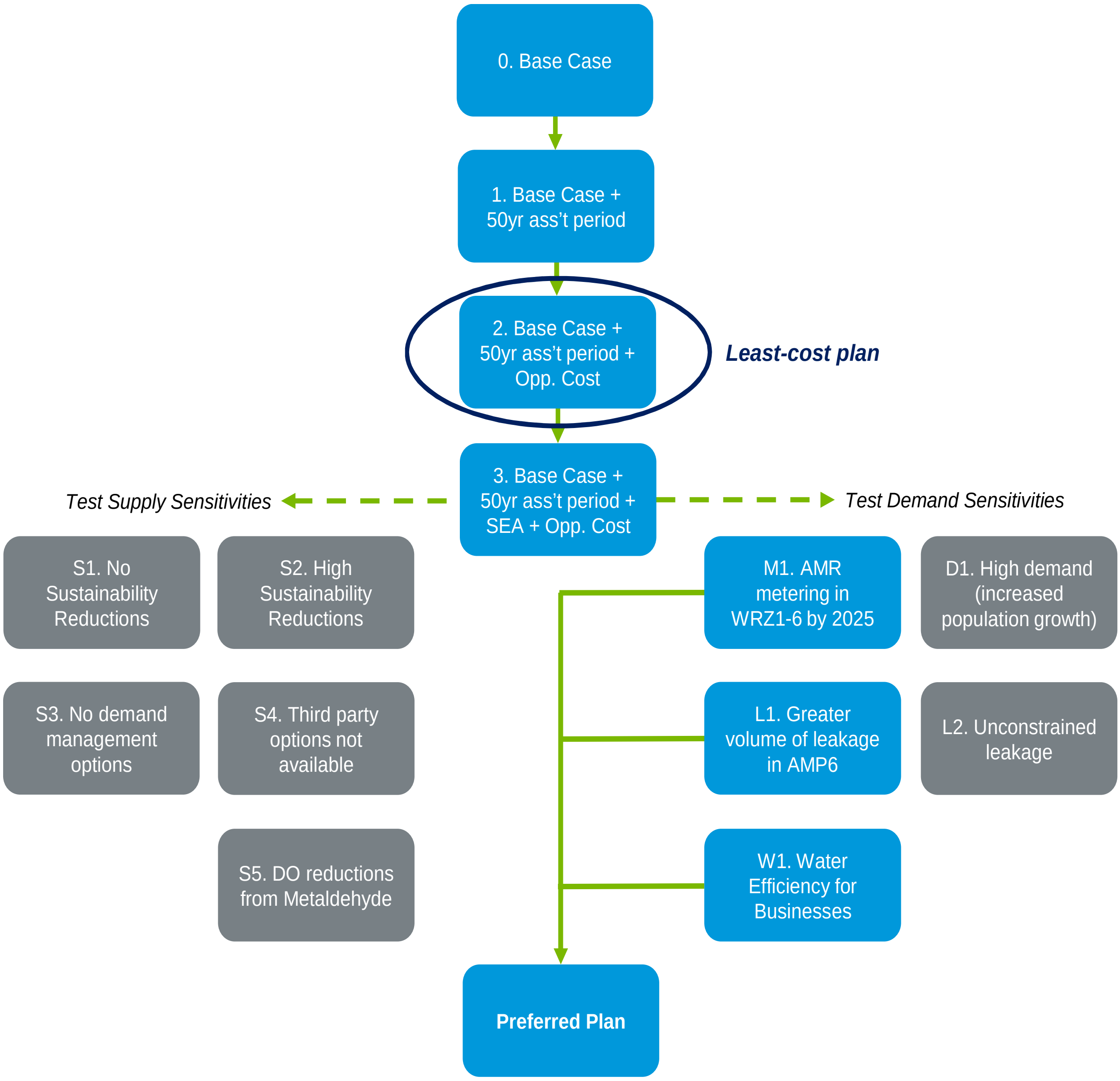


Figure 57: Scenario map with Preferred Plan components highlighted

11.3.2 The cost of our Preferred Plan

Table 26 shows the breakdown of total cost by component, including both the investment programme and all existing source supply costs, which also includes existing bulk supplies from neighbouring companies. The costs are shown in the five-year period in which they are incurred, and are presented in 2011/12 prices. The costs shown include capital investment, operational expenditure, capital maintenance, and environmental, social and carbon costs.

Total Expenditure, £ millions	AMP6 2015-20	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	TOTAL 2015-40
Leakage	19.08	14.71	18.22	31.85	44.01	127.87
Metering	57.85	51.29	3.76	35.21	31.23	179.34
Water efficiency	3.16	2.20	0.28	1.07	2.57	9.28
Demand Management schemes	**80.09**	**68.20**	**22.26**	**68.13**	**77.81**	**316.49**
Supply (ground & surface water)	5.26	1.96	0.71	5.52	26.90	40.35
Bulk transfers	0.59	0.60	0.45	2.10	2.90	6.64
Network improvements	0.00	6.73	5.97	2.18	7.67	22.55
Supply side schemes	**5.85**	**9.29**	**7.13**	**9.80**	**37.47**	**69.54**
Total per AMP for Supply and Demand	**85.94**	**77.49**	**29.39**	**77.93**	**115.28**	**386.03**
WFD no deterioration investigative works	0.25	0.25	0.25	0.25	0.25	1.25
Delivery of Sustainability Reductions *	13.54	0.00	0.00	0.00	0.00	13.54
TOTAL	**99.73**	**77.74**	**29.64**	**78.18**	**115.53**	**400.82**

Table 48: Summary of Preferred Plan costs

* *See section 11.9. Expenditure to mitigate sustainability reductions beyond AMP7 has not been determined. Our change protocol will apply to ensure that we meet our obligations.*

Our plan is not least cost as we think it is important we have a range of measures to balance the risk in delivery and benefit. We consider the provision of flexibility and resilience to maintain security of supplies to customers is of paramount importance.

Overall, we believe the additional social, environmental and economic benefits offered by our Preferred Plan offers best value to customers, stakeholders and the environment.

We describe customer and stakeholder support for our Preferred Plan in section 11.5.

11.4 Comparing our Preferred Plan and the least-cost plan

11.4.1 Introduction

Our Preferred Plan builds on the Base Case scenario, considers a longer assessment period (and therefore can determine options with lower whole-life costs), accounts for the opportunity cost of bulk transfers of water, and the conclusions and preferences from customer research and the results of our SEA.

In this section, we compare our Preferred Plan with our least-cost plan to explain the decisions we have made. Our least-cost plan, scenario 2 from Figure 57, is described in section 9.6.2.4.

11.4.2 Cost comparison

11.4.2.1 Summary

Table 49 compares the costs of our Preferred Plan and least-cost plan for the five-year period of 2015-2020 (AMP6) and the total cost for the planning period (2015-40). The costs are presented in 2011/12 prices and include capital investment, operational expenditure, capital maintenance, and environmental, social and carbon costs.

Total Expenditure, £ millions Capital Investment, Fixed & Variable Operational Expenditure, Capital Maintenance and Environmental, Social and Carbon costs	**Preferred Plan**		**Least-cost plan**	
	AMP6 (undiscounted)	Total 2015-40 (NPV)	AMP6 (undiscounted)	Total 2015-40 (NPV)
Leakage	19.08	60.24	15.52	43.68
Metering	57.85	81.22	44.6	54.25
Water efficiency	3.16	5.17	0.00	3.32
Demand Management schemes	**80.09**	**146.63**	**60.12**	**101.25**
Supply (ground water)	5.26	6.08	6.54	5.91
Supply (surface water)	0.00	0.00	0.00	10.45
Bulk transfers	0.59	2.19	0.70	3.36
Network improvements	0.00	9.76	4.88	14.03
Supply side schemes	**5.85**	**18.03**	**12.13**	**33.76**
Total per AMP for Supply and Demand	**85.94**	**164.66**	**72.25**	**135.01**

Table 49: Comparing the costs of our revised WRMP Preferred Plan with the least-cost plan

We have excluded the WFD ‘no deterioration’ works and the delivery of sustainability reductions from the cost comparison as they would be the same for both our Preferred Plan and the least-cost plan.

The difference in costs between the two plans is driven by the specific options selected and the timing of their delivery to solve the supply / demand balance.

Both of the plans have the same ‘maximum’ leakage reduction constraint per AMP (as identified in Table 37) but the Preferred Plan has additional requirements, specifically relating to metering and water efficiency.

The least-cost plan is able to select options that have, as a result of our strategic environmental assessment, been classified as having a high environmental risk, such that it can select cheaper options that are not available to our Preferred Plan where we have excluded the high environmental risk options in accordance with the outcome of our SEA consultation and Environmental Report for this revised Plan.

Further detail is provided in the next sections.

11.4.2.2 Leakage

Our Preferred Plan includes a larger leakage reduction programme than our least-cost plan. As explained in section 9.5.2, the cost to detect and repair leaks increases with proximity to the background level of leakage, i.e. the cost per mega litre of leakage reduction is not linear.

Not only does our Preferred Plan identify a larger leakage reduction in AMP6, the total leakage reduction over the planning period is also much greater. The volume of leakage in our Preferred Plan is close to the volume of leakage selected by our unconstrained leakage scenario L2, described in section 9.7.2.1.

Option Type	Period	DYCP yield in Preferred Plan (Ml/d)	DYCP yield in least-cost plan (Ml/d)
Leakage (all options)	2015-20	20.00	16.86
	2020-25	24.75	29.36
	2025-30	29.50	30.95
	2030-35	37.50	31.60
	2035-40	49.27	32.12

Table 50: Comparison of cumulative yield developed by leakage options in each quinquennium

The least-cost plan does not select leakage reduction by ALC beyond AMP8, and selects no leakage reduction at any point in the planning period in our Southeast region.

The difference in scope and scale of our leakage reduction programmes for our revised WRMP Preferred Plan and last-cost plan are presented in Table 51 and Table 52 respectively.

WRZ	Leakage reduction selected by our Preferred Plan					Total Leakage Reduction
	2015-20	2020-25	2025-30	2030-35	2035-40	
1	4.00	3.00	0.00	3.00	0.00	**10.00**
2	5.50	0.00	4.50	0.00	4.12	**14.12**
3	3.50	0.00	0.00	2.40	2.01	**7.91**
4	3.50	0.00	0.00	2.40	0.00	**5.90**
5	2.00	1.50	0.00	0.00	0.00	**3.50**
6	1.50	0.00	0.00	0.00	0.73	**2.23**
7 *	0.00	0.25	0.25	0.00	0.00	**0.50**
Total	**20.00**	**4.75**	**4.75**	**7.80**	**6.86**	**44.16**

Table 51: Leakage reduction by ALC selected per WRZ in each AMP by our Preferred Plan

* *We have forced 0.25Ml/d into AMP6 and AMP7 for WRZ7 in our Preferred Plan, which otherwise would not select any leakage by ALC for our Southeast region.*

WRZ	Leakage reduction selected by the least-cost plan					Total Leakage Reduction
	2015-20	2020-25	2025-30	2030-35	2035-40	
1	3.48	3.50	0.00	0.00	0.00	**6.98**
2	5.50	4.50	0.00	0.00	0.00	**10.00**
3	2.47	3.00	0.00	0.00	0.00	**5.47**
4	3.50	0.00	0.00	0.00	0.00	**3.50**
5	1.91	1.50	0.00	0.00	0.00	**3.41**
6	0.00	0.00	1.28	0.00	0.00	**1.28**
7	0.00	0.00	0.00	0.00	0.00	**0.00**
Total	**16.86**	**12.50**	**1.28**	**0.00**	**0.00**	**30.64**

Table 52: Leakage reduction by ALC selected per WRZ in each AMP by the least-cost plan

As explained in section 8.4.2.4, there are a number of different leakage reduction options available to us. Whilst ALC options provide the greatest volume, other options are selected in both our Preferred Plan and the least-cost plan. Our Preferred Plan selects more of these types of options in total. See Table 53.

Option Type	Period	DYCP yield in Preferred Plan (Ml/d)	DYCP yield in least-cost plan (Ml/d)
Leakage (excluding ALC)	2015-20	0.00	0.00
	2020-25	0.00	0.00
	2025-30	0.00	0.32
	2030-35	0.20	0.97
	2035-40	5.11	1.49

Table 53: Comparison of cumulative yield developed by non-ALC leakage options in each quinquennium

11.4.2.3 Metering

The metering options selected by both the Preferred Plan and the least-cost plan in all WRZ is the community integrated demand management scheme, with water efficiency and customer supply pipe leakage repairs, using AMR technology. As described in section 8.4.3, AMR is a more cost-beneficial option than change of hands or optant metering only programmes.

Metering is selected in all of our Central region WRZs in our revised WRMP least cost plan, but delivery is in two parts with WRZ1, 4, and 5 delivered in AMP6 with the other WRZ selected to be delivered at the end of the planning period from 2034, a gap of nearly 15 years. We felt that this approach with customers would be inequitable and lead to higher costs as a result of unacceptability of individual installation, so we propose that we universally meter all WRZ by

2025 in our revised WRMP Preferred Plan. Table 54 illustrates the metering delivery programmes in our revised WRMPs, comparing the least-cost plan with our Preferred Plan.

WRZ	Delivery year in revised WRMP Preferred Plan	Delivery year in revised WRMP least-cost plan
1	**2017**	2015
2	**2019**	2036
3	**2018**	2034
4	**2022**	2018
5	**2015**	2020
6	**2024**	2038

Table 54: Timing of universal metering in our Central region, comparing draft and revised

The yield derived by universal metering is the same at DYAA and DYCP. Table 55 compares the yield developed by the metering programmes of our Preferred Plan and the least-cost plan.

Option Type	Period	DYCP yield in Preferred Plan (Ml/d)	DYCP yield in least-cost plan (Ml/d)
Metering	2015-20	29.24	24.51
	2020-25	55.12	28.05
	2025-30	49.92 *	24.88 *
	2030-35	48.75	36.14
	2035-40	48.75	52.52

Table 55: Comparison of cumulative yield developed by metering in each quinquennium

* *The water efficiency component of the metering option decays over time, generally between 5 and 10 years.*

11.4.2.4 Water efficiency

Water efficiency options develop the same yield at DYAA and DYCP. The least-cost plan does not select any water efficiency options until 2029. As a result, there is very little decay on the yield associated with the water efficiency options, giving the impression that more water efficiency has been selected. See Table 56. In fact, the exact same options are selected, but they are spread over the planning period in our Preferred Plan. In response to stakeholder feedback, we have included the delivery of commercial water efficiency options for each WRZ in our Preferred Plan, such that they are delivered in the same five-year period as the universal metering option in that zone (for our Central region), and in AMP7 for our Southeast region (when there is a deficit in the supply / demand balance).

Option Type	Period	DYCP yield in Preferred Plan (Ml/d)	DYCP yield in least-cost plan (Ml/d)
Water efficiency	2015-20	1.87	0.00
	2020-25	2.52	0.00
	2025-30	1.23 *	0.03
	2030-35	1.43	2.65
	2035-40	3.24	6.90

Table 56: Comparison of cumulative yield developed by water efficiency in each quinquennium

* *Water efficiency yield decays over time, generally between 5 and 10 years.*

11.4.2.5 Supply: groundwater

Until 2035, our Preferred Plan selects smaller yields at both DYAA and DYCP than the least-cost plan. In AMP10, from 2035, our Preferred Plan solves the supply / demand balance by selecting a number of groundwater schemes that collectively provide 11.65Ml/d. We resolve the supply / demand balance in our Southeast region without using any groundwater options. The least-cost plan is able to select options that have been classified as presenting a high environmental risk, some of which have a large yield and seemingly low costs (see section 11.4.2.6). This means that the least-cost plan is less reliant on groundwater sources in the last five years of the planning period. See Table 57.

Option Type	Period	DYAA yield in Preferred Plan (Ml/d)	DYCP yield in Preferred Plan (Ml/d)	DYAA yield in least-cost plan (Ml/d)	DYCP yield in least-cost plan (Ml/d)
Supply (Groundwater)	2015-20	1.97	10.92	1.97	10.92
	2020-25	2.08	11.33	2.22	13.47
	2025-30	2.38	11.92	2.71	13.90
	2030-35	2.38	11.85	2.71	13.83
	2035-40	9.78	23.50	3.02	14.42

Table 57: Comparison of cumulative yield developed by supply schemes in each quinquennium

11.4.2.6 Supply: surface water (reservoirs)

The option included in the least-cost plan utilises an existing reservoir owned by the Canal & River Trust that supports the canal network, and provides 14.5Ml/d at average and 18.85Ml/d at peak (ID 832). The reservoir is also designated as a Site of Specific Scientific Interest (SSSI) and a Local Nature Reserve, and is used for flood mitigation. This option was identified by our SEA to present a high risk to the environment due to the work involved to develop the reservoir for our use, the need to install further water treatment, and the high pumping costs to lift water from the River Brent to the Grand Union Canal in order for the water to be carried to our treatment works.

Our Preferred Plan does not include building any new reservoir options as they were excluded through the screening process used in preparation of our Strategic Environmental Assessment. Details are provided in Technical Report 3.8: *Environmental Report* and its appendices.

Option Type	Period	DYCP yield in Preferred Plan (Ml/d)	DYCP yield in least-cost plan (Ml/d)
Reservoirs	2015-20	0.00	0.00
	2020-25	0.00	0.00
	2025-30	0.00	0.00
	2030-35	0.00	18.85
	2035-40	0.00	18.85

Table 58: Comparison of cumulative yield developed by reservoirs in each quinquennium

However, it should be noted that we do promote an option to return our own currently non-operational storage reservoir to service (see section 11.4.2.8), which we release by installing new pipework and treatment (ID 622). This option was not excluded by our SEA as the reservoir already exists and is near to our treatment works. It is classified as a 'network improvement option'. However, the site is a local nature reserve so we will be working with local environmental groups to protect any habitats in conjunction with the recommissioning process.

11.4.2.7 Bulk transfers

Both our Preferred Plan and the least-cost plan select the same transfers during the planning period, but the least-cost plan selects some options earlier as shown in Table 59. This results in increased bulk transfer costs for the least-cost plan.

Option Type	Period	DYCP yield in Preferred Plan (Ml/d)	DYCP yield in least-cost plan (Ml/d)
Bulk transfers	2015-20	17.00	17.00
	2020-25	19.00	19.00
	2025-30	18.80 **	18.80 **
	2030-35	18.80	19.80
	2035-40	22.50	22.50

Table 59: Comparison of cumulative yield developed by bulk transfers in each quinquennium

** *At South East Water's request, the yield associated with their bulk supply to our WRZ7 reduces from 2Ml/d to 1.8Ml/d.*

11.4.2.8 Network improvements

The network improvement options selected in both our Preferred Plan and the least-cost plan are the same; however, the costs are less in our Preferred Plan as the options are implemented later in the planning period. See Table 60.

Option Type	Period	DYCP yield in Preferred Plan (Ml/d)	DYCP yield in least-cost plan (Ml/d)
Network improvements	2015-20	0.00	0.00
	2020-25	0.00	28.00
	2025-30	29.32	31.32
	2030-35	31.32	31.32
	2035-40	32.72	32.72

Table 60: Comparison of cumulative yield developed by network constraints in each quinquennium

11.4.3 Balancing supply and demand

Our revised WRMP Preferred Plan and least least-cost plan both fully resolve the supply / demand balance with a range of option types. We believe our Preferred Plan is a better balance for our customers, stakeholders and the environment than our least-cost plan.

The graphs presented in Table 61 are at company level and relate to the balancing of supply and demand. Points of note include:

- Our Preferred Plan includes a larger programme of leakage reduction than our least-cost plan.
- Our Preferred Plan reduces demand more swiftly than our least-cost plan due to the smooth delivery of our universal metering programme in our Central region. The least-cost plan delivers metering in two distinct periods, with three WRZ in AMP6 and the remaining WRZ from 2034.
- The least-cost plan does not select any water efficiency options in the first ten years of the planning period.
- Our Preferred Plan generates fewer supply schemes than our least-cost plan, as we have promoted more demand management schemes. As a result, our Preferred Plan has a smaller impact on the environment.
- Demand is lower at the end of the planning period in our Preferred Plan.

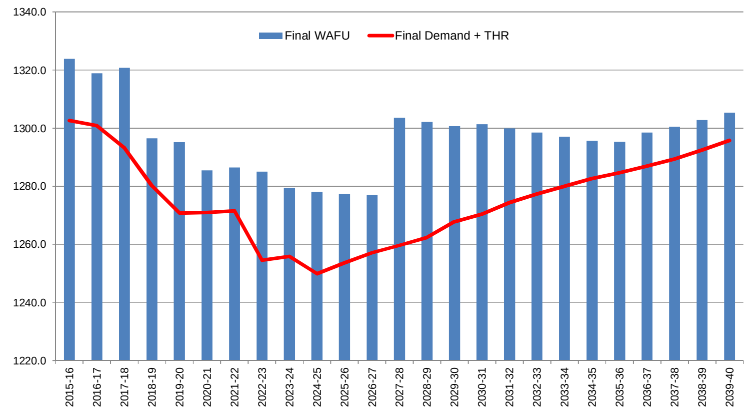
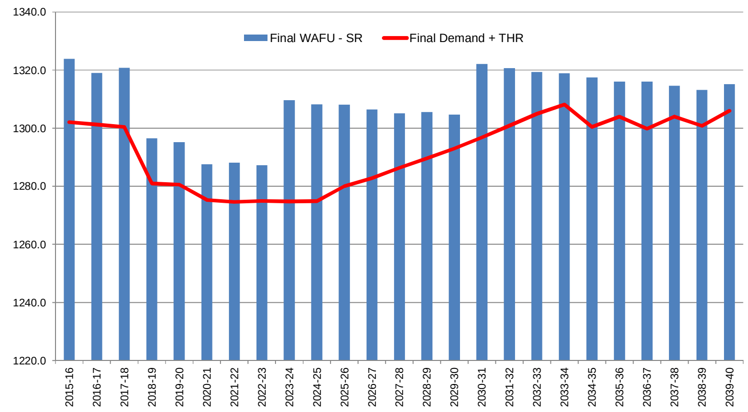
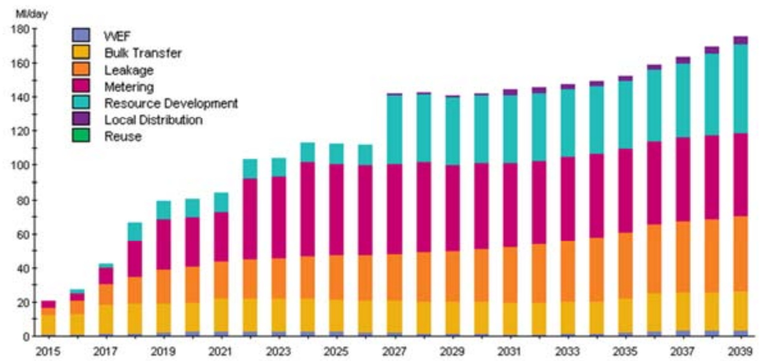
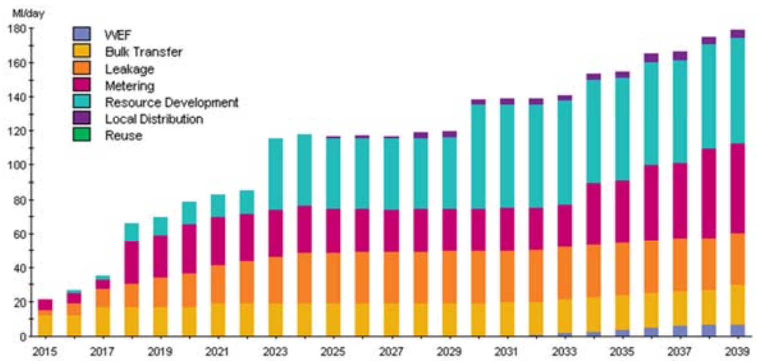
Aspect	Preferred Plan	Least-cost plan	Comments
Supply / demand balance: reduction in demand (DYCP) *			Greater reduction in demand in Preferred Plan, particularly in early years; fewer supply options needed. Demand is lower at the end of the planning period.
Range of options (DYCP) *			More groundwater (supply) options selected to balance demand in least-cost plan. Metering not required in all WRZ. Less leakage.

Table 61: Comparing our Preferred Plan with the least-cost plan

* *Note that the graphs presented show the available capacity of the options, not the utilisation*

11.4.4 Risk assessment

In order to ensure that our Preferred Plan met the objectives of the WRMP, we included a risk assessment process to evaluate the scenarios. The risk factor categories are shown in Table 62 along with the maximum score available in each category (the higher the score, the higher the risks associated with that scenario).

Risk Factor	Description of Risk	Risk Factor Maximum Score
Reduces PCC	Does the option mix encourage a reduction in PCC to meet Government objectives? Failure to reduce PCC may result in a challenge to our plan from regulators and Government.	25
Range of Options	Is the set of options a balanced mix? Where a given solution is too dependent on particular options or option types, e.g. large proportion of groundwater and no metering, there is over-exposure to risk in delivering the benefits and limited flexibility.	25
Drought Resilience	All schemes offered to the model should operate during normal Levels of Service operations, but do schemes provide any additional resilience during a drought, and therefore benefits in addition to meeting supply / demand deficits?	25
Delivery	Is the scheme difficult to promote making delivery uncertain? Examples include accuracy of cost, environmental concerns, planning requirements or dependency on third parties.	25

Table 62: Risk factors, description and maximum score

We used a simple 5 x 5 matrix of severity and likelihood to rank the overall risk of our Preferred Plan and the least-cost plan. We compare in Table 63 the risk review of our Preferred Plan and the least-cost plan, which shows that our Preferred Plan presents less risk.

Risk Factor	Preferred Plan			Least-cost plan		
	Severity	Likelihood	Risk Score	Severity	Likelihood	Risk Score
Reduces PCC	1	2	2	2	3	6
Balanced Mix	1	1	1	1	1	1
Drought Resilience	2	3	6	2	3	6
Delivery	2	3	6	4	5	20
			15			**33**

Table 63: Risk Score for our Preferred Plan and the least-cost plan

11.5 Consultee support for our Preferred Plan

11.5.1 Introduction

We have carefully considered the requirements we have applied to determine our Preferred Plan to ensure we offer the most cost beneficial option that meets the needs of our customers, stakeholders and the environment whilst achieving the objectives of our WRMP. The key decisions were influenced by the responses to our consultation and the additional engagement activities we carried out during the summer of 2013.

11.5.2 Support for the level of sustainability reductions

We recognise that confirmed sustainability reductions will be mandated either through our regulator's notification or under the Water Framework Directive as an output from River Basin Management Plans. We felt that it could be helpful for consultees to share their views on sustainability reductions included in our WRMP to inform of the next round of River Basin Management Plans, which are due to be published by the end of 2015.

A number of consultees were supportive of the level of sustainability reductions presented in our draft WRMP. We asked customers in our draft WRMP consultation if they would be willing for bills to rise to protect local river environments; a bill rise of around £10 was suggested. Over 71% of respondents to this question agreed that they are willing for bills to rise to enable the proposed sustainability reductions to be achieved.

One of the key themes arising from our draft WRMP consultation was '*support for our plans to reduce abstraction where environmental damage is occurring, and acceptance for the impact on bills'*. The results of our engagement programme are given in section 10. Table 64 identifies the specific evidence for customer support of our sustainability reductions from our online panels and Let's Talk Water campaign.

Evidence	Source
What priority should we place on reducing the amount of water we take from underground sources to leave more water for rivers? 59% gave a stronger than neutral response – self-selecting audience 56% gave stronger than neutral response – panel	Let's Talk Water – p12, fig 2.14 and fig 3.15 p32 (Technical Report 3.8.6)
Is the local environment important to you e.g. strong flowing rivers and streams and good/diverse populations of wildlife? 87% yes	Panel 2 draft WRMP – p33 (Technical Report 3.8.2)
Should we carry out more evaluations at our water sources in order to understand the impact that taking water from them has on the local environment? 75% yes	Panel 2 draft WRMP – p34 (Technical Report 3.8.2)
Would you be prepared to see an increase in your water bill to avoid harm to the environment? The increase would be used to carry out more work to help us evaluate the effect on the local environment of taking water from that source. 59% yes	Panel 2 draft WRMP – p38 (Technical Report 3.8.2)

Evidence	Source
Would you be willing to reduce the amount of water you use to keep local streams and rivers flowing? 65% yes	Panel 2 draft WRMP – p38 (Technical Report 3.8.2)
Should we take less water from the environment in order to sustain/improve flows in streams and rivers? 49% yes 37% don't know	Panel 2 draft WRMP – p35 (Technical Report 3.8.2)
Should we reduce abstraction where this increases the likelihood of rivers drying up? 72% yes, the environment should be protected.	Panel 5 – resilience – p78 (Technical Report 3.8.2)
Should we reduce abstraction and increase average bills? Of those responding, 87% said yes. This was made up of 78% who would accept a bill rise of between £4.60 and £6.40 over 5 years with a further 9% valuing abstraction reduction at a level that they would accept a bill rise at whatever the cost.	Panel 5 – resilience – p79 (Technical Report 3.8.2)

Table 64: Evidence base for customer support of our sustainability reductions

Our online panels are statistically representative of our customer base and, together with the representations received in response to our draft WRMP consultation, demonstrate a high level of support for sustainability changes to reduce the impact of damaging abstractions on the environment.

In their representation on our draft WRMP, Natural England shared their concern that they felt we were misleading our consultees in that customers will be given a choice about whether sustainability reductions will be implemented. It was not our intention to cause confusion and many of our consultees supported our proposals, however, at this point in time we have agreed to implement these changes and in due course we expect to either receive notification of licence changes from the Environment Agency or the changes will become mandatory following consultation on the next River Basin Management Plans. Further, if funding is approved by Ofwat under the next price review, we recognise that these sustainability changes will become a regulatory output from our plans.

We will investigate the potential for further sustainability reductions from the 'uncertain' classification of sources and we have included provision through our Business Plan change protocol for the implementation of these measures, should they be confirmed to us as an outcome of the forthcoming River Basin Management Plans.

11.5.3 Support for excluding the high environmental risk options

Consultee responses from the Hertfordshire Geological Society and the Hertfordshire and Middlesex Wildlife Trust specifically stated their support for the exclusion of the high environmental risk options from our feasible options list.

Most of the consultee comments relating to our options concerned metering, leakage and water efficiency. Whilst there were a small number of comments about reservoirs and desalination, they mainly concerned resilience to drought. The frequency of comments raised by our consultees about option types, amongst other topics, is presented in the word cloud of Figure 51.

We excluded 16 schemes from our feasible options list on the grounds that they presented a high risk to the environment, for both our draft WRMP and revised WRMP. Details of the screening assessment are included in our Technical Report 3.9: *Environmental Report*.

The 16 excluded schemes included reservoirs, desalination plants and effluent reuse as well as a small number of groundwater and pipeline capacity options. Conversely, customers have told us that they would like reservoirs and desalination included in our WRMP, which conflicts with our decision to exclude them under environmental risk grounds. We have explained our reasons for the exclusion of reservoirs in section 11.5.9.2 and reuse schemes in section 11.5.9.3.

One of the key themes arising from our draft WRMP consultation in support of our proposal to exclude the high environmental risk options was '*calls for commitments to fully assess the natural environment, built environment, heritage and archaeological aspects prior to the delivery of the projects in our Preferred Plan*'. Reservoirs, due to their footprint, have a high likelihood of impacting the natural environment, particularly during construction, although some issues can be mitigated during the feasibility phase. Desalination and effluent reuse plants have the potential to impact on the natural environment during both construction and operation, due to the high energy costs of their operation.

We looked to our willingness to pay study to identify further support for the exclusion of high environmental risk options. Our willingness to pay consultants ran a focus group to develop the stated preference questionnaire (see Technical Report 3.8.7).

Cost was a key factor for respondents when considering options for water resources. While supply side options such as desalination and reservoirs have a relatively high preference when considered in isolation, the indicative results of the willingness to pay work lead us to conclude that, by adding bill impact, the overall order of preference for options can change and these more expensive resource options would not appear high on the options list for customers as a result.

Figure 58 presents the approximate costs per mega litre of water developed by a particular type of option. The costs shown are indicative and represent the average cost per Ml/d for each type of feasible option that is being considered. Within each type of option, the cost of individual schemes can vary considerably. Figure 58 shows that fixing leaks is cheaper option than desalination (taking more from the sea), and that generally options to reduce demand are less expensive than options to develop new water resources. The costs presented here represent the approximate costs to build the new asset, and do not account for operational expenditure or environmental, social and carbon costs, which, for a desalination plant, are very high.

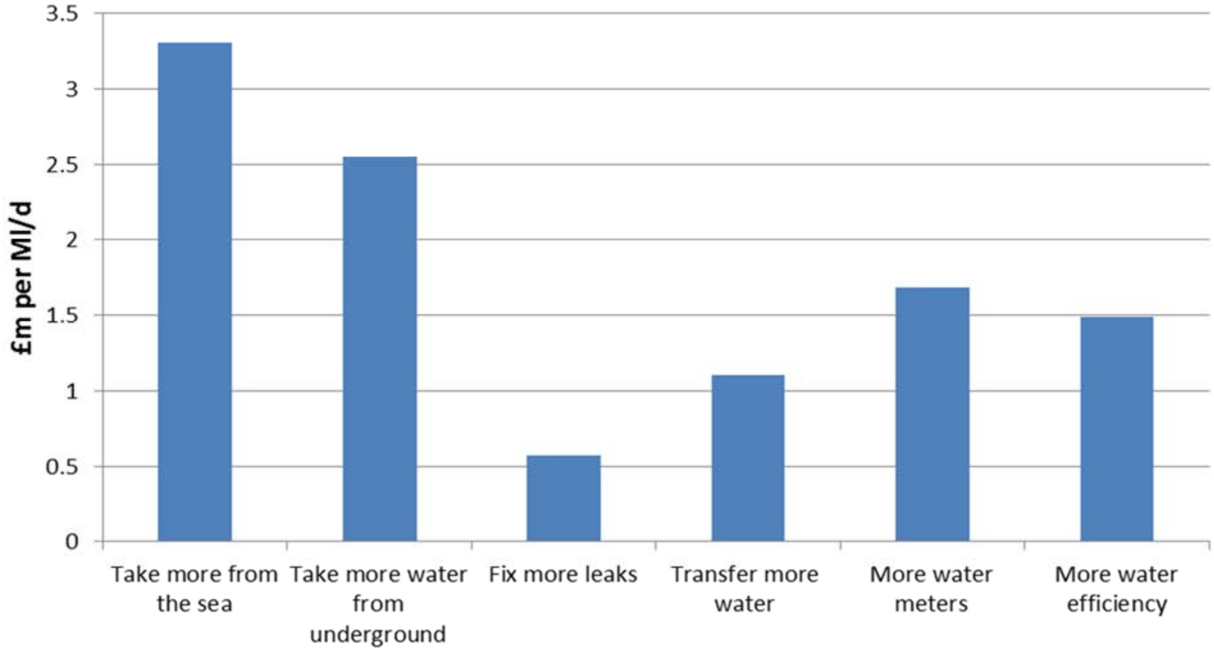


Figure 58: Approximate capital investment cost to build different option types per mega litre, excluding river abstractions

11.5.4 Support for universal metering

A universal metering programme was proposed in our draft WRMP and remains key to our water resources strategy for our revised WRMP.

In our draft WRMP consultation, we asked consultees if they agreed with our view that metering is the fairest way to pay for water, and that we should do more to help our customers be more efficient in the use of water. We proposed to achieve this by a street-by-street universal metering programme. Over 88% of the consultees who responded to this question agreed with our proposal.

One of the key themes arising from consultee responses was '*support for our plans to deliver a programme of universal metering, coupled with water efficiency awareness, to help customers reduce their consumption and save money, but seeking assurance that we have enough flexibility in our WRMP to accommodate variance in our forecast of 13.6% demand reduction*'. We have assessed a range of demand reductions and have provided flexibility in our revised WRMP through our headroom provision (D4 uncertainty). For our Business Plan, we have also considered the cost effectiveness of retro-fitting existing metered households with automated meter reading (AMR) devices, at the same time as we fit meters in the same area as part of our universal metering programme. We estimate this will provide an additional benefit of approximately 1Ml/d over AMP6, which we have not included in our modelling due to the degree of uncertainty, but providing flexibility to compensate for the risk of the assumed demand savings from our universal metering programme.

In our draft WRMP, WRZ2 was the last to be selected for universal metering. Markyate Parish Council responded to our consultation expressing concern that delaying metering in their parish (in WRZ2) would be "detrimental" to Markyate residents.

Metering is selected in all of our Central region WRZs in our revised WRMP least cost plan, but delivery is in two parts with WRZ1, 4, and 5 delivered in AMP6 with the other WRZ selected to be delivered at the end of the planning period. We felt that this approach with customers would be divisive and lead to higher costs as a result of unacceptability of individual installation, so we propose that we universally meter all WRZ by 2025 in our revised WRMP Preferred Plan.

Table 65 illustrates the metering delivery programmes in our draft and revised WRMPs, comparing the least-cost plan with our Preferred Plan.

WRZ	Delivery year in draft WRMP least-cost Plan (scenario 2b)	Delivery year in draft WRMP Preferred Plan	Delivery year in revised WRMP least-cost plan (scenario 2)	Delivery year in revised WRMP Preferred Plan
1	2015 (5 year delivery)	2015 (5-year delivery)	2015	**2017**
2	2015 (5 year delivery)	2020	2036	**2019**
3	2015 (5 year delivery)	2015 (5-year delivery)	2034	**2018**
4	2015 (5 year delivery)	2015 (5-year delivery)	2018	**2022**
5	*Not selected*	2015 (5-year delivery)	2020	**2015**
6	*Not selected*	2015 (5-year delivery)	2038	**2024**

Table 65: Timing of universal metering in our Central region, comparing draft and revised

There was a high degree of support for our universal metering proposals from our draft WRMP consultees (as evidenced in Table 66), although the Consumer Council for Water expressed concern with the speed of our proposed delivery programme. Consequently, we have slowed the delivery of the programme in our revised WRMP such that it will complete over ten years, approximately equally over two AMPs.

We wrote to the Consumer Council for Water to explain the change we had made in response to their representation; a copy of our letter is given in Appendix D.

Evidence	Source
Do you believe water meters are the fairest way for everyone to pay for the water they use? 75% yes	Panel 2 draft WRMP – p22 (Technical Report 3.8.2)
If we have to install meters on a compulsory basis, should everyone have one or should we only install in areas where water is in shorter supply? 77% Everyone	Panel 2 draft WRMP – p26 (Technical Report 3.8.2)

Table 66: Evidence base for customer support of our universal metering programme

11.5.5 Support for leakage reduction

Leakage reduction throughout the planning period is a key component of our water resources strategy. In our draft WRMP consultation, we asked if customers would support leakage reduction beyond the economic level. Of those who responded, over 70% of consultees supported this approach. One of the key themes arising from our draft WRMP consultation was '*support for our plans to reduce leakage beyond the economic level together with a preference for a greater response to leakage management in times of water scarcity*'.

We summarise the evidence from our online panels, bill acceptability study and Let's Talk Water campaign together with the response to our draft WRMP consultation question in Table 67.

Evidence	Source
Should we increase the rate at which we fix leaks on our network? 75% yes	Panel 2 draft WRMP – p31 (Technical Report 3.8.2)
Should we continue to search for and fix all leaks (both visible and hidden) even if it costs more than the value of water that is lost? 78% yes self-selecting audience 88% yes panel	Let's talk water – p7 fig 2.8 and fig 3.9 p27 (Technical Report 3.8.6)
From the statement you have just read, do you think we manage leakage appropriately? 78% yes	Panel 4 – leakage – p54 (Technical Report 3.8.2)
Do you think we should do more to reduce leakage further, beyond the economic level, if this would mean delaying or avoiding a hosepipe ban? 62% agreed we should spend more though views on the approach differed. Some considered we should manage the balance of the work during these times to avoid a bill increase. Others considered we should do more, even if it costs more.	Panel 4 – leakage – p61 (Technical Report 3.8.2)
Does the speed at which we repair leaks become more important to you when water is more scarce such as during times od drought? 76% yes	Panel 4 – leakage – p60 (Technical Report 3.8.2)
Do you think these targets strike the right balance of metering and leakage? 54% yes 18% don't know	Panel 4 – leakage – p63 (Technical Report 3.8.2)
Meeting our leakage targets – How should we use targets? 55% - Set a target that is achieved for most of the time and is the most economical.	Panel 4 – leakage – p68 (Technical Report 3.8.2)
Bill acceptability – 82% support changes presented in the plan. Of this, 50% agree with the change and its impact on bills is acceptable. 32% agree with it but impact on bills not acceptable.	P25 – views on resource management – bill acceptability phase 1 main study report (Technical Report 3.8.8 (i))
Our customers have told us that they agree with our approach on spending more on repairing pipes than is cost effective for the volume of water saved. Of those who responded to this question, over 75% said yes.	P6 – draft WRMP response log (Technical Report 3.8.5)

Table 67: Evidence base for customer support of our leakage reduction programme

We have also looked to our willingness to pay study to further evidence support for a progressive leakage reduction programme. Section 5.1 of our willingness to pay study (see Technical Report 3.8.7) considers the importance of making a balanced investment programme.

The order shown in Table 68 indicates customer preferences for different options if all other factors, such as cost and environmental impacts, remain equal.

Option Type	Online order of preference	Computer-aided personal interview (CAPI) order of preference	Combined order of preference
Leakage	1	5	**1**
Water efficiency	2	1	**2**
Desalination	4	2	**3**
Metering	3	6	**4**
Transfers	5	3	**5**
Groundwater	6	4	**6**
Rivers	7	7	**7**

Table 68: Customer priorities for water resource options

Table 68 shows that leakage and water efficiency are valued highly, combining the information on costs and benefits means we can conclude that leakage should be preferred to all other options. As water efficiency is one of the 'cheaper' options, it is likely that this will also be a high priority. The data for options in general shows that the resource options (abstraction from the sea "desalination" and groundwater) are the most expensive whereas the demand side options and transfers are relatively cheaper.

The values in **Figure** 59 represent the value to customers of implementing the options. By presenting the preferences in monetary terms, it is possible to combine these values with costs to understand the overall impact on consumers.

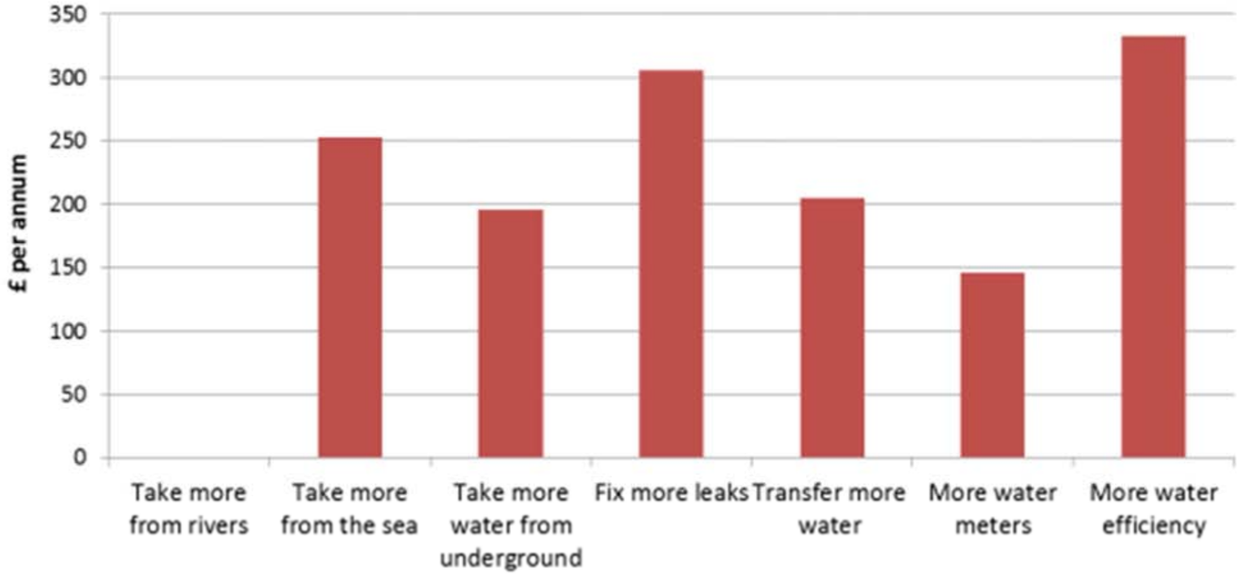


Figure 59: Customer preferences for option types when factoring in costs

We can make some high level observation on the benefit values. The values presented are mean values representing a mid-point within a range. Analysis of the data has indicated that there are three broad levels of preference.

– Options with strong preferences: Leakage and water efficiency. The results suggest that these should be included in the plan unless they are prohibitively expensive
– Options with no preference: River abstraction. This option should not be included in the plan unless it is very cheap.
– Options with some preference: These are the options between the two extremes. Whether these are included in the plan should be based much more on the reliability and cost of the option.

11.5.6 Support for non-household water efficiency

We have included more information in our revised WRMP about our non-household customers, including the level of metering, which, in all WRZ, has a greater level of penetration than the meter penetration of our household customers.

Consultees have told us in their commentary and qualitative statements that they would like to see more about the consumption of non-domestic customers and their need to reduce demand as the draft WRMP had bias towards reducing the consumption of domestic customers. Table 69 presents comments from our draft WRMP consultees with regard to the need for our non-household customers to reduce consumption.

Comment	Consultee
The Plan focusses *"almost exclusively"* on domestic use.	Steve Shaw – resident – response on 25/6/13 – p6 (Technical Report 3.8.5)
NFU educates its members to read meters regularly to detect leaks early, saving waste and reducing bills. Acknowledges need to work with water companies to try to smooth out demand peaks caused by horticulture. Hoping Affinity will help identify collaborative opportunities and support farmers in establishing on-farm reservoirs.	John Archer – National Farmers Union – response 2/8/13 – p11 (Technical Report 3.8.5)
Why has there not been a sensitivity around non-household consumption?	Dr H Bailey and Mr A Champion – Herts Geological Society – response 5/8/13 – p13 (Technical Report 3.8.5)
Supports move from potable to grey and recycled water use for business and industry plus build these into new builds and retrofitting storage where possible. Self-sufficient agri-irrigation via irrigation reservoirs and grey water collection and reuse.	Jenny Bate – Kent Downs AONB – response 9/8/13 – p18 (Technical Report 3.8.5)
Provides little information on water issues such that that of agriculture or major businesses and how they have been considered in the plan as well as the stress they put on available resources.	John Laverty – Institution of Civil Engineers – response 12/8/13 – p20 (Technical Report 3.8.5)

Table 69: Comments from our consultees regarding non-household water efficiency

11.5.7 Support for demand management in favour of taking more water from the environment

We proposed significant demand management measures of leakage reduction, universal metering and water efficiency for household and non-household customers in our draft WRMP, and this remains key to our water resources strategy for our revised WRMP.

We looked to our willingness to pay study to identify support for demand management programmes in favour of taking more water from the environment. Our willingness to pay consultants ran a focus group to develop the stated preference questionnaire (see Technical Report 3.8.7). Participants generally preferred measures that reduced the water use, such as fixing leaks in supply pipes, water meters and water efficiency measures over measures that increased supply. The outcomes of the work also showed that river abstraction should not be included in our WRMP unless it is 'very cheap'.

Overall, customers would prioritise demand management options over supply side options. Online respondents favour fixing more leaks and encouraging more customer water efficiency and metering. Computer-aided personal interview (CAPI) respondents also favour more customer water efficiency.

The results emphasise options that manage demands rather than enhance supplies. We have calculated preference weights for the different water management options. These weights are derived from statistical modelling of the choices made by respondents. They are derived from Odds Ratios that measure the relative probability or chance that respondents prefer an option over another. They are normalised to be relative to a base case of maintaining current level of service – a higher weight implies a higher preference. Results imply that if all costs (including environmental and social) are equal, online respondents prefer leakage reduction followed by water efficiency and metering whereas CAPI respondents prefer water efficiency followed by desalination.

The highest level of preference was, therefore, for leakage reduction and water efficiency. For options with some level of preference, such as water transfers and desalination, decisions on these should depend much more on the reliability and cost of the option.

We summarise the results of our second online panel in Table 70 that identify support for demand management measures.

Evidence	Source
Would you be willing to reduce the amount of water you use to keep local streams and rivers flowing? 65% yes 22% don't know	Panel 2 draft WRMP – p37 (Technical Report 3.8.2)
To adapt to the reduction in abstraction we want to reduce levels of leakage, install more meters and help customers be more water efficient. Do you agree we are taking the right action? 51% - yes providing it is cost effective 18% - yes it is important to always have enough water – whatever the cost of managing and satisfying demand.	Panel 2 draft WRMP – p37 (Technical Report 3.8.2)

Table 70: Evidence base for customer support of our demand management programme

11.5.8 Support for sharing water resources

We have included more information in our revised WRMP about our water trading discussions with neighbouring water companies and third parties, as well as more detail of the outcomes of the recent WRSE Phase 3 programme of work. Section 11.4 of our revised WRMP identifies the bulk transfers of water that we have agreed with neighbouring water companies to support our Preferred Plan.

Consultees have told us in their commentary and qualitative statements that they are supportive of bulk transfers of water. Table 71 presents comments from our draft WRMP consultees with regard to support for sharing water in our region.

Comment	Consultee
Supportive of bulk transfers.	David Brazier – Kent CC – response 18/7/13 – p8 (Technical Report 3.8.5)
Supports the principle of bulk transfers as per WRSE to prevent the activation of sleeper abstraction licences or unused portions of licences in areas of environmental sensitivity and water scarcity.	Lucy Lee - WWF – response 12/8/13 – p24 (Technical Report 3.8.5)

Table 71: Comments from our consultees regarding non-household water efficiency

11.5.9 Where we have not made changes to our WRMP

11.5.9.1 Introduction

The WRPG Guiding Principles requires companies to explain where they have not made changes as a result of representations received during the consultation period.

Our consultees raised a number of points that we did not take forward into our revised WRMP. This section provides our rationale behind those decisions.

11.5.9.2 Reservoirs

A number of consultees asked us to consider including reservoirs in our WRMP, particularly as a drought resilience measure.

The Preferred Plan in our draft WRMP included option ID 622 in WRZ2. This option is for the recommissioning of our existing reservoir in Bushey, which requires some main laying between the reservoir and our nearby water treatment works, and was described as "mains reinforcement in Bushey". We appreciate this statement did not make clear to our customers and stakeholders that the option allowed us to make use of a reservoir that is currently non-operational, such that we had included a reservoir option in our draft WRMP. This option remains in our revised WRMP to balance supply and demand from 2027, and we have continued to investigate the environmental aspects of the option under our SEA (see Technical Report 3.9: *Environmental Report*).

However, we have not included for any other reservoir options in our revised WRMP.

We have assessed the geology of our operational area and included options in our plan for small storage reservoirs similar to agricultural irrigation reservoirs to store groundwater for use in peak periods. We have also developed an option using the Canal & River Trust reservoir at Brent. These options were included in our feasible options list but not selected as it was not cost-effective compared to alternative options.

> "I believe that too little is being done to ensure full water supplies during dry periods. The company should commence building reservoirs"

We have explored options for partnering with other water companies in the construction of a large storage reservoir to store surplus winter water in rivers and retain it for use in dry years or peak periods. Such reservoirs are expensive, occupy large areas of land and are often rejected by local communities due to the high impact on the local environment during the construction phase of the project that takes many years so we need to ensure these are necessary before we build them. We supported Thames Water's proposals to develop a reservoir in south-west Oxfordshire at PR09 and we have also expressed support for a reservoir in south Lincolnshire as we feel that in view of water scarcity in the South East of England we will eventually need such schemes.

Six large storage sites have been explored in the South East of England as part of the WRSE project and we have evaluated their cost-effectiveness alongside other options to balance supply and demand such as leakage reduction, metering and water efficiency as well as further resource development although these options are very limited without causing more environmental damage. In the latest study, options for large storage reservoirs have been rejected in favour of cheaper options such as demand management for the foreseeable future.

We are also working with Anglian Water, other water companies and the Environment Agency on the Water Resources East Anglia project as this embraces our East region and the northern part of our Central region.

We will continue with these strategic partnerships through AMP6 to evaluate further opportunities for conjunctive use and storage options for our future plans for PR19.

11.5.9.3 *Reuse schemes: desalination, grey water and effluent reuse*

A number of consultees asked us why we had not included any desalination, grey water recycling or effluent reuse schemes in our draft WRMP.

We have considered desalination, grey water and sewerage effluent recycling options in our feasible list of options for our modelling. These schemes are relatively expensive due to the complex water treatment plant required and high energy consumption so they also have a high carbon footprint. This means they are often not preferred compared to less carbon intensive options and they have not been selected for our Preferred Plan as we have chosen to exclude them under SEA grounds and because our modelling could solve the supply / demand balance without significant additional cost.

> “More money should be spent on desalination, despite the cost”

However, as water is becoming scarce in the South East of England, these schemes will become more cost-effective with time and therefore it is important we keep these under review for our future plans.

11.5.9.4 *Drought resilience*

Although a number of our consultees supported our drought resilience investment proposals, we have removed the specific drought resilience expenditure as explained in section 11.9.

11.5.9.5 *Retention of some of our licence in Stevenage*

A number of consultees supported the full closure of our Whitehall pumping station as a result of sustainability reductions.

For AMP5, the Environment Agency had notified us of sustainability reductions to reduce the licensed capacity of our Whitehall pumping station to 15 Ml/d at both average and peak to improve flows in the River Beane. In October 2012, the EA advised that Whitehall pumping station should close entirely and for our draft WRMP, we estimated the cost of replacing that capacity with additional imports from our

> “Closing Whitehall Pumping Station: We both agree that the pumping station should close”

bulk transfer at Grafham.

However, we are constrained in the use of water from our Grafham bulk transfer in zones where we have an undertaking for higher metaldehyde concentrations or adequate blending to dilute the pollutants. In addition, cessation of pumping at Whitehall would mean there is single source of supply under certain circumstances that poses a greater threat to resilience of supplies to customers.

To reduce the risk from cessation of supply, we have proposed to retain some peak output capacity at Whitehall for use in peak periods only (10Ml/d compared to the previous total of 28Ml/d), and this is equivalent to a retention of 2Ml/d at average compared to the original capacity of 21Ml/d, so we are still reducing the output by 90%. This retained volume means we can maintain resilience of supplies to customers and avoid the need for an estimated £30million investment to reinforce the zone and this helps to keep water bills down.

The retention of a small proportion of our licence means that we will maintain the operability of Whitehall such that, in the event of localised flooding, we are able to operate the pumping station to help protect people, their properties and the local wildlife from the associated impacts.

One consultee expressed concern that the full closure of one of our pumping stations as a result of sustainability reductions would increase the risk of flooding, as his property backed on to the River Mimram. Localised flooding can be a consequence of sustainability reductions, despite the significant environmental benefits, but the retention of small licence volumes and the ability to operate our pumping stations helps to mitigate this risk. At the Environment Agency's request, we have in the past operated our pumping stations at Friars Wash (River Ver) and Amersham (River Misbourne) to help alleviate local flooding events. We recognise, however, that retaining sources for use in emergencies will incur additional cost so this will only be done where agreed with the Environment Agency. We agree with the Agency's concern that such use must be strictly controlled, relate to specific and limited emergency conditions and not prejudice the meeting of environmental outcomes.

11.5.9.6 Albion Water supply option

Albion Water responded to our consultation on our draft WRMP and offered supplies from tankers for drought conditions.

Our coastal companies do not have a supply deficit, so we considered this for our Central region only. We have previously considered options for tanker supplies and these were rejected on grounds of cost in comparison to other supply and demand options; consequently, we decided not to pursue the option at this time; however, we propose to discuss the option with Albion Water for potential use in extreme drought conditions.

11.5.9.7 Sustainability reductions in the Chess catchment

A number of consultees asked us to consider reducing our abstractions on the River Chess.

> "I would also like Affinity to consider what reductions it could make to abstraction in the Chess catchment"

The Environment Agency has reviewed flow conditions in all catchments and water bodies in our operational area to evaluate the effects of abstraction. The Chess catchment is not cited by the Agency as a river of concern, therefore we are not planning sustainability reductions in that area.

11.6 About our Preferred Plan

11.6.1 The impact on supply and demand

Our supply / demand balance for all zones prior to delivering our Preferred Plan is shown in Figure 60, showing again the size of the problem that we set out to solve.

We remain in deficit in each year of the planning period, with the deficit growing as demand increases due to population growth and the reduction in supply because of sustainability reductions and climate change.

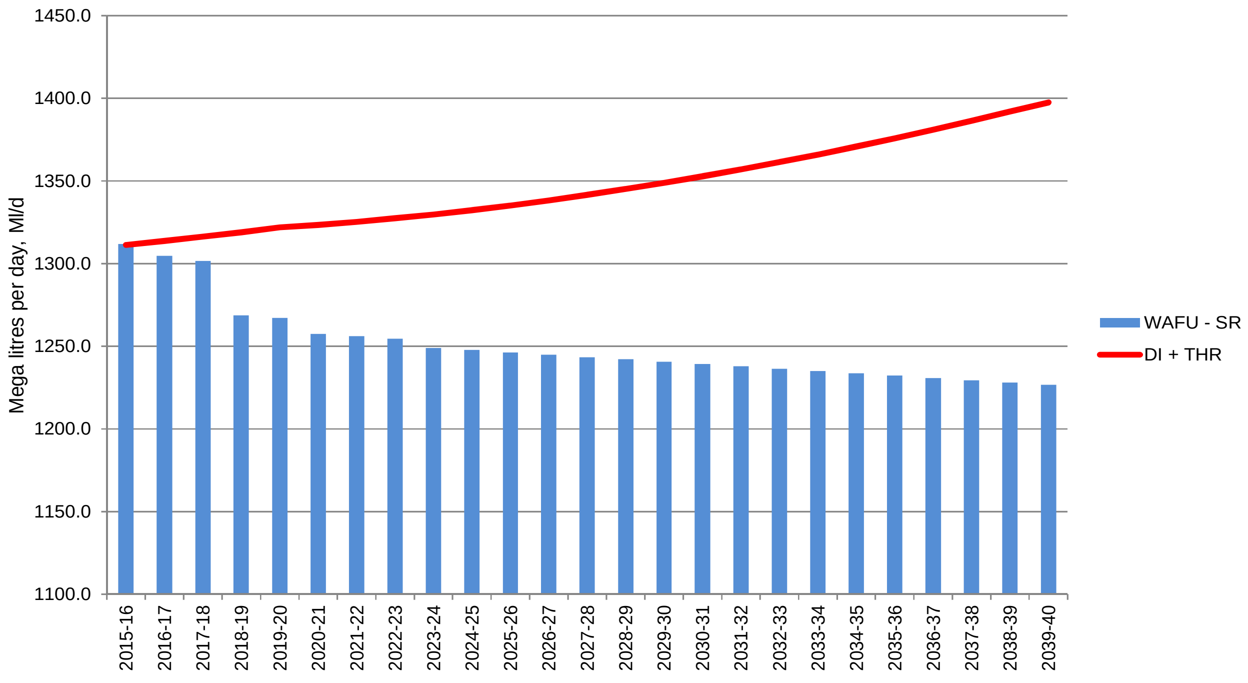


Figure 60: Supply / demand balance before our Preferred Plan, DYCP

Figure 61 shows the impact of delivering our Preferred Plan on our company level supply / demand balance, showing that we do not move into deficit at any point during the planning period. Demand falls during the first ten years as a result of our metering and water efficiency programme, before reaching a plateau and increasing as population growth increases. The stepped increases in the WAFU bars are caused by the delivery of supply side options.

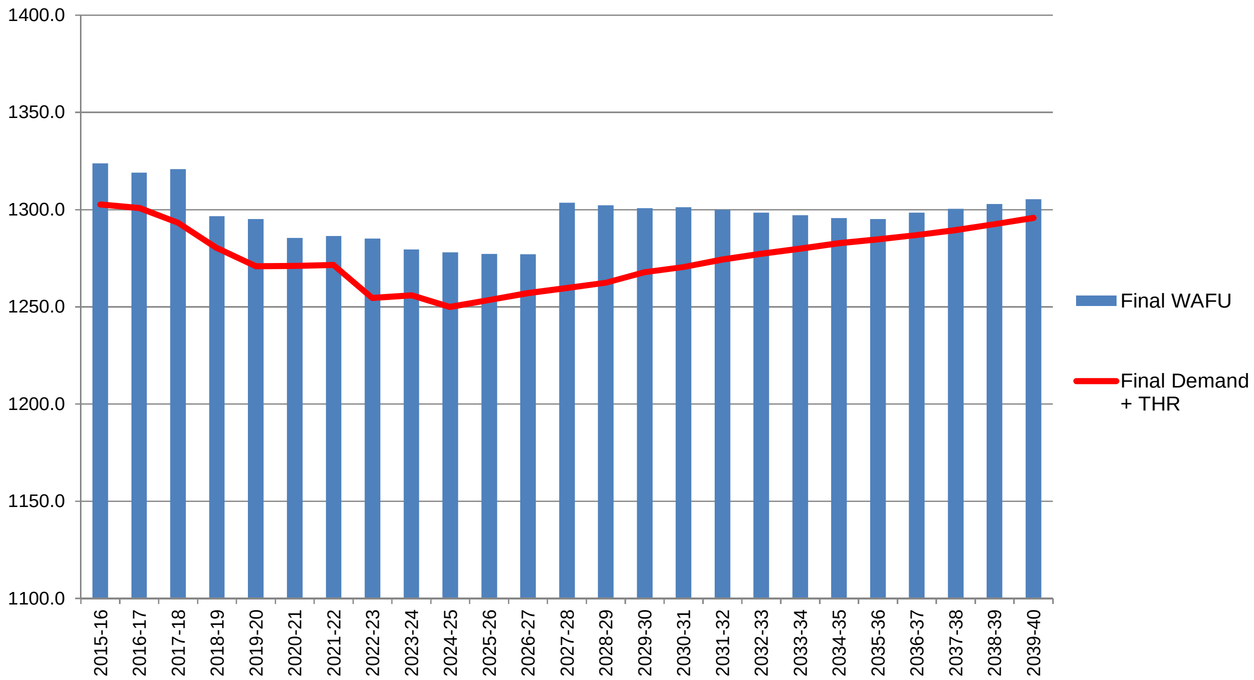


Figure 61: Supply / demand balance with our Preferred Plan implemented, DYCP

11.6.2 Delivery of options during the planning period

The charts in Figure 62 and Figure 63 show the means by which 'new' water is being developed by our Preferred Plan at DYAA and DYCP respectively.

At DYCP, over 60% of the additional water in the first five years of the planning period is developed by demand management options, namely metering, water efficiency and leakage reduction programmes. At DYAA, the proportion of demand management measures to supply side measures is even greater.

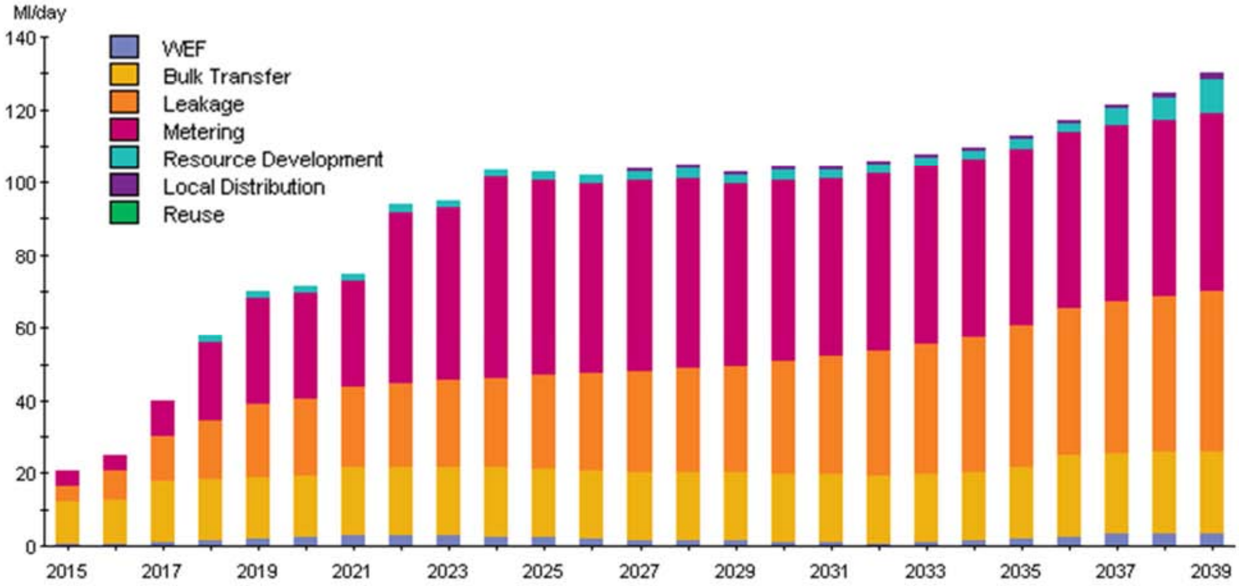


Figure 62: 'New' water provided by option type at DYAA

The significant difference in resource development yield between DYAA and DYCP shows that we are adhering to the principles of WRSE by maximising bulk transfers of water whilst delivering demand management measures. It is difficult to close the supply / demand balance at peak without developing supply side options such as the optimisation of groundwater abstraction within licence, but as Figure 63 shows, the volumes are small in the early years when compared with the demand management programme we propose.

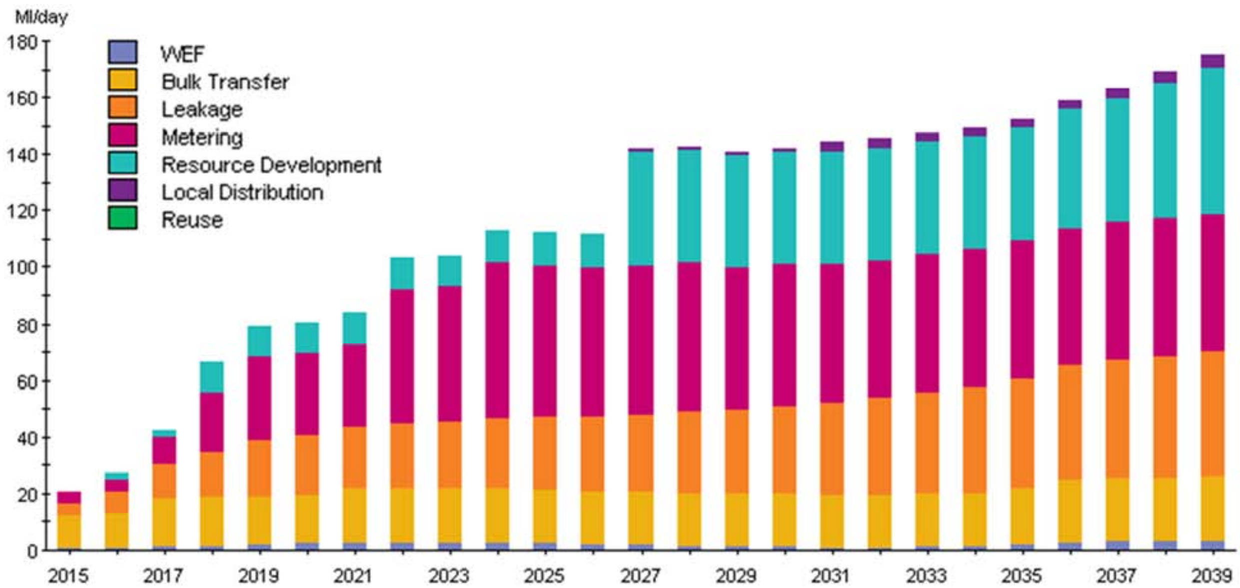


Figure 63: 'New' water provided by option type at DYCP

There is a significant increase in the capacity of our system in 2027. This arises from the completion of construction of a single option in WRZ2 (ID 622) that provides a significant increase in yield during peak conditions (28Ml/d), but none at average.

Table 72 shows the cumulative water developed (yield) derived by option type.

Option Type	Period	Yield at DYAA (Ml/d)	Yield at DYCP (Ml/d)
Leakage	2015-20	20.00	20.00
	2020-25	24.75	24.75
	2025-30	29.50	29.50
	2030-35	37.50	37.50
	2035-40	49.27	49.27
Metering	2015-20	29.24	29.24
	2020-25	55.12	55.12
	2025-30	49.92	49.92
	2030-35	48.75	48.75
	2035-40	48.75	48.75
Water Efficiency	2015-20	1.87	1.87
	2020-25	2.52	2.52
	2025-30	1.23 *	1.23 *
	2030-35	1.43	1.43
	2035-40	3.24	3.24
Supply (Ground & Surface Water)	2015-20	1.97	10.92
	2020-25	2.08	11.33
	2025-30	2.38	11.92
	2030-35	2.38	11.85
	2035-40	9.78	23.50
Bulk Transfers	2015-20	17.00	17.00
	2020-25	19.00	19.00
	2025-30	18.80 **	18.80 **
	2030-35	18.80	18.80
	2035-40	22.50	22.50
Network Improvements	2015-20	0.00	0.00
	2020-25	0.00	0.00
	2025-30	0.97	29.32
	2030-35	0.97	31.32
	2035-40	1.57	32.72

Table 72: Cumulative yield developed by option type in each quinquennium

* *Water efficiency yield decays over time, generally between 5 and 10 years.*

** *At South East Water's request, the yield associated with their bulk supply to our WRZ7 reduces from 2Ml/d to 1.8Ml/d.*

11.6.3 The impact on PCC

Table 24 shows how per capita consumption (PCC) changes during the planning period at DYAA as our Preferred Plan is implemented. We show the weighted average PCC, which takes into account the difference in PCC of our metered and unmetered customers. The changes in PCC in our Central region are largely driven by our metering and water efficiency programme. In our Southeast and East regions, we continue to offer optant meters and water efficiency devices under our baseline water efficiency programme, gradually reducing PCC over time.

“Everyone should be making an effort to limit their consumption of water, thereby improving the environment”

We have identified PCC as a key success measure in our PR14 Business Plan, and we fully commit to supporting our customers to reduce their consumption.

Water resource zone	2012 l/h/d	AMP5 2014/15 l/h/d	AMP6 2019/20 l/h/d	AMP7 2024/25 l/h/d	AMP8 2029/30 l/h/d	AMP9 2034/35 l/h/d	AMP10 2039/40 l/h/d
1	170.42	168.42	151.33	150.29	147.85	145.89	144.33
2	163.23	161.76	146.26	143.37	143.86	142.37	141.09
3	153.71	151.98	136.88	132.99	132.05	129.65	127.68
4	165.06	163.32	160.27	143.04	143.72	142.41	141.48
5	163.72	161.95	147.60	145.72	143.17	141.07	139.39
6	166.04	164.71	162.51	148.28	146.74	147.66	146.74
Central region weighted average PCC	164.24	162.53	152.75	143.68	142.63	141.23	139.83
7 (Southeast region)	130.35	126.19	124.06	122.21	121.41	121.15	121.22
8 (East region)	123.14	121.92	120.32	118.26	117.54	117.35	117.61
Company weighted average PCC	**160.18**	**158.38**	**147.39**	**137.58**	**136.73**	**135.71**	**134.76**

Table 73: Changes in NYAA weighted average PCC at the end of each quinquennium

Water resource zone	2012 l/h/d	AMP5 2014/15 l/h/d	AMP6 2019/20 l/h/d	AMP7 2024/25 l/h/d	AMP8 2029/30 l/h/d	AMP9 2034/35 l/h/d	AMP10 2039/40 l/h/d
1	190.46	187.04	169.51	168.09	165.39	163.26	161.62
2	174.54	171.95	156.28	153.21	153.59	152.02	150.70
3	160.69	157.94	142.70	138.66	137.61	135.12	133.09
4	181.24	178.25	174.93	157.40	157.91	156.51	155.52
5	174.17	171.24	156.70	154.60	151.91	149.71	147.98
6	184.84	182.52	179.57	164.76	162.76	163.30	162.06
Central region weighted average PCC	176.77	173.92	162.63	153.55	153.12	153.24	153.72
7 (Southeast region)	142.98	138.41	136.07	134.05	133.17	132.88	132.96
8 (East region)	135.44	133.73	131.97	129.71	128.92	128.72	129.00
Company weighted average PCC	**173.45**	**170.57**	**159.33**	**150.44**	**150.26**	**150.58**	**151.25**

Table 74: Changes in DYAA weighted average PCC at the end of each quinquennium

Water resource zone	2012 l/h/d	AMP5 2014/15 l/h/d	AMP6 2019/20 l/h/d	AMP7 2024/25 l/h/d	AMP8 2029/30 l/h/d	AMP9 2034/35 l/h/d	AMP10 2039/40 l/h/d
1	243.52	239.73	221.82	220.36	217.83	216.23	215.35
2	233.17	230.25	214.64	211.46	212.14	211.19	210.68
3	224.21	220.90	205.17	200.40	199.03	196.60	194.89
4	235.80	232.45	229.09	211.45	212.32	211.60	211.47
5	235.55	232.16	217.37	214.85	212.21	210.43	209.35
6	251.87	249.32	247.07	232.57	231.34	232.99	233.13
Central region weighted average PCC	236.29	233.08	219.49	208.60	209.09	210.37	212.16
7 (Southeast region)	187.71	182.25	180.08	178.54	179.58	180.08	181.05
8 (East region)	177.82	176.05	174.57	172.42	172.21	172.82	174.07
Company weighted average PCC	**231.55**	**228.30**	**214.63**	**203.90**	**204.84**	**206.40**	**208.42**

Table 75: Changes in DYCP weighted average PCC at the end of each quinquennium

11.7 The bulk transfers of our Preferred Plan

11.7.1 Introduction

We have balanced supply and demand with a combination of options. A key component of our Preferred Plan is the trading of water with other water companies and third parties. This section summarises the arrangements we have made in the bulk transfers of water, which provide additional flexibility and resilience in our operations in that we can use this water to manage outage.

Note that the utilisation graphs presented solve our supply / demand balance including target headroom for both DYAA and DYCP. For our Business Plan, we have developed forecasts based on most likely utilisation, derived from our weighted average annual demand, but including additional allowances for specific project outage, efficiency and risk on the basis that it is unlikely that all headroom will materialise in the short-term in every year.

Table 76 lists the existing and new bulk imports and exports that underpin our Preferred Plan.

ID	Existing or New transfer	Donating Company	Receiving Company	Average Ml/d (max)	Peak Ml/d (max)
1	Existing	Anglian	Affinity WRZ3	91.0	109.0
2	Existing	Thames	Affinity WRZ4	10.0	10.0
2a	**New**	Thames	Affinity WRZ4	17.0	17.0
3	Existing	Thames	Affinity WRZ4	0.2	0.2
4	Existing	Thames	Affinity WRZ4	2.0	2.0
5	Existing	Thames	Affinity WRZ6	2.27	2.27
5a	**New**	Thames	Affinity WRZ6	2.7	2.7
6	Existing	Cambridge	Affinity WRZ5	0.31	0.31
7	Existing	Affinity WRZ3	Cambridge	0.04	0.04
8	Existing	Affinity WRZ3	Anglian	0.14	0.14
9	Existing	Essex & Suffolk	Affinity WRZ5	0.03	0.03
10	Existing	Affinity WRZ6	South East	36.0	36.0
11	Existing	Affinity WRZ7	Southern	0.1	0.1
12	Existing	Affinity WRZ8	Anglian	8.1	8.1
13	**New**	South East	Affinity WRZ7	2.0 *	2.0 *
14	**New**	Southern	Affinity WRZ7	1.0	1.0

Table 76: List of new and existing bulk transfers for our revised WRMP

*   *2.0Ml/d available until 2026, when the capacity reduces to 1.8Ml/d at both average and peak.*

Figure 64 gives the indicative locations of the existing and new bulk transfers of water identified in our Preferred Plan.

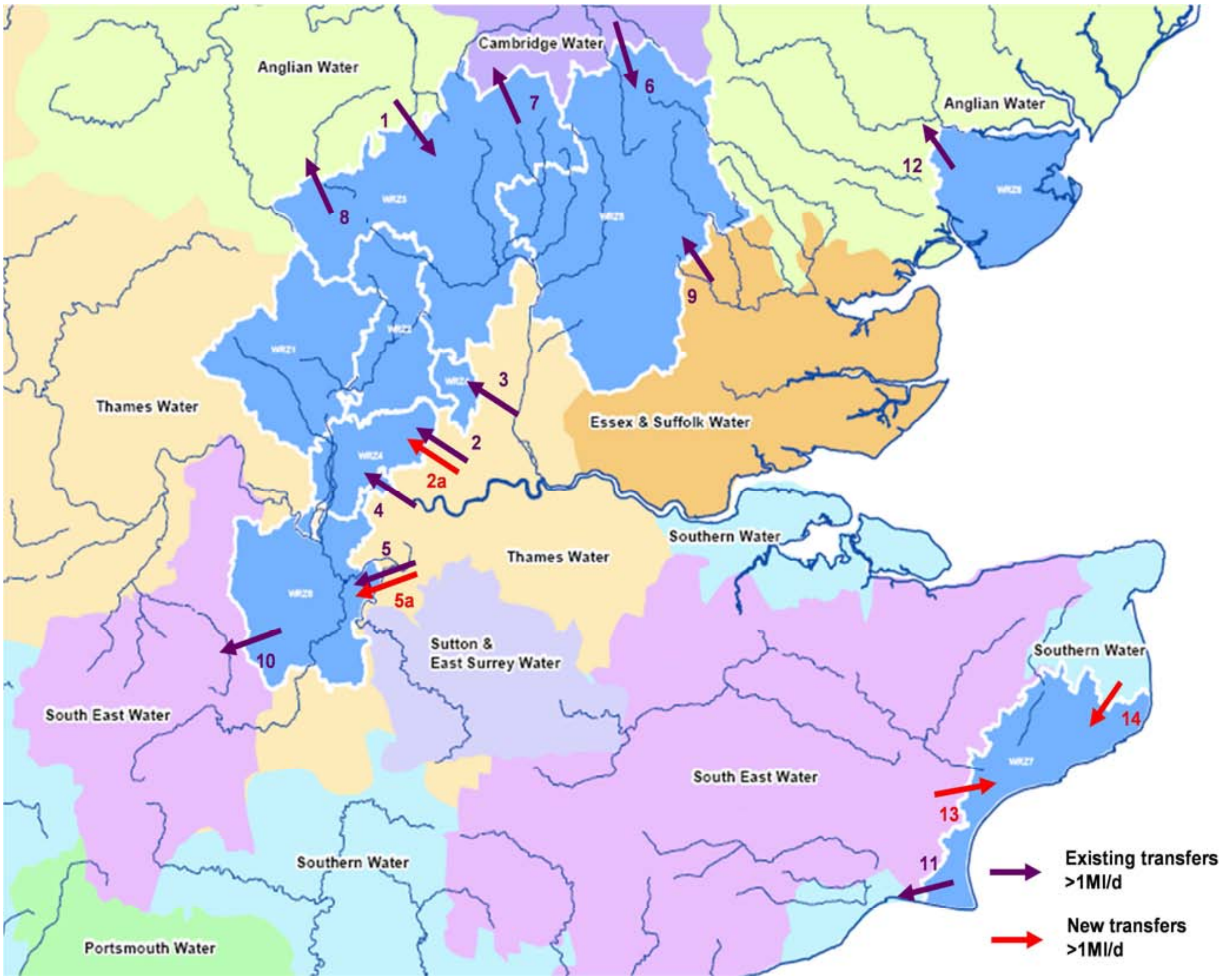


Figure 64: Locations of existing and future import and export arrangements

11.7.2 Bulk transfer arrangements with Anglian Water

11.7.2.1 Central Region

The availability of the resource we share with Anglian Water (ID 1) is of critical importance to our WRMP. The combination of significant sustainability reductions in WRZ3 and the forecast increase in population in the northern parts of our Central region means that we are more likely to maximise our take, particularly under peak conditions, and are therefore unable to reduce our demand of our entitlement.

Figure 65 gives our expected utilisation of the shared resource at DYAA and DYCP.

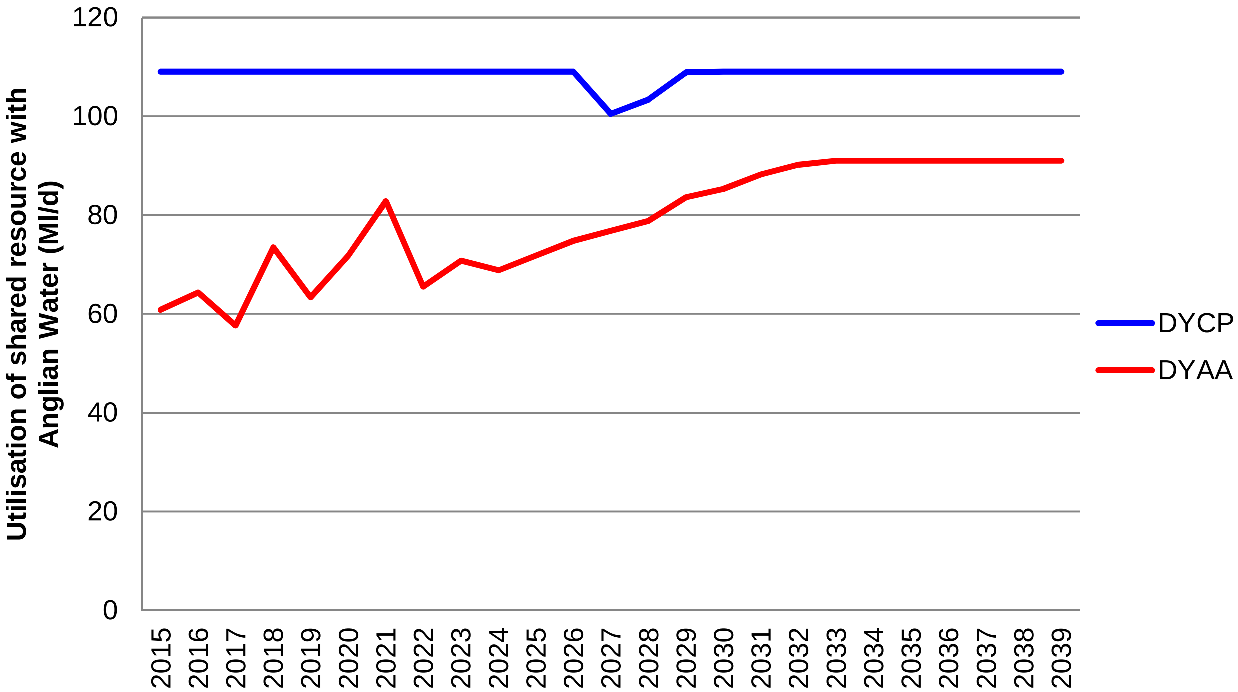


Figure 65: Our utilisation of shared resource with Anglian Water over the planning period

We are aware that Anglian Water also suffers deficits in their neighbouring zones, which are fed by the shared resource. We are keen to keep the feasibility of a more flexible use of the resource under review.

11.7.2.2 East Region

Our East region, WRZ8, maintains a small surplus throughout the planning period.

This is despite selling a proportion of our entitlement of the shared resource back to Anglian Water (ID12), such that we have 30% of the total volume. North of our WRZ8 is projected to be a significant growth area for Anglian Water, and we would be keen to explore water trading arrangements that support Anglian Water whilst maintaining a secure supply for our customers.

We have agreed with Anglian Water to further extend their allocation from Ardleigh from 2031 to a split of 80 / 20, which reduces our availability to 5.4Ml/d at both average and peak. Due to our surplus, we can accommodate this change and have reflected in our WRP tables.

11.7.3 Bulk transfer arrangements with Cambridge Water

We expressed an interest to purchase a source from Cambridge Water very close to our WRZ3 boundary. Cambridge Water declined the offer, but suggested a formal bulk transfer arrangement, and advised of their proposed charging arrangements. Our modelling determined that the use of this bulk supply was not cost effective for our customers. We were also advised that the water had high nitrate content, which had not previously been seen at the source, likely to have arisen from three successive dry winters followed by record-breaking rainfall in the summer of 2012. As such, the water would need to be blended to reduce the nitrate concentration, as there is no treatment at Cambridge Water's site.

We will re-establish our emergency supply agreement with Cambridge Water for AMP6 and will continue our negotiations to explore how we can negotiate a more cost effective agreement for our customers, as Cambridge Water remains in surplus throughout the planning period whilst we are in deficit.

Whilst we do not rely on the supply to meet demand at DYAA and DYCP, it would be valuable if we saw another third dry winter after we have implemented sustainability reductions. We plan to have an arrangement in place within AMP6.

11.7.4 Bulk transfer arrangements with South East Water

11.7.4.1 Bulk export in WRZ6

We have maintained the 36Ml/d bulk export from our WRZ6 to South East Water (ID10). We have reflected this in our supply / demand balance at all conditions throughout the planning period.

11.7.4.2 Bulk import to WRZ7

An arrangement has existed in the past with South East Water for a 2Ml/d bulk import to WRZ7. Previously, this supply has been used periodically, mostly to assist with operational events such as planned outage and to provide additional resilience. South East Water has agreed to make a 2Ml/d bulk transfer available to us (ID13), maintaining the same conditions as the prior arrangement.

Our modelling identifies that we will need to use a proportion of the 2Ml/d import in each year of the planning period from 2021, however we may seek to use the supply earlier for operational flexibility, such as during planned outages or flushing programmes. Figure 66 refers.

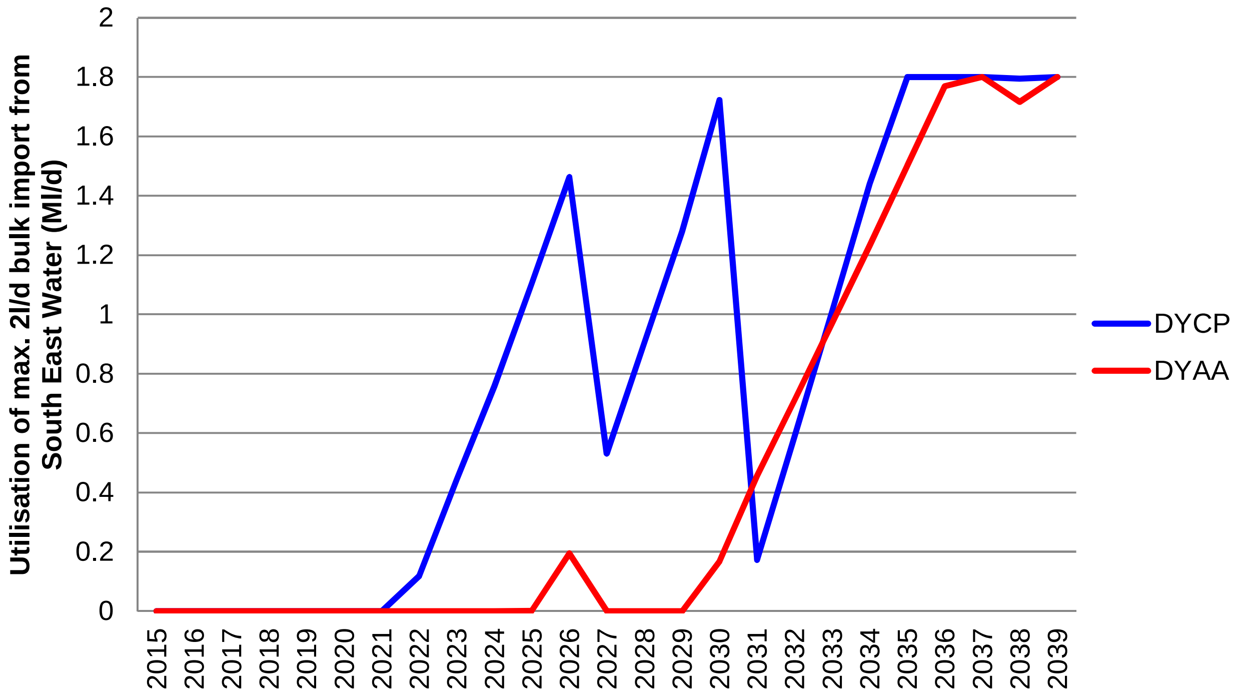


Figure 66: Our utilisation of South East Water bulk supply into WRZ7 over the planning period

In accordance with South East Water's wishes, we have reduced the available capacity to 1.8Ml/d from 2026, to comply with their WRMP and the WRSE modelling outputs. We require the full 1.8Ml/d in the later years of the planning period.

The current arrangement with South East Water runs until 2019. We will seek to extend the agreement for a further five years on a rolling basis at that time.

11.7.5 Bulk transfer arrangements with Southern Water

Southern Water has confirmed they can supply 1Ml/d year-round, with the potential to increase to 4Ml/d for a short duration (less than 20 days) in the event of operational issues in our WRZ7.

In summer 2013, a draft agreement was circulated between our companies for a year-round 1Ml/d bulk import from Southern Water to our WRZ7. In the past, the agreement was limited to 4Ml/d from September to December, when our groundwater stocks were typically healthy. The agreement also carried a high fixed annual charge, whether the supply was used or not, which did not represent best value for our customers.

Our modelling identifies that we will need to use the 1Ml/d import from 2035, however we may seek to use the supply earlier for operational flexibility.

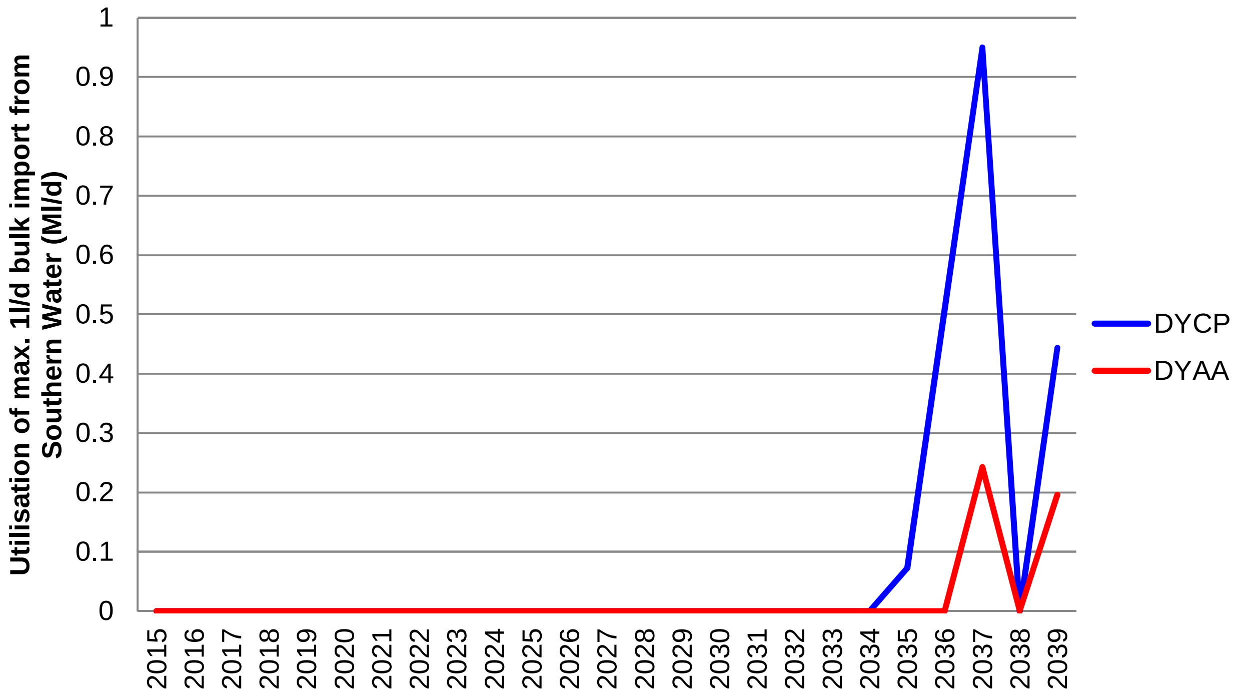


Figure 67: Our utilisation of Southern Water bulk supply into WRZ7 over the planning period

We have subsequently agreed terms for a new contract with Southern Water governing the use of this year-round supply, at a significantly reduced fixed annual charge, such that our customers will benefit from the additional resilience provided by the available supply at the lowest cost.

11.7.6 Bulk transfer arrangements with Thames Water

11.7.6.1 Increase in bulk supply to WRZ4

Our modelling identifies that we will need to have access to the full existing entitlement, 27Ml/d, of our treated water bulk supply from Thames Water (ID2 and ID2a) during peak conditions at various points throughout the planning period.

We understand that DYAA remains the critical condition for Thames Water, and thus our take under dry year conditions needs to be reflected in their DYAA forecasts, rather than at peak. Our analysis identifies that our DYAA usage is minimal in the early years of the planning period, whilst DYCP is variable as we use the bulk supply from Thames Water whilst we implement other options. Figure 68 refers.

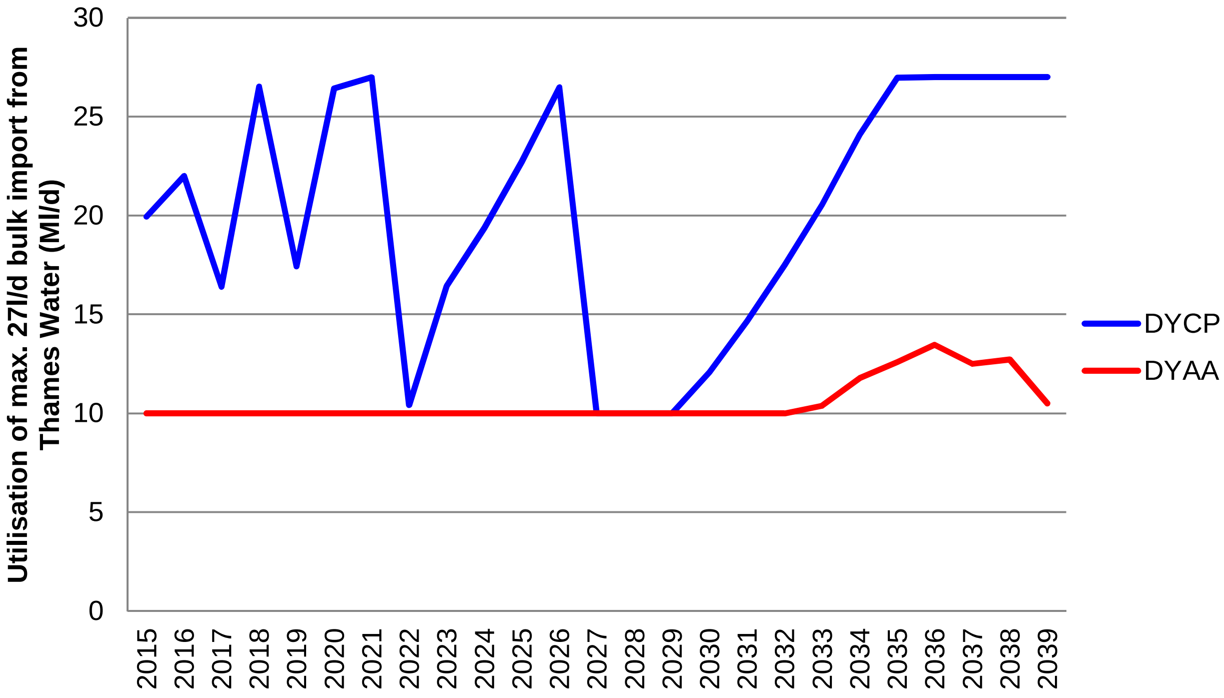


Figure 68: Our utilisation of Thames Water bulk supply into WRZ4 over the planning period

Thames Water has taken our requirement for an increased supply at DYCP and converted it to an equivalent DYAA forecast, which it has then used in its own modelling and confirmed it can meet our needs and will include them in its WRMP.

11.7.6.2 Increase in bulk supply to WRZ6

In the last year of the planning period, our modelling selects an increase in our take at an existing bulk supply that feeds our WRZ6, increasing the capacity by 2.7Ml/d to a total of 5Ml/d. Prior to our modelling, Thames Water confirmed that there are no further costs (e.g. to upgrade infrastructure) associated with the increase in capacity.

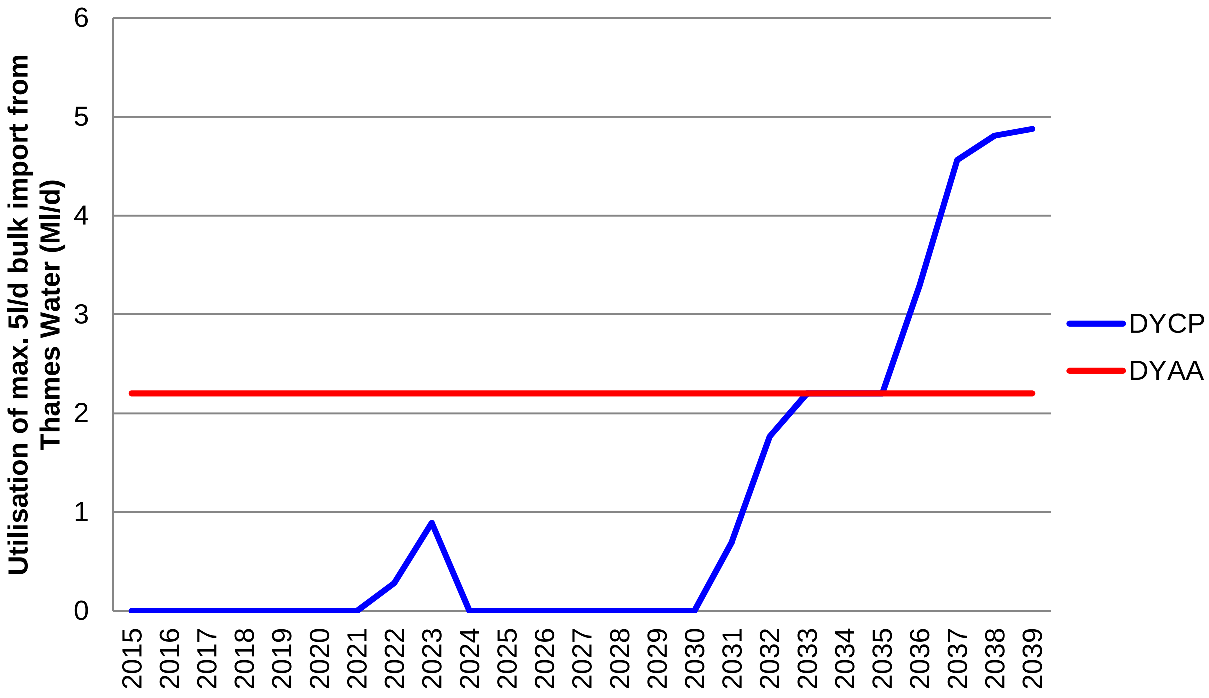


Figure 69: Our utilisation of Thames Water bulk supply into WRZ6 over the planning period

Thames Water has confirmed they will meet our needs and will reflect them in their WRMP.

11.7.6.3 Raw water bulk supply to WRZ4

We take a raw water supply of 2Ml/d from Thames Water to one of our treatment works in WRZ4. This forms part of an agreement that allows us to use Thames Water's reservoir storage in the event of a serious pollution incident impacting our run-of-river source on the River Thames. The overall agreement is only for the duration of the pollution event but there is a provision for up to 10Ml/d as a sweetening flow in the connecting pipeline, which can be interpreted as a raw water bulk supply.

Our inspection of the records for this supply for recent years shows that average transfers are significantly less than the 10Ml/d allowance. We have agreed with Thames Water that the bulk supply be reduced from 10Ml/d to 2Ml/d and the existing agreement has been formally amended to reflect the reduced requirement. This does not affect the supply / demand balance of our WRMP.

11.7.6.4 Other bulk supplies

We do not propose any changes to the other bulk supplies we receive from Thames Water.

11.7.7 Bulk transfer arrangements with the Canal & River Trust

Some of our modelling scenarios did select water trading options from the Canal & River Trust. We found that the selection of these options was sensitive to the tolerance of our modelling, i.e. when reducing the tolerance they were less likely to be selected, with other options found to be more cost effective.

Our Preferred Plan does not include any options for water trading with the Canal & River Trust, although we remain keen to explore opportunities with them for water trading in the future.

11.7.8 Bulk transfer arrangements with other third parties

As the water available in the South East of England is reducing as a result of climate change and the need to achieve good ecological status in accordance with the Water Framework Directive, we have had to consider alternative supplies such as a bulk transfer of water from a third party licence holder.

Our Preferred Plan identifies a number of third party options for delivery in the last years of the planning period. We have been exploring some of these options for many years as we considered ways to improve our resilience and security of supply for our customers. We will work with both the licence holders and the Agency to determine the viability of these options, as licence change may not be permitted, for example from agricultural or industrial. Further, such licences may also be subject to sustainability changes, rendering the options unavailable.

We will gather information and maintain dialogue with the parties concerned to ensure we maintain a positive water balance.

11.8 The environmental aspects of our Preferred Plan

11.8.1 General

As we consider that our WRMP is subject to the SEA Directive, we published our Scoping Report for consultation in October 2012 and we published an Environmental Report with our draft WRMP in May 2013.

We have updated our Environmental Report in support of our revised WRMP to take account of the feedback we received during the draft WRMP consultation period and to demonstrate the additional work we carried out to investigate the cumulative effects of options and our consideration for no deterioration under the Water Framework Directive. Our Environmental Statement comprises our Strategic Environmental Assessment and our Habitats Regulation Assessment.

Our reports show how we have taken into account wider aspects of social and environmental pressures and costs and how this has affected the selection of supply and demand options and ultimately the range of investments we are proposing in our Preferred Plan. For example, in overall terms, a greater emphasis on demand management programmes provides more environmental benefits than supply side schemes.

11.8.2 Implementing sustainability reductions and maintaining levels of service

In 2012, many of our groundwater sources fell to their lowest recorded levels. We updated our Drought Management Plan in response to these severe environmental conditions, and developed a programme of options that would increase our resilience to drought. We included those proposals in our draft WRMP in order to seek customers' views about whether to make additional investment. Our consultation showed that 63% of customers would pay more to improve drought resilience[19].

As we have worked hard over the past years to increase our resilience to environmental events such as flooding and drought, our customers already benefit from a resilient supply. Our consultation showed that the majority of customers (72%) are satisfied with the current levels of service for temporary use bans at one in ten years[20].

Our customers have indicated a strong preference to protect the environment by reducing our unsustainable abstractions; 86% would like us to reduce abstraction and increase bills[21].

However, in order to deliver sustainability reductions, we need to build additional infrastructure to ensure that customers do not suffer a greater level of risk to their supply when the sustainability reductions are implemented than before. Generally, we will achieve this by installing new pipelines to give our system greater capacity to move water to where it is needed. This inherently provides our customers with improved resilience to severe drought, as the drought resilience proposals we identified in our draft WRMP were mostly about improving our ability to move water around.

69% of our customers understood that investment is needed to reduce the likelihood of restrictions during a drought, but that they would prefer us to find lower cost alternatives[22]. The work we have undertaken between the publication of our draft WRMP and the release of our Statement of Response scrutinised the need for both sustainability reductions mitigation and drought resilience. As described in section 11.9, the schemes we need to deliver sustainability reductions inherently provide drought resilience, therefore reducing the need for two different programmes of work. The resulting investment programme is less than what we identified in our draft Plan, whilst delivering the same benefits.

We have carefully considered the impacts of this new infrastructure on the environment as part of our cumulative effects assessment in our SEA. We will mitigate any environmental risks in the development of each scheme such that they are designed out.

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[19] Results of our online panel to understand customer preferences for levels of service, sustainability reductions and drought resilience. 55% would pay £2 to reduce the frequency of restrictions, with a further 9% prepared to pay any price. 23% want less frequent restrictions but are not prepared to pay, whilst 13% are prepared to accept the risk of water shortages in order to keep bills down.

[20] Results of our online panel to understand customer preferences for levels of service, sustainability reductions and drought resilience. 72% prepared to accept 1 in 10 years. 15% would accept being inconvenienced more frequently, while 12% would prefer less frequent restrictions,

[21] Results of our online panel to understand customer preferences for levels of service, sustainability reductions and drought resilience. 14% do not want the environment protected if it results in higher bills, but 9% would accept any cost, 34% would accept £6.40 increase over 5 years and 43% would accept £4.60 over 5 years.

[22] Results of our online panel to understand customer preferences for levels of service, sustainability reductions and drought resilience. 16% agree that spending more to reduce the likelihood of restrictions is important, while 69% understand additional investment is needed but would like us to find cheaper options. 15% did not want to pay to ensure there would be no restrictions on use during long droughts.

11.8.3 The impact of our SEA

As described in section 9.6, we ran two SEA scenarios to understand the impact on the cost and the supply / demand balance:

– All high risk options removed from the least cost plan;

– All high and medium risk options removed from the least cost plan.

We also ran a sensitivity on our Preferred Plan:

– Preferred Plan options for AMP6 and AMP7 with all high risk SEA options removed for the duration of the planning period, with only low risk options available from 2025 (i.e. all medium risk options removed from 2025).

The results are summarised in Table 77.

Scenario	Description	WAFU cost, £M	Investment cost, £M	Total Cost, £M	Deficits
2	Base case (least cost)	322.43	135.02	457.45	None
3	High SEA risk options removed from least cost plan	322.15	144.19	466.35	None
SEA1	High and medium SEA risk options removed from least cost plan	311.77	239.27	551.04	WRZ5 and WRZ7, from 2039
SEA2	Preferred Plan for AMP6 and AMP7 with high SEA risk options excluded, only low risk options available from 2025	310.13	221.33	531.46	WRZ5 and WRZ7, from 2038

Table 77: Comparison of SEA scenarios

Our analysis shows that the exclusion of options with 'high' environmental risk adds very little to the total cost of the scenario when compared to the Base Case. As the other scenarios result in zonal deficits that could not be resolved, they are not viable considerations for our Preferred Plan.

We believe that the costs of mitigating the environmental risks associated with the 'high' risk options would outweigh the small increase in the total investment where such options are excluded.

As proposed in our draft WRMP, we have maintained our position in the removal of all 'high' risk options in the build-up of our Preferred Plan. A number of stakeholders who responded to our consultation were supportive of this approach.

11.8.4 Water Framework Directive: no deterioration

Our WRMP has balanced the significant challenges presented by sustainability reductions, growth and climate change whilst accounting for our customers' willingness to pay.

We have been advised by the Agency that a large volume of 'unknown' sustainability reductions in the Colne valley could be formally notified to us in 2015. This gives us no opportunity to consult with customers, stakeholders and regulators with regard to willingness to pay or accommodating the significant impact on bills in our final WRMP or Business Plan for AMP6. Such reductions in our water available for use would increase the deficit between supply and demand and would require investment that is not yet part of our WRMP. Further, our scenario S2 described in 9.6.3.3 included an additional 50Ml/d of sustainability reductions in WRZ2 for implementation in AMP7 and could not solve the supply / demand balance.

We do not yet know the scope and scale of the volumes that the Agency are considering notifying us of and the WRPG prevents us from being able to consider the impact of 'unknown' sustainability reductions in our Plan. We believe that the Agency's future River Basin Management Plans present the ideal opportunity for consultation on proposed sustainability reductions and we look forward to supporting the Agency in reaching a conclusion that our customers approve of.

Our SEA has gone to extensive lengths to demonstrate no deterioration in ecological status of the schemes we need deliver throughout the planning period, although this is particularly challenging for options that are needed some way in the future.

We have included a small provision in our WRMP for investigative works to establish the impact on the environment of the options in our Preferred Plan, particularly with regard to no deterioration. We will continue to review our future projects as part of our annual review of our WRMP, and will investigate potential deterioration effects as necessary so that we are able to draw firm conclusions to ensure no deterioration through adoption of alternative solutions well before any option is included in subsequent WRMPs.

Water companies' WRMPs must be reviewed annually to report on progress and to explain the needs for any changes to the Plan in accordance with legislation. We believe our annual review presents the ideal opportunity to report on our progress in establishing no deterioration of future options.

11.9 Drought resilience & sustainability reductions mitigation

In our draft WRMP, we put forward proposals to improve resilience against a third dry winter drought based on work we carried out in the spring of 2012 when we had experienced two very dry winters and we were forecasting unprecedented drought conditions by the autumn of that year. In the event, the crisis was averted by an equally unprecedented rainfall pattern over the summer that was a 1 in 200 year event. We describe this in detail in section 3.2.1.6.

In our draft WRMP, we submitted our estimate to reduce the impact of a third dry winter drought on customers for a capital investment of £15million. As evidenced by the response from our consultees presented in section 10.3, our drought resilience proposals were generally supported. This was also backed up by our online panel in August 2013 (see section 10.5.3).

For our revised WRMP, we have reviewed the supply deficit we forecast in severe drought and, at the same time using our MISER operational model, we have worked out in detail what measures would be needed in each of our hydraulic demand zones to achieve site by site sustainability reductions of 42Ml/d in AMP6 and 28Ml/d in AMP7.

Implementation of sustainability reductions means we will have to replace this lost groundwater with a combination of demand management measures (leakage reduction, metering and water efficiency) and by transferring water from other areas.

In establishing how we will replace lost groundwater, we have used out MISER model to design reinforcements to our network. We have taken account of the need to prevent deterioration in the quality of supplies replaced by other water. Whilst we have an undertaking for metaldehyde in some of our zones, by retaining 10Ml/d peak licence in our Stevenage area, we have avoided the wider use of imports that have elevated levels of metaldehyde and reduced the network reinforcements needed by a cost of £30million. We have minimised the cost of mitigation measures by agreeing with the Environment Agency the retention of 10Ml/d peak licence in our Stevenage area.

As a consequence of this work, we will be investing to reinforce our network in AMP6 and AMP7 to be able to replace lost local resources as well as building greater capacity to move water around. The level of investment outlined in Table 78 has been minimised as a result of our implementation of a wide range of leakage reduction and demand management measures to reduce the demand for water. Note that these figures are in 2012/13 prices, but have been discounted back to 2011/12 prices in Table 48.

River	Scheme	To be delivered by	Capital cost
Ver	New trunk main in St Albans	2016	£2,392,884
Ver	Network modifications in St Albans	2016	£28,000
Beane	New trunk main to Stevenage	2018	£4,048,630
Beane	Pumping station modifications near Stevenage	2018	£824,150
Misbourne	Pumping station modifications near Amersham	2018	£157,853
Misbourne	New trunk main from Amersham to Hughenden	2017	£2,290,389
Misbourne	Pipeline and network modifications near Amersham	2017	£833,405
Gade	New trunk main in Hemel Hempstead	2018	£588,520
Gade	Network modifications near Hemel Hempstead	2018	£45,000
Gade	Pumping station modifications in Hemel Hempstead	2018	£212,000
Mimram	Pumping station modifications north of Welwyn Garden City	2018	£288,000
n/a	Trunk main from Bovingdon to Hemel Hempstead	2018	£1,885,975
n/a	New booster station pumping from Baldock to Royston	2018	£391,000
		TOTAL	£13,985,806

Table 78: Sustainability reductions resilience schemes

These investments mean that we have also reduced the severity of drought our customers will experience following a third dry winter (which corresponds to the level 4 trigger in our Drought Management Plan and a return event of 1 in 118 years) such that the supply deficit under those conditions is now forecast to be only 1.5Ml/d by 2020 and 15Ml/d by 2040. As the severity of drought conditions will be reduced following the introduction of measures to achieve sustainability reductions and the scale of the forecast deficits is managed under our Drought Management Plan (also revised to take account of sustainability reductions), we are no longer proposing specific further investment for drought measures.

As a result of discussions with the Environment Agency in November 2013 (see Appendix B2), we have included provision for an early start on the implementation of sustainability reductions measures as part of transitional expenditure in 2014/15.

11.10 Resilience and flexibility

Our operational system has high resilience in that we currently have a diversity of water sources from both groundwater and surface water together with an interconnected pumping network. This means that our customers have low vulnerability to operational failure events or single year droughts that affect surface water dominated systems, but longer term low rainfall events can still result in the need to impose restrictions on use.

Our Preferred Plan identifies the need to continue and extend a number of existing bulk supplies from our neighbouring water companies. In most cases, we do not fully utilise the supply in every year of the planning period for all conditions. This provides resilience and flexibility in that we can use these bulk supplies to assist us in managing our assets and keeping outage to a minimum.

We recognise we need to continue to reduce leakage not only where it economic to do so but to meet the expectations of our customers. We have proposed to reduce leakage steadily over the period of our plan and at a pace that will enable us to verify the increasing cost of reducing leakage as we progress. We will review our proposed investments annually and where leakage remains cost-effective or cost-beneficial compared to other options to balance supply and demand we will amend our plan to include additional leakage reductions. This means our Plan will remain flexible and reflect best value as we proceed.

Reducing abstraction at sixteen of our sources also means we will reinforce our network to transfer more water to replace lost local supplies, as described in section 11.9, and the retention of a small volume at peak (which has much less affect on the environment) enables us to retain operational flexibility in the event of drought or emergencies.

11.11 Our Preferred Plan for each water resource zone

11.11.1 Introduction

The WRPG's Guiding Principles requires companies to explain the changes in timing and selection of schemes to maintain a balance of supply and demand as a result of the draft WRMP consultation period. In this section of our SoR, we explain the changes in option selection and delivery year in each of our water resource zones (WRZ). The tables presented in this section should be considered in addition to the sustainability reductions resilience schemes presented in Table 78 of section 11.9.

– Options that did not appear in our draft WRMP but are included in our revised WRMP are coloured **blue**.
– Options that were in our draft WRMP but are not in our revised WRMP are coloured **red**.
– Options that have been delayed in our revised WRMP are shaded **orange**, whilst options that have been brought forward in our revised WRMP are shaded **green**.

Please note that the active leakage control (ALC) options in from our draft WRMP have been replaced by a single option for the AMP to account for the improvements we have made to our modelling approach with respect to leakage reduction, as explained in section 9.5.2.

11.11.2 Water Resource Zone 1

11.11.2.1 Key points

– Discrete ALC leakage options in AMP6 and AMP7 have been replaced by a single ALC option deriving a total of 10Ml/d over the planning period.
– We have delayed universal metering in this WRZ until 2024. Customers can still choose to have a meter installed under our optant metering programme in the interim.
– As we will not meter our household customers until AMP7, we have delayed our commercial water efficiency options until AMP7.
– The additional leakage beyond AMP7 has mitigated some of the yield that was delivered a third party licence scheme (ID 840), which we removed from our feasible options list as a result of the Agency's concern that there was no current licence available for trading.
– Population is projected to grow by 12% in WRZ1, compared to 6% in our draft WRMP. This has necessitated the selection of new options not present in our draft WRMP to balance supply and demand.
– The resilience options are no longer required as explained in section 11.9.

11.11.2.2 Revised WRMP options for WRZ1

Table 79 gives the revised WRMP Preferred Plan list of options for Water Resource Zone 1.

Option Type	ID	Option Name	draft WRMP Delivery Year	rWRMP Delivery Year
Leakage	651	Leakage reduction through increased ALC, 2Ml/d in AMP6	2015	not req'd
Metering	990	Metering: community integrated AMR & water efficiency	2015	2017
Water Efficiency	936	Water audits Commercials (non-process)	2015	2015
Water Efficiency	937	Water audits Commercials (process)	2015	2015
Resilience	T02	Reinforcement in WRZ1	2015	not req'd

Option Type	ID	Option Name	draft WRMP Delivery Year	rWRMP Delivery Year
Leakage	423	Leakage reduction - pressure management with new PRVs	2016	2035
Leakage	949	Leakage reduction - subdivide large DMAs	2016	2035
Supply	070	Source optimisation in Ashridge	2018	2021
Leakage	L14	Leakage reduction through increased ALC, 2Ml/d in AMP7	2022	not req'd
Water Efficiency	567	Additional Water Efficiency for households	2035	2033
Leakage	ALC4	Leakage reduction by ALC 2015-40 (10Ml/d)	x	2015
Supply	884	Source optimisation in the lower Gade valley	x	2018
Water Efficiency	070	Dual flush WCs	x	2034

Table 79: Schemes selected in Water Resource Zone 1

11.11.3 Water Resource Zone 2

11.11.3.1 Key points

– Discrete ALC leakage options in AMP6 and AMP7 have been replaced by a single ALC option deriving a total of 14.12Ml/d over the planning period.

– We have brought universal metering in this WRZ forward one year to 2019. Customers can still choose to have a meter installed under our optant metering programme in the interim.

– The additional leakage beyond AMP7 has mitigated some of the yield that was delivered by a third party licence scheme (ID 840), which we removed from our feasible options list as a result of the Agency's concern that there was no current licence available for trading.

– Population is projected to grow by 14% in WRZ2, compared to 6% in our draft WRMP. This has necessitated the selection of new options not present in our draft WRMP to balance supply and demand.

11.11.3.2 Revised WRMP options for WRZ2

Table 80 gives the revised WRMP Preferred Plan list of options for Water Resource Zone 2.

Option Type	ID	Option Name	draft WRMP Delivery Year	rWRMP Delivery Year
Leakage	651	Leakage reduction through increased ALC, 2Ml/d in AMP6	2015	not req'd
Water Efficiency	936	Water audits Commercials (non-process)	2015	2015
Water Efficiency	937	Water audits Commercials (process)	2015	2015
Leakage	950	Leakage reduction - subdivide large DMAs	2016	2035
Leakage	423	Leakage reduction - pressure management with new PRVs	2017	2035
Leakage	L14	Leakage reduction through increased ALC, 2Ml/d in AMP7	2020	not req'd

Option Type	ID	Option Name	draft WRMP Delivery Year	rWRMP Delivery Year
Metering	990	Metering: community integrated AMR & water efficiency	2020	2019
Supply	622	Mains reinforcement in Bushey (recommission reservoir)	2028	2027
Water Efficiency	567	Additional Water Efficiency for households	2035	2033
Leakage	ALC4	Leakage reduction by ALC 2015-40 (14.12Ml/d)	x	2015
Water Efficiency	070	Dual flush WCs	x	2034
Supply	090	Source optimisation in St Albans	x	2038
Supply	601	Peak licence scheme in north Watford	x	2038

Table 80: Schemes selected in Water Resource Zone 2

11.11.4 Water Resource Zone 3

11.11.4.1 Key points

- This WRZ is the third to be universally metered, within the same AMP as our draft WRMP.
- Discrete ALC leakage options in AMP6 and AMP7 have been replaced by a single ALC option deriving a total of 7.91Ml/d over the planning period.
- Feedback from the Agency and Natural England identified some concern that we had not adequately proved that a peak licence scheme (ID 502) would not cause deterioration in the ecological status. Whilst we have carried out further assessment (captured in our updated Technical Report 3.9: *Environmental Report*), we have been able to delay the need to develop this scheme until AMP10 to allow us to conduct further tests.
- Population is projected to grow by 25% in WRZ3, compared to 21% in our draft WRMP. This has necessitated the selection of new options not present in our draft WRMP to balance supply and demand.
- The increased population and housing growth has introduced a number of new schemes that were not present in our draft WRMP. There are a number of new groundwater supply schemes because an option in WRZ4 (ID 840) was removed from the feasible options list in response to the Agency's representation on our draft WRMP. The need to develop other schemes has been partially offset by the greater volume of leakage that has been selected by our model.
- The pipeline capacity upgrade scheme (ID 076) had previously been selected by our model in our draft WRMP, but was not utilised at DYAA or DYCP. We believe our model was incorrectly configured and has been corrected in our revised WRMP; consequently, the option is not selected in our revised WRMP.
- The resilience options are no longer required as explained in section 11.9.

11.11.4.2 Revised WRMP options for WRZ3

Table 81 gives the revised WRMP Preferred Plan list of options for Water Resource Zone 3.

Option Type	ID	Option Name	draft WRMP Delivery Year	rWRMP Delivery Year
Leakage	651	Leakage reduction through increased ALC, 2Ml/d in AMP6	2015	not req'd
Metering	990	Metering: community integrated AMR & water efficiency	2015	2018
Water Efficiency	936	Water audits Commercials (non-process)	2015	2015
Water Efficiency	937	Water audits Commercials (process)	2015	2015
Leakage	423	Leakage reduction - pressure management with new PRVs	2016	2035
Resilience	T02	New pipeline between WRZ3 & WRZ5	2015	not req'd
Resilience	T02	Reinforcement west-east in WRZ3	2017	not req'd
Leakage	L14	Leakage reduction through increased ALC, 2Ml/d in AMP7	2020	not req'd
Supply	076	Pipeline capacity upgrade in WRZ3	2021	not req'd
Supply	502	Peak licence scheme in Hertford	2027	2036
Water Efficiency	567	Additional Water Efficiency for households	2035	2033
Leakage	ALC4	Leakage reduction by ALC 2015-40 (7.91Ml/d)	x	2015
Supply	548	Replacement borehole in Hertford	x	2025
Water Efficiency	070	Dual flush WCs for households	x	2034
Supply	511	Peak licence scheme in west Luton (Greensand)	x	2037
Supply	100	Source optimisation in south east Royston	x	2038
Supply	134	Third party licence in Luton	x	2039
Water Efficiency	666	Airport water efficiency - Luton	x	2039

Table 81: Schemes selected in Water Resource Zone 3

11.11.5 Water Resource Zone 4

11.11.5.1 Key points

- Discrete ALC leakage options in AMP6 and AMP7 have been replaced by a single ALC option deriving a total of 5.9Ml/d over the planning period.
- We have delayed universal metering in this WRZ until 2024. Customers can still choose to have a meter installed under our optant metering programme in the interim.
- As we will not meter our household customers until AMP7, we have delayed our commercial water efficiency options until AMP7.
- The additional leakage beyond AMP7 has mitigated some of the yield that was delivered by a third party licence scheme (ID 840), which we removed from our feasible options list as a result of the Agency's concern that there was no current licence available for trading.
- Population is projected to grow by 18% in WRZ4, compared to 15% in our draft WRMP. We have not had to develop any further options to balance supply and demand in this WRZ, although neighbouring zones that had been reliant on the yield provided by option ID 840 have had to develop new options as a result of this option being removed from our feasible options list.

11.11.5.2 Revised WRMP options for WRZ5

Table 82 gives the revised WRMP Preferred Plan list of options for Water Resource Zone 4.

Option Type	ID	Option Name	draft WRMP Delivery Year	rWRMP Delivery Year
Leakage	423	Leakage reduction - pressure management with new PRVs	2015	2034
Leakage	651	Leakage reduction through increased ALC, 2Ml/d in AMP6	2015	not req'd
Metering	990	Metering: community integrated AMR & water efficiency	2015	2022
Supply	T01	Thames Water bulk transfer, 12Ml/d available 2015 – 2016	2015	2015
Water Efficiency	936	Water audits Commercials (non-process)	2015	2020
Water Efficiency	937	Water audits Commercials (process)	2015	2017
Leakage	952	Leakage reduction - subdivide large DMAs	2017	not req'd
Supply	T01	Increase Thames Water bulk transfer to max (17Ml/d)	2018	2018
Water Efficiency	666	Airport water efficiency - Heathrow	2020	2039
Leakage	L14	Leakage reduction through increased ALC, 2Ml/d in AMP7	2022	not req'd
Water Efficiency	329	Dual flush WCs for households	2035	2033
Water Efficiency	567	Additional Water Efficiency for households	2035	2033
Supply	840	Third party source in Uxbridge	2037	not req'd
Leakage	ALC4	Leakage reduction by ALC 2015-40 (5.9Ml/d)	x	2015

Table 82: Schemes selected in Water Resource Zone 4

11.11.6 Water Resource Zone 5

11.11.6.1 Key points

– Discrete ALC leakage options in AMP6 and AMP7 have been replaced by a single ALC option deriving a total of 3.5Ml/d over the planning period.

– This WRZ is the first to be universally metered, as per our draft WRMP.

– Population is projected to grow by 25% in WRZ5, compared to 13% in our draft WRMP. This has necessitated the selection of a new option not present in our draft WRMP to balance supply and demand.

– The increased population and housing growth projected in WRZ5 has introduced a supply scheme that was not present in our draft WRMP. The need to develop other schemes has been partially offset by the greater volume of leakage that has been selected by our model.

– The resilience options are no longer required as explained in section 11.9.

11.11.6.2 Revised WRMP options for WRZ5

Table 83 gives the revised WRMP Preferred Plan list of options for Water Resource Zone 5.

Option Type	ID	Option Name	draft WRMP Delivery Year	rWRMP Delivery Year
Leakage	423	Leakage reduction - pressure management with new PRVs	2015	not req'd
Leakage	651	Leakage reduction through increased ALC, 2Ml/d in AMP6	2015	not req'd
Metering	990	Metering: community integrated AMR & water efficiency	2015	2015
Water Efficiency	936	Water audits Commercials (non-process)	2015	2015
Water Efficiency	937	Water audits Commercials (process)	2015	2015
Resilience	T02	Re-commission source in WRZ5	2015	not req'd
Resilience	T02	Group licence in WRZ5 **	2015	not req'd
Resilience	T03	Purchase third party licence for WRZ5	2016	not req'd
Supply	104	Source optimisation in Widford	2018	2018
Supply	160	Source optimisation in Hempstead	2018	2018
Supply	169	Increase licence in Stansted	2018	2016
Leakage	L14	Leakage reduction through increased ALC, 2Ml/d in AMP7	2020	not req'd
Water Efficiency	567	Additional Water Efficiency for households	2035	2033
Water Efficiency	666	Airport water efficiency - Stansted	2038	2039
Leakage	ALC4	Leakage reduction by ALC 2015-40 (3.5Ml/d)	x	2015
Supply	513	Source optimisation near Great Dunmow	x	2038

Table 83: Schemes selected in Water Resource Zone 5

** *This option was included in error in our draft WRMP, as it should have been mutually exclusive with ID 169.*

11.11.7 Water Resource Zone 6

11.11.7.1 Key points

- Discrete ALC leakage options in AMP6 and AMP7 have been replaced by a single ALC option deriving a total of 2.23Ml/d over the planning period.
- The additional leakage beyond AMP7 has removed the need for a groundwater optimisation scheme in Guildford.
- We have delayed universal metering in this WRZ until 2024. Customers can still choose to have a meter installed under our optant metering programme in the interim.
- As we will not meter our household customers until AMP7, we have delayed our commercial water efficiency options until AMP7.
- Population is projected to grow by 15% in WRZ6, compared to 11% in our draft WRMP. We have introduced a water efficiency option that was not present in our draft WRMP to balance supply and demand.

11.11.7.2 Revised WRMP options for WRZ6

Table 84 gives the revised WRMP Preferred Plan list of options for Water Resource Zone 6.

Option Type	ID	Option Name	draft WRMP Delivery Year	rWRMP Delivery Year
Leakage	651	Leakage reduction through increased ALC, 2Ml/d in AMP6	2015	not req'd
Metering	991	Metering: community integrated AMR & water efficiency	2015	2024
Water Efficiency	936	Water audits Commercials (non-process)	2015	2020
Water Efficiency	937	Water audits Commercials (process)	2015	2020
Leakage	423	Leakage reduction - pressure management with new PRVs	2016	2035
Leakage	L14	Leakage reduction through increased ALC, 2Ml/d in AMP7	2023	not req'd
Water Efficiency	567	Additional Water Efficiency for households	2035	2033
Supply	752	Increased import from Thames Water	2036	2036
Supply	005	Local Source Recommissioning	2039	2038
Supply	173	Source optimisation near Guildford	2039	not req'd
Leakage	ALC4	Leakage reduction by ALC 2015-40 (2.23Ml/d)	x	2015
Water Efficiency	070	Dual flush WCs for households	x	2035

Table 84: Schemes selected in Water Resource Zone 6

11.11.8 Water Resource Zone 7

11.11.8.1 Key points

- There is no supply / demand deficit in AMP6 at either DYAA or DYCP.
- As a result, no water resources investment is required in the period 2015 to 2020.
- Population is projected to grow by 12% in WRZ7, compared to 10% in our draft WRMP. We have been able to balance supply and demand without developing options that did not appear in our draft WRMP.
- Discrete ALC leakage options in AMP6 and AMP7 have been replaced by a single ALC option deriving a total of 0.5Ml/d over the planning period.
- Enlarging existing pipes helps to remove constraints in our network, allowing us to make best use of our current abstractions. These options are needed from AMP8 onwards.
- We have agreements in place for bulk supplies from South East Water and Southern Water so that we can use the imports to assist us in the event of a planned outage or to increase our resilience for a short time, e.g. during a period of warm weather when demand increases, but until 2021 (South East Water) and 2035 (Southern Water) we do not need them to balance supply and demand.

11.11.8.2 Revised WRMP options for WRZ7

Table 85 gives the revised WRMP Preferred Plan list of options for Water Resource Zone 7.

Option Type	ID	Option Name	draft WRMP Delivery Year	rWRMP Delivery Year
Water Efficiency	936	Water audits Commercials (non-process)	2015	2020
Water Efficiency	937	Water audits Commercials (process)	2015	2020
Leakage	651	Leakage reduction through increased ALC, 2Ml/d in AMP6	2018	not req'd
Supply	629	Local licence recovery	2018	not req'd
Network	626	Network improvement near Barham	2018	2030
Network	900	Dover constraint removal	2018	2026
Supply	639	Southern Water import continuation (1Ml/d)	2018	2035
Leakage	423	Leakage reduction - pressure management with new PRVs	2021	not req'd
Leakage	L16	Leakage reduction through increased ALC, 1Ml/d in AMP7	2023	not req'd
Leakage	955	Leakage reduction - subdivide large DMAs	2024	2027
Network	627	Local network improvement	2028	2037
Supply	942	South East Water Import 3Ml/d	2031	not req'd
Water Efficiency	329	Dual flush WCs for households	2034	not req'd
Leakage	ALC4	Leakage reduction by ALC 2015-40 (0.5Ml/d)	x	2020
Supply	638	South East Water Import 2Ml/d (continuation of existing)	x	2021

Table 85: Schemes selected in Water Resource Zone 7

11.11.9 Water Resource Zone 8

As our East region does not have a supply / demand deficit, we do not propose any additional investment beyond our existing programmes of work, including optant metering and water efficiency. This is the same strategy that we presented in our draft WRMP.

11.12 The uncertainty of our Preferred Plan

11.12.1 Introduction

The WRPG requires us to consider the uncertainty of our Preferred Plan and to account for that uncertainty in our headroom assessment. The Environment Agency also advised us in their representation to make this improvement for our revised WRMP.

11.12.2 Uncertainty of our Preferred Plan in headroom

Section 8 of this document explains our approach to the determination of our feasible options. Our approach was in accordance with the WRPG and we believe we have been able to reduce the uncertainty of the options through their diligent development. However, we are unable to engineer out all risks associated with the options, nor those elements that are outside of our control, such as housing growth.

We have rerun our headroom model with these uncertainties to produce a new target headroom. We have built this into the supply / demand balance and have run a specific sensitivity as described in section 11.12.3.7.

Full details are given in Technical Report 2.4: *Headroom*.

11.12.3 Additional sensitivities we have tested

11.12.3.1 Introduction

Section 8.0 of the WRP Guideline asks companies to test their plans. In this section, we explain the scenarios we have modelled to test the robustness and flexibility of our Preferred Plan. Scenario testing can help to determine and justify the target headroom profile. It is also an opportunity to identify risks and uncertainties that we should seek to minimise during the planning period.

We have developed a small number of scenarios to test the robustness of our Preferred Plan in response to potential changes. Unless otherwise identified in the sensitivity descriptions below, the settings applied in each model run were the same as those applied to our Preferred Plan as described in section 11.3.1. Figure 70 identifies the sensitivities we have tested.

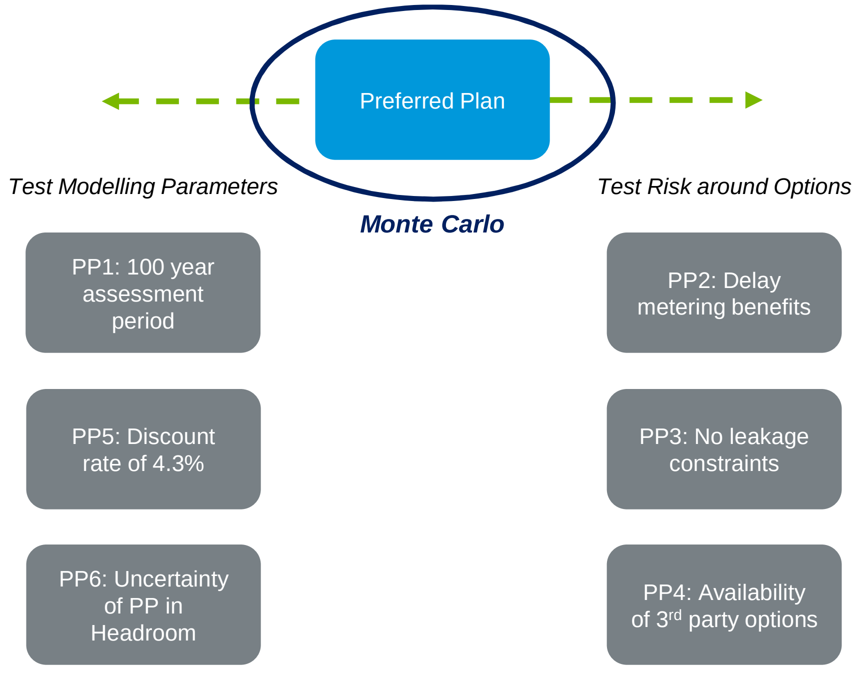

Figure 70: Sensitivity testing of our Preferred Plan

11.12.3.2 Scenario PP1: 100-year Assessment Period

With the exception of the scenarios designed to replicate the principles of the WRSE modelling, we choose to use a 50-year assessment period to avoid bias in the model of selecting expensive options towards the end of the planning period.

In section 2.4.2 of the WRPG, water companies are asked to take account of whole-life costs of the schemes required to solve the supply / demand balance in the 25-year planning period. Increasing the assessment period beyond 50 years affected the efficiency of our modelling; we modelled this scenario with a 100-year assessment period to show that modelling with a 50-year assessment period has not impacted the option selection by the model for our Preferred Plan.

For this scenario, the same settings were applied as for our Preferred Plan model run but beyond this the model had free choice on the implementation of all other options.

11.12.3.3 *Scenario PP2: Delaying the metering benefits*

In preparation for our PR14 Business Plan and in support of this WRMP, we have been working on our delivery plans for our community-integrated universal metering and water efficiency programme. Accounting for the feedback we received during the draft WRMP consultation, we have worked on transitional arrangements to minimise 'bill shock' and social tariffs to support vulnerable customers. As evidenced by our Southeast metering trials, explained in section 3.2.3.3, the pace of behavioural change is related to the timing of the transition from unmeasured to measured charging. We are planning our communications campaign to promote the early 'switching' from an unmeasured tariff to a measured tariff when the meter has been installed, but there may be some customers who choose to wait until the very end of the transitional period before they move to a measured tariff.

The potential impact of this is that the yield savings associated with our metering options selected as part of our Preferred Plan may be delayed. Whilst our communications campaign will highlight the additional benefits of reducing water consumption, such as corresponding lower energy bills as a result of shorter showers, we felt it was necessary to test the impact of delayed savings and the slower-than-forecast reduction in average PCC. We wanted to see if any other options are selected that we may wish to consider developing if, during the delivery of the metering programme, such delay to the yield savings is observed.

Other than changes to the yield of the metering option, this scenario was set up with all the same settings as our Preferred Plan.

11.12.3.4 *Scenario PP3: No leakage constraints*

Although our model has the functionality to select the most economical level of leakage when considered against all other options, in order to ensure our Preferred Plan is equitable and is in accordance with DEFRA's aspirations to ensure leakage does not rise, we have applied constraints to the model as described in section 9.5.2.3.

For this scenario, we have removed these constraints to allow us to identify the ELL across our supply area. This will allow us to identify areas that are performing both above and below the current ELL and if further ALC is needed will help inform the best areas to target. As a result, leakage could rise in one or more WRZ during the planning period where it is more economical to do so.

With the exception of the leakage options, all other model constraints are as per the Preferred Plan scenario run.

11.12.3.5 *Scenario PP4: Availability of third party options*

In the final year of the planning period, our Preferred Plan includes a third party transfer option from a private company who has an abstraction licence for industrial use. We have maintained an interest in this particular option and have investigated it a number of times over the last ten years but it has not been cost-beneficial for us to pursue until this WRMP, when we have deficits.

As the option is selected in 2039, it is not clear whether the supply will still be available for us to be able to trade, or whether the current licence holder will be the future licence holder. This scenario was developed to identify what alternative scheme or schemes would be selected if this option was not available to us.

All other third party supplies not from other water companies were also switched off in this scenario to ensure that another uncertain scheme would not be selected in its place.

11.12.3.6 *Scenario PP5: Discount rate of 4.3%*

The WRP Guideline directs companies to use a discount rate of 4.5% in their modelling.

For our PR14 Business Plan modelling, our Board has agreed that we will use a discount rate of 4.3%. To identify whether there will be any issues caused with two different discount rates from the different optimisations, we have run this scenario with the same model constraints as our Preferred Plan with a discount rate of 4.3% and compared it with the results of our Preferred Plan with a discount rate of 4.5%.

11.12.3.7 *Scenario PP6: Preferred Plan target headroom*

We have accounted for the uncertainty in our Preferred Plan by considering the risk around our options in the following components of our headroom assessment:

- S4 Bulk transfers;
- S5 Gradual pollution causing a reduction in abstraction;
- S9 Uncertain output from new resource developments; and
- D4 Uncertain outcome from demand management methods.

Examples of the uncertainties we have accounted for include the take-up of water efficiency advice for household customers during the implementation of our universal metering programme and the availability of water from third party options. Section 6.3 of Technical Report 2.4: *Headroom* gives full details of the additional uncertainties we have considered.

Other than changes to target headroom, this scenario was set up with all the same settings as our Preferred Plan, including the same volumes of leakage reduction in each AMP, and was not allowed to select any other options. This was to establish the volume of any remaining deficit such that we could determine the contingency options we should consider.

11.12.4 Sensitivity results

11.12.4.1 Overview

Figure 71 shows the total comparative cost of each of the Preferred Plan sensitivities, including the cost of abstracting, treating and distributing water from our existing sources and external transfers, presented in ascending order.

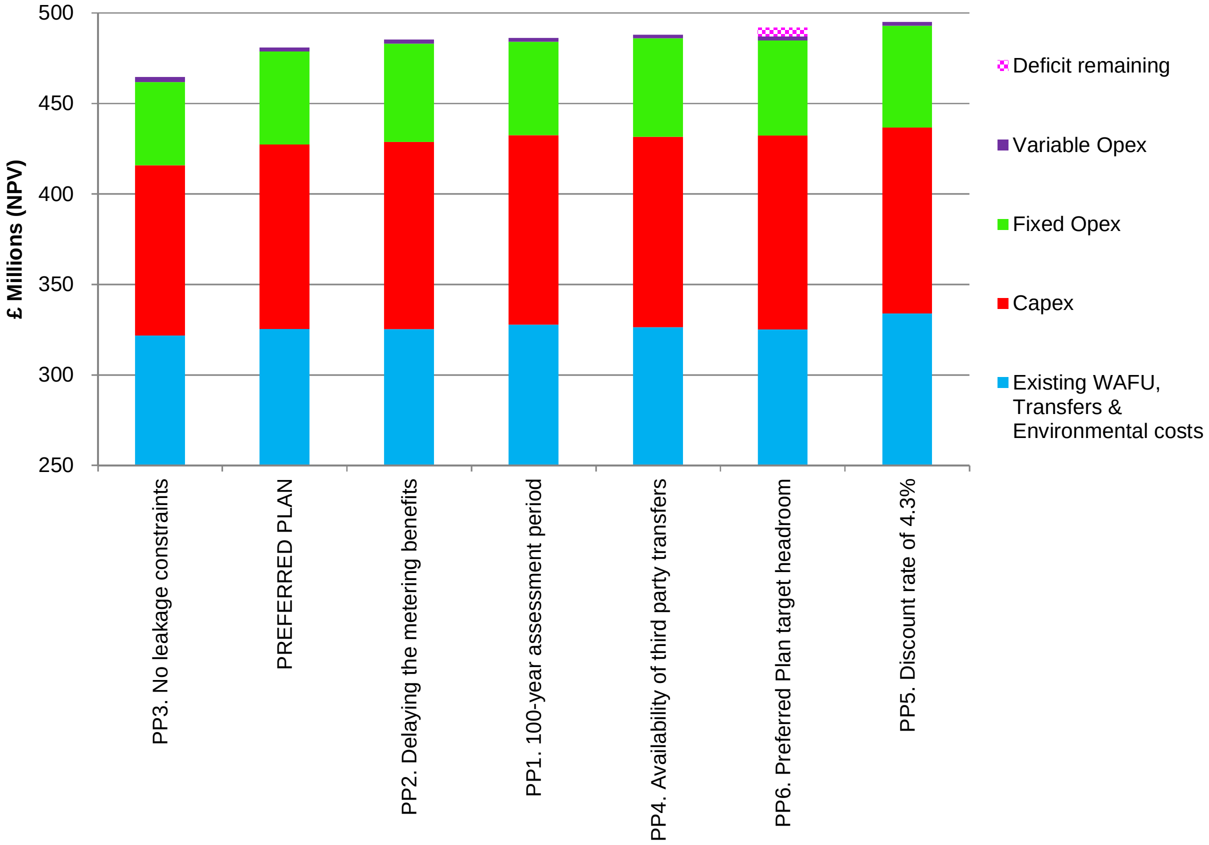

Figure 71: Results of our Preferred Plan sensitivity testing

With the exception of scenario PP6, Preferred Plan target headroom, all sensitivities solved the supply / demand balance without resulting in deficits.

Although there is a small deficit of 4.63Ml/d in WRZ5 in scenario PP6, it was in the final year of the planning period. If this was observed in actuality, we would resolve the deficit by increasing the amount of leakage reduction to ensure we meet the supply demand / balance. Therefore, we consider that it is still a useful scenario for demonstrating the robustness of our Preferred Plan.

Figure 72 presents the results of our Preferred Plan sensitivity testing with WAFU excluded.

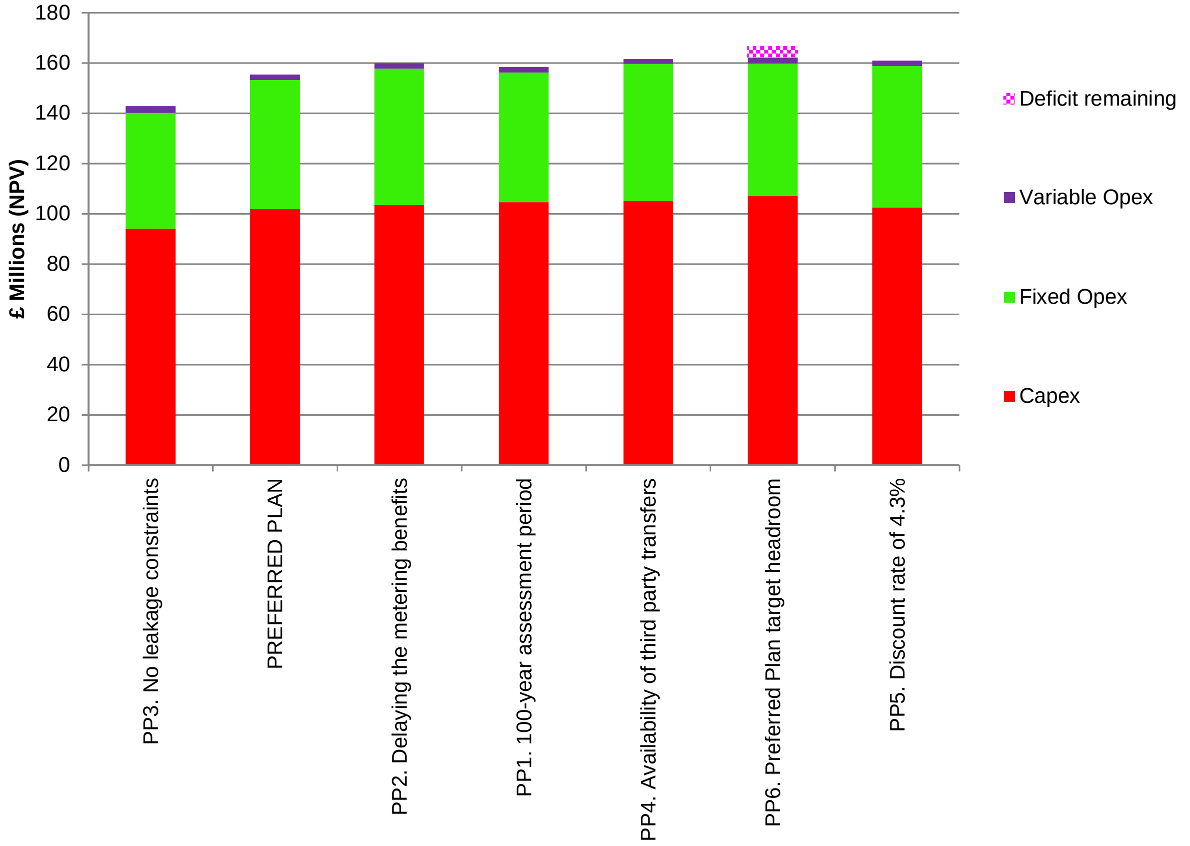

Figure 72: Results of our Preferred Plan sensitivity testing, excluding WAFU

Table 86 shows the total costs and the investment costs of our Preferred Plan sensitivities.

	PP3. No leakage constraints	Preferred Plan	PP2. Delaying the metering benefits	PP1. 100-year ass't period	PP4. Availability of third party transfers	PP6. Preferred Plan target headroom	PP5. Discount rate of 4.3%
Total Cost, £millions	464.46	**480.84**	485.21	486.22	487.92	487.21	494.93
Investment Total, £millions	146.24	**164.65**	169.76	169.69	173.03	171.14	171.67

Table 86: Total costs and investment costs of our Preferred Plan sensitivities

Using these scenarios, we have identified the variation in start dates for the options selected in our Preferred Plan. The following sections present these variations and discuss the results. This helps us to understand any potential risks in our plan.

11.12.4.2 Variation in AMP6

In AMP6, the variation from our Preferred Plan is around the delivery of the metering programme and a water efficiency option. We have found during scenario testing and the development of our Preferred Plan that the order the metering programme is delivered in can be very sensitive. This is because the model is allowed a 2% tolerance from the global optimum solution as explained in section 9.3.1.3.

There may be various near optimal solutions that fall within that 2% tolerance and we have found that the order of the metering programme can be sensitive because of this. Should we find that demand reduction was not occurring as planned, then we could choose to accelerate the metering programme to ensure the balance between supply and demand is maintained.

Type	ID	WRZ	Option name	Preferred Plan	Earliest Selected Delivery	Latest Selected Delivery	Variation (years)
Metering	990	2	Community integrated AMR & water efficiency	2019	2015	2019	4
Water Efficiency	937	4	Water audits (commercial process)	2017	2017	2020	3
Metering	990	1	Community integrated AMR & water efficiency	2017	2016	2019	3
Metering	990	5	Community integrated AMR & water efficiency	2015	2015	2017	2

Table 87: AMP 6 scheme variation

11.12.4.3 Variation in AMP7

In AMP7, there are a small number of supply and demand management options with different delivery years selected. Generally, options are brought forward one or two years. The results are shown in Table 88.

Type	ID	WRZ	Option name	Preferred Plan	Earliest Selected Delivery	Latest Selected Delivery	Variation (years)
Supply	070	1	Source optimisation in Ashridge	2021	2018	2021	3
Water Efficiency	937	6	Water audits (commercial process)	2020	2017	2020	3
Metering	990	4	Community integrated AMR & water efficiency	2022	2020	2023	3
Supply	638	7	South East Water import 2Ml/d	2021	2021	2022	1

Table 88: AMP 7 scheme variation

11.12.4.4 Variation in AMP8

In AMP8, there are a small number of supply and network improvement options with different delivery years selected. Generally, options are brought forward one or two years. The results are shown in Table 89.

Type	ID	WRZ	Option name	Preferred Plan	Earliest Selected Delivery	Latest Selected Delivery	Variation (years)
Supply	548	3	Replacement borehole in Hertford	2025	2025	2039	14
Network	900	7	Dover constraint removal	2027	2019	2027	8
Supply	622	2	Mains reinforcement in Bushey (recommission reservoir)	2027	2026	2030	4

Table 89: AMP 8 scheme variation

11.12.4.5 Variation in AMP9

In AMP9, there are small variations to the Preferred Plan option set, affecting mainly small yield water efficiency options. The results are given in Table 90.

Type	ID	WRZ	Option name	Preferred Plan	Earliest Selected Delivery	Latest Selected Delivery	Variation (years)
Network	626	7	Network improvement near Barham	2031	2027	2031	4
Water Efficiency	329	1	Dual flush WCs	2034	2033	2035	2
Water Efficiency	329	2	Dual flush WCs	2034	2033	2035	2
Water Efficiency	329	3	Dual flush WCs	2034	2033	2035	2
Leakage	423	4	Leakage reduction - pressure management with new PRVs	2034	2034	2035	1

Table 90: AMP 9 scheme variation

11.12.4.6 Variation in AMP10

The largest variation on the options selected in our Preferred Plan sensitivity analysis is found in AMP10, at the very end of the planning period. The largest variation is on a peak licence scheme. The results are shown in Table 91.

Type	ID	WRZ	Option name	Preferred Plan	Earliest Selected Delivery	Latest Selected Delivery	Variation (years)
Supply	502	3	Peak licence scheme in Hertford	2036	2021	2036	15
Network	627	7	Local network improvement	2038	2034	2038	4
Supply	511	3	Peak licence scheme in west Luton (Greensand)	2037	2036	2039	3
Supply	752	6	Increased import from Thames Water	2036	2035	2038	3
Supply	100	3	Source optimisation in south east Royston	2038	2036	2039	3
Supply	639	7	Deal Import Continuation	2035	2034	2037	3
Leakage	949	1	Leakage reduction - subdivide large DMAs	2035	2033	2035	2
Supply	090	2	Source optimisation in St Albans	2038	2037	2039	2
Supply	601	2	Peak licence scheme in north Watford	2038	2037	2039	2
Supply	513	5	Source optimisation near Great Dunmow	2038	2037	2039	2
Leakage	423	2	Leakage reduction - pressure management with new PRVs	2035	2034	2035	1
Water Efficiency	329	6	Dual flush WCs	2035	2034	2035	1
Leakage	423	1	Leakage reduction - pressure management with new PRVs	2035	2034	2035	1
Supply	005	6	Local source recommissioning	2038	2038	2039	1
Supply	134	3	Third party licence in Luton	2039	2038	2039	1

Table 91: AMP 10 scheme variation

11.12.5 Contingency options

We are required to identify options that we consider to be our contingency, should our Preferred Plan not provide the level of demand reductions or the yield from our supply side options.

Our sensitivity analysis has identified that our Preferred Plan is robust as it can solve the supply / demand balance with a range of uncertainties, including the delay to the benefits associated with our universal metering programme.

In all except PP6, the Preferred Plan sensitivities were able to select from our other feasible options. Table 92 identifies the options that were selected, together with the earliest and latest delivery years.

Type	ID	WRZ	Option name	Earliest Selected Delivery	Latest Selected Delivery
Supply	868	3	Third party licence in Hertford	2022	2027
Water Efficiency	329	7	Dual flush WCs	2033	2035
Leakage	423	5	Leakage reduction - pressure management with new PRVs	2034	2035
Leakage	952	4	Leakage reduction - subdivide large DMAs	2035	2035
Supply	842	7	South East Water import 3Ml/d	2033	2033

Table 92: Alternative options selected in our Preferred Plan sensitivity analysis

As we restricted our model to the selection of the same ALC leakage reduction as our Preferred Plan (with the exception of scenario PP3), we can also undertake more leakage reduction by ALC as a contingency.

11.13 Carbon

The Climate Change Act 2008 sets out legally binding commitments to cut greenhouse gas emissions in order to reduce the effects of climate change. Water companies have a part to play in this overall ambition, and accounting for the cost of carbon in decision making is a key way of achieving this.

We have calculated the carbon footprint of our baseline for 2015 to 2040 and the impact of our revised WRMP Preferred Plan. Our baseline carbon footprint builds on the figures report in our 2013 Annual Return, factored in line with the distribution input of our baseline supply / demand balance.

The results are shown in Table 93 and Figure 73 but do not account at this stage for the effect of any downstream main laying required within zones or the investment that would be needed to improve our drought resilience against a third dry winter.

	AMP6	AMP7	AMP8	AMP9	AMP10
Carbon saved, tonnes	-10,102	-46,022	-56,144	-42,124	-37,985

Table 93: Tonnes of carbon saved in each quinquennium of the planning period

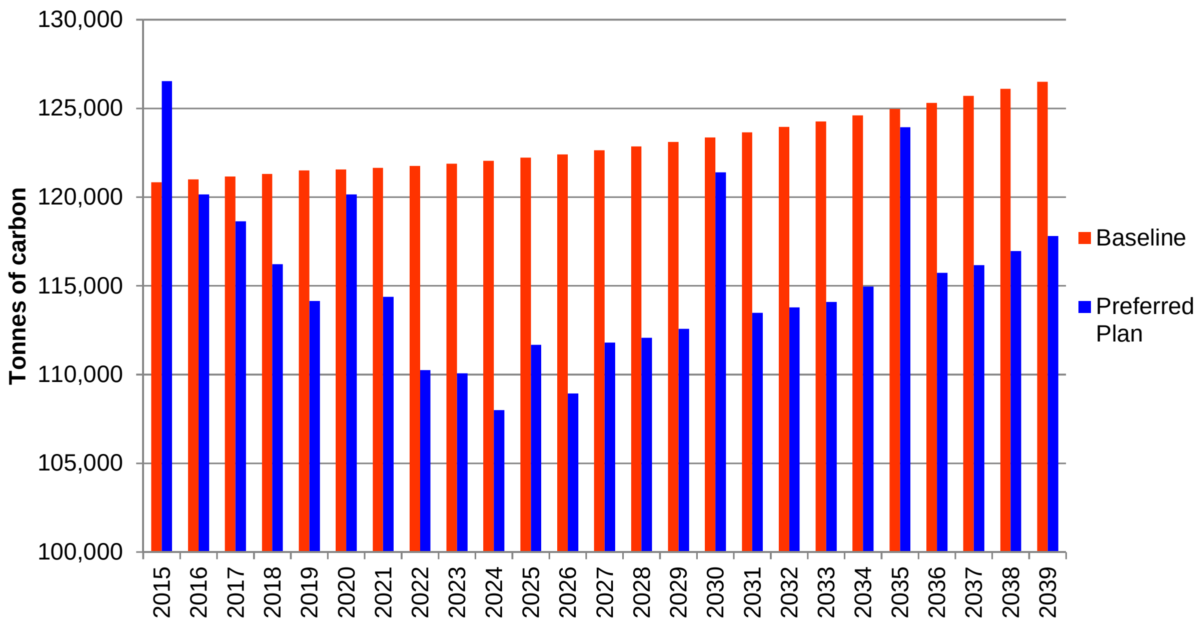

Figure 73: Preferred Plan carbon footprint, NYAA

The downward trend in the first ten years of the planning period is as a result of our universal metering programme. The 'spikes' in 2015, 2020, 2025m 2030 and 2035 are as a result of our leakage reduction programme and the way our model applies the costs and benefits, but are valid as leakage reduction carries a significant carbon 'cost'.

Overall, however, our Preferred Plan maintains carbon below the baseline.

11.14 Impact on customer bills

The impact on our customers' bills as a result of our revised WRMP Preferred Plan is included in our Business Plan. We have sought to minimise the impact on our customers' bills by integrating our WRMP with our Business Plan proposals, which are to be submitted to Ofwat on 2nd December 2013.

11.15 Preferred Plan cost breakdown

11.15.1 Introduction

Customer bills are affected differently by capital and operational expenditure. As explained in section 11.3.2, the total cost of our Preferred Plan is made up of a number of components:

- Capital investment;
- Operational expenditure;
- Capital maintenance;
- Environmental, social and carbon costs.

In this section, we provide a more detailed breakdown of these components. The costs are displayed in 2011/12 prices (our WRMP's base year) by quinquennium.

11.15.2 Capital investment costs

Table 94 presents the Capex investment costs to deliver our Preferred Plan throughout the planning period.

Construction Capital Expenditure, £ millions	AMP6 2015-20	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	TOTAL 2015-40
Leakage	8.94	4.28	5.05	11.63	16.12	46.02
Metering	50.72	44.30	0.00	0.00	0.00	95.02
Water efficiency	0.00	0.00	0.00	0.00	0.00	0.0
Demand Management schemes	**59.66**	**48.58**	**5.05**	**11.63**	**16.12**	**141.04**
Supply (ground & surface water)	5.09	1.50	0.00	1.04	20.03	27.66
Bulk transfers	0.00	0.00	0.00	1.46	0.63	2.09
Network Constraints	0.00	6.49	4.65	0.00	1.19	12.33
Supply side schemes	**5.09**	**7.99**	**4.65**	**2.50**	**21.85**	**42.08**
Total per AMP for Supply and Demand	**64.75**	**56.57**	**9.70**	**14.13**	**37.97**	**183.12**
WFD no deterioration investigative works	0.25	0.25	0.25	0.25	0.25	1.25
Delivery of Sustainability Reductions	13.54	0.00	0.00	0.00	0.00	13.54
TOTAL	**78.54**	**56.82**	**9.95**	**14.38**	**38.22**	**197.91**

Table 94: Capital investment of our Preferred Plan by quinquennium

11.15.3 Operational expenditure

Table 95 presents the Opex costs to deliver our Preferred Plan throughout the planning period.

Operational Expenditure, £ millions	AMP6 2015-20	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	TOTAL 2015-40
Leakage	5.43	7.99	9.60	12.99	19.96	55.97
Metering	7.67	8.44	5.98	5.98	5.98	34.05
Water efficiency	3.21	2.29	0.38	1.18	2.75	9.81
Demand Management schemes	**16.31**	**18.72**	**15.96**	**20.15**	**28.69**	**99.83**
Supply (ground & surface water)	0.13	0.37	0.47	0.47	1.63	3.07
Bulk transfers	0.59	0.59	0.43	0.61	2.22	4.44
Network Constraint Removal	0.00	0.00	1.06	1.78	1.88	4.72
Supply side schemes	**0.72**	**0.96**	**1.96**	**2.86**	**5.73**	**12.23**
Total per AMP for Supply and Demand	**17.03**	**19.68**	**17.92**	**23.01**	**34.42**	**112.06**
WFD no deterioration investigative works	0.00	0.00	0.00	0.00	0.00	0.0
Delivery of Sustainability Reductions	0.00	0.00	0.00	0.00	0.00	0.0
TOTAL	**17.03**	**19.68**	**17.92**	**23.01**	**34.42**	**112.06**

Table 95: Operational expenditure of our Preferred Plan by quinquennium

11.15.4 Capital maintenance costs

Table 96 presents the capital maintenance costs to deliver our Preferred Plan throughout the planning period.

Capital Maintenance, £ millions	AMP6 2015-20	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	TOTAL 2015-40
Leakage	0.00	0.00	0.00	0.00	0.00	0.0
Metering	0.00	0.00	0.00	31.45	27.47	58.92
Water efficiency	0.00	0.00	0.00	0.00	0.00	0.0
Demand Management schemes	**0.00**	**0.00**	**0.00**	**31.45**	**27.47**	**58.92**
Supply (ground & surface water)	0.00	0.00	0.14	3.84	4.94	8.92
Bulk transfers	0.00	0.00	0.00	0.00	0.00	0.0
Network Constraint Removal	0.00	0.00	0.00	0.00	0.00	0.0
Supply side schemes	**0.00**	**0.00**	**0.14**	**3.84**	**4.94**	**8.92**
Total per AMP for Supply and Demand	**0.00**	**0.00**	**0.14**	**35.29**	**32.41**	**67.84**
WFD no deterioration investigative works	0.00	0.00	0.00	0.00	0.00	0.0
Delivery of Sustainability Reductions	0.00	0.00	0.00	0.00	0.00	0.0
TOTAL	**0.00**	**0.00**	**0.14**	**35.29**	**32.41**	**67.84**

Table 96: Capital maintenance of our Preferred Plan by quinquennium

11.15.5 Environmental, social and carbon costs

Table 97 presents the environmental, social and carbon costs to deliver our Preferred Plan throughout the planning period.

Environmental, Social & Carbon costs, £ millions	AMP6 2015-20	AMP7 2020-25	AMP8 2025-30	AMP9 2030-35	AMP10 2035-40	TOTAL 2015-40
Leakage	4.71	2.44	3.57	7.23	7.93	25.88
Metering	-0.54	-1.45	-2.22	-2.22	-2.22	-8.65
Water efficiency	-0.05	-0.09	-0.10	-0.11	-0.18	-0.53
Demand Management schemes	**4.12**	**0.90**	**1.25**	**4.90**	**5.53**	**16.7**
Supply (ground & surface water)	0.04	0.09	0.10	0.17	0.30	0.7
Bulk transfers	0.00	0.01	0.02	0.03	0.05	0.11
Network Constraints	0.00	0.24	0.26	0.40	4.60	5.5
Supply side schemes	**0.04**	**0.34**	**0.38**	**0.60**	**4.95**	**6.31**
Total per AMP for Supply and Demand	**4.16**	**1.24**	**1.63**	**5.50**	**10.48**	**23.01**
WFD no deterioration investigative works	0.00	0.00	0.00	0.00	0.00	0.0
Delivery of Sustainability Reductions	0.00	0.00	0.00	0.00	0.00	0.0
TOTAL	**4.16**	**1.24**	**1.63**	**5.50**	**10.48**	**23.01**

Table 97: Environmental, social and carbon costs of our Preferred Plan by quinquennium

12 Next steps

12.1 The way forward

We expect to publish our final Plan in early 2014. Our programme from that point will include:

- Continue to support our business plan submission to Ofwat to ensure we have an appropriate level of resource funded in future prices to deliver our Water Resources Management Plan;
- Informing our customers and stakeholders about our plan and the service they can expect to receive;
- Reducing demand through leakage reduction, metering and water efficiency;
- Securing partnerships with key stakeholders in delivery of our plan;
- Firming up contracts for new bulk transfers from neighbouring water companies;
- Investigating ways to increase efficiency and flexibility in the delivery of our Preferred Plan;
- Launching our early start programme under the Pr14 transitional arrangements;
- Supporting the development of River Basin Management Plans;
- Maintaining and improving our assets to increase resilience and developing operational plans to change the way we operate our system to pave the way for introduction of sustainability reductions whilst ensuring resilience of supplies is maintained at all times;
- Translating the improvements in methodology and intelligence achieved in preparing our plans into ‘business as usual’;
- Establishing a programme of further improvement towards PR19;
- Promulgating the targets we have established as outputs relating to our plan including those developed through our Strategic Environmental Assessment and Environmental Reports and putting in place processes to monitor our operational performance during AMP6; and
- Amending our Drought Management Plan to be consistent with our Water Resources Management Plan.

Implementing our Preferred Plan will be a significant challenge, as this will mean a significant change in our operations whilst accommodating population growth and erosion of our resources through climate change.

12.2 Making sure our customers and the environment have enough water

12.2.1 Introduction

It is important that we have a balanced investment programme to manage supply and demand so that we can leave more water in the environment. However, relying solely on large levels of leakage reduction or metering or water efficiency to reduce demand presents significant risks to our customers. To reduce this risk our Preferred Plan includes a balance range of measures to reduce demand and change our operations to reduce abstraction.

12.2.2 Sustainability reductions

We have agreed 'certain' and 'likely' sustainability reductions with the Environment Agency for 2015 to 2025 and we will commence work in 2014/15 on detailed design of the measures needed to modify our assets and operations to ensure we can achieve the programme of reductions and milestones.

We will also continue our studies under our National Environment Programme (NEP) to evaluate the impact of our operations on the environment and assess the benefits from sustainability reductions. This programme includes a number of areas where the requirements for further sustainability reductions remains uncertain.

We will continue to work in partnership with the EA to inform the River Basin Management Plan process so that further obligations under the Water Framework Directive are identified and not disproportionate.

We anticipate we will have to reduce abstraction further in future so we have placed an emphasis on demand management measures in the short term. If we are more successful in reducing demand than our plan forecast that would be more in line with what we have experienced in our Southeast region, then we will be well placed to be able to further reduce abstraction and improve the conditions in more local water catchments.

We will refresh our programme of environmental monitoring to embrace the new requirements from our NEP.

12.2.3 No deterioration

We recognise our obligations to prevent deterioration of the environment. This will become more important as we reduce abstractions as this means we will place greater reliance on other sources of water. We will monitor the overall effect our abstractions have on the environment through our AIM reporting mechanism.

We will also continue our programme of environmental monitoring and put in place measures to assess the impact of our abstractions at all environmentally sensitive sites so we will be able to demonstrate 'no deterioration' of our operations.

We recognise our obligations to ensure our proposals for future groundwater development do not cause deterioration. We have carried out an initial assessment of all supply options and rejected those with unacceptable impacts. We will further investigate those schemes identified in our Preferred Plan starting in 2014 to ensure we can verify no deterioration of the environment from their implementation in sufficient time that we will be able to switch to alternative schemes.

12.2.4 Deployable output and level of service

In our work for this water resources plan, we have reviewed our deployable output assessment and level of service for return periods of drought triggers. We have used industry standard methods for these assessments but recognise a need to develop these methods to improve their accuracy and reliability for future plans.

We have embarked on a programme to review our deployable output assessment. We are currently supporting the latest UKWIR project exploring improvements in the methodology. We will seek industry partners to commission a further research programme to develop an improved industry standard and in particular to explore statistical techniques making best use of current monitoring data. We will also implement work to examine more closely the relationship between individual source performance compared to overall regional groundwater behaviour to better inform our future assessment of drought triggers and levels of service.

We will update our Drought Management Plan to reflect our latest assessment of drought trigger levels of service and changes that have arisen following our endorsement of the revised Code of Practice for implementation of restrictions on use during drought.

12.3 Supplying high quality water you can trust

We have seen a significant effect of pollution on our resources and we have been proactive in both monitoring pollution and investigating pollution threats to encourage polluters to take responsibility for their actions. We will continue this programme in AMP6.

We have also been proactive in catchment management and have proposed an enhanced programme for AMP6. We will extend our partnering arrangements and our activities in both Central and Southeast regions to mitigate the effect of pesticides, herbicides and nitrate use. We recognise the importance of this programme to support ‘no deterioration’ to meet WFD objectives.

In designing mitigation measures for sustainability reductions, we were reminded by the DWI of the need to prevent deterioration of the quality of water supplies to customers. We support the use of enforcement to control the catchment use of pesticides and herbicides such as the designation of water protection areas by the Environment Agency under the Water Framework Directive but in view of current elevated levels of metaldehyde in raw water storage we have designed mitigation measures to prevent the use of water with elevated levels of metaldehyde in areas that have not received this water before. We see it is important to control the future use of pesticides by both voluntary and enforcement measures and we will continue to work with our neighbouring water companies, the Environment Agency, the farming community, agrochemical suppliers and local and highway authorities to reduce pesticide loading of water resources in vulnerable catchments.

12.4 Our approach to leakage reduction

Our customers have placed a high priority on leakage reduction in the next planning period, we need to reduce demand in order to leave more water in the environment. Our programme of leakage reduction is challenging and will fulfil the following objectives:

– A continuous reduction in leakage over the entire planning period.

– Control of leakage year on year below a predetermined leakage target.

– Continual improvement towards increasing efficiency in managing and controlling leakage.

- Continuing our innovative implementation of fast logging to assess legitimate night use on a weekly basis to improve our assessment of net night use and therefore improve the efficiency of our leakage reduction targeting.
- Continuing the monitoring of leakage activities compared to benefits at DMA level will enhance our understanding of the natural rate of rise and the cost of reducing leakage further.
- Implementing leakage monitoring on our critical mains.
- Improved assessment of leakage benefits from mains renewals.
- Improved assessment of supply pipe leakage associated with our integrated metering programme.

We will ensure a continually reducing leakage level through the careful monitoring and response to leakage outbreaks and the natural rate of rise of leakage encountered together with controlled implementation of leakage reduction measures from one leakage level to another. This will improve the robustness of our ELL and SELL for use in assessing the comparative cost effectiveness of alternative options to manage supply and demand.

By installing AMR meters in properties, we have the opportunity to detect supply pipe leaks both at installation when repairs will be offered free of charge and later. Assessment of supply pipe leakage has been difficult in the past but we are developing our understanding of the added benefit of AMR meters using our pilot trial area in our Southeast area. As our programme of universal metering progresses, we will monitor the incidence of supply pipe leakage as this will generate valuable evidence to validate estimates of supply pipe leakage and improve our understanding of the frequency and severity of leaks.

We recognise that in order to achieve our target for leakage for all conditions we will need to operate at lower levels during benign weather periods. Conversely, we recognise customer views that leakage should be repaired more rapidly in times of drought.

Our plan will remain flexible. As we continue to reduce leakage, the reliability of costs to reduce leakage further will also improve. We will review the cost-effectiveness of leakage reduction on a progressive basis and will reduce leakage further should this prove to be more cost-effective than alternative measures to balance supply and demand.

12.5 Our universal metering programme

12.5.1 Introduction

We have used a range of evidence from our own and wider industry studies to estimate demand savings of 13.6% from metering. We will monitor consumption patterns from our universal metering programme both before transition to meter charges and afterwards to validate our prediction of savings and carry out research to assess the effect of metering on point of use of water to determine the optimum support package for customers. This information will also be invaluable to assess the overall savings from universal metering such that we will be able to mobilise additional measures if demand savings are less that predicted or give us flexibility to accommodate further sustainability measures that are expected as a result of the River Basin Management Plan process.

Shared supplies can present significant difficulties for meter installation. We are aware, from customer feedback, that customers in multi-dwelling buildings such as blocks of flats, have been disappointed when unable to have meters installed. In AMP6, through the use of remote read AMR units, we anticipate a significant proportion of these types of properties will now be able to be metered successfully.

12.5.2 Where metering is infeasible

Experience has shown that there are a number of situations where metering of individually occupied premises is not possible. This may be due to complex plumbing or difficulties in achieving access for surveys and meter installations.

For those customers who cannot be metered because of the plumbing arrangements at their property, we will examine whether further work at a sensible economic cost to the company could make metering possible. If the cost is prohibitive, the customer will be asked if they wish to pay for the work to be carried out in order to have the benefit of a meter installed.

In the event that it is not possible to physically install a meter, that property will be transferred onto an assessed charge.

12.5.3 Metering installation

We will install an AMR unit on all future meter installations in all three regions.

We have proved that the technology works with our trials in AMP5 and we are going to be able to provide more information to customers on their water use in the future, both as part of their bills or through our website. There is a body of evidence to suggest that regular feedback can have a positive effect on reducing consumption.

AMR technology has the potential to be adapted to allow customers to monitor their own water usage in near real time.

12.5.4 Meter projections

In the five years of AMP6, from 2015 to 2020, our Preferred Plan will achieve over **29Ml/d** reductions in demand from compulsory metering by AMR in four of our six water resource zones in the Central region. Our programme will include supporting customers in reducing demand by promoting water efficiency advice, and undertaking customer supply pipe repairs that are found to be leaking badly.

Table 38 and Table 39 show the levels of meter penetration by year in AMP6, including new properties. We will complete our universal metering programme in the remaining two Central regions in AMP7 and expect to reach 90% metering in Central by 2025.

	AMP6					
	2015/16	2016/17	2017/18	2018/19	2019/20	TOTAL
Optants	9,164	9,164	8,103	6,031	4,610	37,072
Selective (street)	47,237	63,512	63,512	63,512	42,323	280,096
New builds	9,196	9,235	8,962	8,827	9,176	45,396
% penetration	49%	50%	56%	65%	72%	

Table 98: Projection of metered households in AMP6 for Central

	AMP6					
	2015/16	2016/17	2017/18	2018/19	2019/20	TOTAL
Optants	600	580	560	530	510	2780
Selective (street)	0	0	0	0	0	0
New builds	581	468	349	261	248	1907
% penetration	79%	80%	81%	81%	82%	

Table 99: Projection of metered households in AMP6 for East

No table is supplied for Southeast (WRZ7) as there is no pro-active metering programme in that region due to the high levels of penetration (93%), and our forecast is that the remaining customers who can opt to have a meter will be minimal.

12.6 Water efficiency

We will continue our baseline water efficiency promotion in 2014 and this will form the retail element of our programme.

We propose a comprehensive programme of water efficiency support when customers transfer to metered charging. We plan to launch an enhanced awareness campaign during 2014 to prepare the way for our metering programme and we will provide information, products and audits to support customers during the optional transition period.

We will build on our existing programme of enhanced dialogue with groups of commercial customers by launching a water audit programme. We will target potentially high consumption customers and offer audits to reduce their consumption and bills.

12.7 Demand forecasting for PR19

Introduction of universal metering will have a significant effect on our long term unmeasured household consumption study. We will review our programme and restructure it to ensure we take full advantage of the change from unmeasured to measured charging to assess the optant and switching effect. The sample will erode as universal metering progresses but we expect to be able to maintain a statistically robust sample through AMP6 at least. This knowledge coupled with evidence from monitoring the effect of metering from our universal metering programme will improve the accuracy of our future demand forecast.

Forecasting commercial demand is complex and uncertain. We propose to reduce that uncertainty by carrying out further research into the relationship between national, regional and local economic factors and sector consumption patterns. We will also derive added value from our commercial logging programme to assess legitimate night use by examining total consumption and not just night use.

We have examined the influence of weather patterns on demand and propose to continue that work from 2014.

12.8 In conclusion

We will continue to challenge the rigor of our approach to water resources planning. We have contributed to national policy development and regional and local planning and will continue to do so in the future to improve and innovate our planning to maintain resilience of supplies for customer and seek improvement in the level of service we offer.

Appendices

Appendix A: List of Technical Reports

ID	Title	Submitted with SoR
1.1	**Deployable Output Assessment**	**Yes**
1.1.1	Surface Water Deployable Output Assessment	Yes
1.2	**Level of Service Hindcasting – Assessment of the Frequency of Drought Restrictions**	**Yes**
1.2.1	Drought Planning for Third Dry Winter Scenario	
1.3	**Assessment of Climate Change Impacts on Deployable Output**	**Yes**
1.3.1	Ardleigh Reservoir Briefing note for Affinity Water (Anglian Water)	
1.3.2	The Impacts of Climate Change on DO (H R Wallingford)	
1.4	**Sustainability Reductions**	**Yes**
1.4.1	AMP5 NEP Progress and Summary of PR14 Schemes	Yes
1.5	**Outage**	**Yes**
1.5.1	Summary Report for Outage (Central and Southeast Regions)	
1.6	**Water Resource Zone Integrity**	
1.6.1	Water Resource Zone Integrity Assessment for Affinity Water (Central region)	
2.0	**Demand Forecast**	**Yes**
2.0.1	Identiflow monitoring for Affinity Water – Summer 2013 (WRc)	Yes
2.1	**Micro-component Analysis**	
2.1.1	Customer Analysis and Micro-component Demand Forecasting	
2.2	**Domestic Housing and Population Forecast**	**Yes**
2.2.1	Population, Household and Dwelling Forecasts for WRMP14: Phase 1 Draft Final Report (Experian)	
2.3	**Non-household Demand Forecast**	
2.4	**Headroom**	**Yes**
2.4.1	Summary Report for Headroom (Central and Southeast, February 2013)	
3.1	**Options Appraisal**	
3.1.1	Unconstrained Options Study	
3.1.2	Option Screening and Constrained Options Methodology	
3.1.3	Constrained Options Dossiers	Yes
3.2	**Leakage Strategy Report**	**Yes**
3.2.1	Update of the Sustainable Economic Level of Leakage (SELL) for PR14 (RPS)	
3.3	**Metering Strategy & Cost Benefit Analysis**	**Yes**
3.3.1	Affinity Southeast - Effects of Metering	
3.3.2	Metering Trials - 2nd interim report	
3.4	**Water Efficiency**	**Yes**
3.5	**Water Company & Third Party Bulk Transfers**	
3.6	**Water Resources in the South East Modelling**	
3.7	**Economics of Balancing Supply and Demand Model Development, Commissioning & Use**	**Yes**
3.8	**Engaging Customers in Future Planning**	**Yes**
3.8.1	Engagement Planning Phases	Yes
3.8.2	Panel Survey Findings	Yes
3.8.3	Environmental Forum Report	Yes
3.8.4	A Review of our Plan Following Feedback from our Regulators	Yes
3.8.5	Draft WRMP Consultation Response Log	Yes
3.8.6	Let's Talk Water	Yes
3.8.7	Willingness to Pay Study	Yes
3.8.8	Bill Acceptability Study	Yes
3.8.9	Deliberative Forum Report	Yes
3.8.10	Customer Challenge Group Briefing Pack	Yes
3.9	**Environment Report (including Strategic Environmental Assessment and Habitats Regulations Assessment)**	**Yes**
3.9.1	SEA Scoping Report	
4.0	**WRP Tables: Commentary & Exception Report**	**Yes**

Appendix B: List of Stakeholders & Consultees

In accordance with Government regulations, we are required to state who we will consult with on our plans.

Listed here are the stakeholders and consultees with whom we consulted during our pre-consultation and we will engage with this same group about our draft Water Resources Management Plan.

Key to acronyms to Stakeholders & Consultees table:

Customer code key	Group	Includes
A	All customers all types	Universal - all.
B	Domestic	Metered, unmeasured, all bill types
C	Commercial	Monthly billed
D	Commercial	Quarterly / 6 monthly billed
E	Commercial	Small to medium enterprise customers - actively managed by Commercial team by 11 sector profiles
F	regulators	National (FN), Regional (FR) and Local (FL) regulatory bodies.
G	MPs and MEPs	MPs (GM) and MEPs (GE)
H	Local and regional authorities	Councils (HC), Chief Executive Officers (HX) and GLA (HG)
I	Health protection agencies	EHOs and CCDCs
J	Parish councils	Parish council Clerks
K	NGOs	RSPB, CPRE, National Trust, Waterwise, WWF, Blueprint for Water etc…
L	Trade & professional associations	NFU, CLA, Housebuilders Federation, CIWEM, Horticultural Trade Assoc, Sport UK, English Cricket Boards, Football Association, Chambers of Commerce, Enterprise Groups, Energy Saving Trust, Housing Associations.
M	Local environmental groups	Chiltern Chalk Streams Society, Friends of Mimram, Beane Restoration Society, Ver Society, Hertfordshire & Middlesex Wildlife, Groundwork Hertfordshire & Thames Valley, Hertfordshire Environmental Forum.
N	Community support groups	Age UK, CAB, St Albans Civic Society
O	Customer Challenge Group	As defined by Stakeholder Engagement Manager
P	Water companies	Thames, Anglian, Cambridge, Essex, South East, Southern, Sutton & East Surrey
Q	Potential third party suppliers	Vauxhall, McMullens.
R	Libraries	All
S	Staff	All
T	Contractors	
U	Suppliers	

List of Stakeholders & Consultees

(Names of individuals have been omitted)

Position	Organisation Name	code	sector	area
	A D Bly Construction	E	Construction & Engineering	
Clerk	Abbess, Beauchamp and Berners Roding Parish Council	J		Central
Clerk	Abbots Langley Parish Council	J		Central
Chairman	Abington Pigotts Parish Council	J		Central
	Active Luton	E	Sports & Leisure	
	Age UK	N		
Clerk	Albury Parish Council	J		Central
Clerk	Aldbury Parish Council	J		Central
Clerk	Aldenham Parish Council	J		Central
Clerk	Alkham Parish Council	J		Southeast
Clerk	Alresford Parish Council	J		East
Chief librarian	Amersham Library	R		Central
Clerk	Amersham Town Council	J		Central
Managing Director	Anglian Water Group	P		
Clerk	Anstey Parish Council	J		Central
Clerk	Ardeley Parish Council	J		Central
Clerk	Ardleigh Parish Council	J		East
Clerk	Arkesden Parish Council	J		Central
Chairman	Artington Parish Council	J		Central
Clerk	Ash Parish Council	J		Southeast
Clerk	Ash Parish Council	J		Central
Clerk	Ashdon Parish Council	J		Central
Head of Environmental Health	Ashford Borough Council	I		
Clerk	Ashley Green Parish Council	J		Central
Clerk	Ashwell Parish Council	J		Central
Clerk	Aspenden Parish Council	J		Central
Clerk	Aston Parish Council	J		Central
Head of Environment Services	Aylesbury Vale District Council	I		
Clerk	Aylesham Parish Council	J		Southeast
Manager	Aylett nurseries	E	Agricultural & Environmental services	
Clerk	Ayot St Peter Parish Meeting	J		Central
Clerk	Aythorpe Roding Parish Council	J		Central
Clerk	Bar Hill Parish Council	J		Central
Clerk	Barkway Parish Council	J		Central
Clerk	Barley Parish Council	J		Central
Manager	Barnet Health Care Trust	E	Pharmaceutical, medical & health service	
Clerk	Barnston Parish Council	J		Central
Clerk	Barrington Parish Council	J		Central
Clerk	Bartlow Parish Council	J		Central
Clerk	Barton le Clay Parish Council	J		Central
Clerk	Barton Parish Council	J		Central
Clerk	Bayford Parish Council	J		Central
Clerk	Beaumont Parish Council	J		East
CCDC	Bedfordshire & Hertfordshire Health Protection Team	I		
Head of Public Protection	Bedfordshire Council	I		
Senior Conservation Officer	Bedfordshire Wildlife Trust	M		
	Beds Wildlife Trust	M		
Clerk	Bengeo Rural Parish Council	J		Central
Clerk	Benington Parish Council	J		Central
Clerk	Berden Parish Council	J		Central

Position	Organisation Name	code	sector	area
Clerk to the Council	Berkhamsted Town Council	J		Central
	Berystede Hotel	E	Hotels, Catering and Laundry Services	
Clerk	Billington Parish Council	J		Central
Clerk	Binfield Parish Council	J		Central
Clerk	Birchanger Parish Council	J		Central
Clerk	Bisham Parish Council	J		Central
Town Clerk	Bishops Stortford Town Council	J		Central
Clerk	Bisley Parish Council	J		Central
Clerk	Blackmore, Hook End and Wyatts Green Parish Council	J		Central
Clerk	Bledlow Cum Saunderton Parish Council	J		Central
	Boultbee	E	Business and Consulting	
Clerk	Bovingdon Parish Council	J		Central
Manager	Bowmans Farms	E	Food, Drink, Tobaco and retail services	
Senior Environmental Health Officer	Bracknell Forest Borough Council	I		
Director of Environment	Bracknell Forest Council	HC		
Chief Executive	Bracknell Forest Council	HX		
Clerk	Bracknell Town Council	J		Central
Clerk	Bradfield Parish Council	J		East
Clerk	Bramfield Parish Council	J		Central
Clerk	Braughing Parish Council	J		Central
Clerk	Bray Parish Council	J		Central
Facilities Resource	BRE Building Research Establishment	E	Construction & Engineering	
Director of Environment & Culture	Brent Borough Council	HC		
Chief Executive	Brent Borough Council	HX		
Clerk	Brent Pelham and Meesden Parish Council	J		Central
Head of Planning and Regulation	Brentwood Borough Council	HC		
Chief Executive	Brentwood Borough Council	HX		
Environmental Health & Enforcement Manager	Brentwood Borough Council	I		
Clerk	Brenzett Parish Council	J		Southeast
Clerk	Brickendon Liberty Parish Council	J		Central
Clerk	Brightlingsea Parish Council	J		East
Chairman	British Disabled Waterski Association	M		
	British Trust for Ornithology	M		
	British Water Ways	M		
Clerk	Britwell Parish Council	J		Central
Clerk	Brookland Parish Council	J		Southeast
Clerk	Broxted Parish Council	J		Central
Clerk	Buckhurst Hill Parish Council	J		Central
CCDC	Buckinghamshire & Milton Keynes Health Protection Team	I		
Chief Executive	Buckinghamshire County Council	HX		
Clerk	Buckland and Chipping Parish Council	J		Central
Clerk	Buntingford Town Council	J		Central
Clerk	Burmarsh Parish Council	J		Southeast
Branch Secretary	Butterfly Conservation Association	M		
	Butterfly Conservation Association	M		
Clerk	Bygrave Parish Council	J		Central
Clerk	Caddington Parish Council	J		Central
Clerk	Caldecote Parish Council	J		Central
Clerk	Cambourne Parish Council	J		Central

Position	Organisation Name	code	sector	area
Managing Director	Cambridge Water Ltd	P		
	Campaign to Protect Rural England	K		
Environmental Health Manager	Canterbury City Council	I		
Clerk	Capel-le-Ferne Parish Council	J		Southeast
	Car Wash Association	L		
Clerk	Carlton cum Willingham Parish Council	J		Central
	Carmelite	E	Business and Consulting	
Clerk	Castle Camps Parish Council	J		Central
Director of Sustainable Communities	Central Bedfordshire Council	HC		
Chief Executive	Central Bedfordshire Council	HX		
Clerk	Chalfont St Giles Parish Council	J		Central
Chief librarian	Chalfont St Peter Library	R		Central
Clerk	Chalfont St Peter Parish Council	J		Central
Clerk	Chalgrave Parish Council	J		Central
Clerk	Chalton Parish Council	J		Central
Managing Director	Charis Grants	O		
	Chartered Institution of Water and Environmental Management	L		
Clerk	Chartridge Parish Council	J		Central
Clerk	Chenies Parish Council	J		Central
Clerk	Chepping Wycombe Parish Council	J		Central
Chief librarian	Chertsey Library	R		Central
Clerk	Chesham Bois Parish Council	J		Central
Clerk	Chesham Town Council	J		Central
Chairman	Chickney Parish Council	J		Central
Clerk	Chigwell Parish Council	J		Central
Project Manager	Chiltern Chalk Streams, Chiltern Conservation Board	M		
Head of Health & Housing	Chiltern District Council	HC		
Interim Head of Health and Housing	Chiltern District Council	HC		
Chief Executive	Chiltern District Council	HX		
Environmental Health Officer	Chiltern District Council	I		
	Chiltern Society	M		
Clerk	Chipperfield Parish Council	J		Central
Chief librarian	Chipping Barnet Library	R		Central
Clerk	Chobham Parish Council	J		Central
Clerk	Chorleywood Parish Council	J		Central
Clerk	Chrishall Parish Council	J		Central
	Citizens Advice	N		
Clerk	Clavering Parish Council	J		Central
Clerk	Claygate Parish Council	J		Central
Chairman	Clothall Parish Meeting	J		Central
Clerk	Codicote Parish Council	J		Central
Clerk	Coleshill Parish Council	J		Central
Clerk	Colnbrook & Poyle Parish Council	J		Central
	Colne Valley Angling Society	M		
Clerk	Colney Heath Parish Council	J		Central
Clerk	Comberton Parish Council	J		Central
Clerk	Compton Parish Council	J		Central
Policy Manager	Consumer Council for Water	FN		
Local ConsumerAdvocate (LCA) London and the SE	Consumer Council for Water	O		
	Consumer Council for Water London & South East	I		
Clerk	Cookham Parish Council	J		Central
Clerk	Coton Parish Council	J		Central
Clerk	Cottenham Parish Council	J		Central
President	Country Land and Business Association	L		

Position	Organisation Name	code	sector	area
Director	Countryside Management Service	M		
Clerk	Cox Green Parish Council	J		Central
Clerk	Crowthorne Parish Council	J		Central
Clerk	Croxley Green Parish Council	J		Central
Clerk	Croydon Parish Council	J		Central
Corporate Director Housing and Regeneration	Dacorum Borough Council	HC		
Chief Executive	Dacorum Borough Council	HX		
Maintenance Team Leader	Dacorum District Council	O		
Environment & Sustainability Officer	Dacorum Environmental Forum	M		
	Dacorum Environmental Forum Water Group	M		
Environmental Health Officer	Darcum Borough Council	I		
Clerk	Datchet Parish Council	J		Central
Clerk	Datchworth Parish Council	J		Central
	Day Aggregates	E	Construction & Engineering	
Clerk	Debden Parish Council	J		Central
Clerk	Dedham Parish Council	J		East
	DEFRA	FN		
Clerk	Denton-with-Wooton Parish Council	J		Southeast
Site Manager	Do & Co Event & Airline Catering	E	Manufacturing	
Deputy Head Teacher	Doddinghurst Infant School	E	Education	
Clerk	Doddinghurst Parish Council	J		Central
Chief Executive	Dover District Council	HC		
Chief Executive	Dover District Council	HX		
Team Leader for Environmental Protection	Dover District Council	I		
Clerk	Dover Town Council	J		Southeast
Clerk	Downley Parish Council	J		Central
	Drinking Water Inspectorate	O		
Clerk	Dry Drayton Parish Council	J		Central
Clerk	Duxford Parish Council	J		Central
	DWI	FN		
Clerk	Dymchurch Parish Council	J		Southeast
Executive Director of Customer Services	Ealing Borough Council	HC		
Chief Executive	Ealing Borough Council	HX		
Chief librarian	Ealing Road Library	R		Central
Chief librarian	East Barnet Library	R		Central
	East Berkshire	I		
Clerk	East Clandon Parish Council	J		Central
Head of Environmental Services	East Hertfordshire District Council	HC		
Chief Executive & Director of Customer & Community Services	East Hertfordshire District Council	HX		
Environmental Health Manager (Commercial)	East Hertfordshire District Council	I		
Clerk	East Horsley Parish Council	J		Central
Head of Housing Management	East Kent Housing	O		
	East of England Regional Assembly	M		
Clerk	Eastry Parish	J		Southeast
Clerk	Eastwick and Gilston Parish Council	J		Central
Clerk	Eaton Bray Parish Council	J		Central
Facilities Manager	Efco & Kite Glass	E	Manufacturing	
Clerk	Effingham Parish Council	J		Central
Chairman	Eggington Parish Council	J		Central
Clerk	Elham Parish Council	J		Southeast
Clerk	Ellesborough Parish Council	J		Central

Position	Organisation Name	code	sector	area
Strategic Director - Services	Elmbridge Borough Council	HC		
Chief Executive	Elmbridge Borough Council	HX		
Senior Environmental Health Officer	Elmbridge Borough Council	I		
Clerk	Elmdon Parish Council	J		Central
Clerk	Elmstead Parish Council	J		East
Clerk	Elmsted Parish Council	J		Southeast
Clerk	Elsenham Parish Council	J		Central
Clerk	Elstree and Borehamwood Town Council	J		Central
Clerk	Elsworth Parish Council	J		Central
	Energy Saving Trust	L		
Director of Environment	Enfield Borough Council	HC		
	English Heritage - East of England Region	M		
	English Heritage - London Region	M		
	English Heritage - South East Region	M		
	Environment Agency	FL		
	Environment Agency	FL		
	Environment Agency	FL		
	Environment Agency	FL		
	Environment Agency	FL		
	Environment Agency	FL		
	Environment Agency	FN		
	Environment Agency	FR		
	Environment Agency	FR		
Water Planning Manager	Environment Agency - South East	O		
Head of Environmental Services	Epping Forest District Council	HC		
Chief Executive	Epping Forest District Council	HX		
Engineering, Drainage and Quality Team Manager	Epping Forest District Council	I		
Chief librarian	Epping Library	R		Central
Clerk	Epping Town Council	J		Central
Clerk	Epping Upland Parish Council	J		Central
Clerk	Essendon Parish Council	J		Central
	Essex and Suffolk Water	P		
Chief Executive	Essex County Council	HC		
Executive Director for Environment	Essex County Council	HC		
Chief Executive	Essex County Council	HX		
CCDC	Essex Health Protection Unit	I		
Clerk	Eton Town Parish Council	J		Central
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		

Position	Organisation Name	code	sector	area
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Member of the European Parliament	European Parliament	GE		
Chairman	Eversdens Parish Council	J		Central
Manager	Expeditors International UK Ltd	E	Transport & Motor vehicles	
Clerk	Eythorne Parish Council	J		Southeast
Clerk	Farnham Parish Council	J		Central
Secretary of the Parish Meeting	Fawley Parish Meeting	J		Central
	Federation for Window Cleaners	L		
PAA	Federation House	K		
Clerk	Felsted Parish Council	J		Central
Clerk	Fen Ditton Parish Council	J		Central
Clerk	Fen Drayton Parish Council	J		Central
Clerk	Flamstead Parish Council	J		Central
Clerk	Flaunden Parish Council	J		Central
Clerk	Folkestone Town Council	J		Southeast
Clerk	Fowlmere Parish Council	J		Central
Clerk	Foxton Parish Council	J		Central
Clerk	Frating Parish Council	J		East
	Friends of Stockers Lake	M		
	Friends of the Mimram	M		
Chief librarian	Friern Barnet Library	R		Central
Clerk	Frinton & Walton Parish Council	J		East
Clerk	Fulbourn Parish Council	J		Central
Clerk	Furneux Pelham Parish Council	J		Central
Clerk	Fyfield Parish Council	J		Central
Clerk	Gamlingay Parish Council	J		Central
	Garden Centre Association	L		
Clerk	Girton Parish Council	J		Central
UK Environment Manager	GlaxoSmithKline	O		
Clerk	Goodnestone Parish Council	J		Southeast
Clerk	Grantchester Parish Council	J		Central
Clerk	Graveley Parish Council	J		Central
Clerk	Great Abington Parish Council	J		Central
Clerk	Great Amwell Parish Council	J		Central
Clerk	Great and Little Chishill Parish Council	J		Central
Clerk	Great and Little Hampden Parish Council	J		Central
Clerk	Great Bentley Parish	J		East
Clerk	Great Bromley Parish	J		East
Clerk	Great Canfield Parish Council	J		Central
Clerk	Great Chesterford Parish Council	J		Central
Clerk	Great Dunmow Parish Council	J		Central
Clerk	Great Easton & Tilty Parish Council	J		Central
Clerk	Great Gaddesden Parish Council	J		Central
Clerk	Great Hallingbury Parish Council	J		Central

Position	Organisation Name	code	sector	area
Clerk	Great Marlow Parish Council	J		Central
Clerk	Great Missenden Parish Council	J		Central
Clerk	Great Oakley Parish Council	J		East
Clerk	Great Sampford Parish Council	J		Central
Clerk	Great Shelford Parish Council	J		Central
Clerk	Great Wilbraham Parish Council	J		Central
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
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	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
	Greater London Authority	HG		
Owner	Greenacres Equestrian	E	Agricultural & Environmental services	
Executive Director	Groundwork Herts	M		
Executive Director	Groundwork Thames Valley	M		
Energy and Sustainability Manager	GSK WARE R&D	E	Pharmaceutical, medical & health service	
Strategic Director	Guildford Borough Council	HC		
Chief Executive	Guildford Borough Council	HX		
Environmental Control Officer	Guildford Borough Council	I		
Chief librarian	Guildford Library	R		Central
Clerk	Guston Parish Council	J		Southeast
Clerk	Hadstock Parish Council	J		Central
Director of Urban Environment	Haringey Council	HC		
Chief Executive	Haringey Council	HX		
Chief librarian	Harlesden Library	R		Central
Environmental Health Manager	Harlow Council	I		
Strategic Director	Harlow District Council	HC		
Head of Environmental Health	Harlow District Council	HC		
Chief Executive	Harlow District Council	HX		
Chief librarian	Harlow Library	R		Central
Clerk	Harlton Parish Council	J		Central
Clerk	Harpenden Rural Parish Council	J		Central
Clerk	Harpenden Town Council	J		Central
Corporate Director of Community and Environmental Services	Harrow Council	HC		
Head of Community Safety	Harrow Council	HC		
Corporate Director of Place Shaping	Harrow Council	HC		

Position	Organisation Name	code	sector	area
Chief Executive	Harrow Council	HX		
Clerk	Harston Parish Council	J		Central
Clerk	Harwich Parish Council	J		East
Clerk	Haslingfield Parish Council	J		Central
Clerk	Hatfield Broad Oak Parish Council	J		Central
Clerk	Hatfield Heath Parish Council	J		Central
Clerk	Hatfield Town Council	J		Central
Clerk	Hatley Parish Council	J		Central
Clerk	Hauxton Parish Council	J		Central
Head Teacher	Havelock School	E	Education	
Clerk	Hawkinge Parish Council	J		Southeast
Chief librarian	Hayes Libary	R		Central
Clerk	Hazlemere Parish Council	J		Central
Energy Manager	Health Protection Agency	E	Pharmaceutical, medical & health service	
Clerk	Heath Reach Parish Council	J		Central
Water and Environment Manager	Heathrow Airport Limited	O		
Clerk	Hedsor Parish Council	J		Central
Clerk	Hempstead Parish Council	J		Central
Chief librarian	Hendon Library	R		Central
Clerk	Henham Parish Council	J		Central
Clerk	Herongate and Ingrave Parish Council	J		Central
Clerk	Hertford Heath Parish Council	J		Central
Clerk	Hertford Town Council	J		Central
Director of Environment and Commercial Services	Hertfordshire County Council	HC		
Chief Executive & Director of Environment	Hertfordshire County Council	HX		
Sustainability Team Leader	Hertfordshire County Council	M		
Clerk	Hertingfordbury Parish Council	J		Central
	Herts & Middlesex Bat Group	M		
Chief Executive	Herts & Middlesex Wildlife Trust	M		
Conservation Manager	Herts & Middlesex Wildlife Trust	M		
	Herts Chamber of Commerce	L		
Director of Environment	Hertsmere Borough Council	HC		
Chief Executive	Hertsmere Borough Council	HX		
Asst. Chief Environmental Health Officer	Hertsmere Borough Council	I		
Clerk	Hexton Parish Meeting	J		Central
Clerk	Heydon Parish Council	J		Central
Clerk	High Easter Parish Council	J		Central
Clerk	High Ongar Parish Council	J		Central
Clerk	High Roding Parish Council	J		Central
Clerk	High Wych Parish Council	J		Central
Clerk	High Wycombe Charter Trustees	J		Central
Clerk	Hildersham Parish Council	J		Central
Director of Environmental & Consumer Protection	Hillingdon Borough Council	HC		
Clerk	Hinxton Parish Council	J		Central
Clerk	Histon Parish Council	J		Central
Clerk	Hockliffe Parish Council	J		Central
Clerk	Holwell Parish Council	J		Central
	Home Builders Federation	L		
Clerk	Hormead Parish Council	J		Central
Clerk	Horningsea Parish Council	J		Central
	Horticultural Trades Association	L		
Clerk	Horton Parish Council	J		Central
Clerk	Hougham Without Parish Council	J		Southeast
Clerk	Houghton Regis Parish Council	J		Central

Position	Organisation Name	code	sector	area
	Huco Engineering Indust. Ltd.	E	Construction & Engineering	
Clerk	Hughenden Parish Council	J		Central
Clerk	Hunsdon Parish Council	J		Central
Clerk	Hurley Parish Council	J		Central
Clerk	Hyde Parish Council	J		Central
Clerk	Hythe Town Council	J		Southeast
Clerk	Ibstone Parish Council	J		Central
Clerk	Ickleford Parish Council	J		Central
Clerk	Ickleton Parish Council	J		Central
Clerk	Ingatestone and Fryerning Parish Council	J		Central
	Inland Waterways	M		
Chief librarian	Iver Heath Library	R		Central
Clerk	Ivychurch Parish Council	J		Southeast
Purchasing Coordinator	Kelly Communications	E	Utilities	
Clerk	Kelshall Parish Meeting	J		Central
Clerk	Kelvedon Hatch Parish Council	J		Central
	Kempton Investment LTD	E	Business and Consulting	
Chief librarian	Kensal Rise Library	R		Central
Clerk	Kensworth Parish Council	J		Central
Council Leader	Kent County Council	HC		Southeast
Corporate Director	Kent County Council	HC		Southeast
CCDC	Kent Health Protection Unit	I		
Clerk	Kimpton Parish Council	J		Central
Clerk	Kings Langley Parish Council	J		Central
Clerk	Kings Walden Parish Council	J		Central
	Kingsbury Secondary Assessment Centre	E	Education	
Clerk	Kingston Parish Council	J		Central
Clerk	Knapwell Parish Meeting	J		Central
Clerk	Knebworth Parish Council	J		Central
Manager	Kwik Fit/Stapletons	E	Food, Drink, Tobaco and retail services	
Manager	Kwik Fit/Stapletons	E	Food, Drink, Tobaco and retail services	
Manager	Kwik Fit/Stapletons	E	Food, Drink, Tobaco and retail services	
Manager	Kwik Fit/Stapletons	E	Food, Drink, Tobaco and retail services	
Manager	Kwik Fit/Stapletons	E	Food, Drink, Tobaco and retail services	
Clerk	Lambourne Parish Council	J		Central
Clerk	Landbeach Parish Council	J		Central
Clerk	Lane End Parish Council	J		Central
Clerk	Langdon Parish Council	J		Southeast
Clerk	Langley Parish Council	J		Central
Clerk	Latimer Parish Council	J		Central
Clerk	Lawford Parish Council	J		East
Clerk	Leaden Roding Parish Council	J		Central
Clerk	Leighton Linslade Town Council	J		Central
Clerk	Letchworth Garden City Council	J		Central
Clerk	Lilley Parish Council	J		Central
Clerk	Linton Parish Council	J		Central
Clerk	Litlington Parish Council	J		Central
Clerk	Little Abington Parish Council	J		Central
Clerk	Little Bardfield Parish Council	J		Central
Clerk	Little Bentley Parish Council	J		East
Clerk	Little Berkhamsted Parish Council	J		Central
Clerk	Little Bromley Parish	J		East

Position	Organisation Name	code	sector	area
Clerk	Little Canfield Parish Council	J		Central
Clerk	Little Chesterford Parish Council	J		Central
Clerk	Little Clacton Parish	J		East
Clerk	Little Dunmow Parish Council	J		Central
Clerk	Little Gaddesden Parish Council	J		Central
Clerk	Little Gransden Parish Council	J		Central
Clerk	Little Hadham Parish Council	J		Central
Clerk	Little Marlow Parish Council	J		Central
Clerk	Little Missenden Parish Council	J		Central
Clerk	Little Oakley Parish Council	J		East
Clerk	Little Sampford Parish Council	J		Central
Clerk	Little Shelford Parish Council	J		Central
Clerk	Little Wilbraham & Six Mile Bottom Parish Council	J		Central
Clerk	Lolworth Parish Meeting	J		Central
Director Environment and Operations	London Borough Barnet	HC		
Deputy Chief Executive & Executive Director of Environment & Regeneration	London Borough Barnet	HC		
Chief Executive	London Borough Barnet	HX		
Group Manager (Food, Health & Safety)	London Borough of Barnet	I		
Regulatory Service Manager	London Borough of Brent	I		
Senior Environmental Health Officer	London Borough of Ealing	I		
Chief Executive	London Borough of Enfield	HX		
Team Leader for Environmental Health	London Borough of Enfield	I		
Lead Officer for Food and Safety	London Borough of Haringey	I		
Team Manager, Environmental Protection and Animal Services	London Borough of Harrow	I		
Chief Executive	London Borough of Hillingdon	HX		
Team Manager Food Health and Safety Team	London Borough of Hillingdon	I		
Food Safety Manager	London Borough of Houndslow	I		
Director of Environment	London Borough of Hounslow	HC		
Chief Executive	London Borough of Hounslow	HX		
Clerk	London Colney Parish Council	J		Central
	London Colney Village Concern	M		
	London Underground	L		
	London Wildlife Trust	M		
Clerk	Longstanton Parish Council	J		Central
Clerk	Longstowe Parish Council	J		Central
Clerk	Loughton Town Council	J		Central
Corporate Director	Luton Borough Council	HC		
Chief Executive	Luton Borough Council	HX		
Environmental Health Service Manager	Luton Borough Council	I		
Chief librarian	Luton Central Library	R		Central
Chairman	Luton rugby FC	E	Sports & Leisure	
Clerk	Lydd Town Council	J		Southeast
Clerk	Lydden Parish Council	J		Southeast
Clerk	Lympne Parish Council	J		Southeast
Clerk	Manuden Parish Council	J		Central
Clerk	Margaret Roding Parish Council	J		Central
Clerk	Markyate Parish Council	J		Central
Clerk	Marlow Bottom Parish Council	J		Central
Clerk	Marlow Town Parish Council	J		Central
Clerk	Matching Parish Council	J		Central

Position	Organisation Name	code	sector	area
Estates And Facilites Manager	McNicholas Construction	E	Construction & Engineering	
Clerk	Medmenham Parish Council	J		Central
Clerk	Melbourn Parish Council	J		Central
Clerk	Meldreth Parish Council	J		Central
Chief librarian	Mill Hill Library	R		Central
Clerk	Milton Parish Council	J		Central
Clerk	Mistley Parish Council	J		East
Clerk	Moreton, Bobbingworth & The Lavers Parish Council	J		Central
Clerk	Mountnessing Parish Council	J		Central
Clerk	Nash Mills Parish Council	J		Central
Chief Executive	National Association for AONB	M		
Director	National Farmers Union	M		
Lead Adviser	Natural England	FN		
Central Processing Team	Natural England	FN		
Clerk	Navestock Parish Council	J		Central
Clerk	Nazeing Parish Council	J		Central
Clerk	Nettleden with Potten End Parish Council	J		Central
Clerk	New Romney Town Council	J		Southeast
Clerk	Newchurch Parish Council	J		Southeast
Chairman	Newham and Caldecote Parish Council	J		Central
Clerk	Newington Parish Council	J		Southeast
Clerk	Newport Parish Council	J		Central
Clerk	Newton Parish Council	J		Central
	Nexus Community	E	Sports & Leisure	
	Nexus Community	E	Sports & Leisure	
	NFT Distribution Limited	E	Transport & Motor vehicles	
	NHP (UK) Limited	E	Agricultural & Environmental services	
Clerk	Nonington Parish Council	J		Southeast
	Norbert Dentressangle	E	Transport & Motor vehicles	
Clerk	Normandy Parish Council	J		Central
CCDC	North East and North Central London Health Protection Unit	I		
Head of Leisure & Environmental Services	North Hertfordshire District Council	HC		
Acting Environmental Protection Manager	North Hertfordshire District Council	I		
	North Herts College	E	Education	
Clerk	North Mymms Parish Council	J		Central
Clerk	North Weald Bassett Parish Council	J		Central
Director	North West London Health Protection Unit	I		
Clerk	Northaw & Cuffley Parish Council	J		Central
Clerk	Northbourne Parish Council	J		Southeast
Clerk	Northchurch Parish Council	J		Central
Manager	Notcutts	E	Agricultural & Environmental services	
Clerk	Nuthampstead Parish Meeting	J		Central
Clerk	Oakington & Westwick Parish Council	J		Central
	Oaklands College	E	Education	
Clerk	Ockham Parish Council	J		Central
	Odyssey Knebworth LTD	E	Sports & Leisure	
Clerk	Offley Parish Council	J		Central
	OFWAT	FN		
	Old Fold Manor Golf Club	E	Sports & Leisure	

Position	Organisation Name	code	sector	area
Chief librarian	Old Harlow Library	R		Central
Clerk	Old Windsor Parish Council	J		Central
Clerk	Ongar Parish Council	J		Central
Clerk	Orwell Parish Council	J		Central
Clerk	Over Parish Council	J		Central
	Padfield (Hayleys) Ltd	E	Agricultural & Environmental services	
Clerk	Pampisford Parish Council	J		Central
Clerk	Papworth Everard Parish Council	J		Central
Chairman	Papworth St Agnes Parish Meeting	J		Central
Clerk	Penn Parish Council	J		Central
Clerk	Piddington and Wheeler End Parish Council	J		Central
Clerk	Pirbright Parish Council	J		Central
Clerk	Pirton Parish Council	J		Central
Clerk	Postling Parish Council	J		Southeast
Clerk	Preston Parish Council	J		Southeast
Clerk	Preston Parish Council	J		Central
Clerk	Princes Risborough Town Council	J		Central
Clerk	Puttenham Parish Council	J		Central
Clerk	Quendon & Rickling Parish Council	J		Central
Clerk	Radnage Parish Council	J		Central
Clerk	Radwell Parish Meeting	J		Central
Clerk	Radwinter Parish Council	J		Central
	Ramblers Association	K		
Chair	Rampton Parish Council	J		Central
Clerk	Ramsey & Parkeston Parish Council	J		East
Clerk	Redbourn Parish Council	J		Central
Clerk	Reed Parish Council	J		Central
	Rickmansworth Waterways Trust	M		
Clerk	Ridge Parish Council	J		Central
Clerk	Ringwould with Kingsdown Parish Council	J		Southeast
Clerk	Ripley Parish Council	J		Central
Clerk	Ripple Parish Council	J		Southeast
	River Chess Association	M		
	River Chess Group	M		
Clerk	River Parish Council	J		Southeast
Commercial Services Team Leader	Royal Borough of Windsor and Maidenhead	I		
	Royal Horticultural Society	M		
Clerk	Roydon Parish Council	J		Central
Clerk	Royston Town Council	J		Central
Water Policy Officer	RSPB	M		
	RSPB	M		
Development Officer	RSPB Central England Office	M		
Estates	Ruby Food Products	E	Manufacturing	
Head of Environmental Protection	Runnymede Borough Council	HC		
Chief Executive	Runnymede Borough Council	HX		
Environmental Health and Licensing Manager	Runnymede Borough Council	I		
Clerk	Rushden and Wallington Parish Council	J		Central
	Safestore	E	Manufacturing	
Chief librarian	Saffron Walden Library	R		Central
Clerk	Saffron Walden Parish Council	J		Central
Clerk	Saltwood Parish Council	J		Southeast
Clerk	Sandgate Parish Council	J		Southeast
Executive Officer	Sandhurst Town Council	J		Central
Clerk	Sandon Parish Council	J		Central

Position	Organisation Name	code	sector	area
Clerk	Sandridge Parish Council	J		Central
Clerk	Sarratt Parish Council	J		Central
Clerk	Sawbridgeworth Town Council	J		Central
Clerk	Sawston Parish Council	J		Central
Clerk	Seale & Sands Parish Council	J		Central
Clerk	Seer Green Parish Council	J		Central
Clerk	Sellindge Parish Council	J		Southeast
Clerk	Send Parish Council	J		Central
Clerk	Shackleford Parish Council	J		Central
Clerk	Shalford Parish Council	J		Central
Clerk	Sheering Parish Council	J		Central
Clerk	Shenley Parish Council	J		Central
Clerk	Shepherdswell-with-Coldred Parish Council	J		Southeast
Clerk	Shepreth Parish Council	J		Central
Chief Executive	Shepway District Council	HC		
Chief Executive	Shepway District Council	HX		
Environmental Health Officer	Shepway District Council	I		
Clerk	Shere Parish Council	J		Central
Clerk	Sholden Parish Council	J		Southeast
Chairman of the Parish Meeting	Shottesbrooke Parish Council	J		Central
Clerk	Shudy Camps Parish Council	J		Central
Clerk	Slip End Parish Council	J		Central
Strategic Director	Slough Borough Council	HC		
Chief Executive	Slough Borough Council	HX		
Food & Safety Manager	Slough Borough Council	I		
Head of Sustainable Development	South Bucks District Council	HC		
Head of Environment	South Bucks District Council	HC		
Director of Services	South Bucks District Council	HC		
Chief Executive	South Bucks District Council	HX		
Environmental Health Manager	South Bucks District Council	I		
Executive Director	South Cambridgeshire District Council	HC		
Corporate Manager	South Cambridgeshire District Council	HC		
Chief Executive	South Cambridgeshire District Council	HX		
Managing Director	South East Water Ltd	P		
Deputy Chief Executive	Spelthorne Borough Council	HC		
Head of Environmental Services	Spelthorne Borough Council	HC		
Chief Executive	Spelthorne Borough Council	HX		
Environmental Health Manager	Spelthorne Borough Council	I		
Facilities Manager	St Edmunds College	E	Education	
Clerk	St Ippolyts Parish Council	J		Central
Clerk	St James Parish Council	J		East
Clerk	St Margarets-At-Cliffe Parish Council	J		Southeast
Clerk	St Martha Parish Council	J		Central
Clerk	St Mary in the Marsh Parish Council	J		Southeast
Clerk	St Michael Parish Council	J		Central
Clerk	St Osyth Parish Council	J		East
Clerk	St Paul's Walden Parish Council	J		Central
Clerk	St Stephen Parish Council	J		Central
Regulatory Services Manager	St. Albans City and District Council	I		
Head of Environmental & Regulatory Services	St. Albans City Council	HC		
Chief Executive	St. Albans City Council	HX		
Chief librarian	Staines Library	R		Central
Clerk	Stanbridge Parish Council	J		Central
Clerk	Stanford Parish Council	J		Southeast
Clerk	Stanford Rivers Parish Council	J		Central
Clerk	Stanstead Abbotts Parish Council	J		Central
Clerk	Stanstead St Margarets Parish Council	J		Central

Position	Organisation Name	code	sector	area
Clerk	Stansted Mountfitchet Parish Council	J		Central
Clerk	Staple Parish Council	J		Southeast
Clerk	Stapleford Abbotts Parish Council	J		Central
Clerk	Stapleford Parish Council	J		Central
Clerk	Stapleford Tawney Parish Council	J		Central
Manager	Station Hotel Newcastle	E	Hotels, Catering and Laundry Services	
Clerk	Stelling Minnis Parish Council	J		Southeast
Strategic Director of Environmental Services	Stevenage Borough Council	HC		
Strategic Director	Stevenage Borough Council	HC		
Principal Community Development Manager	Stevenage Borough Council	HC		
Green Spaces Policy and Development Manager	Stevenage Borough Council	HC		
Chief Executive & Head of Paid Service	Stevenage Borough Council	HX		
Environmental Health Manager (Commercial Services)	Stevenage Borough Council	I		
Clerk	Stocking Pelham Parish Council	J		Central
Clerk	Stokenchurch Parish Council	J		Central
Clerk	Stourmouth Parish Council	J		Southeast
Clerk	Stow-cum-Quy Parish Council	J		Central
Clerk	Streatley-Parish-Council	J		Central
Clerk	Strethall Parish Council	J		Central
Clerk	Studham-Parish-Council	J		Central
Clerk	Sundon-Parish-Council	J		Central
Clerk	Sunningdale Parish Council	J		Central
Clerk	Sunninghill & Ascot Parish Council	J		Central
CCDC	Surrey and Sussex Health Protection Unit	I		
Strategic Director for Environment and Infrastructure	Surrey County Council	HC		
Chief Executive	Surrey County Council	HX		
Head of Built Environment	Surrey Heath Borough Council	HC		
Chief Executive	Surrey Heath Borough Council	HX		
Senior Environmental Health Officer	Surrey Heath Borough Council	I		
Clerk	Sutton-By-Dover Parish Council	J		Southeast
Clerk	Swavesey Parish Council	J		Central
Chairman	Tadlow (Parish Meeting) Parish Council	J		Central
Clerk	Takeley Parish Council	J		Central
Chief Executive	Tendring District Council	HC		
Chief Executive	Tendring District Council	HX		
	Tendring District Council	O		
Clerk	Tendring Parish Council	J		East
Clerk	Teversham Parish Council	J		Central
Secretary	Tewin Flyfishing Club	M		Central
Clerk	Tewin Parish Council	J		Central
Manager	TGF Pizza	E	Food, Drink, Tobaco and retail services	
CEO	Thames Water Utilities Ltd	P		
Clerk	Thaxted Parish Council	J		Central
	The Association of Professional Landscapers	L		
Secretary	The Audley Fly Fishing Club	M		Central
	The British Association of Leisure Parks, Piers and Attractions Ltd.	L		
	The British Veterinary Association	L		
Business Manager	The Chauncy School	E	Education	

Position	Organisation Name	code	sector	area
	The England and Wales Cricket Board	L		
	The Football Association	L		
	The Independents hotel Association	L		
Clerk	The Lee Parish Council	J		Central
	The National Society of Allotment and Leisure Gardeners Ltd.	L		
	The National Trust	K		
Strategic Director of Environmental Services and Deputy Chief Executive	The Royal Borough of Windsor and Maidenhead	HC		
Chief Executive	The Royal Borough of Windsor and Maidenhead	HX		
	The Swimming Pool and Allied Trades Association	L		
	The Upham Pub Company	E	Hotels, Catering and Laundry Services	
Accounts	The Weybridge Club	E	Sports & Leisure	
Clerk	Therfield Parish Council	J		Central
Clerk	Theydon Bois Parish Council	J		Central
Clerk	Theydon Garnon Parish Council	J		Central
Clerk	Thorley Parish Council	J		Central
Clerk	Thorpe-le-Soken Parish Council	J		East
Clerk	Thorrington Parish Council	J		East
Director of Community & Environmental Services	Three Rivers District Council	HC		
Chief Executive	Three Rivers District Council	HX		
Residential Standards Manager	Three Rivers District Council	I		
Clerk	Thriplow Parish Council	J		Central
Clerk	Tilmanstone Parish Council	J		Southeast
Clerk	Tilsworth Parish Council	J		Central
Clerk	Toddington Parish Council	J		Central
Clerk	Toft Parish Council	J		Central
Clerk	Tongham Parish Council	J		Central
Accounts manager	Total UK Ltd	E	Manufacturing	
Clerk	Totternhoe Parish Council	J		Central
Clerk	Tring Rural Parish Council	J		Central
Clerk	Tring Town Council	J		Central
	Turfgrass Growers Association	L		
Clerk	Turville Parish Council	J		Central
Clerk	Ugley Parish Council	J		Central
Member of the European Parliament	UK Government	GE		
Member of the European Parliament	UK Government	GE		
Member of the European Parliament	UK Government	GE		
Member of the European Parliament	UK Government	GE		
Member of the European Parliament	UK Government	GE		
Member of the European Parliament	UK Government	GE		
Member of the European Parliament	UK Government	GE		
Member of the European Parliament	UK Government	GE		
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		

Position	Organisation Name	code	sector	area
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
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Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
Member of Parliament	UK Government	GM		
	UK Sport	L		
Director of Operations	Uttlesford District Council	HC		
Chief Executive	Uttlesford District Council	HX		
Head of Environmental Health	Uttlesford District Council	I		
Secretary	Ver Valley Society	M		
	Ver Valley Society	M		
	Ver Valley Society	M		
Clerk	Walkern Parish Council	J		Central
Clerk	Waltham Abbey Town Council	J		Central
Clerk	Waltham St Lawrence Parish Council	J		Central
Clerk	Wanborough Parish Council	J		Central
Clerk	Ware Town Council	J		Central
Clerk	Wareside Town Council	J		Central

Position	Organisation Name	code	sector	area
Clerk	Warfield Parish Council	J		Central
Clerk	Waterbeach Parish Council	J		Central
Head of Environmental Services	Watford Borough Council	HC		
Executive Director (Services)	Watford Borough Council	HC		
Managing Director	Watford Borough Council	HX		
Environmental Health Manager	Watford Borough Council	I		
Clerk	Watford Rural Parish Council	J		Central
	Watling Chase Community Forest	M		
Clerk	Watton-At-Stone Parish Council	J		Central
Clerk	Weeley Parish Council	J		East
Director Strategy and Development	Welwyn Hatfield Borough Council	HC		
Chief Executive	Welwyn Hatfield Borough Council	HX		
Environmental Health Team Leader	Welwyn Hatfield Council	I		
Clerk	Welwyn Parish Council	J		Central
Procurement Manager	Wembley Arena	E	Sports & Leisure	
Clerk	Wendens Ambo Parish Council	J		Central
Clerk	Wendens Lofts Parish Council	J		Central
	West Berkshire	I		
Clerk	West Clandon Parish Council	J		Central
Clerk	West End Parish Council	J		Central
Clerk	West Horndon Parish Council	J		Central
Clerk	West Horsley Parish Council	J		Central
Clerk	West Wickham Parish Council	J		Central
Clerk	West Wycombe Parish Council	J		Central
Chairman	Westmill Parish Council	J		Central
Clerk	Weston Colville Parish Council	J		Central
Clerk	Weston Parish Council	J		Central
Clerk	Wexham Court Parish Council	J		Central
Chief librarian	Weybridge Library	R		Central
Clerk	Whaddon Parish Council	J		Central
Clerk	Wheathampstead Parish Council	J		Central
Clerk	Whipsnade Parish Council	J		Central
Chiltern Society	White Hill Centre	M		
Clerk	White Roding Parish Council	J		Central
Clerk	White Waltham Parish Council	J		Central
Clerk	Whitfield Parish Council	J		Southeast
Clerk	Whittlesford Parish Council	J		Central
Clerk	Wicken Bonhunt Parish Council	J		Central
Chairman	Widdington Parish Council	J		Central
Clerk	Widford Parish Council	J		Central
Clerk	Wigginton Parish Council	J		Central
Chief librarian	Willesden Green Library Centre	R		Central
Clerk	Willingham Parish Council	J		Central
Clerk	Wimbish Parish Council	J		Central
Clerk	Wimpole Parish Council	J		Central
Clerk	Windlesham Parish Council	J		Central
Clerk	Wingham Parish Council	J		Southeast
Clerk	Winkfield Parish Council	J		Central
Clerk	Wivenhoe Parish Council	J		East
Clerk	Wix Parish Council	J		East
Neighbourhood Services Manager	Woking Borough Council	HC		
Strategic Director	Woking Borough Council	HC		
Chief Executive	Woking Borough Council	HX		
Neighbourhood Services Manager	Woking Borough Council	I		
	Woking Football Club	E	Sports & Leisure	
Chief librarian	Woking Library	R		Central

Position	Organisation Name	code	sector	area
Assistant Clerk	Wooburn & Bourne End Parish Council	J		Central
Clerk	Woolmer Green Parish Council	J		Central
	World Wildlife Fund	K		
Policy and Programme Officer	World Wildlife Fund	M		
Clerk	Worplesdon Parish Council	J		Central
Clerk	Worth Parish Council	J		Southeast
Clerk	Wrabness Parish Council	J		East
Clerk	Wraysbury Parish Council	J		Central
	WWF	O		
Head of Environment	Wycombe District Council	HC		
Corporate Director	Wycombe District Council	HC		
Chief Executive	Wycombe District Council	HX		
Divisional Environmental Health Officer	Wycombe District Council	I		
Chairman	Wyddial Parish Meeting	J		Central
Clerk	Wymondley Parish Council	J		Central
CCG Chair		O		
County Councillor	Hertfordshire County Council (St Albans South Division)	HC		Central
	Ver Valley Society	M		Central
Vice Chair	St Albans Civic Society	N		

Appendix C: Additional consultees

Additional stakeholders and customers that responded to our draft WRMP consultation will be informed of our Statement of Response.

Position	Organisation Name	code	sector	Area
	P Ayling, Tewin Water Farm, Digswell, Welwyn, AL6 0BH	B	Domestic customer	
Chairman	Digswell Lake Society	M	Local Environment Group	Central
Environmental Project Officer	Essex County Council	HC	*Different name to those on consultee list*	Central
	W Trower, Walkern Bury Farm, Bassus Green, Stevenage SG2 7JH	B	Domestic customer	
	S Shaw	B	Domestic customer	
	J Carpenter	B	Domestic customer	
Strategic Environment	Chiltern District Council	HC	*Different name to those on consultee list*	Central
	Beane Mimram Partnership	M	Local Environment Group	Central
	R Harley, Orchard Cottage, 2 Rollswood Road, Welwyn AL6 9TX	B	Domestic customer	
	A McNab, The Stables, Dene Lane, Aston SG2 7EP	B	Domestic customer	
Planning Officer (Projects Team)	North Hertfordshire District Council	HC	*Different name to those on consultee list*	Central
Infrastructure Delivery Coordinator	Elmbridge Borough Council	HC	*Different name to those on consultee list*	Central
	S Cheek	B	Domestic customer	
	P Miles	B	Domestic customer	
Head of Sustainability and Leisure	Spelthorne Borough Council	HC	*Different name to those on consultee list*	Central
Chairman	Watton-at-Stone Parish Council	J	*Different name to those on consultee list*	Central
Regional Director – SE England	Institution of Civil Engineers	L		
Councillor	Hughenden Parish Council	J	*Different name to those on consultee list*	Central
	Aston St Mary's Eco Club	M		
	A Gardiner	B	Domestic customer	
	J & B Woodget	B	Domestic customer	
	P & B Hewitt	B	Domestic customer	
	A & D Trotter	B	Domestic customer	
	C Lowe	B	Domestic customer	
	A Comerford, Peter Roberts Canal & River Trust	K		
	A Mead	B	Domestic customer	
	Dr H Bailey, Hertfordshire Geological Society	M		Central
	A Bott	B	Domestic customer	
	F Burrows	B	Domestic customer	
	M Jeffery, Albion Water	P		
	P Dodgson	B	Domestic customer	
	G Warren, CPRE Kent	K		Southeast
	R Cole	B	Domestic customer	
	D Stimpson	B	Domestic customer	
	K Ashby	B	Domestic customer	
	D Ashby	B	Domestic customer	
	B Biggs	B	Domestic customer	

Position	Organisation Name	code	sector	Area
	Jacqui & Steve Brown	B	Domestic customer	
	E & G Coles	B	Domestic customer	
	B Eccles	B	Domestic customer	
	Gordon & Anne Ewan	B	Domestic customer	
	J Harboard	B	Domestic customer	
	G Lush	B	Domestic customer	
	G Stergios	B	Domestic customer	
	K Graves, Impress the Chess	M		Central
	J Bate, Kent Downs AONB	M		Southeast
	I Knight River Beane Restoration Association	M		Central
	C Mungovan	B	Domestic customer	
	L Derrick	B	Domestic customer	
	S & D Pilkinton, 11 High Street, Markyate AL3 9PG	B	Domestic customer	
	P F Stanbury, 15 Wrights Orchard, Aston, Stevenage SG2 7HR	B	Domestic customer	
Hertfordshire Living Rivers Officer	Herts and Middlesex Wildlife Trust	M	*Different name to those on consultee list*	Central
Senior Planning Officer	Stevenage Borough Council	HC	*Different name to those on consultee list*	Central
Chilterns Chalk Streams Project Officer	Chilterns Conservation Board	M		Central
Programme Manager – UK Rivers	World Wildlife Fund	M	*Different name to those on consultee list*	
	A Chudzik, Rivers Edge, Fully Mill Lane, Welwyn AL6 9NH	B	Domestic customer	
	N Hurt	B	Domestic customer	