Water Resources Management Plan

2010–2035

Main Report

October 2009

Southern Water

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GLOSSARY OF TERMS

Term	***Meaning / Definition***
AA	Annual Average
ADO	Average Deployable Output
AISC	Average Incremental Social Cost
AMP4	Asset Management Plan 4 (for the period 2005-10)
AMP5	Asset Management Plan 5 (for the period 2010-15)
ASR	Aquifer Storage and Recovery
BAG	Benefits Assessment Guideline
BSWE	Base Service Water Efficiency target
BWHW	Bournemouth and West Hampshire Water, a neighbouring water company
Capex	Capital expenditure
CC	Climate Change
CDD	Cistern Displacement Device
CP	Critical Period
CWA	Commercial Water Audit
Defra	Department for Food and Rural Affairs
DI	Distribution Input
DO	Deployable Output
DWRMP	Draft Water Resources Management Plan, submitted for consultation in March 2008
DYAA	Dry Year Annual Average planning scenario
DYCP/PDO	Dry Year Critical Period planning scenario
DYMDO/MDO	Dry Year Minimum Deployable Output planning scenario
EA	Environment Agency
ELL	Economic Level of Leakage
EU	European Union
FDWS	Folkestone and Dover Water Services, a neighbouring water company
HA	Hampshire Andover Water Resource Zone
HHA	Household Water Audit
HK	Hampshire Kingsclere Water Resource Zone
HS	Hampshire South Water Resource Zone
IOW	Isle of Wight Water Resource Zone
JR07	June Return 2007
KM	Kent Medway Water Resource Zone
KT	Kent Thanet Water Resource Zone
l/h/d	Litres per head per day

LoS	Levels of Service
MDO	Minimum Deployable Output
Ml	Megalitres
Ml/d	Megalitres per day
MLE	Maximum Likelihood Estimation
NYAA	Normal Year Annual Average planning scenario
Ofwat	Office of Water Services; the water industry's financial regulator
Opex	Operational expenditure
PCC	Per Capita Consumption
PDO	Peak Deployable Output
PET	Potential Evapo-transpiration
PR	Periodic Review
PR04	Periodic Review conducted in 2004
PR09	Periodic Review 2009
PWC	Portsmouth Water, a neighbouring water company
RSA	The Environment Agency's Restoring Sustainable Abstraction programme
SAC	Special Area of Conservation
SB	Sussex Brighton Water Resource Zone
SDB	Supply Demand Balance
SDS	Strategic Direction Statement – outlining strategic priorities for water and wastewater services
SEA	Strategic Environmental Assessment
SELWE	Sustainable Economic Level of Water Efficiency
SEW	South East Water, a neighbouring water company, which, as of December 2007, incorporates the former Mid Kent Water
SESW	Sutton and East Surrey Water, a neighbouring water company
SH	Sussex Hastings Water Resource Zone
SN	Sussex North Water Resource Zone
SW	Sussex Worthing Water Resource Zone
SWS	Southern Water Services Ltd; also called 'the company' in this WRMP
TWUL	Thames Water, a neighbouring water company
WAFU	Water Available For Use
WFD	The EU's Water Framework Directive
WRMP	Water Resources Management Plan – as required for PR09
WRP	Water Resources Plan – as formulated for PR04
WRPG	Water Resources Planning Guidelines, produced by the Environment Agency
WRSE	Water Resources in the South East Group; a group chaired by the EA and comprising representatives from water companies, Ofwat, SEERA and Natural England

WRZ	Water Resource Zone
WSW	Water Supply Works
WTP	Willingness To Pay
WTW	Water Treatment Works

Executive Summary

This Water Resources Management Plan sets out in detail how Southern Water proposes to ensure that there is sufficient security of water supplies to meet the anticipated demands of all its customers over the 25-year planning period from 2010 to 2035.

There are many challenges over the next 25 years to be faced by the water industry in general, and the South East of England in particular. These challenges include: Increased demand from housing growth; the effects of climate change and the need to reduce energy use; and maintaining high levels of environmental protection. Our plan has to be robust enough in the light of these challenges to maintain security of supplies and provide the best value for customers.

Southern Water also faces a number of specific challenges including constraints on the development of new resources; the complexity of its own separated areas of supply; and the need to reach the best regional solution with the other companies within the region.

This plan shows how Southern Water has responded positively to these challenges by taking a robust approach to planning a resilient system for the future. The plan is consistent with the views expressed in the company's Strategic Direction Statement which was published in December 2007.

All water company Water Resources Management Plans have for the first time been subject to full public statutory consultation with regulators, stakeholders, customers and other interested parties. This has come at a critical time for water resources planning and Southern Water welcomes the opportunity to receive the views of all parties as it plans for the future.

The final version of this Water Resources Management Plan has taken into account the views expressed in the 125 representations received during the consultation process on the draft Water Resources Management Plan (draft WRMP) and reinforces the statements made in the company's Statement of Response to the representations received.

A draft Environmental Report was produced at the time of the draft WRMP as part of the Strategic Environmental Assessment (SEA) process. Since then the Environmental Report has been revised and an SEA Statement produced. A high-level appropriate assessment has also been undertaken of the plan.

The plan is firmly "demand management-led" and assumes: The completion of a programme of universal metering by 2015; further reductions in leakage; and the continued promotion of water efficiency initiatives to meet both the Ofwat baseline water efficiency target and as part of a least cost strategy. There will also need to be some new resource developments. We have been an active member of the Water Resources in the South East (WRSE) group whose results have informed this plan. This means that the strategy also firmly incorporates the requirement for a regional solution and therefore takes the needs of other water companies into account.

The strategy for our Western Area takes account of discussions with Ofwat and the Environment Agency and additional work since submission of the draft WRMP to explore options for implementation of Sustainability Reductions on the River Itchen. The Testwood schemes included in this plan for Hampshire South Water Resource Zone (WRZ) are required to allow the progressive implementation of Sustainability Reductions from 2015.

The value of the 25-year company preferred regional strategy is £283.4 million (based on NPV costs), of which the majority, £175.6 million, will be for reducing our abstraction from the environment through the introduction of demand management measures, and £107.8 million for new resource developments.

This significant water resources investment strategy demonstrates how Southern Water is committed to achieving security of supplies for the next 25 years, and represents the least-cost environmentally sustainable solution.

A summary of the 25-year strategy is as follows:

Water Resource Zone	Schemes During AMP5	Schemes beyond AMP 5 – company only solution	Schemes beyond AMP 5 – Water Resources in the South East of England
Isle of Wight	• Enhanced Metering • Asset improvement schemes for groundwater sources (1.55 Ml/d peak, 1.05 Ml/d average) • Optimisation of inter-zonal transfers (cross-Solent main)	• Water Efficiency kits • 1.1 Ml/d further leakage reduction • Refurbishment of L536 borehole • Refurbishment of K628 borehole	As previous column
Hants South	• Universal Metering • Asset improvement schemes for groundwater sources (12.00 Ml/d peak, 8.00 Ml/d average) • Increase Testwood WSW to licence limit • Development of the enabling Testwood to Otterbourne transfer • Optimisation of inter-zonal transfers (cross-Solent main)	• Candover & Alre augmentation schemes • 7.8 Ml/d of leakage reduction • R176 borehole rehabilitation And, subject to satisfactory completion of AMP5 schemes: • River Itchen Sustainability Reductions residual at end of AMP5	As previous column
Hants Kingsclere	• Universal Metering • Asset improvement schemes for groundwater sources (1.2 Ml/d peak only)		
Hants Andover	• Universal metering • Asset improvement schemes for groundwater sources (0.2 Ml/d peak & average)		
Sussex North	• Universal metering • Renewal of the existing bulk supply contract from Portsmouth Water • Asset improvement schemes for groundwater sources (0.30 Ml/d peak, 0.10 Ml/d average) • Optimisation of inter-zonal transfers (from Sussex Worthing) • River Arun Abstraction	• Renewal of the bulk supply of contract to South East Water	As previous column

Sussex Worthing	• Universal metering • Asset improvement schemes for groundwater sources (1.75 Ml/d peak, 4.25 Ml/d average) • Optimisation of inter-zonal transfers (to Sussex North and Sussex Brighton)		
Sussex Brighton	• Universal metering • Asset improvement schemes for groundwater sources (7.25 Ml/d peak & average) • Optimisation of inter-zonal transfers (from Sussex Worthing)		• Provision of a 4 Ml/d bulk supply to South East Water
Sussex Hastings	• Universal metering • Asset improvement schemes for groundwater sources (0.25 Ml/d peak only) • Optimisation of inter-zonal transfers (Bewl-Darwell transfer)	• Renewal of bulk supply to South East Water • Licence variation at Darwell reservoir • Re-introduction of the S556 source • 0.5 Ml/d leakage reductions	As previous column
Kent Medway	• Universal metering • Asset improvement schemes for groundwater sources (10.25 Ml/d peak, 8.75 Ml/d average) • Optimisation of inter-zonal transfers (to Kent Thanet)	• Renewal of the C522 scheme bulk supply to South East Water • Licence variation to the River Medway Scheme • Licence variation of S271 groundwater source • 6.5 Ml/d of further leakage reduction	As previous column, but additional schemes • Aylesford wastewater recycling scheme • Raising Bewl Water An the assumption that these will enable the following • Bulk Supply from Bewl Water to South East Water • Bulk Supply from Burham to South East Water
Kent Thanet	• Universal metering • Optimisation of inter-zonal transfers (from Kent Medway) • Renewal of the bulk Supply to Folkestone and Dover	• 0.1 Ml/d of further leakage reduction	As previous column, but additional schemes • Enhancement of the bulk Supply to Folkestone and Dover

1 Introduction

1.1 Purpose of this Water Resources Management Plan

This Water Resources Management Plan (also referred to as WRMP) sets out in detail how Southern Water proposes to ensure that there is sufficient security of water supplies to meet the anticipated demands of all its customers over the 25-year planning period from 2010 to 2035. The company currently supplies a total of 2.26 million customers across an area of some 4450 sq. kms in the South East of England, from East Kent in the east, through Sussex, to Hampshire and the Isle of Wight in the west.

This is the first time that all water company WRMPs have been subject to statutory consultation with regulators, stakeholders, customers and any other interested parties. This comes at a critical time for water resources planning in the South East. Southern Water welcomes the views expressed in the 125 representations received during the consultation process.

In looking at the next 25-year planning period, there is no doubt that major challenges face water companies in the South East region, including Southern Water in particular. Although not all are new to WRMPs, a number of factors have brought these challenges into much sharper focus since the last Water Resources Plan (WRP) which was published in 2004. These factors include:

- The need to ensure there is a robust and resilient water supply system that will not fail, even under the most severe conditions;
- The additional demands from the growth in new housing proposed by the Government and the likelihood that current projections of growth will be further increased;
- The need to deliver a regional solution with other companies that constitutes a least cost and sustainable solution;
- The need to take into account the growing impact of climate change on all aspects of forward planning (including energy use), not just drought-related impacts;
- The requirement under recent EU environmental legislation (Habitats Directive) for potentially very sizeable reductions in the water available for supply from some of the company's existing sources. These reductions are much greater than envisaged for the last WRP in 2004;
- The need to take account of the lessons learnt from the severe drought of 2004-06;
- The company's robust investigation and re-evaluation over the last three years of the reliable yield from its sources;
- The marked increase in the frequency and severity of droughts in the last two decades, and a growing acknowledgement in recent years within the industry of the need to plan for further increases in the frequency and severity of future droughts;
- The potential for further reductions in water available for supply as other related legislative provisions are implemented in the future (e.g. the Water Framework Directive, and the Restoring Sustainable Abstraction programme), although companies have been instructed not to include them in the WRMP;
- The requirement to take into account how the Strategic Environmental Assessment (SEA) has informed the WRMP; and

- The opportunity to take into consideration the various issues raised during the consultation process.

Southern Water has responded positively to these challenges in this WRMP which sets out a robust approach to planning a resilient system to ensure security of supplies for the next 25 years. The WRMP demonstrates that the company preferred regional strategy to address all these challenges comprises a combination of measures across different parts of its supply area. The balance of such measures will include: demand management measures such as increased meter installation; reduced leakage and water efficiency initiatives; as well as new resource developments and infrastructure improvements, as required. This strategy has taken into account a range of economic, environmental, and political and social considerations, including those concerning carbon footprint and energy usage, along with the results of the SEA. The certainty with which each of the particular measures will deliver the required outcomes will also be critical, as will the requirement placed on all water companies to, wherever possible, develop "least-cost" solutions in order to minimise increases in customer bills.

In summary, this WRMP shows how Southern Water proposes to ensure that it can supply the needs of its customers over the next 25 years in a manner that is: robust; resilient; flexible; and economically, politically and socially acceptable; whilst being environmentally sustainable.

1.2 Statutory Requirements for this Water Resources Management Plan

Water companies have previously prepared WRPs on a voluntary basis. Companies are now required to prepare and maintain WRMPs on a statutory basis. The process also now requires these WRMPs be subject to public consultation.

This WRMP has been prepared according to the requirements as set out by the following statutory provisions:

- Sections 37A and 37B of the Water Industry Act 1991, inserted by virtue of Section 62 of the Water Act 2003;
- The Water Resources Management Plan Regulations 2007 (SI 2007/ 727);
- The Water Resources Management Plan Direction 2007;
- The Water Resources Management Plan (No.2) Direction 2007;
- The Water Resources Management Plan (No.2) (Amendment) Direction 2007;
- The Southern Water Services Limited Water Resources Management Plan Direction 2007; and
- The Water Resources Management Plan Direction (England) 2008.

Copies of relevant statutory provisions are given in Appendix A.

Table 1.1 shows the statutory requirements as part of the above provisions, and cross-references them to the relevant sections of this WRMP.

The WRMP has to be maintained, and is therefore a live document which Southern Water will be keeping under review. Southern Water is required to send to the Secretary of State a statement of its conclusions following each review, which is to be conducted on at least an annual basis. Southern Water will prepare a revised WRMP where:

- The review indicates a "material change of circumstances"; or
- The Secretary of State directs it to; and
- In any event, not later than 5 years after this WRMP is published.

Southern Water published its Drought Plan in September 2008, which was also subject to the process of statutory consultation. The Drought Plan demonstrates how the company would manage the security of supplies in the event of impending or actual drought events, which are normally of shorter duration than the planning period for the WRMP.

It should be noted that, according to Section 37B (10) of the Water Industry Act 1991, this WRMP does not include any information that is considered commercially sensitive, nor does it include any information that is adjudged to be contrary to the interests of national security.

		Contents of a WRMP as specified by legislation	WRMP Ref.
(a)	WIA 1991 S.37A (3) (a)	Southern Water's estimate of the quantities of water required to meet its obligations.	Section 10.3.5, Section 10.4.5, Section 10.5.5
(b)	WIA 1991 S.37A (3) (b)	The measures which Southern Water intends to take or continue to take to meet its obligations.	Table 10.8, Table 10.16, Table 10.24
(c)	WIA 1991 S.37A (3) (b)	The likely sequencing and timing for implementing those measures.	
(d)	Dir 2007 S.2	Planning period means 25 years from 1st April 2010.	Section 1.1
(e)	Dir 2007 S.3 (a)	How frequently Southern Water expects that it may need to impose prohibitions or restrictions on its customers in relation to:	Section 3.3.1, Table 3.1
		(i) The provisions of a Drought Order restricting "non essential uses" under s.76 WRA 1991.	As above
		(ii) A Drought Order restricting "non essential uses" under s.74(2)(b) WRA 1991; and	Section 3.3.1
		(iii) The provisions of an Emergency Drought Order under s.75 WRA 1991.	As above
(f)	Dir 2007 S.3 (b)	The appraisal methodologies which Southern Water has used in choosing the measures it intends to take or continue for the purpose of making its WRMP.	Section 8
(g)	Dir 2007 S.3 (c)	The emissions of greenhouse gases which are likely to arise as a result of each measure which Southern Water has identified to meet its obligations.	Section 11
(h)	Dir 2007 S.3 (d)	How the supply and demand forecasts contained in the WRMP have taken into account the implications of climate change.	Section 5.7, Section 6.5.7
(i)	Dir 2007 S.3 (e)	How Southern Water has estimated future household demand in its area over the planning period.	Section 6.5
(j)	Dir 2007 (2) S.2 (a)	Its estimate of the increase in the number of domestic premises in its area, over the planning period, in respect of which it will be obliged to fix charges by way of a water meter by reason of a notice served by the consumer under s.144A WIA 1991.	Section 6.5.3
(k)	Dir 2007 (2) S.2 (b)	Where the whole or part of its area has been determined by the Secretary of State to be an area of serious water stress, Southern Water's estimate of the number of domestic premises which are in that area and in respect of which it will fix charges by way of water metering.	Section 6.5.3

		Contents of a WRMP as specified by legislation	WRMP Ref.
(l)	Dir 2007 (2) (Am) S.2 (c)	Its estimate of the increase in the number of domestic premises in its area over the planning period in respect of which Southern Water may be able to make a charges scheme[1] because the conditions for prohibiting such a charge scheme[2] are not met (excluding domestic premises which are in the estimate in (k) above).	Section 6.5.3
(m)	Dir 2007 (2) S.2 (d)	Full details of the likely effect of what is forecast pursuant to the estimates provided under paragraphs (j), (k) and (l) above.	Section 10.3.8, Section 10.4.8, Section 10.5.8
(n)	Dir 2007 (2) S.2 (e)	The estimated cost to the water undertaker in relation to the installation and operation of water meters to meet what is forecast pursuant to the estimates provided under paragraphs (j), (k) and (l) above, and a comparison of that cost with the other measures which it might take to manage demand for water, or increase supplies of water, to meet its obligations.	Section 10.3.13, Section 10.4.13, Section 10.5.13
(o)	Dir 2007 (2) S.2 (f)	A programme for the implementation of what is forecast pursuant to paragraphs (k) and (l)	Section 6.5.3
(p)	SWS Dir 2007	Submission of draft water resources management plan to Secretary of State by 15th March 2008	Appendix A
(q)	Dir (England) 2008	Revised submission date for statement of response, to 29th January 2009 for Southern Water	Appendix A

Table 1.1 References to Statutory Requirements

[1] Defined under s.143 WIA 1991 to be a scheme which fixes, over a 12 month period, the charges to be paid for any services provided by the undertaker in the course of carrying out its functions

[2] Those conditions are set out in s144B and the Water Industry (Prescribed Conditions) Regulations 1999 as amended

1.3 Consultation Requirements

There have now been three phases of the consultation process for this WRMP. Firstly, in accordance with Section 37A (8) of The Water Industry Act 1991, water companies must undertake pre-consultation with Ofwat, the Environment Agency, the Secretary of State and any licensed suppliers in its supply area. Southern Water took the opportunity to widen the scope of this pre-consultation phase to include a number of other bodies, namely, neighbouring water companies, RSPB, the Wildlife Trusts and the Consumer Council for Water (CCW). A copy of the pre-consultation letter and full list of pre-consultation parties is given in Appendix B.

In accordance with the requirement for full public consultation, the draft Water Resources Management Plan (DWRMP) was sent to those parties prescribed in Section 2(2) of The Water Resources Management Plan Regulations 2007 (SI 2007/ 727), in accordance with the requirements of Section 37B of The Water Industry Act 1991. Southern Water has again taken the opportunity to widen the basis of its consultation, and a full list of consultees is given in Appendix B.

The company published the DWRMP on 1st May 2008, and the twelve week consultation period lasted from then until 25th July 2008.

The DWRMP was published for consultation in a variety of formats to ensure that it was available for both technical review/comment and also for wider public consultation.

The DWRMP was published as:

- The main consultation document comprising the Main Report and the Appendices, and a 14-question questionnaire;
- The Non-Technical Summary, giving an overview of the DWRMP; and
- A brochure giving the high level summary of the DWRMP.

As part of the consultation process, a letter was sent to more than 900 stakeholders to advise them that the consultation period had started and that the DWRMP was available on the internet.

An Environmental Report that described the outcomes from a Strategic Environmental Assessment (SEA) of the DWRMP was published for public consultation at the same time as the DWRMP.

Southern Water received 125 representations to the consultation, all forwarded via Defra.

In accordance with Section 4 of the Water Resources Management Plan Regulations 2007, water companies had to prepare and publish a Statement of Response to the representations received during the consultation process. Southern Water published its Statement of Response to the representations received, according to the Water Resources Management Plan Direction (England) 2008, on 29th January 2009. The Statement of Response was available on its website. A link to the site was emailed to all those respondents who had provided an email address. A letter and CD were sent to all respondents who had provided an address, with the offer of a paper copy of the Statement of Response, if requested.

The actions described in the Statement of Response were taken into account in the WRMP - Revised Draft following Consultation which was issued to Defra and the Environment Agency in March 2009.

On 3rd August 2009, Defra announced that the company should publish its WRMP in its final version.

1.4 Strategic Environmental Assessment (SEA)

The requirement to undertake an SEA in the European Union (EU) came about when the EC Directive (2001/42/EC) 'on the assessment of the effects of certain plans and programmes on the environment', known as the 'SEA Directive', came into force in 2004. The Directive was transposed into UK law by the Environmental Assessment of Plans and Programmes Regulations (SI 1633/2004). The Directive and associated regulations make an SEA a mandatory requirement for certain plans and programmes which are likely to have significant effects on the environment.

The Directive's overall objective is to "provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment."

The previous PR04 WRP did not require an SEA because it was prepared before the SEA Regulations came into force. However, the options appraisal process conducted during the AMP4 Water Resources Investigations did take account of environmental issues and the results of these assessments were taken into account in the SEA. Southern Water considers the WRMP currently being prepared as a "water management plan", within the terms of the SEA Directive, and will set the framework for future development. An SEA is therefore required to be undertaken of the WRMP.

In compliance with the appropriate sets of guidance on the SEA process, an SEA Scoping Report was produced and was published for consultation. The responses received were addressed and included in the preparation of the Draft Environmental Report. The Report summarised the findings and results of the SEA process and presented information on the likely significant effects of the WRMP options considered.

The Environmental Report was published for information and consultation alongside the draft WRMP and the results of the SEA were taken into account in the formation of the final WRMP.

The Environmental Report has been revised to incorporate consultee comments and changes to the WRMP. An Environmental Statement will be published shortly after the final WRMP, indicating how the information and results in the final WRMP and Revised Environmental Report have been influenced and informed by each other.

A high-level strategic assessment has been undertaken of the possible impact of the proposed plan on the integrity of European and Ramsar sites under the Conservation (Natural Habitats &c) Regulations 1994 (the Habitat Regulations). A report of the assessment will be published with the final WRMP.

1.5 Content and Structure of the Plan

The sections of this WRMP aim to provide a clear and logical explanation of the development of the WRMP as follows:

- **Section 2: The Southern Water Supply Area**

  Gives a brief overview of Southern Water's Supply Area, summarises the location and nature of the Water Resource Zones (WRZ), its boundaries with other companies, the main sources of water for supply, and the inter-connections with other water companies and WRZs.

- **Section 3: The Challenges Addressed in this Plan**

  Describes the major challenges that face the industry in general and also those specific to Southern Water as it seeks to plan and manage water supplies for the next 25 years.

- **Section 4: Principles of Water Resource Planning**

  Sets out the fundamental principles for developing a WRMP to ensure security of supplies, through the use of the supply demand balance.

- **Section 5: The Supply Forecast**

  Provides the details of, and results from, the extensive work undertaken to develop a robust Supply Forecast. The results are then used to develop the baseline supply demand balances and thus the WRMP strategy.

- **Section 6: The Demand Forecast**

  Describes the means by which the Demand Forecast is developed over the same period as the Supply Forecast. Forecasting demand is a particularly complex process involving a range of assumptions for the various components of demand. Clear explanations of these assumptions are provided where relevant.

- **Section 7: Dealing With Uncertainty**

  Shows how estimation of both the baseline Supply and Demand Forecasts are subject to some uncertainty, especially over a 25-year planning period. This section shows how these uncertainties are taken into account in this WRMP.

- **Section 8: Options Appraisal**

  Summarises the options appraisal process, and how both supply and demand side options have been considered in the WRMP.

- **Section 9: Formulation of the Water Resource Strategy**

  Explains the investment modelling methodology and the investment model itself, and how the robustness of the solution can be tested using scenario modelling and sensitivity testing.

- **Section 10: The Water Resources Strategy**

Describes in detail the formulation of the company preferred regional strategy for each sub-regional areas and WRZ. Starting from the baseline supply demand balance and the options available, the company preferred regional strategy is given and justified against other potential strategies under different scenarios.

- **Section 11: Overview of the Water Resources Strategy**

Summarises the key components of the company's proposed investment strategy to ensure that it provides security of supplies, in order to meet the demands for water over the 25 years between 2010 and 2035. This forms a key component of the company's detailed Business Plan for the five-year period from 2010 to 2015, as part of the proposals for revised price limits for which the approval of Ofwat will ultimately be required.

2 The Southern Water Supply Area

2.1 Overview

The Southern Water area of supply is complex in nature due to the fragmented geographical areas of supply and the inter-connections between its own supply areas as well as those with a number of other water companies. The area supplied by Southern Water covers a total of some 4,450 sq. kms, and extends from East Kent in the east, through parts of Sussex, to Hampshire and the Isle of Wight in the west. The total number of customers served is 2.26 million, with water supplied to 619,000 unmeasured properties (households and non-households) and 388,000 measured properties. Around 334,000 (35%) of the company's domestic customers are currently metered; around 93% of the households on the Isle of Wight were metered in the late 1980s as part of the National Metering Trial areas.

2.2 Water Resource Zones and Sub-Regional Areas

The geographically separate supply areas, known as Water Resource Zones (WRZs), supplied by Southern Water, and also the geographical relationship with other water companies in the region, are shown in Figure 2.1.

Figure 2.1 Southern Water's Current Area of Supply

Water resources planning takes place at the level of the Water Resource Zone (WRZ) which is the largest area in which all customers bear the same risk of restrictions during drought. There are ten WRZs in the Southern Water area. However, some of these WRZs are, or may be, connected by means of treated or raw water transfers. Therefore, for the purposes of strategic planning, where actions in one WRZ can have an impact in connected WRZs, it is possible to amalgamate some of these WRZs into larger, sub-regional areas.

The spatial basis for water resources planning within the Southern Water supply area is as follows:

Western sub-regional area (Western area), which includes the following WRZs:

- Isle of Wight WRZ;
- Hampshire South WRZ;
- Hampshire Andover WRZ; and

- Hampshire Kingsclere WRZ.

Central sub-regional area (Central area), which includes the following WRZs:

- Sussex North WRZ;
- Sussex Worthing WRZ; and
- Sussex Brighton WRZ.

Eastern sub-regional area (Eastern area), which includes the following WRZs:

- Kent Medway WRZ;
- Kent Thanet WRZ; and
- Sussex Hastings WRZ.

The number of WRZs has been increased since the previous WRP in 2004, with the division of the previous Sussex Coast WRZ into the Sussex Worthing and Sussex Brighton WRZs. This division arose because the capacity of the only inter-connection between the two areas was identified as a constraint on the free movement of water between the areas. When this transfer capacity is increased, the two WRZs can again be treated as a single WRZ.

It should be noted that these new WRZs will be used for reporting purposes from the start of AMP5, in 2010-11, and are therefore used for the formulation of the strategy within this plan.

2.3 Boundaries with Other Water Companies

Southern Water also has boundaries with seven other water companies. These are:

- Bournemouth and West Hampshire Water;
- Wessex Water;
- Portsmouth Water;
- Thames Water;
- Sutton and East Surrey Water;
- South East Water, which includes the area of the former Mid Kent Water, and
- Veolia South East, formerly Folkestone and Dover Water Services.

There are a number of bulk supplies between the companies. The bulk supplies are described in more detail in section 5 (The Supply Forecast), and section 10, which describes the individual Area strategies. Clearly, the number of boundaries, and the existing and potential future inter-connections, with so many water companies raises a number of opportunities for optimising the strategic use of resources across the region. However, it also adds significantly to the complexity of the planning process, and the selection of a single “company preferred” strategy, within a regional context. These issues are discussed further within section 3.3.4 which addresses the challenges of planning in a regional context and also in section 10.

2.4 Licensed Suppliers and Competition

There are currently no licensed suppliers within the Southern Water area of supply.

The final report of Defra’s Cave Review of competition within the water industry was published in April 2009. This Water Resources Management Plan does not include or assume any effects from competition, given the uncertainty about its future scope or pace. However, the WRMP will be developed to reflect competition as it develops, as part of maintaining the WRMP as described in section 1.2.

2.5 Southern Water Sources of Supply

The majority (68%) of Southern Water's supplies comes from groundwater, predominantly from the Chalk aquifer which is widespread across the region. A further 28% comes from river abstractions: most notably the Eastern Yar on the Isle of Wight; the Test and Itchen in Hampshire; the Western Rother in West Sussex; the Eastern Rother in East Sussex; and the Medway and Stour in Kent.

The remaining 4% of supplies come from the surface water impounding reservoirs, all of which are owned and operated by the company. The largest of these is Bewl Water. This is a pumped storage reservoir, with water being abstracted from the River Medway, stored and subsequently released as required for re-abstraction further downstream. The reservoir is owned and operated by Southern Water, but South East Water has an entitlement to 25% of the scheme yield.

The other three reservoirs in the Southern Water supply area are Darwell, Powdermill and Weir Wood. Darwell and Powdermill are used to supply the Sussex Hastings WRZ, with Darwell also providing a bulk supply of water to South East Water. Weir Wood, in north Sussex, supplies parts of Crawley and Horsham and also provides bulk supplies to South East Water.

It is winter rainfall that determines the status of sources and hence the ability to abstract water from them. Southern Water is situated in the South East of England, one of the driest regions in the country. Total annual rainfall averages about 730 mm. a year. However, it is the rainfall during the autumn and winter periods that is critical to the availability of water resources in the region. It is only during this period that rainfall can infiltrate through the soil to recharge groundwater reserves, store river baseflow for the following year and replenish surface water storage. Rainfall during this critical period averages about 400 mm. Most of the rainfall over the rest of the year (on average about 330 mm.) is lost to the atmosphere through evaporation and transpiration from plants during the spring and summer periods, or runs off the land directly into rivers, and is thus of little value in replenishing groundwater resources.

Experience has shown that it is often not the case for customers in different sub-regional areas to endure the same degree of supply shortages in what appear to be very similar drought conditions. The primary reason for this is that different "types" of droughts, or droughts with different characteristics (e.g. dry winters; dry summers; a dry winter followed by a dry summer; successive dry winters etc.) affect various different types of sources in different ways, and the particular shortages in a given sub-regional area will be a factor of the type of drought being experienced and its affects on the mix of the types of sources in that Area. A secondary issue is that quite subtle variations in rainfall across the region can also have significant effects on the availability of water in different WRZs and thus the sub-regional areas. These issues were explored in some depth as part of the Drought Permit/Order applications made by the company during the 2004-06 drought and the recent 2008 revision of the Southern Water Drought Plan.

2.6 The "Twin-Track" Approach

Fundamental to the development of a water resources strategy is the "twin-track" approach. This comprises the parallel approach of: reducing demand through demand management; such as leakage reduction, appropriate metering policies and the promotion of water efficiency initiatives; and the associated development of new sources, inter-zonal transfers or inter-company bulk supplies, as required.

Since privatisation in 1989, Southern Water has proactively pursued the twin-track approach. The profile of investment is given in Figure 2.2 and shows that Southern Water has invested nearly £244 million on maintaining security of supplies, of which some £84 million has been

invested on water resource schemes, whilst twice this amount, some £160 million, has been spent on demand management measures.

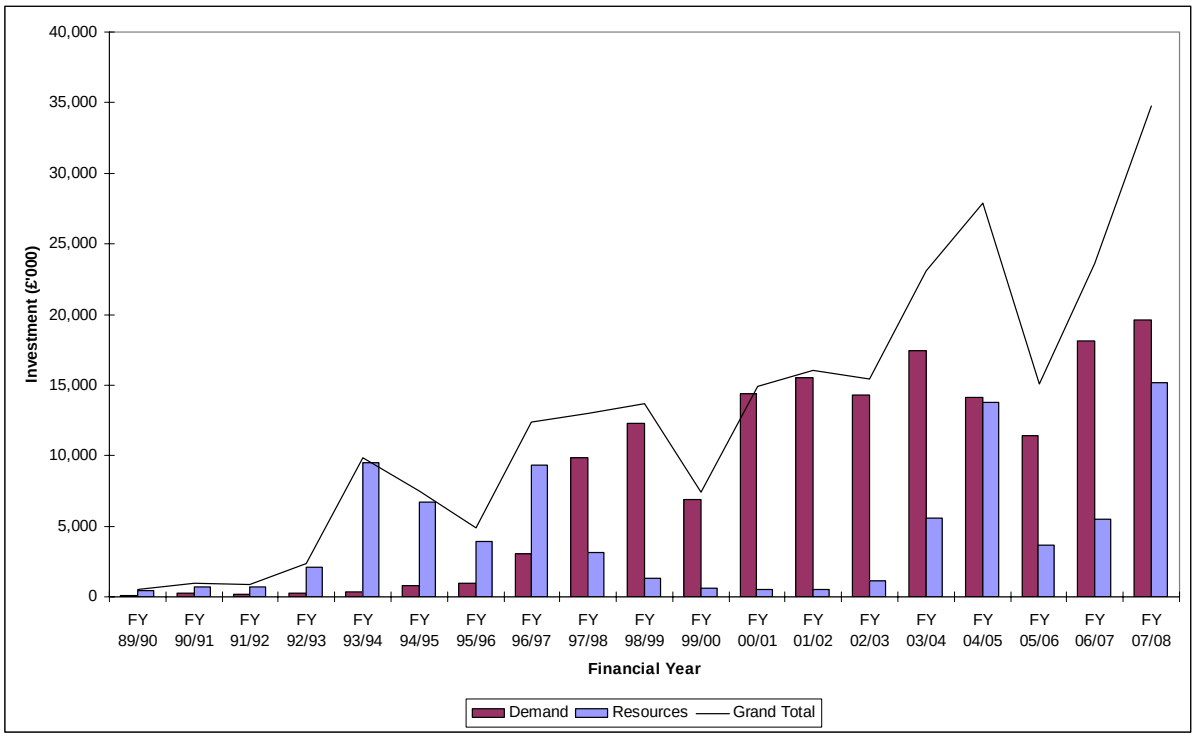


Figure 2.2 Annual Investment on Demand Management and Water Resource Schemes since 1989

3 Challenges Addressed in this Plan

3.1 Introduction

There are a number of major challenges that Southern Water needed to address in the formulation of this WRMP to develop a cost-effective and sustainable plan for maintaining the security of water supplies to its customers over the next 25 years. These challenges fall into two broad categories: the "generic" challenges which face the water industry in general; and also the specific challenges facing companies in the South East region, and Southern Water in particular.

3.2 Generic Challenges

3.2.1 Security of Supplies

A water supply system must be planned to be robust and resilient, and be able to maintain the security of supplies under the most severe conditions. Furthermore, its design must ensure the provision of essential water supplies under all foreseeable circumstances. The conclusions from the recent House of Lords Select Committee Report on Water Resources indicated that the introduction of standpipes and/or rota cuts would not be acceptable. This view was supported by Defra in its Drought Direction 2007, which instructed companies to state what measures, in the event of a severe drought, could be taken to ensure that such events would not occur. This WRMP shows how Southern Water plans to ensure that security of supplies is maintained so that such measures are not required.

3.2.2 New Housing

The number of households that will need to be supplied with water will grow significantly under the Government's plans for new houses. This issue is especially acute in the South East. Current plans, the Draft South East Plan, including the proposed amendments by the Secretary of State and published September 2008, suggest that around 30,000 new houses will be built every year for the next 25 years, of which about a quarter will be in the Southern Water supply area. This growth in housing and the associated impact on demand are taken into account in the Demand Forecast described in section 6. It is possible that the requirement for new houses will grow beyond current projections, with some planning scenarios suggesting that the effect of more than 40,000 new properties per annum in the southern region should be investigated.

3.2.3 Climate Change

The increased climatic variability, as well as a pattern of warmer drier years that would not necessarily be classified as drought years, is set within what is now acknowledged to be a period of rapid and irreversible climate change. In the light of such changes, what remains unclear is the magnitude of that future change, and WRMPs must therefore address the probability that climate change will increase the frequency, duration and magnitude of drought events.

The company's response to this fundamental concern has resulted in significant refinements in several aspects of water resources planning. It recognises that it must plan for a wider range of possible conditions than has hitherto been the case and must, in the process, significantly enhance the resilience of its supply system under this extended range of drought conditions. The need for this was highlighted during the 2004-06 drought. Given the severe conditions that were experienced, and the real possibility of them extending into a third dry winter, Southern Water undertook a very robust re-evaluation of the water available from its

sources under drought conditions and a fundamental review of the principles underlying the design of its water resources supply system. It now believes that design scenarios should more explicitly take into account the fact that essential supplies must be maintained during even the most severe drought.

Accordingly, it has extended its analysis to take into account the historic records of droughts over a longer period than previously considered in order to build in the need for security of supplies. Southern Water believes that, by considering this longer historic sequence, it will enable planning for enhanced security of supplies, not only for the present, but also in the future, in view of the all the major uncertainties that are faced.

3.2.4 Energy Use

Directly related to the issue of climate change has been a sharply increased focus on energy use within the water industry. Whilst the financial cost of energy has always been a significant component of the industry's operating and planning processes, the potential environmental costs associated with greenhouse gas emissions are now an equally important consideration. The increased focus on energy use extends not only to existing operations but is now a major factor in the evaluation of potential new resource developments, as will be discussed in this WRMP.

3.2.5 Impacts of Environmental Legislation

The environmental sustainability of existing abstraction licences, many of which were granted more than 40 years ago, has been under intense review in recent years. New EU and national legislative requirements enhancing the degree of protection afforded to the water environment is likely to mean that more water will now need to be left in some rivers, particularly during dry years.

Recent, and forthcoming, decisions by the Environment Agency as a result of its interpretation of European environmental legislation including the Habitats Directive and the Water Framework Directive, and consequential UK law and regulations deriving from the European Directives are likely to affect the company's abstraction licences. This means that in dry years much less water could be available.

It is anticipated that future further reductions in abstraction licences may be made as a result of the Environment Agency's Restoring Sustainable Abstraction (RSA) Programme which will implement the legislative requirements of the EU Habitats Directive and the EU Water Framework Directive as well as recognising the objective of protecting sites of more local environmental interest. However, as will be seen later, companies have been instructed not to take into account these potential further losses in this WRMP. Also, once the relevant determinations have been made under the RSA programme, the results of such determinations on the supply forecast may constitute a "material change in circumstances" which would require Southern Water to prepare a revised WRMP.

3.2.6 Providing Best Value to Customers

Finally, it is important to explicitly state that, despite the Government's commitment to robust planning that ensures the security of water supplies under a wide range of climatic conditions, its commitment to the environmental sustainability of the water supply industry and its commitment to the provision of additional housing in the South East, it remains, through Ofwat, the economic regulator, equally committed to the principle that customer bills should not rise by more than is absolutely necessary to fulfil these foregoing requirements.

This "least-cost" challenge remains a key focus of this WRMP and, in this context, the broader consultation on the plan was extremely timely. Southern Water welcomed the responses on all aspects of its proposals for the next 25 years received as part of the consultation process.

3.3 Specific Challenges for Southern Water

The previous section considered a number of the more generic challenges faced by all water companies in the development of WRMPs, although in many respects the magnitude of these challenges is greatest for companies in the South East. However, in addition to these, there are also a number of challenges that are specific to Southern Water, as it seeks to fulfil its commitment to provide excellent service to its customers. Following consultation with customers, stakeholders and regulators, the company has set itself a wide range of equally challenging targets to achieve this commitment in its Strategic Direction Statement, published in December 2007, which are discussed in following sections. This WRMP has also been subject to public consultation and has taken any comments into account, as detailed in its Statement of Response.

3.3.1 Target Levels of Service

Southern Water has stated targets for Levels of Service that set out the design standard to which it is planning in its WRMP and that are consistent with those in the Drought Plan. There are two Target Levels of Service directly related to the WRMP. The first, customer Target Levels of Service, relates to the frequency and nature of restrictions that customers may experience, in the form of sprinkler bans, hosepipe bans and bans on "non-essential uses" under drought conditions. The second relates to the environmental Target Levels of Service, which relates to the frequency of Drought Permits/Orders, that allow increased abstraction from some of its sources. Table 3.1 shows these Target Levels of Service.

Target Levels of Service (TLoS) **Type of restriction/ measure**	**Target Levels of Service Frequency** **(% of years)** **(taken as the no. of years, irrespective of duration during the year)**
Customer TLoS	
Sprinkler/ Unattended hosepipe ban	1 in 8 years (12.5%)
Full hosepipe ban	1 in 10 years (10%)
Drought Order for non-essential use	1 in 20 years (5%)
Environmental TLoS	
Source Drought Permit/Order	1 in 20 years (5%)

Table 3.1 Target Levels of Service

It is worth noting that in 2007 the Government undertook consultation as to whether the existing powers under the hosepipe ban, and the non-essential use bans under Drought Orders, needed to be rationalised. Changes in legislation have not yet been introduced but there are provisions included in the draft Floods and Water Bill (published in April 2009) that have the potential to change the risk of bans and/or other restrictions. If enacted, such provisions may lead in turn to a change in the Target Levels of Service.

The Regulations state that each company should publish the potential frequency with which it expects to impose restrictions under Emergency Drought Orders, that is, rota cuts and/or standpipes. The company considers that the design standards that it is trying to adopt would reduce the likelihood of recourse to such measures to an absolute minimum, and, to that end, has added an additional section in its Drought Plan to cover the management of severe droughts. The current design is based on drought events within the period of over 100 years of historic record, and as such the company considers that such measures would take place at a lesser frequency than this. It also considers that, before any consideration of such events, there would likely be prior government designation of some form of national or regional emergency.

3.3.2 Actual Levels of Service

The South East of England has experienced a number of droughts within recent years, notably 1989-1992, 1995 and more recently 2004-2006. These have placed great stress on the water resources in the area. During these periods, Southern Water undertook a number of initiatives, including accelerating investment in the re-introduction of some disused sources and carrying out improvements to a number of existing sources to alleviate the effects of the drought, and reducing leakage by nearly 10%, to well below the Ofwat target. However, the situation became sufficiently serious that the company considered it necessary to introduce restrictions on the use of water during these drought events, and to apply for Drought Permits/Orders to maintain supplies from sources. The need for such measures illustrates that the company has been unable to meet its Target Levels of Service.

3.3.2.1 Customer Level of Service

Two measures can be used to demonstrate that, despite its best endeavours to alleviate the effects of the droughts, Southern Water was unable to meet its customer Target Levels of Service:

- The number of years that restrictions have been in force, irrespective of the duration within the year (expressed as a percentage). Using this measure, the company has in some of its WRZs introduced sprinkler/full hosepipe bans in eight out of the last 20 years (40%), although this varied from no restrictions (i.e. 0%) in the Hampshire WRZs to eight years (40%) in some of the Sussex WRZs; and
- The amount of time on average that customers have been subject to restrictions, calculated as the percentage of the actual (population times weeks of restriction) compared to the total (population times weeks under review). This measure could be considered to be a more accurate reflection of actual Levels of Service, as it takes into account of both the population affected, and the total time for which it was affected. Again, it would be expected that, for Target Levels of Service to be met, this measure would be a maximum of 10%. However, the company average for this measure is 15% (varying from 1% in the Western Area to 23% in the Central Area).

The potential scale of restrictions in the 2004-06 drought went beyond hosepipe bans and, for the first time since 1992, the company applied for, and was granted, Drought Orders to enable it to limit or restrict so called “non-essential uses”. In the event, the powers under these Drought Orders were not implemented, but the impact of the applications for these Drought Orders and the possible effects had they been implemented were felt very keenly by many businesses, stakeholders and customers.

Area	Target Levels of Service		Actual Levels of Service	
	1 in x years	% years	Percentage of reporting years, for most frequently affected WRZ in Area	Time expressed as % of (population x weeks)
Hosepipe ban / Sprinkler/unattended hosepipe ban				
Western	1:10	10%	10%	1%
Central	1:10	10%	40%	23%
Eastern	1:10	10%	40%	22%
Company	**1:10**	**10%**	40%	15%
Drought Orders implemented "Non essential use" ban				
Western	1:20	5%	-	-
Central	1:20	5%	**-**	**-**
Eastern	1:20	5%	5**%**	9%
Company	**1:20**	5%	**5%**	**3%**

Table 3.2 Summary of Restrictions in the Areas since 1989

Table 3.3 shows that the frequency of restrictions and drought authorisations in the Central and Eastern Areas does not meet the Target Levels of Service and this is of considerable concern to the company. Southern Water considers that, with increased pressure on water resources in the future, and the potential effects of climate change on the frequency and variability of drought, this past performance must be corrected as a matter of urgency through the formulation of this WRMP.

3.3.2.2 Environmental Levels of Service

A number of Drought Permits and Drought Orders have also been granted throughout the company's area in order to change licence conditions to improve security of supplies (Table 3.3). A summary of the sources subject to, and the conditions attached to, these Drought Permits/Orders, will be described in more detail in the analysis of the individual Areas in section 10.

Area	Number of Source Drought Permits/Drought Orders
Western	1
Central	4
Eastern	37
Company	**42**

Table 3.3 Number of Source Drought Permits and Drought Orders since 1989

It should be noted, however, that whilst abstraction did not always take place under the terms of the Drought Permits/Orders, it was nonetheless necessary to apply to have the powers in place should they have been required to maintain supplies. This is an important point for design of the supply system for the future, when estimates of past system performance are

based in the full knowledge of the nature, severity and duration of the design event, and it is not possible to say whether applications for drought authorisations would have been made in these design events to cover the possibility that the situation deteriorated.

3.3.2.3 The impact of a Supply Demand Balance deficit

In the event that a WRZ, or Area, has a supply demand balance deficit, there is a theoretical risk that, in the event of drought conditions, the supplies will be put under more stress than would normally be the case, and it there is an increased risk that the activities associated with the Drought Plan may have to be introduced, which could involve any of the following:

- Demand side measures, such as appeals for restraint up to the introduction of restrictions;
- Supply side measures, if available, to create more deployable output; and
- Applications for Drought Permits/Orders to allow abstraction to continue beyond current licence constraints.

The likelihood of the need to resort to such measures depends on, amongst other things, the extent of the supply demand balance deficit.

At the start of, and during, AMP5, there are a number of WRZs that have supply demand balance deficits, even after taking into account the optimisation of inter-zonal transfers to reduce baseline supply demand balance deficits. The extent of AMP5 deficits in the various Areas can be summarised as follows:

- In the Western Area, there are no supply demand balance deficits in any of the WRZs, namely the Isle of Wight, Hampshire South, Hampshire Andover and Hampshire Kingsclere WRZs, in the AMP5 period;
- In the Central Area, the Sussex North WRZ has a supply demand balance deficit at the start of AMP5 of about 11 Ml/d reducing to about 6 Ml/d at the end of AMP5 for the MDO condition, and about 7 Ml/d reducing to about 3 Ml/d at the end of AMP5 for the PDO condition;
- The Sussex Worthing WRZ does not have a supply demand balance deficit during the AMP5 period;
- The Sussex Brighton WRZ has a supply demand balance deficit for the first two years of the planning period of roughly 1 and 2 Ml/d for the MDO and PDO condition respectively;
- In the Eastern Area, the Sussex Hastings WRZ does not have a supply demand balance deficit during the AMP5 period;
- The Kent Medway WRZ has a supply demand balance deficit for the first four years of the planning period for the ADO condition only, of about 7 Ml/d for the first two years, reducing to about 3 and then 0.5 Ml/d; and
- The Kent Thanet WRZ has a supply demand balance deficit for the first two years of AMP5 for the PDO condition only, of about 4 Ml/d reducing to 3 Ml/d by the end of AMP5.

3.3.2.4 Willingness to Pay

Whilst it is recognised that it would be uneconomic and environmentally unsatisfactory to plan for a supply system that has no restrictions/Drought Permits/Orders under any condition, it is nevertheless important to consider the balance between the cost to provide a resilient supply system against the potential requirement for restrictions on occasion. An indication of this balance can be made by considering the willingness to pay.

As part of the formulation of the Strategic Direction Statement, Southern Water commissioned a Willingness to Pay (WTP) survey. Further details are provided in Appendix K. The results

show that customers' Willingness to Pay for a system that would achieve Target Levels of Service amounted to a Net Present Value (NPV) over the 25-year planning period of £70.2 m. with a lower and upper bound at 95% confidence limit of £52.0 m. and £102.4 m.

3.3.3 The Need for Effective Demand Management

Southern Water and its customers have made significant progress in managing the demand for water. In line with the twin track approach described in section 2.6, a number of issues have faced the company in the preparation of this WRMP, as it seeks to meet the challenge of ensuring that effective measures are implemented to optimise the efficient use of water. These issues are discussed further in the sections below under the headings of: increased household metering; enhanced leakage reduction; and water efficiency initiatives.

Demand management measures were also assessed as part of the SEA, and were found in general to have a net positive effect, though leakage and metering programmes can have some short term negative impacts.

3.3.3.1 Increasing Household Metering

Southern Water stated in its Strategic Direction Statement, issued in December 2007, that it is committed to delivering high levels of meter installation as soon as possible. Southern Water believes that metering has a number of benefits to customers, the environment, the company and many other stakeholders, and is therefore committed to achieving high levels of meter installation as soon as possible. Metering is the fairest way to pay for water; it enables customers to influence their own bills; it is consistent with sending out economic signals which will assist in the development of competition, and will enable greater focus to be given to reducing customer side supply pipe leakage. The company believes that this will not only encourage immediate reductions in demand, which will have benefits for the environment and in energy reduction, but it will also enable further reductions to be realised through the introduction of tariff structures when appropriate. The company also believes that this commitment would be supported by its customers and stakeholders, and this was confirmed in the consultation responses.

It should be noted that, at present, it is only when there is a change of occupier in the Sussex WRZs, or where a customer specifically requests the installation of a meter, that the company can install a meter at a household. Over 80,000 meters have been requested by customers in the past five years and if this rate of installation were to continue throughout the planning period, then a further 330,000 properties would become metered by 2035. At that point, around 77% of domestic customers would be receiving a metered supply.

However, the company's supply area has now been designated as an "area of serious water stress" by the Environment Agency. This designation requires Southern Water to consider universal metering, within its WRMP and, if accepted, will mean that it can introduce this metering policy throughout its supply area.

It is currently the intention to achieve a level of 100% meter installation by 2015, and this level has been included in the Demand Forecast in section 6.

3.3.3.2 Reducing Leakage

Southern Water continues to maintain its position as the best performing company for leakage levels among the water and sewerage companies in the country. This has resulted from its commitment to, and investment in, leakage reduction which has yielded savings since 1989 of more than 157 million litres of water per day (equivalent to the consumption from more than 400,000 households).

The current internal company target and 2007-08 out-turn figure for leakage is 82 Ml/d, which is the lowest level per property of all the UK water and sewerage companies. It is already significantly below the company's short-term "Sustainable Economic Level of Leakage"

(SELL) target of about 117 Ml/d and the Ofwat target for the period 2004-05 to 2009-10 of 92 Ml/d, and, under the long term SELL, which was estimated as 89.5 Ml/d. The SELL is the level at which evidence suggests that further efforts to reduce leakage are likely to be uneconomic from a purely financial viewpoint, taking into account the "external" (i.e. the environmental and social impacts) costs of leakage control activities. This approach ensures that that leakage targets are set at a level that is optimal for customers and society as a whole.

A range of surveys suggests that customers are willing to play their part in conserving water if they believe that the water company is also playing its part. It is in this context that Southern Water has determined that it will continue its extensive efforts to reduce leakage to the optimum of 60 Ml/d, which is in line with the aspirations set out in the Strategic Direction Statement.

Southern Water recognises the magnitude of the task it is setting itself, and the number of other enabling factors that will need to be in place to support this initiative, such as: mains replacement; a high level of metering; advances in meter reading technology; but believes that effective leakage control will be vital as it faces the many other challenges described in this section. The consideration of the potential ultimate level of leakage reduction is considered outside the scope of the timescale addressed in this WRMP, but will continue to be investigated.

3.3.3.3 Water Efficiency

Southern Water recognises the importance of water efficiency and will continue to encourage its customers, through a variety of initiatives, to reduce their demand for water, to both help reduce bills and to protect the environment.

The promotion and sponsorship of community events; water audits in domestic and commercial premises; publicity campaigns; provision of horticultural advice; a schools education programme; the provision of water efficient products for the home and garden are all examples of the initiatives that the company has used to promote water efficiency in the home and in the workplace.

The company is also required to meet the new Ofwat target for water efficiency, known as the Base Service Water Efficiency (BSWE) target. This is a minimum target for water saved in relation to the number of properties served. For the company to successfully meet its water efficiency target, it must ensure that 1.01 Ml/d is saved through water efficiency activity each year in AMP5 (from 2010-11 to 2014-15).

Companies are also expected to achieve a Sustainable Economic Level of Water Efficiency (SELWE) as part of their economic, sustainable approach to balancing supply and demand over the planning period. This is in addition to measures introduced to achieve the baseline Ofwat targets.

3.3.4 Planning in a Regional Context

3.3.4.1 The Nature of the Supply System

Southern Water's current water supply system is the result of the historic development and integration of a number of local systems over more than a century. Thus, the structure of the supply system and WRZs is complex, due to the fragmented geographical areas of its own supply system, and also due to the inter-connections with a number of other water companies.

3.3.4.2 Bulk Transfer Agreements

Over the years, the company has introduced a number of schemes to increase the security of supplies by increasing the connectivity between different WRZs in order to enhance its

capacity to transfer water from areas of surplus to areas of deficit, and further options in this regard have been assessed in developing this WRMP.

There are also a number of inter-company transfers of water, which take place under conditions stated in the relevant bulk supply agreements between the companies, which have been developed over the last 50 years.

One issue of inter-company importance for strategic planning is the consideration of these various bulk supply agreements to other companies in this WRMP. Nearly all inter-company agreements specify, as a minimum, such factors as quantities available, charges and duration of contract. With regard to the latter, a number of the agreements to provide exports of water from Southern Water to other companies will terminate during the planning period. Over that same period, several of the WRZs that provide these bulk supplies are forecast to develop a supply demand balance deficit. This means that, in order to maintain supplies to other companies, Southern Water will have to develop new resources, or introduce further demand management measures. The company has taken the view that it will continue to renew all existing bulk supply agreements to other companies throughout the planning period, subject to the volumes that are applicable at the time of contract renewal. This could result in Southern Water having to develop additional resources, and adopt further demand management measures, in order to maintain these inter-company bulk supplies.

The influence of these bulk supplies on the formulation of the strategy is discussed further in section 5.

The possibility of further bulk transfers is discussed in general terms in section 3.3.4.4 and section 9.5, with discussion of the individual Area strategies section 10.

3.3.4.3 Water Resources Development Constraints in South East England

A major challenge facing future planning of water resources is the range of potential constraints in the South East of England on the development of new sources. The entire region has been designated as being in an “area of serious water stress” by the Environment Agency. There has for many years been an Environment Agency policy of no increase in abstraction from groundwater for consumptive purposes. In addition, the high population density gives rise to a very high premium on space and this, combined with large areas of outstanding natural beauty that are rightly afforded a high degree of environmental protection, significantly reduces the options available for new abstraction, storage, treatment and supply infrastructure. For example, there are very few remaining sites in the South East that might be suitable for a new reservoir. Southern Water believes that, given such constraints, all the potential sites for development of new resources during the planning period, provided they are socially, economically and politically acceptable and environmental sustainable, should be identified and reserved for future development.

3.3.4.4 The Water Resources in the South East Group

Southern Water has boundaries with a number of other companies. This emphasises the importance of inter-company co-operation in strategic planning, as well as the need for consistency in the interface between companies and regulators. Southern Water, together with all of the other companies, has therefore played an active role in the Water Resources in the South East Group (WRSE). This group is chaired jointly by the Environment Agency and a company representative, and comprises members from water companies, Ofwat, SEERA and Natural England. It meets at managing director, technical and specialist sub-group levels.

The WRSE considers the shared strategic development of water resources in South East England, which has led to the development of some further bulk supplies between water companies during recent years, the majority of which have involved Southern Water. Southern Water also continues to be actively involved in the WRSE modelling work which is being undertaken by the Group to inform possible future regional solutions for optimising the use of resources.

However, whilst the work of the WRSE Group helps to facilitate appropriately integrated solutions across the region, each company remains responsible for developing its own strategy in line with the requirements of its own Board. Thus, whilst it may be quite reasonable for Southern Water's company preferred strategy to differ from that which might have arisen from work undertaken by the WRSE Group, some justification may be required if regulatory approval for the individual company preferred strategy is to be forthcoming. The water resources strategy in the WRMP presents the "company preferred regional strategy" which is consistent with the latest available results from the WRSE modelling work. This aspect is further discussed in general terms in section 9.5 with discussion of the individual Area strategies in section 10.

3.3.5 The Need for System Resilience

It is important to note that groundwater and the different types of surface water sources will react differently to differing hydrological conditions. Similarly, WRZs may incur differing degrees of stress under the same hydrological conditions due to their different mix of types of source. This has been well illustrated during recent droughts, with different, often adjacent, WRZs and companies experiencing markedly different levels of stress in the supply system.

The implications of this for Southern Water are that, in order to develop a system that is as resilient as possible to different design droughts, due consideration must be given to the optimum balance of the type of sources that it has in any given WRZ and how they will respond under a variety of design scenarios. This should be an important factor in the choice of new resources. For instance supply a forecast deficit at times of peak demand might be met through increased treatment capacity, whereas average or minimum resource period deficits may require the development of more storage or the provision of a drought resilient solution such as transfers, wastewater recycling or desalination.

4 Principles of Water Resources Planning

4.1 Introduction

This section gives a brief introduction to the water resources planning process, and introduces some of the key concepts, including the supply demand balance, which is the difference between the supplies available and the anticipated demand, the planning period and critical planning periods. These concepts will be described, and addressed, in further detail in sections 5 to 10.

4.2 Objective of Water Resources Planning

The building block for water resource planning is the Water Resource Zone (WRZ), which is defined as the largest area in which all customers bear the risk of restrictions during drought. There are ten WRZs in the Southern Water area. The over-riding objective of a water resources plan is to ensure that there are always enough supplies available to meet anticipated demands in all WRZs and for every design critical period, even under the conditions of greatest water supply stress. This is known as meeting the supply demand balance.

Such design conditions normally occur when there has been a lack of rainfall during the previous autumn and winter recharge period, coupled with high demands as a result of hot and dry summer conditions. As such, these conditions do not often occur, and therefore water resources planning normally has to consider simulating how the water supply system would have reacted during previous drought events that have been identified in the historic record. There are a number of historic droughts which are normally used to represent design events, such as 1900-03, 1920-22, 1930-33 and sometimes 1976. It is worth noting that the recent drought of 2004-06 is not included in this list, but if the lack of rainfall had continued for only a relatively short period of time then it would have moved into the design event category.

Therefore, in the water resources planning process, the aim is to ensure that there are sufficient supplies available to meet anticipated demands over the long term planning horizon for every year of the planning period under the various critical design events.

4.3 The Supply Demand Balance

The supply demand balance is, quite simply, the difference between supplies available and anticipated demands. It is determined from the Supply Forecast, which is the forecast of the supplies available, and the Demand Forecast, which is the forecast of anticipated demands. The difference between the Supply Forecast and the Demand Forecast is known as available headroom. However, as will be seen later, estimates of both supplies available and demands are subject to sources of uncertainty, which is known as headroom uncertainty. Therefore, a buffer between the Supply Forecast and the Demand Forecast is included in the supply demand balance. This buffer is known as the Target Headroom and is the amount of available headroom that is considered to be an acceptable planning allowance in the supply demand balance.

If available headroom becomes less than Target Headroom at any time, or for any critical period, during the planning period in the "baseline" supply demand balance, some form of intervention option is needed to redress the balance. A number of options may be available to meet any supply demand balance deficit. These options can be on the supply side, to

increase supplies available to meet demands, or on the demand side, to reduce the supplies that are needed.

4.4 Planning Period and Critical Planning Periods

There are two conditions for which the supply demand balance has to be satisfied:

- For each year of the 25-year planning period from 2010 to 2035; and
- For each critical period during each year of the planning period.

4.4.1 Planning During the Planning Period

Figure 4.1 shows how the baseline supply demand balance over the planning period can be used to determine whether the supply demand balance is in surplus or deficit, and when this change from surplus to deficit occurs and thus when some form of supply or demand intervention is required to maintain security of supplies.

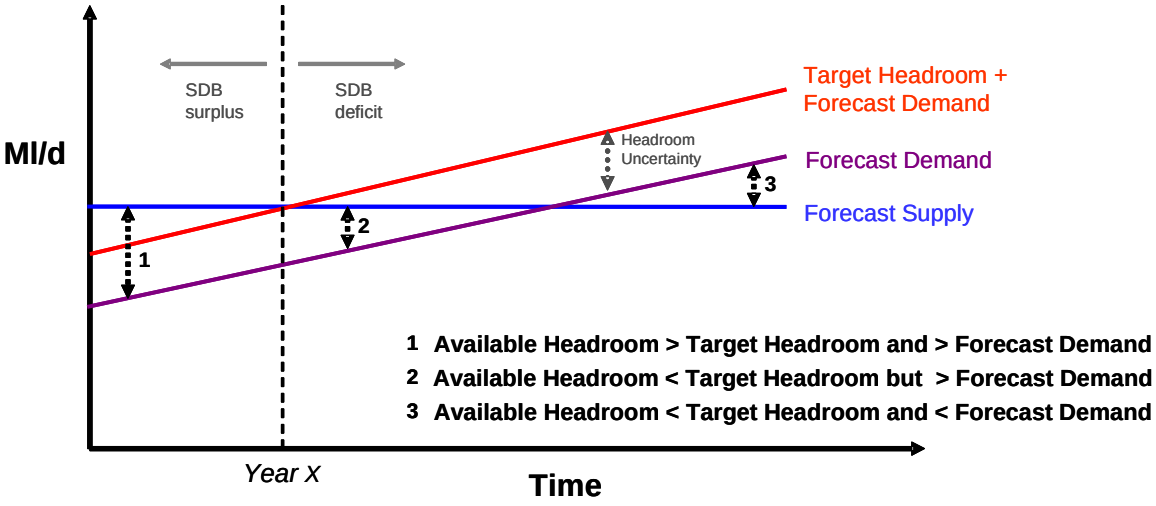


Figure 4.1 Schematic of Supply Demand Balance

4.4.2 Critical Period Planning Scenarios

The status of the supply demand balance will vary throughout the year, as both supplies available and demands vary within the year. This "within year" variability is described in detail in section 6.2, but can be summarised as leading to the definition of three "critical periods" that must be considered for each year of the planning period. These critical periods are all based on a design "Dry Year" condition, since it is in such years that the supply demand balance will be under most stress.

The three critical periods are as follows:

- The "average annual period", whereby average demand over the year is compared against the average annual supplies that are available. This is known as the average deployable output (ADO) scenario;
- The "peak demand period", whereby the demands over the period of peak demand during the year, normally defined as a week, are compared against the supplies available during that period. This is known as the peak period deployable output (PDO) scenario; and

- The "minimum resource period", whereby demands over the period are compared with supplies when supplies available are expected to be at their minimum. This minimum resource period normally occurs during late summer/early autumn when river flows are at their minimum and groundwater levels are at their lowest prior to the onset of the winter recharge period. This is known as the minimum deployable output (MDO) scenario.

It should be noted that, for Southern Water, and this WRMP, the average annual period is not normally the most relevant in terms of the supply demand balance, and is only the driver for investment in the Eastern Area. This is due to the nature of the sources within the Southern Water supply area.

Surface water storage reservoirs, which can be most easily seasonally managed to cope with the average annual condition, only account for 4% of the supplies available to Southern Water. Groundwater sources, which can also, but to a more limited extent, be used to seasonably manage supplies over the year, account for 68% of supplies. However, they are still prone to depletion of available output at times of peak demand and at times of minimum groundwater levels late in the year. Run-of-river abstractions, with no associated storage facility, account for 28% of supplies, and are least able to be managed for the average annual condition. This is because they can only abstract from the flows available at the time of the peak demand period and the minimum flow condition. If flows are not sufficient, then abstraction cannot take place, or could be severely curtailed. Thus, the average amount of abstraction available throughout the year, defined as total annual abstraction divided by 365 days, is meaningless when designing for the annual average condition in such cases.

Therefore, the discussion and design of the supply demand balance for Southern Water throughout this WRMP, will only address the peak period (PDO) and minimum resource period (MDO) conditions for the Western and Central Areas, and the Annual Average (ADO) and PDO conditions for the Eastern Area.

4.5 The Water Resources Planning Process

The water resources planning process, to ensure the supply demand balance is maintained for each year, and for each critical period, during the planning period, is undertaken according to the following steps, for each WRZ and sub-regional area:

- Estimation of the baseline Supply Forecast (See section 5);
- Estimation of the baseline Demand Forecast (See section 6);
- Estimation of the uncertainties and Target Headroom required (See section 7);
- Calculation of the baseline supply demand balance for each year and critical period of the planning period, to determine if there are any years or critical periods where there is a supply demand balance deficit. (See section 10);
- Identification of all feasible supply and demand options which could be used to reduce or close the supply demand balance deficit (See section 8 for general discussion, and section 10 for WRZ and Area specific details);
- Undertaking investment modelling to determine the water resources strategy and further undertake scenario modelling and sensitivity testing to determine the robustness of the solution (See section 9); and
- Formulation of the final planning solution for the company-preferred regional strategy, which will specify the chosen supply and demand side options selected, their timing for implementation and the justification for their selection. (See section 10 for WRZ, and Area details and section 11 for the company preferred strategy).

5 The Supply Forecast

In order to plan effectively to ensure security of supplies, it is important to know what supplies will be available in the design event. Southern Water has developed and refined its understanding of what supplies would be available in a variety of design events through the development of a number of advanced mathematical models. Southern Water believes that, in order to provide the desired level of security of supplies in the future, it should plan for the worst historic event, including the possibility of a "third dry winter" design scenario. This scenario was close to being realised, had the drought of 2004-06 extended into the third winter. In the event, it did not extend, but the Government had asked that all companies in the South East region prepared plans for such an eventuality.

Since publication of the DWRMP, a summary report on the approach to the calculation of surface water deployable output has been prepared[1]; the report has been audited[2]. A complementary report on severe droughts and climate change impacts on groundwater deployable output has also been prepared since the DWRMP[3]. The groundwater report brings together the various elements of work undertaken for the AMP4 Water Resources Investigations and this WRMP.

The Halcrow audit report states:

> "We strongly support the overall approach of using conjunctive use DOs in an extended period simulation with the objective of enabling Southern Water to meet its stated levels of service with the defined frequencies over the long term. The company, probably in common with many others, has clearly not met its water availability LoS objective with the required frequency. The company is, therefore, to be commended on the work it is doing to address this issue."

5.1 Elements of the Supply Forecast

It has been mentioned previously that the Supply Forecast refers to the estimation of the total supplies available to meet demands in the WRZ, for each year, and for each critical period, throughout the planning period.

The value of the total supplies available is made up from a number of elements, as follows:

- Water Available for Use (WAFU), where WAFU is calculated as deployable output less outage:
  - Where, deployable output is the volume of water that can be pumped into supply from a given source (borehole, river intake, or reservoir) on a daily basis under the three *dry year* planning scenarios described in the section 4.4.2. Thus, the following different values of *deployable output* can be defined:
    - *Average deployable output (ADO)* – this is the deployable output of a source for the "average annual period";
    - *Peak deployable output (PDO)* – this is the deployable output of a source during the "peak demand period"; and
    - *Minimum deployable output (MDO)* – this is the deployable output of a source during the "minimum resource period";

[1] Southern Water WRMP Support, Technical note: Surface water Deployable Output, Atkins July 2008, (Ref: 5050675/70/DG/036)
[2] Southern Water, Deployable Output Assessment Audit, Halcrow, September 2008
[3] Assessment of impact of severe drought and climate change on groundwater DO, Atkins, March 2009 (Ref: 5050675/70/DG/092)

- Outage, which is the deployable output that may be unavailable for supply at any given time due to unplanned events such as mechanical, electrical or treatment failures, or pollution incidents upstream of a river abstraction.

Once WAFU, which is `the water available for use from sources indigenous to the WRZ, has been calculated, there are a number of other elements which need to be taken into account in the calculation of total supplies available, as follows:

- Total supplies available equals:
  - WAFU, from above;
  - Less treatment works losses and operational use, which accounts for potential reductions in WAFU due to losses arising from the water treatment process or losses in the local raw water distribution system before the treated water is pumped into the supply network;
  - Less inter-zonal or inter-company bulk exports from the WRZ;
  - Plus inter-zonal or inter-company bulk imports to the WRZ;
  - Less Sustainability Reductions. These are reductions in the deployable output of a source arising from the implementation of environmental legislation to protect the water environment; and
  - Plus/less climate change effects. The scenarios for future climate change will all have varying degrees of impact on the deployable output of water supply sources. In the vast majority of cases deployable output will be reduced, but in a few cases a small increase in deployable output is possible. The calculation by water companies of the potential impacts of climate change on the deployable output of sources is based on protocols agreed the Environment Agency.

The methodologies used to describe the estimation of the above elements of the Supply Forecast are presented in sections 5.2 to 5.7.

5.2 Deployable Output

This section sets out the methods the company has used to assess the deployable output of its sources for both groundwater and surface water, together with the results of these assessments. The company has carried out a significant re-assessment of the deployable output of its sources since the last Water Resources Plan, in 2004, due to: improved collection of data; work undertaken as a result of the observed effects of the recent severe drought; and the modelling of sources that has been undertaken during the AMP4 Water Resources Investigations.

It should be noted that the following sections detail the investigations, analysis and results that will be used for the planning period, from 2010-11 to 2034-35. They will not be introduced into the baseline Supply Forecast until the start of the planning period in 2010-11. This is to ensure that there are no inconsistencies or discontinuities in the reported supply demand balance during the rest of the current AMP4 period. A full presentation of the sequencing of the introduction of various design assumptions in the build-up of the Supply Forecast over the entire planning period is given in section 5.2.3.

A prerequisite for the calculation of deployable output is the definition of the design event that is used for planning purposes. During recent droughts water use restrictions were introduced and Drought Permits/Orders were granted that modified the conditions of some abstraction licences. This experience highlighted the difference between actual and target Levels of Service. The company therefore considered it appropriate to review the design principles for the estimation of deployable output for both its surface water and groundwater sources. This resulted in a complete re-assessment of deployable output in all Areas based on detailed modelling of individual sources, drought back-casting, technical re-evaluation of source capabilities during droughts and conjunctive use modelling. Two key improvements were

carried out as part of AMP4 Water Resources Investigations to enable a much better understanding of the drought capability and drought supply risk associated with Southern Water's sources:

- All surface and groundwater sources have now been assessed on a consistent basis, which allows the output of surface and groundwater sources to be assessed as a combined total during historic drought events. This is known as the 'Unified Methodology' [4]of deployable output assessment and represents a significant improvement in gaining an understanding of Southern Water's overall source capability during drought conditions. For previous deployable output assessments, outputs for surface and groundwater sources were derived from different droughts, of different severity; and
- Detailed water resource models were produced for the Western, Central and Eastern Areas using the MISER water resource modelling application. These models allow the distribution of sources, demand and strategic transfers to be spatially and temporally modelled.

These improvements in turn enabled the achievement of the following two key objectives:

- It allowed the 'conjunctive use' of sources to be modelled. For example, in the Central Area, the S466 groundwater source and Weir Wood reservoir can be used to supplement abstraction from the S648 river source during dry periods in the summer, but they can be rested following rainfall 'spate' events where river flows are temporarily higher. The MISER model allowed the significant deployable output benefit of this combined operation to be evaluated and quoted for the MDO period; and
- It provided a better understanding of the impact and significance of key strategic infrastructure constraints. This allowed additional resource development options to be identified, and meant that constraints could also be reflected in the cost and deployable output of new resource development schemes where appropriate.

In order to apply the Unified Methodology referred to above, it was first necessary to model the outputs that could have been obtained during a long record of historical droughts. Historic surface water flows were therefore reviewed and modelled as far back as the 1890s[5]. This allowed the worst historic drought for each sub-regional area to be calculated, based on the make up of its sources, the nature of demand and available storage. Realistic, pragmatic assessments of groundwater capability under the identified key surface water droughts were evaluated, and compared with the severity of the more recent drought events that formed the 'baseline' groundwater deployable output assessments. As it allowed combined deployable output under more severe, historic droughts to be evaluated, application of the Unified Methodology inevitably resulted in a reduction in the total deployable output available in a WRZ, taking into account the simultaneous impact on both surface and groundwater sources. However, Southern Water believes that the adoption of the Unified Methodology provides a much more realistic and prudent approach to developing a robust supply system that can actually provide the required levels of supplies during future drought events. Further details of the analysis of surface and groundwater deployable output are given in sections 5.2.1 and 5.2.2 respectively.

The conjunctive use modelling approach using the MISER models has reduced the deployable output impact of historic drought events by presenting a realistic assessment of the operational capability of sources. This would not have been possible if simple, separate analyses of minimum drought outputs for the different types of sources had been used for individual sources, and, thus results in an improved representation of the supply system.

[4] Halcrow Group Ltd. / Imperial College London, 2000. A Unified Methodology for the Determination of Deployable Output from Water Sources Volumes 1 & 2. UKWIR Ref 00/WR/18/1, EA Ref W258. (UK Water Industry Research / The Environment Agency.)

[5] The impact of climate change on severe droughts, Major droughts in England and Wales from 1800 and evidence of impact, Environment Agency

It should be noted that previously only historic droughts for which operational records exist were used to calculate the deployable output of a source. Should droughts occur with a greater severity than has previously been observed, then the supplies available to the company might be less than current deployable output estimates. It is also important to recognise that in making assessments with behavioural modelling, there is perfect knowledge of the start, duration and end of droughts included in the simulation. The company does not have this prior knowledge to inform operational practice during extreme droughts. In order to maintain security of supplies it may decide on actions to conserve its resources should the duration of the drought continue beyond the length assumed for planning and until it is certain that the drought is over. During such very extreme events, the company would also be working to its Drought Plan, to ensure continued supplies of water would be available to its customers during the drought.

5.2.1 Surface Water

Since the DWRMP, a summary report that describes the approach to the assessment of surface water deployable output undertaken for the AMP4 Water Resources Investigations and then the WRMP processes has been written. As noted previously, the approach taken has been audited and endorsed[2].

Surface water sources include direct 'run-of-river' abstractions and surface water impounding reservoirs, which can be supported by pumped inflow. The potential impact of drought events on these sources will differ depending on the conditions of the abstraction licence and the nature of the source. In order to review the widest range of droughts possible, analyses were carried out to develop a flow series back to the 1890s using a rainfall-runoff model. This flow series was then used to assess the critical drought period for each surface water source.

The general approach to calculating the surface water source deployable output was as follows:

- Analysis of the available flow records within each catchment, at relevant gauging stations to assess the availability of long-term flow data, and an assessment of the catchment and factors affecting runoff;
- Derivation of the naturalised flow series at each of the assessment points, using the finalised data series for observed flow and all artificial influences (i.e. discharges and abstractions);
- Development and calibration of rainfall-runoff models;
- Derivation of a long term flow series using long term rainfall and potential evapo-transpiration (PET) records for South East England;
- De-naturalisation of the long term flow series to include all artificial influences apart from Southern Water abstractions; and
- Use of the long term flow series to calculate the deployable output of each surface water source using MISER.

Much of this work was carried out as part of the AMP4 Water Resources Investigations and additional detail about the modelling work carried out is included in Appendix D.

Following this analysis, the critical droughts within each sub-regional area as a whole were identified and used for water resource planning purposes. The worst surface water historic droughts for each Area were identified as follows:

- Western Area: 1920-1922;
- Central Area: 1920-1922; and
- Eastern Area: 1900-1903.

The range of design events result from the different responses in each Area due to the mixture of sources in the individual Areas. The critical event for the Western and Central Areas is 1920-1922, as the sources are prone to the effects of relatively short, two year, very

severe droughts. Conversely, the sources in the Eastern Area are most sensitive to the effects of conditions during 1900-1903, when there was an extended three year drought which progressively eroded reservoir and groundwater storage.

5.2.2 Groundwater

Since the DWRMP, the company has undertaken more work on the assessment of groundwater deployable output. Work focussed on the impacts of severe drought conditions that occurred before the period for which operational data are available and on the impacts of climate change.

The assessment of groundwater deployable output used for the planning period follows the Unified Methodology[4]. The deployable outputs estimated for the last Water Resources Plan, in 2004, were based on the 2003 re-assessment of deployable outputs. These estimates have subsequently been updated by re-assessments of groundwater deployable outputs in both 2005 and 2006. These groundwater deployable output assessments are all based on historically observed values of water levels and outputs. Often, the drought event used to define the deployable output is from 1990-1992, 1996-1998 or the recent 2004-2006 drought, as these are the only ones for which actual observed data is generally available. However, these estimates are not consistent with the drought periods used to define the deployable output of surface water sources, which are based on either the 1900-1903 or the 1920-1922 droughts. Thus, in order to apply the Unified Methodology, it is necessary to estimate the value of groundwater deployable output which would have been available at the same time, during these earlier, more severe, drought events.

Assessment of the potential impact of historic droughts on groundwater deployable outputs is complicated when there is little or no data available from such historic events on which to base estimates of groundwater levels. In order to make an assessment of the potential reduction in deployable output during the critical 'surface water' drought, the following general approach was taken for all WRZs (but with variations to take account of the different availability of historic data and robust recharge and/or groundwater models in each WRZ), following a peer review:

- Conceptualisation of all groundwater sources to identify those at risk from extreme drought (e.g. in particular sources where adits or other hydrogeological constraints such as fissures define the deployable output);
- Groundwater recharge modelling over the long term record using either existing models or lumped recharge calculation, depending on what techniques are available for the WRZ;
- Estimation of regional groundwater levels during the critical drought, based on the extended recharge series using either the existing groundwater models or a regression analysis using observation boreholes with sufficiently long records;
- Estimation of source rest water levels at boreholes which are considered to be vulnerable; and
- Assessment of the potential impact of this change in water level on the source deployable output by downshifting the assessment diagrams.

The approach is described in more detail in the summary groundwater report[3].

This process enabled a consistent estimate of deployable output for each WRZ and Area to be made between the surface and groundwater assessments for the design event.

5.2.3 Summary of Deployable Outputs

This section sets out the values of deployable output that have been used in this WRMP for the different time periods in which the differing design standards have been applied.

For surface water deployable outputs, the following values have been used, for different time periods, as follows:

- From the baseline year 2007-08 to the end of AMP4 (2009-10), the values used will be the original PR04 values, in line with the PR04 baseline condition, together with any AMP4 improvements; and
- From the start to the end of the planning period (2010-11) to 2034-35, the values used will be as calculated from the methodology described in the section 5.2.1 above.

For groundwater, the situation is more complex, as there will be a progressive series of values used, to reflect the changing assumptions, as follows:

- The baseline year 2007-08, will use the original PR04 values, in line with the PR04 baseline condition, or 2006 re-assessments (where available);
- For 2007-08 these values will also include any AMP4 improvements in deployable output to date and will remain constant until the start of the planning period (2010-11);
- For the start of the planning period (2010-11), the values used will take into account the 2006 re-assessments, together with the results from application of the Unified Methodology;
- During the AMP5 period, up to 2014-15, these values will be modified to take into account any AMP5 planned source improvements; and
- Up to the end of the planning period in 2034-35, the values used will be those used at the end of AMP5.

The deployable output values used in the baseline supply demand balance have therefore changed from those presented in the last WRP in 2004. These changes are presented graphically in Appendix I for each Area at both MDO and PDO, showing the value of deployable output both increasing and decreasing as a result of the work carried out to re-assess the deployable output of both ground and surface water sources. Table 5.1 summarises the PR09 baseline (2010-11) deployable output for the company by WRZ and source type.

Enhancements to groundwater deployable output are planned during AMP5 and these will be included in the baseline Supply Forecast during AMP5, but these are not shown in Table 5.1 which is the PR09 baseline at 2010-11. A review of the methodologies used, and results of all surface and groundwater deployable output assessments is included in Appendix D.

Area	WRZ	Groundwater (Ml/d)		Surface Water (Ml/d)		Total (Ml/d)	
		MDO	PDO	MDO	PDO	MDO	PDO
Western	HS	96.33	114.77	149.46	149.46	245.79	264.23
	HA	22.47	28.20	0.00	0.00	22.47	28.20
	HK	8.68	9.48	0.00	0.00	8.68	9.48
	IoW	20.72	25.49	10.00	12.00	30.72	37.49
	Total	**148.20**	**177.94**	**159.46**	**161.46**	**307.66**	**339.40**
Central	SN	23.85	39.29	16.20	24.50	40.05	63.79
	SB	89.30	108.52	0.00	0.00	89.30	108.52
	SW	57.85	68.98	0.00	0.00	57.85	68.98
	Total	**171.00**	**216.79**	**16.20**	**24.50**	**187.20**	**241.29**
Eastern	SH	1.82	3.50	38.66	42.85	40.48	46.35
	KM	109.98	135.67	34.60	46.90	144.58	182.57
	KT	50.97	57.29	3.50	3.50	54.47	60.79
	Total	**162.77**	**196.46**	**76.76**	**93.25**	**239.53**	**289.71**
Company	**Total**	**481.97**	**591.19**	**252.42**	**279.21**	**734.39**	**870.40**

Table 5.1 PR09 Baseline (2010-11) Deployable Output by Source Type and WRZ

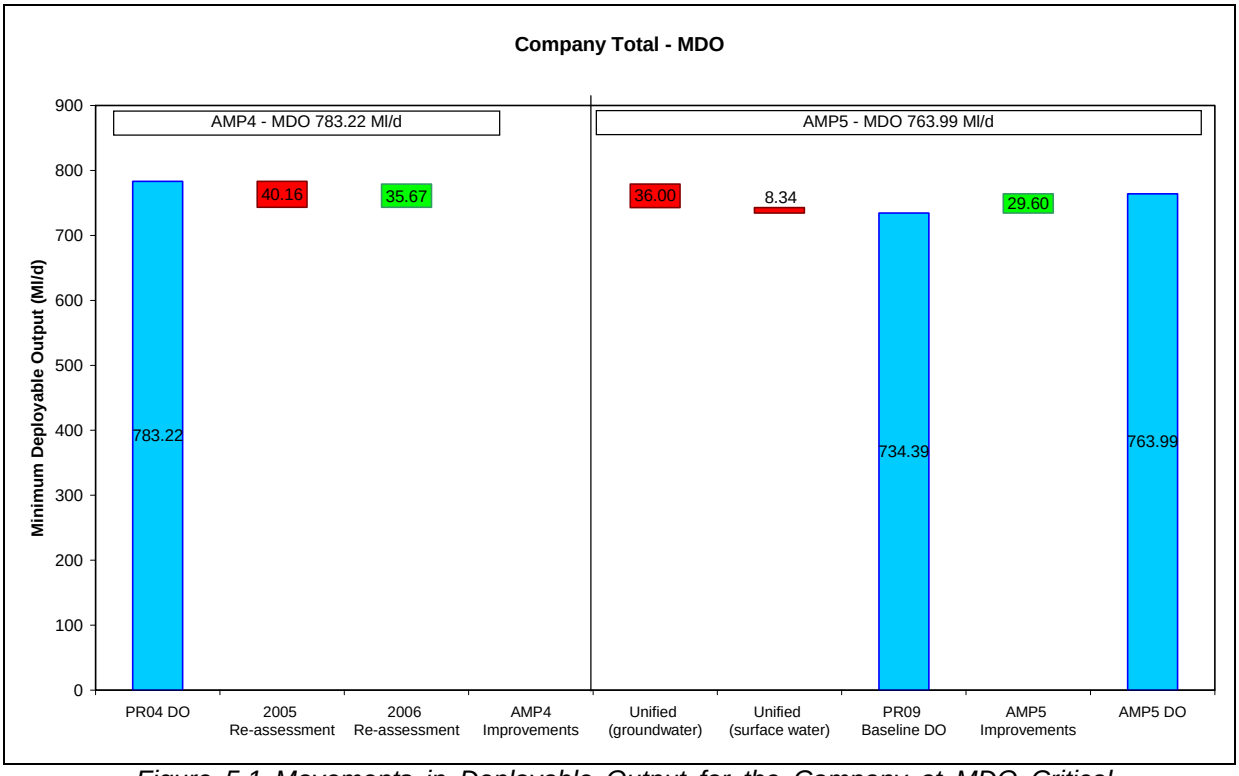


Figure 5.1 Movements in Deployable Output for the Company at MDO Critical Period (Ml/d)

For the MDO critical period condition Figure 5.1 shows the following,:

- There is a net reduction in MDO from the PR04 baseline to the start of the planning period for PR09 of 4.49 Ml/d due to;
  - a reduction of 40.16 Ml/d as a result of the 2005 reassessments; and
  - an increase of 35.67 Ml/d as a result of the 2006 reassessments.
- A decrease of 36.00 Ml/d from the 2006 reassessment due to the adoption of the Unified Methodology for groundwater sources;
- A decrease of 8.34 Ml/d due to the adoption of the Unified Methodology for surface water sources; however
- There will be an increase in MDO of 29.60 Ml/d during AMP5 due to assumed groundwater source improvements.

Therefore, overall in the baseline Supply Forecast there will be a net reduction in MDO from AMP4 baseline to AMP6 baseline of 19.23 Ml/d (from 783.22 Ml/d to 763.99 Ml/d) equivalent to 2.5%.

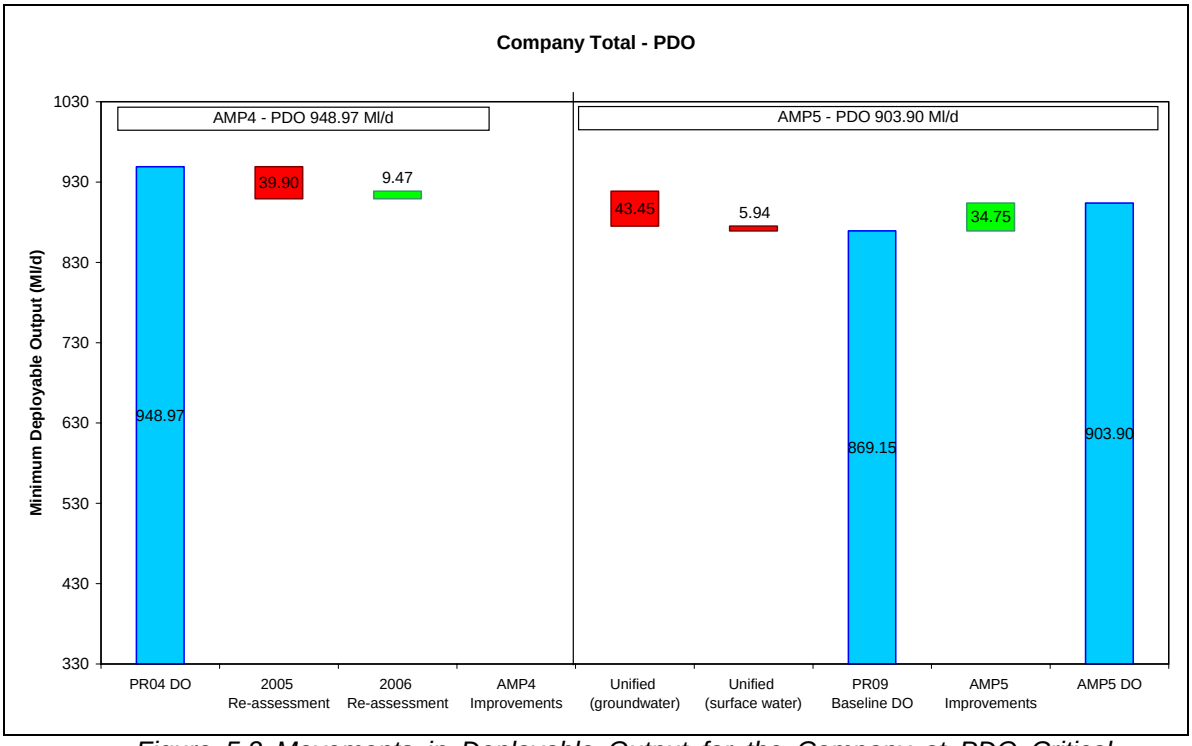


Figure 5.2 Movements in Deployable Output for the Company at PDO Critical Period (Ml/d)

Figure 5.2 for the PDO critical period condition shows the following:

- There is a net reduction in PDO from the PR04 baseline to the start of the planning period for PR09 of 30.43 Ml/d due to;
  - a reduction of 39.90 Ml/d as a result of the 2005 reassessments; and
  - an increase of 9.47 Ml/d as a result of the 2006 reassessments;
- A decrease of 43.45 Ml/d from the 2006 reassessments due to the adoption of the Unified Methodology for groundwater sources;
- A decrease of 5.94 Ml/d due to the adoption of the Unified Methodology for surface water sources; however

- There will be an increase in MDO of 34.75 Ml/d during AMP5 due to assumed groundwater source improvements.

Therefore, overall in the baseline supply forecast there will be a net reduction in PDO from AMP4 baseline to AMP6 baseline of 45.07 Ml/d (from 948.77 Ml/d to 903.90 Ml/d) equivalent to 4.7%.

5.3 Treatment Works Losses and Operational Use

The treatment of water from most sources will result in process and operational losses, except when treatment is in the form of simple chlorination. The following data therefore relates to the treatment process water, i.e. the net loss of water, excluding water returned to the source.

A review of the estimation of such losses has been made for all Southern Water's Water Supply Works (WSW). This shows that there are 106 sources at which there will be some form of process loss, nine are surface water sources, and 97 are groundwater sources. Estimates of the revised process losses are summarised by WRZ, sub-regional area and company level for both the MDO and PDO condition in Table 5.2.

Area	WRZ	Estimated Treatment Works Losses and Operational Use (Ml/d)	
		MDO	PDO
Western	IoW	0.49	0.50
	HS	1.18	1.18
	HK	0.04	0.04
	HA	0.13	0.13
	Total	**1.84**	**1.85**
Central	SN	0.44	0.39
	SW	0.60	0.60
	SB	0.50	0.50
	Total	**1.54**	**1.49**
Eastern	SH	0.34	0.38
	KM	1.20	1.20
	KT	0.61	0.61
	Total	**2.15**	**2.19**
Company total		**5.53**	**5.53**

Table 5.2 Summary of Treatment Works Losses and Operational Use by WRZ

Although the volume of process losses will be kept under review, it is not considered that there are any opportunities for further reductions in process losses through investment with the exception of B513 which is the location of an AMP5 asset maintenance scheme. The potential scale of the reduction in process losses has been estimated and is included in Table 5.2.

5.4 Outage

Outage refers to the planning allowance made for the temporary unplanned loss of deployable output from a source. This can result from such factors as mechanical, electrical or treatment failure or any form of unplanned event which leads to the temporary loss. An allowance for outage is made in the supply demand balance, calculated at the level of the WRZ.

Estimates of outage have previously been made on the pragmatic basis of taking either the value of the average deployable output of independent groundwater sources in a WRZ, or 5 Ml/d, whichever is the smaller. However, this had the potential to give unrepresentative values, particularly in small WRZs with relatively few sources. Therefore, a risk based approach was derived to give what were considered to be more representative values.

A revised assessment of the outage allowance has been carried out for this WRMP using a risk-based approach, based on actual recorded data, which is described in more detail in Appendix D. The results of this analysis are summarised at the level of WRZ, area and company in Table 5.3.

Area	WRZ	Outage allowance (Ml/d)	
		MDO	PDO
Western	IoW	1.93	2.34
	HS	4.59	6.54
	HK	0.77	1.49
	HA	1.52	2.44
	Total	**8.81**	**12.80**
Central	SN	2.34	2.30
	SW	3.07	4.39
	SB	3.63	5.18
	Total	**9.04**	**11.87**
Eastern	SH	1.62	3.94
	KM	4.06	5.90
	KT	3.62	4.64
	Total	**9.29**	**14.48**
Company total		**27.15**	**39.16**

Table 5.3 Summary of Outage Allowances by WRZ (Ml/d)

The outage allowances presented in Table 5.3 are based solely on outage at groundwater sources, with the sole exception of Sussex Hastings WRZ, where the estimates take into account known outages to surface water sources.

It is the intention to continue to monitor actual outage on a continuous basis. In particular the following aspects will be reviewed:

- Any changes as a result of ongoing data collection;
- The possible inclusion of a partial, significant loss of deployable output from surface water sources, as it is considered that this would constitute a legitimate, and experienced, form of surface water outage;

- The partial reduction in groundwater source deployable outputs given the historical occurrence of pollution events and single borehole failure at multiple borehole source sites;
- Whether an allowance should be made for flooding events; and
- The potential for reducing the outage allowance through an enhanced asset maintenance regime.

However this will require the current enhanced data collection procedures to have been in place for a longer period so that the required data are available for a more representative period of time.

5.5 Raw and Potable Water Transfers and Bulk Supplies

There are a number of bulk transfers of water, both raw and potable, within the Southern Water area of supply. These can be both from a WRZ (export), or to a WRZ (import). There are two basic types of transfer, as follows:

- Inter-zonal, whereby the transfer takes place between Southern Water WRZs (see Table 5.4); and
- Inter-company, whereby the transfer takes place between a Southern Water WRZ and another water company (see Table 5.5).

Area	From	To	Capacity (Ml/d)
			Exports
Western	HS	IoW	14.00
Central	SW	SN	15.00
	SN	SW	15.00
	SW	SB	7.00[1]
Eastern	KM	SH	35.00 (raw)
	KM	KT	22.80

Note: [1] scheme becomes available once strategic scheme completed

Table 5.4 Summary of Inter-Zonal Transfers from 2010-11 (Start of Planning Period)

Area	WRZ	Imports		Exports	
		MDO (Ml/d)	PDO (Ml/d)	MDO (Ml/d)	PDO (Ml/d)
Western	IoW	-	-	-	-
	HS	-	-	23.00	23.00
	HK	-	-	-	-
	HA	-	-	0.31	0.41
	Total	**0.00**	**0.00**	**23.31**	**23.41**
Central	SN	15.00	15.00	5.40	5.40
	SW	-	-	-	-
	SB	-	-	-	-
	Total	**15.00**	**15.00**	**5.40**	**5.40**
Eastern	SH	-	-	8.00	8.00
	KM	-	-	18.12	19.32
	KT	0.01	0.01	4.00	-
	Total	**0.01**	**0.01**	**30.12**	**27.32**
Company total		**15.01**	**15.01**	**58.83**	**56.13**

Table 5.5 Summary of Inter-Company Bulk Transfers from 2010-11 (Start of Planning Period) (Ml/d)

Southern Water is a net exporter of water, with exports of about 60 Ml/d at both MDO and PDO, compared to imports of about 15 Ml/d at both MDO and PDO. Currently, these contractual volumes have to be taken into account in the baseline supply demand balance.

There are a number of issues to consider regarding bulk transfers within the context of the WRMP, which are briefly addressed below.

There are a number of existing inter-zonal transfers between the WRZs within Southern Water. These allow the transfer of supplies from WRZs with a surplus supply demand balance to those with a deficit. The transfers will have a given capacity, which may not need to be fully utilised at the start of the planning period for all conditions because the transfer is optimised to meet the deficit year by year. Thus, spare capacity may exist for future increases in transfers to support the recipient WRZ. This in turn allows for the possibility of increasing the capacity of the transfer if further spare supplies become available in the donor WRZ. It also has the implication that, should further supplies be required in the inter-connected WRZs, then it may be more appropriate to develop resources in either the donor, or recipient, WRZ. This gives flexibility to the choice of scheme option selection within the investment model.

There are also a number of inter-company transfers, some of which are of significant volume, although others, such as the small metered supplies, serve only a few properties. The terms and conditions of the larger inter-company transfers are set out in some form of agreement. These agreements will normally state such aspects as: volume; duration of the agreement; and financial arrangements, although no two agreements are the same. However, many of the current agreements are due to expire during the current planning period, one as early as 2012.

Furthermore, all of the donor WRZs (apart from Hampshire Andover) which provide for these bulk exports will develop a supply demand balance deficit during the planning period. It has already been stated that Southern Water has included in the baseline supply demand balance renewal until the end of the planning period of all existing bulk supplies at the volumes that are applicable at the time of contract renewal.

Southern Water has reaffirmed its commitment to the development of a regional solution within the context of the WRSE companies. A number of potential inter-company transfers have been identified as part of the work of the WRSE group modelling work. These additional bulk transfers are summarised in Table 5.6 and are included in the investment model for the WRSE scenario only. In addition, a number of resource development schemes that formed part of the WRSE regional solution are proposed to be introduced. This is likely to result in a surplus of water which will be available for bulk transfer in the Eastern Area; however, the magnitude of such a transfer or transfers has not yet been agreed.

Transfer	Peak (Ml/d)	MDO (Ml/d)
Sussex Brighton		
SB export SEW Mid-Sussex	Constant from 2028-29: 4.0	Constant from 2028-29: 4.0
Kent Thanet		
KT export Folkestone & Dover – Deal High	Additional from 2027-28: 2.0	-

Table 5.6 Summary of Additional Inter-Company Bulk Transfers for WRSE Scenario

5.6 Sustainability Reductions

5.6.1 Overview

All abstractions are subject to the terms of the existing abstraction licences. Many of these licences were issued in 1965, when the provisions of the 1963 Water Resources Act came into force. The Environment Agency considers that the terms of some of these licences are such that the abstraction could cause environmental damage, or could have an impact on sites with environmental designations. Thus, there is a possibility that some licences may be varied, or even revoked, if it is proven that they could cause environmental damage. In order to manage the requirements of recent European and national environmental legislation and initiatives, the Environment Agency has set up the over-arching Restoring Sustainable Abstraction (RSA) Programme.

During AMP4, a number of investigations have been undertaken, mostly under the Habitats Directive, to determine if the abstractions under investigation could cause environmental damage, and thus needed to be revised. Such revisions are generally known as Sustainability Reductions. Most of these investigations are ongoing and final results have only been indicated for the River Itchen SAC. It should be noted that although the investigations have been carried out during AMP4, there is no strict timetable for the implementation of any measures, although at the time of the DWRMP the Environment Agency indicated that it expected all measures to be completed by 2015. In the period since the DWRMP, the company has worked with the Environment Agency, Ofwat and Portsmouth Water to explore options for the implementation of the proposed Sustainability Reductions. A draft Memorandum of Understanding (MoU) was prepared by the company following that work to set out the roles and responsibilities of the various parties to progress the development of options that would allow the proposed Sustainability Reductions to be implemented. The MoU (reproduced in Appendix A) has now been approved by all parties, and the Environment Agency has indicated that there could be a progressive timetable for implementation of the Sustainability Reductions up to the end of AMP6.

At various times during preparation of this WRMP, the Environment Agency has provided figures for the Sustainability Reductions to be included in the supply demand balance. Southern Water received the first set of figures for Sustainability Reductions in June 2007

(letter is included in Appendix D.4). This gave an "indicative" Sustainability Reduction for only the River Itchen SAC investigation. The impact of the proposed licence revisions is extremely significant for the Hampshire South WRZ and the Western sub-regional area, as described in section 10.3. The "indicative" Sustainability Reductions advised in 2007 were confirmed by the Environment Agency in its letter dated 28th November 2008 (included in Appendix D.4) as "Certain"; the letter also included information on NEP (National Environment Programme) schemes to be included in AMP5.

Table 5.7 gives a summary of the Sustainability Reductions set out in the Environment Agency letters. Table 5.8 gives a summary of the schemes and investigations to be undertaken during AMP5 that the Environment Agency identified in the NEP letter dated November 2008.

Area	WRZ	Reference no.	Site name	Priority	Details
Western	IoW	4SO501002	Brading Marshes	Medium	No Sustainability Reductions advised by EA.
	HS	3POSW5106	River Itchen SAC	High	Sustainability Reductions advised by EA comprise at S517 and Y841 totalling 107 Ml/d at MDO and 86 Ml/d at PDO due to a proposed MRF of 198 Ml/d.
	HK	None			
	HA	None			
Central	SN	4SW00301	Arun Valley SPA, Ramsar, SSSI	Medium	Potential impact on the S466 groundwater abstraction. Removed by the EA in its December 2008 letter.
	SW	None			
Eastern	SH	None			
	KM	3MK3000801	North Kent Marshes	Medium	Potential impact on groundwater sources in this WRZ. No Sustainability Reductions advised by EA in its December 2008 letter.
	KT	Little Stour 3SO3000301 Wingham River 4SO300101	Little Stour, Wingham River	-	The EA advises that it does not have sufficient information to provide details on potential Sustainability Reductions to the X868, R168 and A853 sources. Options appraisal to be undertaken in AMP5

Table 5.7 Summary of Sustainability Reductions to be included in the Southern Water WRMP

Area	WRZ	Reference no.	Site name	Priority	Details
	HS	3POSW5106	River Itchen SAC	High	**Implementation**
		RSA-SOHA0003	River Test	Not given	**Investigation** New scheme that was not identified by EA in 2007.
	HK	None			
	HA	None			
Central	SN	None			
	SW	None			
	SB	GB107041012450	Lewes Winterbourne	Not given	**Investigation** New scheme that was not identified by EA in 2007 and not advised to the company in advance of December 2008 letter.
Eastern	SH	None			
	KM	None			
	KT	Little Stour 3SO3000301 Wingham River 4SO300101	Little Stour, Wingham River	-	**Options appraisal**

Table 5.8 NEP investigations to be undertaken during AMP5

At the time of the DWRMP, the only information provided regarding the magnitude of possible Sustainability Reductions related to the River Itchen SAC. As shown in Table 5.7, there remains the possibility that further proposals will be made that affect the remaining sites. Whereas most of the investigations to date have been associated with the Habitats Directive Review of Consents, the Table 5.8 illustrates that further reviews of abstraction licences under Restoring Sustainable Abstraction programme and the Water Framework Directive drivers may lead to further pressures on the company's resource base.

At the time of the DWRMP, and further confirmed in the NEP letter (dated November 2008), all companies were instructed by the Environment Agency in its Water Resources Planning Guideline that they would be told by the Environment Agency what Sustainability Reductions should be included in their WRMPs. Companies were instructed not to include any allowance for any other Sustainability Reduction, or any allowance for the possibility of the non-renewal of time dated licences, either as a reduction in deployable output, or as a factor in the calculation of headroom uncertainty. Southern Water is of the view that this continues to represent a major source of uncertainty in this WRMP and could adversely affect its robustness in future years.

5.7 Climate Change Effects on Supply

At the time of the DWRMP, it was expected that the results of UKCIP08 would have been released in time for them to inform the final WRMP, but the new scenarios (under the name UKCP09) were only released in July 2009. Additional work undertaken since the DWRMP has therefore been restricted mainly to the refinement of the previous analysis on groundwater sources, and to reviews of the operation of the River Medway Scheme in the context of AMP4 Water Resources Investigations. There has also been additional guidance from both Ofwat[6] and the Environment Agency[7] on how the impacts of climate change on supplies should be taken into account.

The impacts of climate change on surface water sources were assessed using three different climate change models to determine the minimum, 'most likely' and maximum expected climate change impacts. The 'most likely' model has been used as the central reduction in deployable output, with the maximum and minimum models providing the bounds for headroom uncertainty using a triangular distribution. Impacts on deployable output and Target Headroom limits were interpolated linearly, providing an incremental impact and increase in headroom over the planning period.

In the Eastern Area, the operation of Bewl Water is currently constrained by the operational need for a minimum input to P647 of 30 Ml/d. With this constraint in place, it is not possible to successfully run the MISER model over the design scenario, as there is insufficient water in the Medway to allow effective re-fill of Bewl to support the P647 abstraction. The medium and high scenarios were thus based on modelling with the minimum P647 flow constraint removed. This suggests that the operation of the system is particularly sensitive under high climate change scenarios, and will therefore need to be kept under review.

The output of the three reservoir system (Bewl, Darwell and Powdermill) has thus been considered in combination. The climate change input on the whole system was calculated for the three climate change scenarios, and this impact was apportioned equally between Kent Medway and Sussex Hastings WRZs.

One further issue associated with the Eastern Area is that due to the way in which the system operates, the 'most likely' climate change impact on the peak week is actually slightly less than the minimum climate change scenario. The impact of climate change on the company's surface water sources is shown in Table 5.9.

Analysis has been undertaken since the DWRMP to assess the impact of climate change on groundwater sources. Details of the work are given in the summary report on groundwater deployable output [3]. The results of the assessment of the impact of climate change on groundwater are shown as Table 5.10.

The assessment of the impact of climate change on both surface water and groundwater supplies will need to be kept under review, particularly following release of the UKCP09 climate change scenarios. Further guidance from UKWIR and other bodies on how to apply use the new scenarios in future planning is expected following review and interpretation of the new scenarios. Delay in the release of the new scenarios means that it has not been possible to include their impact in this WRMP. However the approaches used for this WRMP can be applied to the new scenarios.

The recent Ofwat policy[6] states:

> "Companies will need to provide robust evidence for any step changes to the estimates of existing supply capacity (for example, deployable output) and demand that they use in their investment planning for the 2010-15 period, whether those changes are related to new information on climate change or to other factors. In preparing their evidence, companies should take account of their experience during the 2005-06 drought, which tested supply capacity and demand."

[6] Water supply and demand policy, Ofwat November 2008
[7] Revision to Water resource planning guideline, Environment Agency, December 2008

Section 5.2 describes how the reassessment of source yields and assessment of climate change impacts were undertaken and refers to separate reports that provide the robust evidence required by Ofwat. The potential impacts of climate change on deployable output have not been included in the baseline values of DO during AMP5. The impact is assumed only from the start of AMP6 onwards; climate change does not therefore affect any investment decisions during AMP5.

Area	WRZ	MDO Reduction, 2025			PDO Reduction, 2025		
		Headroom			Headroom		
		Min	Most Likely	Max	Min	Most Likely	Max
Western	IoW	0.0	0.0	0.0	1.40	2.09	2.77
	HS	0.0	0.0	0.0	0.0	0.0	0.0
	HK	-	-	-	-	-	-
	HA	-	-	-	-	-	-
	Total	**0.0**	**0.0**	**0.0**	**1.40**	**2.09**	**2.77**
Central	SN	0.0	0.0	0.0	0.0	0.0	0.0
	SW	-	-	-	-	-	-
	SB	-	-	-	-	-	-
	Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Eastern	SH	2.71	5.02	6.90	3.41	5.68	7.83
	KM	4.57	8.46	13.16	10.61	17.68	24.51
	KT	-	-	-	-	-	-
	Total	**7.28**	**13.48**	**20.06**	**14.02**	**23.36**	**32.34**
	Company	**7.28**	**13.48**	**20.06**	**15.42**	**25.45**	**35.11**

Table 5.9 Climate Change Impacts on Surface Water Deployable Output in 2025 (Ml/d)

Area	WRZ	MDO Reduction, 2025			PDO Reduction, 2025		
		Headroom			Headroom		
		Min	Most likely	Max	Min	Most likely	Max
Western	IoW	-0.07	0.08	0.29	-0.06	0.09	0.31
	HS	-1.25	0.00	1.50	-1.10	0.05	2.05
	HK	0.00	0.00	0.00	0.00	0.00	0.00
	HA	-0.04	-0.01	0.02	-0.04	0.00	0.04
	Total	**-1.36**	**0.07**	**1.81**	**-1.20**	**0.14**	**2.40**
Central	SN	-0.05	0.03	0.05	-0.05	0.03	0.05
	SW	-0.69	0.18	0.69	-0.92	0.23	0.92
	SB	-1.54	0.39	1.54	-0.95	0.24	0.95
	Total	**-2.28**	**0.59**	**2.28**	**-1.92**	**0.50**	**1.92**
Eastern	SH	-0.10	0.20	0.40	-0.10	0.25	0.50
	KM	0.00	3.89	6.43	0.00	2.71	5.92
	KT	-1.20	2.58	6.00	-3.09	3.28	10.03
	Total	**-1.30**	**6.67**	**12.83**	**-3.19**	**6.24**	**16.45**
	Company	**-4.94**	**7.33**	**16.92**	**-6.31**	**6.88**	**20.77**

Table 5.10 Climate Change Impacts on Groundwater Deployable Output in 2025 (Ml/d)

6 Demand Forecast

6.1 Introduction

This section sets out how Southern Water's Demand Forecast has been derived. During the Reporting Year 2007-08, the company supplied 564 Ml/d on average each day. This is about 40% greater than that supplied in the early 1960s. Despite the challenges to be faced by the company during the planning period and in particular the forecast increase in population and households, demand is forecast to decrease by 2.3% as a result of the significant demand management measures included in this Plan. The headlines for the demand forecast are:

- Total population supplied is forecast to rise from 2,257,000 in 2007-08 to 2,701,000 in 2034-35;
- Total connected properties are projected to increase from 1,043,000 in 2007-08 to 1,328,000 in 2034-35;
- The normal year average daily demand is forecast to decrease to 551 Ml/d by 2034-35, as a result of universal metering. If only optant metering policies were adopted, the NYAA demand would still be expected to fall, but only slightly, to 560 Ml/d (a decrease of 0.6%); and
- The average PCC for the company under "normal year" conditions is forecast to decrease from 152 l/h/d in 2007-08 to 127 l/h/d in 2034-35. In 2030-31, the overall household PCC is forecast to be 128 l/h/d, which is ahead of the government's aspirational target of 130 l/h/d by 2030.

Figure 6.1 shows how the annual average daily volume of water supplied by the company and the former statutory water undertakers from which the company was formed has varied since the 1960s. The volume supplied (called Distribution Input) peaked in 1989 at around 720 Ml/d, from which it has fallen back to levels not experienced since the 1970s. This trend in declining consumption is attributed to reductions in domestic customer use in response to: changes in lifestyle; customer awareness of the environment; ongoing water efficiency campaigns; increases in domestic metering; reductions in commercial demand, and a significant decrease in leakage. The impact of the forecast increase in population on demand is described in section 6.5.

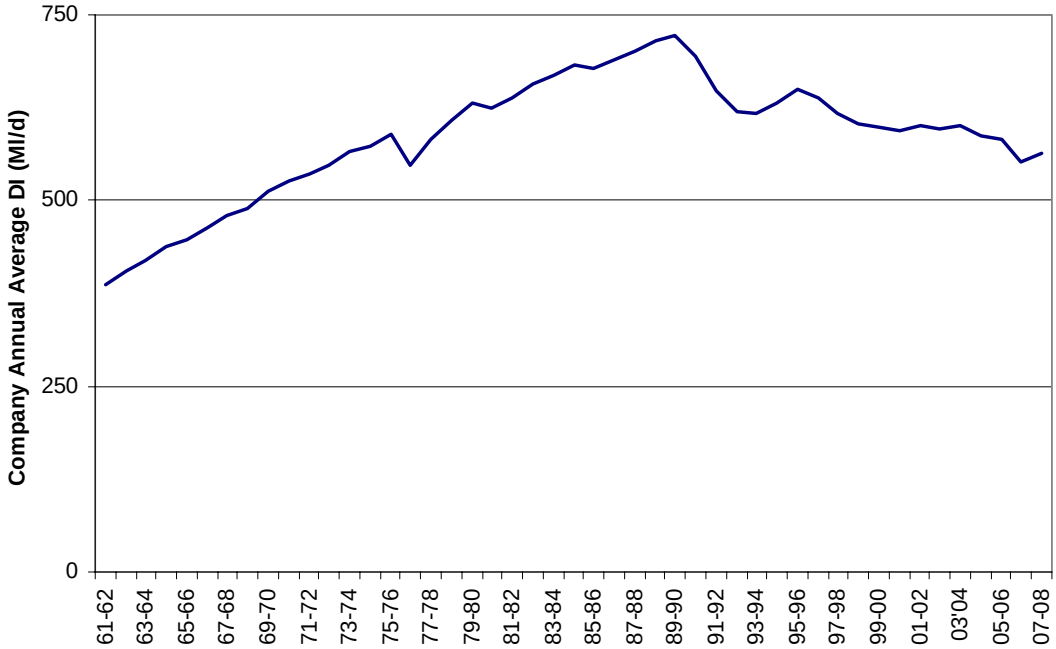


Figure 6.1 Company Annual Average Distribution Input, 1961-2007

Demand for water varies seasonally and with the prevailing weather conditions, peaking during the late spring/summer months as discretionary use increases, and then falling to a minimum during the autumn and winter. Figure 6.2 show the daily variation in demand during 2007-08 in which a peak week demand of 628 Ml/d was recorded in May, while the minimum weekly demand of 540 Ml/d was recorded during October.

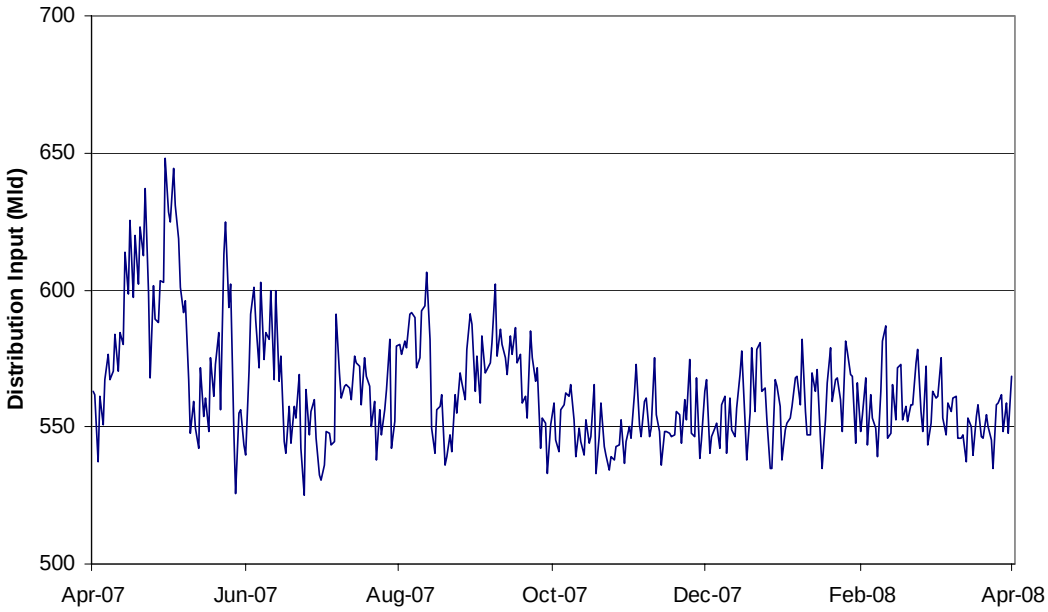


Figure 6.2 Variations in Distribution Input during 2007-08

Hot, dry summer weather, as for example in 1995, leads to significant increases in daily demand, although in times of drought, as in 1976 and 2004-05, the introduction of demand restrictions can bring about rapid reductions in customer use.

Variations in discretionary use throughout the day, particularly during the warmer summer months are generally considered the main reason behind the observed increases in summer

demands. Figure 6.3, based on work carried out by WRc[8], shows the variation in recorded household demands on typical winter and summer days.

Indoor consumption is relatively constant between the two periods, but outdoor discretionary use during the summer period, due principally to garden watering, is considerably greater during the summer than the winter.

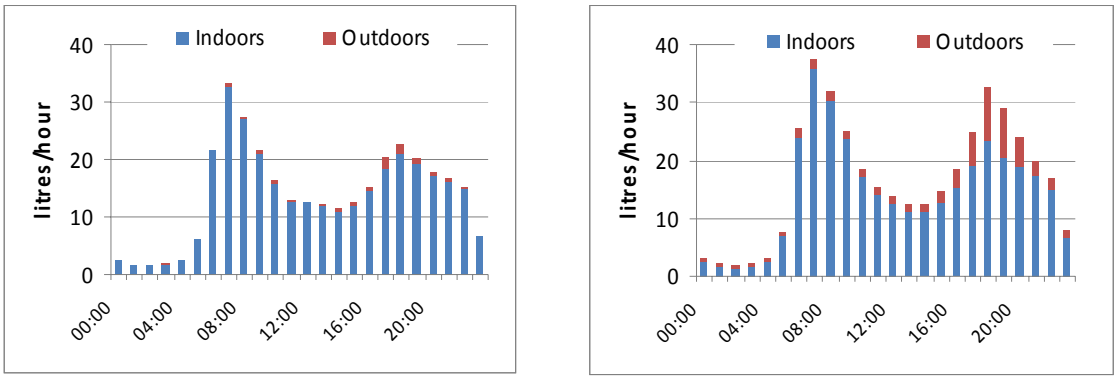


Figure 6.3 Typical Daily Household Consumption Profiles in Winter (left) and Summer (right) (After WRc 2005)

For planning purposes, the measure used for describing peak demand is the average daily consumption taken over seven consecutive days; the maximum annual figure being the so-called "average day peak week" or critical period demand, or PDO demand. In 2007-08, the peak week demand was 628 Ml/d, some 11% above the average and 15% greater than that recorded in the autumn. Demand forecasts are presented in this document for both average annual and critical period, (AA and CP) demands as required by the Water Resource Planning Guideline, and also during the autumn period, when groundwater sources are at their lowest levels – known as the minimum deployable output (MDO) period.

Historic peak week demands have been reviewed to assess the maximum that might be expected under the required forecast design scenarios during the planning period to 2034-35. In 2007-08, 35% of households supplied by the company were metered; a figure which has increased steadily since the compulsory metering of the Isle of Wight in the late 1980s, (carried out as part of the National Metering Trials). Metered domestic customers tend to use less water than unmetered customers, so the historic peak demand record has been rebased to reflect the current level of meter installation. The revised annual peak series has subsequently been used to derive the dry year demand estimates.

The base year for this new forecast is 2007-08, and demands recorded during that year are considered to be reasonably representative of what may be termed a *normal* year. The derivation of base year demands under the normal year, and for the dry year planning scenarios (DYAA, DYCP, and DYMDO) are described in section 6.3.

In 2007-08, the company supplied water to 945,000 domestic households (excluding void households), 334,000 of which were metered (35%) and to a further 61,000 commercial customers (excluding void non-households), 88% of which were metered. In addition, water was used for operational purposes by the company, water was taken but was unbilled (both by legal and illegal means), and the remainder was lost through leakage from the distribution system and from the supply pipes which connect individual properties to the distribution main. Table 6.1 lists the Components of Demand and shows the proportion of water attributed to each component.

[8] WRc (2005), *Increasing the value of domestic water use data for demand management*, Report P8832

Component of Demand	Company (Ml/d)	%DI
Unmeasured households (umHH)	244.3	43%
Measured households (mHH)	89.7	16%
Unmeasured Non-households (uNH)	5.7	1%
Measured Non-households (mNH)	131.6	23%
Distribution System Losses	65.3	12%
Customer Supply Pipe Losses	16.2	3%
Operational Use & Unbilled	10.7	2%
Total Demand	563.6	100%

Table 6.1 The Components of Demand, 2007-08

During the year, domestic household consumption accounted for around 59% of Distribution Input, while commercial customers used a further 24%. Leakage, including that lost from customers' supply pipes accounted for 15%, while the minor components accounted for the remaining 2% of supply.

Many of the assumptions on which this forecast is based are subject to uncertainty. But overall, this forecast reflects Southern Water's current view of the impact of factors such as the projected growth in population and housing numbers and changing levels of commercial activities on future demands, given existing policies and preferred options regarding metering and other demand management measures.

6.2 Demand Scenarios

This WRMP presents demand forecasts for a range of design scenarios, as specified in the Environment Agency's Water Resource Planning Guideline. The required scenarios are:

- **Normal Year Annual Average demands (NYAA)** – developed by normalising the base year (2007-08), where necessary, to compensate for the influence of weather and demand restrictions. The idea is to derive estimates of demand that would occur under 'normal' conditions;
- **Dry Year Annual Average demands (DYAA)** – the annual average demand in a year with low rainfall, but without any demand restrictions in place. This demand is used with the average deployable output (ADO) supply scenarios;
- **Dry Year Critical Period demands (DYCP)** – a scenario to look at the peak week demand during summer in a dry year. Peak week demand is the average daily value in the seven day period for which the largest demand is seen. This demand is used with the peak deployable output (PDO) supply scenarios; and
- **Dry Year MDO demand (MDO)** – the autumn demand in a dry year. Autumn is the period when ground water levels and river flows are generally at their lowest and sources are operating close to their minimum deployable outputs (MDO). Whilst demand in this period is generally not as high as in the summer, it is important to investigate this scenario because the available supplies are generally vulnerable.

Figure 6.4 illustrates the definitions of these periods in relation to the baseline demands observed in the Hampshire South WRZ during 1995-96, a period which included the very dry summer of 1995. All water companies are required to provide forecasts for the NYAA and DYAA scenarios because this allows comparison between the various companies. However,

the dry year peak week demand (DYCP) or the MDO demand may be the more important investment driver in some WRZs; depending on local characteristics, for example, the volume of storage available and the composition of sources. For this reason, forecasts for these two periods are also presented.

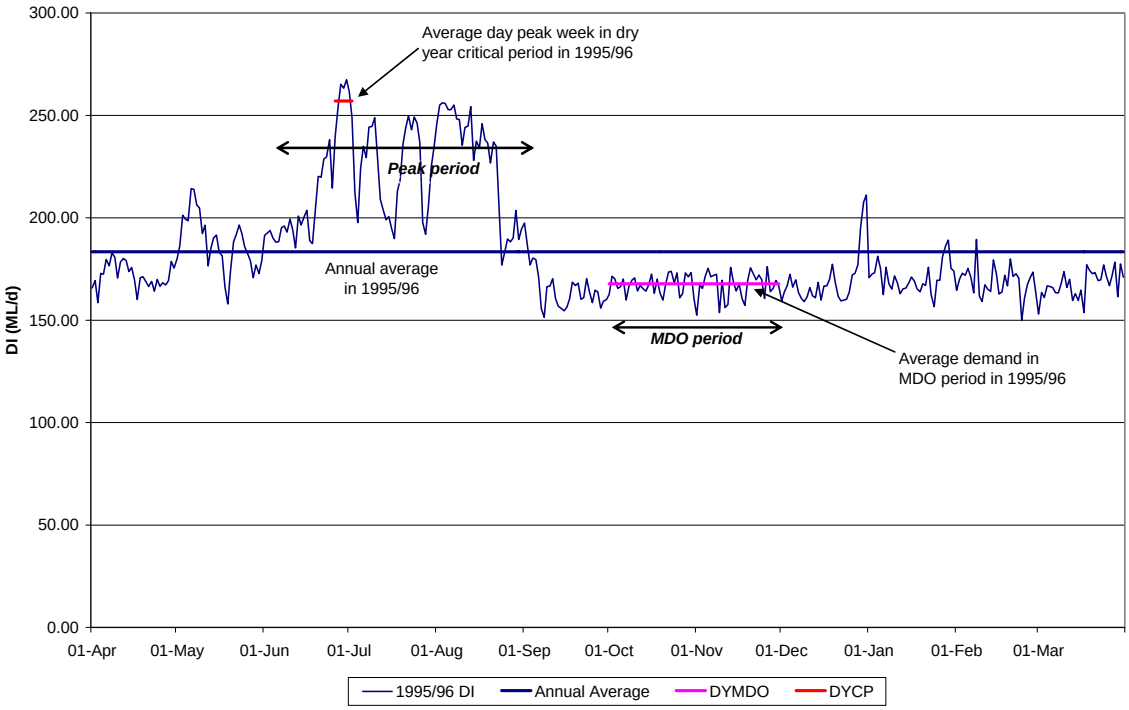


Figure 6.4 Definition of Demand Scenarios and Planning Periods

6.3 Base Year Demand

6.3.1 Normalisation of the Base Year Demand

The base year for this demand forecast is 2007-08 and component data are available at the WRZ level, based on the annual returns submitted to Ofwat and the Environment Agency.

Demand, particularly that used by households, is influenced by rainfall and temperature. During the summer months rainfall reduces the demands from garden watering and other outside activities. Conversely, drought conditions, particularly when accompanied by sustained periods of high temperature, can lead to rapid increases in demand. Long term rainfall and temperature records were used to assess the summer conditions, i.e. occurring in the period from April to September. This period was considered to be the one of most relevance to demand, as illustrated in Figure 6.5. During the summer of 2007-08 total rainfall was only slightly less than average compared with other years, although it was warmer than average. However, July was unusually wet and demands in that month were less than those observed earlier in the year with the peak week demand of 628 Ml/d being observed in May.

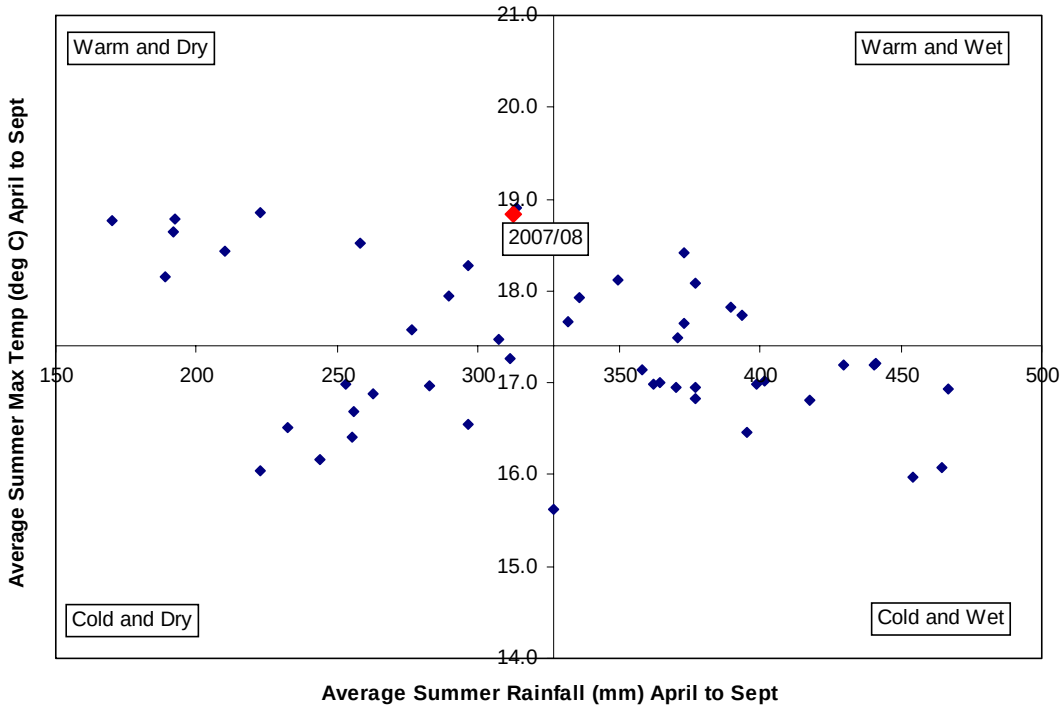


Figure 6.5 Classification of Dry/Wet and Warm/Cold Years (1959-60 to 2007-08)

On balance it is considered that in demand terms, at least, the year was not exceptional and the recorded demands have not been adjusted to compensate for unseasonal consumption. Thus we assume that 2007-08 was a normal or typical year, and the average daily demand during the year (the Normal Year Annual Average or NYAA) was 564 Ml/d.

6.3.2 Dry Year Demands

Distribution Input data for the years 1995-96 to 2007-08 were analyzed with leakage removed from Distribution Input to focus on trends in actual demand rather than on total Distribution Input. Non-household demand was also removed from Distribution Input because it is not generally subject to seasonal variation in the company supply area. Data for the early 1990s, whilst available, was considered to be less robust than current data and is also less representative of the current customer base.

The resulting series was subsequently rebased to produce estimates of the demands which would have been experienced in previous years if the base year conditions (i.e. current meter installation levels and customer numbers) had been in place. Rebasing of household demand in each WRZ over the period 1995-96 to 2007-08 was undertaken using the assumed suppression effects of metering on the actual un-metered customer base.

A dry year is one with very low summer rainfall but unconstrained demand (i.e. it is a year without demand restrictions in place). The company's published Target Levels of Service is for hosepipe restrictions to be introduced no more frequently than once in ten years.

Dry year annual average (DYAA) demand was determined from the rebased historic demand series for each WRZ as the 90th percentile of the annual average series of rebased demands. This is considered equivalent to the 1 in 10 year demand.

Historic peak and MDO household demands were rebased using the maximum peak week demand observed in each year and the maximum rolling 30-day average demand over the period October to November respectively.

The 90th percentile of the rebased historic peak and MDO demands was used to provide estimates of the dry year (unconstrained) demand for these two periods. Thus, the rebased

peak week and MDO demands are also considered to represent a 1 in 10 year demand. The demands resulting from this analysis are presented in Table 6.2.

Area	WRZ	Base year Dry Year Demand (Ml/d)	Base year Peak Period Demand (Ml/d)	Base year MDO Period Demand (Ml/d)
Western	IoW	34.96	44.36	33.70
	HS	157.83	206.41	152.33
	HK	5.24	7.13	4.95
	HA	16.62	21.30	17.51
Central	SN	67.57	85.20	65.92
	SW	42.95	51.57	41.94
	SB	86.47	103.80	84.39
Eastern	SH	26.95	32.69	26.69
	KM	122.33	148.95	116.47
	KT	46.39	59.81	43.67

Table 6.2 Calculated Dry Year Demand in the Base Year (2007-08)

The dry year demand (in Ml/d) has been used as the starting point for the demand forecast presented in this report. A dry year factor has been calculated and applied to the base year household PCC to match the dry year demand (in Ml/d), assuming the normal year factor and non-household factor are both unity.

6.4 Base Year Components of Demand

The base year from which the demand forecasts are derived is 2007-08 because this is the latest complete year for which data are available.

6.4.1 Base Year Population and Property Estimates

Base year population and property estimates, and the split in these between different components of demand have been taken from the latest June Return (JR08 out-turn data). A summary of the base year estimates of total properties and population for each resource zone is given in Table 6.3.

Area	WRZ	Base year properties	Base year population
Western	IoW	67,230	135,201
	HS	257,726	589,154
	HA	28,017	63,902
	HK	6,619	14,814
	Total	**359,592**	**803,071**
Central	SN	107,079	242,607
	SW	88,046	168,384
	SB	154,942	320,824
	Total	**350,067**	**731,815**
Eastern	SH	51,795	101,033
	KM	192,115	441,309
	KT	89,729	180,186
	Total	**333,639**	**722,528**
Company Total		**1,043,298**	**2,257,414**

Table 6.3 Summary of Base Year Properties and Population (2007-08)

6.4.2 Reconciliation of the Base Year Water Balance

The components of demand comprise household and non-household customer use, operational use; losses from the company's distribution system and other non billed losses. Table 6.1 (above, in section 6.1) lists the components as reported to Ofwat in January, 2009, being a re-statement of the corresponding Table10b(1) from the JR08 returns to Ofwat, reflecting the up to date property and population forecasts described earlier and minor changes to other components.

6.4.3 Base Year Per Capita Consumption

In 2007-08, the company-wide estimate of the Per Capita Consumption of unmeasured customers (uPCC) was 159 l/h/d, while that of measured customers (mPCC) was around 13% lower, at 138 l/h/d.

The unmeasured customer PCC is currently derived from data obtained from the Southern Area Group Control Area Monitoring Programme which is a collaborative data sharing exercise involving several of the water companies in the South East. The metered customer PCC is derived from consumption data held on the Company's billing system.

Unmeasured and measured PCC varies between WRZs because of differing socio-economic, climatic and geographic factors. The 2007-08 estimates of PCC, derived for each WRZ based on the water balance, and considered representative of normal year (NYAA) consumption, are presented in Table 6.4.

Area	WRZ	Unmeasured household PCC Base year 2007-08	Measured household PCC Base year 2007-08
Western	IoW	138.5	120.1
	HS	153.6	136.9
	HA	158.2	140.1
	HK	159.2	159.6
Central	SN	151.6	148.4
	SW	168.1	145.3
	SB	168.5	139.9
Eastern	SH	168.0	138.8
	KM	157.9	146.1
	KT	158.3	142.8
Company		**158.5**	**138.1**

Table 6.4 Base Year PCC Comparisons (l/h/d)

6.5 Demand Forecast

The 2007-08 out-turn estimates of the components of demand form the base from which the forecast has been developed. The demand forecast is built up from the population and property forecasts, together with assumptions on changes in PCC and commercial activities over the planning period, plus consideration of the company policies on metering, water efficiency and leakage reduction.

6.5.1 Population and Property Forecast

Population and property estimates through the planning period have been developed for the company by Experian, using the best practice methodology published by the Environment Agency (EA 2007)[9]. This methodology produces two forecasts: the first is based on historical trends projected forward; whilst the second derives estimates based on policy as presently promulgated in draft regional plans.

Experian were commissioned by several companies, including Southern Water (Experian, 2007), to provide the most likely scenario based on a combination of the population growth from the policy based projections but constrained to the total national trend based projection. This work has now been updated to take account of recently published regional data (Experian 2008). This analysis provided a "best estimate" forecast on which the demand forecast has been developed.

In summary, the total base year population and property numbers have been derived from the June Return (JR08) data, with expected annual changes from the Experian forecasts.

The most likely scenario forecast suggests that the total population in the company's supply area will grow by approximately 444,000 from 2,257,000 in 2007-08 to 2,701,000 in 2034-35. Over the same period, the number of properties connected to the company's distribution system is predicted to rise by 285,000 from 1,043,000 in the base year to 1,328,000 by 2034-35. Household occupancy rates are expected to fall over the same period, from approximately 2.32 in the base year to 2.16 in 2034-35.

The split between metered and unmetered household properties through the planning period depends on the metering policy adopted. This is discussed in detail in section 6.5.3.

The total number of metered and unmetered non-household properties has been assumed to remain constant through time, which is consistent with the general trend observed in recent years, as discussed in section 6.5.4.

Void properties are those which are connected to the company's distribution system but are temporarily not being billed. The proportion of empty properties at any one time can be expressed as a percentage of the total housing stock (taken from JR08 data) and this proportion is assumed to remain constant over the planning period.

6.5.2 Household demand – the Per Capita Consumption Forecast

Changes in Per Capita Consumption (PCC) can be forecast by:

- Extrapolating long-term historical trends; or
- Developing a model which builds PCC from forecast changes in the underlying micro-components of demand.

Both approaches have limitations, because there is uncertainty in predicting how customers' water use may change over the long term. Extrapolation on the basis of historical trends has the benefit of providing a reasonably realistic short term forecast, but does not allow for any

[9] Environment Agency, Methods of Estimating Population and Household Projections. Report SC030238, 2007

long term changes in regulations or customer behaviour. Nor does it allow consideration of technological advances in water using appliances.

Figure 6.6 shows the annual estimates of company wide unmeasured and measured PCC from 1994-95 onwards as published in the Ofwat June Returns. The figure shows year on year variations in both unmeasured and measured PCC but there is no apparent long term trend in the unmeasured PCC series. It could therefore be plausible to assume that there will be zero change in unmeasured PCC from the baseline position over the planning period.

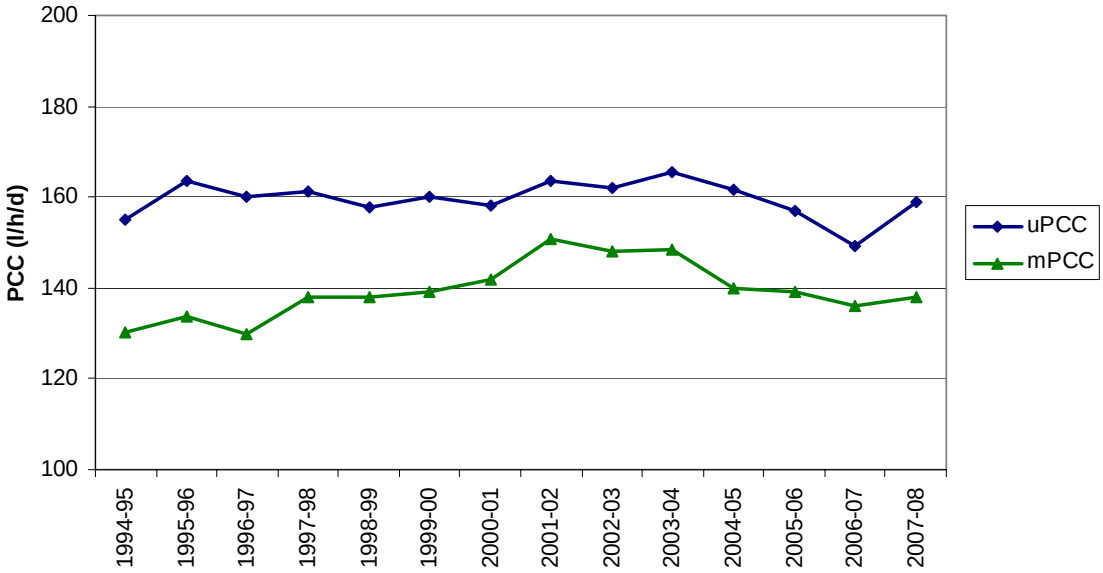


Figure 6.6 Trends in Company PCC from 1994-95

Figure 6.6 also shows the measured household PCC series. The relatively low measured PCC in the early 1990s reflects the reduced consumption of the compulsorily metered customers on the Isle of Wight and the small number of metered properties elsewhere at that time. The more recent data, however, shows no significant trends over time. For this reason it could also be plausible to assume that there will be no change in the PCC of existing metered customers from the current figure over the planning period.

Micro-component modelling, on the other hand, can be used to predict long term changes in demand, although the accuracy of this approach is highly dependent on the validity of the assumptions made about the likely impact of technological change on appliance water use, of the nature and timing of any regulatory controls and of behavioural changes in water using activities by the customer. Clearly, there will be a significant degree of uncertainty in any forecasts developed using the approach.

Nevertheless, following the requirements of the Water Resources Planning Guideline, predictions of future PCC have been based on the micro-component approach. The unmeasured NYAA PCC forecast resulted in a 7-9% decrease by the end of the planning period, depending on WRZ specific assumptions. The existing measured customer base PCC at NYAA was also forecast to decrease over the planning period by 9-11%.

A significant number of new homes are proposed for the South East over the planning period, many of which are expected to be flats or smaller dwellings, with a lower occupancy level than existing properties. In general, the lower the household occupancy rate, the higher the individual consumption. However, it has become mandatory for all new socially funded housing to meet the *Code for Sustainable Homes* code level 3 of 105 l/h/d (Defra 2008, *Future Water*). In the demand forecast it has therefore been assumed that, from the start of the planning period (2010-11) all new socially funded housing would have a PCC of 105 l/h/d.

Consumption in recently built properties, relative to that in the older housing stock, is generally unknown. However, for this demand forecast, the remainder of new houses have been assumed to meet the equivalent of a code level 0, which equates to a design standard

of 125 l/h/d. However, without regulation and enforcement it is unclear how such a consumption target can be achieved or sustained over time.

The forecast for optant and selective measured PCC is based simply on an assumed saving from the unmeasured household micro-component PCC forecast. Selective PCC in this case refers to customers metered under change of occupancy, company selective (high water users), and universal metering programmes. It has been assumed, based on available literature and expert judgement, that the average saving for optants is 8% of unmeasured PCC, while the equivalent for selective is assumed to be 10%.

The consequence of these assumptions is that the average household PCC for the company under "normal year" conditions is forecast to decrease from 152 l/h/d in 2007-08 to 127 l/h/d in 2034-35. In 2030-31, the overall household PCC is forecast to be 128 l/h/d, which is lower than the government's aspirational target of 130 l/h/d by 2030. The forecast of overall household PCC is presented in Figure 6.7.

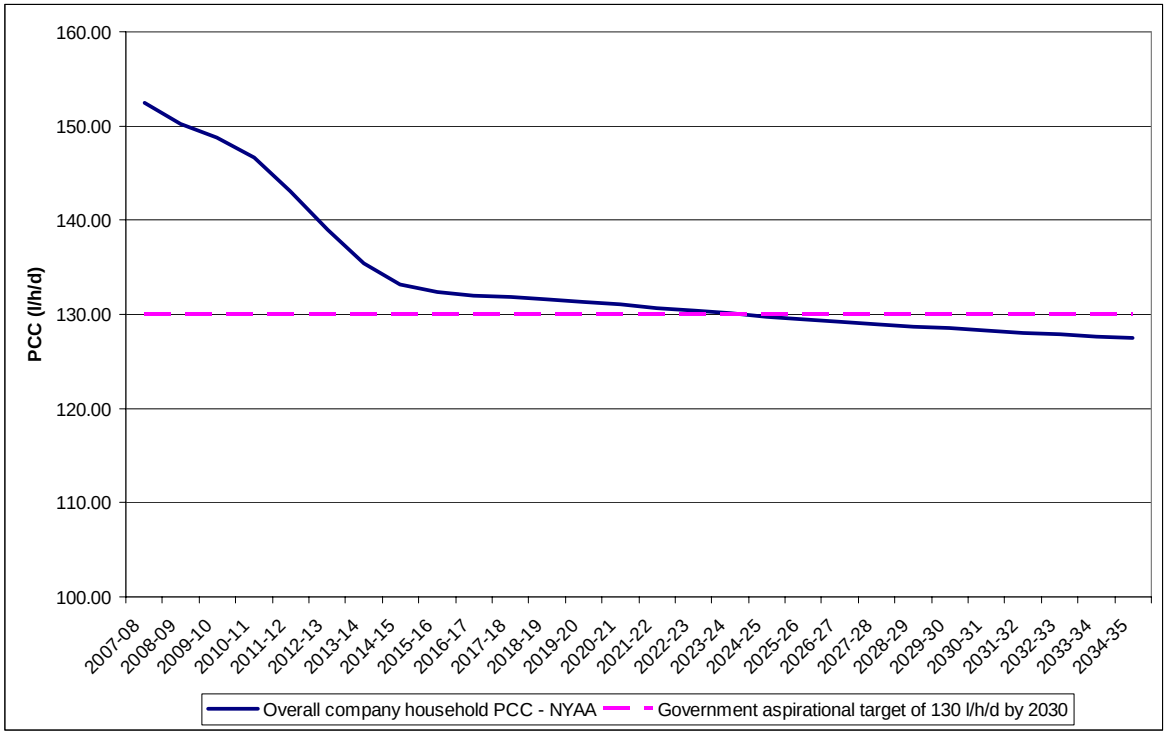


Figure 6.7 Overall Household PCC at Company Level for the Normal Year

The normal year PCC forecasts are multiplied by derived factors, in order that the base year distribution input matches the calculated demand in each WRZ under each demand forecast scenario, presented in Table 6.2. During peak periods (the DYCP design scenario), an additional 5% saving is attributed to all measured PCC forecasts, to account for documented additional reductions in demand in summer periods due to metering. However, this has not been applied to new build properties, which are assumed to already incorporate measures to reduce PCC in summer periods in their base level of PCC.

The micro-component based PCC forecast applies to all newly metered customers in the year immediately following meter installation. Assumptions regarding the baseline water efficiency target and climate change impacts are also incorporated into the calculation of measured household demand and these are discussed in sections 6.5.6 and 6.5.7 respectively.

The sensitivity of the forecast to assumptions surrounding PCC growth have been tested and included in the headroom component of the supply demand balance.

6.5.3 Meter Installation Policy

Meter installation is generally considered to be one of the best means of reducing household demand because it enables customers to monitor their consumption through their water bill. It also enables the company to develop a better understanding of demands on the distribution system which in turn helps tackle leakage. The SEA identified that although metering has the potential for disturbance to local communities in the short term during their installation, this negative effect is outweighed by the overall environmental benefits of metering.

The impact of metering on domestic demand is dependent upon a range of factors including: property type, customer demographics, the number of occupants in the property, whether the meter installation was voluntary or not, and the amount of external water use. It is also dependent on the location of the meter, which can be sited either within the property, or external to it. Installing the meter externally has the benefit of helping to alert customers to any leakage associated with their supply pipes; and timely repairs to leaking supply pipes helps to reduce overall losses from the distribution system.

It has long been Southern Water policy to require meters to be installed in new build properties, while metering on change of occupier has also been in operation in Sussex since 2005. Meters are installed externally wherever possible.

The company supply area has now been designated by the Environment Agency as an "area of serious water stress". This has been an important consideration in the drive towards the company preferred approach of universal metering, with the installation programme proposed to be carried out between 2010 and 2015, by which time it is expected that all households will be metered. However, a range of future metering policies have also been examined for this WRMP:

- **Optant metering policy** – assumes optants, selectives (high water users), and new properties would be metered throughout the company supply area. Under this scenario the existing policy of change of occupier metering in the Sussex WRZs would cease at the end of AMP4.

  Under this policy, it is anticipated that the number of optant households will increase over the period 2010-11 to 2034-35 by 471,000. The number of selective (high water user) is expected to increase by 4,000;

- **Change of occupier metering (universal)** – extends the existing policy of metering on change of occupancy throughout the Sussex WRZs to all other WRZs. This would be in addition to the baseline policy for optant, selective, and new property metering

  Under this policy, it is anticipated that the number of change of occupier households will increase over the period 2010-11 to 2034-35 by 246,000, while the number of optants will increase by 285,000 over the same period, and selectives (high water users) by 2,000; and

- **Universal metering in AMP5** – assumes all properties in all WRZs will be metered in the period 2010-15. All new properties would continue to be metered. It is assumed that this policy would also produce associated benefits due to reduced supply pipe losses.

  Under this policy, it is anticipated that the number of universally metered households will increase over the period 2010-11 to 2034-35 by 523,000, while the number of meters installed under the optants and selective (high water users) meter programme will increase by 33,000 over the same period. Optant and selective metering will only occur ahead of the commencement of the universal metering programme in each WRZ. A likely profile of universal metering is presented in Table 6.5.

Area	WRZ	AMP5				
		2010/11	2011/12	2012/13	2013/14	2014/15
Western	IoW					✓
	HS		✓	✓	✓	
	HK	✓				
	HA	✓				
Central	SN	✓				
	SW					✓
	SB		✓			
Eastern	SH			✓		
	KM			✓	✓	✓
	KT				✓	

Table 6.5 Likely Profile of Universal Metering, 2010-15

6.5.4 Non-Household Demand

The company supplies water to some 61,000 non-household customers, 88% of which are metered. Analysis of historic non-household consumption data derived from published June Returns data (see Figure 6.8) suggests that demand in this sector is decreasing with time, albeit relatively slowly, and there is no evidence to suggest that this trend is likely to reverse, at least in the short term. Conversely, local increases in commercial demand could accompany the growth in housing construction referred to above but, as yet, there is no indication of where or if such commercial developments will take place.

For the purposes of this WRMP therefore, it has been assumed that non-household demand will continue its gradual decline until the end of AMP6, from which point it is assumed to remain at a constant level until the end of the planning period.

Furthermore, it has been assumed that non-household consumption is generally unaffected by weather. This assumption is consistent with the observation that there has been relatively little variation in this component of demand in recent years despite the variable summer weather conditions. Therefore, the dry year, MDO and peak factors for non-household demands have been taken as unity and the base year demands for these scenarios have been derived from the JR08 out-turn figures.

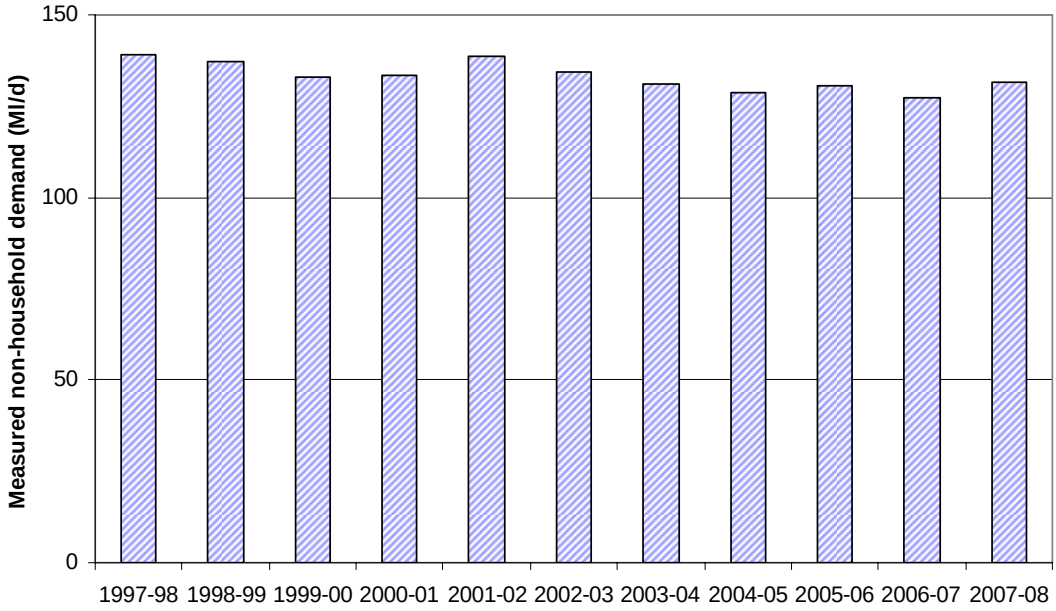


Figure 6.8 Measured Non-Household Demand at Company Level, 1997-98 to 2007-08

6.5.5 Leakage

Leakage is comprised of two components:

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

Distribution losses are the responsibility of the company. Supply pipe losses are the responsibility of the householder, but the company has provided a free supply pipe repair service for many years in order to contain this component of leakage.

A low level of leakage is desirable because it defers the need for investment in new resources which would otherwise be required to meet increases in demand over time. However, it is not necessarily economic to reduce leakage to very low levels, because to do so could involve large incremental costs for relatively small savings in demand. In such circumstances, it may be preferable to develop other options which can achieve the same water savings but at far lower costs. Thus, a balance must be found between reducing leakage to levels that can offset investments in new resources, and the cost of a given level of leakage reduction. The concept of the Economic Level of Leakage (ELL) is used for this purpose.

The Economic Level of Leakage (ELL) is the level of leakage where the marginal cost of active leakage control equals the marginal cost of the leaking water. Active leakage control refers to those management policies and processes used to locate and repair unreported leaks from the water company supply system and from customer supply pipes. There is now also a requirement for water companies to focus on ensuring that leakage levels are set to fully reflect the preferences of society. In order to achieve this, costs and benefits included in the Economic Level of Leakage (ELL) calculations must include not only the impacts borne directly by the water companies, but also the "external" (i.e. the environmental and social impacts) of leakage control activities. This approach ensures that leakage targets are set at a level that is optimal for customers and society as a whole. In this case, ELL becomes the Sustainable Economic Level of Leakage (SELL).

In 2007-08, leakage from Southern Water's distribution system and customer supply pipes was 82 Ml/d, following MLE adjustments. This is significantly below the latest estimates[10] of the company's short-term ELL of 118.5 Ml/d, and short-term SELL of 116.5 Ml/d. The long term SELL was estimated as 89.5 Ml/d. Figure 6.9 shows the steady state relationships, as derived by WRc, between leakage rate and the 2007-08 cost of maintaining that rate. For comparison the mandatory company target level of leakage set by Ofwat[11] for the period 2004-05 to 2009-10 is 92 Ml/d.

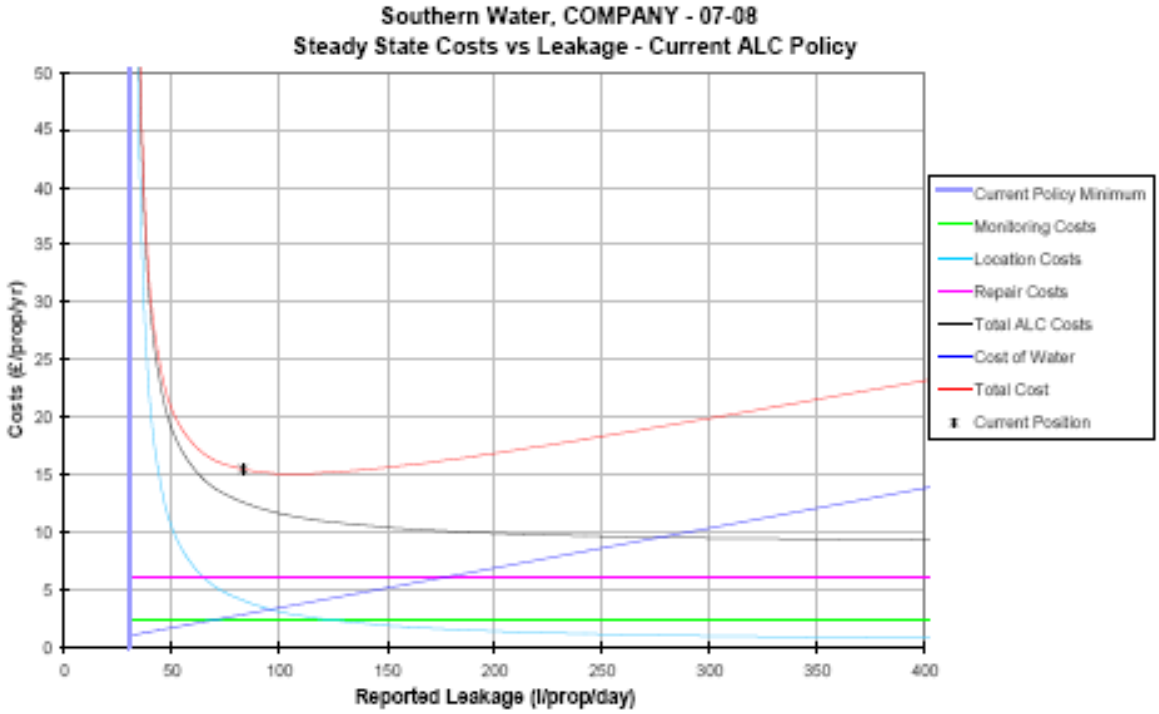


Figure 6.9 Leakage/Cost Relationship for Current Leakage Policy, (after WRc, 2008)

Both short-run and long-run SELL are above the current level of leakage. Therefore allowing leakage to rise, particularly in resource zones in which there is no supply demand balance deficit, is an option to be considered. But in general it is not economic or politically acceptable to do so because leakage would need to be reduced back down to near current levels within the short to medium term to again balance supply and demand. Due to the risks and uncertainties surrounding both the savings that could be achieved by allowing leakage to rise and the costs of bringing it back down, WRc considered it prudent for the company to maintain leakage at current levels (WRc, 2008)

Notwithstanding the comments above, the company has evaluated the following leakage policy options:

- Maintain leakage at the 2007-08 out-turn level of 82 Ml/d (post-MLE adjustment) throughout the planning period;
- Reduce leakage in conjunction with the programme of universal metering to achieve reductions in supply pipe leakage. This is expected to result in a reduction in leakage down to approximately 76 Ml/d by the start of AMP6;
- Allow leakage levels in each WRZ to rise to the Ofwat target (calculated on a WRZ basis); and

[10] WRc (Feb 2009), Sustainable Economic Level of Leakage Analysis, 2007-2008, Final report, Ref UC7893.06
[11] Ofwat, 2004, Security of Supply, leakage and the efficient use of water, 2003-04 Report

- Using one of the above leakage scenarios, allow investment modelling to select further leakage reduction schemes on a WRZ by WRZ basis, whereby, if selected, such schemes would form part of the least cost strategy to balance supply and demand, in conjunction with water efficiency and other resource development options.

This last option could lead to a reduction in leakage for the company as a whole, because in some WRZs it may be economic to undertake further leakage reductions to offset the need for additional resource developments. However in those WRZs, which do not have a supply demand balance deficit, or already operate below their own ELL, it may not be economic to further reduce leakage.

6.5.6 Water Efficiency Targets

Since the DWRMP, Ofwat have published their proposals regarding water efficiency targets (*Future Water Efficiency Targets*, 2008). These targets aim to build on water companies' existing duty to promote the efficient use of water to their customers to ensure that companies play their part in helping to meet the Government's aspirational target, set out in *Future Water* (Defra 2008) of reducing individual water usage to 130 litres per person per day by 2030.

Each company must meet a minimum target for water saved in relation to the number of properties served. Ofwat has proposed that the annual base service target of saving shall be one litre of water per billed property per day through approved water efficiency activity.

If Southern Water is to successfully meet its water efficiency target, it must ensure that 1.01 Ml/d is saved through water efficiency activity each year in AMP5 (from 2010-11 to 2014-15). This target is to be met through both household and non-household activity.

A review of potential water efficiency options was carried out using the latest literature available, including that from Ofwat and Waterwise. Those options considered feasible were ranked by their Average Incremental Social Cost (AISC) to indicate their cost effectiveness and the results of this analysis have been used to formulate the least cost strategy to achieve Ofwat's baseline water efficiency target.

In line with current best practice, the deterioration in the effectiveness of each water efficiency measure over time due to various reasons such as breakdown, lack of maintenance, removal or replacement, has been modelled using a time varying yield curve assumption, based on exponential decay and dependent on the asset life of each measure. Thus, although the proposed programme will meet the 1.01 Ml/d target in each year of AMP5 (as shown in Figure 6.10), the total water efficiency saving will not reach 5 Ml/d over the five year period from 2010-11 to 2014-15, due to decreasing yield assumptions (as presented in Figure 6.11).

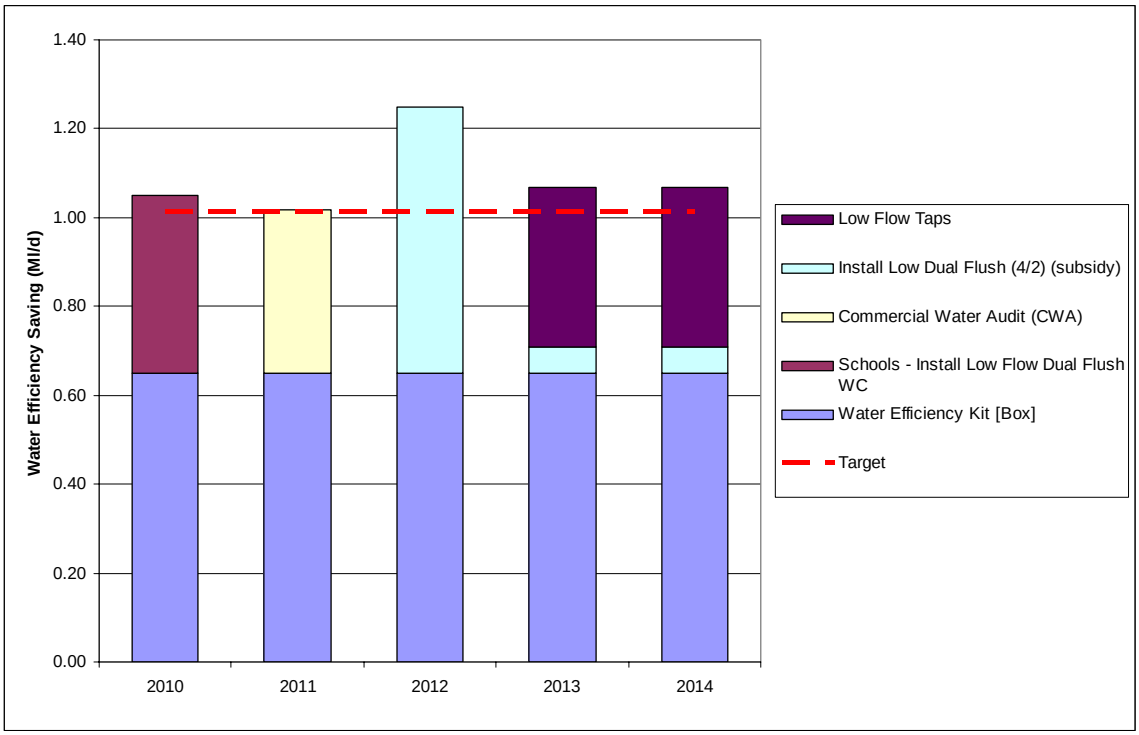


Figure 6.10 Company Level Water Efficiency Schemes to meet the Ofwat Target in Each Year of AMP5

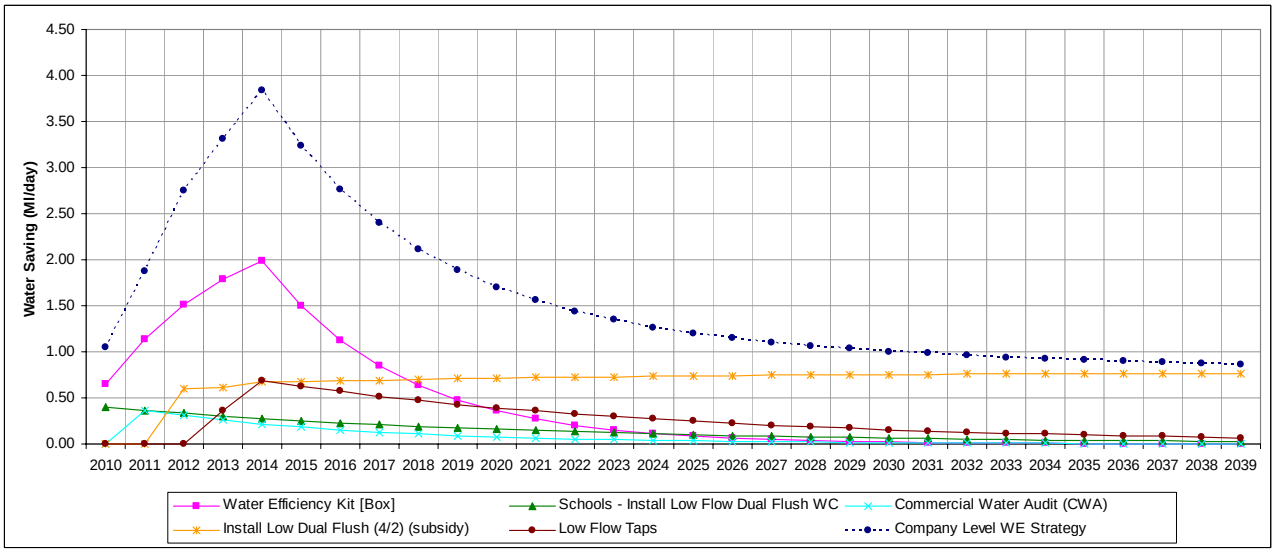


Figure 6.11 Company Level Ofwat Target Water Efficiency Activity Through the Planning Period

6.5.7 Climate Change Effects on Demand

The effects of climate change on demand have been estimated using the results from the *Climate Change and Demand for Water (CCDeW)* report[12], which was published in February 2003 as an update to a benchmark study by Herrington in 1996[13] .

[12] SEI (2003), Climate Change and Demand for Water, Stockholm Environment Institute, Oxford.
[13] Herrington P, (1996), Climate Change and the Demand for Water. HMSO

The CCDeW study examined the impact of the UKCIP02 climate change scenarios across a number of socio-economic customer groups to provide a range of potential impacts on water demands extending from the 2020s to the 2050s.

The Beta socio-economic scenario, entitled 'World Markets', has been used as this is most similar to conventional development. There is little difference between the climate change scenarios for the 2020s, and so the medium-high emissions scenario has been used because most information is provided on this within CCDeW. For domestic demand, this gives a 1.45% mean increase in the 2020s, while for the 2050s factors the mean increase is 2.92%. For commercial / industrial demand, a mean of 2.7% has been used in the 2020s, while for the 2050s the mean was 5.7%.

The methodology adopted to apply the CCDeW factors is described in detail in Appendix E.

6.6 Summary of Forecast Demands

A number of different demand forecast scenarios have been use in the development of this WRMP. More details are given in section 9 and section 10. An illustration of the impact on demands of different metering assumptions is given here.

The baseline forecast assumes continuation of existing policies, namely "optant only" except in the Sussex WRZs where meters are installed on change of occupier:

- Normal year average annual demand is forecast to decrease from 564 Ml/d in the 2007-08 to 559 Ml/d at the end of the planning period;
- Dry year annual average demands are forecast to reduce from 607 Ml/d in the base year to 604 Ml/d in 2034-35; while
- Peak week dry year demands are predicted to decrease from 761 Ml/d in 2007-08 to 744 Ml/d at the end of the planning period.

Under the universal metering programme (scenario 3):

- Normal year average annual demand is forecast to decrease from 564 Ml/d in the 2007-08 to 550 Ml/d at the end of the planning period;
- Dry year annual average demands are forecast to reduce from 607 Ml/d in the base year to 595 Ml/d in 2034-35; while
- Peak week dry year demands are predicted to decrease from 761 Ml/d in 2007-08 to 732 Ml/d at the end of the planning period.

By contrast, if the "optant only" metering forecast is used (scenario 1), i.e. without universal metering or change of occupier metering, then:

- Normal year average annual demand is forecast to decrease only slightly from 564 Ml/d in the 2007-08 to 560 Ml/d at the end of the planning period;
- Dry year annual average demands are forecast to reduce slightly from 607 Ml/d in the base year to 605 Ml/d in 2034-35; while
- Peak week dry year demands are predicted to decrease from 761 Ml/d in 2007-08 to 746 Ml/d at the end of the planning period.

The figures below (Figure 6.12 to Figure 6.15) illustrate these forecasts at the company level for these three demand forecast scenarios. Each figure includes the actual and rebased historical demand compared to the three modelled demand forecasts: the baseline is for the continuation of current policies; scenario 1 is the optant scenario (i.e. optant and selective (large water users) only); scenario 3 is for universal metering and consequent reductions in supply pipe leakage.

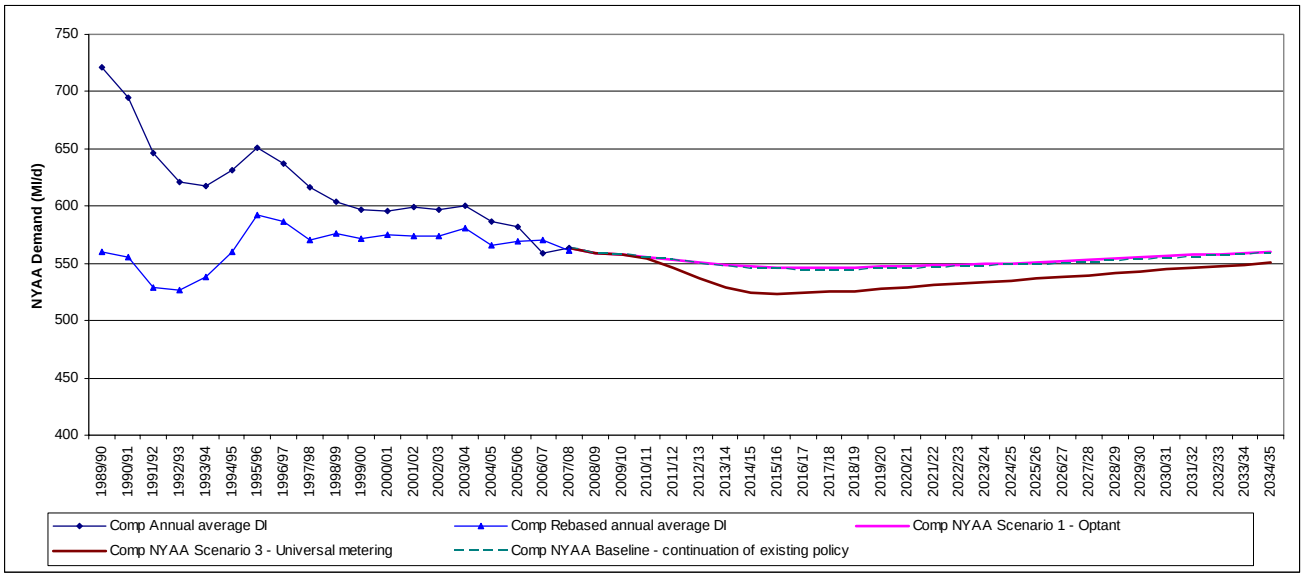


Figure 6.12 Normal Year Annual Average Company Forecast

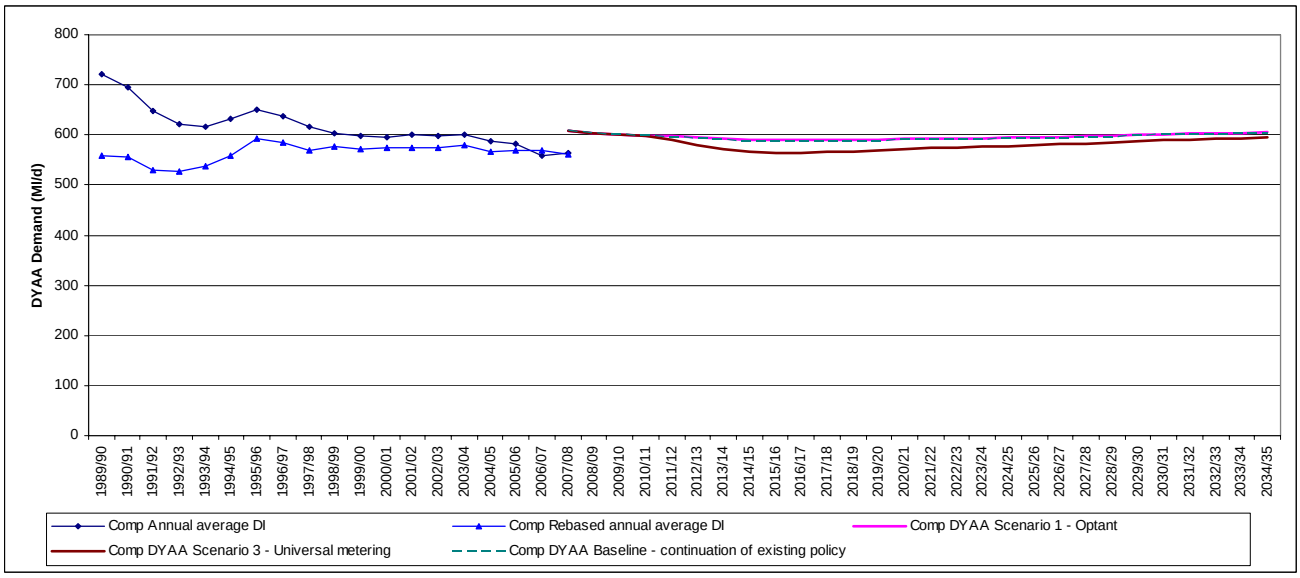


Figure 6.13 Dry Year Annual Average Company Forecast

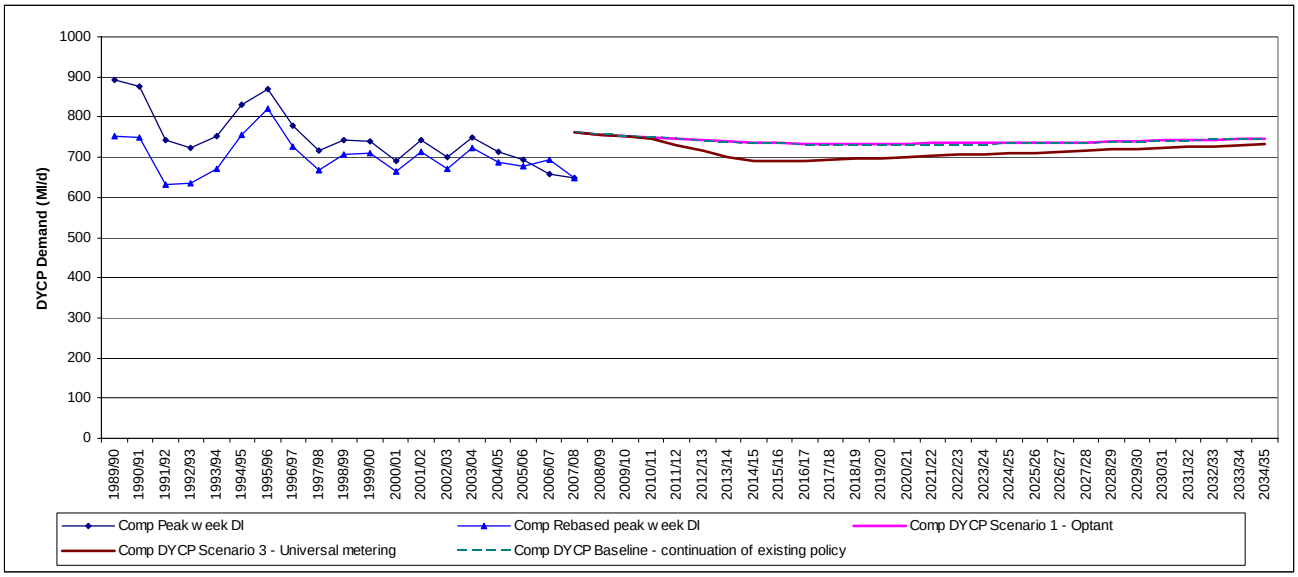


Figure 6.14 Dry Year Critical Period Company Forecast

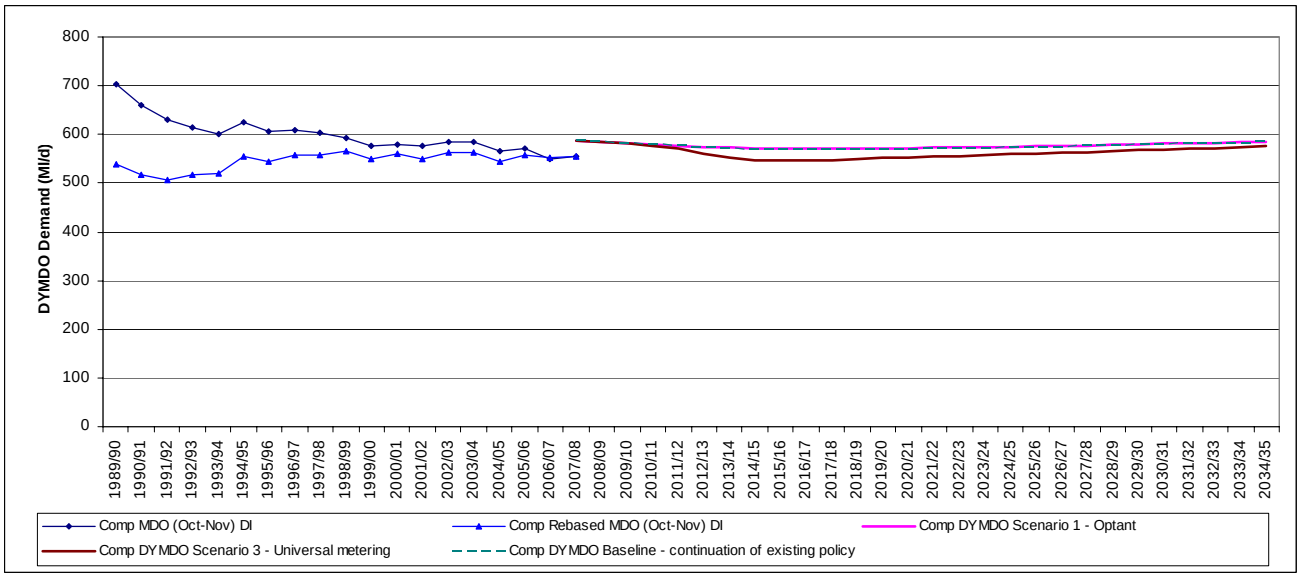


Figure 6.15 Dry Year MDO Company Forecast

The figures below (Figure 6.16 to Figure 6.19) present, at the company level, the demand forecasts for the key metering scenarios investigated during the development of this WRMP.

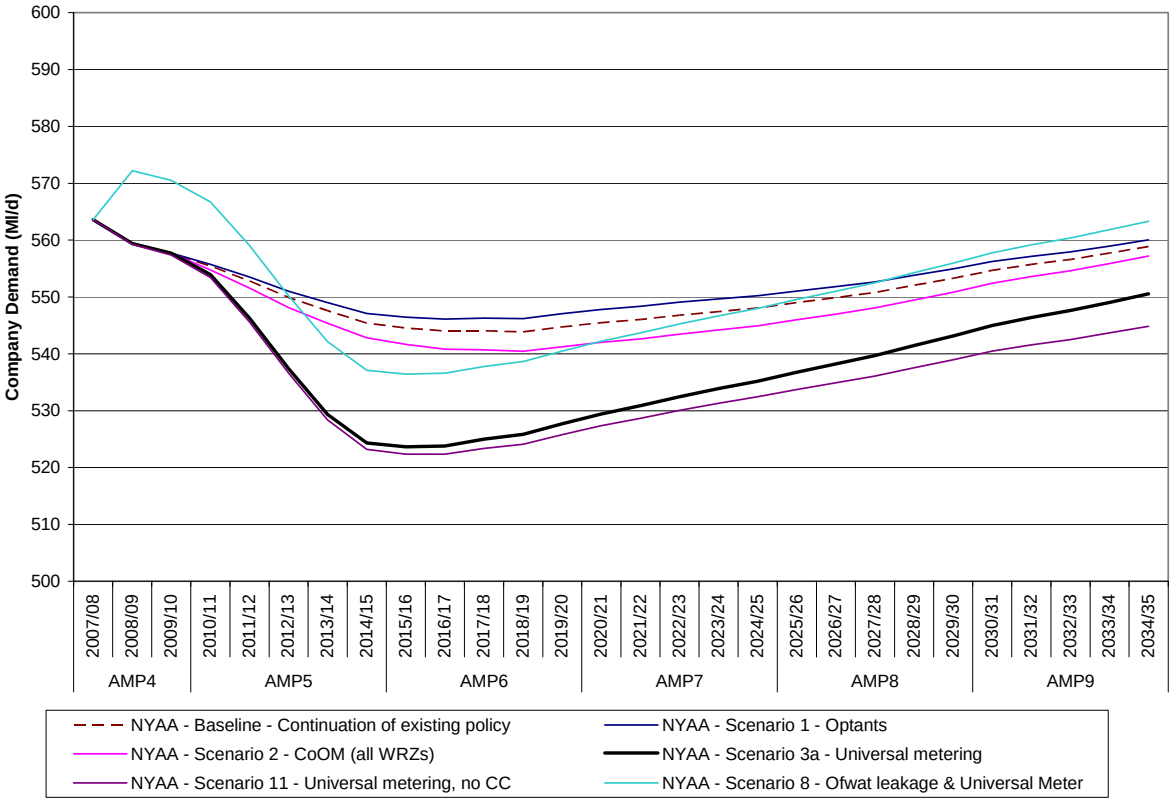


Figure 6.16 Normal Year Annual Average Company Forecasts for all Demand Scenarios

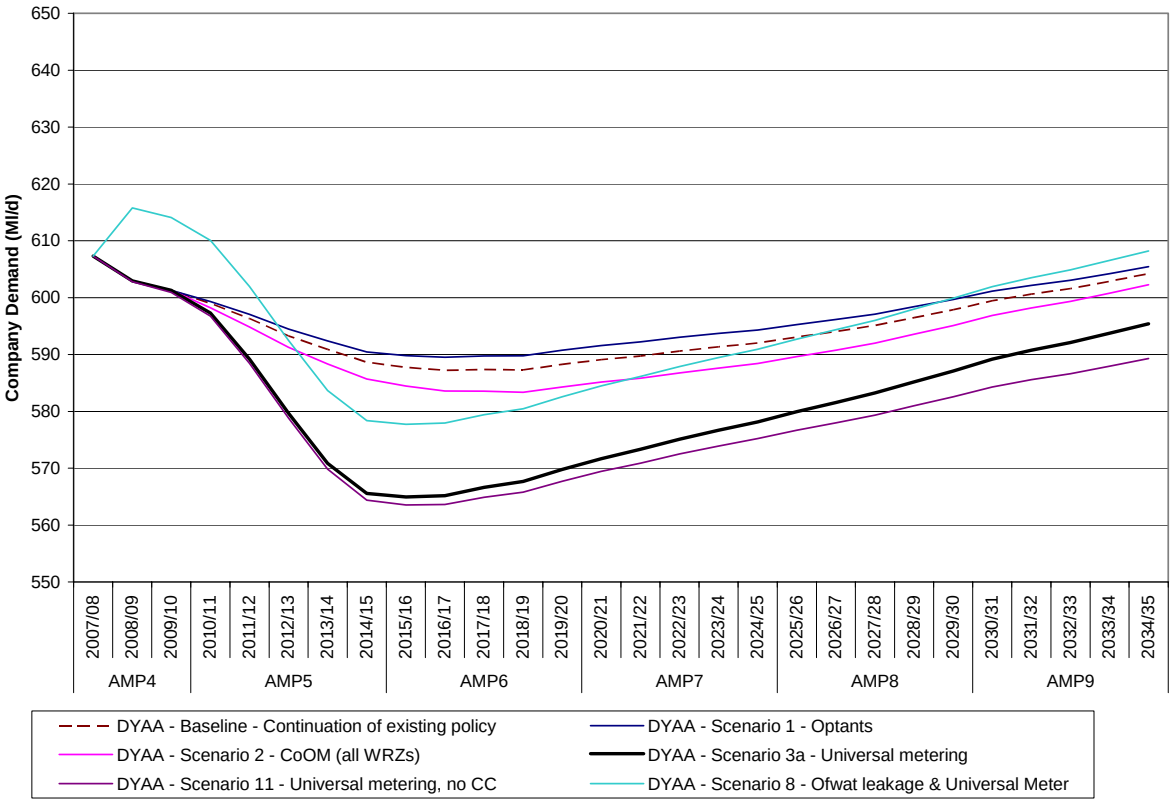


Figure 6.17 Dry Year Annual Average Company Forecasts for all Demand Scenarios

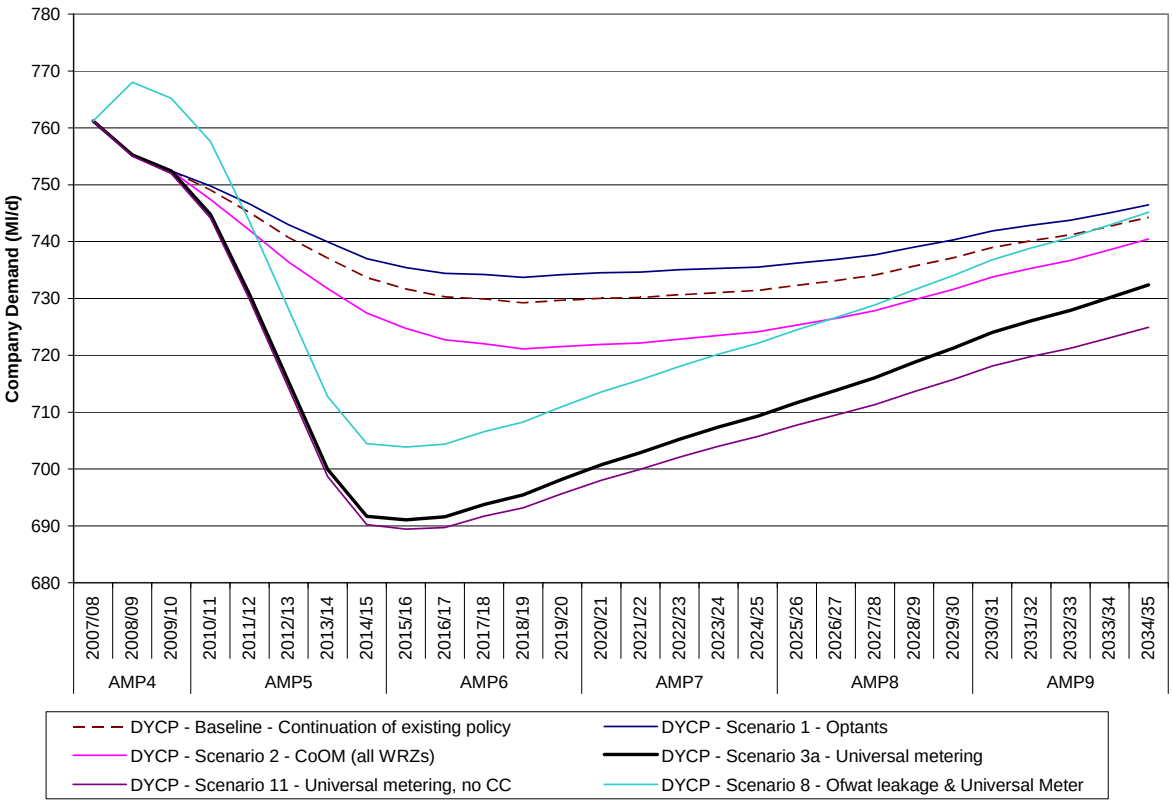


Figure 6.18 Dry Year Critical Period Company Forecasts for all Demand Scenarios

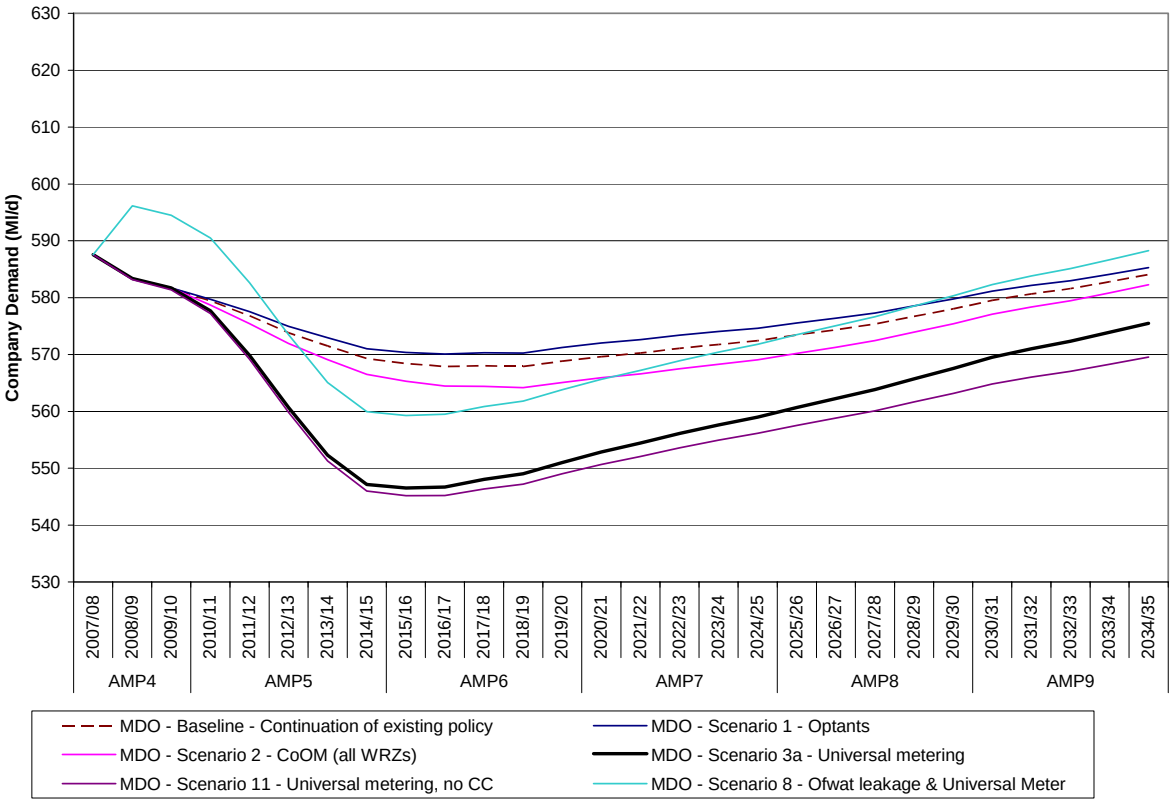


Figure 6.19 Dry Year MDO Company Forecasts for all Demand Scenarios

7 Dealing with Uncertainty

7.1 Introduction

The previous sections have outlined how the estimates for the elements of the supply demand balance have been derived. It is acknowledged that each of these estimates will, by definition, be subject to some degree of uncertainty. This section reviews how uncertainty has been included in this WRMP to ensure the supply demand balance is not put at risk, and also describes what known sources of future uncertainty the company has been advised should not be included in this WRMP.

Uncertainty in the supply demand balance falls into six broad categories:

1. Natural variability in the hydrological/hydrogeological conditions that affect the output available from sources. This uncertainty is typically taken into account when Deployable Output is calculated;
2. Uncertainty in the operational availability of supplies from sources. These are typically specified risks that are taken into account in outage allowances;
3. Variability in the magnitude of forecast demands depending on the assumptions made. This variability is usually taken into account through scenario analysis;
4. Specified uncertainties affecting the supply side and the demand side values used in the supply demand balance. These uncertainties are taken into account in the Target Headroom allowance;
5. Uncertainty in whether and/or when any given demand side or supply side option can in fact be delivered. This form of uncertainty, which includes uncertainties in obtaining planning and other consents, is generally treated deterministically by including an assumed lead time into the option selection process; and
6. Uncertainty due to outcomes from legislation/regulations not having been determined by the relevant regulatory bodies and government departments, including the RSA programme, further Habitats Directive decisions, the Water Framework Directive and other local sites of environmental interest, although some of these uncertainties may be addressed through NEP schemes.

The Tables and Figures in this section have been updated to take account of revisions to the following components of the supply demand balance:

- Deployable Output;
- Impacts of climate change on Deployable Output;
- 2007-08 as the base year for the demand forecast instead of base year of the 2006-07 used for the DWRMP;
- Revisions to forecast PCC; and
- Changes in metering policy.

The selection of the appropriate percentile of headroom uncertainty is referred to as the glidepath. Since the DWRMP, the company has also reviewed the percentile or % risk profile over time on which the selection of Target Headroom was based. Following the review and consideration of comments on the DWRMP, a gradually falling glidepath has been assumed for the first three AMP periods.

7.2 Headroom Uncertainty and Target Headroom

In all planning for future events, it is inevitable that there will be uncertainties about what might happen in the future, and so it is important that the sources of uncertainties are understood, and, wherever possible, managed. Protection against specified uncertainties can be built into the supply demand balance by including a headroom allowance. Headroom is defined as "a planning allowance that a prudent water company should take into account when developing plans to balance supplies and demands and to deliver its Target Levels of Service". This allowance is called "Target Headroom" and is designed to cater for specified uncertainties in both demand side and supply side uncertainties.

Target Headroom is the threshold of minimum acceptable headroom, which, if breached, would represent an increased risk to the company that it would not able to meet its Target Levels of Service. This would then be the trigger for options to either increase the available supplies, reduce demands or a combination of both. If options are not implemented to provide Target Headroom then the occurrence of drought conditions might trigger Drought Permits and/or Drought Orders more frequently than intended. The guidance does not prescribe what level of security of supply a company should aim for, and therefore what level of headroom allowance to use. It is left to each company to determine the Target Headroom that is used in its WRMP.

7.3 Application of the Improved Headroom Methodology

The analysis of headroom used in this WRMP is the Improved Methodology[14], which was first used for the previous PR04 WRP. This methodology requires the uncertainty for each of the headroom components to be defined as a probability distribution. All the headroom components are then combined using Monte Carlo simulation to give overall headroom uncertainty.

The full list of sources of headroom uncertainty is as follows, although it should be noted that the Environment Agency has specifically advised companies not to include some of these elements, as identified below:

Supply side sources:

- S1 Vulnerable surface water sources (included);
- S2 Vulnerable groundwater licences (included);
- S3 Time limited licences (not included);
- S4 Bulk transfers – imports from other companies (included);
- S5 Gradual pollution (included);
- S6 Accuracy of supply side data (included);
- S6/1 Uncertainty for yields constrained by source infrastructure (included);
- S6/2 Meter uncertainty for licence critical sources (included);
- S6/3 Uncertainty for aquifer constrained groundwater sources (included);
- S6/4 Uncertainty for surface water (included);
- S7 Sustainability Reductions (included as described in section 10.3);
- S8/1 Uncertainty of climate change (included); and
- S9 Uncertainty of new source yields (included).

Demand side sources:

- D1 Accuracy of sub-component data (included);

[14] UKWIR, 2002, An Improved methodology for assessing Headroom. Report 02/WR/13/2

- D2 Uncertainty in the demand forecast (included);
- D3 Uncertainty of the impact of climate change on demand (included); and
- D4 Uncertainty of demand management (included).

The headroom calculations for this WRMP have been refined and updated through the use of work undertaken as part of the AMP4 Water Resources Investigations and work specifically undertaken for this WRMP. Further details of the work undertaken and the results are given in Appendix F.

7.4 Results and Discussion

Monte Carlo analysis was undertaken using the appropriate probability distribution parameters set out in Appendix F. The analysis calculated headroom uncertainty from 1,000 iterations of the model; and the results are produced in the form of percentiles. The interpretation of the results is that if, in a given year the available headroom equals, for example, the 90th percentile of the headroom uncertainty, then this ensures that there is a 10% risk that the supply demand balance would be in deficit.

A key feature of the application of the new UKWIR methodology is the selection of the percentile of the headroom uncertainty distribution that is used to set the value of Target Headroom at key intervals over the planning period. In its Water Resources Planning Guideline, the EA notes that "In general we would expect companies to accept a higher level of risk in future than at present". The selection of the appropriate percentile of headroom uncertainty is referred to as the glidepath.

Given the severe consequences in the event of potential or actual failure of the security of supplies, and the need to improve the current actual outturn Levels of Service, Southern Water is averse to exposing itself to unnecessary risk, and is keen to take a prudent approach to setting the value of Target Headroom so that it can achieve and maintain the Target Levels of Service. However, it also acknowledges the importance of not over-planning for risks that may not become reality in the more distant future, towards the end of the planning period, which would increase the apparent need for additional resource development which in the event might not be required.

The selection of headroom uncertainty percentiles and the appropriate glidepath have been reviewed since the DWRMP to take account of the new base year, updated demand forecasts and responses received on the DWRMP.

The level of Target Headroom adopted for the WRMP is the 90th percentile from 2014, the 85th percentile from 2019, and the 80th percentile from 2024; from 2024 onwards, the Target Headroom is kept constant in terms of the absolute value in Ml/d. Values of the proposed Target headroom for the whole company supply area used for this WRMP are given in Table 7.1 and are illustrated in Figure 7.1. The results show that the adopted values of Target Headroom are prudent, in that, in terms of percentages compared to estimated Distribution Input, they are equivalent to 5.3% at the beginning of the planning period, rise to around 6 % at the end of AMP5 and then fall to around 5% by the end of the planning period.

Target Headroom for the Whole Supply Area (Ml/d) and (% of Distribution Input (DI))							
	2007	**2009**	**2014**	**2019**	**2024**	**2029**	**2034**
PDO (Ml/d)	40.38	40.39	41.67	38.55	37.75	37.75	37.75
As % of DI	5.3%	5.4%	6.0%	5.5%	5.3%	5.2%	5.2%
MDO(Ml/d)	31.11	30.85	32.17	29.15	28.63	28.63	28.63
As % of DI	5.3%	5.3%	5.9%	5.3%	5.1%	5.0%	5.0%

Table 7.1 Whole Company Supply Area – Proposed Target Headroom (Ml/d) and % DI

A summary of the percentiles for the first three AMP periods and for comparison estimates of the equivalent percentile (at MDO) for the constant value from 2024 onwards is given in Table 7.2.

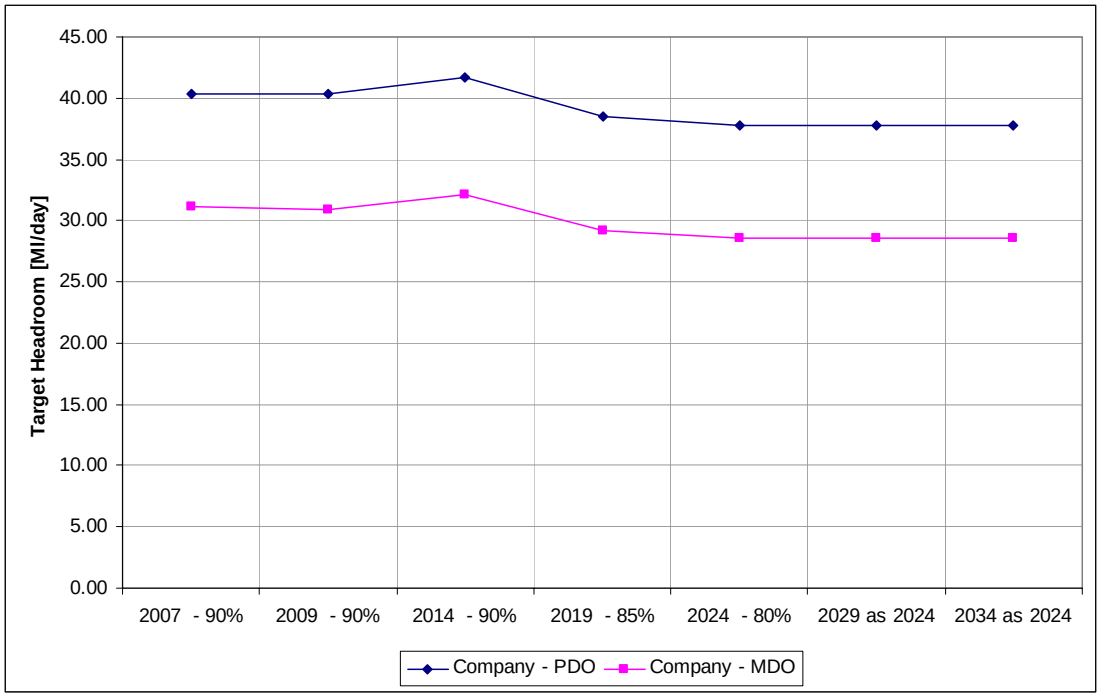


Figure 7.1 Whole Company Supply Area: Proposed Target Headroom

Headroom percentiles for each Area									
	2007	2009	2014	2019	2024	2029		2034	
						MDO	PDO	MDO	PDO
Western	90%	90%	90%	85%	80%	74%	74%	69%	68%
Central	90%	90%	90%	85%	80%	75%	75%	70%	70%
Eastern	90%	90%	90%	85%	80%	76%	74%	69%	68%
Overall	90%	90%	90%	85%	80%	75%	74%	69%	69%

Table 7.2 Whole Company Supply Area – Headroom Uncertainty Percentiles

The output from the Monte Carlo simulation has been reviewed to identify main sources of headroom uncertainty in each of the WRZs and thus the main influencing factors with respect to risk. Tornado plots for the base year and 2034 are included in Appendix F.

The values of demand side headroom have changed as a result of the change in base year and other revisions to the demand forecasts in the light of company policy, reviews of the comments received on the DWRMP, and the more pessimistic economic outlook. However as shown in section 10, the magnitude of Target Headroom is not the dominant driver of the options that make up the company's preferred investment strategy. The value of Target Headroom can however have an influence on the timing of when schemes are required, although the variance is only a few years.

The main consequence of revisions since the DWRMP is that Target Headroom starts at a higher value in the base year, but then stays relatively flat before falling from 2014 onwards. One of the reasons for this is increased uncertainty following the rebasing of 2007-2008 demands (see section 6.2). The sensitivity of Distribution Input to factors outside the company's control is well illustrated by the significant rise in DI in the first part of 2009 associated with a prolonged period of extremely cold weather.

In all WRZs, and under PDO and MDO conditions the main source of headroom uncertainty is in D2 (uncertainty in the demand forecast). From 2024 in many WRZs D4 (uncertainty of demand management) begins to contribute more. S8 (supply side uncertainty associated with climate change) becomes more evident from AMP8 onwards in those WRZs where surface water storage schemes dominate.

The company will continue to work to improve the sources of information that it has available for analysis of uncertainties, and will continue to collaborate on industry-wide studies on climate change uncertainties.

7.5 Uncertainties Not Allowed for Inclusion in this WRMP

In its Water Resources Planning Guideline published in April 2007 and not changed in the November 2008 update, the Environment Agency stated that "Companies should not make allowances for the risk of non-renewal of time-limited licences in headroom" (section 9.3). Ministers have instructed the Environment Agency to ensure that time-limited licences do not present a risk to security of supply. In addition to the risk of non-renewal of licences, there are similar risks to the baseline Deployable Output from a range of environmental drivers such as the Habitats Directive, the RSA programme, the National Environment Programme (NEP) and eventually the Water Framework Directive. The Water Resources Planning Guideline states that "any notice given will provide sufficient time to restore the supply-demand balance…", with the inference that there is no need for a headroom allowance to guard against the risk from time-limited licences reducing Deployable Output.

The Water Resources Planning Guideline also notes that "headroom uncertainty should not be significantly influenced by the headroom components accuracy of supply side data (S6) and "accuracy of sub-component data (D1)/2". However, accuracy of supply side data attributed to uncertainty surrounding source outputs such as uncertainty about Deployable Output has been included in the WRMP headroom analysis because these are valid risks to the security of the source output available to the company. For surface water sources, this component is likely to relate to uncertainties over historic rainfall estimates, rainfall/runoff models and drought severity, whereas for groundwater this is likely to relate to drought severity (Rest Water Levels) and interpretation of the physical constraints such as location of adits, water bearing fissures, borehole screen etc., in relation to the drought bounding curves.

It is worth noting some aspects of the profile of Target Headroom over time. At the start of the planning period, total Target Headroom is 31 Ml/d (5.3% DI) and 40 Ml/d (5.3% DI) at MDO and PDO respectively. The levels of Target Headroom adopted decrease over the planning period, falling to 29Ml/d (5.0% DI) and 38 Ml/d (5.3%DI), respectively, at the end of the period.

At first sight this may appear to be counterintuitive, because uncertainty would be expected to increase over time. This is undoubtedly true, but the value of Target Headroom included in this WRMP reflects the level of risk that the company is prepared to take. This Water Resource Planning Guideline state that companies should be prepared to accept greater levels of risk later in the planning period as reflected in the choice of the percentile of headroom uncertainty used to set Target Headroom. Southern Water has adopted this approach by adopting the following profile: the 90th percentile represents a 10% risk that available supplies will be unable to meet demands plus Target Headroom; the 85th percentile represents a 15% risk; the 80th percentile represents a 20% risk.

The values Target Headroom at the start of the planning period are within the industry range, and the values are justified for the following reasons:

- Over the first AMP period there is considerable uncertainty about short-term demand forecasts arising from: the general economic downturn; the potential for rising consumption as the memory of drought restrictions and associated behavioural changes fades, and the observed and significant increase in Distribution Input following a prolonged period of wet and then very cold weather;

- These short-term uncertainties should reduce over time, as their causes are analysed and more fully understood; and
- Target Headroom then decreases over successive AMP periods as the percentile of headroom uncertainty reduces (with increased acceptance of risk).

A constant value of Target Headroom in the later AMP periods is realistic and pragmatic. If Target Headroom is allowed to increase to the end of the planning period, a supply demand balance deficit would occur earlier than would otherwise be the case, and so additional resource and/or demand side options would be triggered. However, by the time this point is reached, various components of headroom uncertainty would themselves have reduced or been removed, and so the value of Target Headroom would be closer to current values.

We consider that the chosen glidepath makes the overall strategy more realistic, in that it does not include schemes that in all probability will not be required. It also increases the certainty with which we feel the schemes identified in the strategy will actually be required at the dates identified.

7.6 Approach to Reducing Uncertainty

The company has considered the influence of climate change and demand forecast uncertainty in the derivation of Target Headroom, and ways of reducing their influence. It has concluded that the estimates that it has used are representative, and has discussed them with the EA, which accepts its view. The company has also considered the impact of these sources of uncertainty on the Water Resources Investment Strategy. It has been shown that these factors do become increasingly important from AMP8 onwards. However, any potential impact on the investment programme has been mitigated by two factors. Firstly, the selected risk profile caps Target Headroom from the end of AMP7 in absolute terms, and thus the impact of any one parameter becomes subdued. Furthermore, it is correct that any investment identified in 15 years time will again be reviewed in five years time at the time of the formulation of the next WRMP. The baseline Target Headroom in five years time will be probably very close to the current baseline, notwithstanding any revisions to baseline headroom uncertainty. Thus, the investment profile could remain relatively stable and the schemes selected in 15 years time from now, should not be delayed when the review takes place in 5 years time.

8 Options Appraisal

8.1 Introduction

Where there are forecast deficits in the baseline supply demand balance, these can be met through the introduction of supply side options to increase supplies, or demand side options to reduce demand. The effect of these two different types of options on the supply demand balance is shown in Figure 8.1.

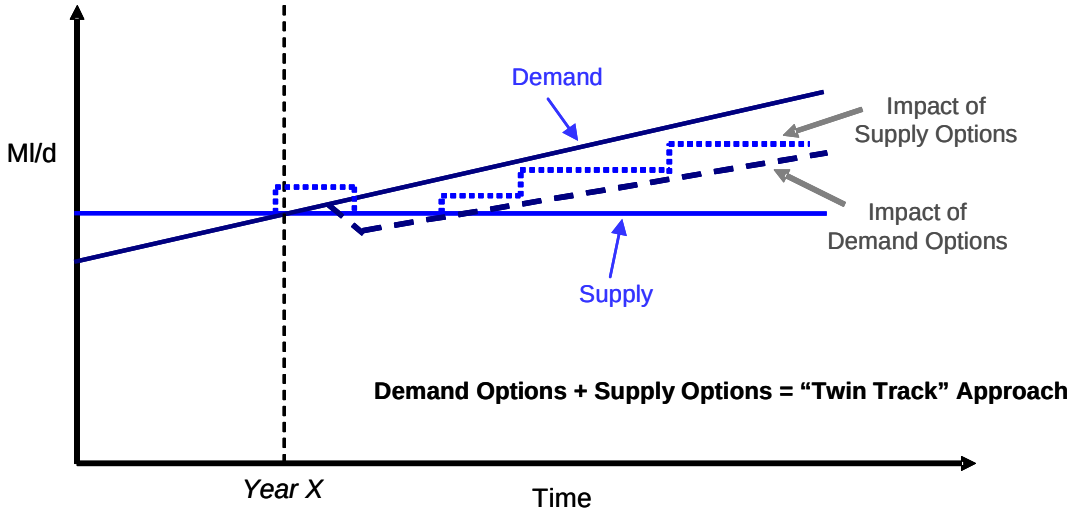


Figure 8.1 Twin Track Approach to Address the Supply Demand Balance

This section sets out an overview of the range of demand and supply side options available, and gives some generic observations on them. The demand side options considered for this WRMP are:

- Increased level of meter installation;
- Introduction of variable metering tariffs;
- Leakage reduction; and
- Water efficiency initiatives.

The supply side options considered are:

- Bulk Transfer;
- Wastewater recycling;
- Aquifer Storage and Recovery;
- Desalination; and
- Area Specific Water Resource Developments.

Details of the specific options within each WRZ and Area have been identified from a number of sources, including the following:

- Options considered as part of previous WRMPs;
- The extensive and detailed AMP4 Water Resources Investigations;

- Options identified by work carried out for the WRSE Group;
- Options from other companies;
- Options identified by respondents during the consultation of the DWRMP; and
- Other options which have been identified from miscellaneous sources during the course of the preparation of this WRMP.

A full listing of the options required for each Area to meet the supply demand balance deficit is provided in section 10, while further detailed description of each option is provided in Appendix G. The selection of options was informed by Strategic Environmental Assessment (SEA); a summary of the SEA assessments of each of the generic options is given in section 8.3. The environmental and social impacts, and possible mitigation measures for options selected in the WRMP strategy are discussed in section 10.

8.2 Demand Management Options

Demand management options can be effective in controlling what might otherwise be unrestricted growth in demand for water, which itself can trigger investment in resource developments earlier in the planning period. The implementation of demand management measures is therefore an important component of the company's approach to water resource planning.

Previous WRMPs have included demand management programmes such as: domestic metering on change of occupier; selective and optant metering programmes; aggressive leakage reduction activity; and the promotion of water efficiency initiatives. As a result, the company's level of domestic meter installation is higher than the England and Wales average, and the company is one of three water companies referred by Ofwat as reporting significant increases in free supply pipe replacements.

The demand management options under consideration in this WRMP were generically assessed for their environmental effects in the SEA Report. They were found to be broadly compatible with the majority of SEA objectives, having a net positive environmental effect due to the minimal amount of physical intervention required in implementing each measure.

Demand management describes various policy and technical initiatives that are available to a water company to manage demands, and includes the following:

- Increasing levels of meter installation;
- Introducing variable metering tariffs;
- Leakage reduction; and
- Water efficiency initiatives.

An unconstrained list of all potential demand management options was identified, based on previous work conducted as part of the AMP4 Water Resources Investigations, and from a full literature review of the current issues, costs and potential benefits associated with all possible demand management options. All options were reviewed, and those that were not applicable were discarded. Feasible options were then assessed in more detail and, where appropriate, an economic assessment was undertaken.

Whilst there may be strong political and environmental reasons for promoting demand management measures, their role of demand management measures in a long-term least-cost investment plan may depend on the characteristics of the supply demand balance, and in particular the magnitude of any deficits, when such deficits occur, and the time when new supply side options might become available. Where there are large deficits, that arise from step changes in the supply side of the supply demand balance as a result of Sustainability Reductions and/or reappraisal of deployable output using more robust and long-term hydrological and operational data, then it is unlikely that demand management measures on their own would be sufficient to reduce a deficit, but would form part of a twin-track approach.

Nevertheless, the company believes that an ambitious demand management programme should underpin the long-term strategy for its water resources. This WRMP is based on a the most cost effective and sustainable strategy , which includes a suite of significant demand management initiatives on enhanced domestic metering installation, further leakage reduction and water efficiency initiatives.

8.2.1 Metering

Metering is generally considered to be one of the most effective means of reducing demand, as it provides a financial incentive to use water more efficiently. The company currently meters all new connections in its supply area, and on change of occupier in its Sussex WRZs.

The rationale behind domestic metering as a demand management measure is that paying by volume of water used should encourage customers to use water sensibly and to restrict the discretionary use of water for activities such as garden watering and car washing. Paying by volume may also encourage efficiencies in non-discretionary use such as toilet flushing, clothes and dish washing, bathing and cooking.

Also identified is the potential for customers to modify their water using behaviour in response to paying by volume. This can be reinforced by the company through household water efficiency campaigns such as those investigated for this WRMP; e.g. subsidies for water-efficient washing machines, dishwashers and low-flush WCs, household water efficiency kits and other devices. The opportunity for introducing water efficiency initiatives on the back of increased meter installation was identified through the consultation process and taken into account in this WRMP strategy.

The SEA identified that metering has the potential for disturbance to local communities in the short term during their installation, but this negative effect is considered non-significant and is far outweighed by the overall environmental benefits of metering. The company proposes installing external meters which should minimise disruption to households, and implementing the installation programme simultaneously over a large area which will help minimise any disturbance to communities.

The impact of all these consequences from metering is reflected in Per Capita Consumption (PCC), expressed in l/head/day. In the past, PCC has remained relatively constant, however, this WRMP has been based on a micro-component forecast of PCC, taking into account potential technological and regulatory changes in future, as well as estimates of potential customer behaviour changes.

The assumptions of the savings that might be delivered through metering used in this WRMP are in line with current industry thinking. There is a risk that savings in PCC may not be sustained in the long term, but it is assumed that this risk can be managed through a combination of water efficiency campaigns, customer awareness and potentially the implementation of a variable tariff structure to limit discretionary use.

A range of different domestic metering options have been considered and the associated impact on the demand forecast taken into account in the supply demand balance and investment modelling. The scenarios investigated are:

- Baseline metering policy (optant and selective only, with current change of occupier metering in the Sussex WRZs finishing at the end of AMP4;
- Change of occupier metering policy extended to all WRZs; and
- Universal metering in all WRZs during AMP5 (2010-15), together with associated benefits of reduced supply pipe leakage losses.

Based on the results of cost benefit investigations, the company preferred policy is to undertake a programme of universal metering throughout its supply area, during AMP5. Universal metering also enables focus on leakage from customers supply pipes, and it is considered that significant further leakage savings will be achieved.

8.2.2 Tariffs

Variable tariffs based on volume usage are widely considered to be a useful mechanism for encouraging more efficient water use, particularly at peak times. However, the prerequisite for any tariff is the installation of a meter. The subsequent success of a varying tariff structures is likely to be dependent on the level of meter installation, so might not be applicable until late in the planning period if the metering policy selected does not reach the high level of meter installation rates rapidly. However, it may be a feasible option to consider if meter installation is accelerated due to universal metering.

Therefore, an additional demand management option considered in association with a universal metering programme is the use of sophisticated tariffs. A literature review was conducted in order to estimate the additional reduction in demand due to implementing variable (rising block) and seasonal tariffs. Social implications, such as the impact on customers' bills and vulnerable customers, will need be given due consideration when proposing future charging policies.

Current research suggests that, on completion of the universal metering programme, the development of appropriate tariffs could lead to further reductions in demand of up to 5% at annual and potentially up to 10% at peak, over and above the effect of metering alone[15]. These options have been included in our potential future options, but can only be considered when meters have been installed.

8.2.3 Leakage Reduction

Southern Water currently operates below their Ofwat target level of leakage, which was set in 2005. Our new leakage level is as a direct response to the drought of 2004-06. The option to allow leakage to rise back to the target level has been considered and subsequently rejected as it does not form part of a longer term economic strategy. The SEA assessed that leakage reduction had the potential for negative effects to local communities due to disruption, dependent upon the scale of the works involved, but that these effects would be short term. However, in the long term, leakage reduction was found by the SEA to be compatible with a number of the SEA objectives as it enables the best use of existing resources.

The company proposes to maintain leakage at the existing low level in the baseline supply demand balance and implement additional leakage reduction over the planning period where it is economic to do so.

As part of the sustainable economic level of leakage (SELL) assessment, costs of reducing leakage in gradual steps over the short and long term have been calculated for each WRZ. These costs and savings are compared directly with all other options in the investment model in order to determine a least cost strategy.

The proposed leakage strategy would be implemented during the next asset management plan cycle, 2010 to 2015, on the back of the proposed strategy of universal metering, which will assist in further reducing supply pipe leakage.

8.2.4 Water Efficiency

Companies are expected to achieve a Sustainable Economic Level of Water Efficiency (SELWE) as part of their economic approach to balancing supply and demand over the planning period. This is in addition to measures introduced to achieve the baseline Ofwat targets, known as the Base Service Water Efficiency (BSWE) target (see discussion of the baseline target in section 6).

Water efficiency measures are regarded as the preferred demand management measure from the SEA perspective as they have no potential conflicts with the SEA objectives.

A range of water efficiency options were individually assessed for their potential to contribute to reducing household and non-household demand, their cost and their practicality. An

[15] Herrington (2007), Waste not, want not? Water tariffs for sustainability. Report to WWF-UK.

unconstrained list of feasible options and the assessment process is detailed in Appendix G. Some options, such as grey water recycling, are considered unviable due to very low cost effectiveness. The following water efficiency options, however, were considered viable for consideration in the company's strategy:

Household options:

WCs

- Cistern displacement devices (CDD);
- Retro-fit dual flush mechanisms; and
- Low dual flush toilets (4/2 litre) (subsidy scheme).

Domestic Taps

- Tap inserts; and
- Low flow taps.

Showers

- Shower timers; and
- Low flow shower heads.

Other

- Low use washing machines (subsidy scheme);
- Low use dishwasher (subsidy scheme);
- Household water audits (HHA); and
- Household water efficiency kit, which comprised two options:
  - Household water efficiency kit with manned household audit; containing CDDs, tap inserts, low flow shower heads, shower timers, tea towel, booklet containing advice on water efficiency, and involving a manned audit to distribute devices as requested by the customer; and
  - Standard kit for distribution upon customer request; containing CDD, tap insert, shower timer, tea towel and booklet, and involving a basic self audit.

External devices

- Trigger hoses;
- Water butts

Non-household options:

- Commercial water audits (CWA);
- Schools and universities (low dual flush WC replacement).

Costs and water savings were calculated for each option and the most cost-effective were selected to meet the baseline water efficiency target. Other viable options not included in the baseline strategy were then considered in the investment model alongside all other supply and demand side options and considered available from 2010-11. Options selected in the baseline were also able to be reselected towards the end of planning period if required under a least-cost strategy. Some options were treated as mutually exclusive as appropriate.

The results of the investment modelling and company SELWE strategy are discussed in section 10.

8.3 Resource Development Options

A number of supply side options have been investigated for this WRMP. The detail of these options is considered in sections 10.2 to 10.4 for each Area. The range of options considered can be sub-divided into the following categories, each of which is described below:

- Bulk Transfer;
- Wastewater recycling;
- Aquifer Storage and Recovery;
- Desalination;
- River augmentation schemes; and
- Area Specific Water Resource Developments.

8.3.1 Option Screening Process

The screening process made use of work conducted by Atkins under the AMP4 Water Resources Investigation projects, which covered all Southern Water Areas. The objectives of the screening process were:

1. To provide a comprehensive list of 'unconstrained' options that could be considered in order to provide additional water supplies to each of Southern Water's Water Resource Zones. This included all schemes that had been previously considered by Southern Water in the AMP4 Water Resources Plan, as well as additional schemes that were identified by either Southern Water or the Environment Agency as part of the AMP4 Water Resources Investigations evaluation process.
2. To provide a summary technical evaluation of each option, to determine whether it represents a viable water resource development that should be considered in greater detail, or whether there are fundamental reasons why the scheme is unsuitable for further investigation. The following could be justifiable reasons for exclusion of schemes at the initial stages:
   - Technical feasibility;
   - Practicality, reliability and deliverability; and
   - Environmental or social impacts that mean the option is fundamentally unacceptable.

Options that address improving deployable output at existing sources through routine asset maintenance / source improvements were not included within the options appraisal work. These types of options (where feasible and practicable) are already incorporated in water resource modelling as completed options

All studies and options were the subject of review and, where appropriate, further desk based research to determine a list of "feasible" options. The constrained options were each examined in terms of:

- The practicability of the option;
- Its potential benefit in water resource terms;
- The extent of environmental impact, on both aquatic and terrestrial ecology;
- Its potential impact on other factors, such as heritage, noise and air pollution;
- Any constraints on the option in planning terms; and
- Its cost, in terms of both the capital and operational expenditure required, including an allowance for the cost of carbon.

The environmental and social costs / benefits of each option were estimated, where possible, using the Environment Agency's Assessment of benefits for water quality and water resources schemes in the PR04 Environment Programme (Environment Agency, 2003);

known as the Benefits Assessment Guidance, or BAG. However, there are inherent uncertainties associated with the calculation of these environmental costs and benefits, and not all transfer costs involved were necessarily adaptable to the wide range of options assessed.

The result of the option screening process was to produce a list of "feasible" options for each of Southern Water's three sub-regional areas, with associated cost, that could then be used in the investment model to derive a least-cost plan over the 25-year planning period.

8.3.2 Strategic Environmental Assessment (SEA)

Those options considered as feasible following the screening process were then subject to a Strategic Environmental Assessment (SEA) as part of the WRMP process and to fulfil the requirements of the SEA Directive (see section 1.4).

This assessment expanded on the identification of environmental and social impacts by the AMP4 Water Resources Investigations for each of the water resource options considered in the DWRMP. Potential mitigation measures were also considered, particularly with reference to those options included in the proposed WRMP strategy.

A high level compatibility assessment was carried out for each of the generic resource development options outlined below, against 17 SEA objectives in order to identify conflicts between the two in the short, medium and long term. A brief summary is given of the findings of this high-level assessment for each of the generic options.

Overall, a number of potential conflicts between WRMP resource development options and SEA objectives were identified. The SEA found that the extent of these conflicts was dependent on the nature of implementation and location of the specific options. Therefore the feasible list of WRMP options was subject to further in-depth SEA investigation, the results of which informed this WRMP strategy. The environmental and social impacts and possible mitigation measures for options selected in this WRMP strategy are discussed in section 10.

8.3.2.1 Bulk Transfers

Bulk transfers are a means of supplying additional water to a WRZ with a supply demand balance deficit from a WRZ with a supply demand balance surplus. The range of possible transfer options open to Southern Water includes:

- Enabling transfers (inter-zonal transfers between Southern Water WRZs);
- Inter-company bulk transfers within the South East region;
- Termination of existing bulk supplies to other water companies; and
- Transfers from outside the South East region.

The transfer of water from areas of surplus to those of deficit has always been a fundamental part of Southern Water's water resources strategy. However, a key consideration is the availability of surplus supplies in potential donor WRZs or other companies. Consideration also needs to be given to other factors such as the magnitude of the surplus available, the timing of availability and the duration for which it is available.

The SEA found that bulk transfers were compatible with a number of SEA objectives but depending on the requirement for construction of additional pipelines and routing, they may have potential conflicts against some SEA objectives, particularly during the construction phase.

8.3.2.2 Wastewater recycling

The recycling of wastewater, to reduce pressure on existing water abstractions and further resource development options, can be sub-divided into the following categories:

- Direct potable re-use;
- Direct non-potable re-use;
- Indirect potable use: recharge of groundwater aquifers; and
- Indirect potable use: supplementing river flows and surface water storage.

However, there are a number of other issues associated with the recycling of wastewater that need to be considered and overcome if it is to be widely adopted in the future. These relate to environmental impact of wastewater discharge, public health, public perception and cost. The only categories that will be considered as part of this WRMP process are direct non-potable re-use and indirect potable use by augmenting river flows and surface water storage. Direct potable re-use is unacceptable due to the high levels of risk and the recharge of groundwater using wastewater is not permitted under European legislation.

The advantages of wastewater recycling schemes are that they should be resilient to climate change, and offer flexibility in implementation and operation. However, there could be serious concerns raised with regards to the energy usage involved to operate such schemes, bearing in mind the possibility of multiple pumping and treatment required. There are examples of indirect wastewater recycling schemes across the company's supply area, although they may not be perceived as such in view of their size.

The SEA found that, while compatible with some SEA objectives, wastewater recycling has the potential for negative environmental impacts. These are associated with the potential infrastructure and additional pipelines required and the nature of the treated wastewater, dependent upon the nature of implementation of the scheme. The SEA concluded that the potential for negative medium/long term impacts could be reduced by appropriate mitigation measures.

8.3.2.3 Aquifer Storage and Recovery

The principle of Aquifer Storage and Recovery (ASR) is that either potable water, or raw water that could be used for potable purposes, is injected into a confined or semi-confined aquifer to create a 'bubble' of fresh water than can be re-abstracted when required.

The SEA report found that the environmental applicability of ASR relates to the impacts that such a scheme would have on parts of aquifers that either affect surface water bodies or sources that are currently used for potable water. Taking into consideration its broad compatibility with SEA objectives, subject to the nature of implementation and potential mitigation measures, the SEA concluded that ASR was the preferred resource development option.

8.3.2.4 Desalination

Desalination considers the opportunity of making use of saline groundwater, and coastal and tidal river waters which cannot be exploited by traditional treatment techniques. It has become less expensive in recent years as the cost of membrane technologies used in reverse osmosis processes has reduced. The potential sources of saline water are:

- Coastal Waters;
- Tidal Rivers;
- Offshore Waters;
- Deep Groundwater; and
- Coastal Aquifers.

The first two sources, coastal waters and tidal rivers, are the two most commonly identified sources, and are probably the easiest to design and manage from an operational viewpoint.

A number of environmental factors were taken into account when considering desalination during the AMP4 Water Resources Investigations, among which are:

- Construction and the subsequent abstraction and brine discharge may have adverse environmental impacts on coastal and marine habitats and wildlife;
- Treatment works may have significant visual impacts, especially in residential, tourist and designated areas along the coastline;
- Significant supporting infrastructure (roads, power, pipelines) is required, which may have social and environmental impacts;
- Tidal rivers in the South and South East of England are considered a valuable habitat and many of those within or near the company's supply area are subject to one or more environmental designation;
- Groundwater aquifers, given that they are likely to be non-renewable (i.e. a fossil aquifer), when subject to abstraction may have impacts on adjacent aquifers;
- Extraction from coastal aquifers may result in saline intrusion into fresh groundwater sources; and
- The potential requirements in terms of energy, although these can be reduced if the plant is only used intermittently, and modern design includes the facility for much enhanced energy recycling and the use of green energy source.

The SEA generic assessment of desalination as an option found that it has the potential for conflicts with a number of SEA objectives in both the short, medium and long term. These were dependent upon a number of factors relating to the nature of implementation of the plant and potential mitigation measures for long term impacts suggested. These are discussed in section 10.

8.3.2.5 Area Specific Water Resource Developments

These options refer to the various Area specific options that are not covered by the categories above. They all include the development of new resources in specific locations within each of the Areas. The options in this category are outlined below, and can vary widely in terms of the volumes of supplies available, from minor local source improvements to the development of major strategic options such as surface water reservoirs:

- New surface storage reservoirs;
- Increases in abstraction from either surface or groundwater;
- Enlarging existing reservoirs;
- Re-commissioning old/existing licences;
- Licence variations; and
- Upgrading Water Supply Works treatment facilities.

The availability of any of these options will vary considerably within each Area, and so each option needs to be considered on its own merits. However, it must be remembered that the development of an option in one WRZ can have an effect on all interconnected WRZs within the Area.

The SEA assessment at generic level identified a range of potential conflicts between different Area specific options and the SEA objectives, and each scheme was subject to more detailed analysis. These findings are contained within section 7 of the Environmental Report and a summary findings and discussion of potential mitigations measures for options included in this WRMP strategy is provided in section 10.

8.4 Other Considerations

There are a number of factors that influence the choice and timing of options to address a forecast supply demand balance deficit. These are as follows:

- **The Nature of the Deficit**

In any given WRZ, a forecast supply demand balance deficit may arise under one or more of the conditions defined by the ADO, PDO or MDO scenario (see section 4.4). The deficit triggers the need for new investment in demand or supply side options and the conditions which are the drivers of the need for such investment may have a direct bearing on the appropriateness of one option over another. For instance, a deficit under a PDO scenario may be able to be solved by increased treatment capacity or higher meter installation, whereas average or minimum resource period imbalances may require the development of more storage, the provision of a more reliable supply of water such as wastewater recycling or desalination, or again, increased meter installation and further leakage reduction;

- **Magnitude of an Option**

A key factor is obviously the potential that a given option has to reduce demand or increase deployable output such that available headroom equals or exceeds Target Headroom;

- **Cost of an Option**

Costs take into account both the initial capital investment required and the subsequent operational costs of a given option;

- **Timing of Availability**

Some options require a long lead time before they can contribute to the supply demand balance. Both the lead-time and the confidence in that lead-time (i.e. the likelihood that it will be available when it required) are important. Confidence in lead-times reduces sharply with an increase in the number and complexity of factors on which an option depends that are outside the control of the company;

- **Reliability of an Option**

This addresses the confidence that a given option will "deliver" the required reduction in the supply demand balance deficit. Where an option depends heavily on assumptions about changes in customer behaviour, or may be significantly impacted by some of the climate change scenarios, they would be considered less reliable than an option which will be unaffected by such factors (e.g. large storage options; wastewater recycling; and desalination). Furthermore, most options on the supply side will require some form of consent, for example planning permission, abstraction licence or any other form of consent. The potential for being granted these consents must be a factor to be considered;

- **Energy and Carbon Costs**

Like environmental impacts, energy and carbon costs need to be well understood. The monetary costs of energy will be automatically taken into account as part of the assessment of capital and operational costs of an option. It should also be understood that high energy costs should not automatically be equated with high carbon costs, since the company may choose to supply the energy needs of an option from renewable sources; and

- **Social and Political Acceptability**

Some options for demand management or new water resources are subject to greater social and/or political acceptability criteria than others. An obvious example would be the direct recycling of wastewater which may not be considered a socially acceptable option despite the availability of technology to treat wastewater to the required drinking water standards.

9 Formulation of the Water Resources Strategy

9.1 The Investment Model

The objective of the water resources investment model is to ensure that sufficient supply and demand side measures are identified to maintain the supply demand balance, for each critical period scenario, throughout the entire 25-year planning period (2010 – 2035) at least cost. Therefore, if there is a supply demand balance deficit for any critical period planning scenario during the planning period, the least-cost strategy should select the option, or combination of options, which maintains the supply demand balance at least, discounted, cost, given the assumptions for the model run.

The method used to determine this least-cost solution follows the Water Resources Planning Guideline, and uses the methodology recommended in the UKWIR report[16] "Economics of Balancing Supply and Demand". This recommended the use of a mathematical optimisation model, based on the technique of integer programming. Southern Water has adopted this approach, and has used the optimisation software What'sBest! (WB!) version 9.0. A description of the model is given in Appendix H.

The modelling approach consists of a number of different elements and processes, as presented in Figure 9.1. This schematic shows how the strategy, as reported in section 10, is developed.

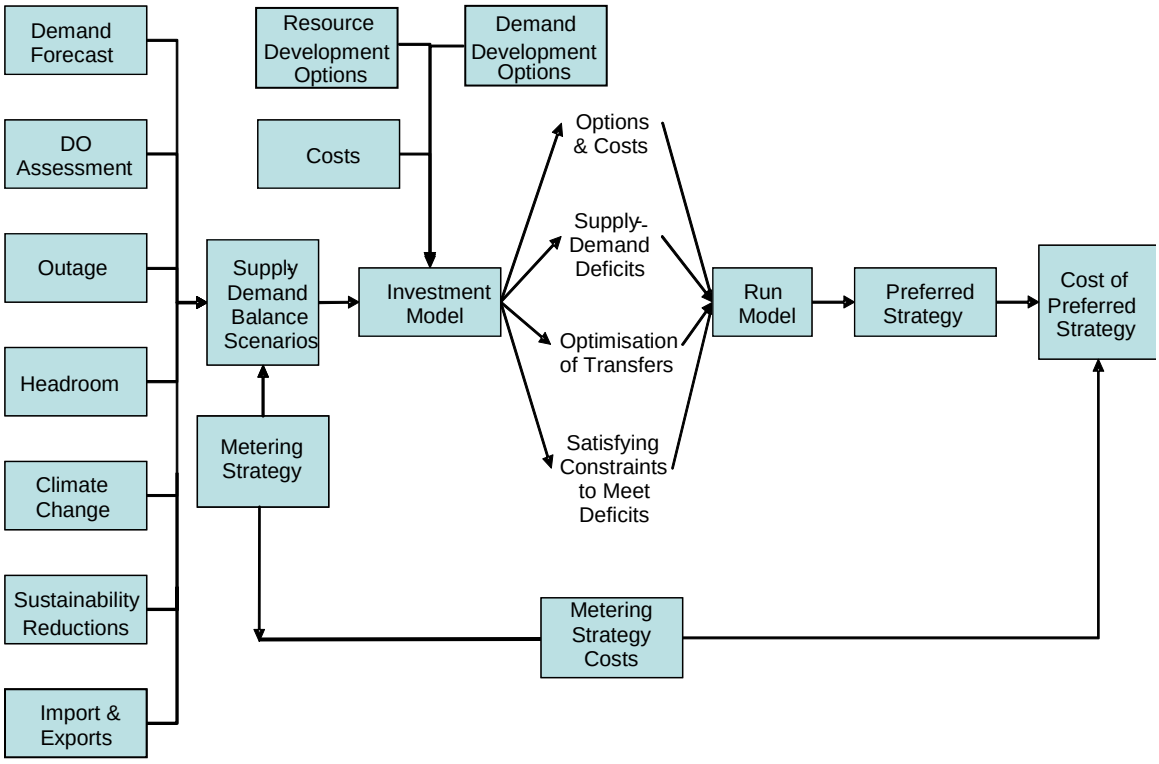


Figure 9.1 Schematic of Investment Modelling Approach

[16] UKWIR, 2002, The Economics of Balancing Supply & Demand (EBSD) Guidelines. Report 02/WR/27/4

Separate investment models were developed for each of the three sub-regional areas. This was because although the building blocks for the strategy are the WRZs, there are inter-connections between WRZs, either current or potential, that make up the sub-regional areas. Thus, actions in one WRZ can have an impact on other inter-connected WRZs. As a result, the model has to take account of the supply demand balances in all the WRZs in the Area at the same time in order to develop a co-ordinated least-cost solution.

The investment modelling process considers both supply and demand side options. However, the optimisation process is computationally difficult and very time consuming, as a result of the complexity of the problem and the immense number of iterations that have to be made. Consideration of the different demand management options can make this process even more complex.

Demand management options were introduced in the investment model in the following way:

- Water efficiency options were included as individual options, available every year, each with its own capex, opex and savings;
- Leakage options were potentially more difficult and complex in that there could be a start date for every year of the planning period, and an infinite amount of leakage reduction to achieve. To assist in the modelling process a number of discrete leakage reduction volumes were calculated. Further details are given in Appendix G.
- Metering options are more difficult to introduce in to the model because there could be individual options which comprised all the combinations of a start date for every year of the planning period, and an end date of any interval between the start date of the programme and the end of the planning period. In order to overcome these difficulties it was decided to create a number of scenarios which would simplify the modelling process. It was considered that very high levels of metering would be achieved by the end of the planning period, even if this was only as a result of optants. This is because of the number of switchers now observed since the introduction of the free optant switching option. Following classification as an area of serious water stress, the company had to consider universal metering as part of the 25-year strategy. Work was undertaken (see Appendices G and H) which showed that it was more cost effective to introduce universal metering over a five year period than, for instance over the whole of the planning period. Accordingly, it was decided that the universal metering programme would be introduced as a scenario which assumed a five year programme starting at the start of AMP5, i.e. 2010. The results of this scenario, in terms of costs and benefits, was compared with three other scenarios: one based solely on optants (scenario 1); and the other based on change of occupier throughout the company's area (scenario 2), as against solely Sussex, where this policy is already in force; and the third based on a continuation of the existing metering policies in each of its' ten water resource zones.

9.2 Scenario Modelling

The model output will be the least-cost solution, given the input data and assumptions that underpin the values of this data. However, it is often useful to check the robustness of a given solution or test alternative solutions, if other underlying assumptions were used. This is known as scenario modelling.

In essence, the approach used for scenario modelling is to change the baseline input data, assuming different assumptions to derive the values of the input data. The model is then re-run, and the resulting solution checked against the baseline solution.

Details of the different scenarios and results from the investment modelling are reported in section 10, where the following scenarios have been tested:

- Baseline: continuation of current metering policies, comprising "change of occupier" (CoOM) in the Sussex WRZs and optant metering in all other WRZs;
- Scenario 1: An "optant" strategy, with metering assumed to be optant and selective (large water users) only;
- Scenario 2: CoOM in all WRZs. This was useful for comparison with the company's preferred demand management-led strategy of universal metering;
- Scenario 3: A "universal metering" strategy for all WRZs to achieve 100% penetration by the end of AMP5, together with associated savings due to supply pipe leakage reductions;
- Scenario 4: A "regional" strategy comprising scenario 3 metering but with WRSE-preferred resource developments and bulk supplies to other water companies;
- Scenario 8: A "leakage rise to Ofwat target" strategy;
- Scenario 11: A "universal metering no climate change" ; and
- A hybrid scenario comprising "universal metering" in those WRZs that would otherwise have a supply demand balance deficit, and continuation of existing metering policies in those WRZs without a supply demand balance deficit (i.e. CoOM in the Sussex WRZs and Optant metering in the other zones).

9.3 Sensitivity Testing

The robustness of the selected strategy can be assessed by undertaking sensitivity analysis. Sensitivity analysis comprises determining the impact on the strategy from changes in the values of the input data, given the same basic assumptions. A number of potential sensitivities were identified and considered for both the Supply Forecast and the Demand Forecast.

For example, changes to the Supply Forecast could include such items as: changes to Deployable Output through the adoption of new methodologies, or in the light of new data; the introduction of further reductions in deployable output as a result of further Sustainability Reductions; and the potential loss of sources.

Sensitivities to the Demand Forecast could include such items as: differences in assumed demand savings as a result of metering; changes in demand due to the introduction of more efficient household design; and reductions in demand due to the development of more sophisticated tariff structures

9.4 The Importance of Strategic Decisions

The processes of option identification, appraisal and investment modelling have been progressively refined and improved over the last 10-15 years and, in combination, form a sophisticated and robust approach to water resources planning. However, there still remains the need for the company to make sensible strategic decisions regarding options that might not otherwise be chosen by the systematic approach described above.

This is particularly the case in the consideration of metering and in deriving this plan the costs and benefits of metering have been fully explored to ensure that it could be compared equally with resource development schemes and leakage reductions. Strategic decisions also need to be taken in the consideration of resource options. For example, if the forecast supply demand balance deficit is relatively small and unlikely to grow significantly over time a single solution, or a series of small-scale solutions will be appropriate. However, if demand is forecast to increase significantly over time, leading to a large supply demand balance deficit, the situation needs to be considered from a strategic viewpoint. While a series of smaller

scale options may be appropriate, there may be some circumstances in which investment in a single, much larger option is the best way forward (see Figure 9.2). Although this may result in a significant surplus or resources in the short-term, it may prove to be the most effective long-term solution and facilitate the provision of bulk supplies to other companies in the interim should they be required.

Furthermore, the importance of environmental considerations must be recognised. There may be environmental considerations, both in support of and against, all schemes, which are often difficult to express purely in monetary terms. In this respect, the Environmental Report, undertaken as part of the Strategic Environmental Assessment, has been used to help assess such environmental considerations. The Environmental Report on the WRMP was made available as part of the consultation for the DWRMP, and an SEA Statement will be published alongside the final WRMP report, summarising how the information and results in the final WRMP and Environmental Report (revised following consultation on the draft Environmental Report and DWRMP) have been influenced and informed by each other (see section 10.1.9).

The need to make strategic decisions does not remove the need for very clear arguments to support them, but it does mean that it is always important for the company to review the outputs from its options appraisal and investment modelling to ensure that the company preferred strategy really is the optimal solution for the company, its customers and the environment.

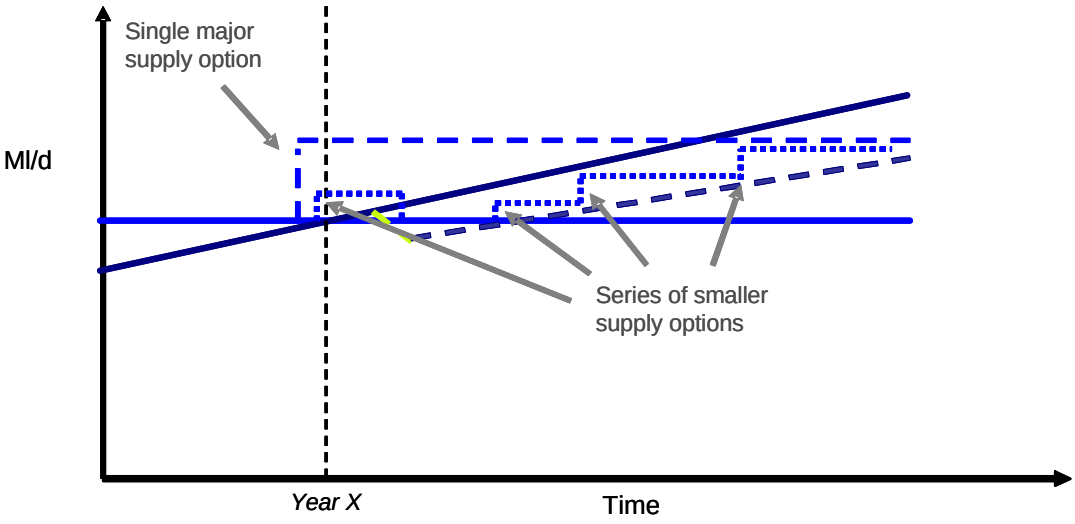


Figure 9.2 Illustration of Options to Address the Supply Demand Balance

9.5 The Importance of a Regional Solution

As mentioned in section 2, the water supply system within the South East of England is very complex, due to the nature of the individual company systems which have been developed independently for over more than a century. There are a number of water companies, each sharing boundaries with a number of other companies. It is also the area with the most pressures on it, being not only classified as an “area of serious water stress”, but also likely to be in the forefront of the effects of climate change.

Given the complexity of the situation, there are a number of benefits arising from the development of a regional strategy which is reflected through the integration of the strategies of the individual companies. The benefits of such an approach include the following:

- It demonstrates joined-up thinking between companies, and identifies synergies with the strategic plans of other companies;
- It avoids the potential for the selection of mutually incompatible or even mutually exclusive schemes to be selected;

- It creates the progression of regional developments that might avoid pursuing individual company strategies that could lead to unnecessary developments which could in turn result in the creation of excessive headroom, greater environmental impact, a solution that is not least-cost and higher customer bills than necessary; and
- It creates the opportunity to make the optimum use of limited resources, and realise any potential for economies of scale with minimum impact/cost.

9.5.1 The Work of Water Resources in South England Group (WRSE)

The WRSE Group was formed in 1999 to progress the joint strategy for the South East region. Southern Water has already adopted a number of the conclusions for the sharing of resources identified by the group, with the following schemes being successfully completed during AMP4:

- Export to South East Water from Darwell, facilitated via the upgrade of the Bewl-Darwell transfer;
- Export to Folkestone and Dover Water via a bulk supply from Deal High reservoir; and
- Import from Portsmouth Water to the Sussex North/Sussex Worthing WRZs, facilitated by a variation to the Eastergate group licence.

Central to the work of the group during AMP4 has been the development of a regional water resources investment model under the direction of the Environment Agency. The model is an optimisation model, and applies the methodology recommended in the Economics of Balancing Supply and Demand. The modelling platform uses the software package WhatsBest!, which is the package used by Southern Water and a number of other companies.

Input data has been provided by the individual companies and has been subjected to cost consistency checks. A number of different scenarios have also been investigated. It is accepted that, as the data is proved by the companies themselves, there should be some consistency with the modelling work of the companies themselves. However, it also means that there may be some difference in the design standards used by the various companies, such as: the metering policy; Target Levels of Service for the frequency of restrictions; design conditions for the estimation of Deployable Output and the adopted target headroom glidepath.

It must be recognised that it has never been the intention that the regional model will give a single, definitive solution that should override the more detailed modelling work of the individual companies. However, by investigating a number of different scenarios, for instance with different PCC estimates or differing population forecasts, in the modelling work, it should be possible to identify those schemes which are “most commonly selected”, and which therefore could be expected to be worthy of further investigation by the individual companies. As such, the results of the regional model should be used to inform the formulation of strategy at individual company level.

It is also important to recognise that the results of the model identify the most commonly selected schemes; it also identifies the most often selected ways of allocating or sharing such resource developments to create the building blocks for a regional solution. It is then the responsibility of the companies to identify, investigate and agree on the potential bulk supply and/or shared resource schemes.

It will be realised that the modelling work requires iteration between the models/data updates of the companies and the EA. The iterative process comprises:

- A bottom-up approach, whereby the companies provide updates of their data, and company preferred solutions for use in the regional model; and
- A top-down approach, whereby the Environment Agency runs the regional model, and feeds back the regional results to the companies for comparison/use within their models.

9.5.2 The Results of the WRSE Regional Model

There have been a number of major modelling phases during AMP4. There was a substantial set of runs undertaken during the latter part of 2008 that used data from DWRMPs where possible. However Southern Water, in common with some other companies, felt that the results were not sufficiently definitive, nor were they produced in time for them to be taken into consideration. Nevertheless Southern Water has included in the baseline condition renewal of all existing bulk supplies until the end of the planning period at the pre-existing volumes, in order to support the notion of a regional solution.

Since submission of the DWRMPs the draft Business Plan another major WRSE modelling exercise was undertaken. This allowed comparison of the DWRMPs company preferred strategies with what might be a more regional solution. The results of this exercise, which compared the sum of the individual company strategies with a regional strategy, allowed for shared developments/bulk supplies, and should reduce the available headroom above target headroom, and also the overall total cost of the regional strategy.

The results of the regional model were provided to the technical WRSE group and to the Managing Directors group.

The results of the regional model suggested that within a regional context for shared resources and/or bulk supplies there could be the development of other options identified by Southern Water; namely the raising of Bewl Water, the Aylesford wastewater recycling scheme and the provision of a bulk supply to South East Water from Sussex Brighton WRZ.

The results of the most recent WRSE modelling were not available at the time of this FWRMP.

9.5.3 Influence of the Regional Results on this WRMP

Southern Water has accepted the results of the WRSE regional model available to date, and has agreed to include them within its own model. These are discussed more fully in the commentary of the individual Area strategies in section 10.

The schemes that have been included within the Southern Water company preferred regional strategy as a result of the results of the WRSE regional modelling work are:

- Introduction of River Medway scheme licence variation;
- Acceleration of Aylesford wastewater recycling scheme;
- Raising Bewl Water;
- Enhancement of bulk supply to FDWS, which, although not within the WRSE results, was identified by the companies and agreed to be a more realistic than a desalination scheme that was identified in the results from the regional modelling work;
- Provision of new bulk supply to SEW from Sussex Brighton WRZ; and
- Development of a Memorandum of Understanding, with Portsmouth Water Company and the Environment Agency regarding the progression of the River Itchen Sustainability Reduction.

It was expected that a further set of regional modelling runs would be undertaken during early summer 2009 making use of data from final Business Plans and any further updates since the Statement of Response. As noted in section 9.5.2 the results have not been available to inform further update of the FWRMP and therefore the plan has used the most up to date modelling work prior to publication, to inform the plan.

9.5.4 General Principles for the Provision of Bulk Supplies

The inclusion of some regional schemes within the baseline condition of this WRMP, either for joint scheme development and/or shared resources/bulk supplies, will result lead to additional

costs over and above the company-only strategy. The resulting final planning scenario will therefore not be the least-cost strategy for Southern Water on its own. It is therefore essential to state the conditions that will ensure that the customers of Southern Water are not disadvantaged by the inclusion of these schemes in the company preferred regional strategy.

The exact terms and conditions of any future agreements between Southern Water and other companies for the provision of supplies, either from bulk transfers or joint development, will be determined on a case-by-case basis. The following points set out without prejudice the general principles which will underlie any inclusion of regional strategy schemes within the company's WRMP:

- Company's own customers, and their security of water supply, are of paramount importance in the provision of bulk supplies;
- Water is a commodity for sale, and as such, can be used for the provision of bulk supplies;
- Any incremental expenditure on the company, be it from the renewal of existing bulk supplies, or the provision of new ones, should be met entirely by the recipient company; and
- The promotion of any new scheme that allows the provision of new bulk supplies would be expected to be subject to the same level of environmental scrutiny as any other scheme.

10 The Water Resources Strategy

10.1 General

10.1.1 Introduction

The previous sections have described the various elements and stages in the development of the water resources strategy that is presented in the Water Resources Management Plan. Of particular importance are:

- The need to develop a robust and resilient supply system that will not fail under the most severe conditions;
- The considerable number of challenges facing the water industry in general, and those specific to the South East region and Southern Water;
- The principles underlying the process of water resources planning;
- The derivation of the key building blocks for the formulation of a water resources strategy, namely the:
  - Supply Forecast;
  - Demand Forecast;
  - The treatment of likely uncertainties;
  - Supply and demand side options available;
  - Use of the investment model to determine a company preferred solution;
- The influence of a regional solution; and
- The outcome of the Strategic Environmental Assessment (SEA).

This section now uses all the above considerations to formulate the water resources strategy.

10.1.2 Objectives of the Water Resources Strategy

The objective of the water resources strategy is to ensure the security of supplies for the next 25 years through the development of a robust and resilient supply system that is able to:

- Reduce the risk of failure under any foreseeable scenario to an absolute minimum;
- Meet Target Levels of Service to our customers and the environment;
- Be firmly based on a demand management-led approach, supported by resource development as appropriate;
- Ensure development of a water supply system that can cope with increased housing development;
- Be fully prepared to meet the challenges of climate change, and to take into account the adverse impact of carbon emissions;
- Develop those options that are the most environmentally sustainable, whilst being economically effective, and socially and politically acceptable, from the options available;
- Select appropriate demand and supply side options that can be implemented in a timely manner as and when they are required;

- Tailor the specific area strategies to the specific individual requirements of the areas;
- Be flexible enough so that it can be adapted to changing circumstances; and
- Contribute to an integrated regional solution.

10.1.3 Development of Individual Area Water Resources Strategies

The details of the water resources strategy for each area and for each WRZ are set out in sections 10.3 to 10.5.

The strategy is presented using the following structure:

- An overview of the key features of the area and WRZs, in terms of location, sources of supply and their management, a summary of demand, recent strategic developments and performance against Target Levels of Service;
- A summary of the baseline supply demand balance for each of the WRZs in the area and a review of some of the key issues to be addressed. The assumptions for the baseline scenario are given in the area sub-sections below, and full build-up tables of the supply demand balance are given in Appendix I;
- The demand and supply side options available to meet any supply demand balances deficits;
- The influence of the WRSE work and the need to contribute to a regional solution;
- The influence of the findings of the SEA, including discussion of mitigation measures for options selected in the area strategy; and
- A presentation of the strategy for the area, with accompanying discussion and justification. The elements of the water resources strategy are set out for the following time periods:
    - AMP5, the first five years from 2010-11 to 2014-15, which will form the basis of the Final Business Plan Submission;
    - AMP6 to the end of the planning period, 2015 to 2035, based on the least-cost strategy for a company only strategy; and then
    - An explanation of how this AMP6 to the end of the planning period company only strategy is modified to take into account the recommendations of the WRSE regional modelling results. It should be noted that this comprises the current company preferred regional solution, as described in this final Water Resources Management Plan.

The baseline assumptions for supply and demand side measures are described. It is assumed that inter-zonal transfers will be managed as appropriate throughout the planning period; the transfers are mentioned here for completeness.

The company preferred regional strategy is then summarised in Section 11 which sets out the company's water resources investment strategy throughout its area of supply until the end of the planning period in a regional context.

As required the WRP Tables have been prepared for the baseline and the final planning solution only. The Tables have been compiled in a separate document.

10.1.4 The Baseline Condition

The baseline condition is used to define the starting point for the WRZ supply demand balances from which the final planning solution is developed. The baseline condition represents continuation of current management policies.

The main constituents of the baseline supply demand balances are:

- The Supply Forecast based on current values for deployable output and improvements to be made during AMP5;
- The Demand Forecast based on externally-derived population and household growth projections and most significantly the level of meter installation and reductions in supply-pipe leakage that would be achieved under continuation of current company policies; and
- The renewal of existing inter-company bulk supplies until the end of the planning period at the rates in place at the time existing agreements expire.

Using these assumptions for the baseline supply demand balances over the whole of the planning period defines all the changes in the supply demand balance that might be expected to occur, irrespective of any additional intervention by the company. The baseline represents a "no-change" condition and shows whether any deficits would occur over the planning period and what the magnitude of any deficit would be.

The different elements included in the baseline supply demand balance are described in the following sections.

10.1.5 Supply Forecast

The supply forecast section sets out the values of deployable output that have been used in this WRMP.

The following values for surface water deployable outputs have been used:

- From the base year 2007-08 to the end of AMP4 (2009-10), the values are the original PR04 values, in line with the PR04 baseline condition, together with any AMP4 improvements; and
- From the start to the end of the planning period, 2010-11 to 2034-35, the values are those derived from the analysis described in section 5.2.

The situation is more complex for groundwater. A progressive series of values has been used to reflect the changing assumptions for the different time periods as follows:

- The base year 2007-08, which will use the original PR04 values, in line with the PR04 baseline condition, or 2006 re-assessments (where available);
- For 2007-08 these values also include any AMP4 improvements in deployable output to date and will remain constant until the start of the planning period (2010-11);
- For the start of the planning period, 2010-11, the values used will take into account the 2006 re-assessments, together with the results from the Unified Methodology;
- During the AMP5 period up to 2014-15, these values will be modified to take into account any AMP5 planned source improvements; and
- Up to the end of the planning period in 2034-35, the values used will be those used at the end of AMP5.

10.1.6 Demand Forecast

Demand forecasts for a number of metering policies have been fully tested to understand the most optimal metering policy. Under a universal metering policy the installation of the meters will be completed in 5 years and the repair of the supply pipes contribute to the continued reduction of leakage.

The following four metering strategies were tested as part of the process to identify the most suitable strategy for the company in the future:

- A continuation of existing policies;
- A policy of optant metering only;
- A policy of change of occupier metering only; and
- A policy of universal metering.

Each policy has been modelled and the resultant resource strategy determined. The combination of these costs is then used to determine the overall cost effectiveness of the strategy.

10.1.7 Inter-Company Bulk Supplies

The baseline assumptions are that all existing inter-company transfers, both imports and exports, will be renewed and will continue to be renewed until the end of the planning period at the volumes at the time existing agreements expire.

10.1.8 Customer Levels of Service

Two measures can be used to demonstrate the effects of droughts on the company's Target Levels of Service:

- The number of years that restrictions have been in force (expressed as a percentage), irrespective of the duration during the year; and
- The amount of time on average that customers have been subject to restrictions, calculated as the percentage of the actual (population times weeks of restriction) compared to the total (population times weeks under review). This measure could be considered to be a more accurate reflection of actual levels of service, as it takes into account both the population affected, and the total time for which it was affected. If Target Levels of Service are being met then this measure would not exceed 10%.

A summary Table showing the frequency of restrictions compared to the Target Levels of Service is given for each area.

10.1.9 Environmental Levels of Service

A discussion of past performance against environmental Levels of Service in each area is included in the relevant section.

10.1.10 Influence of a Supply Demand Balance deficit

Section 3.3.2.3 notes that in the event that a WRZ or area has a supply demand balance deficit, there is a theoretical risk that, in the event of drought conditions, the supplies will be put under more stress than would normally be the case, and it there is an increased risk that the activities associated with the Drought Plan may have to be introduced, which could involve any of the following:

- Demand side measures such as appeals for restraint up to the introduction of restrictions;
- Supply side measures, if available, to create more deployable output; and
- Applications for Drought Permits/Orders to allow abstraction to continue beyond current licence constraints.

The likelihood of such measures being required depends on, amongst other things, the magnitude of the supply demand balance deficit.

10.1.11 Influence of Water Resources in South East (WRSE) Group

The importance of planning in a regional context has been referred to throughout this plan. The company has been an active member of the WRSE Group. WRSE preferred options have been identified from within the Southern Water option set and were discussed in section 9.

We have received a confirmed request from Folkestone and Dover Water Services for the potential inclusion of an additional bulk supply from Deal reservoir. Portsmouth Water has indicated that it will not be seeking a bulk supply, although it will consider providing one as part of the further work regarding the River Itchen Sustainability Reductions. No other confirmed requests or offers have been received.

In the absence of a complete list of potential requirements from all companies in terms of timing and volume, it was not possible to include them in the baseline supply demand balance. This means that it has not been possible to use the optimisation model that was used for the Economics of Balancing Supply and Demand (EBSD) approach to the company only solution for the development of a regional solution.

The company preferred regional strategy has therefore been derived using the following two-stage process:

- Firstly, a least-cost optimised strategy was derived, which includes renewal of existing bulk supplies; and then
- The WRSE preferred options were "forced" into the strategy to develop a regional solution, at what was considered to be the earliest start date.

This strategy will mean that a margin of headroom above the company's target headroom becomes available over the course of the plan. This margin would then be made available as bulk supplies to other companies. Such a strategy will not be the company least-cost strategy because each of the WRSE options will have been "forced" in at the earliest start date and at the maximum capacity. It will only be possible to derive an optimised, least-cost regional strategy when a baseline regional supply demand balance has been agreed that includes all the potential volumetric and timing requirements of all the other companies. We have discussed this approach with the Environment Agency and we believe that the Agency supports our stance and approach to modelling a regional strategy.

10.1.12 Influence of SEA

10.1.12.1 SEA Process

The SEA Directive (2001/42/EC) makes a Strategic Environmental Assessment (SEA) a mandatory requirement for certain plans and programmes which are likely to have significant effects on the environment. Southern Water considers this WRMP as a "water management plan", thus falling within the terms of the SEA Directive, so an SEA has been undertaken of the WRMP.

In compliance with the appropriate sets of guidance on the SEA process, an SEA Scoping Report was produced and was published for consultation. The responses received were addressed and included in the preparation of the Draft Environmental Report which in turn was published for consultation alongside the WRMP – "Draft for Consultation". The Report summarised the findings and results of the SEA process and presented information on the likely significant effects of the WRMP options considered.

The Environmental Report has now been revised to reflect consultee comments and changes to the draft WRMP. An SEA Statement will be published alongside the final WRMP and will

indicate how the information, analysis and modelling results presented in the final WRMP and Revised Environmental Report have been influenced and informed by each other.

10.1.12.2 Assessment of Options

All options considered in this WRMP have been subject to an SEA as part of the WRMP process and in fulfilment of the requirements of the SEA Directive. This assessment expanded on the identification of environmental and social impacts by the AMP4 Water Resources Investigations for each of the water resource options considered in the draft WRMP. Potential mitigation measures were also considered, particularly with reference to those options included in the proposed WRMP strategy.

A high level compatibility assessment was carried out for each of the generic resource development options outlined below, against 17 SEA objectives in order to identify conflicts in the short, medium and long term.

Overall, a number of potential conflicts between WRMP resource development options and SEA objectives were identified. The SEA found that the extent of these conflicts was dependent on the nature of implementation and location of the specific options. Therefore the feasible list of WRMP options was subject to further in-depth SEA investigation, the results of which informed this WRMP strategy. The environmental and social impacts and possible mitigation measures for options selected in the WRMP strategy are outlined in detail in the following sections.

The demand management measures proposed for the WRMP strategy were also assessed in the SEA. It was found that metering has the potential for disturbance to local communities in the short term during their installation, but this negative effect is considered non-significant and outweighed by the overall environmental benefits of metering.

The SEA identified that leakage reduction had the potential for negative effects to local communities due to disruption, dependent upon the scale of the works involved, but that these effects would be short term. However, in the long term, leakage reduction was found by the SEA to be compatible with a number of the SEA objectives as it enables the best use of existing resources.

Water efficiency measures are regarded as the preferred demand management measure from the SEA perspective because they have no potential conflicts with the SEA objectives.

10.1.13 Scenario Analysis

A number of scenarios have been modelled in order to check the stability of the company preferred strategy. The different scenarios were:

- The baseline condition with continuation of current metering policies;
- An “optant” strategy (scenario 1), with metering assumed to be optant and selective (large water users) only. This assumes continuation of the current policy of change of occupier (CoOM) in the Sussex WRZs until the end of AMP4 only. This is useful for comparison with the company’s preferred demand management-led strategy of universal metering;
- A “change of occupier metering” strategy (scenario 2), which is the logical extension to the existing policy of metering on change of occupier throughout the Sussex WRZs. This was useful for comparison with the company’s preferred demand management-led strategy of universal metering;
- A “universal metering” strategy (scenario 3), which assumed 100% meter installation from universal metering for all WRZs by the end of AMP5, together with associated savings due to supply pipe leakage reductions;
- A “regional” strategy (scenario 4), which uses the company preferred universal metering strategy, but with WRSE preferred resource developments

and bulk supplies to other water companies forced into the company only universal metering strategy. Note that the company is a net exporter under this scenario;

- A "leakage rise to Ofwat target" strategy (scenario 8), in which leakage in each WRZ is allowed to rise to the Ofwat target level, provided it is currently below the target level in that WRZ;
- A "universal metering no climate change" strategy (scenario 11) to investigate the impact of climate change, which uses the universal metering strategy but with no climate change impacts on either supplies or on demand; and
- A "hydrid metering scenario" which comprises of universal metering in WRZs that would be in deficit within the planning period, otherwise there would be a continuation of current metering policy.

A summary of the assumptions for each of the scenarios used for the investment model runs is given in Table 10.1.

Scenario name		Basis of scenario	Resource options		Meter policy			Leakage options			Climate change assumed
			Company selected	WRSE selected	Optants & selectives	Change of occupier	Universal	JR08 – 82Ml/d	SPL reductions	Ofwat Target	
1	Optant	Optant & selective meters only	✓	×	✓	×	×	✓	×	×	✓
2	Change of occupier	All WRZs from AMP5 (Sussex WRZs from AMP4)	✓	×	✓	✓	×	✓	×	×	✓
3	Universal metering	Universal metering in all WRZs	✓	×	AMP 4	×	✓	AMP 4	✓	×	✓
4	Regional strategy	As scenario 3, but with WRSE resource developments and bulk supplies forced in	×	✓	AMP 4	×	✓	AMP 4	✓	×	✓
8	Leakage rise to Ofwat target	Based on scenario 3, but with leakage rising to target level in each WRZ	✓	×	AMP 4	×	✓	×	×	✓	✓
11	Universal metering no climate change	Based on scenario 3 but with no climate change impacts on supply or demand	✓	×	AMP 4	×	✓	AMP 4	✓	×	×

Table 10.1 Scenario Analysis Undertaken

A discussion of the hybrid metering strategy is given in section 10.6.

10.1.14 Sensitivity analysis

Sensitivity analysis was undertaken to determine the robustness of the company only least-cost strategy. Sensitivity analysis comprises checking the stability of this strategy to changes in the input data used for the Supply and Demand Forecasts, given the same baseline assumptions.

A number of potential sensitivities in input data were identified on both the Supply Forecast and the Demand Forecast. Sensitivity analysis of different demand side assumptions could for example take account take account of the following:

- The savings associated with universal metering;

- The assumed additional savings from reductions in supply pipe leakage;
- The increased demand for housing projections higher than those envisaged in the Draft South East Plan; and
- The potential reduction in demands due to the introduction of more water efficient house design.

Similarly, sensitivity analysis of different supply side assumptions could take account of the following:

- Potential changes in deployable output due to the impact of new data or the application of new methodologies;
- Possible increases or decreases from the effect of climate change; and
- Possible reductions in deployable output due to the impact of further Sustainability Reductions, the Restoring Sustainable Abstraction programme and the Water Framework Directive.

In view of the potentially complex interaction of all these potential sensitivities which have different magnitudes it was decided to frame the analysis within two basic sensitivity "envelopes". These comprised a "possible worst-case", and "possible best-case" sensitivity. Using these envelope sensitivities meant that all potential combinations in the variation of the individual input data could be assessed.

10.2 Overview of Water Resources Strategy

The water resources strategy for each area is set out in detail in sections 10.3 to 10.5. For each area the strategy comprises the following elements, although the balance of the various elements will be different in each area:

During AMP5

- Introduction of universal metering by 2015;
- Asset improvement schemes at a number of groundwater sources that had been identified by the recent review of groundwater source performance;
- The optimum use of inter-zonal transfers, as identified by the investment model;
- Additional inter-zonal transfers, as identified by the investment model;
- The renewal of existing inter-company bulk supplies until the end of the planning period, at the rates at the time of contract renewal;
- New source development, if required, to either close any existing Supply demand balance deficits, and/or to restore security of supplies as a result of Sustainability Reductions; and
- Any further investigation of new resource developments that were identified as past of the WRSE regional modelling work.

From the end of AMP5 through the rest of the planning period to 2035

- It is currently envisaged that no further strategic resource developments will be required to meet Southern Water's needs under the company only universal metering strategy;
- The strategy will deliver the objective of keeping to the target headroom line, through a delicate balance of a number of factors, including the following; source maximisation through potential licence variations; the refurbishment of a few small, currently disused groundwater sources, which may require fairly advanced treatment solutions; progressive leakage reduction up to 19% below the current outturn level to offset the need for the development of major strategic schemes; and the introduction of further water efficiency savings where it is economic to do so;

- It should be noted that we have included the effects of climate change on both supply and demand side elements. However, these have only been introduced after the end of AMP5, and thus their inclusion will not have any bill impact; however
- Southern Water has reaffirmed its commitment to the WRSE modelling work, in the form of adopting the WRSE preferred regional options in its strategy in addition to those identified in the least-cost company only strategy. Whilst the introduction of these schemes will lead to available headroom in excess of our target headroom requirements. The inclusion of these regional schemes in the company preferred regional strategy will increase the 25-year NPV by £47.4 million above the company only least-cost strategy. Further details are provided in the description of the individual area strategies. We believe that this will not contribute to any bill impact during AMP5 as the regional schemes will not be introduced until AMP6 and beyond. This approach demonstrates our continued commitment to the development of a regional solution.

10.3 The Water Resources Strategy for the Western Area

10.3.1 Location

The Western Area covers part of the county of Hampshire and the whole of the Isle of Wight. It comprises the Water Resource Zones (WRZs) of Hampshire South, Hampshire Kingsclere, Hampshire Andover and the Isle of Wight. The Hampshire South WRZ is located in the southern part of Hampshire, extending from the boundaries of the New Forest in the west towards the River Meon in the east. The Hampshire South WRZ supplies the cities of Southampton and Winchester and towns such as Romsey and Eastleigh, in addition to the surrounding rural areas. The Isle of Wight WRZ covers the whole of the Island. The Hampshire Andover WRZ is centred on the town of Andover, and includes the surrounding area, while the Hampshire Kingsclere WRZ surrounds the town of Kingsclere.

There are the following inter-zonal connections:

- From Hampshire South WRZ to the Isle of Wight WRZ, via the cross-Solent main; and
- A number of very small interconnections between the Hampshire South and Hampshire Andover WRZs.

There is one inter-company transfer:

- A very small bulk export to Wessex Water; and
- There is also a bulk supply to an industrial customer.

A schematic showing the key features of the Western Area is shown as Figure 10.1.

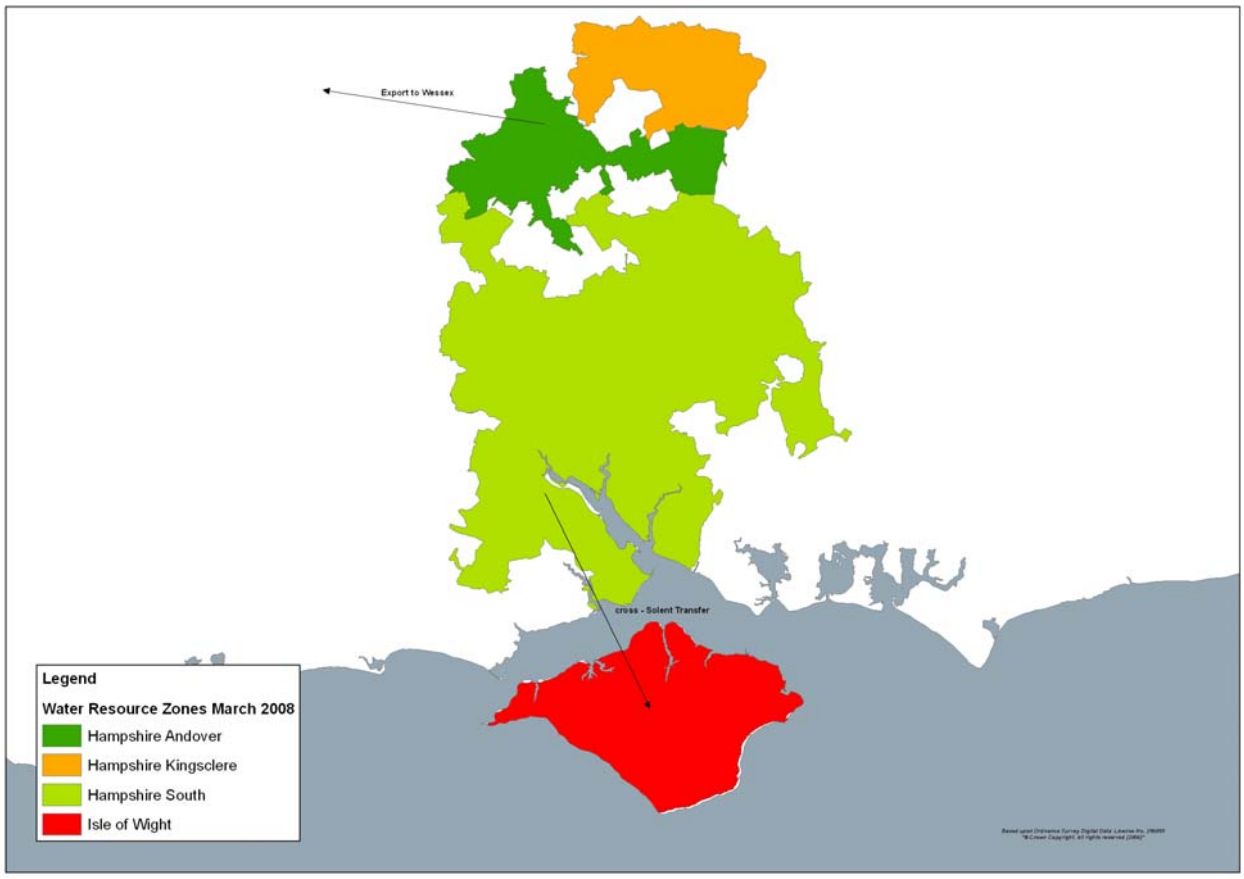


Figure 10.1 Schematic of the Western Area

10.3.2 Sources of Supply

The Western Area is supplied by both surface and groundwater sources. There are three surface water sources and over 30 groundwater sources. The groundwater sources abstract almost exclusively from the Chalk aquifer. The Deployable Output of many of these sources is constrained by the abstraction licence rather than by physical constraints. On the Isle of Wight there are also a number of smaller local groundwater and spring sources from the Greensand aquifers.

The surface water sources comprise the abstractions on the Rivers Test and Itchen in the Hampshire South WRZ, and the Eastern Yar on the Isle of Wight. A significant proportion of the supplies in Hampshire South WRZ is provided by abstractions from the River Test and the River Itchen. Both abstractions are run-of-river sources. Currently there is a Minimum Residual Flow constraint on the Test abstraction, but there are no flow-related constraints in the abstraction licences for the Lower Itchen sources. Flows in the River Itchen can be supported by the Candover and Alre groundwater augmentation schemes which are owned and operated by the Environment Agency.

To date the volume of abstraction from the company's Lower Itchen sources has been limited by the existing licensed quantities and not by hydrology. The groundwater augmentation schemes have not been required to maintain the company's ability to abstract at the licensed volumes. However as discussed in section 10.3.8.1, this situation will change in the future as a direct consequence of proposed changes to these abstraction licences following the Environment Agency Habitats Directive Stage 4 Review of Consents.

The surface water source on the Isle of Wight is located on the River Eastern Yar. It is also a run-of-river scheme. The Minimum Residual Flow condition in the licence means that in most years abstraction is less than the full licensed volume. River flow can be can be supported by

a groundwater augmentation scheme which is owned and operated by the company. Typically the scheme is operated in each year.

The Hampshire Andover and Hampshire Kingsclere WRZs are supplied entirely from Chalk groundwater sources.

10.3.3 Supplies Available

The total deployable output for the area is 307.7 Ml/d at MDO and 339.4 Ml/d at PDO. Each WRZ has a different mixture of types of source, and thus a different ratio of groundwater to surface water. These proportions are shown in Table 10.2, which demonstrates that, whilst the area proportion is roughly 50% groundwater : 50% surface water (MDO), this varies from complete dominance of groundwater in the Hampshire Kingsclere and Andover WRZs, to a balance of around 40% groundwater : 60% surface water in Hampshire South WRZ and 67% groundwater : 33% surface water on the Isle of Wight.

WRZ	Groundwater			Surface Water			Total	
	No. sources	MDO Ml/d	PDO Ml/d	No. sources	MDO Ml/d	PDO Ml/d	MDO Ml/d	PDO Ml/d
HS	8	96.33	114.77	2	149.46	149.46	245.79	264.23
IOW	15	20.72	25.49	1	10.00	12.00	30.72	37.49
HA	6	22.47	28.20	0	0.00	0.00	22.47	28.20
HK	2	8.68	9.48	0	0.00	0.00	8.68	9.48
Total	**31**	**148.20**	**177.94**	**3**	**159.46**	**161.46**	**307.66**	**339.40**

Notes: Values are for indigenous sources only, and do not take transfers, either for inter-zonal or inter-company transfers into account.
Further detail is given for individual sources in Appendix D

Table 10.2 Summary of PR09 Base Year (2010-11) Deployable Outputs for the Western Area

This variation in the groundwater to surface water ratio does not have a major effect in the Hampshire South WRZ because the surface water and groundwater sources are closely inter-linked. However, it does have a significant impact on the Isle of Wight WRZ, as discussed in section 10.3.4.

The deployable output values given in Table 10.2 were used as the starting point for the baseline Supply demand balance from 2010 onwards. There will however be changes to the deployable output of the Lower Itchen sources as a result of the proposed changes to those abstraction licences following the Stage 4 Habitats Directive Review of Consents. These reductions have been included within the baseline Supply demand balance for this WRMP as required for Table WRP1a-BL. Further details and discussion regarding the progressive introduction of the proposed Sustainability Reductions is given in section 10.3.8.1.

10.3.4 Strategic Management of Sources

The Hampshire South WRZ is important for the strategic management of water resources for the Isle of Wight. The nature of the Chalk aquifer means that groundwater sources are reliable and that the aquifer provides the baseflow component of flows in the Rivers Test and Itchen which maintain the run-of river supplies.

The Isle of Wight WRZ is unique in a number of respects. It is not self-sufficient in water resources, and relies on transfers via the cross-Solent main from the Hampshire South WRZ to maintain the supply demand balance. The Island was the site of the largest pilot project of

the National Metering Trials which began in 1989. More than 90% of domestic properties on the Island are metered, and so the options for additional demand savings from metering and the associated reductions in supply pipe losses are limited.

In addition to its demand management activities, the company has developed a strategy to balance supplies from the mainland through the cross-Solent main with indigenous surface water and groundwater resources. The overall aim is to rest indigenous groundwater sources for as long as possible so that there is sufficient groundwater storage to maintain supplies during long dry summer periods. The value of this policy was demonstrated during 2003 when the cross-Solent main was damaged and groundwater sources were needed to maintain supplies on the island. Because the groundwater sources had been rested there was sufficient storage to maintain supplies. The policy also proved valuable during the 2004-06 drought, when the lack of recharge resulted in low levels of groundwater storage so that groundwater source were operating at or close to deployable output.

The Hampshire Andover WRZ has adequate indigenous supplies. Although there are some points where its distribution network is connected to the Hampshire South WRZ, the capacity for transfers between the two WRZs is limited. The Hampshire Kingsclere WRZ is a self-standing WRZ that also has sufficient indigenous supplies.

10.3.5 Demand Summary

Southern Water provides drinking water to a population in the area of about 803,000. Normal year average annual demands are 195.1 Ml/d, which can rise to 214.7 Ml/d during dry years. However, during dry years, the demands at the critical MDO and PDO periods can be 208.5 Ml/d and 279.2 Ml/d respectively, as shown in Table 10.3.

WRZ	Population (000s)	Normal Year Average Annual demand (Ml/d)	Dry Year Annual Average demand (Ml/d)	Dry Year MDO demand (Ml/d)	Dry Year Peak Period demand (Ml/d)
Hampshire South	589.15	144.42	157.83	152.33	206.41
Hampshire Kingsclere	14.81	5.06	5.24	4.95	7.13
Hampshire Andover	63.90	15.28	16.62	17.51	21.30
Isle of Wight	135.20	30.31	34.96	33.70	44.36
Western Area	**803.06**	**195.07**	**214.65**	**208.49**	**279.20**

Table 10.3 Summary of Base Year (2007-08) Demands in the Western Area (Ml/d)

10.3.6 Strategic Development to Date

There have been a number of strategic developments in the area over the last 10-15 years, which are summarised as follows:

- Leakage has been reduced over the last 12 years from 33.7 Ml/d to 26.0 Ml/d;
- There has been an increase in meter installation over the last 12 years in the Hampshire WRZs from 11% to 30%. The Isle of Wight became essentially fully metered as part of the National Metering Trials which began in 1989; and
- In the light of the current robustness of the area's sources and the positive supply demand balance there have been no significant strategic supply side improvements in recent years. However, the cross-Solent main was replaced in 2008, with an increase in actual transfer capacity from 12 Ml/d to 14 Ml/d.

The underwater pipeline was sized to allow an increase up to 20 Ml/d subject to additional infrastructure upgrades at either end.

10.3.7 Levels of Service

This area, as with other parts of the South East, has suffered from the effects of the recent droughts, in 1989-92, 1995 and more recently 2004-06. However, due the robustness of sources and the healthy existing supply demand balance surplus, the area was not as badly affected as the other areas within Southern Water.

A review of the past performance against Target Levels of Service for both the demand (Customer Level of Service) and supply (Environment Level of Service) sides is given below.

10.3.7.1 Customer Level of Service

A summary of the frequency of restrictions since 1989, compared to Target Levels of Service, is given in Table 10.4:

- Hosepipe bans have been imposed on the Isle of Wight for two years giving a percentage of 10%; and
- The Isle of Wight is the only WRZ to have had a hosepipe ban. Although hosepipe bans were in force over parts of two reporting years, the actual duration was less than 24 months, so the appropriate measure for the Island is 4%.

For ease of comparison this analysis has assumed that sprinkler and unattended hosepipe bans have the same Target Level of Service as full hosepipe bans (1-in-10 years) although strictly speaking, the Target Level of Service for sprinkler and unattended hosepipe bans is 1-in-8 years.

WRZ	Target Level of Service		Actual Level of Service	
	1 in x years	% years	% no. of reporting years (taken as the no. of years, irrespective of duration during the year)	Time expressed as % of (population x weeks)
Hosepipe/Sprinkler ban				
Hampshire South	1:10	10%	0%	0%
Hampshire Andover	1:10	10%	0%	0%
Hampshire Kingsclere	1:10	10%	0%	0%
Isle of Wight	1:10	10%	10%	4%
Western Area	**1:10**	**10%**	**10%**	**1%**
Drought Orders implemented **"Non-essential use" ban**				
Hampshire South	1:20	5%	-	-
Hampshire Andover	1:20	5%	-	-
Hampshire Kingsclere	1:20	5%	-	-
Isle of Wight	1:20	5%	-	-
Western Area	**1:20**	**5%**	-	-

Table 10.4 Summary of Restrictions in the Western Area Since 1989

There have been no occasions on which an application has been made, or prepared, for a Drought Order to limit or restrict the so-called "non-essential uses" of water. This has been due to the relative healthy status of the supply demand balance to date.

Table 10.4 clearly shows the resilience of Western Area to past drought events and that the company has always been able to meet its customer Target Levels of Service.

10.3.7.2 Environmental Levels of Service

There was considerable stress on the Isle of Wight sources during the 2004-06 drought. A Drought Order was granted for the U433 source, where the groundwater abstraction is itself subject to a local Minimum Residual Flow condition. The unusually high rainfall during May 2006 meant that it was not necessary to abstract under the terms of the Drought Order. Nevertheless it was vital that the Drought Order was in place in good time should the lack of winter rainfall have persisted to May and beyond.

Southern Water considers that the past performance against environmental Target Levels of Service has been satisfactory.

10.3.7.3 Influence of a supply demand balance deficit on operations during a drought

During the AMP5 period there are no supply demand balance deficits forecast in any of the WRZs in the Western Area, namely the Isle of Wight, Hampshire South, Hampshire Andover and Hampshire Kingsclere WRZs.

10.3.8 The Baseline Supply Demand Balance for the Western Area

The baseline supply demand balances in the WRP Tables assume the following:

- Continuation of current metering policies. In 2007-08 there were 326,600 domestic properties in this area, 45% of which were metered. By 2015, the number of metered domestic properties is expected to rise to 206,300;
- Deployable outputs according to Unified Methodology, which ensures that the deployable outputs for groundwater and surface water sources are estimated for the same design drought event;
- Deployable outputs include assumed incremental yields from source improvements planned for the AMP5 period, with timings assumed throughout the AMP5 period;
- Sustainability Reductions, as given by the Environment Agency, but with a progressive timetable for implementation, from 2015, as set out in the draft Memorandum of Understanding developed as a result of discussions between Ofwat, EA, Portsmouth Water and the company since the draft WRMP;
- Renewal of existing inter-company bulk transfers until the end of the planning period, at the rates prevailing at the time of contract renewal; and
- In the baseline supply demand balance, inter-zonal transfers are adjusted to ensure the optimal use of surplus resources. For the investment model however, the transfers are set to zero at the start of the planning period. Then transfer options up to the full transfer capacity can be selected by the model as part of the derivation of a least-cost solution.

The baseline supply demand balances for each WRZ in the Western Area, assuming Sustainability Reductions, are given in Table 10.5 for both the MDO and PDO conditions. These supply demand balances over the planning period are shown in annotated graphs in Figure 10.2 to Figure 10.9.

Implementation of universal metering throughout the area by 2015 would lead to the following reductions in demand;

- Hampshire South WRZ: 6.9 Ml/d (MDO) and 13.6 Ml/d (PDO);
- Isle of Wight WRZ: 0.3 Ml/d (MDO) and 0.6 Ml/d (PDO);
- Hampshire Andover WRZ: 0.8 Ml/d (MDO) and 1.3 Ml/d (PDO); and
- Hampshire Kingsclere WRZ: 0.1 Ml/d (MDO) and 0.2 Ml/d (PDO).

Water Resource Zone	Planning scenario	Base year 2007-08	2009/10	Start of planning period 2010-11	2014-15	2019-20	2024-25	2029-30	2034-35
Hampshire South	MDO	49.32	50.14	43.26	52.85	-39.26	-40.45	-42.19	-44.17
Isle of Wight	MDO	4.65	4.19	6.87	8.24	-6.02	-6.56	-7.26	-7.96
Hampshire Andover	MDO	2.45	2.43	2.04	2.35	2.28	2.13	1.96	1.73
Hampshire Kingsclere	MDO	2.63	2.68	2.70	2.74	2.73	2.70	2.66	2.63
Hampshire South	PDO	22.66	23.73	3.76	18.82	-52.26	-52.54	-54.36	-56.80
Isle of Wight	PDO	-0.90	-1.67	1.62	3.34	-11.57	-12.94	-14.50	-16.07
Hampshire Andover	PDO	2.63	2.63	2.48	2.85	2.89	2.74	2.59	2.733
Hampshire Kingsclere	PDO	0.10	0.19	0.52	1.79	1.80	1.73	1.69	1.66

Notes: All figures in Ml/d
Positive figures indicate a surplus of resources, negative indicate a deficit

Table 10.5 Baseline Supply Demand Balances for Western Area for the MDO and PDO Condition, Assuming Sustainability Reductions

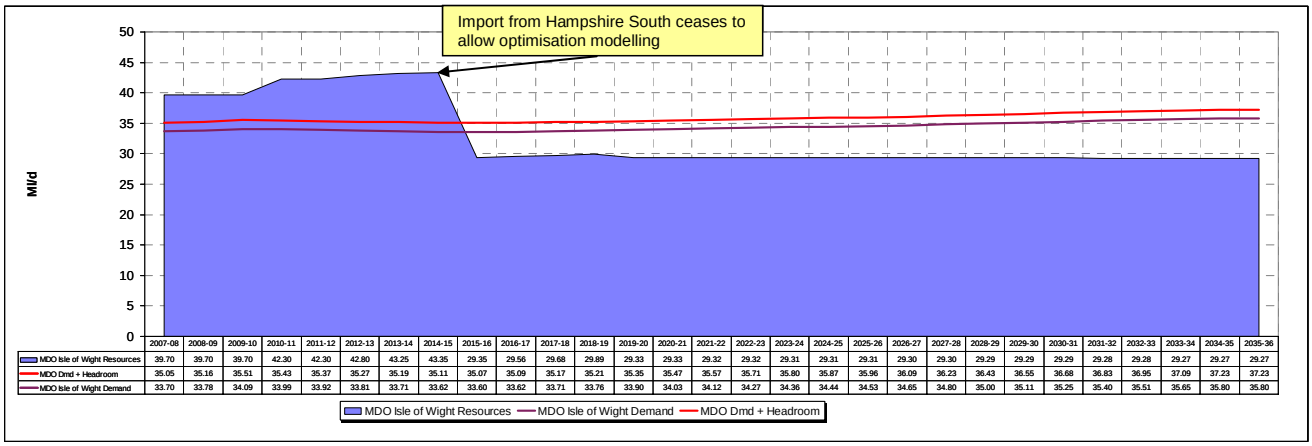
These baseline supply demand balances assume that after 2014-15, when the progressive implementation of the Sustainability Reductions begins, the full inter-zonal transfer from Hampshire South to the Isle of Wight through the cross-Solent main ceases, but any water that is available in the Hampshire South WRZ can still be transferred. At the same time, the investment model is able to choose whether it is better to cease, continue, or increase, existing inter-zonal transfers, or to develop new resources, or to enhance demand management activities in the WRZ in deficit.

Under a scenario which makes allowance for Sustainability Reductions, the following summary of the baseline condition applies, for both the MDO and PDO condition:

- The Hampshire South WRZ starts the planning period with a significant surplus for both the MDO and PDO condition. However, this is radically changed to a very significant deficit in 2019-20, as a result of the introduction of the full Sustainability Reductions for the River Itchen by the end of AMP6. It is assumed that in the previous four years of AMP6 the Sustainability Reduction can be progressively introduced as the level that ensures that available headroom equals target headroom in each year (see Figure 10.3 and Figure 10.7);
- The Isle of Wight WRZ starts the planning period in surplus for the MDO condition and with a small deficit for the PDO condition. This situation remains until the introduction of the Sustainability Reductions for the River Itchen, when the WRZ falls sharply into a significant deficit. Any transfer from Hampshire South WRZ would be at the expense of even greater deficits in that WRZ;
- The Hampshire Andover WRZ starts the planning period in surplus and remains so until the end of the planning period; and

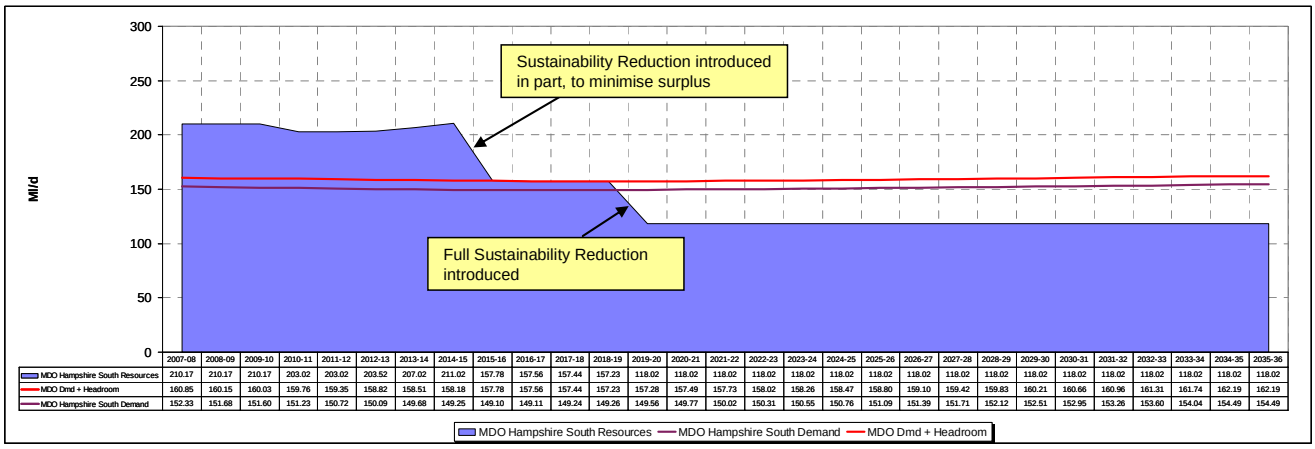
- The Hampshire Kingsclere WRZ starts the planning period in surplus and remains so until the end of the planning period.

The severe impact of the proposed Sustainability Reductions for the River Itchen on the supply demand balances for both the Hampshire South and Isle of Wight WRZs can be clearly seen.



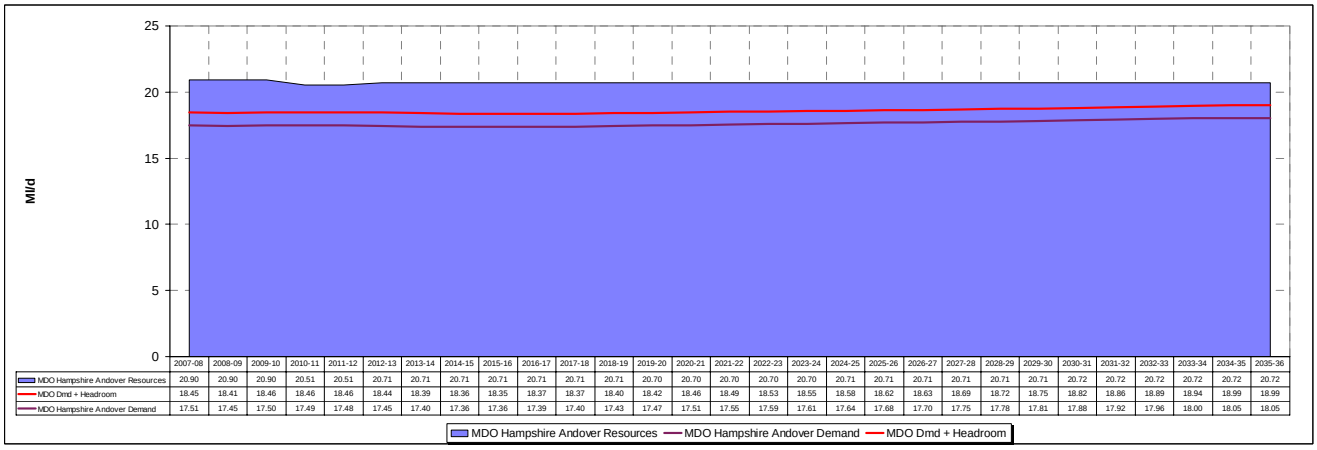
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
MDO Isle of Wight Resources	39.70	39.70	39.70	42.30	42.30	42.80	43.25	43.35	29.35	29.56	29.68	29.89	29.33	29.33	29.32	29.32	29.31	29.31	29.31	29.30	29.30	29.29	29.29	29.29	29.28	29.28	29.27	29.27	29.27
MDO Dmd + Headroom	35.05	35.16	35.51	35.43	35.37	35.27	35.19	35.11	35.07	35.09	35.17	35.21	35.35	35.47	35.57	35.71	35.80	35.87	35.96	36.09	36.23	36.43	36.55	36.68	36.83	36.95	37.09	37.23	37.23
MDO Isle of Wight Demand	33.70	33.78	34.09	33.99	33.92	33.81	33.71	33.62	33.60	33.62	33.71	33.76	33.90	34.03	34.12	34.27	34.36	34.44	34.53	34.65	34.80	35.00	35.11	35.25	35.40	35.51	35.65	35.80	35.80

Figure 10.2 Isle of Wight MDO Baseline Supply Demand Balance assuming Sustainability Reductions



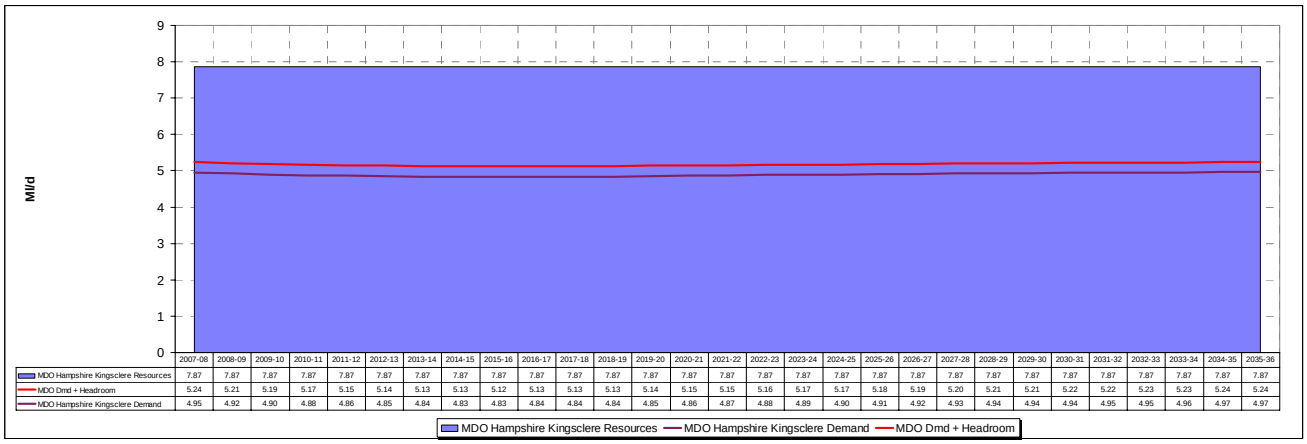
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
MDO Hampshire South Resources	210.17	210.17	210.17	203.02	203.02	203.52	207.02	211.02	157.78	157.56	157.44	157.23	118.02	118.02	118.02	118.02	118.02	118.02	118.02	118.02	118.02	118.02	118.02	118.02	118.02	118.02	118.02	118.02	118.02
MDO Dmd + Headroom	160.85	160.15	160.03	159.76	159.35	158.82	158.51	158.18	157.78	157.56	157.44	157.23	157.28	157.49	157.73	158.02	158.26	158.47	158.80	159.10	159.42	159.83	160.21	160.66	160.96	161.31	161.74	162.19	162.19
MDO Hampshire South Demand	152.33	151.68	151.60	151.23	150.72	150.09	149.68	149.25	149.10	149.11	149.24	149.26	149.56	149.77	150.02	150.31	150.55	150.76	151.09	151.39	151.71	152.12	152.51	152.95	153.26	153.60	154.04	154.49	154.49

Figure 10.3 Hampshire South MDO Baseline Supply Demand Balance assuming Sustainability Reductions



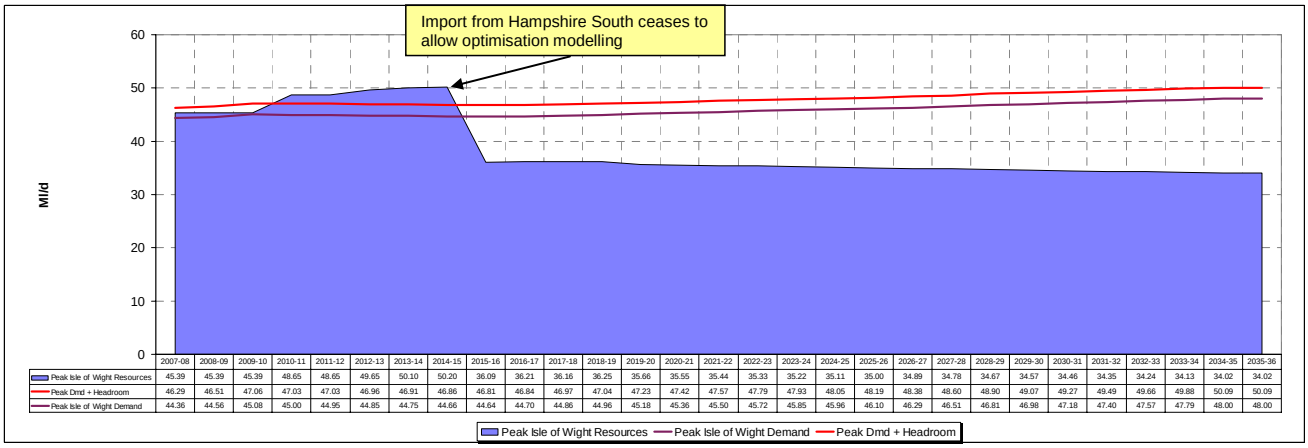
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
MDO Hampshire Andover Resources	20.90	20.90	20.90	20.51	20.51	20.71	20.71	20.71	20.71	20.71	20.71	20.71	20.70	20.70	20.70	20.70	20.70	20.71	20.71	20.71	20.71	20.71	20.71	20.72	20.72	20.72	20.72	20.72	20.72
MDO Dmd + Headroom	18.45	18.41	18.46	18.46	18.46	18.44	18.39	18.36	18.35	18.37	18.37	18.40	18.42	18.46	18.49	18.53	18.55	18.58	18.62	18.63	18.69	18.72	18.75	18.82	18.86	18.89	18.94	18.99	18.99
MDO Hampshire Andover Demand	17.51	17.45	17.50	17.49	17.48	17.45	17.40	17.36	17.36	17.39	17.40	17.43	17.47	17.51	17.55	17.59	17.61	17.64	17.68	17.70	17.75	17.78	17.81	17.88	17.92	17.96	18.00	18.05	18.05

Figure 10.4 Hampshire Andover MDO Baseline Supply Demand Balance



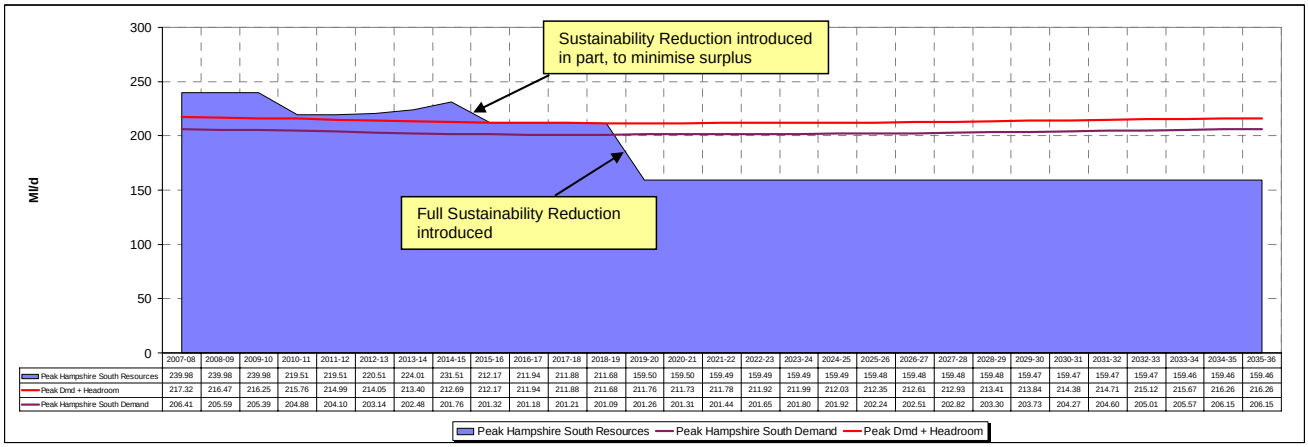
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
MDO Hampshire Kingsclere Resources	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87
MDO Dmd + Headroom	5.24	5.21	5.19	5.17	5.15	5.14	5.13	5.13	5.12	5.13	5.13	5.13	5.14	5.15	5.15	5.16	5.17	5.17	5.18	5.19	5.20	5.21	5.21	5.22	5.22	5.23	5.23	5.24	5.24
MDO Hampshire Kingsclere Demand	4.95	4.92	4.90	4.88	4.86	4.85	4.84	4.83	4.83	4.84	4.84	4.84	4.85	4.86	4.87	4.88	4.89	4.90	4.91	4.92	4.93	4.94	4.94	4.94	4.95	4.95	4.96	4.97	4.97

Figure 10.5 Hampshire Kingsclere MDO Baseline Supply Demand Balance



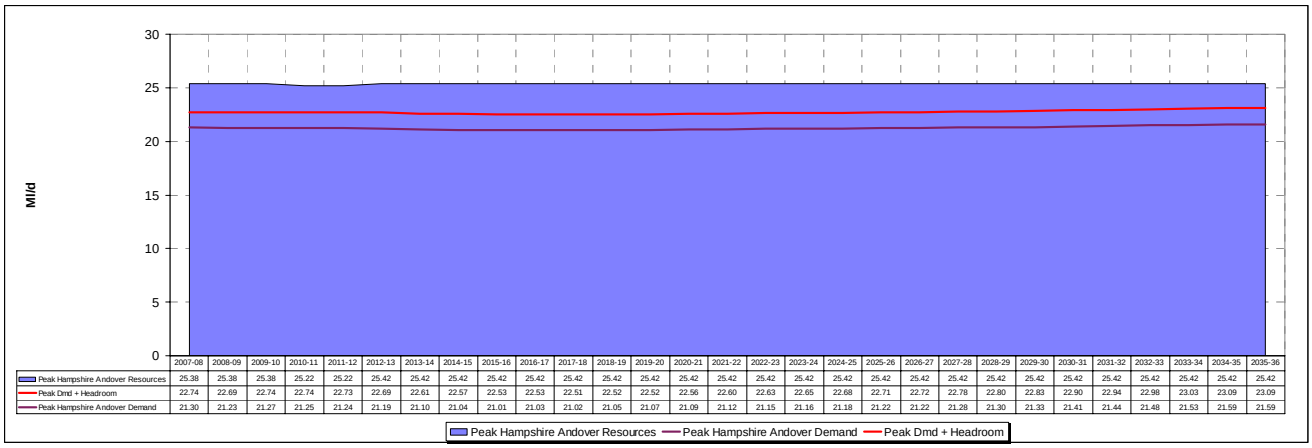
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
Peak Isle of Wight Resources	45.39	45.39	45.39	48.65	48.65	49.65	50.10	50.20	36.09	36.21	36.16	36.25	35.66	35.55	35.44	35.33	35.22	35.11	35.00	34.89	34.78	34.67	34.57	34.46	34.35	34.24	34.13	34.02	34.02
Peak Dmd + Headroom	46.29	46.51	47.06	47.03	47.03	46.96	46.91	46.86	46.81	46.84	46.97	47.04	47.23	47.42	47.57	47.79	47.93	48.05	48.19	48.38	48.60	48.90	49.07	49.27	49.49	49.66	49.88	50.09	50.09
Peak Isle of Wight Demand	44.36	44.56	45.08	45.00	44.95	44.85	44.75	44.66	44.64	44.70	44.86	44.96	45.18	45.36	45.50	45.72	45.85	45.96	46.10	46.29	46.51	46.81	46.98	47.18	47.40	47.57	47.79	48.00	48.00

Figure 10.6 Isle of Wight PDO Baseline Supply Demand Balance assuming Sustainability Reductions



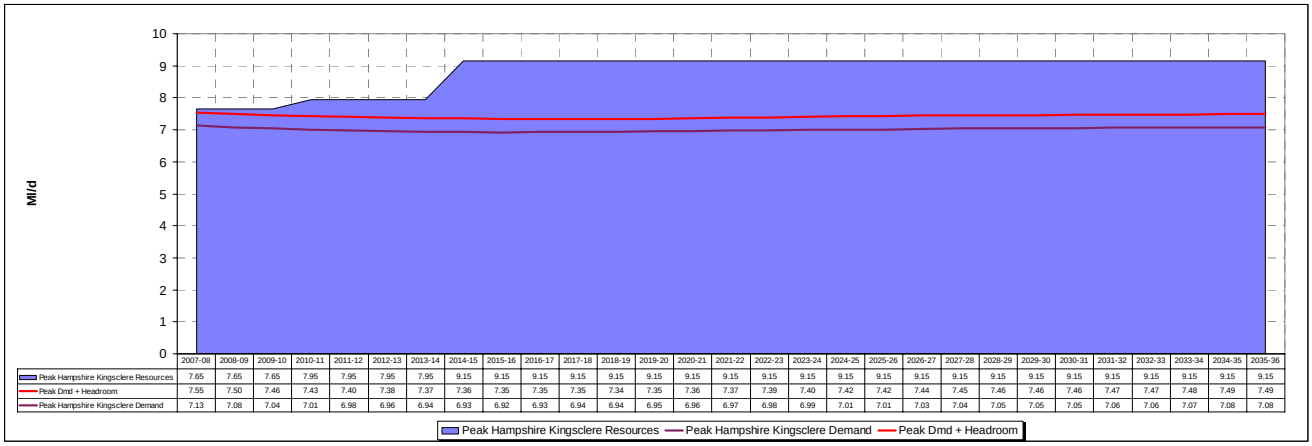
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
Peak Hampshire South Resources	239.98	239.98	239.98	219.51	219.51	220.51	224.01	231.51	212.17	211.94	211.88	211.68	159.50	159.50	159.49	159.49	159.49	159.49	159.48	159.48	159.48	159.48	159.47	159.47	159.47	159.47	159.46	159.46	159.46
Peak Dmd + Headroom	217.32	216.47	216.25	215.76	214.99	214.05	213.40	212.69	212.17	211.94	211.88	211.68	211.76	211.73	211.78	211.92	211.99	212.03	212.35	212.61	212.93	213.41	213.84	214.38	214.71	215.12	215.67	216.26	216.26
Peak Hampshire South Demand	206.41	205.59	205.39	204.88	204.10	203.14	202.48	201.76	201.32	201.18	201.21	201.09	201.26	201.31	201.44	201.65	201.80	201.92	202.24	202.51	202.82	203.30	203.73	204.27	204.60	205.01	205.57	206.15	206.15

Figure 10.7 Hampshire South PDO Baseline Supply Demand Balance assuming Sustainability Reductions



	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
Peak Hampshire Andover Resources	25.38	25.38	25.38	25.22	25.22	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42	25.42
Peak Dmd + Headroom	22.74	22.69	22.74	22.74	22.73	22.69	22.61	22.57	22.53	22.53	22.51	22.52	22.52	22.56	22.60	22.63	22.65	22.68	22.71	22.72	22.78	22.80	22.83	22.90	22.94	22.98	23.03	23.09	23.09
Peak Hampshire Andover Demand	21.30	21.23	21.27	21.25	21.24	21.19	21.10	21.04	21.01	21.03	21.02	21.05	21.07	21.09	21.12	21.15	21.16	21.18	21.22	21.22	21.28	21.30	21.33	21.41	21.44	21.48	21.53	21.59	21.59

Figure 10.8 Hampshire Andover PDO Baseline Supply Demand Balance



	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
Peak Hampshire Kingsclere Resources	7.65	7.65	7.65	7.95	7.95	7.95	7.95	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15
Peak Dmd + Headroom	7.55	7.50	7.46	7.43	7.40	7.38	7.37	7.36	7.35	7.35	7.35	7.34	7.35	7.36	7.37	7.39	7.40	7.42	7.42	7.44	7.45	7.46	7.46	7.46	7.47	7.47	7.48	7.49	7.49
Peak Hampshire Kingsclere Demand	7.13	7.08	7.04	7.01	6.98	6.96	6.94	6.93	6.92	6.93	6.94	6.94	6.95	6.96	6.97	6.98	6.99	7.01	7.01	7.03	7.04	7.05	7.05	7.05	7.06	7.06	7.07	7.08	7.08

Figure 10.9 Hampshire Kingsclere PDO Baseline Supply Demand Balance

10.3.8.1 The Impact of the Proposed Sustainability Reductions

The Habitats Directive Stage 4 Review of Consents undertaken by the Environment Agency concluded that Sustainability Reductions were required to mitigate the effect of current abstractions (including Habitat Directive sites) which have been "investigated and identified" as having a detrimental effect on the environment. The Environment Agency *Water Resources Planning Guideline* (April 2007) requires water companies to include "Sustainability Reductions" in their WRMPs.

The River Itchen is designated as a Special Area of Conservation (SAC). The Environment Agency completed its Stage 4 Review of Consents (November 2007) as part of its assessment of abstractions at the River Itchen SAC. The 48 water resource permissions reviewed by the Environment Agency include public water supply licences (including Southern Water's abstractions), spray irrigation, industrial and industrial cooling, fish farms, watercress farms and two augmentation schemes (River Alre augmentation scheme and Candover boreholes scheme).

The outcome of the Stage 4 Review of Consents was that the Environment Agency has advised Southern Water that significant changes to the Southern Water Lower Itchen abstraction licences are required.

The changes that the Environment Agency proposes to make are as follows:

(a) An aggregate monthly abstraction maximum in the following months:

- June – 4,110 Ml;
- July – 3,940 Ml;
- August – 3,445 Ml; and
- September – 2,280 Ml;

(b) An annual aggregate of 51,138 Ml; and

(c) A "hands off flow" (HoF) condition to be imposed, at 198 Ml/d.

The impact of these proposed changes to abstraction licences results in a very significant reduction in deployable output from the sources affected. The latest NEP letter from the Environment Agency dated 28th November 2008 states that there will be a reduction in deployable output of 104 Ml/d and 86 Ml/d for the MDO and PDO conditions respectively. These reductions represent approximately 50% of the public water supply demand under the respective critical planning periods. The baseline supply demand balance therefore shows a significant deficit when the Sustainability Reductions take effect in 2019-20. This major impact is evident not only in Hampshire South WRZ but also in the Isle of Wight WRZ because once the supply demand balance in the Hampshire South WRZ moves into deficit transfers through the cross-Solent main would not necessarily be available. The Isle of Wight WRZ then also suffers a significant supply demand balance deficit.

Hampshire South WRZ currently has a healthy supply demand balance with available headroom above target headroom. Following implementation of the Sustainability Reductions, funding to restore available headroom to its current level would not be available which means that the current security of the supply demand balance in the WRZ would be reduced.

10.3.9 Options to Meet the Supply Demand Balance in the Western Area

A number of supply side and demand side options have been considered to meet any supply demand balance deficit.

The supply side options have been assessed using the options appraisal methodology described in section 8. In summary an initial list of over 100 options within the Western Area was considered; further details are given in Appendix G. However the availability of new resources within Hampshire South WRZ is severely constrained as a result of the Environment Agency's CAMS process which concluded that all the surface water and groundwater management units are "over licensed", with some management units considered to be "over abstracted".

Following the various successive screening processes, the number of "feasible" options, by generic type, that was chosen to be available for selection by the investment model can be summarised, by generic type, as follows:

- Two sites for surface storage reservoirs, for which the sole lead promoter would be Southern Water;
- Six sites for possible increases in abstraction from either surface water or groundwater;
- No sites for enlarging existing reservoirs;
- Three sites for potential re-commissioning of old/existing sources;
- No possible abstraction licence variations;
- One site for the further upgrade of WSW treatment facilities, for the purposes of the supply demand balance;
- Three potential inter-zonal bulk transfers, either existing or proposed;
- No potential inter-company bulk transfers, either existing or proposed;

- Four potential schemes for wastewater recycling;
- No sites for potential Aquifer Storage and Recovery schemes; and
- Nine potential schemes for desalination.

This shows that a wide range of generic types of option were available for selection, thus ensuring that the selection of preferred schemes was robust. The total number includes a number of generic schemes, for instance desalination at the same site but at different capacities. This is to ensure that a generic option is not ruled out from selection on the basis of capacity and cost alone.

There are three generic types of demand side options: metering; leakage reduction; and water efficiency. Different modelling scenarios have been devised to reflect a different selection of options (see section 10.1.13).

As noted in section 10.3.8, scenario 3 (Universal Metering) has been used as the starting point for the supply demand balance from which the Final Planning Solution has been developed.

In order to consider leakage options, a number of incremental "step" reductions in leakage were considered, based on outputs from the Sustainable Economic Level of Leakage analysis as explained in Chapter 6 and Appendix E.

Water efficiency options for both household and non-households were included in the model. More details of the options are given in section 8 and Appendix G.

10.3.10 The Water Resources Strategy for the Western Area

The water resources strategy is described in three different sections over the planning period:

- AMP5, the first five years from 2010-11 to 2014-15, which formed the basis of the Final Business Plan Submission;
- AMP6 to the end of the planning period, based on the company only least-cost strategy; and then
- An explanation of how this company only strategy is modified to take into account the recommendations of the current WRSE regional modelling results.

The company preferred water resources strategy for each of these intervals, with Sustainability Reductions, is described below and is summarised in Table 10.6.

During AMP5 (2010-15)

The supply demand balance will be satisfied for the Western Area for the AMP5 period through the following:

- A policy of universal metering throughout the area by 2015, which will give benefits in terms of demand savings and associated reductions in supply pipe leakage;
- The optimisation of inter-zonal transfers, from the Hampshire South WRZ to the Isle of Wight WRZ via the cross-Solent main;
- A series of groundwater source improvements, which could deliver over 9 Ml/d for the average condition;
- The development of Testwood WSW up to the current licence limit; and
- The development of the enabling Testwood to Otterbourne transfer.

The Testwood schemes need to be implemented during AMP5 so that implementation of the Sustainability Reductions on the River Itchen can begin from the start of AMP6.

From AMP6 to the end of the planning period (2015-35) (company only)

For the company only least-cost solution, there are a number of other interventions that will be required for on both the supply and demand side, as follows:

- The transfer of the Candover/Alre augmentation scheme to Southern Water from the Environment Agency, to enable the full yield benefits of the scheme to be realised, and satisfy any residual supply demand balance deficit arising from the Sustainability Reductions;
- The refurbishment of two small groundwater sources, at K628 and L536, on the Isle of Wight;
- The refurbishment of three groundwater sources, at R176, O541 and O641, in the Hampshire South WRZ;
- Water efficiency kits being issued on the Isle of Wight as part of a SELWE approach; and
- A total further reduction in leakage of 8.9 Ml/d, which is equivalent to a reduction of 34% below the 2007-08 outturn figure.

From AMP6 to the end of the planning period (2015-35) (company preferred regional solution)

The results of the WRSE modelling results did not suggest any further options that were not included in the company only least-cost solution, and so the company preferred regional solution is the same as the company only least-cost strategy. Therefore, there are no incremental costs to the strategy.

Water Resource Zone	Schemes During AMP5	Schemes beyond AMP 5 – company only solution	Schemes beyond AMP 5 – Water Resources in the South East of England
Isle of Wight	• Enhanced Metering • Asset improvement schemes for groundwater sources (1.55 Ml/d peak, 1.05 Ml/d average) • Optimisation of inter-zonal transfers (cross-Solent main)	• Water Efficiency kits • 1.1 Ml/d further leakage reduction • Refurbishment of L536 borehole • Refurbishment of K628 borehole	As previous column
Hants South	• Universal Metering • Asset improvement schemes for groundwater sources (12.00 Ml/d peak, 8.00 Ml/d average) • Increase Testwood WSW to licence limit • Development of the enabling Testwood to Otterbourne transfer • Optimisation of inter-zonal transfers (cross-Solent main)	• Candover & Alre augmentation schemes • 7.8 Ml/d of leakage reduction • R176 borehole rehabilitation And, subject to satisfactory completion of AMP5 schemes: • River Itchen Sustainability Reductions residual at end of AMP5	As previous column
Hants Kingsclere	• Universal Metering • Asset improvement schemes for groundwater sources (1.2 Ml/d peak only)		
Hants Andover	• Universal metering • Asset improvement schemes for groundwater sources (0.2 Ml/d peak & average)		

Table 10.6 Summary of Water Resources Strategy for the Western Area, with Sustainability Reductions

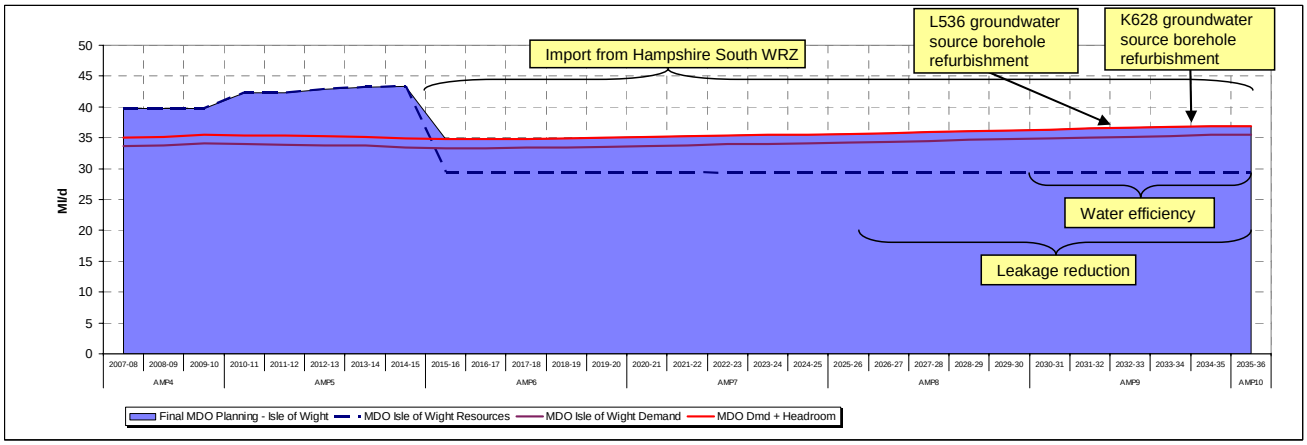


Figure 10.10 Isle of Wight Company Preferred Regional Strategy (Scenario 4), assuming Sustainability Reductions, MDO Solution

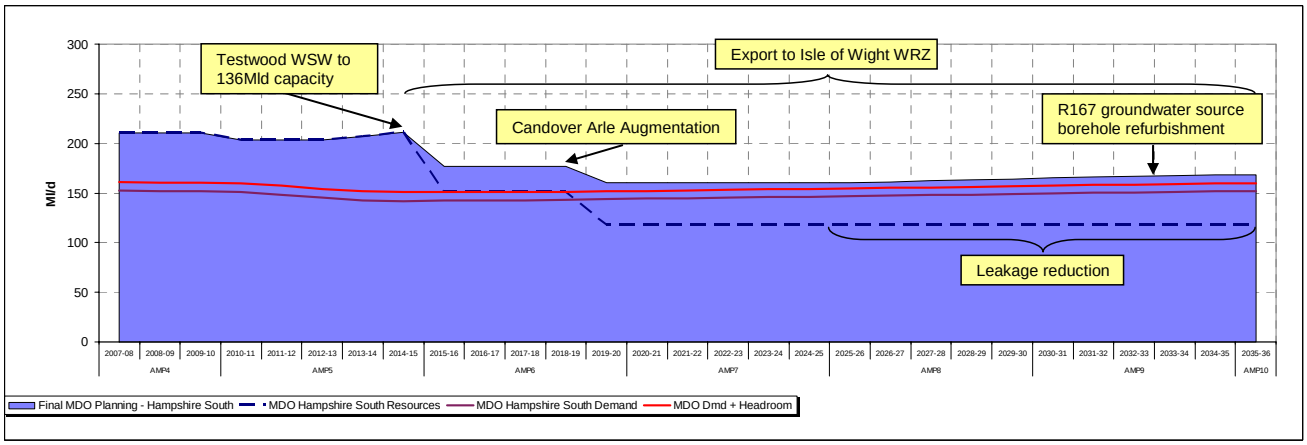


Figure 10.11 Hampshire South Company Preferred Regional Strategy (Scenario 4), assuming Sustainability Reductions, MDO Solution

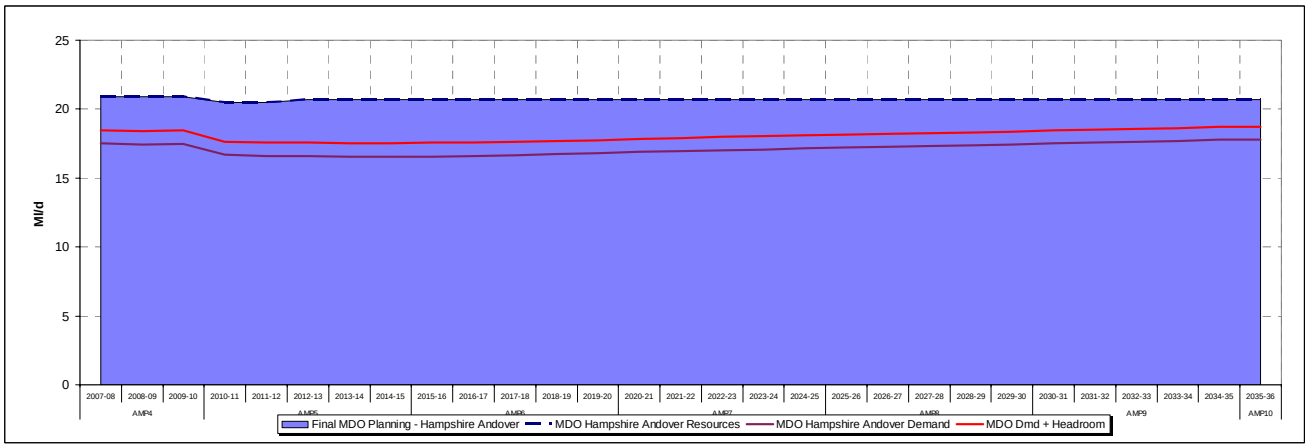


Figure 10.12 Hampshire Andover Company Preferred Regional Strategy (Scenario 4), MDO Solution

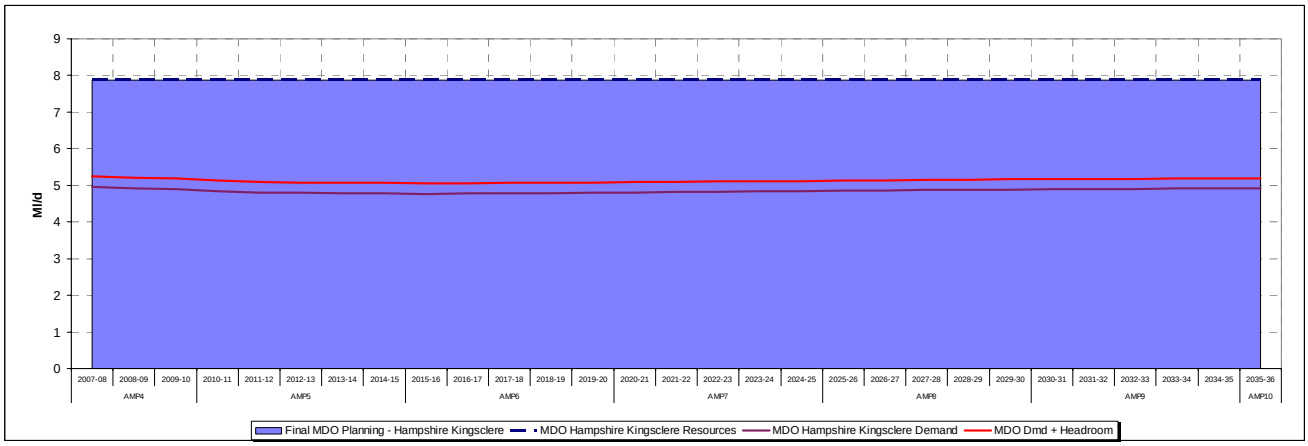


Figure 10.13 Hampshire Kingsclere Company Preferred Regional Strategy (scenario 4), MDO Solution

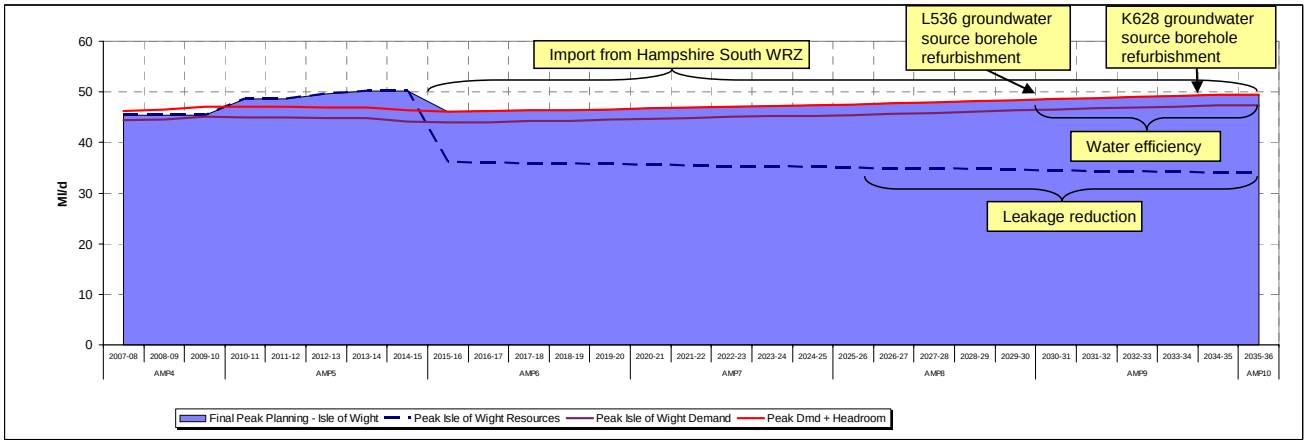


Figure 10.14 Isle of Wight Company Preferred Regional Strategy (Scenario 4), assuming Sustainability Reductions, PDO Solution

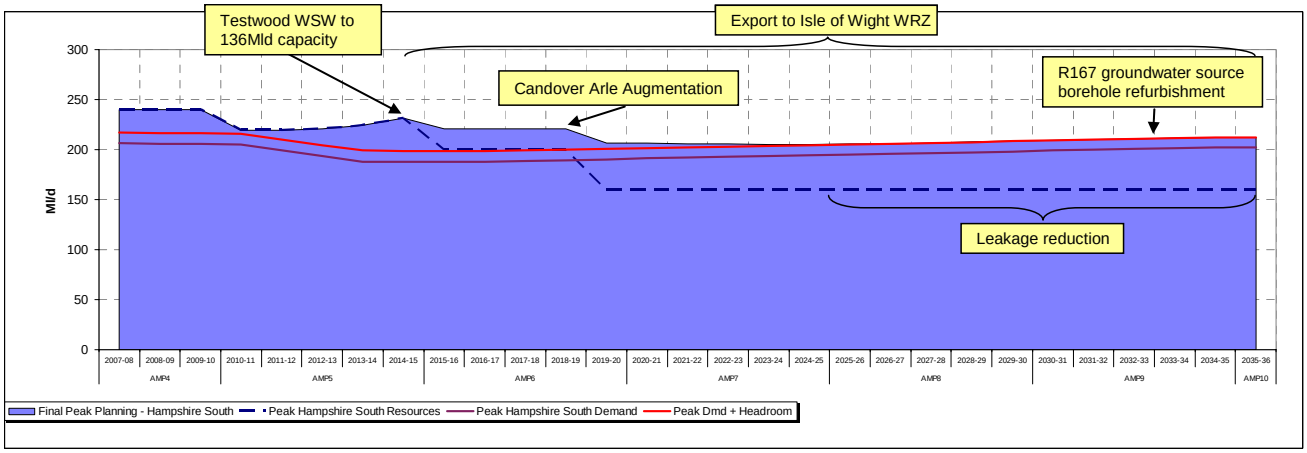


Figure 10.15 Hampshire South Company Preferred Regional Strategy (Scenario 4), assuming Sustainability Reductions, PDO Solution

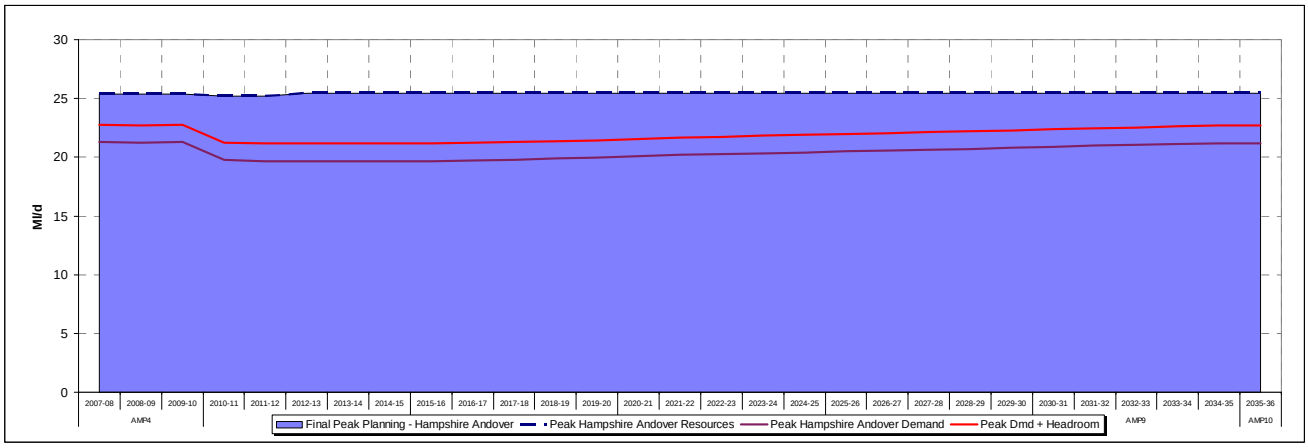


Figure 10.16 Hampshire Andover Company Preferred Regional Strategy (Scenario 4), PDO Solution

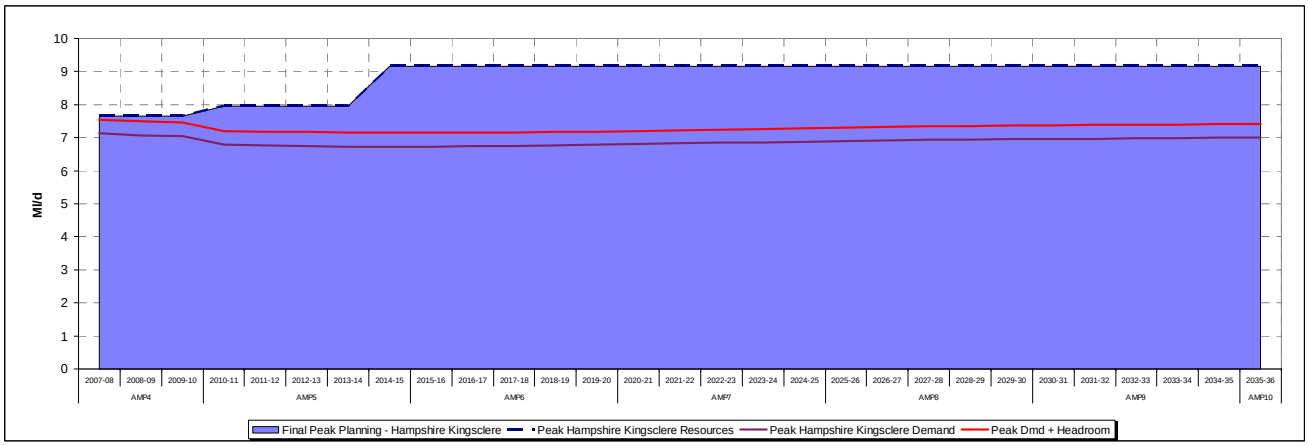


Figure 10.17 Hampshire Kingsclere Company Preferred Regional Strategy (Scenario 4), PDO Solution

10.3.10.1 SEA Influence on Strategy

All options were assessed against 17 SEA objectives, and assigned an overall environmental risk (high, medium or low), based on the significance of potential long term effects.

Table 10.7 sets out the environmental risk of each resource development option. More detail is given in Appendix I.

Option	Environmental Risk Score
Development of Testwood WSW up to the current licence limit	Medium
Augmentation with the Alre and Candover Schemes	Medium
R176 borehole rehabilitation	Medium
Refurbishment of L536 Borehole	Medium
Refurbishment of K628 borehole	Medium
Woodmill abstraction (56 Ml/d) and treatment at Otterbourne	Medium
Colden Common Reservoir	High
Cross Solent Increase	Medium
Sandown wastewater recycling (5Ml/d)	Medium

Table 10.7 Environmental Risks of Resource Development Options Selected in the Western Area Strategy

The demand management options (metering; leakage reduction; and water efficiency) were also assessed against the SEA objectives. More detail is given in Appendix I. All three generic demand management measures are broadly compatible with the majority of SEA objectives due to the minimal amount of physical intervention required in implementing each measure. However, water efficiency measures have no potential conflicts with SEA objectives and are therefore the preferred demand management measure from an SEA perspective.

10.3.10.2 SEA preferred strategy

Options assessed as being likely to result in the lowest environmental risk are preferable from a SEA perspective. None of the options in the Western Area were assessed as being likely to have a low environmental risk.

The overriding objective of this WRMP is to identify a package of options that removes the risk of supply demand balance deficits over the whole of the planning period. It is therefore necessary to include within the SEA preferred strategy some options that had been assessed as having medium environmental risk. Employing the mitigation measures proposed for each option will enable the likely environmental damage from adopting these options to be reduced. The medium risk options from the SEA are:

- R176 borehole rehabilitation;
- K628 borehole refurbishment;
- L536 borehole refurbishment;
- J358 WSW route 1;
- Development of Testwood WSW up to the current licence limit (capacity increase to 136 Ml/d);
- Augmentation with the Alre and Candover Schemes;
- Cross-Solent Increase;
- Sandown wastewater recycling;
- Testwood to Otterbourne;

- Woodmill Abstraction (56 Ml/d) and treatment at Otterbourne or Gaters Mill; and
- Woodmill Abstraction (85 Ml/d) and treatment at Otterbourne or Gaters Mill.

The company preferred strategy is therefore compatible with the SEA preferred strategy, with the exception of L536 Borehole which has strong negative effects because pipeline routes are located within an AONB. This scheme is not required under the company preferred strategy until the end of the planning period. However, detailed consideration of all potential mitigation measures would be needed prior to introducing this scheme.

A preliminary 'high-level' strategic assessment was undertaken of the possible impact of the proposed plan on the integrity of European and Ramsar sites under the Habitats Regulations. This concluded that sufficient safeguards are available to ensure that implementation of the plan will not adversely affect the integrity of any of the protected sites.

10.3.11 Scenario Analysis

A number of scenarios have been modelled, in order to check the stability of the company preferred strategy to changes in some of the basic assumptions.

	Scenario	**Company preferred Regional strategy**	**Company only Universal metering**	**Company only Change of occupier**	**Company only Optant**	**Company only Universal metering with no climate change**	**Company only Leakage rise to Ofwat target**	**Hybrid Baseline where no deficit, otherwise universal metering**
	Number	**4**	**3**	**2**	**1**	**11**	**8**	
	Metering policy	Universal	Universal	Change of occupier	Optant and selective	Universal	Universal	Universal or optant
	Leakage policy	JR08, then SPL saving	JR08, then SPL saving	JR08	JR08	JR08, then SPL saving	Ofwat, then SPL saving	JR08, then SPL saving
	WRSE preferred options & bulk supplies	Yes	No	No	No	No	No	Yes
WRZ	**Scheme**	**Earliest year required**						
Hampshire South	Testwood new DAF plant to utilise full licence & enabling transfer pipeline to Otterbourne	2015	2015	2015	2015	2015	2015	2015
	Candover Alre Augmentation	2019	2019	2019	2019	2019	2019	2019
	West Tytherley borehole rehabilitation	2033	2033	2031	2027	-	-	2033
	Woodmill abstraction (56 Ml/d) and treatment at Otterbourne	-	-	-	-	-	2028	-
	New surface water storage at Colden Common Reservoir	-	-	2033	-	-	-	-
	Leakage reduction	2025 reduction by 7.8 Ml/d	2025 reduction by 7.8 Ml/d	2019 reduction by 8.4 Ml/d	2017 reduction by 8.4 Ml/d	2028 reduction by 4.8 Ml/d	2010 reduction by 6.6 Ml/d	2025 reduction by 7.8 Ml/d
	Water efficiency kit (box)	-	-	2030	2030	-	2025	-
	Water efficiency low flow shower heads	-	-	-	2030	-	-	-
Isle of Wight	L536 borehole rehabilitation	2032	2032	2027	2019	-	2026	2032
	K628 borehole rehabilitation	2034	2034	2034	2028	-	2027	2034
	Sandown wastewater recycling (5Ml/d)	-	-	-	2031	-	-	-

	Scenario	Company preferred Regional strategy	Company only Universal metering	Company only Change of occupier	Company only Optant	Company only Universal metering with no climate change	Company only Leakage rise to Ofwat target	Hybrid Baseline where no deficit, otherwise universal metering
	Number	**4**	**3**	**2**	**1**	**11**	**8**	
	Cross-Solent main increase (to 20 Ml/d)	-	-	-	-	-	2033	-
	Leakage reduction	2026 reduction by 1.1 Ml/d	2026 reduction by 1.1 Ml/d	2019 reduction by 1.2 Ml/d	2017 reduction by 1.3 Ml/d	2032 reduction by 0.7 Ml/d	2020 reduction by 1.2 Ml/d	2026 reduction by 1.1 Ml/d
	Water efficiency kit (box)	2030	2030	2030	2030	-	2025	2030
	Water efficiency low flow shower heads	-	-	2030	-	-	-	-
	Water efficiency trigger hoses	-	-	-	-	-	2025	-
Hants. Andover	*No supply side, water efficiency, or leakage reduction schemes*	-	-	-	-	-	-	-
Hants. Kings.	*No supply side, water efficiency, or leakage reduction schemes*	-	-	-	-	-	-	-
Costs (£m)								
Total metering cost (£m)		52.70	52.70	56.81	48.17	52.70	52.70	52.20
Total resource, leakage reduction and water efficiency activity cost (£m)		42.65	42.65	48.28	55.48	40.30	56.26	42.65
Total cost of Strategy (£m)		**95.35**	**95.35**	**105.09**	**103.65**	**93.00**	**108.96**	**94.85**

Table 10.8 gives a summary of the different baseline assumptions for these scenarios, and the results in terms of scheme inclusion, scheme timing, and costs for the different investment strategies. The following points can be seen from the results:

- The company only least-cost scenario (3) assumes the baseline condition of universal metering by 2015;
- All scenarios assume the renewal of existing bulk supplies to other companies until the end of the planning period, at the rates which are appropriate at the time of renewal;
- The company only least-cost scenario (3) selects further leakage reductions of 8.9 Ml/d;
- Under the company only change of occupier metering scenario (2), the scheme options remain the same, but they are needed up to 5 years earlier, although an additional scheme (new surface water reservoir at Colden Common) is required in Hampshire South WRZ at the end of the planning period. The scenario includes further leakage reductions of 9.6 Ml/d;
- Under the company only optant metering scenario (1), the same resource development schemes are selected, but at times up to 13 years before the company only universal metering scenario (3); and Sandown desalination is also introduced towards the end of the planning period. The scenario includes further reductions in leakage of 9.7 Ml/d;
- Under the company only scenario, without any allowance for climate change impacts (11), only two schemes are required: Increase Testwood WSW to licence limit; and use of the Candover Alre groundwater augmentation

schemes to support public water supply abstractions. Both these are required at the same time as the company only universal metering scenario (3) to allow the Sustainability Reductions to be implemented. No other resource development options are necessary, but further leakage reduction of 5.5 Ml/d is required;

- Under the scenario which allows leakage to rise up to the Ofwat target level (8) in any WRZ currently operating below its target level, the same options are required as for the company only universal metering scenario (3), but these may be needed 6-7 years earlier. In addition, the scenario requires Woodmill abstraction (56 Ml/d) rather than the far smaller R176 borehole rehabilitation, and additional water is transferred to the Isle of Wight by increasing the cross-Solent main to 20 Ml/d. Further leakage reduction of 8.8 Ml/d is required from 2010. The cost of this strategy was £13.6 m greater than for the company preferred least-cost scenario (3); and
- The total cost of the resources strategy (including new resources, leakage reduction, and water efficiency) plus metering strategy, for the various company only scenarios is as follows:
    - Universal metering - £95.4 m.
    - Change of occupier - £105.1 m.
    - Optant and selective - £103.7 m.
    - Hybrid scenario -£94.9m
- There is no difference in cost between the company preferred regional strategy and the company only least-cost strategy.

	Scenario	**Company preferred Regional strategy**	**Company only Universal metering**	**Company only Change of occupier**	**Company only Optant**	**Company only Universal metering with no climate change**	**Company only Leakage rise to Ofwat target**	**Hybrid Baseline where no deficit, otherwise universal metering**
	Number	**4**	**3**	**2**	**1**	**11**	**8**	
	Metering policy	Universal	Universal	Change of occupier	Optant and selective	Universal	Universal	Universal or optant
	Leakage policy	JR08, then SPL saving	JR08, then SPL saving	JR08	JR08	JR08, then SPL saving	Ofwat, then SPL saving	JR08, then SPL saving
	WRSE preferred options & bulk supplies	Yes	No	No	No	No	No	Yes
WRZ	**Scheme**	**Earliest year required**						
Hampshire South	Testwood new DAF plant to utilise full licence & enabling transfer pipeline to Otterbourne	2015	2015	2015	2015	2015	2015	2015
	Candover Alre Augmentation	2019	2019	2019	2019	2019	2019	2019
	West Tytherley borehole rehabilitation	2033	2033	2031	2027	-	-	2033
	Woodmill abstraction (56 Ml/d) and treatment at Otterbourne	-	-	-	-	-	2028	-
	New surface water storage at Colden Common Reservoir	-	-	2033	-	-	-	-

	Scenario	Company preferred Regional strategy	Company only Universal metering	Company only Change of occupier	Company only Optant	Company only Universal metering with no climate change	Company only Leakage rise to Ofwat target	Hybrid Baseline where no deficit, otherwise universal metering
	Number	**4**	**3**	**2**	**1**	**11**	**8**	
	Leakage reduction	2025 reduction by 7.8 Ml/d	2025 reduction by 7.8 Ml/d	2019 reduction by 8.4 Ml/d	2017 reduction by 8.4 Ml/d	2028 reduction by 4.8 Ml/d	2010 reduction by 6.6 Ml/d	2025 reduction by 7.8 Ml/d
	Water efficiency kit (box)	-	-	2030	2030	-	2025	-
	Water efficiency low flow shower heads	-	-	-	2030	-	-	-
Isle of Wight	L536 borehole rehabilitation	2032	2032	2027	2019	-	2026	2032
Isle of Wight	K628 borehole rehabilitation	2034	2034	2034	2028	-	2027	2034
Isle of Wight	Sandown wastewater recycling (5Ml/d)	-	-	-	2031	-	-	-
Isle of Wight	Cross-Solent main increase (to 20 Ml/d)	-	-	-	-	-	2033	-
Isle of Wight	Leakage reduction	2026 reduction by 1.1 Ml/d	2026 reduction by 1.1 Ml/d	2019 reduction by 1.2 Ml/d	2017 reduction by 1.3 Ml/d	2032 reduction by 0.7 Ml/d	2020 reduction by 1.2 Ml/d	2026 reduction by 1.1 Ml/d
Isle of Wight	Water efficiency kit (box)	2030	2030	2030	2030	-	2025	2030
Isle of Wight	Water efficiency low flow shower heads	-	-	2030	-	-	-	-
Isle of Wight	Water efficiency trigger hoses	-	-	-	-	-	2025	-
Hants. Andover	*No supply side, water efficiency, or leakage reduction schemes*	-	-	-	-	-	-	-
Hants. Kings.	*No supply side, water efficiency, or leakage reduction schemes*	-	-	-	-	-	-	-
Costs (£m)								
Total metering cost (£m)		52.70	52.70	56.81	48.17	52.70	52.70	52.20
Total resource, leakage reduction and water efficiency activity cost (£m)		42.65	42.65	48.28	55.48	40.30	56.26	42.65
Total cost of Strategy (£m)		**95.35**	**95.35**	**105.09**	**103.65**	**93.00**	**108.96**	**94.85**

Table 10.8 Results of Scenario Analysis for the Western Area, with Sustainability Reductions

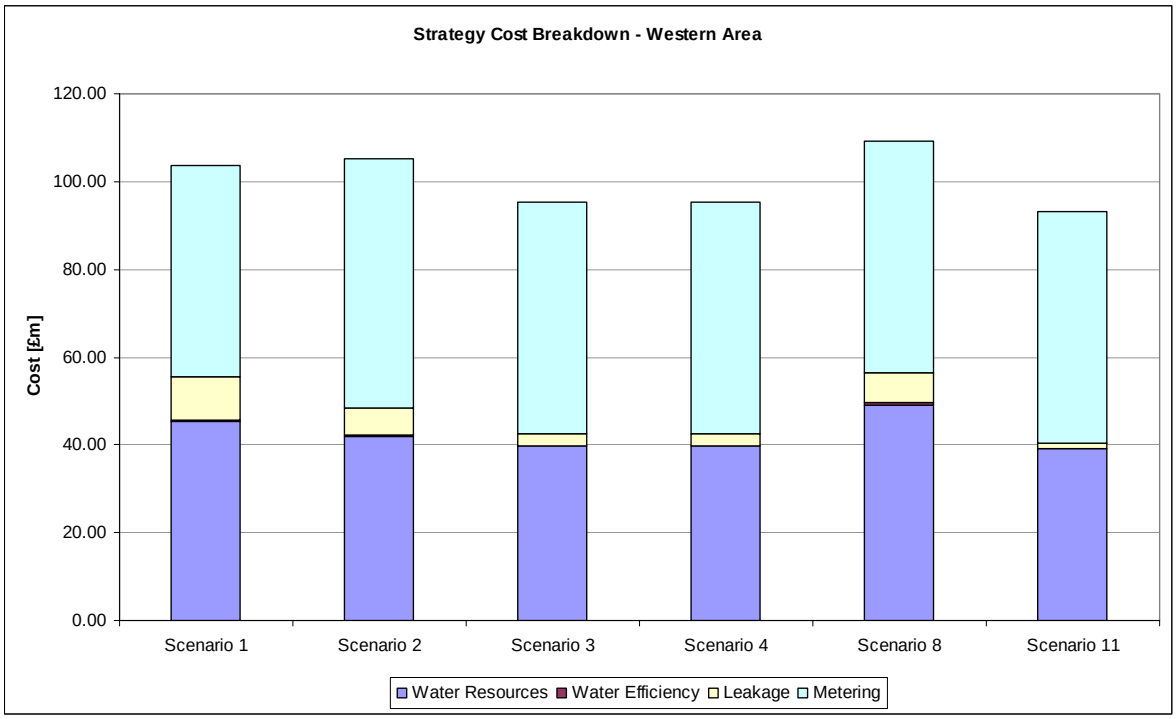


Figure 10.18 Western Area Scenario Cost Comparisons

10.3.12 Sensitivity Analysis

10.3.12.1 Range of Sensitivity Analysis

The "possible worst-case" focused on any changes in supply side or demand side factors which would worsen the supply demand balance. Any decrease in deployable output and/or increase in demand would mean that deficits would occur earlier in the planning period and would be larger than those identified in the baseline conditions. This could pose a threat to the security of supplies if the selected schemes, and/or any others that might then be required, could not be commissioned quickly enough.

Following consideration of a number of such demand and supply side factors and the potential magnitude of each, it was decided that a "global" change in the demand forecast of +/- 5% should be assumed for the area. This sensitivity assumption would change the supply demand balance components for the Western Area as follows:

- A change in demand of +/- 5% is equivalent to +/- 10.5 Ml/d and +/- 13.9 Ml/d at the MDO and PDO condition respectively by the end of the planning period; and
- A change in demand of +/- 5% is equivalent to a change in the area deployable output +/- 3.4% and +/- 4.1% at the MDO and PDO condition respectively.

10.3.12.2 Results of Sensitivity Analysis

The results of the sensitivity analysis for the possible "best-case" and "worst-case" are presented in Table 10.9 and can be summarised as follows:

Under the "worst-case" sensitivity:

- There is no change to the timing of the Testwood WSW increase to utilise full licence capacity, nor the Candover Alre Augmentation, as these are both driven by the Sustainability Reduction;

- The Woodmill abstraction is required in 2026, replacing the much smaller West Tytherley borehole rehabilitation scheme;
- The cross-Solent main increase (to 20 Ml/d) is required, but K628 is no longer needed on the Isle of Wight;
- The refurbishment of L536 borehole is still needed, but earlier than in the base case;
- Further leakage reduction is required from 2020; and
- Additional water efficiency schemes are selected in both Hampshire South and the Isle of Wight WRZs.

In summary, if the assumptions of worst-case sensitivity analysis were to occur, the Woodmill Scheme would be needed together with an increase in the capacity of the cross-Solent main.

Under the “best-case” sensitivity:

- There is no change to the timing of the Testwood WSW increase to utilise full licence capacity, nor the Candover Alre Augmentation;
- None of the borehole schemes are required in either Hampshire South WRZ or on the Isle of Wight; and
- There is no need for further leakage reduction or water efficiency schemes.

In summary, the results of the best-case sensitivity analysis do not change the need for the Testwood scheme at full licence and use of the Candover Alre Augmentation schemes because these are both driven by the introduction of the Lower Itchen Sustainability Reductions.

	Scenario	Company preferred Regional strategy	Company only Universal metering	Increase in demand of 5% by end of planning period	Decrease in demand of 5% by end of planning period
	Number	**4**	**3**	**"Worst case"**	**"Best case"**
	Metering policy	Universal	Universal	Universal	Universal
	Leakage policy	JR08, then SPL saving	JR08, then SPL saving	JR08, then SPL saving	JR08, then SPL saving
	WRSE preferred options & bulk supplies	Yes	No	No	No
WRZ	**Scheme**	**Earliest year required**			
Hampshire South	Testwood new DAF plant to utilise full licence & enabling transfer pipeline to Otterbourne	2015	2015	2015	2015
	Candover Alre Augmentation	2019	2019	2019	2019
	R176 borehole rehabilitation	2033	2033	-	-
	Woodmill abstraction (56 Ml/d) and treatment at Otterbourne	-	-	2026	-
	Leakage reduction	2025 reduction by 7.8 Ml/d	2025 reduction by 7.8 Ml/d	2020 reduction by 5.4 Ml/d	-
	Water efficiency kit (box)	-	-	2025	-
	Water efficiency low flow shower heads	-	-	2025	-
Isle of Wight	L536 borehole rehabilitation	2032	2032	2025	-
	K628 borehole rehabilitation	2034	2034	-	-
	Cross-Solent main increase (to 20 Ml/d)	-	-	2030	-
	Leakage reduction	2026 reduction by 1.1 Ml/d	2026 reduction by 1.1 Ml/d	2021 reduction by 1.2 Ml/d	-
	Water efficiency kit (box)	2030	2030	2025	-
Hants. Andover	*No supply side, water efficiency, or leakage reduction schemes*	-	-	-	-
Hants. Kings.	*No supply side, water efficiency, or leakage reduction schemes*	-	-	-	-
	Costs (£m)				
	Total metering cost (£m)	52.70	52.70	52.70	52.70
	Total resource, leakage reduction and water efficiency activity cost (£m)	42.65	42.65	56.47	38.49
	Total cost of Strategy (£m)	**95.35**	**95.35**	**109.17**	**91.19**

Table 10.9 Results of Sensitivity Analysis for the Western Area

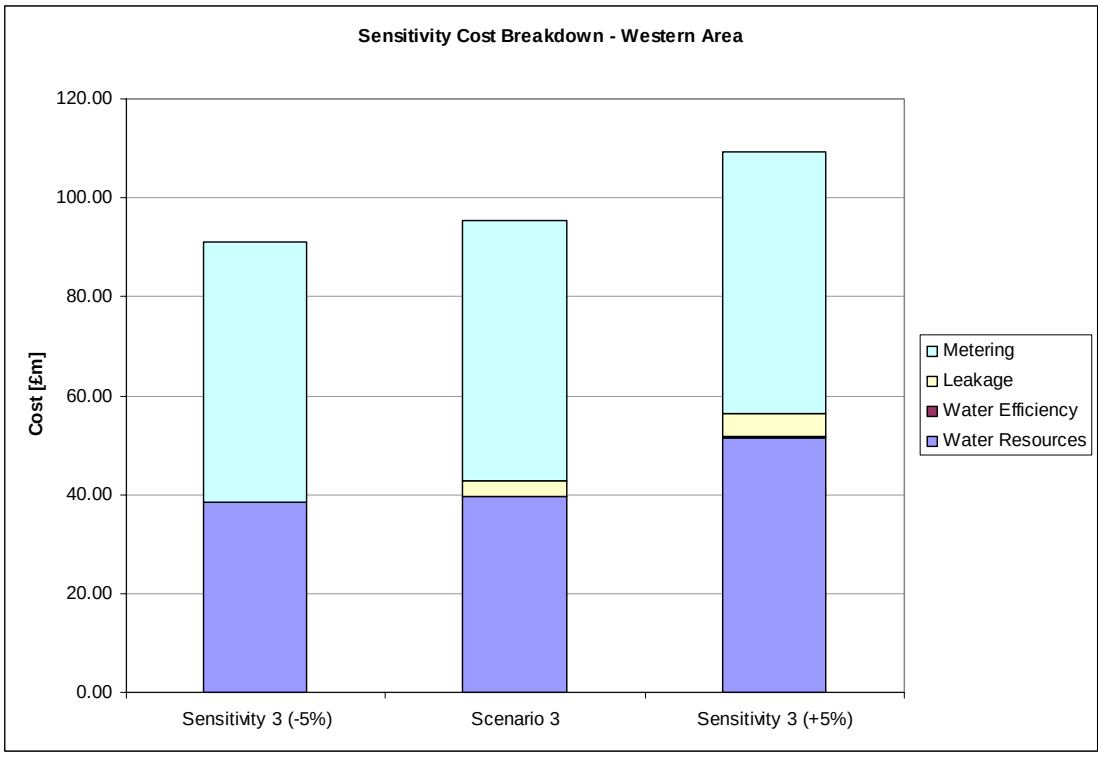


Figure 10.19 Western Area Sensitivity Analysis Cost Comparisons

10.3.13 Conclusions

The proposed Sustainability Reductions have a significant impact on the baseline supply demand balance, and therefore the Water Resources Strategy for the area. Following submission of the draft WRMP the company has met with Ofwat, EA, Natural England and Portsmouth Water to explore alternative options for allowing the Sustainability Reductions to be implemented without compromising security of supply. The company prepared a draft Memorandum of Understanding that set out the roles and responsibilities of each party and the schemes that would need to be implemented before the Lower Itchen abstraction licences would be voluntarily changed. Investigations would also need to be undertaken during AMP5 to confirm or otherwise the assumptions for the proposed operation of the Candover and Alre groundwater augmentation schemes which have been used for the supply demand balance of Hampshire South WRZ.

The Memorandum of Understanding has been agreed and signed off by the relevant parties and is included in Appendix A.

The company would not be able to confirm its commitment to implementation of the full Sustainability Reductions at the end of AMP6 unless the following options are implemented in the Hampshire South and Isle of Wight WRZs, so that the security of supplies is maintained throughout the planning period (see Table 10.6):

- Universal metering;
- Leakage reduction;
- Asset improvement schemes for groundwater sources;
- Increase of Testwood WSW to licence limit;
- Development of the enabling Testwood to Otterbourne transfer and associated distribution infrastructure; and
- Optimisation of inter-zonal transfers (cross-Solent main).

10.4 The Water Resources Strategy for the Central Area

10.4.1 Location

The Central Area is situated in central and north west Sussex, and comprises the WRZs of Sussex North, Sussex Worthing and Sussex Brighton. The Sussex North WRZ lies north of the South Downs, and includes the towns of Crawley and Horsham and the rural parts of mid-Sussex. The Sussex Worthing WRZ extends across the coast from just beyond the river Arun in the west to the river Adur in the east and includes the towns of Worthing, Littlehampton and Arundel. The Sussex Brighton WRZ extends across the coast from the river Adur in the west to Peacehaven in the east, and includes the city of Brighton and Hove and the surrounding area.

There are the following inter-zonal connections:

- The Sussex North and Sussex Worthing WRZs are connected via a bi-directional main; and
- The Sussex Worthing WRZ is connected to the Sussex Brighton WRZ via a main, but the direction of the transfer is currently only from the Sussex Worthing WRZ to the Sussex Brighton WRZ.

There are the following inter-company connections:

- A bulk import to R648 in the Sussex North WRZ from Portsmouth Water, recently enhanced by the facility to take part of this bulk import into the Sussex Worthing WRZ;
- A bulk export to South East Water from Weir Wood reservoir; and
- Some small exports to South East Water from the Sussex North WRZ.

A schematic of the Central Area is given as Figure 10.20.

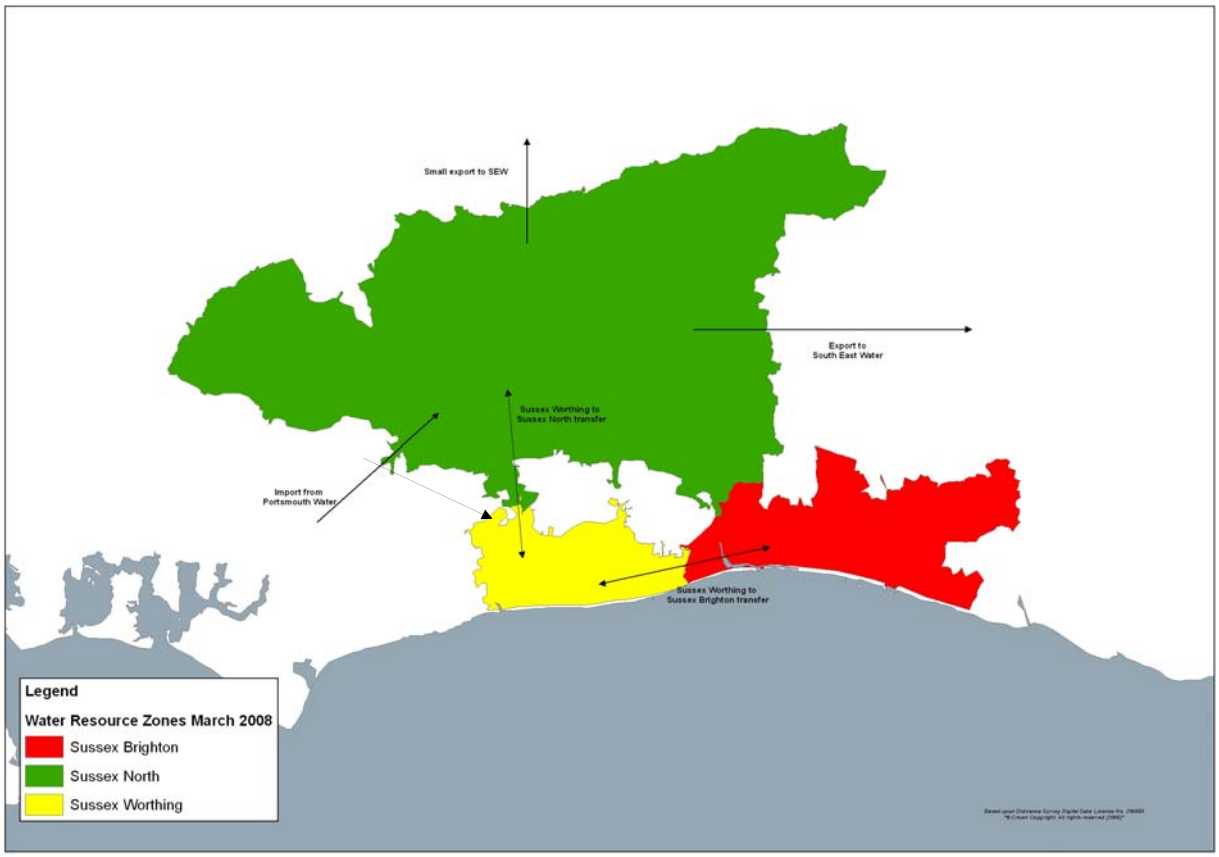


Figure 10.20 Schematic of the Central Area

10.4.2 Sources of Supply

The area is supplied by both surface water and groundwater sources. There are two surface water sources and over 30 groundwater sources in the Central Area. The Sussex North WRZ contains the only surface water sources in the area; at R648, which is supported by the S466 groundwater wellfield; and Weir Wood reservoir, together with a number of minor local groundwater sources.

R648 is the largest source in the area. It comprises a run-of-river abstraction which is subject to a Minimum Residual Flow condition which normally curtails abstraction during the late summer and autumn periods every year. There is no storage facility associated with this abstraction. The surface water abstraction is supported by adjacent groundwater sources. Weir Wood is a small direct impounding reservoir, which has no facility for pumped inflow.

The Sussex Worthing and Brighton WRZs are supplied entirely from Chalk groundwater sources. The nature of the sources in Sussex Worthing WRZ means that the WRZ is more drought resilient than the Sussex North and Sussex Brighton WRZs. The hydrogeological nature of the Brighton Chalk block, and the presence of a number of old, well and adit systems means that the sources can be very vulnerable to drought events.

10.4.3 Supplies Available

The total deployable output for the area is 187.2 Ml/d for MDO and 241.3 Ml/d for PDO. Sussex Worthing and Sussex Brighton WRZs have a combined, groundwater sourced, MDO and PDO of 147.2 Ml/d and 177.5 Ml/d respectively.

The total proportion of groundwater to surface water for the area is approximately 90% : 10%. However, a more detailed breakdown shows that the Sussex Worthing and Sussex Brighton WRZs are solely dependent on groundwater sources, whereas the Sussex North WRZ has a groundwater : surface water ratio of 60% : 40%. Furthermore, the Sussex North WRZ depends on a surface water balance of 46% run-of-river and 54% direct inflow reservoir storage.

This mixture of source types means that the area is especially sensitive to design drought events as explained in section 10.4.4.

WRZ	Groundwater			Surface Water			Total	
	No. sources	MDO Ml/d	PDO Ml/d	No. sources	MDO Ml/d	PDO Ml/d	MDO Ml/d	PDO Ml/d
Sussex North	7	23.85	39.29	2	16.20	24.50	40.05	63.79
Sussex Worthing	11	57.85	68.98	0	0.00	0.00	57.85	68.98
Sussex Brighton	13	89.30	108.52	0	0.00	0.00	89.30	108.52
Total	**31**	**171.00**	**216.79**	**2**	**16.20**	**24.50**	**187.20**	**241.29**

Note: Values are for indigenous sources only, and do not take transfers, either for inter-zonal or inter-company transfers into account.

Note: further detail is given for individual sources in Appendix D

Table 10.10 Summary of Base Year (2010-11) Deployable Outputs for the Central Area

10.4.4 Strategic Management of Sources

The mix of types of source within the area and their distribution within the different WRZs, combined with the lack of storage makes the whole area very susceptible to short-term, severe, drought events. Therefore, one of the primary objectives for the future development of water resources in this area is to make the supply system more resilient to drought events, especially against a background of the increasing impacts of climate change.

R648 is the largest source. However, it is a run-of-river source, with an associated Minimum Residual Flow condition. It is therefore very prone to even single season events. It also has no storage facility to provide over-year protection. The only reservoir is at Weir Wood. However this direct inflow reservoir is small with no pumped inflow facility. It is also prone to even single season events.

The coastal WRZs of Sussex Worthing and Sussex Brighton are supplied solely from groundwater sources and are susceptible to one, two and three season droughts, with the associated progressive reduction in groundwater storage, and resulting loss in deployable output. The WRZs are therefore single source type dominant, and thus there are no other source types to support them. Many of the old well and adit systems, especially in the Brighton area, are prone to severe problems if the adits are dewatered. The sources can also suffer from saline intrusion. A seasonal groundwater operational management strategy has been developed and is used to optimise the seasonal management of these sources, but the whole area is prone to recharge deficit conditions.

There is a bi-directional transfer between the Sussex North and Sussex Worthing WRZs. However, if the transfer is from Sussex Worthing WRZ, the groundwater sources in that WRZ will become depleted and thus even more prone to longer design drought events.

The Sussex North WRZ, and more recently, the Sussex Worthing WRZ, can be supported through the bulk supply import from Portsmouth Water. However, balancing the utilisation of the different types of sources of supply, all of which are sensitive to even short duration droughts, becomes very difficult and reveals how sensitive the area is to actual droughts as well as design drought events.

10.4.5 Demand Summary

Southern Water provides drinking water to a population in the area of about 732,000. Normal year average annual demands are 187.5 Ml/d, which can rise to 197.0 Ml/d during dry years. However, during dry years, the demands at the critical MDO and PDO periods can be 192.3 Ml/d and 240.6 Ml/d respectively, as shown in Table 10.11.

WRZ	Population (000s)	Normal Year Average Annual demand (Ml/d)	Dry Year Annual Average demand (Ml/d)	Dry Year MDO demand (Ml/d)	Dry Year Peak Period demand (Ml/d)
Sussex North	242.61	62.37	67.57	65.92	85.20
Sussex Worthing	168.38	41.53	42.95	41.94	51.57
Sussex Brighton	320.82	83.60	86.47	84.39	103.80
Central Area	**731.81**	**187.50**	**196.99**	**192.25**	**240.57**

Table 10.11 Summary of Base Year (2007-08) Demand in the Central Area (Ml/d)

10.4.6 Strategic Development to Date

There have been a number of strategic developments over the last 10-15 years within the area that have improved, to some extent, its flexibility and drought resilience. These include:

- Leakage has been reduced over the last 12 years from 32.6 Ml/d to 29.5 Ml/d;
- There has been an increase in meter installation over the last 12 years from 8% to 36%;
- The development of the Portsmouth Water bulk import to the Sussex North WRZ up to 15 Ml/d, and, recently, the subsequent connection to the Sussex Worthing WRZ;
- The upgrade of the Sussex Worthing WRZ to Sussex North WRZ transfer to 15 Ml/d; and
- The construction of a strategic main to connect and provide support for the local groundwater sources.

10.4.7 Levels of Service

The area, as with other parts of the south-east, has suffered from the effects of the recent droughts, in 1989-92, 1995 and more recently 2004-06. There was serious stress on the area's water resources and a risk to security of supply. In order to respond to the increasingly severe drought conditions Southern Water followed its Drought Plan and introduced its programme of both demand side and supply side measures which had an impact on Customer and Environmental Levels of Service.

10.4.7.1 Customer Level of Service

A summary of the frequency of restrictions since 1989, compared to Target Levels of Service, is given in Table 10.12. Despite its best endeavours to alleviate the effects of the droughts, Southern Water was unable to meet its Target Levels of Service:

- In some WRZs in this area the company has introduced sprinkler/full hosepipe bans in eight out of the last 20 years (40%), although this varied from seven years (35%) in the Sussex North WRZ to eight years (40%) in both the Sussex Worthing and Sussex Brighton WRZs.
- The amount of time on average that customers have been subject to restrictions, calculated as the percentage of the actual (population times weeks of restriction) compared to the total (population times weeks under review) is 23% (varying from 19% in the Sussex North WRZ to 25% in the Sussex Worthing and Brighton WRZS). If Target Levels of Service are being met then this measure would not exceed 10%.

There has also been one occasion on which a Drought Order was granted authorising Southern Water to limit or restrict the so-called "non-essential uses" of water. This Drought Order was granted in 2006, and covered the whole area. It turned out that powers granted under this Drought Order did not need to be used due to the successful introduction of a number of other supply and demand side measures combined with wetter hydrological conditions.

WRZ	Target Levels of Service		Actual Levels of Service	
	1 in x years	% years	% no. of reporting years (taken as the no. of years, irrespective of duration during the year)	Time expressed as % of (population x weeks)
Hosepipe/Sprinkler ban				
Sussex North	1:10	10%	35%	19%
Sussex Worthing	1:10	10%	40%	25%
Sussex Brighton	1:10	10%	40%	25%
Central Area	**1:10**	**10%**	**40%**	**23%**
Drought Orders implemented "Non-essential use" ban				
Sussex North	1:20	5%	0%	0%
Sussex Worthing	1:20	5%	0%	0%
Sussex Brighton	1:20	5%	0%	0%
Central Area	**1:20**	**5%**	**0%**	**0%**

Table 10.12 Summary of Restrictions in the Central Area Since 1989

10.4.7.2 Environment Level of Service

Four Drought Permits/Orders were applied for and granted during this period. Three of these were for a reduction in the Minimum Residual Flow (MRF) for the surface water abstraction at R648. Applications were also prepared on a number of other occasions, but changes in demand and supply circumstances meant that the applications were not submitted. A Drought Order was authorised in 2006 to reduce the amount of compensation water to be released from Weir Wood reservoir.

Whilst there were a number of occasions that the sources did not, in the event, need to be operated under the terms of the Drought Permits/Orders, it was necessary to have the Drought Permits/Orders in place, should drought conditions have continued and increased the risk to security of supplies.

Southern Water considers that the past performance against Target Levels of Service must be improved. This can only be achieved through the development of a more robust supply system with a supply demand balance that is resilient in the face of drought conditions. This requires the introduction of a number of supply and demand side measures.

10.4.7.3 Influence of a supply demand balance deficit on operations during a drought

Even after taking into account inter-zonal transfers to reduce baseline supply demand balance deficits, the Sussex North and Sussex Brighton WRZs would experience deficits for the full five years and first two years of the AMP5 period respectively. There would be no deficits in the Sussex Worthing WRZ.

The Sussex North WRZ has a supply demand balance deficit for the full five years of AMP5 of about 11 decreasing to 6 Ml/d over the period for the MDO condition and about 7 decreasing

to 3 Ml/d for the PDO condition. This represents about 12 and 6% of Distribution Input respectively, and compares to the sum of the planning allowances for target headroom and outage of about 5 and 6 Ml/d respectively.

As mentioned previously the MDO situation is sensitive because there is limited storage in the Sussex North WRZ. The MDO condition is caused by low river flows at Hardham which affect the Hardham run-of-river abstraction. The possibility of such a condition occurring can be predicted some months in advance from analysis of the river flow recession curve. In addition the MISER model developed for the AMP4 Water Resources Investigations means that there is now a much better understanding of the water supply system which will assist in operational management under all, not just drought conditions. Furthermore, any opportunities to accelerate the groundwater asset improvement schemes in the other WRZs should be taken to enable enhanced transfers to be made to the Sussex North WRZ.

The Sussex Brighton WRZ has a supply demand balance deficit for the first two years of the planning period of about 1 and 2 Ml/d for the MDO and PDO condition respectively. This represents about 1 and 2 % of Distribution Input respectively, and compares to the sum of the planning allowances for target headroom and outage of about 8 and 11 Ml/d respectively.

Whilst these deficits are not large, the situation will require monitoring closely, and any opportunity to accelerate the groundwater asset improvement schemes for the WRZ needs to be taken.

10.4.8 The Baseline Supply Demand Balance for the Central Area

The baseline supply demand balances in the WRP Tables assume the following:

- Continuation of current metering policies. In 2007-08 there were 316,200 domestic properties in this area, 36% of which were metered. By 2015, the number of metered domestic properties is expected to rise to 227,100;
- Deployable outputs according to the Unified Methodology, which ensures that the deployable outputs for groundwater and surface water sources are estimated for the same design drought event;
- Deployable outputs include assumed incremental yields from source improvements for both AMP4 and planned for the AMP5 period, with timings assumed throughout the AMP5 period;
- No Sustainability Reductions (as advised by the Environment Agency);
- Renewal of existing inter-company bulk transfers until the end of the planning period, at the rates prevailing at the time of contract renewal; and
- Inter-zonal transfers are adjusted in the supply demand balance to represent the optimal use of surplus resources; while for the purposes of the investment model they are set to zero at the start of the planning period.

The baseline supply demand balances for each WRZ in the Central Area are given in Table 10.13 for both the MDO and PDO conditions. These baseline supply demand balances over the planning period are shown in annotated graphs Figure 10.21 to Figure 10.26. Full detailed build-up tables given In Appendix I.

Water Resource Zone	Planning scenario	Base year 2007-08	2009-10	Start of planning period 2010-11	2014-15	2019-20	2024-25	2029-30	2034-35
Sussex North	MDO	0.00	0.00	-11.07	-5.91	-6.26	-7.02	-7.84	-8.77
Sussex	MDO	12.87	14.01	0.00	0.63	1.05	1.03	0.50	0.00

Worthing									
Sussex Brighton	MDO	2.69	4.84	-0.96	8.49	9.75	9.85	9.32	8.72
Sussex North	PDO	1.55	2.07	-7.07	-2.72	-1.78	-2.43	-4.02	-5.84
Sussex Worthing	PDO	18.67	20.09	0.00	0.00	0.00	0.00	0.00	0.00
Sussex Brighton	PDO	1.37	4.22	-2.65	8.11	10.39	11.03	10.61	10.01

Notes: Positive figures indicate a surplus of resources, negative indicate a deficit

Table 10.13 Baseline Supply Demand Balance for Central Area for the MDO and PDO Condition (Ml/d)

In these baseline supply demand balances, inter-zonal transfers from 2010-11 are balanced to make the best use of inter-connected resources where water can be transferred from a WRZ with a surplus to one with a deficit, namely from Sussex Worthing to Sussex North in the Central Area. At the same time, the investment model is able to chose whether it is better to cease continue, or increase, existing inter-zonal transfers, or to develop new resources, or enhance demand management in the WRZ in deficit.

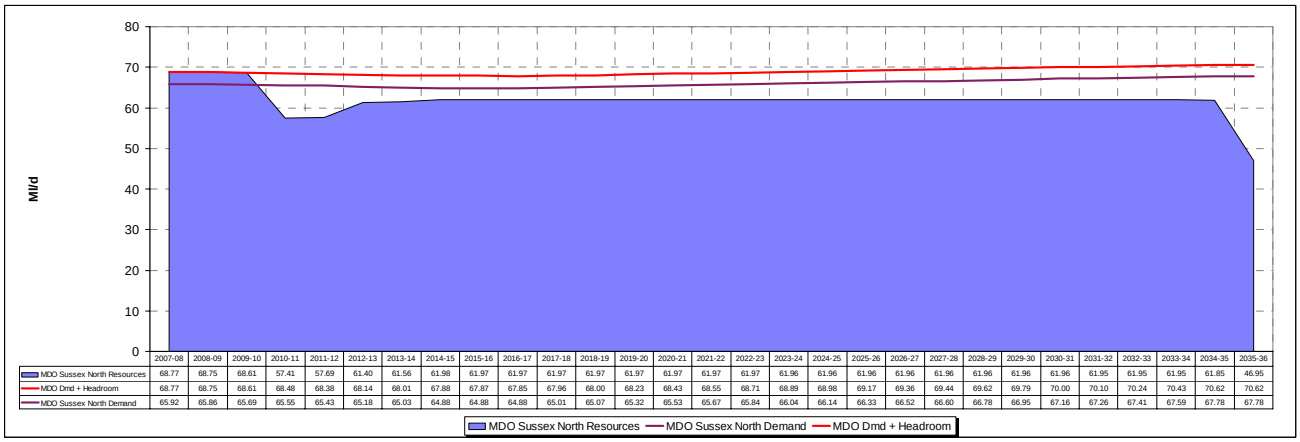
Despite the relatively healthy baseline supply demand balances, this area has very little resilience to drought events over one, two or three seasons. In the event that the drought of 2004-06 had continued into a third dry winter, there would have been very serious concerns over supplies to the area in general, and to the groundwater sources in the coastal WRZs in particular.

For both the MDO and PDO conditions:

- The Sussex North WRZ starts the planning period in severe deficit, and remains so throughout the planning period. This change from previous analysis is mainly as a result of the more rigorous methodology used to estimate the design drought surface water deployable outputs being available as a result of the AMP4 Water Resources Investigations, given the conjunctive use of the various source types available. It also arises from the application of the Unified Methodology, which ensures that the same drought event is used to estimate both surface and groundwater deployable outputs. Application of this methodology has reduced groundwater deployable outputs in the Sussex Brighton and Sussex Worthing WRZs, which in turn means that there is less water to transfer from the Sussex Worthing WRZ to the Sussex North WRZ during the design event;
- The Sussex Worthing WRZ starts the planning period in surplus and remains so throughout the planning period, enhanced by some AMP5 source improvements. The baseline supply demand balance shows surplus water being transferred to Sussex North; and
- The Sussex Brighton WRZ starts the planning period in deficit, but, due to decreasing demands and AMP5 improvements to groundwater sources, returns to surplus for the remainder of the planning period.

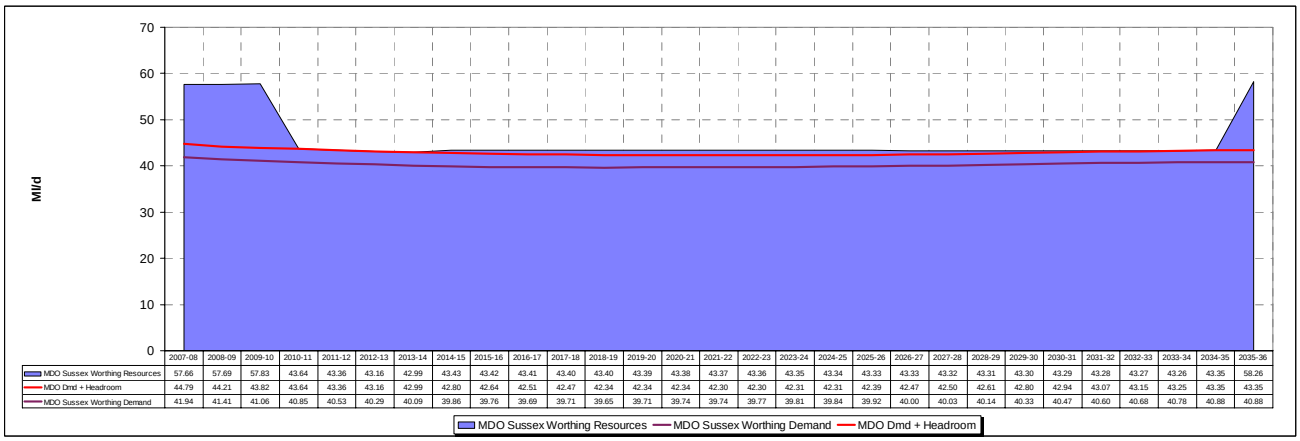
Implementation of universal metering throughout the area by 2015 would lead to the following reductions in demand;

- Sussex Nouth WRZ: 1.0 Ml/d (MDO) and 2.1 Ml/d (PDO);
- Sussex Worthing WRZ: 1.5 Ml/d (MDO) and 2.4 Ml/d (PDO); and
- Sussex Brighton WRZ: 3.6 Ml/d (MDO) and 5.7 Ml/d (PDO).



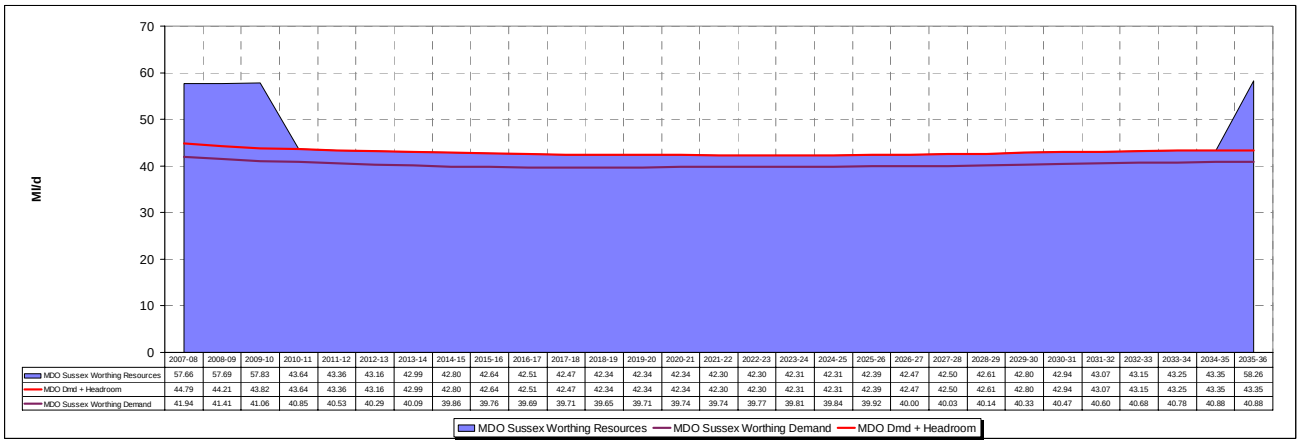
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
MDO Sussex North Resources	68.77	68.75	68.61	57.41	57.69	61.40	61.56	61.98	61.97	61.97	61.97	61.97	61.97	61.97	61.97	61.97	61.96	61.96	61.96	61.96	61.96	61.96	61.96	61.96	61.95	61.95	61.95	61.85	46.95
MDO Dmd + Headroom	68.77	68.75	68.61	68.48	68.38	68.14	68.01	67.88	67.87	67.85	67.96	68.00	68.23	68.43	68.55	68.71	68.89	68.98	69.17	69.36	69.44	69.62	69.79	70.00	70.10	70.24	70.43	70.62	70.62
MDO Sussex North Demand	65.92	65.86	65.69	65.55	65.43	65.18	65.03	64.88	64.88	64.88	65.01	65.07	65.32	65.53	65.67	65.84	66.04	66.14	66.33	66.52	66.60	66.78	66.95	67.16	67.26	67.41	67.59	67.78	67.78

Figure 10.21 Sussex North MDO Baseline Supply Demand Balance



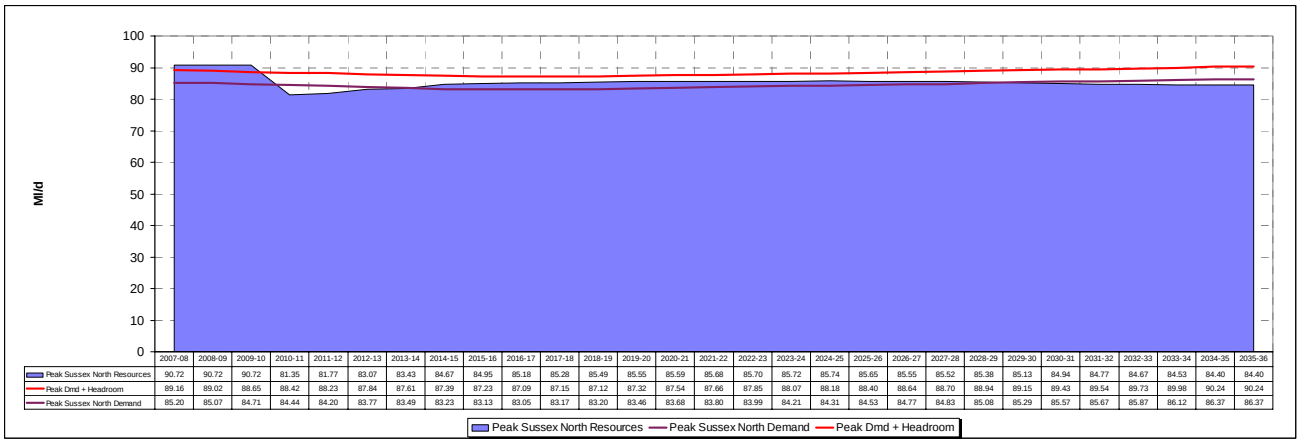
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
MDO Sussex Worthing Resources	57.66	57.69	57.83	43.64	43.36	43.16	42.99	43.43	43.42	43.41	43.40	43.40	43.39	43.38	43.37	43.36	43.35	43.34	43.33	43.33	43.32	43.31	43.30	43.29	43.28	43.27	43.26	43.35	58.26
MDO Dmd + Headroom	44.79	44.21	43.82	43.64	43.36	43.16	42.99	42.80	42.64	42.51	42.47	42.34	42.34	42.34	42.30	42.30	42.31	42.31	42.39	42.47	42.50	42.61	42.80	42.94	43.07	43.15	43.25	43.35	43.35
MDO Sussex Worthing Demand	41.94	41.41	41.06	40.85	40.53	40.29	40.09	39.86	39.76	39.69	39.71	39.65	39.71	39.74	39.74	39.77	39.81	39.84	39.92	40.00	40.03	40.14	40.33	40.47	40.60	40.68	40.78	40.88	40.88

Figure 10.22 Sussex Worthing MDO Baseline Supply Demand Balance



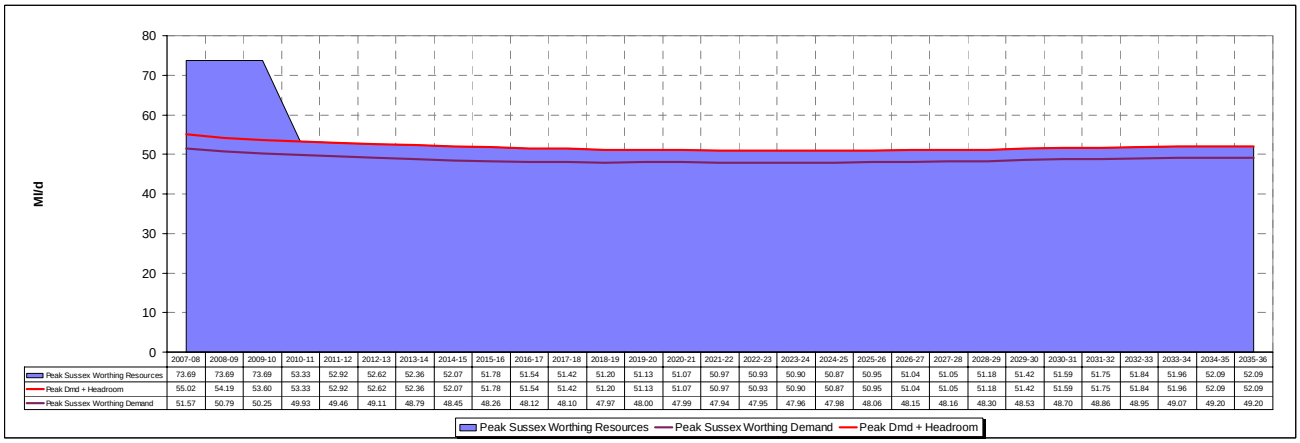
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
MDO Sussex Worthing Resources	57.66	57.69	57.83	43.64	43.36	43.16	42.99	42.80	42.64	42.51	42.47	42.34	42.34	42.34	42.30	42.30	42.31	42.31	42.39	42.47	42.50	42.61	42.80	42.94	43.07	43.15	43.25	43.35	58.26
MDO Dmd + Headroom	44.79	44.21	43.82	43.64	43.36	43.16	42.99	42.80	42.64	42.51	42.47	42.34	42.34	42.34	42.30	42.30	42.31	42.31	42.39	42.47	42.50	42.61	42.80	42.94	43.07	43.15	43.25	43.35	43.35
MDO Sussex Worthing Demand	41.94	41.41	41.06	40.85	40.53	40.29	40.09	39.86	39.76	39.69	39.71	39.65	39.71	39.74	39.74	39.77	39.81	39.84	39.92	40.00	40.03	40.14	40.33	40.47	40.60	40.68	40.78	40.88	40.88

Figure 10.23 Sussex Brighton MDO Baseline Supply Demand Balance



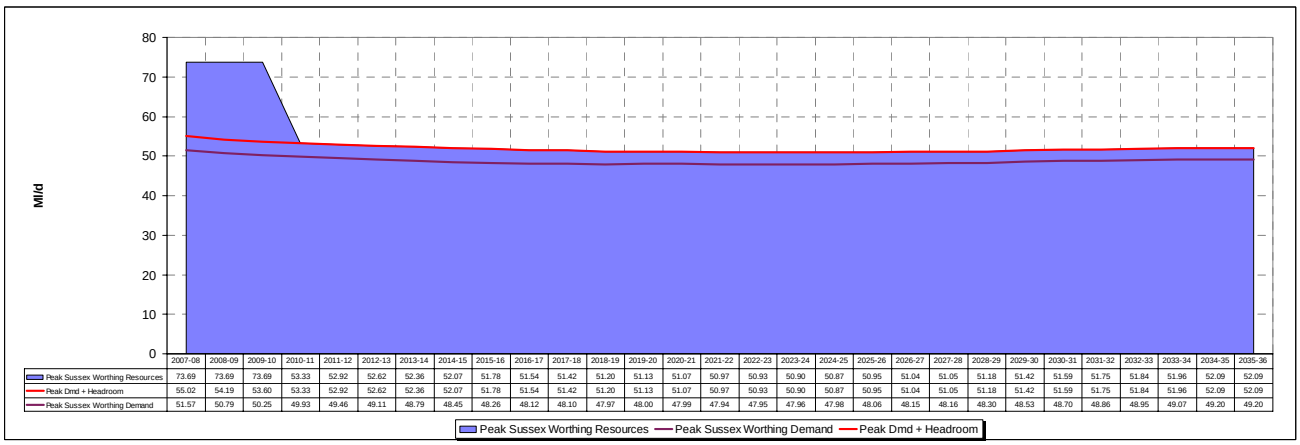
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
Peak Sussex North Resources	90.72	90.72	90.72	81.35	81.77	83.07	83.43	84.67	84.95	85.18	85.28	85.49	85.55	85.59	85.68	85.70	85.72	85.74	85.65	85.55	85.52	85.38	85.13	84.94	84.77	84.67	84.53	84.40	84.40
Peak Dmd + Headroom	89.16	89.02	88.65	88.42	88.23	87.84	87.61	87.39	87.23	87.09	87.15	87.12	87.32	87.54	87.66	87.85	88.07	88.18	88.40	88.64	88.70	88.94	89.15	89.43	89.54	89.73	89.98	90.24	90.24
Peak Sussex North Demand	85.20	85.07	84.71	84.44	84.20	83.77	83.49	83.23	83.13	83.05	83.17	83.20	83.46	83.68	83.80	83.99	84.21	84.31	84.53	84.77	84.83	85.08	85.29	85.57	85.67	85.87	86.12	86.37	86.37

Figure 10.24 Sussex North PDO Baseline Supply Demand Balance



	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
Peak Sussex Worthing Resources	73.69	73.69	73.69	53.33	52.92	52.62	52.36	52.07	51.78	51.54	51.42	51.20	51.13	51.07	50.97	50.93	50.90	50.87	50.95	51.04	51.05	51.18	51.42	51.59	51.75	51.84	51.96	52.09	52.09
Peak Dmd + Headroom	55.02	54.19	53.60	53.33	52.92	52.62	52.36	52.07	51.78	51.54	51.42	51.20	51.13	51.07	50.97	50.93	50.90	50.87	50.95	51.04	51.05	51.18	51.42	51.59	51.75	51.84	51.96	52.09	52.09
Peak Sussex Worthing Demand	51.57	50.79	50.25	49.93	49.46	49.11	48.79	48.45	48.26	48.12	48.10	47.97	48.00	47.99	47.94	47.95	47.96	47.98	48.06	48.15	48.16	48.30	48.53	48.70	48.86	48.95	49.07	49.20	49.20

Figure 10.25 Sussex Worthing PDO Baseline Supply Demand Balance



	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
Peak Sussex Worthing Resources	73.69	73.69	73.69	53.33	52.92	52.62	52.36	52.07	51.78	51.54	51.42	51.20	51.13	51.07	50.97	50.93	50.90	50.87	50.95	51.04	51.05	51.18	51.42	51.59	51.75	51.84	51.96	52.09	52.09
Peak Dmd + Headroom	55.02	54.19	53.60	53.33	52.92	52.62	52.36	52.07	51.78	51.54	51.42	51.20	51.13	51.07	50.97	50.93	50.90	50.87	50.95	51.04	51.05	51.18	51.42	51.59	51.75	51.84	51.96	52.09	52.09
Peak Sussex Worthing Demand	51.57	50.79	50.25	49.93	49.46	49.11	48.79	48.45	48.26	48.12	48.10	47.97	48.00	47.99	47.94	47.95	47.96	47.98	48.06	48.15	48.16	48.30	48.53	48.70	48.86	48.95	49.07	49.20	49.20

Figure 10.26 Sussex Brighton PDO Baseline Supply Demand Balance

10.4.9 Options to Meet the Supply Demand Balance in the Central Area

A number of demand and supply side options have been considered to meet any supply demand balance deficit.

The supply side options have been assessed using the options appraisal methodology described in section 8. In summary, an initial list of nearly 120 options has been considered within the Central Area, for which further details are given in Appendix G.

Following the various screening processes, the number of "feasible" options, by generic type, that was chosen to be available for selection by the investment model can be summarised, by generic type, as follows:

- Two sites for a new surface storage reservoir, for which the sole lead promoter would be Southern Water;
- Five sites for possible increases in abstraction from either surface or groundwater, although only one or two would be chosen;
- No sites for enlarging existing reservoirs;
- One site for potential re-commissioning of old/existing sources;
- Three possible abstraction licence variations;
- No sites for the further upgrade of WSW treatment facilities, for the purposes of the supply demand balance;
- Three potential inter-zonal bulk transfers, either existing or proposed;
- No potential inter-company bulk transfers, either existing or proposed;
- Two potential schemes for wastewater recycling;
- One site for potential Aquifer Storage and Recovery scheme; and
- Four potential schemes for desalination.

This shows that a wide range of generic types of option were available for selection, thus ensuring that the selection of preferred schemes was robust. The total number includes a number of generic schemes, for instance desalination, at the same site but for different capacities. This is to ensure that a generic option is not ruled out from selection on the basis of the size and associated cost alone.

There are three generic types of demand side options: metering; leakage reduction; and water efficiency. Different modelling scenarios have been devised to reflect a different selection of options (see section 10.1.13).

As noted in section 10.3.8, scenario 3 (Universal Metering) has been used as the starting point for the supply demand balance from which the Final Planning solution has been developed.

In order to consider leakage options, a number of incremental "step" reductions in leakage were considered, based on outputs from the Sustainable Economic Level of Leakage analysis, as explained in Chapter 6 and Appendix G.

Water efficiency options for both households and non-households were included in the model. More details of the options are given in section 8 and Appendix G.

10.4.10 The Water Resources Strategy for the Central Area

The water resources strategy is described in three different sections over the planning period:

- AMP5, the first five years from 2010-11 to 2014-15, which formed the basis of the Final Business Plan Submission;

- AMP6 to the end of the planning period, based on the company only least-cost strategy; and then
- An explanation of how this company only strategy is modified to take into account the recommendations of the WRSE regional modelling results.

The company preferred water resource strategy for each of these intervals is described below and is summarised in Table 10.14.

During AMP5 (2010-15)

The supply demand balance will be satisfied for the Central Area for the AMP5 period through the following:

- A policy of universal metering throughout the area by 2015, which will give benefits in terms of demand savings and associated reductions in supply pipe leakage;
- The optimisation of inter-zonal transfers, from the Sussex Worthing WRZ to the Sussex North and Sussex Brighton WRZs;
- The renewal of the existing bulk supply from Portsmouth Water to Sussex North WRZ;
- A series of groundwater source improvements, which could deliver up to 11.6 Ml/d for the average condition; and
- The construction of a new intake on the River Arun, which has been the subject of extensive investigations during AMP4. A planning application and abstraction licence application have been made, and it is planned that the source will be commissioned by 2012.

From AMP6 to the end of the planning period (2015-35) (company only)

For the company only least-cost solution, there are no further interventions identified as being required until the end of the planning period, with the supply demand balance being satisfied through the optimisation of inter-zonal bulk transfers, the continuation of the inter-company bulk import from Portsmouth Water and the benefits of the supply and demand side interventions made during AMP5.

From AMP6 to the end of the planning period (2015-35) (company preferred regional solution)

Following the results of the WRSE modelling work, Southern Water reaffirmed its commitment to the development of a regional solution. As such, as a result of the preferred options identified from the WRSE modelling work, we have included the following option in our company preferred regional strategy, over and above the company only least-cost solution:

- The provision of a 4 Ml/d bulk supply of 2028 from the Sussex Brighton WRZ to South East Water.

It should be noted that the WRSE work identified the possibility of an enhanced bulk import from Portsmouth, associated with the development of Havant Thicket reservoir. However, this has not been included in our preferred strategy as there was no requirement for it in the supply demand balance.

There is a supply demand balance surplus in Sussex Brighton WRZ and so there is minimal incremental cost associated with the adoption of the company preferred regional strategy.

The Water Resources Strategy for the Central Area is summarised in Table 10.14.

Water Resource Zone	Schemes During AMP 5	Schemes beyond AMP 5 – company only solution	Schemes beyond AMP 5 – Water Resources in the South East of England
Sussex North	• Universal metering • Renewal of the existing bulk supply contract from Portsmouth Water • Asset improvement schemes for groundwater sources (0.30 Ml/d peak, 0.10 Ml/d average) • Optimisation of inter-zonal transfers (from Sussex Worthing) • River Arun Abstraction	• Renewal of the bulk supply of contract to South East Water	As previous column
Sussex Worthing	• Universal metering • Asset improvement schemes for groundwater sources (1.75 Ml/d peak, 4.25 Ml/d average) • Optimisation of inter-zonal transfers (to Sussex North and Sussex Brighton)		
Sussex Brighton	• Universal metering • Asset improvement schemes for groundwater sources (7.25 Ml/d peak & average) • Optimisation of inter-zonal transfers (from Sussex Worthing)		• Provision of a 4 Ml/d bulk supply to South East Water

Table 10.14 Summary of Water Resources Strategy for the Central Area

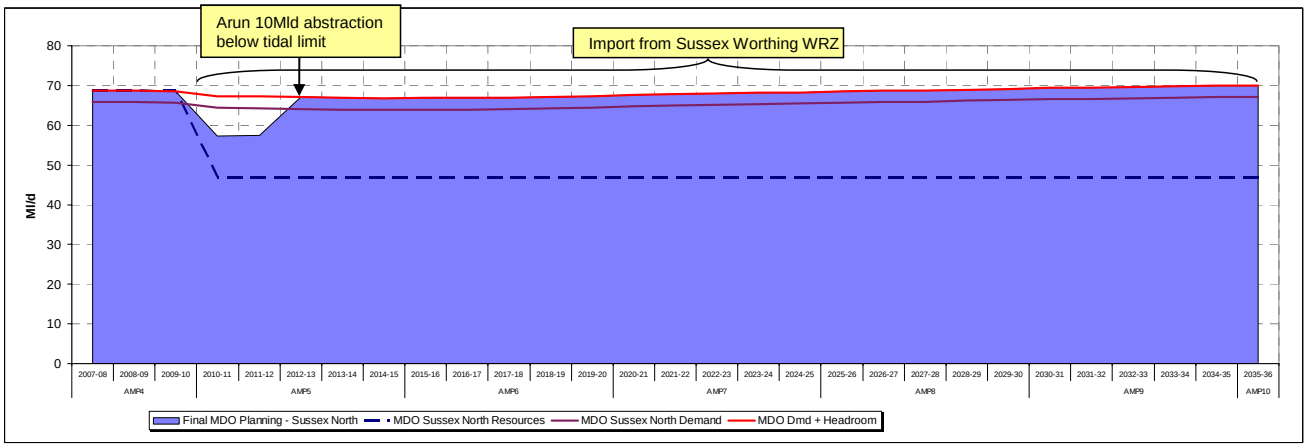


Figure 10.27 Sussex North Company Preferred Regional Strategy (Scenario 4), MDO Solution

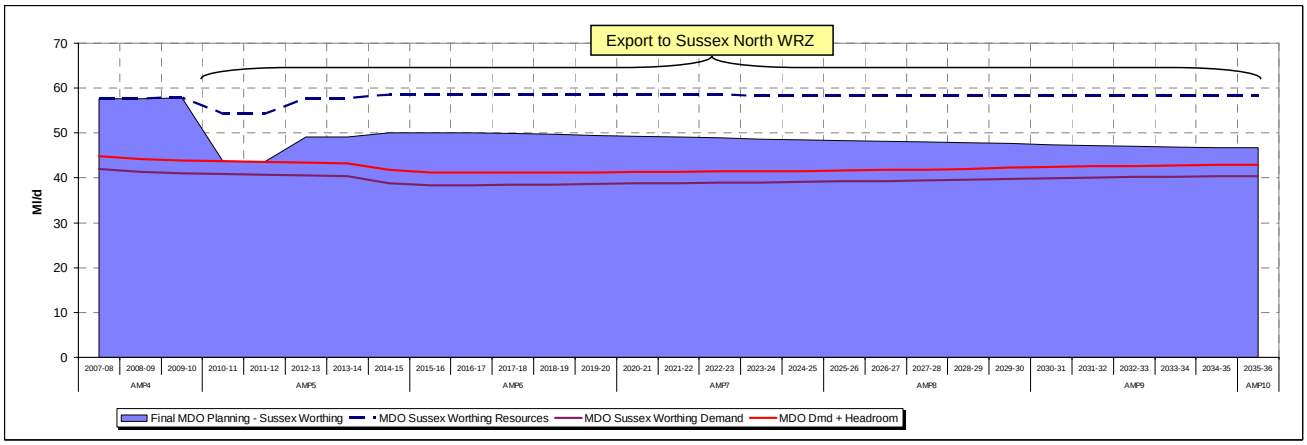


Figure 10.28 Sussex Worthing Company Preferred Regional Strategy (Scenario 4), MDO Solution

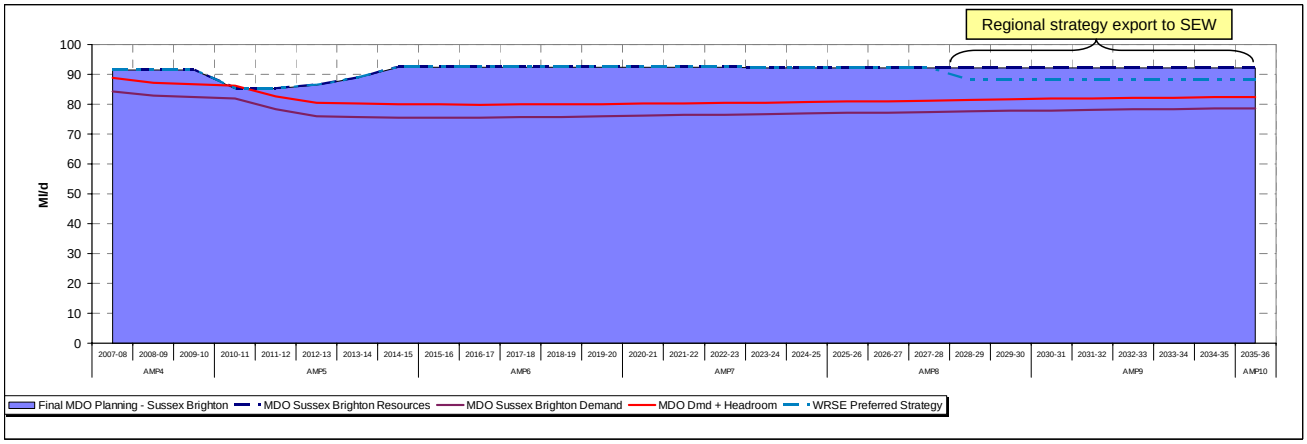


Figure 10.29 Sussex Brighton Company Preferred Regional Strategy (Scenario 4), MDO Solution

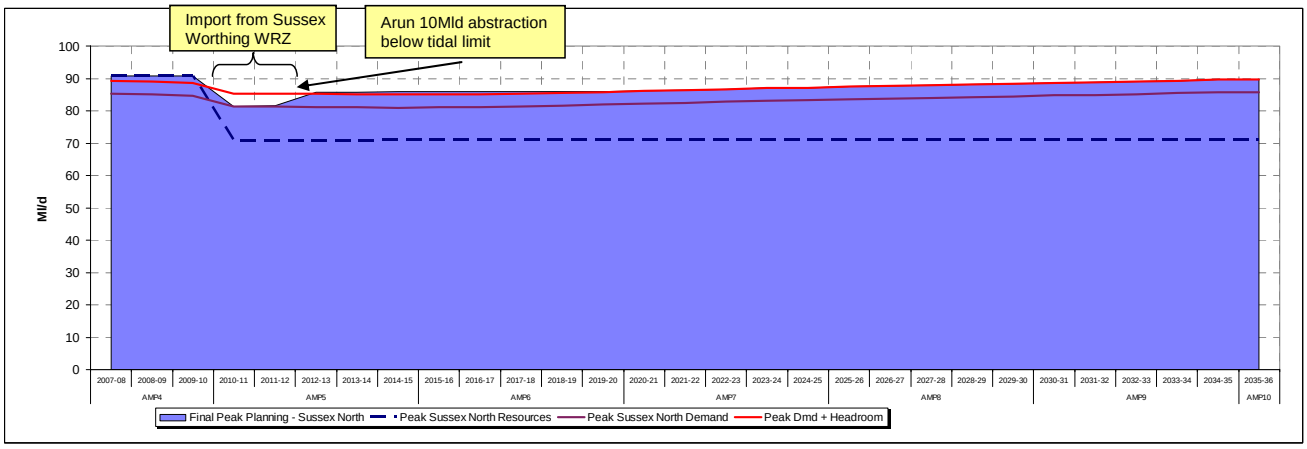


Figure 10.30 Sussex North Company Preferred Regional Strategy (Scenario 4), PDO Solution

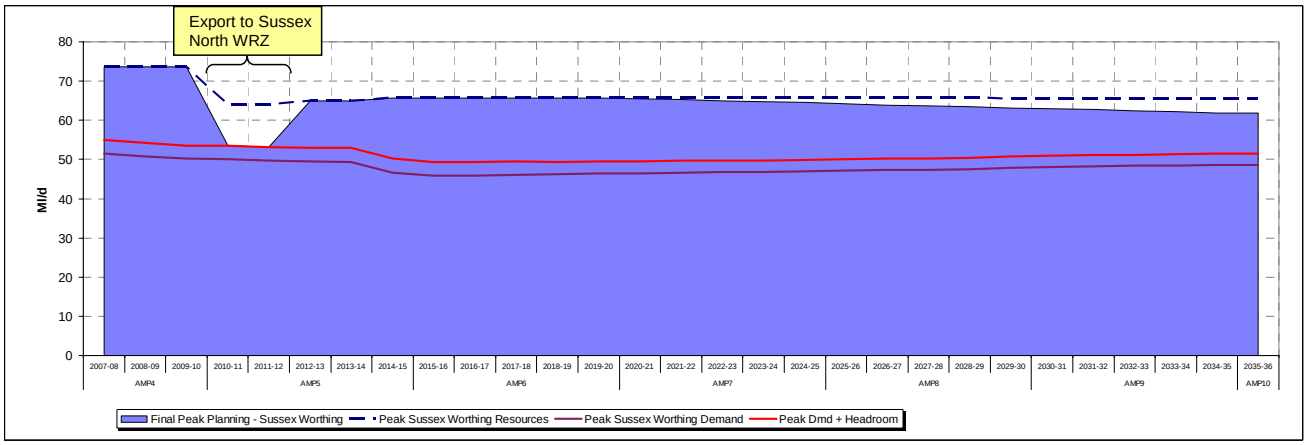


Figure 10.31 Sussex Worthing Company Preferred Regional Strategy (Scenario 4), PDO Solution

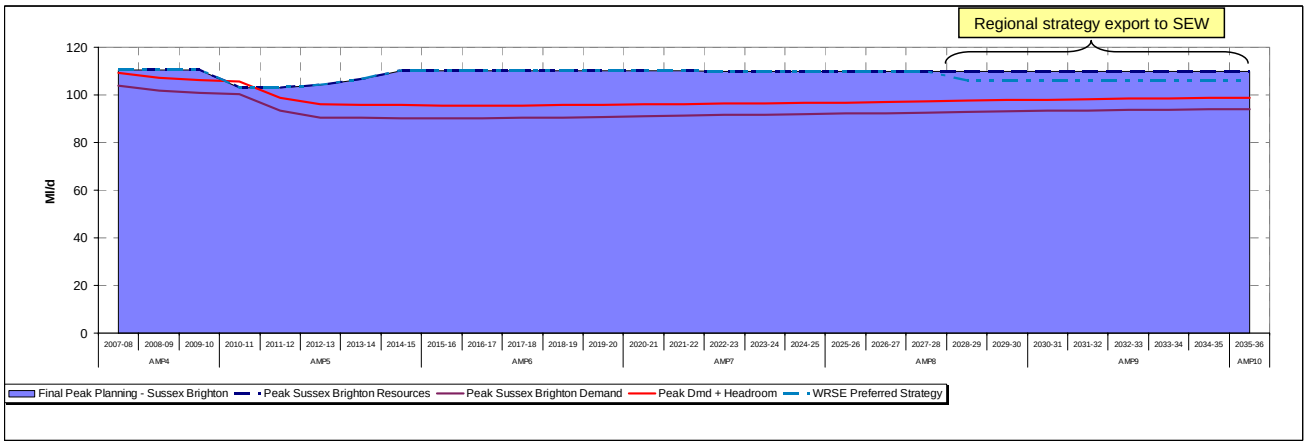


Figure 10.32 Sussex Brighton Company Preferred Regional Strategy (Scenario 4), PDO Solution

10.4.10.1 SEA Influence on Strategy

All options were assessed against 17 SEA objectives, and assigned an overall environmental risk (high, medium or low), based on the significance of potential long term effects.

Table 10.15 sets out the environmental risk of each resource development option. More detail is given in Appendix I.

Option	Environmental Risk Score
N9-10 - Arun Abstraction Below Tidal Limit	Low

Table 10.15 Environmental Risks of Resource Development Options Selected in the Central Area Strategy

The demand management options (metering; leakage reduction; and water efficiency) were also assessed against the SEA objectives. More detail is given in Appendix I. All three generic demand management measures are broadly compatible with the majority of SEA objectives due to the minimal amount of physical intervention required in implementing each measure. However, water efficiency measures have no potential conflicts with SEA objectives and are therefore the preferred demand management measure from an SEA perspective.

10.4.10.2 SEA preferred strategy

The options assessed as being likely to result in the lowest environmental risk are preferable from a SEA perspective and have been used to create the SEA preferred strategy. The low risk, and therefore preferred water resource management options are set out below:

- Arun Abstraction below Tidal Limit.

The company preferred strategy is therefore compatible with the SEA preferred strategy.

10.4.11 Scenario Analysis

A number of scenarios have been modelled, in order to assess the stability of the company only least-cost strategy to changes in some of the basic assumptions.

	Scenario	**Company preferred Regional strategy**	**Company only Universal metering**	**Company only Change of occupier**	**Company only Optant**	**Company only Universal metering with no climate change**	**Company only Leakage rise to Ofwat target**	**Hybrid Baseline where no deficit, otherwise universal metering**
	Number	**4**	**3**	**2**	**1**	**11**	**8**	
	Metering policy	Universal	Universal	Change of occupier	Optant and selective	Universal	Universal	Universal or change of occupier
	Leakage policy	JR08, then SPL saving	JR08, then SPL saving	JR08	JR08	JR08, then SPL saving	Ofwat, then SPL saving	JR08, then SPL saving
	WRSE preferred options & bulk supplies	Yes	No	No	No	No	No	Yes
WRZ	**Scheme**	**Earliest year required**						
sse × Nor	River Arun abstraction below tidal limit (10 Ml/d)	2012	2012	2012	2012	2012	2012	2012

	Scenario	Company preferred Regional strategy	Company only Universal metering	Company only Change of occupier	Company only Optant	Company only Universal metering with no climate change	Company only Leakage rise to Ofwat target	Hybrid Baseline where no deficit, otherwise universal metering
	Number	**4**	**3**	**2**	**1**	**11**	**8**	
	Leakage reduction	-	-	-	-	-	2010 reduction by 0.6 Ml/d	-
	Water efficiency trigger hoses	-	-	-	-	-	2010	-
	Water efficiency low flow shower heads	-	-	-	-	-	2010	-
Sussex Brighton	*No supply side, water efficiency, or leakage reduction schemes*	-	-	-	-	-	-	-
Sussex Worthing	Leakage reduction	-	-	-	-	-	2010 reduction by 0.4 Ml/d	-
Costs (£m)								
Total metering cost (£m)		56.82	56.82	61.25	51.94	56.82	56.82	59.91
Total resource, leakage reduction and water efficiency activity cost (£m)		18.42	18.42	18.62	18.81	18.35	20.22	18.42
Total cost of Strategy (£m)		**75.24**	**75.24**	**79.87**	**70.75**	**75.17**	**77.04**	**78.33**

Table 10.16 gives a summary of the different baseline assumptions for these scenarios, and the results in terms of scheme inclusion, scheme timing, and costs for the different investment strategies. The following points can be seen from the results:

- The company only least-cost scenario (3) assumes the baseline condition of universal metering by 2015;
- All scenarios assume the renewal of existing bulk supplies to other companies until the end of the planning period, at the rates which are appropriate at the time of renewal;
- All scenarios include the Arun abstraction as the only resource development, and do not include for any further reductions in leakage;
- The exception to this is the scenario in which leakage is initially allowed to rise to the Ofwat target level, where further leakage reduction of 1.0 Ml/d is required from 2010 to try to reduce any AMP5 deficits to the same levels as seen in the company only least-cost scenario (3);
- The total cost of the resources strategy (including new resources, leakage reduction, and water efficiency) plus metering strategy, for the various company only scenarios is as follows:
    - Universal metering - £75.2 m.
    - Change of occupier - £79.9 m.
    - Optant and selective - £70.8 m.
    - Hybrid metering policy - £m78.3 m
- There is no difference in cost between the company preferred regional strategy and the company only least-cost strategy, because there is a supply demand balance surplus in Sussex Brighton WRZ and the regional solution

only entails a minor increase in bulk supplies towards the end of the planning period.

	Scenario	Company preferred Regional strategy	Company only Universal metering	Company only Change of occupier	Company only Optant	Company only Universal metering with no climate change	Company only Leakage rise to Ofwat target	Hybrid Baseline where no deficit, otherwise universal metering
	Number	**4**	**3**	**2**	**1**	**11**	**8**	
	Metering policy	Universal	Universal	Change of occupier	Optant and selective	Universal	Universal	Universal or change of occupier
	Leakage policy	JR08, then SPL saving	JR08, then SPL saving	JR08	JR08	JR08, then SPL saving	Ofwat, then SPL saving	JR08, then SPL saving
	WRSE preferred options & bulk supplies	Yes	No	No	No	No	No	Yes
WRZ	**Scheme**	**Earliest year required**						
Sussex North	River Arun abstraction below tidal limit (10 Ml/d)	2012	2012	2012	2012	2012	2012	2012
	Leakage reduction	-	-	-	-	-	2010 reduction by 0.6 Ml/d	-
	Water efficiency trigger hoses	-	-	-	-	-	2010	-
	Water efficiency low flow shower heads	-	-	-	-	-	2010	-
Sussex Brighton	*No supply side, water efficiency, or leakage reduction schemes*	-	-	-	-	-	-	-
Sussex Worthing	Leakage reduction	-	-	-	-	-	2010 reduction by 0.4 Ml/d	-
	Costs (£m)							
	Total metering cost (£m)	56.82	56.82	61.25	51.94	56.82	56.82	59.91
	Total resource, leakage reduction and water efficiency activity cost (£m)	18.42	18.42	18.62	18.81	18.35	20.22	18.42
	Total cost of Strategy (£m)	**75.24**	**75.24**	**79.87**	**70.75**	**75.17**	**77.04**	**78.33**

Table 10.16 Results of Scenario Analysis for Central Area

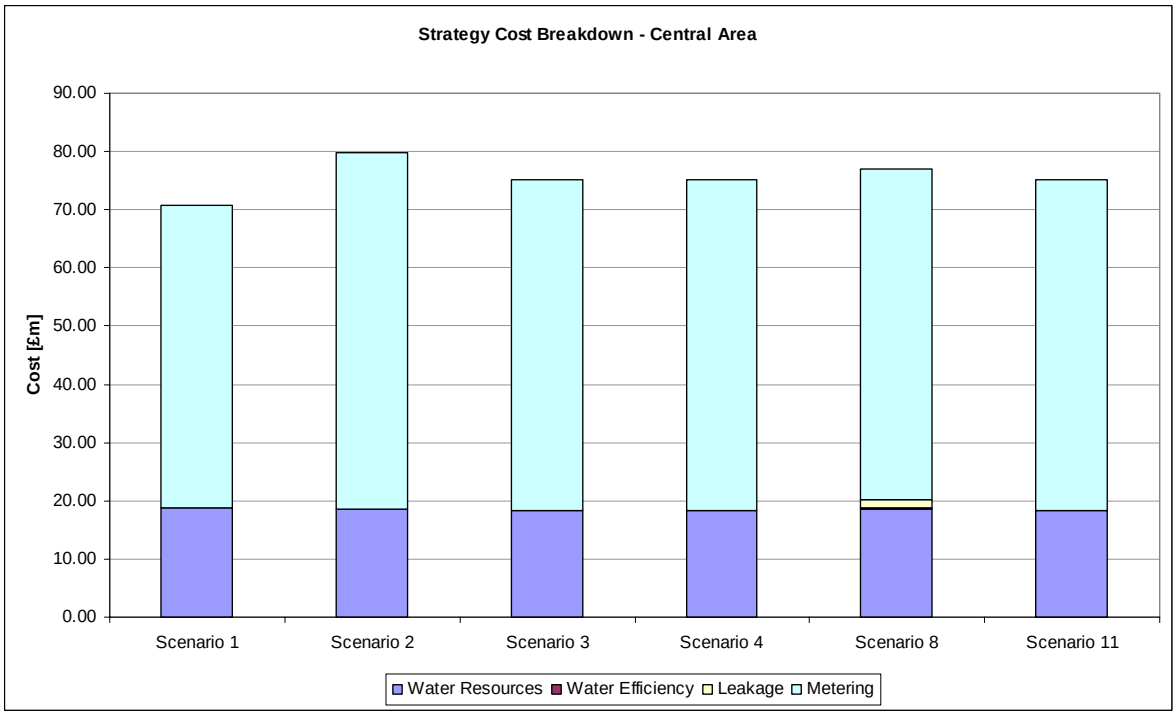


Figure 10.33 Central Area Scenario Cost Comparisons

10.4.12 Sensitivity Analysis

10.4.12.1 Range of Sensitivity Analysis

The "possible worst-case" focused on any changes in supply side or demand side factors which would worsen the supply demand balance. Any decrease in deployable output and/or increase in demands would mean that deficits occur earlier in the planning period and would be larger than those identified in the baseline conditions. This could pose a threat to the security of supplies if the selected schemes, and/or any others that might then be required, could not be commissioned quickly enough.

Following consideration of a number of such demand and supply side factors and the potential magnitude of each it was decided that a "global" change in the demand forecast of +/- 5%, would be assumed for the area. To put this sensitivity into context, at the end of the planning period, for the Central Area:

- A change in demand of +/- 5% would result in an increase in a change in demand of +/- 9.3 Ml/d and +/- 11.4 Ml/d at the MDO and PDO condition respectively by the end of the planning period;
- A change in demand of +/- 5% would be equivalent to a change in the area deployable output of +/- 5.0% and +/- 4.7% at the MDO and PDO condition respectively.

10.4.12.2 Results of Sensitivity Analysis

The results of the sensitivity analysis for the possible "best-case" and "worst-case" are presented in Table 10.17 and can be summarised as follows:

Under the "worst-case" sensitivity:

- The timing of the Arun abstraction scheme remains unchanged; however

- In view of the increase in demand, a small amount of further leakage reduction is required in Sussex North and Sussex Worthing WRZs.

Under the "best-case" sensitivity:

- The timing of the Arun abstraction scheme remains unchanged.

In summary, the company only least-cost strategy is largely unaffected by sensitivity runs, as the selection of the Arun abstraction in Sussex North is governed by the large deficits in that WRZ.

	Scenario	**Company preferred WRSE Regional**	**Company only Universal metering**	**Increase in demand of 5% by end of planning period**	**Decrease in demand of 5% by end of planning period**
	Number	**4**	**3**	**"Worst case"**	**"Best case"**
	Metering policy	Universal	Universal	Universal	Universal
	Leakage policy	JR08, then SPL saving	JR08, then SPL saving	JR08, then SPL saving	JR08, then SPL saving
	WRSE preferred options & bulk supplies	Yes	No	No	No
WRZ	**Scheme**	**Earliest year required**			
Sussex North	River Arun abstraction below tidal limit (10 Ml/d)	2012	2012	2012	2012
Sussex North	Leakage reduction	-	-	2032 reduction by 1.2 Ml/d	-
Sussex Brighton	*No supply side, water efficiency, or leakage reduction schemes*	-	-	-	-
Sussex Worthing	Leakage reduction	-	-	2033 reduction by 0.4 Ml/d	-
	Costs (£m)				
	Total metering cost (£m)	56.82	56.82	56.82	56.82
	Total resource, leakage reduction and water efficiency activity cost (£m)	18.42	18.42	18.96	18.05
	Total cost of Strategy (£m)	**75.24**	**75.24**	**75.78**	**74.87**

Table 10.17 Results of Sensitivity Analysis for the Central Area

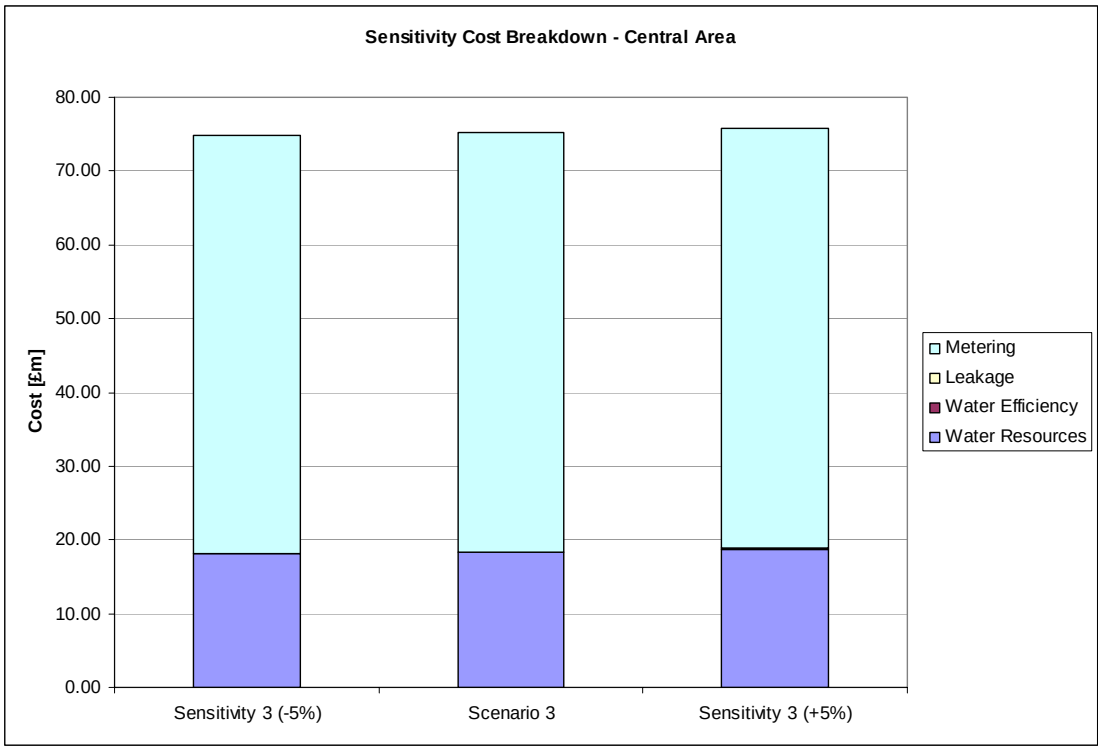


Figure 10.34 Central Area Sensitivity Analysis Cost Comparisons

10.5 The Water Resources Strategy for the Eastern Area

10.5.1 Location

The Eastern Area is situated in north and east Kent, and east Sussex, and comprises the Water Resource Zones (WRZs) of Kent Medway, Kent Thanet and Sussex Hastings. The Kent Medway WRZ is situated in the northern part of Kent, and extends from Gravesend in the west, Sittingbourne in the east and the North Downs in the south. It supplies the towns of Chatham, Rochester, Strood, Gillingham, the Isle of Grain and surrounding area. The Kent Thanet WRZ is located in the north-east corner of Kent, and includes the towns of Margate, Broadstairs, Ramsgate, Sandwich and Deal, together with the rural area east of Canterbury. The Sussex Hastings WRZ is in the eastern part of Sussex, and supplies the towns of Hastings and Rye and the surrounding area.

There are a number of inter-zonal transfers between the WRZs, as follows:

- From the Kent Medway WRZ to the Kent Thanet WRZ via a transfer main; and
- From the Kent Medway WRZ to the Sussex Hastings WRZ via a transfer main.

There are also a number of inter-company transfers:

- An export to South East Water in the Kent Medway WRZ;
- An export to South East Water from its entitlement to 25% of the yield of G457 in the Kent Medway WRZ;
- A number of small metered supplies to South East Water in the Kent Medway WRZ;
- A seasonal export to Folkestone and Dover Water Services from the Kent Thanet WRZ; and
- An export to South East Water from the Sussex Hastings WRZ from Darwell reservoir.

A schematic showing the key features of the Eastern Area is given as Figure 10.35.

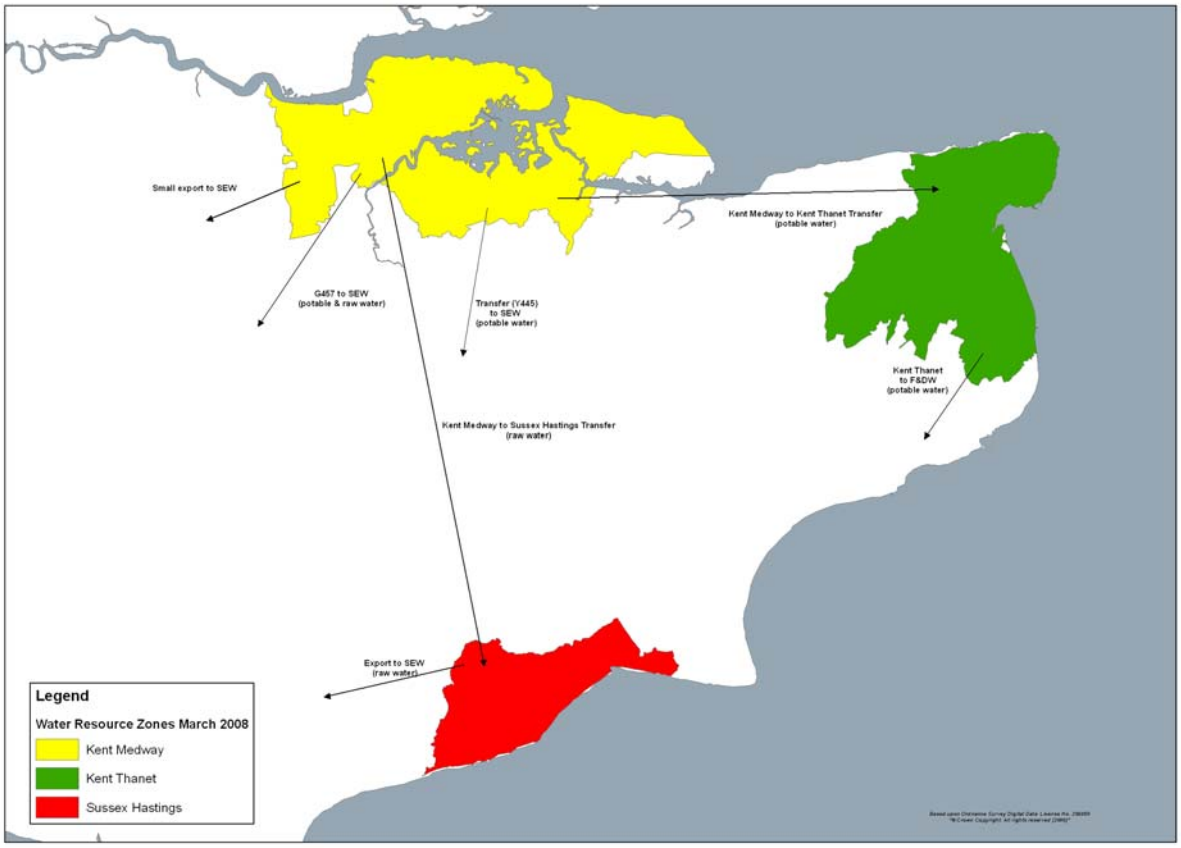


Figure 10.35 Schematic of the Eastern Area

10.5.2 Sources of Supply

The area is supplied by both surface water and groundwater sources. There are four surface water sources and over 50 groundwater sources. Groundwater abstraction is almost exclusively from the Chalk aquifer with a few small sources that abstract from the Lower Greensand. Most of the sources comprise boreholes only, but a number also have a well and adit design.

The surface water sources comprise the three reservoirs; Bewl Water, Darwell and Powdermill and a small direct river abstraction at T656.

G457 is the largest surface water source in the area. It comprises Bewl Water, a reservoir at the headwaters of the River Medway, which is filled from two river intakes, on the River Teise and the River Medway. The reservoir supports the company's downstream abstraction, from where water is pumped for treatment at P647. South East Water is entitled to 25% of the yield of the scheme, and takes some of its entitlement as treated water at P647 and the rest as raw water directly to its treatment works at Bewl Water. There is also a raw water transfer between Bewl Water and Darwell reservoir. This transfer assists in enhancing the yield of Darwell to support the Sussex Hastings WRZ. There is also a bulk supply made from Darwell reservoir to South East Water.

The only surface water source in the Kent Thanet WRZ is on the River Stour. It is a run-of-river abstraction, and subject to a Minimum Residual Flow condition. This abstraction is supported by discharge from a wastewater treatment works, which allows abstraction to continue when the river flow reduces to below the Minimum Residual Flow which controls the abstraction

There are two small reservoirs in the Sussex Hastings WRZ, Darwell and Powdermill. Both are pumped storage impounding reservoirs, with pumped inflows from the Eastern Rother to

Darwell and from the River Brede to Powdermill respectively. There is also the facility to transfer from Bewl Water to Darwell reservoir via a raw water transfer pipeline.

10.5.3 Supplies Available

The total deployable output for the area is 242.2 Ml/d at ADO and 289.7 Ml/d at PDO. Each WRZ has a different mixture of types of source, and thus a different ratio of groundwater to surface water. These proportions are shown in Table 10.18, which demonstrates that, whilst the area proportion is 68% groundwater : 32% surface water (ADO), this varies from almost complete dominance of groundwater in the Kent Thanet WRZ to almost complete dominance of surface water in the Sussex Hastings WRZ, with the Kent Medway WRZ having an intermediate balance of 76% groundwater : 24% surface water.

WRZ	Groundwater			Surface Water			Total	
	No. sources	ADO Ml/d	PDO Ml/d	No. sources	ADO Ml/d	PDO Ml/d	ADO Ml/d	PDO Ml/d
Sussex Hastings	5	1.89	3.50	2	38.08	42.85	39.97	46.35
Kent Medway	33	110.44	135.67	1	30.90	46.90	141.34	182.57
Kent Thanet	12	56.36	57.29	1	4.51	3.50	60.87	60.79
Total	**53**	**168.69**	**196.46**	**4**	**73.49**	**93.25**	**242.18**	**289.71**

Note: Values are for indigenous sources only, and do not take either inter-zonal or inter-company transfers into account.
Note: further detail is given for individual sources in Appendix D.1

Table 10.18 Summary of PR09 Base Year (2010-11) Deployable Outputs for the Eastern Area

This variation in the groundwater to surface water ratio has a major influence on how the area's sources are managed strategically especially when planning for the extreme conditions of a design event. This is an important influence when assessing the most appropriate options for future development.

10.5.4 Strategic Management of Sources

The inter-connections between the various WRZs in the Eastern Area enable the whole area to be strategically managed in a conjunctive way, especially in the design drought event. The nature of the different types of sources within the area, especially the presence of surface water storage, means that the area is generally resilient to one season droughts, but becomes more vulnerable to two season, and particularly to three season drought events, which see the progressive depletion of both surface water and groundwater storage. The Kent Medway WRZ, and the River Medway Scheme in particular, is central to the strategic management of supplies throughout the Eastern Area. The balance of groundwater and surface water supplies is vital in ensuring that the WRZ is provided with some resilience in the event of differing drought conditions. The Kent Medway WRZ supports the Kent Thanet WRZ via a potable water main, and the Sussex Hastings WRZ via the Bewl-Darwell transfer.

The Kent Thanet WRZ is supplied almost exclusively from groundwater sources. It is therefore prone to water resources stress in the event of prolonged periods of low rainfall and drought, which leads to the progressive depletion of groundwater. A number of the sources have extensive adit systems, which can make them even more susceptible to drought conditions. A risk assessment has concluded that adits should not be de-watered due to the

risk of structural failure and increased turbidity. Support can be provided form the Kent Medway WRZ via a potable water main, although this is also groundwater dependant. However these groundwater sources can be supported by the strategic use of the River Medway Scheme. The nature of the conjunctive use of these surface water sources means that the ratio of loss of water at Bewl and gain at Darwell is not 1:1. The supply demand balance takes this into account by an adjustment in the transfer which reverses a small proportion of water to maximise supplies in the Eastern Area as a whole.

The Sussex Hastings WRZ is dependent on surface water supplies from the two reservoirs at Darwell and Powdermill. These two reservoirs are smaller than Bewl and are prone to the effects of shorter duration droughts, even single winter events. However, this can be offset through enhanced refill support via the Bewl-Darwell transfer, which in turn is dependent on the River Medway Scheme.

G457 is thus important to the supply demand balance of the Eastern Area. It should also be noted that, in the event of design drought conditions, this is the only source that can benefit significantly from the introduction of Drought Orders/Permits. Unfortunately, this has been the case too frequently in the past 20 years, with 18 successful applications for Drought Orders/Permits (see section 10.5.7.2). In order to reduce the frequency of applications, more resilience is required for the Eastern Area.

10.5.5 Demand Summary

Southern Water provides drinking water to a population in the area of about 722,500. Normal year average annual demands are 181.0 Ml/d, which can rise to 195.7 Ml/d during dry years. However, during dry years, the demands at the critical MDO and PDO periods can be 186.8 Ml/d and 241.5 Ml/d respectively, as shown in Table 10.19.

WRZ	Population (000s)	Normal Year Average Annual demand (Ml/d)	Dry Year Annual Average demand (Ml/d)	Dry Year MDO demand (Ml/d)	Dry Year Peak Period demand (Ml/d)
Kent Medway	441.31	111.97	122.33	116.47	148.95
Kent Thanet	180.19	43.43	46.39	43.67	59.81
Sussex Hastings	101.03	25.63	26.95	26.69	32.69
Eastern Area	**722.53**	**181.03**	**195.67**	**186.83**	**241.45**

Table 10.19 Summary of Base Year (2007-08) Demand for the Eastern Area

10.5.6 Strategic Development to Date

There have been a number of strategic developments in the area over the last 10-15 years, which are summarised as follows:

- Leakage has decreased over the last 12 years from 28.2 Ml/d to 26.0 Ml/d;
- There has been an increase in meter installation over the last 12 years from 7% to 28%;
- A new river abstraction to enhance the refill of Bewl Water and thus the deployable output of G457;
- The Bewl-Darwell transfer, subsequently upgraded in 2003, to enhance the deployable output of Darwell reservoir and improve security of supplies to the Sussex Hastings WRZ and provide a bulk supply to South East Water; and

- A number of groundwater sources were improved and/or re-introduced as part of the 2004-06 drought initiative in the Kent Medway WRZ.

10.5.7 Levels of Service

The area, as with other parts of the south-east, has suffered from the effects of the recent droughts, in 1989-92, 1995 and more recently 2004-06. There was serious stress on the area's water resources and a risk to security of supply. In order to respond to the increasingly severe drought conditions Southern Water followed its Drought Plan and introduced its programme of both demand side and supply side which had an impact on Customer and Environmental Levels of Service.

10.5.7.1 Customer Levels of Service

A summary of the frequency of restrictions since 1989., compared to Target Levels of Service, is given in Table 10.20. Despite its best endeavours to alleviate the effects of the droughts, Southern Water was unable to meet its Target Levels of Service:

- In some WRZs in this area the company has introduced sprinkler/full hosepipe bans in eight out of the last 20 years (40%), although this varied from six years (30%) in the Kent Medway and Kent Thanet WRZs to eight years (40%) in the Sussex Hastings WRZ.
- The amount of time on average that customers have been subject to restrictions, calculated as the percentage of the actual (population times weeks of restriction) compared to the total (population times weeks under review is 22% (varying from 21% in the Kent Thanet WRZ to 27% in the Sussex Hastings WRZ). It would be expected that, for Target Levels of Service to be met, this measure would be a maximum of 10%.

There have also been a number of Drought Orders to restrict the so-called "non-essential uses" of water. These were restricted to the Kent Medway and Kent Thanet WRZs, and occurred during the early 1990s. A Drought Order was granted in 2006, and covered the whole area. It turned out that powers granted under this Drought Order did not need to be used due to the successful introduction of a number of other supply and demand side measures combined with wetter hydrological conditions.

WRZ	Target Levels of Service		Actual Level of Service	
	1 in x years	% years	% no. of reporting years (taken as the no. of years, irrespective of duration during the year)	Time expressed as % of (population x weeks)
Hosepipe / Sprinkler ban				
Kent Medway	1:10	10%	30%	21%
Kent Thanet	1:10	10%	30%	21%
Sussex Hastings	1:10	10%	40%	27%
Eastern Area	**1:10**	**10%**	**40%**	**22%**
Drought Orders implemented "Non essential use" ban				
Kent Medway	1:20	5%	20%	11%
Kent Thanet	1:20	5%	20%	11%
Sussex Hastings	1:20	5%	-	-
Eastern Area	**1:20**	**5%**	**20%**	**9%**

Table 10.20 Summary of Restrictions in the Eastern Area Since 1989

10.5.7.2 Environment Levels of Service

There have also been 36 Drought Permits/Orders granted since 1989. The following summary gives the sources affected and the terms of the Drought Permit/Order;

- G457 – eighteen Drought Permit/Orders, which authorised the reduction in Minimum Residual Flow conditions controlling abstractions and releases. Whilst most of these were for the purpose of winter refill, some were granted for the more environmentally sensitive summer period, although all authorisations included measures for appropriate environmental mitigation;
- T656 – seven Drought Orders, which authorised the reduction in Minimum Residual Flow conditions controlling abstractions;
- Bewl Darwell transfer – two Drought Orders, which enabled the transfer of water between Bewl Water and Darwell reservoir, pending abstraction licences being subsequently issued;
- Kent Groundwater – two Drought Orders, which authorised the relaxation of abstraction licence conditions for specific sources that were licence constrained in terms of either/and/or peak day, seasonal and annual limits;
- Medway Groundwater – three Drought Orders which authorised the relaxation of abstraction licence conditions for specific sources that were licence constrained in terms of either/and/or peak day, seasonal and annual limits; and
- Thanet Groundwater – five Drought Orders which authorised the relaxation of abstraction licence conditions for specific sources that were licence constrained in terms of either/and/or peak day, seasonal and annual limits;

There were a number of occasions when the sources did not, in the event, need to be operated under the terms of the Drought Permit/Order. Nevertheless it was essential that the Drought Permits/Orders were place, should the drought conditions have continued with increasing and unacceptable risks to security of supplies. It should also be noted that all authorisations were subject to environmental assessment which identified appropriate environmental mitigation measures.

Southern Water considers that the past performance against its Target Levels of Service on both the customer and the environmental side must be improved. This can only be achieved though the introduction of a number of supply and demand side measures to create a more robust supply system with a supply demand balance that is resilient to drought conditions which may become more severe and more frequent under climate change.

10.5.7.3 Influence of a supply demand balance deficit on operations during a drought

Even after taking into account inter-zonal transfers to reduce baseline supply demand balance deficits, Kent Medway and Kent Thanet WRZs would experience deficits in the first four and two years of the AMP5 period respectively. There would be no deficits in the Sussex Hastings WRZ.

The Kent Medway WRZ has a supply demand balance deficit for the first four years of the planning period for the ADO condition only, of about 7 Ml/d for the first two years, followed by 3 Ml/d and 0.3 Ml/d by the fourth year. This represents between about 6 and 1 % of Distribution Input respectively, and compares to the sum of the planning allowances for target headroom and outage of about 10 Ml/d.

The ADO situation, although sensitive, can be managed in the event of drought conditions through the conjunctive use of the different types of sources in the WRZ. Whilst these deficits are noteworthy for the first two years, the situation will require monitoring closely, and any opportunity to accelerate the groundwater asset improvement schemes for the WRZ should be taken.

The Kent Thanet WRZ has a supply demand balance deficit for the first two years of the planning period for the PDO condition only, of about 4 Ml/d and 3 Ml/d respectively. This represents about 7 %and 5 % of Distribution Input respectively, and compares to the sum of the planning allowances for target headroom and outage of about 8 Ml/d.

The PDO situation, although sensitive, can be managed in the event of drought conditions through the conjunctive use of the different types of sources in the adjacent Kent Medway WRZ, which can enable possibly greater inter-zonal transfers, depending on the operational supply demand balance in the adjacent WRZs. Whilst these deficits are noteworthy for the first two years, the situation will require monitoring closely, and any opportunity to accelerate the groundwater asset improvement schemes for the WRZ should be taken.

10.5.8 The Baseline Supply Demand Balance for the Eastern Area

The baseline supply demand balances in the WRP tables assume the following for each WRZ in the Eastern Area:

- Continuation of current metering policies. In 2007-08 there were 302,300 domestic properties in this area, 30% of which were metered. By 2015, the number of metered domestic properties is expected to rise to 162,300;
- Deployable outputs according to the Unified Methodology, which ensures that the deployable outputs for groundwater and surface water sources are estimated for the same design drought event;
- Deployable outputs include assumed incremental yields from source improvements for both AMP4 and planned for the AMP5 period, with timings assumed throughout the AMP5 period;
- No Sustainability Reductions (as advised by the Environment Agency);
- Renewal of existing inter-company bulk transfers until the end of the planning period, at the rates prevailing at the time of contract renewal; and
- Inter-zonal transfers are adjusted in the supply demand balance to represent the optimal use of surplus resources; while for the purposes of the investment model they are set to zero at the start of the planning period.

The baseline supply demand balance over the planning period are given in Table 10.21 for both the ADO and PDO conditions, and are shown in annotated graphs as Figure 10.36 to Figure 10.41. Full detailed build-up tables are given in Appendix I.

Note that in the Eastern Area, Kent Medway WRZ is driven by annual average (AA) deficits rather than MDO, while the other two WRZs are driven by peak deficits. Thus the Eastern Area solution is based on PDO and ADO design scenarios, not the PDO and MDO scenario used in other areas.

Water Resource Zone	Planning scenario	Base year 2007-08	2009-10	Start of planning period 2010-11	2014-15	2019-20	2024-25	2029-30	2034-35
Kent Medway	ADO	19.15	20.80	-7.37	3.68	0.63	-3.74	-8.47	-12.30
Kent Thanet	ADO	10.56	11.25	7.40	8.23	7.95	7.06	6.04	5.04
Sussex Hastings	ADO	0.00	0.00	0.00	0.00	0.00	0.00	0.02	-1.54
Kent Medway	PDO	7.21	10.36	0.00	11.02	6.96	0.33	0.00	-5.26
Kent Thanet	PDO	0.00	0.00	-4.00	0.00	0.00	0.00	-6.64	-8.17
Sussex Hastings	PDO	-0.82	0.00	0.00	0.00	0.00	0.00	-1.06	-2.79

Notes: Positive figures indicate a surplus of resources, negative indicate a deficit

Table 10.21 Baseline Supply Demand Balance for Eastern Area for the ADO and PDO Condition (Ml/d)

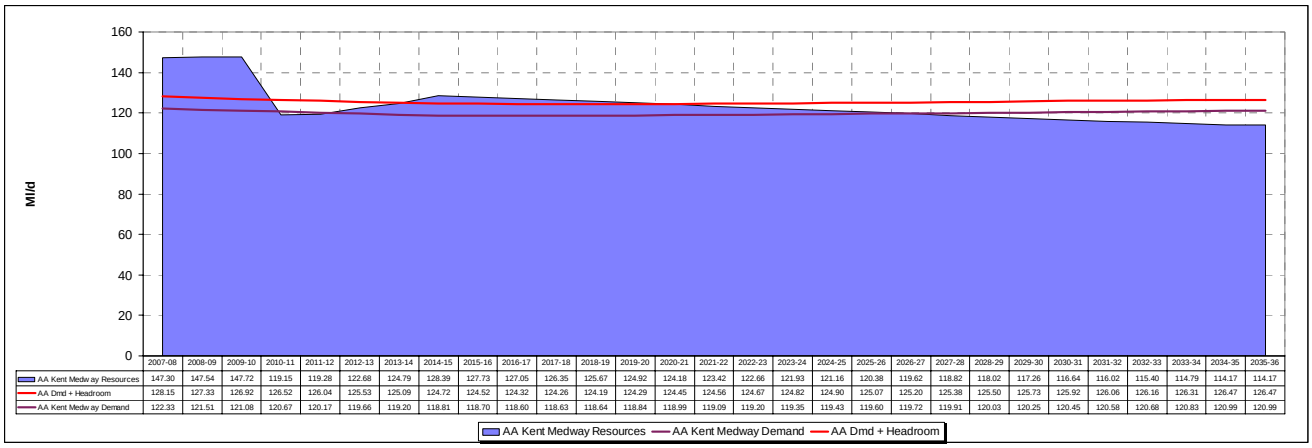
In these baseline supply demand balances, inter-zonal transfers from 2010-11 are balanced to make the best use of inter-connected resources where water can be transferred from a WRZ with a surplus to one with a deficit. At the same time, the investment model is able to chose whether it is better to cease continue, or increase, existing inter-zonal transfers, or to develop new resources, or enhance demand management in the WRZ in deficit.

For the ADO condition:

- The Kent Medway WRZ starts the planning period with a deficit, but achieves a surplus by the end of AMP5 due to various source improvements, and only goes into deficit near the end of the planning period;
- The Kent Thanet WRZ starts the planning period with a surplus, which remains throughout the planning period; and
- The Sussex Hastings WRZ starts the planning period with sufficient supplies and only goes into deficit near the end of the planning period.

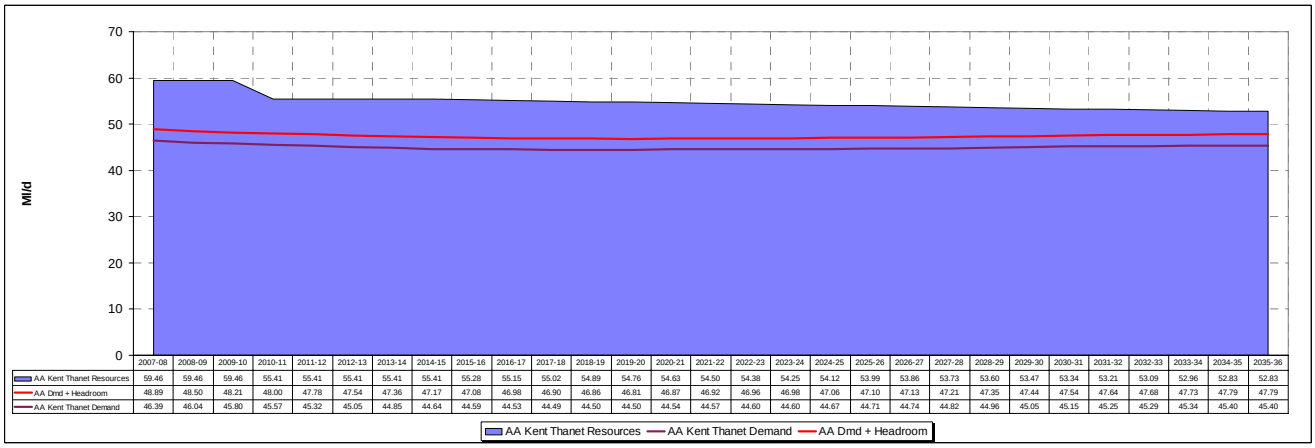
For the PDO condition:

- The Kent Medway WRZ starts the planning period in surplus, and remains so until after 2029-30 with some surplus water transferred to Kent Thanet as required;
- The Kent Thanet WRZ starts the planning period in deficit, before surplus water from Kent Medway is transferred and able to meet demand until the end of AMP7 when it returns to deficit; and
- The Sussex Hastings WRZ starts the planning period with sufficient supplies, but goes into deficit after 2024-25.



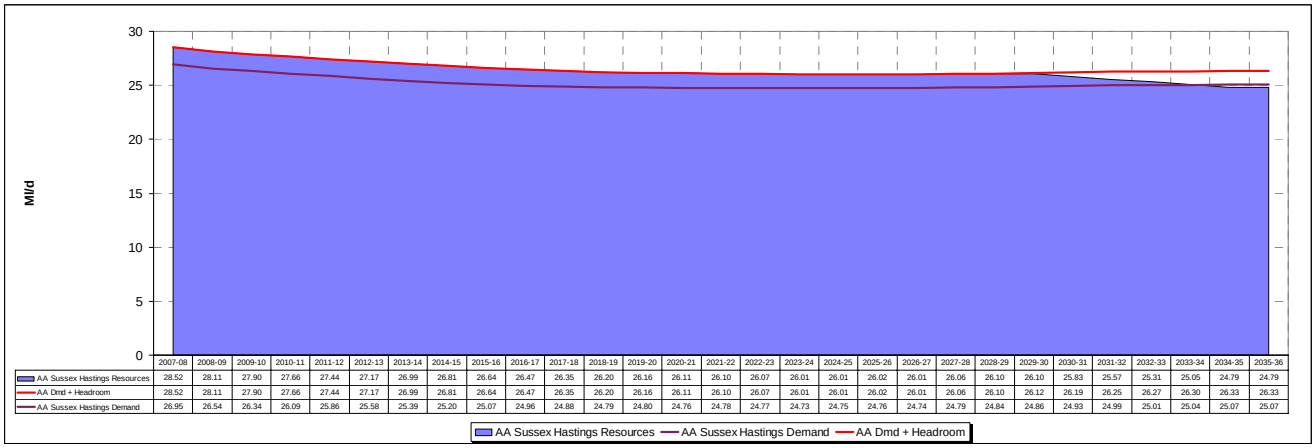
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
AA Kent Medway Resources	147.30	147.54	147.72	119.15	119.28	122.68	124.79	128.39	127.73	127.05	126.35	125.67	124.92	124.18	123.42	122.66	121.93	121.16	120.38	119.62	118.82	118.02	117.26	116.64	116.02	115.40	114.79	114.17	114.17
AA Dmd + Headroom	128.15	127.33	126.92	126.52	126.04	125.53	125.09	124.72	124.52	124.32	124.26	124.19	124.29	124.45	124.56	124.67	124.82	124.90	125.07	125.20	125.38	125.50	125.73	125.92	126.06	126.16	126.31	126.47	126.47
AA Kent Medway Demand	122.33	121.51	121.08	120.67	120.17	119.66	119.20	118.81	118.70	118.60	118.63	118.64	118.84	118.99	119.09	119.20	119.35	119.43	119.60	119.72	119.91	120.03	120.25	120.45	120.58	120.68	120.83	120.99	120.99

Figure 10.36 Kent Medway ADO Baseline Supply Demand Balance



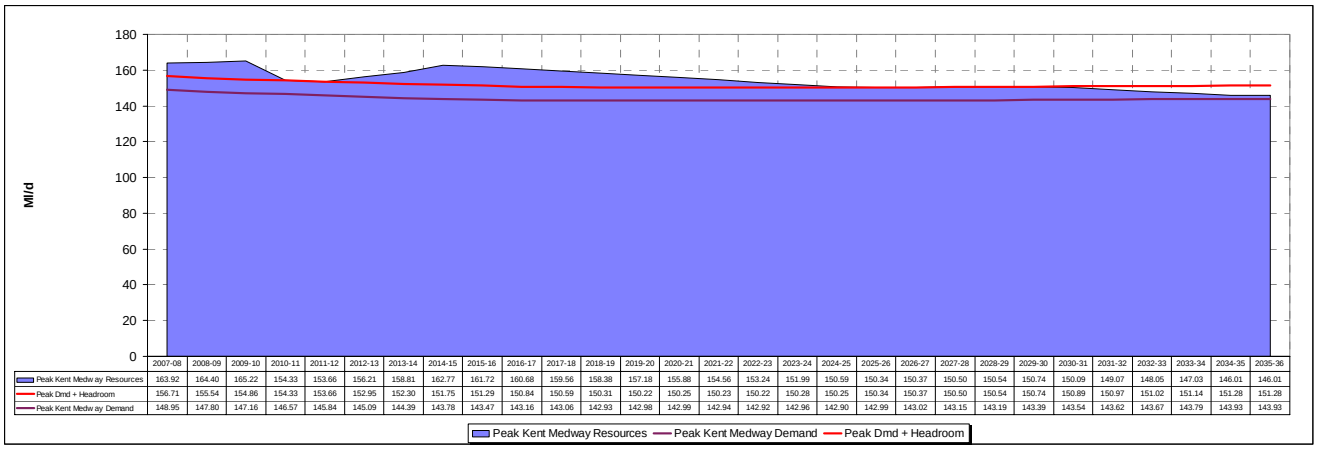
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
AA Kent Thanet Resources	59.46	59.46	59.46	55.41	55.41	55.41	55.41	55.41	55.28	55.15	55.02	54.89	54.76	54.63	54.50	54.38	54.25	54.12	53.99	53.86	53.73	53.60	53.47	53.34	53.21	53.09	52.96	52.83	52.83
AA Dmd + Headroom	48.89	48.50	48.21	48.00	47.78	47.54	47.36	47.17	47.08	46.98	46.90	46.86	46.81	46.87	46.92	46.96	46.98	47.06	47.10	47.13	47.21	47.35	47.44	47.54	47.64	47.68	47.73	47.79	47.79
AA Kent Thanet Demand	46.39	46.04	45.80	45.57	45.32	45.05	44.85	44.64	44.59	44.53	44.49	44.50	44.50	44.54	44.57	44.60	44.60	44.67	44.71	44.74	44.82	44.96	45.05	45.15	45.25	45.29	45.34	45.40	45.40

Figure 10.37 Kent Thanet ADO Baseline Supply Demand Balance



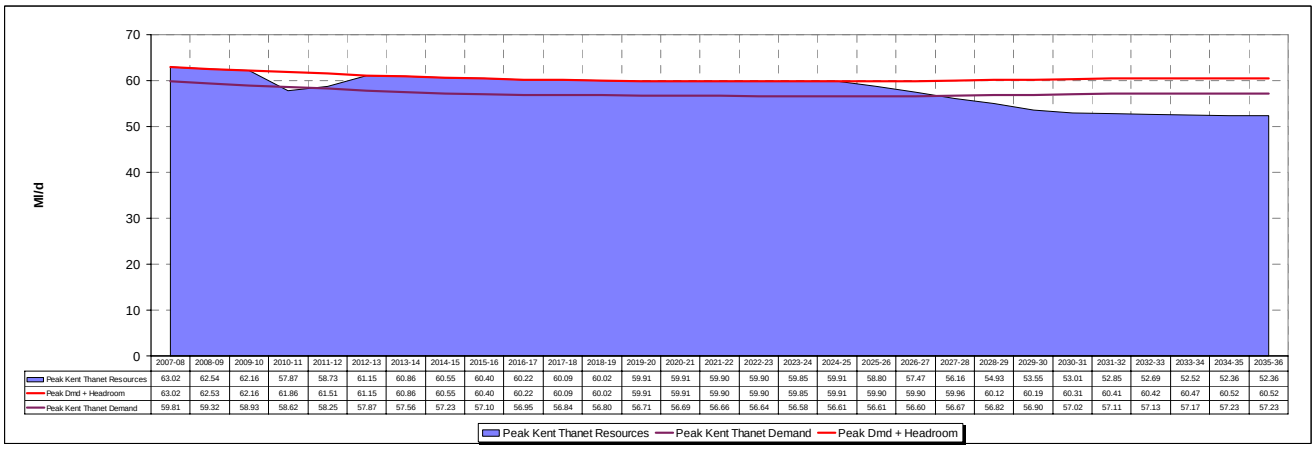
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
AA Sussex Hastings Resources	28.52	28.11	27.90	27.66	27.44	27.17	26.99	26.81	26.64	26.47	26.35	26.20	26.16	26.11	26.10	26.07	26.01	26.01	26.02	26.01	26.06	26.10	26.10	25.83	25.57	25.31	25.05	24.79	24.79
AA Dmd + Headroom	28.52	28.11	27.90	27.66	27.44	27.17	26.99	26.81	26.64	26.47	26.35	26.20	26.16	26.11	26.10	26.07	26.01	26.01	26.02	26.01	26.06	26.10	26.12	26.19	26.25	26.27	26.30	26.33	26.33
AA Sussex Hastings Demand	26.95	26.54	26.34	26.09	25.86	25.58	25.39	25.20	25.07	24.96	24.88	24.79	24.80	24.76	24.78	24.77	24.73	24.75	24.76	24.74	24.79	24.84	24.86	24.93	24.99	25.01	25.04	25.07	25.07

Figure 10.38 Sussex Hastings ADO Baseline Supply Demand Balance



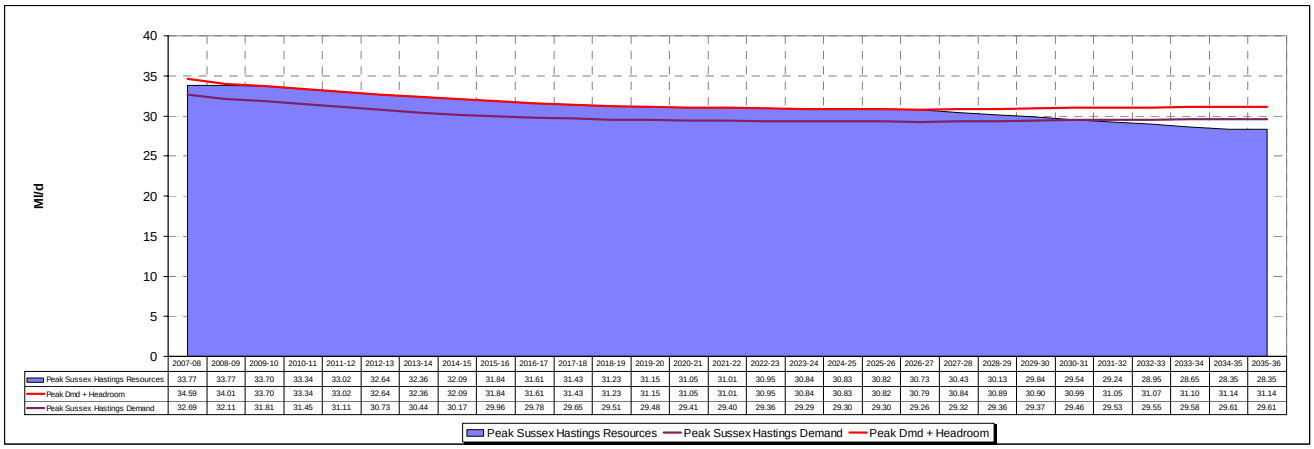
	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
Peak Kent Medway Resources	163.92	164.40	165.22	154.33	153.66	156.21	158.81	162.77	161.72	160.68	159.56	158.38	157.18	155.88	154.56	153.24	151.99	150.59	150.34	150.37	150.50	150.54	150.74	150.09	149.07	148.05	147.03	146.01	146.01
Peak Dmd + Headroom	156.71	155.54	154.86	154.33	153.66	152.95	152.30	151.75	151.29	150.84	150.59	150.31	150.22	150.25	150.23	150.22	150.28	150.25	150.34	150.37	150.50	150.54	150.74	150.89	150.97	151.02	151.14	151.28	151.28
Peak Kent Medway Demand	148.95	147.80	147.16	146.57	145.84	145.09	144.39	143.78	143.47	143.16	143.06	142.93	142.98	142.99	142.94	142.92	142.96	142.90	142.99	143.02	143.15	143.19	143.39	143.54	143.62	143.67	143.79	143.93	143.93

Figure 10.39 Kent Medway PDO Baseline Supply Demand Balance



	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
Peak Kent Thanet Resources	63.02	62.54	62.16	57.87	58.73	61.15	60.86	60.55	60.40	60.22	60.09	60.02	59.91	59.91	59.90	59.90	59.85	59.91	58.80	57.47	56.16	54.93	53.55	53.01	52.85	52.69	52.52	52.36	52.36
Peak Dmd + Headroom	63.02	62.53	62.16	61.86	61.51	61.15	60.86	60.55	60.40	60.22	60.09	60.02	59.91	59.91	59.90	59.90	59.85	59.91	59.90	59.90	59.96	60.12	60.19	60.31	60.41	60.42	60.47	60.52	60.52
Peak Kent Thanet Demand	59.81	59.32	58.93	58.62	58.25	57.87	57.56	57.23	57.10	56.95	56.84	56.80	56.71	56.69	56.66	56.64	56.58	56.61	56.61	56.60	56.67	56.82	56.90	57.02	57.11	57.13	57.17	57.23	57.23

Figure 10.40 Kent Thanet PDO Baseline Supply Demand Balance



	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36
Peak Sussex Hastings Resources	33.77	33.77	33.70	33.34	33.02	32.64	32.36	32.09	31.84	31.61	31.43	31.23	31.15	31.05	31.01	30.95	30.84	30.83	30.82	30.73	30.43	30.13	29.84	29.54	29.24	28.95	28.65	28.35	28.35
Peak Dmd + Headroom	34.59	34.01	33.70	33.34	33.02	32.64	32.36	32.09	31.84	31.61	31.43	31.23	31.15	31.05	31.01	30.95	30.84	30.83	30.82	30.79	30.84	30.89	30.90	30.99	31.05	31.07	31.10	31.14	31.14
Peak Sussex Hastings Demand	32.69	32.11	31.81	31.45	31.11	30.73	30.44	30.17	29.96	29.78	29.65	29.51	29.48	29.41	29.40	29.36	29.29	29.30	29.30	29.26	29.32	29.36	29.37	29.46	29.53	29.55	29.58	29.61	29.61

Figure 10.41 Sussex Hastings PDO Baseline Supply Demand Balance

10.5.9 Options to Meet the Supply Demand Balance in the Eastern Area

A number of demand and supply side options have been considered to meet any supply demand balance deficit.

The supply side options have been assessed using the options appraisal methodology described in section 8. In summary, an initial list of some 90 options has been considered within the Eastern Area, for which further details are given in Appendix G.

Following the various screening processes, the number of "feasible" options, by generic type, chosen to be available for selection by the investment model can be summarised, by generic type, as follows:

- One site for new surface storage reservoir, for which Southern Water would take the lead, although another was considered for possible joint promotion;
- One site for possible increases in abstraction from either surface or groundwater;
- Two sites for enlarging existing reservoirs;
- One site for potential re-commissioning of old/existing sources;
- Three possible abstraction licence variations;
- No sites for the further upgrade of WSW treatment facilities, for the purposes of the supply demand balance;
- Two potential inter-zonal bulk transfers, either existing or proposed, although this was modified as part of the introduction of the results from the WRSE modelling work;
- No potential inter-company bulk transfers, either existing or proposed;
- Four potential schemes for wastewater recycling;
- No sites for potential Aquifer Storage and Recovery schemes; and
- Four potential schemes for desalination.

The summary shows that a wide range of generic types of option were available for selection, thus ensuring that the selection of preferred schemes was robust. The total number includes a number of generic schemes, for instance desalination, at the same site but for different capacities. This was to ensure that a generic option was not ruled out from selection on the basis of the size and associated cost alone.

There are three generic types of demand management measures: metering; leakage reduction; and water efficiency. Different modelling scenarios have been devised to reflect a different selection of options (see section 10.1.10).

As noted in section 10.3.8, scenario 3 (Universal Metering) has been used as the starting point for the supply demand balance from which the Final Planning solution has been developed.

In order to consider leakage options, a number of incremental "step" reductions in leakage were considered, based on outputs from the Sustainable Economic Level of Leakage analysis, as explained in Chapter 6 and Appendix E.

Water efficiency options for both households and non-households were included in the model. More details are given in section 8 and Appendix G.

10.5.10 The Water Resources Strategy for the Eastern Area

The water resources strategy is described in three different sections over the planning period:

- AMP5, the first five years from 2010-11 to 2014-15, which formed the basis of the Final Business Plan Submission;
- AMP6 to the end of the planning period, based on the company only least-cost strategy; and then
- An explanation of how this company only strategy is modified to take into account the recommendations of the WRSE regional modelling results.

The company preferred water resources strategy is described below under each of these headings and is summarised in Table 10.22.

During AMP5 (2010-2015)

The supply demand balance will be satisfied in the Eastern Area for the AMP5 period through the following:

- A policy of universal metering throughout the area by 2015, which will give benefits in terms of demand savings and associated reductions in supply pipe leakage;
- The optimisation of inter-zonal transfers, namely from the Kent Medway to Kent Thanet and the Kent Medway to Sussex Hastings WRZs; and
- A series of groundwater source improvements, which could deliver up to 8.75 Ml/d for the annual average condition.

From AMP6 to the end of the planning period (2015-35) (company only)

For the company only least-cost solution, no strategic scheme has been selected for construction. Instead, there will be a series of small interventions over time, on both the demand and supply side, which will require a delicate balance to ensure that available headroom is kept to a minimum above target headroom. These interventions are as follows:

- A licence variation for the River Medway Scheme;
- A licence variation for Darwell Reservoir;
- A licence variation for the S271 groundwater source;
- The refurbishment of a currently disused groundwater source at S556; and
- A total further reduction in leakage of 7.1 Ml/d, which is equivalent to a reduction of 27% below the 2007-08 outturn figure.

It is assumed that the current inter-company bulk transfers to South East Water at C522 and Darwell reservoir, and to Folkestone and Dover Water at Deal reservoir will be renewed until the end of the planning period.

From AMP6 to the end of the planning period (2015-35) (company preferred regional solution)

Following the WRSE modelling results, Southern Water reaffirmed its commitment to the development of a regional solution. As a result of the preferred options identified from the WRSE modelling work, we have included the following options in our company preferred regional strategy, over and above the company only least-cost solution:

- Enhancement of the bulk supply to Folkestone and Dover Water from Deal reservoir, to provide an additional supply from January to August, of 2 Ml/d;
- Construction of Aylesford wastewater recycling scheme at the earliest start date of 2018; and
- Raising Bewl Water at the earliest start date of 2022.

The last two schemes are regional schemes that would provide bulk supplies to neighbouring companies. It is currently considered that the most likely recipients will be South East Water, although the timing, location and volumetric requirements are yet to be received and confirmed. Current assumptions within this plan are based on the latest published modelling work up to September 2009. Future modelling results will be considered at the time of the annual reviews of the WRMP

The inclusion of these regional schemes in the company preferred regional strategy will increase the 25-year NPV by £47.4 million above the company only least-cost strategy. However, in practice, this is likely to be an over-estimate, because both the Aylesford recycling and Bewl raising schemes are forced into the strategy at their earliest start dates. In practice, the schemes are likely to be required later in the planning period. The actual start date required for the regional solution will be refined following the results of the further regional modelling work. However, this approach demonstrates our continued commitment to the development of a regional solution.

The introduction of these schemes will lead to available headroom in excess of the Southern Water target headroom requirements, and thus will not represent a Southern Water least-cost strategy over the 25-year planning period. However, we believe that this will not contribute to any bill impact during AMP5 as the regional schemes will not be introduced until AMP6 and beyond.

The Water Resources Strategy for the Eastern Area is summarised in Table 10.22.

Water Resource Zone	Schemes During AMP 5	Schemes beyond AMP 5 – company only solution	Schemes beyond AMP 5 – Water Resources in the South East of England
Sussex Hastings	• Universal metering • Asset improvement schemes for groundwater sources (0.25 Ml/d peak only) • Optimisation of inter-zonal transfers (Bewl-Darwell transfer)	• Renewal of bulk supply to South East Water • Licence variation at Darwell reservoir • Re-introduction of the S556 source • 0.5 Ml/d leakage reductions	As previous column
Kent Medway	• Universal metering • Asset improvement schemes for groundwater sources (10.25 Ml/d peak, 8.75 Ml/d average) • Optimisation of inter-zonal transfers (to Kent Thanet)	• Renewal of the C522 scheme bulk supply to South East Water • Licence variation to the River Medway Scheme • Licence variation of S271 groundwater source • 6.5 Ml/d of further leakage reduction	As previous column, but additional schemes • Aylesford wastewater recycling scheme • Raising Bewl Water An the assumption that these will enable the following • Bulk Supply from Bewl Water to South East Water • Bulk Supply from Burham to South East Water
Kent Thanet	• Universal metering • Optimisation of inter-zonal transfers (from Kent Medway) • Renewal of the bulk Supply to Folkestone and Dover	• 0.1 Ml/d of further leakage reduction	As previous column, but additional schemes • Enhancement of the bulk Supply to Folkestone and Dover

Table 10.22 Summary of the Water Resources Strategy for the Eastern Area

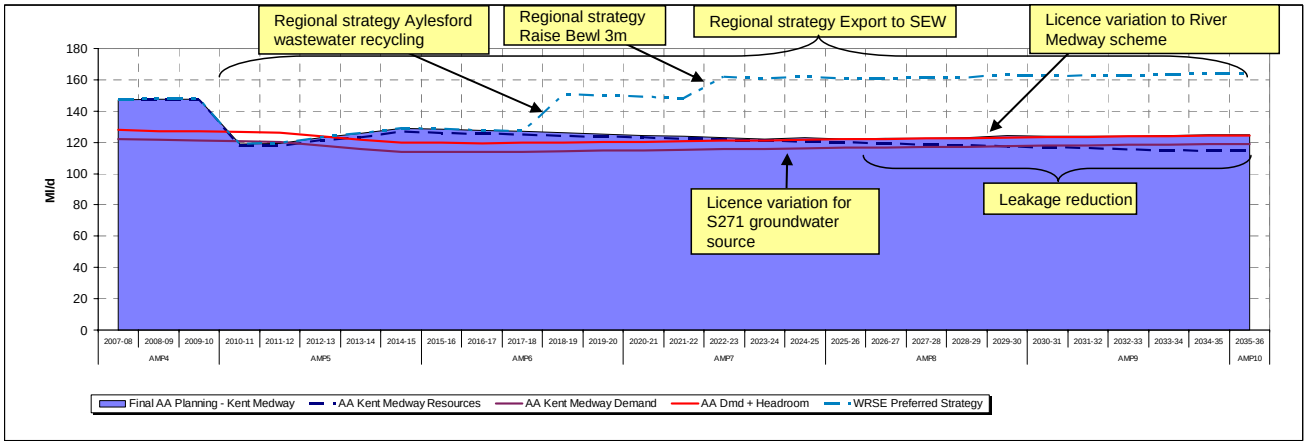


Figure 10.42 Kent Medway Company Preferred Regional Strategy (Scenario 4), ADO Solution

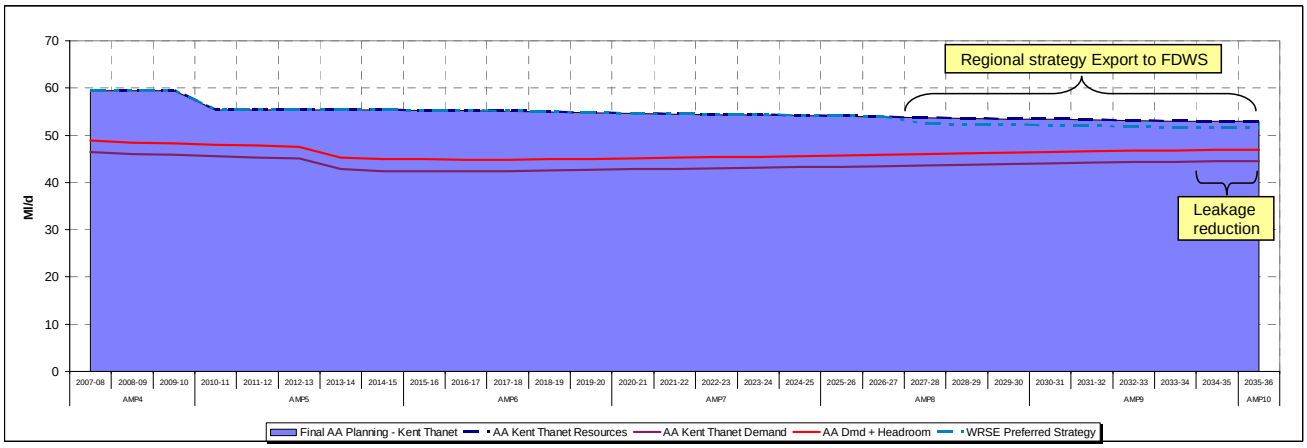


Figure 10.43 Kent Thanet Company Preferred Regional Strategy (Scenario 4), ADO Solution

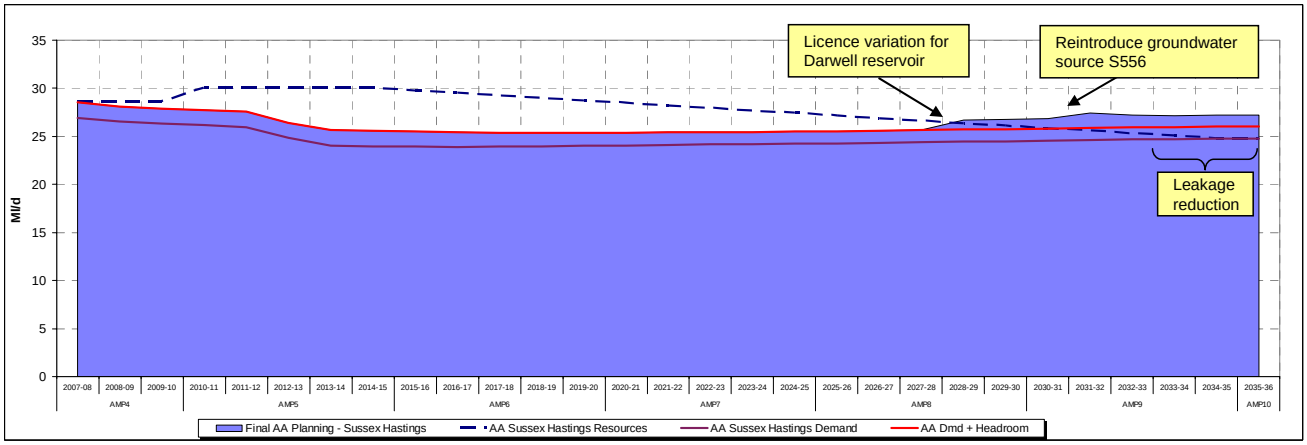


Figure 10.44 Sussex Hastings Company Preferred Regional Strategy (Scenario 4), ADO Solution

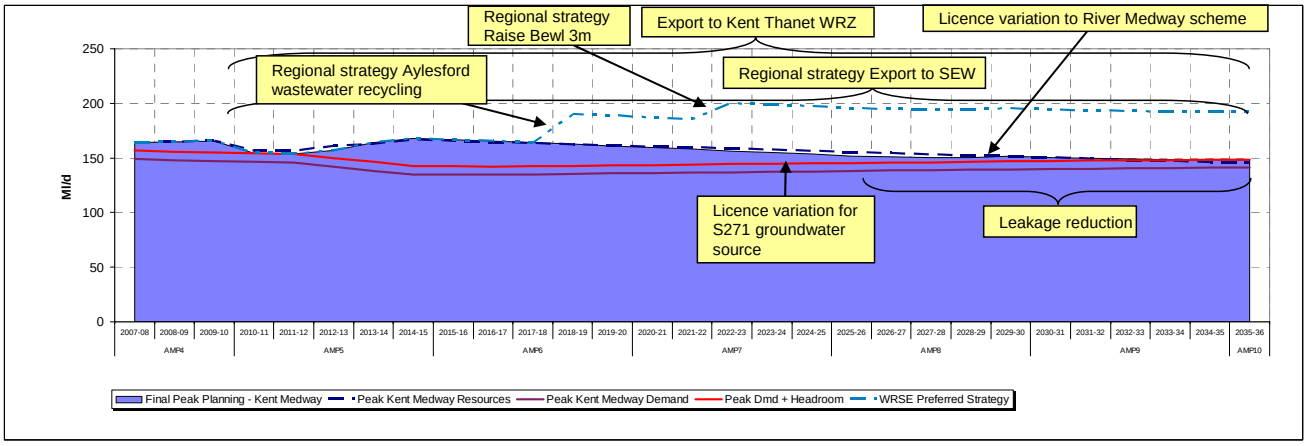


Figure 10.45 Kent Medway Company Preferred Regional Strategy (Scenario 4), PDO Solution

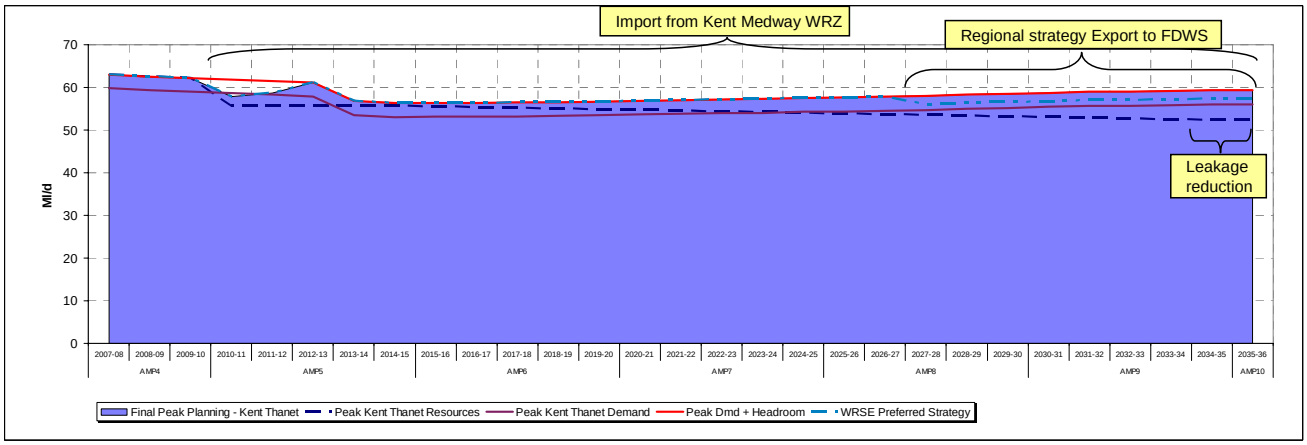


Figure 10.46 Kent Thanet Company Preferred Regional Strategy (Scenario 4), PDO Solution

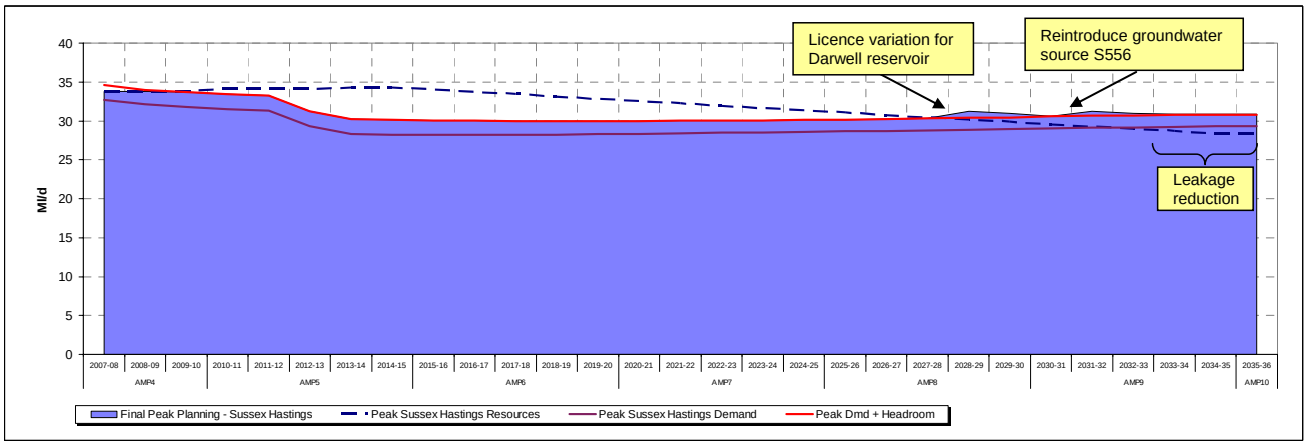


Figure 10.47 Sussex Hastings Company Preferred Regional Strategy (Scenario 4), PDO Solution

10.5.10.1 SEA Influence on Strategy

All options were assessed against 17 SEA objectives, and assigned an overall environmental risk (high, medium or low), based on the significance of potential long term effects.

Table 10.23 sets out the environmental risk of each resource development option. More details are given in Appendix I.

Option	Environmental Risk Score
Licence variation at S271	Medium
Licence variation for River Medway Scheme	Medium
Raise Bewl	High
Wastewater recycling at Aylesford WWTW	High
Darwell Licence Variation	Low
Re-introduce S556 borehole source	Medium
Medway Desalination (10 Ml/d)	High
Increase Capacity of Bewl-Darwell Transfer	Medium

Table 10.23 Environmental Risks of Resource Development Options Selected in the Eastern Area Strategy

The demand management options (metering; leakage reduction; and water efficiency) were also assessed against the SEA objectives. More detail is given in Appendix I. All three generic demand management measures are broadly compatible with the majority of SEA objectives due to the minimal amount of physical intervention required in implementing each measure. However, water efficiency measures have no potential conflicts with SEA objectives and are therefore the preferred demand management measure from an SEA perspective.

10.5.10.2 SEA preferred strategy

The options assessed as being likely to result in the lowest environmental risk are preferable from a SEA perspective and have been used to create the SEA preferred strategy. The low risk and therefore preferred water resource management options are set out below:

- Darwell Licence Variation; and
- Brede Abstraction to Powdermill.

However, the overriding objective of this WRMP is to identify a package of options that removes the risk of supply demand balance deficits over the whole of the planning period. It was therefore necessary to include within the SEA preferred strategy some options that had been assessed as having medium environmental risk. Employing the mitigation measures proposed for each option will enable the likely environmental damage from adopting these options to be reduced. The medium risk options from the SEA are:

- Licence variation at S271;
- Licence variation for River Medway Scheme;
- Duplicate Selling-Fleete Main;
- Re-introduce S556 borehole source; and
- Increase Capacity of Bewl-Darwell Transfer.

The company preferred regional strategy is therefore compatible with the SEA preferred strategy, with the exception of Bewl raising and Aylesford wastewater recycling. Both these schemes are required as part of the WRSE preferred strategy for a regional solution with bulk supplies to other companies. Bewl has strong negative effects on the landscape character

within the AONB, but has limited opportunities for mitigation planting due to lack of space. Aylesford wastewater recycling has a high environmental risk due to high energy consumption. Renewable energy sources could be investigated to reduce the potential effect. A preliminary 'high-level' strategic assessment was undertaken of the possible impact of the proposed plan on the integrity of European and Ramsar sites under the Habitats Regulations. This concluded that sufficient safeguards are available to ensure that implementation of the plan will not adversely affect the integrity of any of the protected sites.

The company only least-cost strategy (scenario 3) does not require either Bewl raising or Aylesford wastewater recycling, and so is entirely compatible with the SEA preferred strategy.

10.5.11 Scenario Analysis

A number of scenarios have been modelled, in order to check the stability of the company only least-cost strategy to changes in some of the basic assumptions. Table 10.24 gives a summary of the different baseline assumptions for these scenarios, and the results in terms of scheme inclusion, scheme timing, and costs for the different investment strategies. The following points can be seen from the results:

- The company only least-cost strategy (3) assumes the baseline condition of universal metering by 2015;
- All scenarios assume the renewal of existing bulk supplies to other companies until the end of the planning period, at the rates which are appropriate at the time of renewal;
- The company only least-cost strategy (3) selects further leakage reductions of 7.1 Ml/d;
- Under the company only change of occupier metering scenario (2), the scheme options remain the same, but they are needed 1-2 years earlier, and includes further leakage reductions of 9.6 Ml/d;
- Under the company only optant and selective metering scenario strategy (1), the same schemes are selected, but at times ranging from 2 to 4 years before the company only universal metering scenario (3), but the scenario also requires the Medway desalination scheme at the end of the planning period. The scenario includes further reductions in leakage of 8.7 Ml/d;
- Under the company preferred scenario, but without any allowance for climate change impacts (11), no resource development options are necessary, and no further leakage reduction is required; and
- Under the scenario which allows leakage to rise up to the Ofwat target level in any WRZ currently operating below its target level, the same options are required as for the company only universal metering scenario (3). However, there are a large number of water efficiency schemes needed in AMP5 (over and above those already included to meet the Ofwat baseline water efficiency target), and further leakage reduction of 10.0 Ml/d is required from 2010. The cost of this strategy was £14.8 m. greater than for the company preferred least-cost scenario (3).
- The total cost of the resources strategy (including new resources, leakage reduction, and water efficiency) plus metering strategy, for the various company only scenarios can be summarised as follows:
    - Universal metering - £65.4 m.
    - Change of occupier - £72.7 m.
    - Optant and selective - £68.6 m.

- Hybrid metering policy – £65.4 m. This is the same cost as for the universal metering because of the supply demand balance deficits occur in AMP 5.

- The incremental cost of the company preferred regional strategy above the company only least-cost strategy is £47.4 m.

Scenario		Company preferred Regional strategy	Company only Universal metering	Company only Change of occupier	Company only Optant	Company only Universal metering with no climate change	Company only Leakage rise to Ofwat target
Number		4	3	2	1	11	8
Metering policy		Universal	Universal	Change of occupier	Optant and selective	Universal	Universal
Leakage policy		JR08, then SPL saving	JR08, then SPL saving	JR08	JR08	JR08, then SPL saving	Ofwat, then SPL saving
WRSE preferred options & bulk supplies		Yes	No	No	No	No	No
WRZ	**Scheme**	**Earliest year required**					
Kent Medway	Licence variation at S271	2024	2024	2022	2020	-	2027
	Licence variation for River Medway Scheme	2029	2029	2028	2027	-	2030
	Medway desalination (10Ml/d)	-	-	-	2033		-
	Wastewater recycling at Aylesford	2018	-	-	-	-	-
	Raise Bewl reservoir	2022	-	-	-	-	-
	Leakage reduction	2026 reduction by 6.5 Ml/d	2026 reduction by 6.5 Ml/d	2023 reduction by 7.5 Ml/d	2013 reduction by 7.0 Ml/d	-	2010 reduction by 7.5 Ml/d
	Water efficiency kit (box)	-	-	2030	2030	-	2030
	Water efficiency low flow shower heads	-	-	2030	-	-	2010
	Water efficiency low use dishwasher subsidy	-	-	-	-	-	2010
	Water efficiency water butts	-	-	-	-	-	2010
	Water efficiency low use washing machine subsidy	-	-	-	-	-	2010
	Water efficiency trigger hoses	-	-	-	-	-	2010
Kent Thanet	Broadoak reservoir	-	-	-	-	-	2034
	Leakage reduction	2034 reduction by 0.1 Ml/d	2034 reduction by 0.1 Ml/d	2031 reduction by 1.3 Ml/d	2031 reduction by 0.6 Ml/d	-	2010 reduction by 1.5 Ml/d
	Water efficiency kit (box)	-	-	-	2030	-	2030
	Commercial water audit	-	-	2030	-	-	2030
	Water efficiency low use dishwasher subsidy	-	-	-	-	-	2010
	Water efficiency water butts	-	-	-	-	-	2010
	Water efficiency low use washing machine subsidy	-	-	-	-	-	2010
	Water efficiency trigger hoses	-	-	-	-	-	2010
	Water efficiency low flow shower heads	-	-	-	-	-	2010 (and 2030)
Ha	Darwell licence variation	2028	2028	2026	2024	-	2026

Scenario		Company preferred Regional strategy	Company only Universal metering	Company only Change of occupier	Company only Optant	Company only Universal metering with no climate change	Company only Leakage rise to Ofwat target
Number		4	3	2	1	11	8
	Re-introduce S556 borehole source	2031	2031	2030	2029	-	2030
	Leakage reduction	2033 reduction by 0.5 Ml/d	2033 reduction by 0.5 Ml/d	2032 reduction by 0.8 Ml/d	2028 reduction by 1.1 Ml/d	-	2029 reduction by 1.0 Ml/d
	Water efficiency commercial water audit	-	-	-	-	-	2030
Costs (£m)							
Total metering cost (£m)		60.83	60.83	65.57	55.60	60.83	60.83
Total resource, leakage reduction and water efficiency activity cost (£m)		51.95	4.52	7.12	13.01	0.21	19.35
Total cost of Strategy (£m)		**112.78**	**65.35**	**72.69**	**68.61**	**61.04**	**80.18**

Table 10.24 Results of Scenario Modelling for the Eastern Area

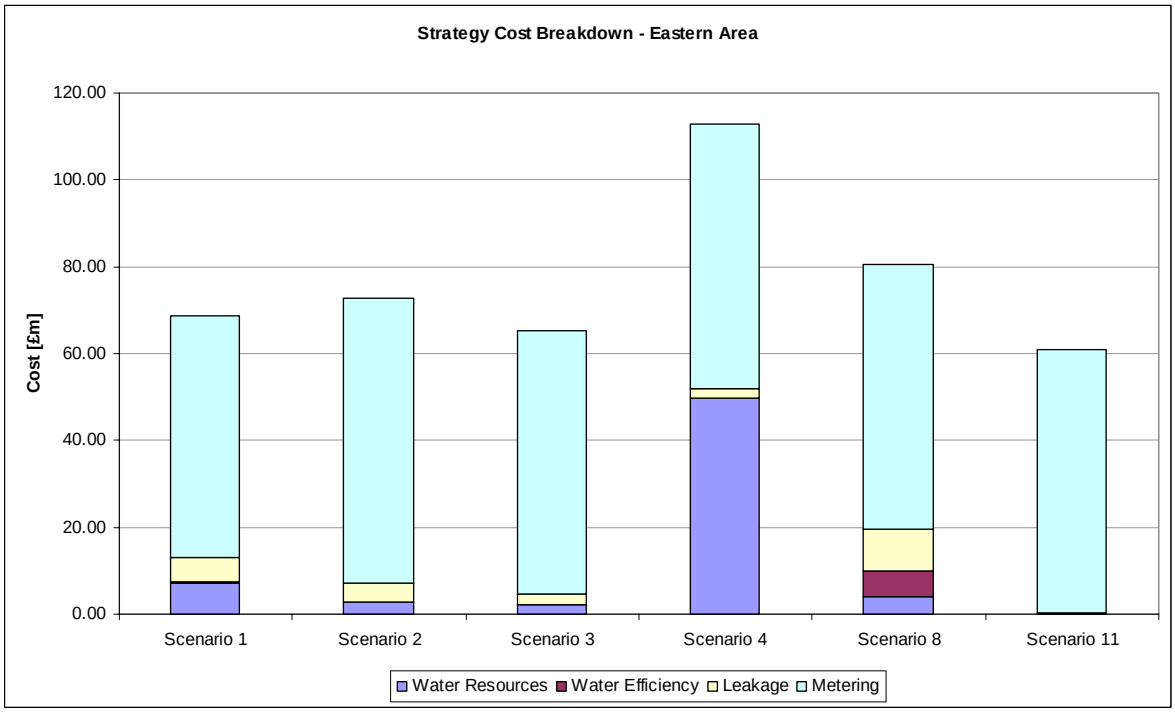


Figure 10.48 Eastern Area Scenario Cost Comparisons

10.5.12 Sensitivity Analysis

10.5.12.1 Range of Sensitivity Analysis

The "possible worst-case" focused on any changes in supply side or demand side factors which would worsen the supply demand balance. Any decrease in deployable output and/or increase in demands would mean that deficits occur earlier in the planning period and would

be larger than those identified in the baseline conditions. This could pose a threat to the security of supplies if the selected schemes, and/or any others that might then be required, could not be commissioned quickly enough.

Following consideration of a number of such demand and supply side factors and the potential magnitude of each it was decided that a "global" change in the demand forecast of +/- 5%, would be assumed for the area. To put this sensitivity into context, at the end of the planning period, for the Eastern Area:

- A +/- 5% change in demand would result in a change in demand of +/- 9.0 Ml/d and +/- 11.3 Ml/d at the MDO and PDO condition respectively by the end of the planning period; and
- A +/- 5% change in demand would be equivalent to a change in the area deployable output +/- 3.7% and +/- 3.9% at the MDO and PDO condition respectively.

10.5.12.2 Results of sensitivity analysis

The results of the sensitivity analysis for the possible "best-case" and "worst-case" are presented in Table 10.25 and can be summarised as follows:

Under the "worst-case" sensitivity:

- The licence variation schemes in Kent Medway WRZ and Sussex Hastings WRZ are brought forward by 2-3 years;
- The re-introduction of S556 borehole in Sussex Hastings WRZ is also brought forward by three years;
- Two schemes are brought into the strategy at the end of the planning period; a desalination plant on the River Medway of 10 Ml/d capacity (in 2030), and an increase in the capacity of the Bewl-Darwell transfer;
- Further leakage reduction is required earlier, although the level of reduction is similar to the base case; and
- Water efficiency schemes are also required in Sussex Hastings WRZ.

In summary, the selection of schemes remains the same but the timings of the introduction of the schemes changes. Two additional schemes are required.

The different timings suggest that there would be sufficient time to bring forward schemes should they be required. The introduction of a new scheme at the very end of the planning period should be viewed with caution since, by the time the scheme is identified as being required, the target headroom will be less, and thus the scheme may not, in the event, be triggered. However, the revised glidepath for target headroom should reduce this effect.

Under the "best-case" sensitivity:

- Two schemes remain unchanged; the S271 licence variation in Kent Medway WRZ, and the Darwell licence variation in Sussex Hastings WRZ; however, the timing of the schemes is delayed by 6-7 years; and
- Further leakage reduction is only required late in the planning period in Kent Medway WRZ, but not in the other two WRZs.

In summary, the results suggest that the need for the Darwell and S271 licence variations remain unchanged.

	Scenario	Company preferred WRSE Regional	Company only Universal metering	Increase in demand of 5% by end of planning period	Decrease in demand of 5% by end of planning period
	Number	4	3	"Worst case"	"Best case"
	Metering policy	Universal	Universal	Universal	Universal
	Leakage policy	JR08, then SPL saving	JR08, then SPL saving	JR08, then SPL saving	JR08, then SPL saving
	WRSE preferred options & bulk supplies	Yes	No	No	No
WRZ	**Scheme**	**Earliest year required**			
Kent Medway	Licence variation at S271	2024	2024	2022	2029
	Licence variation for River Medway Scheme	2029	2029	2026	-
	Medway desalination (10Ml/d)	-	-	2030	-
	Wastewater recycling at Aylesford	2018	-	-	-
	Raise Bewl reservoir	2022	-	-	-
	Leakage reduction	2026 reduction by 6.5 Ml/d	2026 reduction by 6.5 Ml/d	2023 reduction by 6.5 Ml/d	2031 reduction by 3.0 Ml/d
Kent Thanet	Leakage reduction	2034 reduction by 0.1 Ml/d	2034 reduction by 0.1 Ml/d	-	-
Sussex Hastings	Darwell licence variation	2028	2028	2025	2031
	Re-introduce S556 borehole source	2031	2031	2028	-
	Increase capacity of Bewl-Darwell transfer	-	-	2032	-
	Leakage reduction	2033 reduction by 0.5 Ml/d	2033 reduction by 0.5 Ml/d	2030 reduction by 0.6 Ml/d	-
	Water efficiency kit (Box)	-	-	2030	-
	Water efficiency low flow shower heads	-	-	2030	-
	Costs (£m)				
	Total metering cost (£m)	60.83	60.83	60.83	60.83
	Total resource, leakage reduction and water efficiency activity cost (£m)	51.95	4.52	17.54	0.93
	Total cost of Strategy (£m)	**112.78**	**65.35**	**78.37**	**61.76**

Table 10.25 Results of Sensitivity Analysis for the Eastern Area

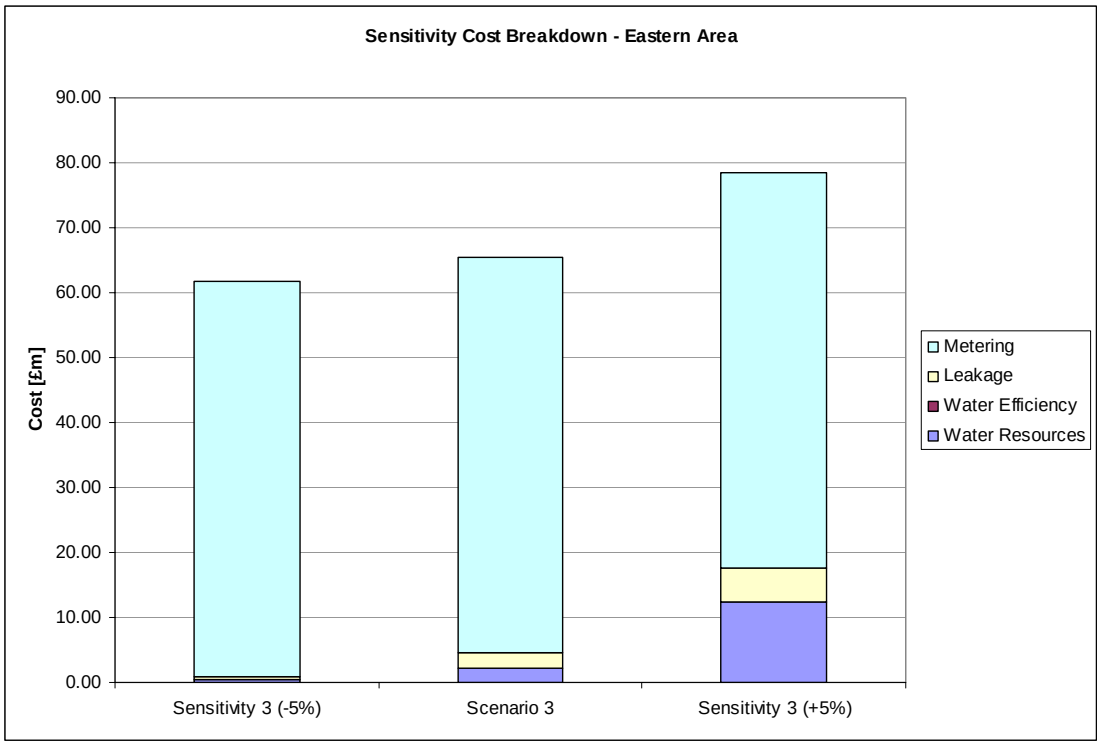


Figure 10.49 Eastern Area Sensitivity Analysis Cost Comparisons

10.6 Discussion of hybrid metering scenario

The hybrid metering scenario addressed the issue of whether it is more cost effective for Southern Water to only meter in those Water Resource Zones which have a supply demand deficit. This scenario tested whether it is more effective to install meters in an efficient and timely manner or continue with a less cost efficient optant metering policy. The comparison this scenario affords is key in that it allows a clear appreciation that it is more efficient to deliver a large scale metering plan than to install meters on a piecemeal basis across the region.

11 Summary of the Water Resources Strategy

This Water Resources Management Plan is the strategy document sets out our vision for the next 25 years. It looks in detail at our three main objectives of: achieving value for customers; resilience in a changing environment and facilitating growth in the South East of England. The WRMP takes into account consultation responses to the draft WRMP and joint discussions with regulators and others on how Sustainability Reductions might be implemented. We have also been an active member of WRSE whose outputs have informed the final WRMP.

The challenges to water resources in this region that we face are significant, but we believe that the options identified in this WRMP are robust and appropriate to meet these challenges. A summary of the components of the overall water resources strategy for the company is shown in Table 11.1. The balance of the various elements of the strategy given in the following summary will vary in the three different areas:

During AMP5

- Introduction of universal metering by 2015;
- Asset improvement schemes at a number of groundwater sources, as identified by the recent review of groundwater source performance;
- The optimum use of inter-zonal transfers, as identified by the investment model;
- Additional inter-zonal transfers, as identified by the investment model;
- The renewal of existing inter-company bulk supplies until the end of the planning period, at the rates at the time of contract renewal;
- New source development, if required, either to close any existing supply demand balance deficits, and/or to restore security of supplies as a result of Sustainability Reductions; and
- Any further investigation of new resource developments that were identified as part of the WRSE regional modelling work.

During the rest of the planning period to 2035

- It is currently envisaged that no further strategic resource developments will be required to meet Southern Water's needs under the company only universal metering strategy;
- The strategy will deliver the objective of keeping to the target headroom line, through a delicate balance of a number of factors, including the following; source maximisation through potential licence variations; the refurbishment of a few small, currently disused groundwater sources, which may require fairly advanced treatment solutions; progressive leakage reduction, up to 19% below the current outturn level to offset the need for the development of major strategic schemes; and the introduction of further water efficiency savings where it is economic to do so;
- It should be noted that we have included the effects of climate change on both supply and demand side elements. However, these have only been introduced after the end of AMP5, and thus their inclusion will not have any bill impact during AMP5; however
- Southern Water has reaffirmed its commitment to the WRSE modelling work, in the form of adopting the WRSE preferred regional options in its strategy in addition to those identified in the least-cost company only strategy. Whilst the

introduction of these schemes will lead to available headroom in excess of our target headroom requirements, we believe that this will not contribute to any bill impact during AMP5, and demonstrates our continued commitment to the development of a regional solution.

Water Resource Zone	Schemes During AMP5	Schemes beyond AMP 5 – company only solution	Schemes beyond AMP 5 – Water Resources in the South East of England
Isle of Wight	• Enhanced Metering • Asset improvement schemes for groundwater sources (1.55 Ml/d peak, 1.05 Ml/d average) • Optimisation of inter-zonal transfers (cross-Solent main)	• Water Efficiency kits • 1.1 Ml/d further leakage reduction • Refurbishment of L536 borehole • Refurbishment of K628 borehole	As previous column
Hants South	• Universal Metering • Asset improvement schemes for groundwater sources (12.00 Ml/d peak, 8.00 Ml/d average) • Increase Testwood WSW to licence limit • Development of the enabling Testwood to Otterbourne transfer • Optimisation of inter-zonal transfers (cross-Solent main)	• Candover & Alre augmentation schemes • 7.8 Ml/d of leakage reduction • R176 borehole rehabilitation And, subject to satisfactory completion of AMP5 schemes: • River Itchen Sustainability Reductions residual at end of AMP5	As previous column
Hants Kingsclere	• Universal Metering • Asset improvement schemes for groundwater sources (1.2 Ml/d peak only)		
Hants Andover	• Universal metering • Asset improvement schemes for groundwater sources (0.2 Ml/d peak & average)		
Sussex North	• Universal metering • Renewal of the existing bulk supply contract from Portsmouth Water • Asset improvement schemes for groundwater sources (0.30 Ml/d peak, 0.10 Ml/d average) • Optimisation of inter-zonal transfers (from Sussex Worthing) • River Arun Abstraction	• Renewal of the bulk supply of contract to South East Water	As previous column

Sussex Worthing	• Universal metering • Asset improvement schemes for groundwater sources (1.75 Ml/d peak, 4.25 Ml/d average) • Optimisation of inter-zonal transfers (to Sussex North and Sussex Brighton)		
Sussex Brighton	• Universal metering • Asset improvement schemes for groundwater sources (7.25 Ml/d peak & average) • Optimisation of inter-zonal transfers (from Sussex Worthing)		• Provision of a 4 Ml/d bulk supply to South East Water
Sussex Hastings	• Universal metering • Asset improvement schemes for groundwater sources (0.25 Ml/d peak only) • Optimisation of inter-zonal transfers (Bewl-Darwell transfer)	• Renewal of bulk supply to South East Water • Licence variation at Darwell reservoir • Re-introduction of the S556 source • 0.5 Ml/d leakage reductions	As previous column
Kent Medway	• Universal metering • Asset improvement schemes for groundwater sources (10.25 Ml/d peak, 8.75 Ml/d average) • Optimisation of inter-zonal transfers (to Kent Thanet)	• Renewal of the C522 scheme bulk supply to South East Water • Licence variation to the River Medway Scheme • Licence variation of S271 groundwater source • 6.5 Ml/d of further leakage reduction	As previous column, but additional schemes • Aylesford wastewater recycling scheme • Raising Bewl Water An the assumption that these will enable the following • Bulk Supply from Bewl Water to South East Water • Bulk Supply from Burham to South East Water
Kent Thanet	• Universal metering • Optimisation of inter-zonal transfers (from Kent Medway) • Renewal of the bulk Supply to Folkestone and Dover	• 0.1 Ml/d of further leakage reduction	As previous column, but additional schemes • Enhancement of the bulk Supply to Folkestone and Dover

Table 11.1 Summary of the Overall Water Resources Strategy

We have adopted a twin-track strategy that combines measures to reduce demand as well as increase supplies. We believe that both types of scheme are required to ensure that we meet future demands in the most resilient way.

We have only sought allowances in price limits for those schemes that need to be delivered in the AMP5 period from 2010 to 2015 and for the NEP schemes advised by the Environment Agency. Investigation of those options that will need to be delivered during 2015 to 2020, will be covered at the next price review. The cost of the company preferred regional strategy in AMP5 is shown in the table below in the form of:

- Indicative cost of constructing the schemes (Capex); and
- Indicative cost of running these schemes (Opex).

	Total Capex and Opex (undiscounted) **2010-15** £m
Universal metering programme	123.2
River Arun Tidal Abstraction	18.2
Testwood WSW improvements	58.3
Total	**199.70**

Table 11.2 Company Level Summary of Proposed Company Capital and Operating Cost Investment Programme for Company Preferred Regional Strategy in AMP5

Table 11.3 presents the company level total cost (NPV) over the planning period for both the company only least-cost strategy and for the company preferred regional strategy. Under the company preferred regional strategy, there would be an additional £47.4 million over the planning period. However, we believe that this will not contribute to any bill impact during AMP5 as the regional schemes will not be introduced until AMP6 and beyond.

Component	**Company Only Least-Cost Strategy (Scenario 3)** **Total NPV cost over planning period** £m	**Company Preferred Regional Strategy (Scenario 4)** **Total NPV cost over planning period** £m
Leakage reduction	5.24	5.24
Water efficiency	0.06	0.06
Water savings	-0.08	-0.09
Metering	170.35	170.35
Resource development	60.38	107.81
Total	**235.95**	**283.37**

Table 11.3 Company Level Summary of Proposed NPV Cost for Company Only Least-Cost Strategy

Carbon footprint

The development of these solutions will have an impact on our energy use. Figure 11.1 shows the change in carbon use as a result of demand management and resource development activity in each year over the planning horizon. It is important to note that this is based solely on operational carbon usage. This suggests that there is unlikely to be a net increase in carbon emissions until AMP7.

The carbon use shown assumes that each year is a dry year, although in reality this is unlikely. Thus, in practice these are overestimates, and it is expected that less energy would be required to balance supply and demand.

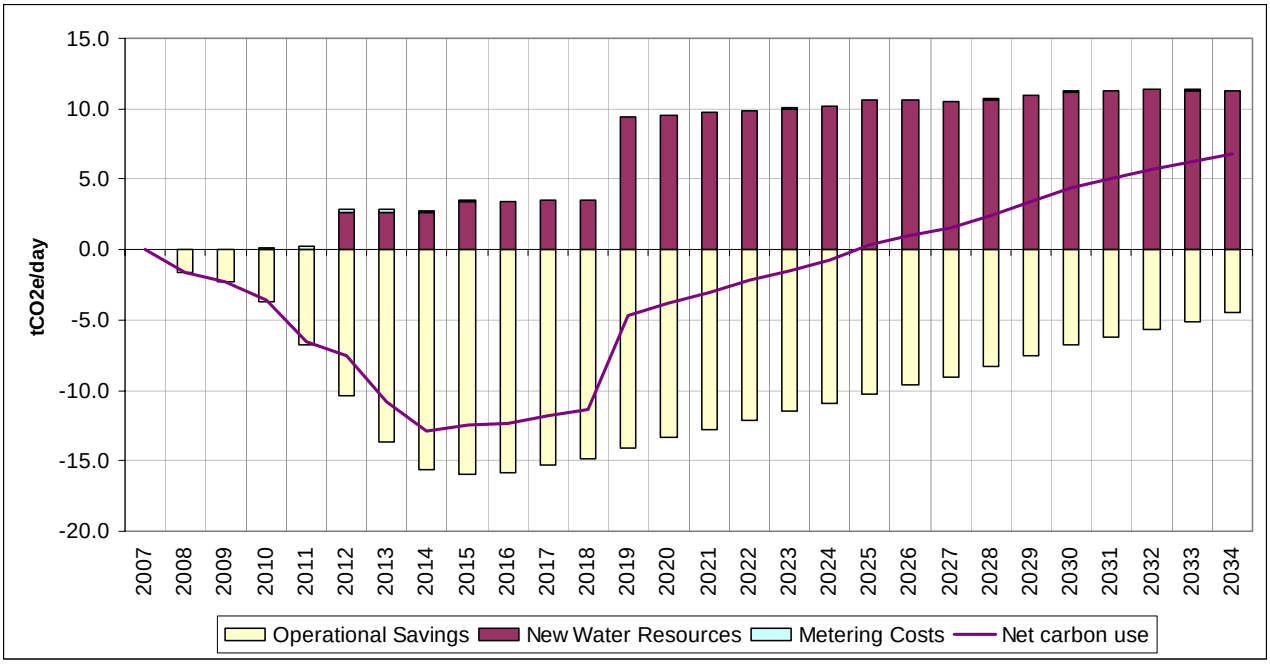


Figure 11.1 Average Change in Carbon Use Due to Company Only Least-Cost Strategy (scenario 3)

Figure 11.2 presents the total operational daily carbon footprint on average, under dry year conditions, for two scenarios: the optant metering scenario (1), and the universal metering scenario (3), which is also the company only least-cost strategy. The total operational carbon footprint in the base year (2007-08) is 211 tCO_2e/day which decreases mainly due to operational savings, before new resources are required. This is most noticeable in 2019, the year in which the Sustainability Reductions are enacted in full.

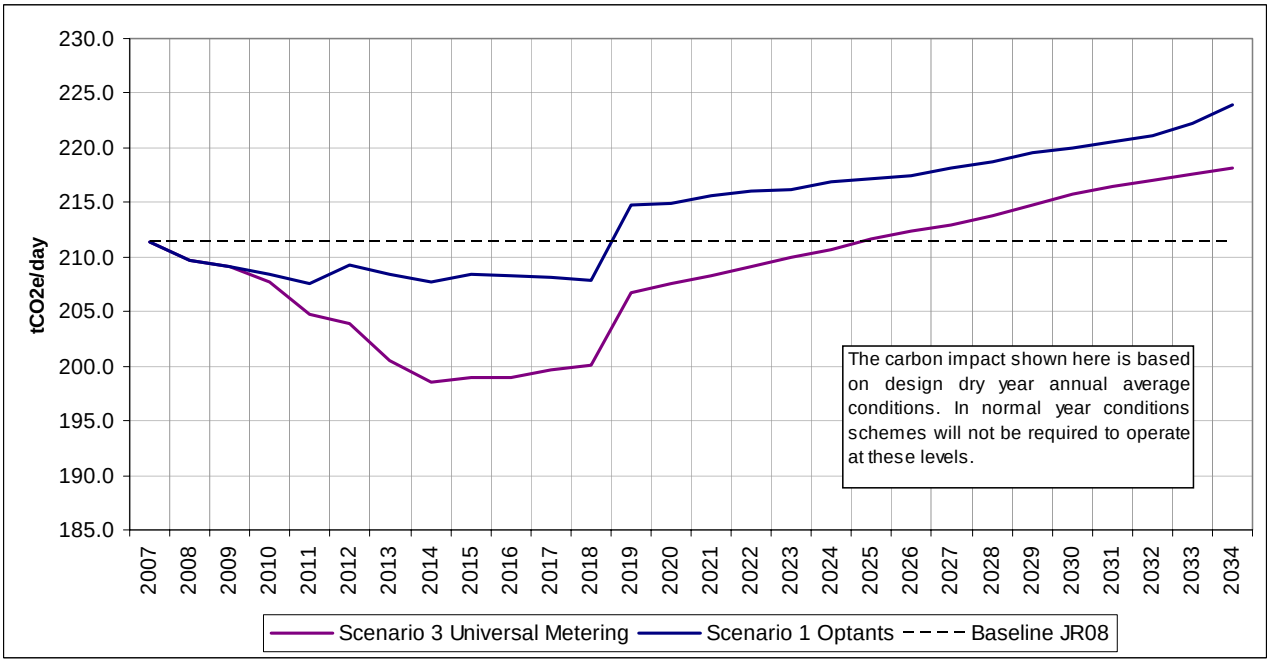


Figure 11.2 Operational Carbon Use Under DYAA Conditions

Summary

Developing a water resources strategy for the future always involves choices, but it is essential that we maintain the investment in our supply system today to ensure that it continues to deliver today, tomorrow and in the future. The subtle balance between reducing demand and ensuring resilience has been a central issue when developing this strategy, primarily because of the vulnerability of a significant number of our sources to prolonged droughts, which was highlighted during the recent drought of 2004 to 2006.

In summary, we believe that, through a combination of a demand management-led approach, with new resource developments as appropriate, we have achieved the best balance to produce a least-cost, environmentally sustainable strategy.