Thames Water

Final Water Resources Management Plan 2015 - 2040

Main Report

Section 8: Programme Appraisal

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Section 8 Programme Appraisal

This section has been revised, from section 8.3 onwards, to explain the programme appraisal for London and the Thames Valley updated in response to new and updated information available since the publication of the draft Plan, and comments received as part of the consultation process.

Sections 8.1-8.2 cover our background and approach to programme appraisal. These have not changed significantly since the draft Plan.

In this section we explain the process that we have followed to assess potential solutions to the supply demand problems identified. We seek to provide a secure and reliable supply of water whilst also providing best value for our customers and the environment.

We have completed this process for all Water Resource Zones (WRZs).

In defining a preferred plan for SWOX WRZ we have identified a plan which has synergies with our plan for London WRZ. We have also considered this approach for the other WRZs in our supply area, in order to maximise these synergies and deliver consistent messaging to all our customers.

We have followed the Water Resources Planning Guideline (WRPG) and other technical guidance and reports in completing our programme appraisal.

We have briefed stakeholders and regulators as we have progressed this work, explaining our approach and considering their comments and feedback.

8.1 Requirements of the WRPG

Table 8-1 sets out the requirements for programme appraisal in the WRPG and describes how we have covered off these points in the development of our plan.

Table 8-1: WRPG requirements for programme appraisal and our consideration of them

WRPG section	WRPG Requirements	Our action
6.6	Economic appraisal should be carried out for all options on the feasible options list. The least cost solution to be determined through analysis of the relative cost effectiveness of all feasible options. Reference should be made to the Economics of Balancing Supply and Demand (EBSD) report, EA and UKWIR, 2002.	We have considered all feasible options in the formulation of the least cost plan. We have completed the process in line with the EBSD report.
	The company's own options and those of neighbouring companies or third parties to be treated consistently.	We have consulted other water companies and third party organisations to identify options for additional resource or demand management. Where sufficient information is available on these options they have been considered in the options appraisal alongside our own options. (Appendix 10, section 7).
	None of the aspects of the least cost solution, such as the sustainable economic level of leakage or water efficiency, should be determined outside the options appraisal process and fixed as inputs.	Programmes of demand management have been compiled containing combinations of demand management options. These have been considered on a comparable basis to resource options in the EBSD modelling.
	Company should take account of the interaction of the least cost solution with existing assets to minimise total costs.	The operation of existing assets is included as part of the modelling performed. We have also included the impact on capital maintenance costs.
	The variable cost elements of schemes should be determined using a forecast of utilisation.	We have determined variable costs using a forecast of utilisation.
	The whole-life (80 years) cost of investments should be used when determining the cost of the plan or an individual option. For an option delivered in the final year of a 25 year planning period (2039/40) the 80 year assessment period would run from April 2039 to March 2119.	We have assessed the whole life cost of options and the plan over a fixed 80 year cost assessment period from April 2015 to March 2095. This difference from guidance is discussed in Appendix W.
2.4	The WRMP plans investment for the 25 year period from April 2015 through to March 2040.	Our modelling covers the 25 year period from April 2015 to March 2040.

WRPG section	WRPG Requirements	Our action
2.4.2	Costs in the plan should be presented in a 2012/13 price base[1].	We have presented all costs based on 2012/13 prices
2.6	Planning should consider DYAA and DYCP (optional) scenarios.	Planning is completed simultaneously for both DYAA and DYCP[2].
2.7	A breakdown of the costs incurred as part of the plan due to complying with Government policy and aspirations should be provided. The Government policy and aspirations for water supply are set out in 'Water for Life'[3].	Our solution to achieving Government aspirations for water use are met by the inclusions of demand savings resulting from the introduction of innovative tariffs and assumptions of behavioural change from our customers in their use of water. The direct cost of these policies will be incurred by our retail business as they relate to the production of a new style of bill to enable the introduction of tariffs. The impact on our WRMP is reflected in the additional risk taken by Thames Water; we are relying on Government, local authorities and other stakeholders such as housing developers to play a role in promoting efficient use of water and our customers to respond and change their use of water.
6.7	Once the least cost solution has been identified companies should assess alternative combinations of options to meet the wider objectives of the Plan identified by Strategic Environmental Assessment (SEA) or sensitivity testing.	We have undertaken a step-wise approach to programme appraisal, firstly developing the least cost plan and then considering wider objectives including the environmental performance, customers' preferences and Government's priorities.
6.7.1	The least cost programme should be reviewed to consider significant non-monetised impacts identified by the SEA, additional risks and uncertainties not captured by options appraisal.	The SEA has highlighted environmental issues which have been taken into account in the programme development. Other risks and uncertainties have also been explored through scenario analysis such as more extreme droughts (Section 10).
6.7.2-6.7.10	Water companies should show how they have accounted for potential impacts on the environment. A company should use the information in the UKWIR guidance and ODPM guidance to determine if an SEA is required and if an SEA is undertaken it must comply with the legal requirements.	We have undertaken an SEA and an HRA; these are presented in Appendices B and C respectively.

[1] Expressing costs in a constant price base removes the effects of inflation and allows for the easy comparison of costs over time. Stating costs in a 2012/13 price base means that costs reflect the actual cost that would be paid if the activity was delivered during the period April 2012 to March 2013.

[2] For the London WRZ no DYCP forecasts of DO are produced. In the EBSD model DYCP data for London is entered as a duplicate of DYAA data. Since DYAA is the planning scenario which drives investment in London there is no loss of accuracy.

[3] Water for Life, Department of the Environment, Farming and Rural Affairs – December 2011

WRPG section	WRPG Requirements	Our action
6.8	Companies need to be clear and transparent about how the decisions have been made when deciding on a preferred solution.	The aim of the step-wise programme appraisal process is to provide a clear and transparent decision making process. This has been reviewed with regulators and stakeholders who considered it to be clear and logical.

The WRPG sets out requirements in respect of the Strategic Environmental Assessment (SEA) (sections 6.7.2-6.7.10). We have completed a SEA in accordance with the WRPG, to comply with legal requirements and in line with industry best practice guidance. It sets out the full environmental assessment completed on component schemes and programmes to support the development of the preferred programme.

8.2 Our approach to determine the preferred programme

We have followed a structured programme appraisal process in producing our plan. The process comprises a series of sequential steps. The process is shown in Figure 8-1 and the steps are summarised below:

Step 1: Economic appraisal to identify the least cost solution

Step 2: Consideration of wider environmental issues through the Strategic Environmental Assessment (SEA)

Step 3: Consideration of wider objectives

Step 4: Comparison of alternative programmes

Step 5: Sensitivity testing

Step 6: Consider future pathways

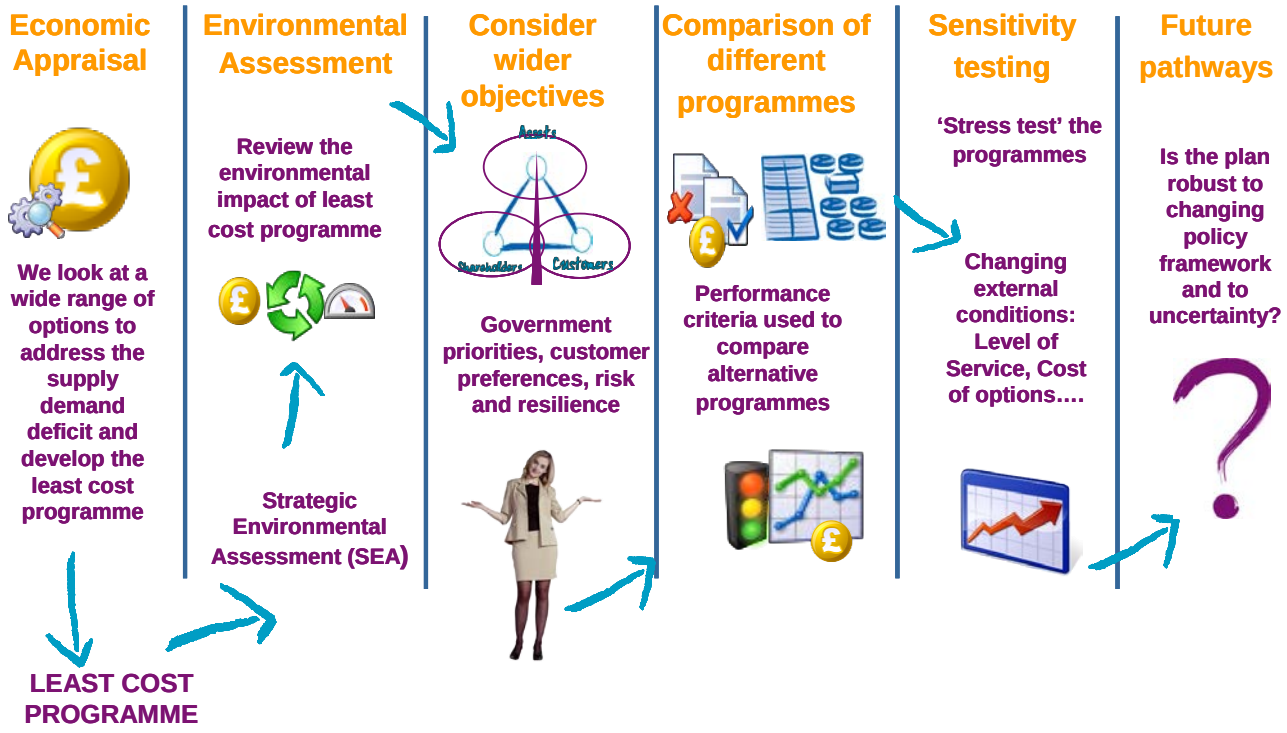


Figure 8-1: Approach to programme appraisal

This section covers steps 1 to 4. Steps 5 and 6 are covered in Section 10.

Steps 1 to 4 cover the economic appraisal to develop the least cost programme followed by consideration of a wider range of objectives, such as the priorities of our customers and policy objectives of Government, to develop a set of alternative programmes. We present the least cost and alternative programmes and discuss the characteristics of the different programmes. We have used performance criteria to aid comparison of the alternative programmes and facilitate a transparent and open assessment and decision making process. The criteria are a mix of quantitative and qualitative parameters and include cost but also factors of wider value.

8.2.1 Step 1: Modelling the least cost programme

The first programme we generate, and the starting point for creating other programmes, is the least cost programme. The least cost programme is created through a mathematical optimisation process which finds the plan with the lowest total cost to customers, society and the environment.

Optimisation is a mathematical process for determining the best solution to a defined problem. We use a technique known as linear programming in the optimisation process used for the WRMP programme appraisal. For a problem to be solved by linear programming it must be defined in a specific manner, but the process will then guarantee that the result is extremely close[4] to the best possible answer. For more detail on the linear programming and how and why it is applied in the WRMP programme appraisal please refer to Appendix W.

We use two systems to complete the optimisation of a least cost plan. The first system, the Integrated Demand Management (IDM) model, optimises a series of demand management programmes. This process is described in more detail in Section 7. The second system, the Economics of Balancing Supply and Demand (EBSD) model, optimises a programme to balance supply and demand.

The EBSD model is given as inputs:

- The baseline supply demand balance, including headroom (Section 6).
- The range of demand management programmes optimised in the IDM model (Section 7).
- The range of water resource and transfer options (Section 7).
- Uncertainty parameters for each demand management and water resource option.

The model then selects the optimum demand management programme per WRZ[5] and a schedule of as many water resource and transfer options as are required to balance supply and demand. The optimum demand management programme could be the baseline programme

[4] In the production of this plan we have used a tolerance of 1%, which is less than the breadth of uncertainty around our demand, supply and cost forecasts. Essentially this means the result is the optimum.

[5] Note that for the baseline programme, the only demand management activities that are delivered are those that a water company is legally compelled to provide; optant metering and baseline water efficiency is one of the demand management programmes available in each WRZ. These baseline activities are also included in all other programmes along with other planned additional activity.

with no further demand management interventions. The programme selected will be very close to the programme with the best possible performance against the objective.

The model will only select a feasible schedule of water resource and transfer options, i.e. the logic of deliverability such as the earliest delivery date, mutual exclusivity for each option must be met. Where there are no feasible options available to maintain the supply demand balance the model will indicate there is a remaining deficit with the use of a penalty option[6].

The objective set for a least cost optimisation is to minimise the cost of the programme selected to customers, society and the environment, this cost is assessed by the net present value of the whole life cost of the programme.

The whole life cost of the programme includes not just the cost to build the options selected but also to operate and maintain them to continue to supply water until they reach the end of their useful life[7] and need to be replaced.

The direct cost of the option, which is those parts of the cost for which Thames Water and ultimately customers pay for directly, is assessed by the impact that cost has on the bills paid by customers rather than the price paid by Thames Water. We believe that this is the best way to represent customer's interests in the optimisation process. For more detail on this calculation please refer to Appendix W.

The cost of an option, and therefore the programme, is assessed not just as the direct financial cost but also by the indirect impact on society and the environment. This includes costs for impacts such as carbon emissions and road congestion. Government has provided guidance on the methodology for valuing carbon emissions[8] and the water industry research group has provided additional guidance[9] on the estimation of emissions from construction. Government has provided guidance on the environmental impact of greenhouse gas emissions[10]. Government has provided forecasts of the costs[11] of:

- Energy from the National Grid.
- The value to society of the emission of greenhouse gases.

[6] A penalty option is an imaginary limitless source of water, it is only included in the model to allow the model to declare a result when it would otherwise be unable to balance supply and demand. The use of a penalty option attracts a very high cost which prevents the model from picking it in preference to feasible options.

[7] All options considered in this WRMP have a useful life of 80 years.

[8] Carbon Valuation in UK Policy Appraisal: A Revised Approach, Department for Energy and Climate Change – October 2011

[9] A framework for accounting for embodied carbon in water industry assets (12/CL/01/15), UKWIR - 2012

[10] 2012 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting, Department for the Environment, Farming and Rural Affairs & Department for Energy and Climate Change – May 2012

[11] Valuation of energy use and greenhouse gas (GHG) emissions, HM Treasury & Department for Energy and Climate Change – October 2012

We have followed the Government and industry guidance for assessing the amount of greenhouse gases emitted by each feasible option. We have followed Government guidance in the valuation of energy use and carbon emissions. More detail of the costs for each option can be found in Appendix A and more detail of how the cost to the environment of the emission of carbon is calculated can be found in Appendix W.

The net present value (NPV) of whole life costs (WLC) for a programme is calculated over a fixed 80 year period, April 2015-March 2095. Costs incurred over this span are converted in to present values by applying the 4.5% per annum discount rate specified in the WRPG. The NPVs contained in this document are expressed using a base year of 2012/13; meaning that costs in 2015/16 are multiplied by a discount factor[12] of 0.876 to convert to present values. More details of the process of discounting including an example calculation can be found in Appendix W.

Discounting is a separate process from indexing. Indexing, and expressing costs in a common price base, removes the effects of inflation from the analysis performed. Inflation is the general rise of prices in the economy over time, for example in 1980 a loaf of bread may have cost 30p whereas today it could cost £1. When we compare costs they are always compared in a 2012/13 prices to ensure that two identical items purchased at different times still have the same cost. We use two measures of inflation in planning. The first is a measure of inflation in the UK construction industry; the construction output price index (COPI), this is used to index all capital expenditure. The second is a measure of general inflation in the UK economy; the retail price index[13] (RPI) this is used to index all other costs.

Some elements of the cost of an option are not incurred just by virtue of delivering an option but are instead incurred in proportion to how much the option is utilised. For example, in constructing a new borehole to abstract water we must purchase the abstraction pump and employ a member of staff to man and maintain the site, these costs are fixed and incurred regardless of how often or how much the option is used. When we need to produce water from this new borehole we must also pay for the power to operate the abstraction pump and the chemicals to disinfect the raw water produced, these costs vary in direct proportion to how much water the option is used to produce.

The volume of water produced by each option is calculated in each year, it is calculated to satisfy two rules which ensure the total variable cost is minimised:

- The total volume of water produced must equal the weighted average distribution input.
- Options are utilised in ascending order of total unit variable cost.

[12] $0.876 = 1/ (1+ 4.5\%)^3$

[13] There are many RPI series, we use the version inclusive of mortgage payments and indirect tax, base year 1987, Office for National Statistics series: CHAW.

Operating costs for existing baseline water resources are included, as an average level for the WRZ, in the model[14]. This means that new options can be used to substitute for existing options where the total unit variable cost is lower and demand management measures which reduce the weighted average demand will reduce the total variable cost of the programme. This is illustrated later in this section. The total operating cost to supply water to meet the weighted average demand for water is included in the net present value of whole life cost of the programme being optimised in EBSD.

For new sources of water such as third party and/or other water company options, the scheme charges to TW will be treated as opex (fixed and variable elements) and these would be compared with the opex costs (plus any maintenance capex element) of existing TW schemes. If the third party scheme requires a pipeline, or other infrastructure to be constructed within the TW boundary, these costs would be TW capex and would be included within the overall cost comparison.

The comparison of the options is undertaken using TW's standard cost benefit analysis, considering the present value of costs from a customer point of view (minimising the present value of the revenue requirement). The process of cost comparison against existing TW schemes uses the existing TW's Economics of Balancing Supply and Demand (EBSD) model. The EBSD model operates over a fixed assessment period of 25 years, and new and existing sources are utilised in ascending order of variable cost per Ml/d. Once the wastewater reuse plant is brought online in AMP8, it will not be utilised to its full capacity initially, although output and therefore costs will increase as demand increases.

Target headroom and headroom uncertainty are used to allow for the risk around forecasts of supply and demand. For more detail on the process of calculating target headroom please refer to Section 5.

The effects of demand management activities, new water resources or new water transfer options on the forecasts of supply and demand are uncertain and hence planning to deliver these options also changes the amount of target headroom that is required. EBSD incorporates this allowance for risk into the target headroom as part of the optimisation process. The model works iteratively: the initial run determines the least cost programme to meet demand, baseline headroom and headroom uncertainty; the uncertainties associated with all options selected are then incorporated into a new target headroom by Monte Carlo analysis; the supply-demand optimiser is then rerun to meet the demand, new target headroom and headroom uncertainty and the process is repeated until solutions converge, as shown in Figure 8-2. For more detail on this modelling process please refer to Appendix W.

[14] This is a requirement included in section 6.6 of the Water Resources Planning Guidelines, Defra et al – October 2012

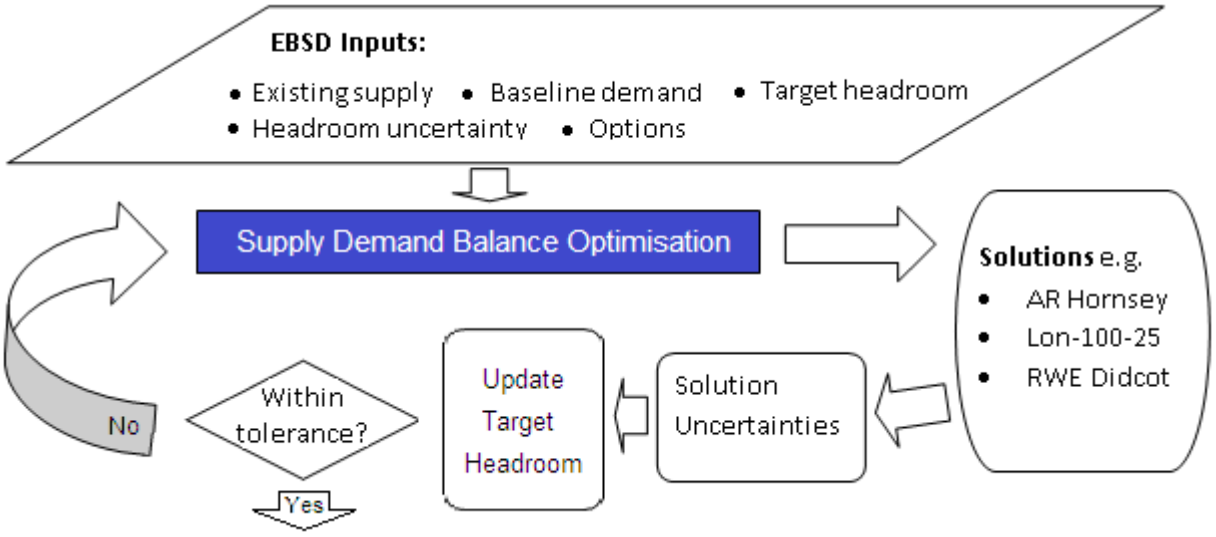


Figure 8-2: Supply-Demand Optimisation with Risk Iteration

As part of the WRMP process we have performed a range of pre-planning consultations[15] with our customers and stakeholders[16], this is part of a continuing programme of dialogue but was specifically focussed at what outcomes customers and stakeholders would like our plans to achieve. The most significant messages from these consultations that have informed how we produced our WRMP were:

- Maintaining secure and reliable supplies of water is the primary objective; the current levels of service in this respect should be maintained.
- Customers do not want to see significant increases in bills[17].
- Customers would like to see a reduction in the level of leakage and an increase in demand management (including reducing leakage, metering and water efficiency). All other things being equal, this is their preferred method of addressing a supply demand deficit.
- Stakeholders and customers would like us to increase the proportion of properties which pay their bill on the basis of the measured volume of water used although concern was also expressed that customers would no longer be able to choose whether or not to be metered[18].
- Customers would prefer not to see additional abstraction of water from the natural environment and are concerned about the environmental impact of such activity.

[15] The same series of studies have been used to support our Business Plan submission to Ofwat.

[16] This term covers the organisations which are affected by or have an interest in Thames Waters operations, including Local Authorities, central Government, environmental NGOs, customer interest groups and others.

[17] Note that this is something that can only be truly seen in the context of whole Thames Water investment plan, but we seek to minimise the impact the WRMP will have on this total figure.

[18] Currently more than half of our customers pay their bills based on the rateable value of the property.

We have also gathered responses from customers on their willingness-to-pay (WtP) for different levels of security of supply and the implementation of new measures to maintain that security of supply in relative terms. For more information on the customer surveys and the WtP valuations please refer to Appendix T.

The WtP values gives us a method by which we can assess the benefits of the WRMP as experienced by customers in monetary terms which makes it directly comparable to the cost to customers of implementing the plan. Hence we can judge whether the plan in total offers good value for money for customers. However the WtP studies did not allow customers to distinguish between the impacts of a scheme that have been given a monetary value through the application of the Benefits Assessment Guidance (BAG) and other impacts. Therefore the WtP values produced may duplicate, at least partly, impacts which are already valued and to include WtP values in addition to the environmental and social costs evaluated through BAG would probably result in double counting.

We have concluded that, in order to avoid the potential for double counting when we used WtP in optimisation we removed the environmental and social costs.[19]

8.2.2 Step 2: Consideration of environmental objectives

The options appraisal process generates the feasible list of options available to be considered in the plan; the costs and benefits of these options are assessed in financial terms, ultimately payable by our customers, and also in terms of the impacts on wider society and the environment.

We convert these impacts into monetary terms so that they can be directly included with the financial costs of options in accordance with the BAG. However, there are some environmental and social impacts which cannot be expressed in monetary terms, these are taken into account in the SEA (Appendix B).

The output of the SEA is taken into account in the overall programme appraisal at this point, which ensures that all impacts are considered in the development of the preferred programme. Appendix B details the methodology of the assessment and also explains how impacts are treated, clarifying that there is no double counting.

[19] As seen in Appendix T the WtP values are high. Used in their raw form they would result in a high surplus in our plan. To correct for this we scaled the figures by a factor of 10. This means the relative preferences of customers is maintained but the WtP numbers should not be compared on a like for like basis with other companies.

8.2.3 Step 3: Wider objectives

As part of the appraisal process we must consider wider objectives. It is important that customers are at the heart of the water company's decision making process as we have detailed above. We need to consider sustainability for the future, taking full consideration of the environmental and social impacts of individual schemes but also the combined programme impacts of our plan, over the planning period and for the future.

In water stressed areas the Government has set aspirations for companies to reduce per capita consumption within their water resource zones within the first five years of the planning period. We considered this in the development of our plan.

It is important that we assess our plan against reliability and resilience; there will be parameters that we can plan for in terms of risk and other factors that are outside of the companies control such as potential population increases, the impacts of climate change and potential future sustainability reductions. Whilst we can forecast potential changes in terms of power increases and chemical costs, we need to challenge these assumptions for different future scenarios.

These aspirations are reflected in our approach to programme appraisal, we consider the full environmental and social impact of our plan, our customers' and stakeholders' preferences and the full range of impacts on the way we operate as a business.

8.2.4 Step 4: Comparison and scoring of programmes

The most important part of a water resources plan is the final planning solution.

The best value solution may not necessarily be the combination of the least cost options. We think the best value solution should be:

- To return the WRZ to supply and demand balance.
- To achieve an appropriate balance for customers in terms of cost and risk.
- To be robust and flexible to the range of risks and uncertainties identified.
- To provide a positive contribution to sustainable development.

To ensure these outcomes, we have developed five criteria for assessing the performance of our plan. These looked at monetised and non-monetised effects of the plan in a structured way, to give a transparent view of different programme choices. These are:

- Financial
- Customers
- Sustainability
- Delivery
- Resilience

The performance criteria are described below. In all cases a high score indicates a positive programme attribute.

1. **Financial** – Our plan should deliver best value for money for customers. This criterion has two components:

a) **Total NPV -** This is the total NPV of all the schemes in a programme, including financial costs (opex and capex), and monetised environmental and social (including carbon) impacts. The scoring criteria are defined as low, medium and high as defined below:

- Low score 1: programme cost > 15% of least cost plan
- Medium score 2: programme cost 5 - 15% of least cost plan
- High score 3: programme cost < 5% of least cost plan

b) **Environmental & Social (E&S) and Carbon NPV –** The environmental, social and carbon impacts of a scheme are monetised in line with the BAG. The assessment is provided in Section 7.

- Low score 1: E&S programme cost > 20 % of least cost plan
- Medium score 2: E&S programme cost - 20 to +20% of least cost plan
- High score 3: E&S programme cost < - 20 % of least cost plan

The Environmental, Social and Carbon NPV costs of the programme are generally a small percentage of the overall Total NPV.

2. **Customers** – Our Plan should deliver efficiently the outcomes customers want. This criterion has two components:

a) **The bill impact for AMP6 (p/wk) -** The differential here is a measure of the relative impact of the programme to the current bill costs, in terms of pence per week increase.

- Low score 1: > 3%
- Medium score 2: 1-3 %
- High score 3: 1% or less

b) **Alignment with customer preferences** - Customers expressed a preference in terms of water resource options and a preference for no Level 4 restrictions (rota cuts). This scoring criterion is an assessment of whether the programme reflects customers' preferences.

- Low score 1: 1 theme recognised
- Medium score 2: 2 to 3 of themes recognised
- High score 3: 4 themes recognised.

3. **Sustainability** – Our Plan should ensure an efficient and sustainable supply of water. This criterion has two components:

a) **Government** has set out their expectation that the demand trend should be downwards in the first 5 years in areas designated to be water stressed and where per capita consumption (PCC) is above the national average. Previous guidance has set target figures for PCC. The scoring reflects aspirations to reduce PCC in the first 5 years and during the planning period. The national average in the WRPG is 147 l/h/d

- Low score 1: > 147 l/h/d by 2040
- Medium score 2: 140 – 147 l/h/d by 2040
- High score 3: < 140 l/h/d by 2040

b) **SEA -** The impact on the environment and society are considered in the appraisal process using the SEA (Appendix B). This does not include those environmental and social impacts which have been monetised and therefore avoids double-counting of impacts.

- Low score 1: Worse than least cost plan (more potentially significant non-monetised impacts)
- Medium score 2: Same as least cost plan
- High score 3: Better than least cost plan (fewer significant non-monetised impacts)

4. **Delivery** – This is a measure of the relative deliverability of the plan. The optimisation will produce a plan with least cost but will not take into account the non-monetised risk of delivering that programme. This criterion has two components:

a) **Deliverability -** This takes into account aspects of how the programme will be delivered, the business synergies and risks. During scoring a series of questions were asked to assess deliverability score.

- Is the programme difficult to promote? Is there a risk of lack of customer or stakeholder acceptance, or failure to achieve planning consent?
- Is the programme complex with multiple coincident delivery dates for complex projects?
- Is the delivery programme environmentally complex or protracted?
- Are there potentially high financial penalties on programme time which have not been monetised in the scheme risk?
- Is there alignment with other asset investment areas?
- Does it improve business knowledge and resilience?

b) **Flexibility -** This takes into account aspects of the flexibility of the programme and. whether the programme contains elements that can be readily modified.

- Can the programme accommodate change?
- Can it accommodate change within the AMP period?
- Is the programme inflexible in terms of sunk development costs, does the profile of costs mean that significant costs span two AMP periods, affording limited potential to enhance the programme between AMP periods.
- Can the programme be flexible or modular in terms of delivering increments of deployable output (5 to 50 Ml/d)?

Scoring methodology for deliverability and flexibility:

- Low (1) – Worse (than least cost plan)
- Medium (2) – Same (as least cost plan)
- High (3) – Better (than least cost plan)

5. **Resilience** – an assessment of the degree to which each option could be affected by future uncertainties and deliver a regional benefit. This criterion comprises two components:

a) **Sensitivity -** This includes sensitivity to:

- Change in unit costs such as power and chemicals
- Ability to deal with population change and network integration
- Water Quality
- Impacts upon emergency planning
- WFD and NEP changes.

b) **Regional perspective** and alignment with WRSE. This section assesses whether the plan provides a benefit in terms of the WRSE position and the future inclusion of beneficial options to Thames Water and neighbouring water companies, arising from the WRSE group, inter company liaisons or arrangements with third parties.

- whether the plan can accommodate and fully utilise beneficial transfers from other UK water companies and potential third party water providers, where these provide greater resilience and best value for our customers.
- Consistent with WRSE outputs

- Can provide further regional resilience in the event it is required[20]
- Accommodate future integration of third party options

Scoring methodology for sensitivity and regional perspective:

- Low (1) – Worse (than least cost plan)
- Medium (2) – Same (as least cost plan)
- High (3) – Better (than least cost plan)

A score of 1 to 3 (where 1 is low and 3 is high) was assigned against each of the above criteria. No weighting has been applied to the criteria.

The results of the programme appraisal process are discussed below. Separate assessments have been undertaken for London and the Thames Valley.

We have discussed our approach to programme appraisal with regulators and stakeholders to ensure the process is clear and understandable and the decision making process is transparent. Regulators and stakeholders have fed back[21] that the approach is both robust and logical.

The programme scoring was conducted with input from a multi-disciplinary team including:

- Thames Water, Water Planning Team
- Thames Water, Water Policy and Strategy Team
- Cascade Consulting Limited
- Atkins

The scoring matrix is shown in Table 8-2.

[20] For example, drought events

[21] The stakeholder engagement forum at which this feedback was received (6 March 2013) is discussed in Appendix S.

Table 8-2: Programme scoring matrix

Score	Quantitative Measures						Qualitative Measures			
	Financial		Customers		Sustainability		Delivery		Resilience	
	Cost: Total NPV (i)	Cost: E&S and Carbon NPV (ii)	Bill Impact (iii)	Alignment with customer preferences (iv)	Government requirement to reduce PCC (vi)	SEA Performance (v)	Deliverability promotability, business risk & synergy (vii)	Flexibility (viii)	Sensitivity (ix)	Regional perspective (x)
Low (1)	>15% of least cost plan	>20% of least cost plan	>3%	1 - 2	>147 l/h/d	Worse (than least cost)	Worse (than least cost)	Worse (than least cost)	Worse (than least cost)	Worse (than least cost)
Medium (2)	5-15% of least cost plan	-20 to 20% of least cost plan	1-3%	2-3/4	140-147/l/h/d	Same (as least cost)	Same (as least cost)	Same (as least cost)	Same (as least cost)	Same(as least cost)
High (3)	<5% of least cost plan	<-20% of least cost plan	1%	4/4	<140l/h/d	Better (than least cost)	Better (than least cost)	Better (than least cost)	Better (than least cost)	Better (than least cost)

Notes:

Scores are not weighted.

(i) Range based on range of programme costs

(ii) Range based on range of E&S costs

(iii) Based on assumption that customers would like affordable bills

(iv) Based on the four main water resource findings: customers have strong preference to avoid rota cuts; would like us to do more to reduce leakage; have an order of preference from leakage-> metering-> resource development; customers would like more help on water conservation

(v) Relative measure

(vi) 147 l/h/day based on government policy for the need for significant demand reduction.

(vii) Score based on promotability, business risk and synergy across the business

(viii) Relative measure

(ix) Relative measure

(x) Relative measure

8.3 Programme appraisal – London

In this section we present the step-wise programme appraisal completed to develop the preferred programme for London WRZ. The overall scoring process for London is summarised in Figure 8.3 and Figure 8.4 and then in Table 8-3 to Table 8-15. For each programme the component schemes are presented, followed by a discussion on the characteristics of the programme and then presentation of the performance of the programme in line with the performance criteria.

In the following sections the steps through the programme appraisal stages are clearly defined.

The objectives of each stage are clarified and the scoring against each of the criteria is detailed.

In the following scoring tables a number of terms are used in an abbreviated form. These are summarised below:

- Water Framework Directive (WFD)
- Treatment plant with Reverse Osmosis (RO)
- Supply and demand balance (S/D)
- Contingency Options (CO)
- Sustainability reductions (NEP)
- Demand management programme (DM)
- Per Capita Consumption (PCC)

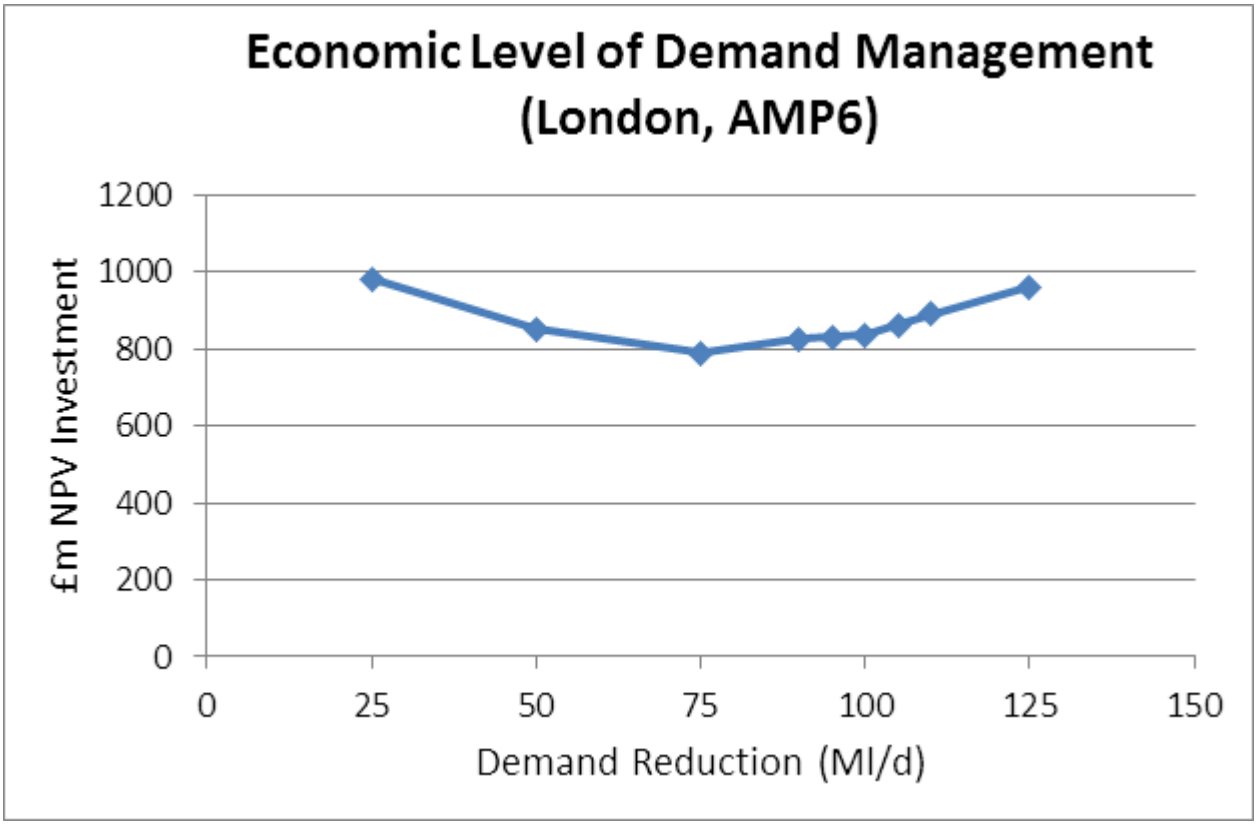
8.3.1 Evaluating the economic level of demand management

In the initial programme appraisals a significant programme of demand management is selected in the short term.

The EBSD programme will select the least cost programme. Thames Water has used the EBSD model to determine the Economic Level of Demand Management (ELDM) using the NPV methodology. This has replaced the traditional Economic Level of Leakage (ELL) approach because of the integration in the delivery and planning of leakage and usage reduction options. This approach creates a better value plan for customers.

A least cost optimisation was run, without the subsequent Monte Carlo iterations of the risk, for all demand management options except those featuring the same volume of AMP6 saving. This was run in the draft WRMP for 200 discrete programmes with demand management profiles which started with 5 distinct demand reductions in AMP6 (25 to 125 Ml/d). For the final WRMP we increased the number of the demand reduction targets in AMP6 to nine, to increase the range of options around the ELDM and preferred programme, to enable an improved selection of a new preferred programme, but reduced the number of programmes with demand management profiles stretching beyond AMP8. The least cost of these programmes is presented as a single point in Figure 8-2. This type of analysis is called Pareto Optimal Frontier analysis.

The ELDM for London in the period of 2015 to 2019 was assessed to evaluate the cost differences between the alternative programmes of demand management.



The results showed that there is a relatively flat cost distribution for demand management programmes between 50 and 100 Ml/d in London in AMP6. The difference between the costs for a programme of 75 Ml/d and 100 Ml/d is of the order of 1% and therefore the maximum percentage variation was within the boundaries of the uncertainty in the costs.

Once risk around the demand management measures is considered the ELDM increases to 100 Ml/d in the least cost programme.

8.3.2 Step 1: Economic appraisal to identify the least cost programme

Table 8-3: London Step 1 - Programme 1: Least cost

Programme 1 - Least cost			
The least cost (including monetised environmental and social costs) programme selected by the EBSD model for the London WRZ.			
Model outputs			
Scheme Name		**Benefit (Ml/d)**	**Implementation date**
DM leakage, metering and water efficiency - (LON-100-35-20-0-0)[22]		212.1	2015-30
BT ESW Chingford reduction		17	2015-35
BT RWE Didcot		17	2015-20
GW ELRED		1	2015
GW Tottenham		1.4	2015
AR Kidbrooke		5	2019
AR SLARS - Streatham		5	2019
GW Southfleet/Greenhithe		9	2021
AR Hornsey		2	2026
GW Addington		1.5	2026
GW Honor Oak		1.5	2026
IPR Abbey Mills (Non-RO)		150	2027
RWT Oxford Canal		17	2038
AR SLARS - Merton		6	2039
ASR Darent Valley (Horton Kirby)		5	2039
Scoring Criteria		**Score**	**Comments**
Financial (£m)			
Total NPV	967	**3**	
E&S and Carbon NPV	33	**2**	
Customer			
Bill impact in AMP6		**2**	
Customer Preferences		**2**	
Sustainability			
PCC level by 2040 (l/h/d)	141	**2**	
SEA		**2**	(See Step 2)

[22] The notation 100-35-20 refers to the level of demand management targeted in AMP periods 6, 7 and 8, respectively, set as inputs to the IDM model. Optant meter forecasting, implementation of innovative tariffs and water use behavioural change then subsequently adjust the benefit delivered.

Programme 1 - Least cost			
Delivery			
Deliverability		**2**	Default as scoring is relative to this run
Flexibility		**2**	Default as scoring is relative to this run
Resilience			
Sensitivity		**2**	Default as scoring is relative to this run
Regional perspective		**2**	Default as scoring is relative to this run
Total score	**21**		

The least cost programme features 212.1 Ml/d of demand management over three AMP periods. This is a significant increase compared to the least cost run in the draft Plan. The increase is driven by the changes to the supply demand balance and a review of the individual demand management interventions as explained in Section 7.

It has been assumed in all programmes that innovative tariffs will be introduced from 2022/23 and that there will be additional behaviour change over the planning horizon to reduce PCC, assuming that efficiency messages by other stakeholders will be more effective when carried out in tandem with our demand management programme.

Two temporary bulk transfers are also chosen from 2015. They are a reduction of our bulk supply to Essex and Suffolk Water and an agreement with RWE to reduce their abstraction from the River Thames at Didcot Power Station, following the closure of part of the site.

A large number of artificial recharge and groundwater schemes are selected, 9 in total. This is to be expected given their good cost benefit and delivery is spread across the planning period. There is a risk in that by selecting so many smaller schemes, flexibility of the programme to minor increases in the supply demand deficit could be reduced.

A large re-use scheme (150 Ml/d) is to be implemented in 2027 utilising Membrane Bioreactor technology (MBR). Therefore there are the following considerations:

- Planned indirect wastewater re-use using MBR at this scale is not a tried and tested technology in the UK.
- The process may not be acceptable to the public.
- The environmental impact of a scheme at this scale require further assessment.

A raw water transfer via the Oxford Canal and innovative groundwater schemes are chosen at the end of period to ensure the balance of supply and demand is maintained.

Overall the programme is considered to be a good starting point. We consider the environmental impacts of the programme in **Step 2**. The selection of a significant amount of demand management needs to be tested further in the programme appraisal (**Step 3a**), as does the selection of re-use using MBR as the strategic resource development scheme in the long-

term (**Step 3b**). The programmes are then assessed to improve practicality/deliverability (**Step 3c**). Lastly, the programmes are compared and considered in **Step 4**.

8.3.3 Step 2: Consideration of environmental impacts through the Strategic Environmental Assessment (SEA)

The least cost plan scores 2 against the SEA performance criterion. This is by default as the criterion measures relative performance against the least cost plan.

Over the 25 year planning period the least cost plan includes 7 resource schemes with potential environmental and Water Framework Directive issues as presented in Table 8-4.[23] If the resource schemes were to be promoted further studies would be required to assess and mitigate the impacts.

Table 8-4: London Step 2: Consideration of environmental impacts through the Strategic Environmental Assessment (SEA)

Scheme Name	SEA commentary
Demand Management (LON 100-35-20)	Demand management schemes are generally sustainable with only short term adverse effects.
GW ELRED	Uncertainty around whether the scheme introduces an impediment to the aquifer reaching Good Quantitative Status
GW Southfleet/ Greenhithe	Potential hydrogeological and hydrological effects due to the abstraction in relation to groundwater quantity and potential for saline intrusion, with potential effects on WFD waterbody status. The area is of paleolithic and paleoanthropologic interest therefore major potential effects on cultural heritage have been assessed due to both construction and operation of the scheme.
GW Addington	Potential hydrogeological and hydrological effects due to the abstraction, with potential effects on WFD waterbody status.
GW Honor Oak	Potential hydrogeological and hydrological effects due to the abstraction in relation to groundwater quantity and potential for saline intrusion, with potential effects on WFD waterbody status. Honor Oak Pumping Station is Grade II listed. Effects of abstraction on its setting should be considered and discounted as appropriate.

[23] Appendix B presents the environmental assessment of all the feasible options

Scheme Name	SEA commentary
Abbey Mills Re-use (NRO) 150	The proposed pipeline route passes through Epping Forest SAC which is sensitive to air quality effects. As a result likely significant effects have been assessed through HRA Screening. The pipeline route also passes near to Linders Field LNR. Scheme operation would discharge waste to the River Roding with potential adverse effects, although WFD status unlikely to be affected as potentially sensitive photosynthetic elements are already assessed as Poor. The proposed pipeline route passes through Wanstead Park (Registered park and Garden). Reuse enables climate change resilience as source not vulnerable to climate change effects. Significant effects in relation to emissions and air quality have been monetised.
Oxford Canal Transfer (Lon)	There is some uncertainty around effects on WFD status of waterbodies associated with the River Cherwell due to transfer of canal water. Effects could be beneficial or adverse.
ASR - Horton Kirby	Potential effects on flows in the River Darent with associated effects on WFD status. Hydrological and hydrogeological effects are subject to ongoing investigations and monitoring. Potential effects on buried archaeology may be associated with change in groundwater levels as a result of operation and disturbance arising from construction of the scheme.

8.3.4 Step 3a: Consideration of wider objectives: Customer preferences

This step involves the refinement of the least cost programme to produce a series of alternative programmes to take into consideration the impact of customer preferences. Customer research has indicated that customers have a strong preference for demand management, prioritising leakage and then metering and water efficiency.

In the draft Plan we used this research to justify the inclusion of further demand management in the preferred programme (a total of 125 Ml/d), beyond that identified in the least cost analysis (75 Ml/d). The least cost plan discussed above contains 212.1 Ml/d water savings as a result of demand management (100-35-20), which is already a significant increase on the draft Plan. In Table 8-5 we show the impact on total NPV of alternative amounts of demand management in AMP6. We also show the increase in cost that would occur if the introduction of tariffs was unsuccessful in reducing demand.

Table 8-5: London Step 3a - Cost of alternative DM programmes

Programme	Cost (£mNPV)	Variance (£mNPV)
Least Cost 100-35-20	***967***	
Remove innovative tariffs	**1,146**	**+179**
Alternative DM LON – 90-0-0	**1,062**	**+95**
Alternative DM LON – 95-25-0	**1,070**	**+103**
Alternative DM LON – 105-25-0	**1,072**	**+105**
Alternative DM LON – 125-0-0	**1,063**	**+96**

In the cases where demand savings in AMP6 are reduced the deficit is made up by further groundwater schemes and wastewater re-use. Where demand savings in AMP6 are increased, resource development is deferred and reduced in size. All programmes result in an increase in cost of ~£100m NPV.

Alternative DM programmes <90 Ml/d do not produce valid solutions as they are unable to solve the supply demand deficit in the early years of AMP6.

We conclude from this that it is worthwhile to keep tariffs in the programme and also that 100 Ml/d of demand management in AMP6 appears to be the economic level. It is likely that demand management beyond AMP6 is also economic. The least cost profile of 100-35-20 has the largest total demand reduction offered to the model and is preferred as it provides the biggest reduction in leakage, PCC and enables the completion of the progressive metering programme in London.

8.3.5 Step 3b: Consideration of wider objectives - Risk and Resilience

Having examined the demand management content of the least cost plan, we now consider the chosen resource options. There are important factors such as public acceptance of strategy and approach, and ensuring compliance with the UK Drinking Water Quality Regulations.

In the following we test the impact on the plan if alternative large resource scheme(s) are chosen, as follows:

- Programme 2 – Exclude MBR-based re-use
- Programme 3 – Exclude all re-use options
- Programme 4 – Reservoirs only
- Programme 5 – Severn-Thames transfers only

The least cost plan selects 238 Ml/d of resource development 150 Ml/d of which is wastewater re-use (using MBR). It chooses MBR as the treatment technology (rather than reverse osmosis (RO)) on cost grounds. This is be expected, however we have not completed our evaluation of lower forms of treatment than RO (Appendix L). Taking this into account and the recommendations of the Independent Expert Reuse Panel[24] it is important to understand how the least cost programme would change in the event that MBR-based re-use was not acceptable from a drinking water quality compliance perspective. It should be remembered that

[24] Thames Water Technology Choice for Planned Indirect Potable Reuse for London. Final Report of the Independent Expert Review Panel 15 March 2013

these assets would be designed for a twenty five year asset life and would need to ensure compliance given the changes that may occur in the wastewater catchment over that period.

In Programme 2, MBR-based re-use options were excluded from the feasible options list and the model re-run. The composition of this programme is shown below

Table 8-6: London Step 3b - Programme 2: Excluding MBR-based re-use

Programme 2 – Excluding MBR-based re-use			
Model re-run excluding MBR-based re-use options			
Model outputs			
Scheme Name		**Benefit (Ml/d)**	**Implementation date**
LON-100-35-20		212.1	2015-30
BT ESW Chingford reduction		17	2015-35
BT RWE Didcot		17	2015-20
GW Tottenham BH		1.4	2015
GW ELRED		1	2015
AR Kidbrooke		5	2019
AR SLARS - Streatham		5	2019
GW Southfleet/Greenhithe		9	2021
AR SLARS – Merton		6	2026
GW Addington		1.5	2026
IPR Deephams STW 60 Ml/d RO		60	2027
RWT Oxford Canal Transfer [London]		17	2032
IPR Beckton STW 100 Ml/d RO		100	2033
ASR Darent Valley (Horton Kirby)		5	2039
Scoring Criteria		**Score**	**Comments**
Financial (£m)			
Total NPV	1,084	**2**	(+11% increase NPV)
E&S and Carbon NPV	77	**1**	(+130% increase NPV)
Customer			
Bill impact in AMP6		**2**	
Customer preferences		**2**	
Sustainability			
PCC level	141	**2**	Demand management programme is unchanged
SEA	Same	**2**	Re-use at Beckton is an improvement over Abbey Mills,but selection of Deephams Re-use as well introduces further potential impacts.
Delivery			
Deliverability	Same	**2**	RO-based re-use is likely to be more deliverable, but there is a need to build 2 plants rather than 1.
Flexibility	Same	**2**	Similar schemes to the least plan other than re-use
Resilience			
Sensitivity	Same	**2**	Similar schemes to the least plan other than re-use
Regional perspective	Same	**2**	Similar schemes to the least plan other than re-use
Total score		**19**	

Excluding MBR-based re-use has the impact of the model selecting RO-based re-use. It still selects re-use over alternative large resource schemes. The impact is an 11% increase in Total NPV (£117m NPV).

Two re-use plants are selected, a 60 Ml/d plant in 2027 and a 100 Ml/d plant in 2033. This is understandable as the increased costs of the RO technology means there is increased overall benefit in deferring construction. This would bring with it practicality/deliverability issues.

The selection of RO also has a detrimental impact on the environmental and social costs related to the impact of increased power consumption.

Wastewater re-use is an emotive issue. We only need to draw on international experience within water stressed areas, where re-use plants planned and promoted are then not implemented due to the strength of public opposition. Nevertheless our own customer feedback in this area has indicated that customers are not opposed to re-use however we recognise that we need to test this further, particularly given the scale of the schemes selected (Appendix T).

Programme 3 assesses what the least cost plan would comprise if wastewater re-use was not publicly acceptable, irrespective of the technology used.

Table 8-7: London Step 3b - Programme 3: All re-use options excluded

Programme 3 – All re-use excluded		
Model re-run have excluded all re-use options		
Model outputs		
Scheme Name	**Benefit (Ml/d)**	**Implementation date**
LON-100-35-20	212.1	2015-30
BT ESW Chingford reduction	17	2015-35
BT RWE Didcot	17	2015-20
GW Tottenham BH	1.4	2015
GW ELRED	1	2015
AR Kidbrooke	5	2019
AR SLARS - Streatham	5	2019
AR SLARS - Merton	6	2021
GW Southfleet/Greenhithe	9	2021
DSL Estuary South 150 Ml/d	150	2027
DSL Long Reach (brackish GW)	15	2038
AR Hornsey	2	2039
ASR Darent Valley (Horton Kirby)	5	2039
GW Addington	1.5	2039
GW Honor Oak	1.5	2039

Programme 3 – All re-use excluded			
Scoring Criteria		**Score**	**Comment**
Financial (£m)			
Total NPV	1,318	**1**	(+36% increase NPV)
E&S and Carbon NPV	117	**1**	(+250% increase NPV)
Customer			
Bill impact in AMP6		**2**	
Customer preferences		**2**	
Sustainability			
PCC level by 2040 (l/h/d)	141	**2**	Demand management programme is unchanged
SEA	Worse	**1**	Both desalination schemes would both result in permanent BAP habitat loss and may also have significant cultural heritage effects
Delivery			
Deliverability	Same	**2**	Similar schemes to the least plan other than desalination for re-use
Flexibility	Same	**2**	Similar schemes to the least plan other than desalination for re-use
Resilience			
Sensitivity	Same	**2**	Similar schemes to the least plan other than desalination for re-use
Regional perspective	Same	**2**	Similar schemes to the least plan other than desalination for re-use
Total score		**17**	

Excluding all re-use options on the basis of public acceptability and potential water quality and environmental considerations results in the model selecting 2 desalination options as replacements.

On a cost basis, desalination would be chosen over other large resource options such as transfers and reservoir development. However, selection of desalination results in a significant increase in the environmental, social and carbon cost of the programme and the locations of both plants on the Thames Estuary has identified wider environmental concerns.

To examine this further, in the next two programmes we have constrained the options in the feasible list so that only Thames catchment reservoirs (Programme 4) and Severn-Thames transfers (Programme 5) are available for selection.

Table 8-8: London Step 3b - Programme 4: Reservoirs only

Programme 4 – Reservoirs only			
Model re-run having excluding all strategic schemes other than reservoirs within the Thames catchment			
Model outputs			
Scheme Name		**Benefit (Ml/d)**	**Implementation date**
LON-100-35-20		212.1	2015-30
BT ESW Chingford reduction		17	2015-35
BT RWE Didcot		17	2015-20
GW Tottenham BH		1.4	2015
GW ELRED		1	2015
AR Kidbrooke		5	2019
GW Addington		1.5	2019
AR SLARS - Streatham		5	2021
GW Southfleet/Greenhithe		9	2021
AR SLARS - Merton		6	2026
GW Honor Oak		1.5	2026
AR SLARS - Kidbrooke Ext		8	2027
ASR Darent Valley (Horton Kirby)		5	2027
RES RR Longworth 50		101	2028
RES RR Abingdon 30		63	2036
Scoring Criterion		**Score**	**Comment**
Financial (£m)			
Total NPV	1,588	**1**	(+64% increase NPV)
E&S and Carbon NPV	-35	**3**	
Customer			
Bill impact in AMP6		**2**	
Customer preferences		**2**	
Sustainability			
PCC level by 2040 (l/h/d)	141	**2**	Demand management programme is unchanged
SEA	Worse	**1**	Two reservoir schemes are selected. There is the potential for significant impacts due to the scale of the schemes and level of disturbance they would cause

Programme 4 – Reservoirs only			
Delivery			
Deliverability	Worse	**1**	The delivery of two reservoir schemes would be a significant challenge
Flexibility	Worse	**1**	Once construction is underway, the scope for flexibility in the reservoir options is limited
Resilience			
Sensitivity	Same	**2**	Similar to the least cost plan
Regional perspective	Same	**2**	Similar to the least cost plan. A single larger reservoir option may be a better regional solution.
Total score	**17**		

Constraining the options list so that only reservoirs can be picked as large resource schemes causes the selection of two options, a 50 Mm^3 reservoir at Longworth and a 30 Mm^3 reservoir at Abingdon.

Developing two reservoirs would be a major undertaking and would be unlikely to go ahead on practicality grounds. A single larger reservoir would be promoted if necessary. The selection of reservoirs increases the overall programme cost significantly, but does provide a lower long-term environmental, social and carbon cost. In general reservoirs could also offer greater qualitative benefits.

Table 8-9: London Step 3b - Programme 5: Severn-Thames transfers only

Programme 5 – Severn-Thames transfers only		
Model re-run have excluding strategic schemes other than Severn-Thames transfers		
Model outputs		
Scheme Name	**Benefit (Ml/d)**	**Implementation date**
LON-100-35-20	212.1	2015-30
BT ESW Chingford reduction	17	2015-35
BT RWE Didcot	17	2015-20
GW Tottenham BH	1.4	2015
GW ELRED	1	2015
AR Kidbrooke	5	2019
AR SLARS - Streatham	5	2019
AR SLARS - Merton	6	2021
GW Addington	1.5	2021
GW Honor Oak	1.5	2026
GW Southfleet/Greenhithe	9	2026
RWT LMDP 50Mm3	207	2027

Programme 5 – Severn-Thames transfers only			
Scoring Criteria		**Score**	**Comment**
Financial (£m)			
Total NPV	1,512	**1**	(+56% increase NPV)
E&S and Carbon NPV	-15	**3**	(-145% decrease NPV)
Customer			
Bill impact in AMP6		**2**	
Customer preferences		**2**	
Sustainability			
PCC level by 2040 (l/h/d)	141	**2**	Demand management programme is unchanged
SEA	Worse	**1**	The Longdon Marsh based supported transfer scheme has some very significant impacts due to the scale of the scheme and level of disturbance.
Delivery			
Deliverability	Worse	**1**	A supported transfer scheme would have significant delivery challenges compared to the least cost plan
Flexibility	Same	**1**	Once construction is underway there would be little scope to alter the Longdon Marsh scheme
Resilience			
Sensitivity	Same	**2**	Similar to the least cost plan. Although the large surplus from 2027 would reduce sensitivity, the potential issues around the transfer scheme itself could increase the sensitivity in the short-medium term.
Regional perspective	Better	**3**	New connectivity between the Severn and Thames
Total score	**18**		

Constraining Severn-Thames transfers into the programme results in a significant uplift in total NPV, but the removal of re-use options improves the environmental and social performance of the programme although there are issues identified in the SEA due to the scale of the scheme and level of disturbance.

Severn-Thames transfer scheme costs are currently based upon the premise that our treatment plants that will receive this water would not require modifications to comply with the UK Water Quality Regulations. In our studies to date on the Severn-Thames Transfers (Section 2), we have highlighted water quality and environmental risks that may require significant mitigation

such as treatment or conditioning of the water before and during transfer, and/or modifications to our receiving water treatment works to ensure compliance.

The DWI has issued guidance to companies on their WRMPs, specifically relating to transfers, both for transfers of water within a company's supply area, and for exports and imports across company boundaries. They have stated two general principles to take account of, as follows:

a) that the company should not expose consumers to a greater risk of exposure to unwholesome water; and

b) that the company must not plan to fail.

There are a number of contaminants in the River Severn which are, at times, present in much higher concentrations than in the River Thames, the pesticide metaldehyde being one example. Adequate treatment at our London water treatment works for metaldehyde, to ensure we would not fail to comply has been assessed as costing in the region of £6 billion.

Summary:

Examination of the large resource schemes leads us to conclude that at the present time the plan should feature wastewater re-use using reverse osmosis.

As such we now take this run forward and examine it in more detail to ensure it is practical and deliverable and takes account of any further requirements for exports to our neighbours.

8.3.6 Step 3c: Consideration of wider objectives - Practicality/deliverability

Using Programme 2 as a base we identified the following changes that could be made to improve practicality/deliverability:

- The replacement of groundwater schemes in AMP6.

  We have concerns that delivering two artificial recharge schemes by 2019 would be challenging. Our preference is to defer these schemes until 2021 and instead accelerate groundwater enhancement at Honor Oak and aquifer storage and recovery in the Darent Valley, which we have been studying in AMP5.

- Developing a single re-use plant.

  We have concerns that delivering two re-use plants at Deephams and Beckton would be impractical. To test the cost impact we have forced a 150 Ml/d plant at Beckton into the plan in 2027. It should be noted that the re-use option taken forward in the programme is at Beckton however this does not preclude reuse at other locations such as Mogden where further investigations are required to understand potential environmental impacts to determine if this is also feasible. These investigations will be completed in AMP6.

Table 8-10: London Step 3c - Programme 6: Practicality and deliverability improvements

Programme 6 – Practicality and deliverability improvements			
Model re-run to improve the practicality and deliverability of Programme 2			
Model outputs			
Scheme Name		**Benefit (Ml/d)**	**Implementation date**
LON-100-35-20		212.1	2015-30
BT ESW Chingford reduction		17	2015-35
BT RWE Didcot		17	2015-20
GW Tottenham BH		1.4	2015
GW ELRED		1	2015
ASR Darent Valley (Horton Kirby)		5	2019
GW Honor Oak		1.5	2019
AR Kidbrooke		5	2021
AR SLARS - Merton DOav 6Mld		6	2021
GW Southfleet/Greenhithe		9	2026
IPR Beckton STW 150 Ml/d RO		150	2027
RWT Oxford Canal Transfer [London]		17	2038
AR Hornsey		2	2039
GW Addington		1.5	2039
Scoring Criteria		**Score**	**Comment**
Financial (£m)			
Total NPV	1,067	**2**	(+10% increase NPV)
E&S and Carbon NPV	67	**1**	(+100% increase NPV)
Customer			
Bill impact		**2**	
Customer preferences		**2**	
Sustainability			
PCC level by 2040 (l/h/d)	141	**2**	Demand management programme is unchanged
SEA	Better	**3**	Developing re-use at one site is preferable to multiple sites and Beckton causes fewer potential impacts than Abbey Mills
Delivery			
Deliverability	Better	**3**	We have produced this programme to improve deliverability.
Flexibility	Same	**2**	Similar to the least cost plan

Programme 6 – Practicality and deliverability improvements			
Resilience			
Sensitivity	Same	**2**	Similar to the least cost plan
Regional perspective	Same	**2**	Similar to the least cost plan
Total score	**21**		

Making these two changes has negligible impact on the total cost of the programme, indeed the cost is slightly reduced. Normally you would expect introducing extra constraints to a model to increase the overall programme cost. The reasons for this are explained below.

In any optimisation problem, close to the optimal solution there are several near-optimal solutions.

Identifying a definitive least cost is very time consuming and computationally challenging. Therefore a tolerance is set so that the model is able to identify the minimum cost solution within a percentage (1%) of the global optimum. Consequently, our model stops optimising when it starts achieving insignificant reductions in the overall solution cost.

The final test would be to see the impact of allowing further inter-company exports to take place as part of the WRSE regional water strategy, however none of the WRSE companies have identified a need for a water supply from London WRZ.[25] Programme 6 therefore is preferred given its improved practicality and deliverability.

[25] Since publication of Thames Water's Water Resources Management Plan 2014 – 2040 Statement of Response October 2013 Sutton and East Surrey Water has advised that it no longer requires a bulk supply from London WRZ of up to 5 Ml/d commencing in 2036. The final WRMP14 has therefore subsequently been amended to reflect this change.

8.3.7 Step 4: Comparing alternative programmes

The performance criteria for each programme are summarised in Table 8-11 and Figure 8-2.

Table 8-11: London Step 4 - Programme appraisal score summary

SCORES	Quantitative Measures						Qualitative Measures				Total
Programme	Financial (£m)		Customer		Sustainability		Deliverability		Resilience		
	Total NPV	E&S and Carbon NPV	Bill Impact for AMP6	Alignment with customer preferences	PCC levels	SEA	Delivery	Flexibility	Sensitivity	Regional perspective	
1. Least cost	3	2	2	2	2	2	2	2	2	2	21
2. No MBR	2	1	2	2	2	2	2	2	2	2	19
3. No re-use	1	1	2	2	2	1	2	2	2	2	17
4. Reservoirs Only	1	3	2	2	2	1	1	1	2	2	17
5. Severn-Thames transfers only	1	3	2	2	2	1	1	1	2	3	18
6. Practicality and deliverability improvements	2	1	2	2	2	3	3	2	2	2	21

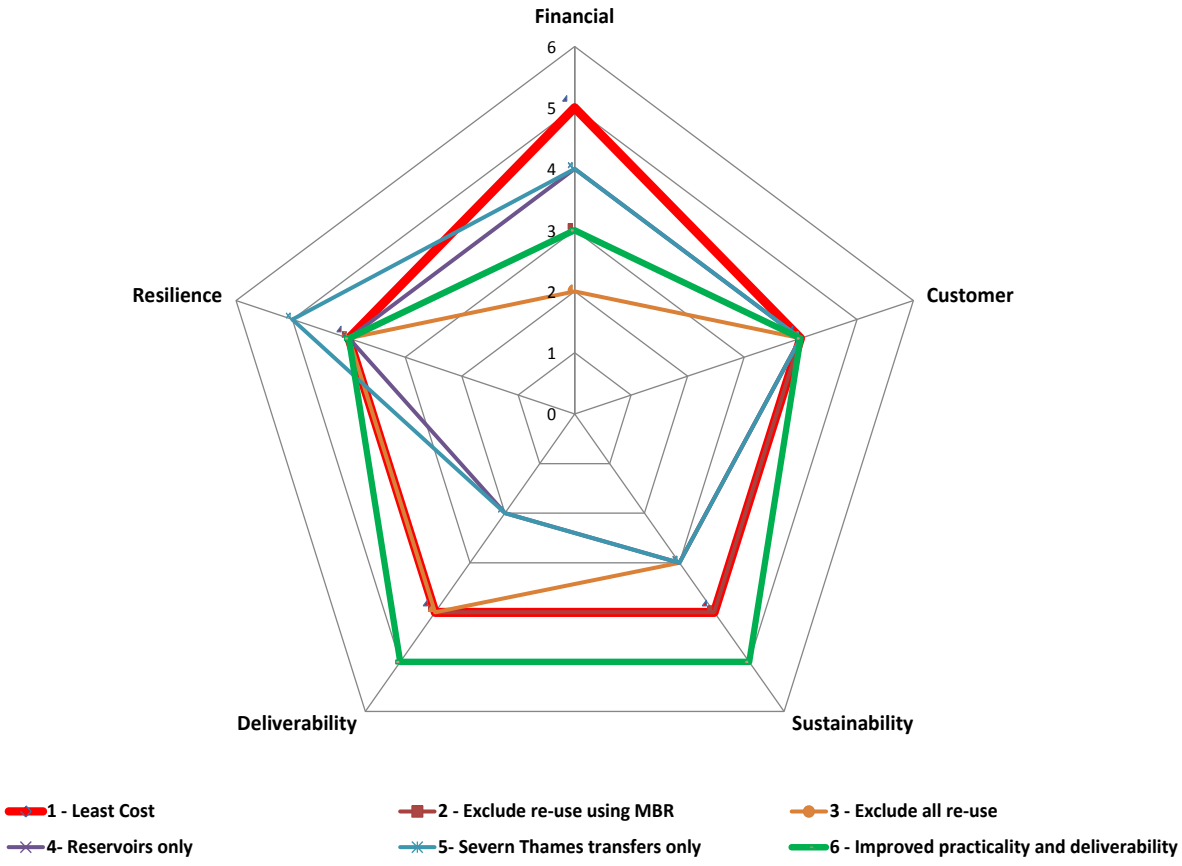


Figure 8-2: Programme appraisal scoring plot - London

Summary:

The results from the programme appraisal process:

- Focus on demand management, early in the planning period was a consistent theme.
- Temporary bulk supplies are a consistent feature.
- The introduction of innovative tariffs reduces the cost of the plan, however there is a risk that they may not be accepted by customers.
- Several small groundwater development options are selected throughout the planning period.
- Re-use options always feature in plans set to minimise cost.
- Re-use using a more advanced treatment process (reverse osmosis) is preferred based on current knowledge.

- Transfer and storage-based programmes are higher cost but can deliver additional qualitative benefits.

On balance, the results indicate that Programme 6 represents the best value plan. It is more flexible, makes a better contribution to sustainable development, and is aligned to customer research, stakeholder feedback and government objectives. The Plan does not have an undue impact on customer bills.

Whist the preferred programme includes wastewater re-use as the preferred long term option on the basis of current knowledge, a large number of uncertainties remain including cost, technology choice, performance and resilience in the face of drought. Furthermore we expect further sustainability reductions in our supply area and the wider South East to meet the requirements of the WFD which will drive the need for additional resources in the long term. Over the next 5 years we need to undertake detailed studies to examine the long term resource options to ensure the best solution is selected. These studies will cover wastewater re-use, reservoir storage, transfers and potential third party options.

8.4 Programme appraisal – Thames Valley

In this section we present the programme appraisal process to develop the preferred programme for resource zones in the Thames Valley.

The same principles were followed to develop the preferred programme for the Thames Valley zones, as used for London, firstly identifying the least cost solution followed by consideration of wider objectives to define the preferred programme.

Whilst the supply demand problems identified in Thames Valley are not as challenging as London, as set out in Section 6, three zones have deficits that require resolution. The SWOX WRZ has both a annual average and critical period deficit. SWA and Guildford WRZs have a critical period deficit only. The deficit is driven largely by a combination of population growth and the impact of climate change as well as sustainability reductions in the 2015-2020 period which reduced overall supply capability.

The initial approach was to conduct a programme appraisal for the zones in deficit only. However in the course of the appraisal it was clear that there were several regional considerations that had implications for all WRZs in Thames Valley and also for London. The approach to the implementation of progressive metering policy is an example of this.

In addition, unlike in London, in the Thames Valley there are options that potentially could reduce our operational costs based upon weighted average water utilisation over the planning period. These 'spend to save' schemes may occur in zones that are not in deficit.

Therefore the programme appraisal is presented for the Thames Valley as a whole, with summaries also provided at WRZ level.

The demand management profiles developed for the Thames Valley zones are in order to achieve 'full' metering. In other words, the metering of all connections to our distribution mains and as many individual households as it is economic to deliver.

Additionally, it has been assumed that innovative tariffs will be introduced from 2022/23 in all programmes and that there will be additional behaviour change over the planning horizon to reduce PCC, assuming that efficiency messages by other stakeholders will be more effective when carried out in tandem with our demand management programme.

8.4.1 Step 1: Economic appraisal to identify the least cost programme

The least cost programme seeks to solve the deficits in SWOX, SWA and Guildford for the lowest long-term cost. It also examines whether there are any 'spend to save' options that could be delivered that would reduce overall operational costs, and hence long-term costs, in all zones.

At this initial stage, no additional exports are considered to neighbouring companies.

Table 8-12: Thames Valley Step 1 - The least cost programme (no additional exports)

Step 1: Programme 1 - Least cost programme (no further exports)			
The least cost programme (including monetised environmental and social costs) selected by the EBSD model for the Thames Valley WRZs. No additional exports. The schemes selected and their benefit and timing for implementation are displayed. A summary of the performance of the programme against the scoring criteria is detailed with commentary.			
Model outputs			
Scheme Name	**WRZ**	**Benefit (Ml/d)**	**Implementation date**
Demand Management (SWOX-02-14-08)[26]	SWOX	29	2020-2030
GW Bibury source enhancement	SWOX	3.2	2039
NTC Datchet	SWA	5.2	2015
GW Medmenham	SWA	10 (av.only)	2017
NTC East Woodhay	Kennet	4	2015
Demand Management (GUI-00-03-00)	Guildford	6	2020-2030
	Henley	0	No schemes selected
Scoring Criteria		**Score**	**Comments**
Financial (£m)			
Total NPV	46	**3**	
E&S and Carbon NPV	0.6	**2**	
Customer			
Bill impact for AMP6		**2**	
Alignment to customer preferences		**1**	
Sustainability			
PCC level by 2040 (l/h/d)		**1**	
SEA		**2**	(see Step 2)
Delivery			
Deliverability		**2**	Default as scoring is relative to this run
Flexibility		**2**	Default as scoring is relative to this run
Resilience			
Sensitivity		**2**	Default as scoring is relative to this run
Regional perspective		**2**	Default as scoring is relative to this run
Total score		**19**	

[26] The notation 02-14-08 refers to the level of demand management targeted in AMP periods 6, 7 and 8, respectively, set as inputs to the IDM model. Optant meter forecasting, implementation of innovative tariffs and water use behavioural change then subsequently adjust the benefit delivered

The least cost programme is more expensive than the draft Plan because the deficits are larger, occur earlier and are in more water resource zones (e.g. additionally in Guildford and SWA WRZs).

In SWOX and Guildford the deficit is primarily solved with demand management, although a small groundwater source enhancement scheme (Bibury) is required in SWOX in 2039. In SWA the deficit is solved by resource development and constraint release. The SWA options are chosen in AMP6, which is earlier than the zone is forecast to go into deficit; this is because the schemes are considered to be 'spend to save' and thus are delivered as soon as possible. A constraint release option is also chosen in Kennet Valley in AMP6 on the basis of spend to save. No scheme is chosen for Henley.

Overall, the programme is the cheapest but it is not aligned with customer preferences, our strategic objectives or the government's wider policy objectives.

Two neighbouring companies have expressed a need for new or larger exports in the longer term. These are:

- South East Water – new treated water transfer from SWA

  South East Water has identified a need for a 10 Ml/d supply from SWA WRZ to meet peak demands. The requirement commences in 2030 at 6.9 Ml/d, increasing to 10 Ml/d in 2034 and then remaining at that level throughout the remainder of the planning period.

- Affinity Water – additional treated water transfer from Guildford

  Affinity Water has identified a need for a 2.7 Ml/d supply from Guildford WRZ to meet average and peak demands. The requirement commences in 2036 at 2.7 Ml/d and remains at that level throughout the remainder of the planning period.

When these are added and the least cost re-run the impact on the programme is as follows:

Table 8-13: Thames Valley Step 1 - The least cost programme (incl. additional exports)

Step 1: Programme 1a - Least cost programme (including further exports)			
The least cost programme (including monetised environmental and social costs) selected by the EBSD model for the Thames Valley WRZs. Including additional exports.			
Model outputs			
Scheme Name	**WRZ**	**Benefit (Ml/d)**	**Implementation date**
Demand Management (SWOX-02-14-08)	SWOX	29	2015-2030
GW Bibury source enhancement	SWOX	3.2	2039
NTC Datchet	SWA	5.2	2015
GW Medmenham	SWA	10 (av.only)	2017
GW Bourne End	SWA	9	2034
NTC East Woodhay	Kennet	4	2015
Demand Management (GUI-00-03-00)	Guildford	6	2020-2030
ASR Guildford (Abbotswood)	Guildford	4.5	2039
	Henley	0	No schemes selected
Scoring Criteria		**Score**	**Comments**
Financial (£m)			
Total NPV	60	**1**	Increase of 30% from Programme 1
E&S and Carbon NPV	1.8	**3**	Over three times the least cost plan, although still relatively low in real terms.
Customer			
Bill impact for AMP6		**2**	
Alignment to customer preferences		**1**	
Sustainability			
PCC level by 2040 (l/h/d)		**1**	>147 l/h/d
SEA	Worse	**1**	Addition of supply schemes (GW Bourne End and ASR Guildford) introduces some impacts, noting that these are minor and, subject to further investigation, likely to be able to be mitigated.
Delivery			
Deliverability	Same	**2**	Negligible impact given the new schemes are required towards the end of the planning period
Flexibility	Same	**2**	As above

Step 1: Programme 1a - Least cost programme (including further exports)			
Resilience			
Sensitivity	Same	**2**	As above
Regional perspective	Better	**3**	Inclusion of additional exports
Total score		**18**	

An additional groundwater scheme (Bourne End) is chosen in SWA in 2034 to allow for the transfer to South East Water.

Furthermore, an additional ASR scheme is required in 2039 to allow for the enhanced transfer to Affinity Water.

The scoring is impacted as whilst the regional perspective improves, the costs increase and the environmental impact associated with delivering the programme is higher.

The least cost plan for Thames Valley, both including and excluding exports, comprises options in all zones except Henley. They are selected both to address the supply demand deficit and as a potential 'spend to save' over the planning period.

Overall, the least cost programmes are not aligned with customer preferences, our strategic objectives or the government's wider policy objectives.

We consider the environmental impacts of the programme in **Step 2**. We examine alignment with wider objectives in **Step 3**. Lastly, the programmes are compared and assessed in **Step 4**.

8.4.2 Step 2: Consideration of environmental impacts through the Strategic Environmental Assessment (SEA)

The options in Programmes 1 and 1a are assessed to consider the environmental impacts as described in the SEA and summarised below:

Table 8-14: Thames Valley Step 2 - Consideration of environmental impacts through the Strategic Environmental Assessment (SEA)

Step 2: Consideration of environmental impacts through the Strategic Environmental Assessment (SEA)	
Model outputs from Programmes 1 and 1a	
Scheme Name	**SEA commentary**
Demand Management (SWOX-02-14-08)	Demand management schemes are generally sustainable with only short term adverse effects.
GW Bibury	The scheme has no significant environmental issues
NTC Datchet	The scheme has no significant environmental issues
GW Medmenham	The scheme has no significant environmental issues
GW Bourne End *(Programme 1a only)*	Potential for localised flow reductions in the River Wye dependent on the extent of contribution by the river at peak abstraction rates. Potential for effects on unknown buried cultural heritage through groundwater drawdown.
NTC East Woodhay	The scheme has no significant environmental issues
Demand Management (GUI-00-03-00)	Demand management schemes are generally sustainable with only short term adverse effects.
ASR Guildford (Abbotswood) *(Programme 1a only)*	Potential construction effects on sensitive habitats including ancient woodland which could be mitigated through pipeline re-routing. Permanent loss of a small area of a local nature reserve to make way for a new WTW, with associated loss of greenspace. Further investigations prior to implementation may suggest this loss could be avoided or mitigated.

The least cost programme with no additional exports (Programme 1), has no predicted significant adverse environmental impacts. Two additional schemes are selected in the least cost programme including additional exports (Programme 1a). Investigations would likely be required but given the schemes are not forecast for implementation until the end of the planning programme, there would be time to review impacts and any necessary mitigation. Nevertheless, there may still be permanent loss of local nature reserve habitat in the case of ASR Guildford.

8.4.3 Step 3: Consideration of wider objectives

Customers have told us that they prefer demand management solutions over resource development. Government policy also favours this. Our own strategy, as set out in the draft Plan and earlier WRMPs, also prefers a focus on demand management in the short term, so in this step we consider the impact on the appraisal criteria should demand management form either all the solution, or the main part of it, should demand management not be enough to balance supply and demand in every WRZ.

Table 8-15: Thames Valley Step 3 - Programme 2: Demand Management only (no additional exports)

Step 3: Programme 2 – Demand management only (no additional exports)			
Demand management only solution. Profiles put together to achieve 'full' metering in zones that are in deficit. No additional exports of water to neighbouring companies.			
Model outputs			
Scheme Name	**WRZ**	**Benefit (Ml/d)**	**Implementation date**
Demand Management (SWOX-02-14-08)	SWOX	29	2020-2030
Demand Management (SWA-01-08-04)	SWA	17	2020-2030
NTC Datchet	SWA	5.2	2038
	Kennet	0	No schemes selected
Demand Management (GUI-00-03-00)	Guildford	6	2020-2030
	Henley	0	No schemes selected
Scoring Criteria		**Score**	**Comments**
Financial (£m)			
Total NPV	54	**1**	increase of 17% on Programme 1
E&S and Carbon NPV	<0.1	**3**	Effectively decreased to zero
Customer			
Bill impact for AMP6		**2**	
Alignment to customer preferences		**2**	
Sustainability			
PCC level by 2040 (l/h/d)		**2**	141-147 l/h/d
SEA	Better	**3**	Inclusion of only demand management schemes which are generally sustainable with only short term impacts is positive.

Step 3: Programme 2 – Demand management only (no additional exports)			
Delivery			
Deliverability	Same	**2**	No additional issues anticipated
Flexibility	Better	**3**	The removal of resource schemes help flexibility as they can be used as contingency if required
Resilience			
Sensitivity	Same	**2**	As per least cost plan
Regional perspective	Same	**2**	As per least cost plan
Total score		**22**	

The introduction of a demand management programme in SWA WRZ creates a surplus in this zone. In 2038-40 the existing transfer pipeline between SWA and SWOX is used to balance supply and demand between these two zones and this means that the Bibury groundwater source enhancement scheme is no longer required in the SWOX WRZ.

Although this programme has a higher cost and thus a lower financial score than the least cost programme, it has a higher final score. This is because it has a higher score in customer, sustainability and delivery measures. It is better aligned with government policy aspirations to reduce PCC in the planning period.

Table 8-16: Thames Valley Step 3 - Programme 2a: Demand Management only (including additional exports)

Step 3: Programme 2a – Demand management only (including additional exports)			
Demand management only solution. Profiles put together to achieve 'full' metering in each zone. Includes additional exports of water to neighbouring companies.			
Model outputs			
Scheme Name	**WRZ**	**Benefit (Ml/d)**	**Implementation date**
Demand Management (SWOX-02-14-08)	SWOX	29	2020-2030
Demand Management (SWA-01-08-04)	SWA	17	2020-2030
NTC Datchet	SWA	5.2	2038
	Kennet	0	No schemes selected
Demand Management (GUI-00-03-00)	Guildford	6	2020-2030
ASR Guildford (Abbotswood)	Guildford	4.5	2039
	Henley	0	No schemes selected
Scoring Criteria		**Score**	**Comments**
Financial (£m)			
Total NPV	63	**1**	Increase of 38% on Programme 1
E&S and Carbon NPV	0.5	**3**	Decrease of 21% on Programme 1
Customer			
Bill impact for AMP6		**2**	
Alignment to customer preferences		**2**	
Sustainability			
PCC level		**2**	141-147 l/h/d
SEA	Same	**2**	ASR Guildford introduces some impacts, although likely to be able to be mitigated, avoided or compensated hence considered the same.
Delivery			
Deliverability	Same	**2**	No additional issues
Flexibility	Better	**3**	The removal of resource schemes help flexibility as they can be used as contingency if required
Resilience			
Sensitivity	Same	**2**	No change
Regional perspective	Better	**3**	Inclusion of additional exports
Total score		**22**	

When allowance is made for exports to neighbouring companies, as per Programme 1a, an additional ASR scheme is required in 2039 to allow for the enhanced transfer to Affinity Water. However, the inclusion of demand management in SWA has meant no resource development is necessary to enable the transfer to South East Water.

This programme shares a number of the advantages over the least cost plan that Programme 2 does.

Our main concern with Programme 2 and 2a is that it would appear unfair to customers if progressive metering was only implemented throughout London and other selected WRZs and not in all of the Thames Valley WRZs. Considering that the whole of our supply area is classified as being seriously water stressed, combined with the drive to reduce demand from stakeholders, it would be useful to examine the impact of rolling out progressive metering throughout the whole of the Thames Valley. This is shown in Programme 3 below.

Table 8-17: Thames Valley Step 3 – Programme 3: Demand management to achieve 'full' metering in all zones (including additional exports)

Step 3: Programme 3 – Demand management to achieve 'full' metering in all zones (including additional exports)			
Demand management only solution. Profiles put together to achieve 'full' metering in each zone. Includes additional exports of water to neighbouring companies.			
Model outputs			
Scheme Name	**WRZ**	**Benefit (Ml/d)**	**Implementation date**
Demand Management (SWOX-02-14-08)	SWOX	29	2020-2030
Demand Management (SWA-01-08-04)	SWA	17	2020-2030
NTC Datchet	SWA	5.2	2038
Demand Management (KEN-01-06-03)	Kennet	13	2020-2030
Demand Management (GUI-00-03-00)	Guildford	6	2020-2030
ASR Guildford (Abbotswood)	Guildford	4.5	2039
Demand Management (HEN-00-01-00)	Henley	2	2020-2030
Scoring Criteria		**Score**	**Comments**
Financial (£m)			
Total NPV	79	**1**	Increase of 72% on Programme 1
E&S and Carbon NPV	0.5	**3**	Decrease of 21% on Programme 1
Customer			
Bill impact for AMP6		**2**	
Alignment to customer preferences		**3**	Equitable, sustainable and demand management focussed
Sustainability			
PCC level		**3**	128 l/h/d
SEA	Worse	**1**	ASR Guildford introduces some impacts, although likely to be able to be mitigated, avoided or compensated.
Delivery			
Deliverability	Same	**2**	No additional issues anticipated
Flexibility	Better	**3**	The reduction in resource development versus the least cost plan helps flexibility as they can be used as contingency if required
Resilience			
Sensitivity	Same	**2**	As per the least cost plan
Regional perspective	Better	**3**	Inclusion of additional exports
Total score		**23**	

Progressive metering throughout the Thames Valley increases overall programme costs by 72%, compared to the least cost plan. However there is an improvement in non-monetised performance and equitability.

On the basis of alignment with company, stakeholder and customer objectives, as well as being an equitable and consistent approach across our supply area, this programme is preferred.

8.4.4 Step 4: Comparing alternative programmes

The programmes are summarised in Table 8-18 and Figure 8-3 below.

Table 8-18: Thames Valley Step 4 - Programme appraisal score summary

SCORES	Quantitative Measures						Qualitative Measures				Summary
Programme	Financial (£m)		Customer		Sustainability		Deliverability		Resilience		
	Total NPV	E&S and Carbon NPV	Bill Impact for AMP6	Alignment with customer preferences	PCC Level	SEA	Delivery	Flexibility	Sensitivity	Regional perspective	Total
1. Least cost	3	2	2	1	1	2	2	2	2	2	19
1a. Including exports	1	3	2	1	1	1	2	2	2	3	18
2. DM only	1	3	2	2	2	3	2	3	2	2	22
2a. Including exports	1	3	2	2	2	2	2	3	2	3	22
3. DM all zones + exports	1	3	2	3	3	1	2	3	2	3	23

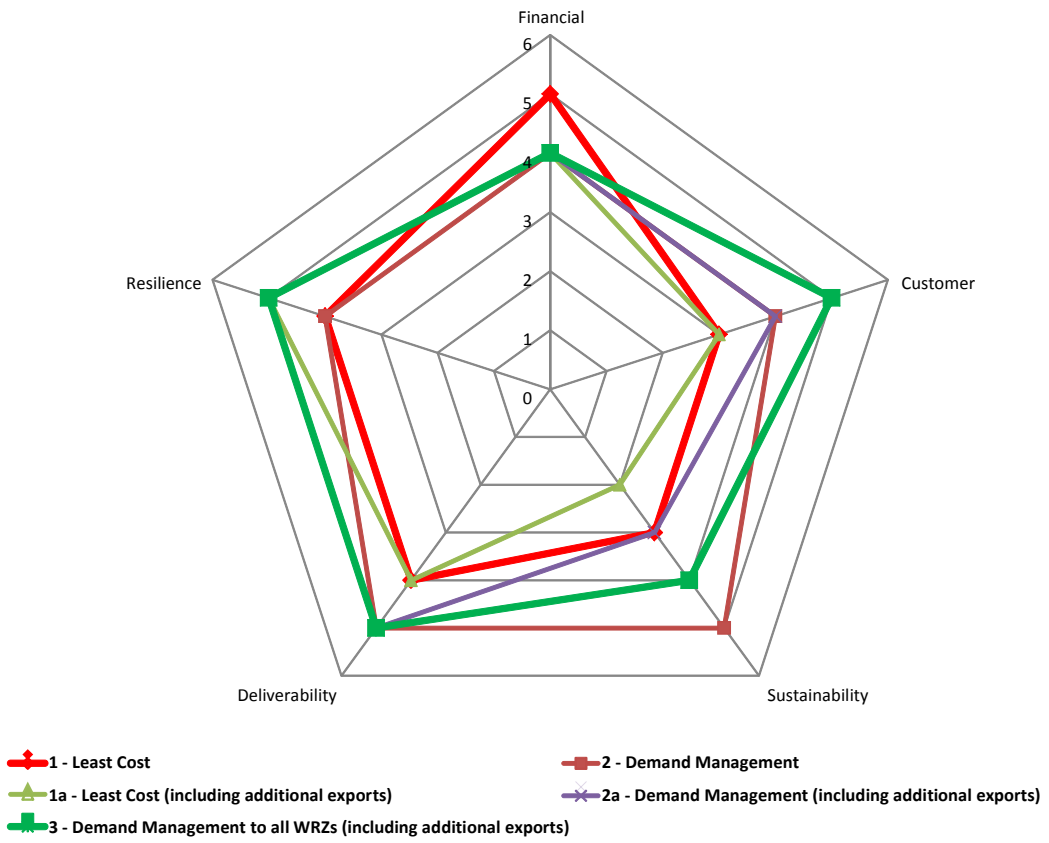


Figure 8-3: Programme appraisal scoring plot - Thames Valley

8.4.5 Summary

The programmes show that there is a trade-off between cost and sustainability. Focussing on achieving demand reduction leads to a higher cost programme which performs better on non-monetised measures.

On balance, to ensure an equitable experience for all our customers, and given the indirect benefits and synergy with the London programme, we consider that a ten-year progressive metering programme commencing in 2020 is the best value programme for Thames Valley.

Equally we are committed to delivering our contribution to the wider water strategy for South East England.

Therefore, we consider that Programme 3 represents the best value plan. It is flexible, makes a better contribution to sustainable development, and is aligned to customer research, stakeholder feedback and government objectives.

The Plan does not have an undue impact on customer bills in AMP6.

8.5 Conclusion

We have followed a structured appraisal process in developing possible future plans. The process is step-wise to illustrate the formulation of the least cost plan and alternative programmes. Performance criteria have been used to compare the programmes and highlight the relative strengths and weaknesses of programmes. The preferred plan represents best value for customers, taking all considerations into account. The process and preferred programme have been shared with our regulators, Customer Challenge Group and other stakeholders. The process has focussed on taking a holistic view of our plan.

London

In London WRZ, the results indicate a preferred plan would focus on a programme of water efficiency, metering (including innovative tariffs), and leakage reduction as well as resource development in the long-term. The focus would be on demand management in the short-term in line with customer preferences and the Government's objective to reduce per capita consumption with contingency options available should the savings not materialise.

However, the results indicate that demand management alone is insufficient to meet the long term supply demand balance. A resource scheme is programmed for delivery between 2025 and 2030 to provide supply resilience.

The plan short-lists a 150Ml/d reverse-osmosis wastewater re-use plant as the potential longer-term solution based on minimising cost. However, given the uncertainties on cost and performance of reuse and the wider environmental sustainability issues in our supply zone and the wider South-East, the results indicate that detailed planning studies should continue through AMP6 for all three long term resource options of reuse, transfers and storage schemes. These studies should be progressed in partnership with other companies, regulators and stakeholders so the final decision meets the strategic needs of South East England.

The preferred plan is not the base least cost plan over the 25 year planning horizon but is considered to be the best value plan.

Thames Valley

In the Thames Valley zones there are effectively no supply-demand deficits forecast in AMP6. The least cost results suggest there are options in SWA and Kennet Valley that could potentially be implemented as 'spend to save' schemes with a long term return but to implement now would have bill implications for AMP6 which might not subsequently be recovered when other long term objectives are taken into account.

Looking at wider objectives suggests a better value plan would be to roll-out metering and water efficiency activities, but not until 2020. This would have the benefit of no investment costs in AMP6 but would give customers throughout our supply area a consistent message on the value of water. We should also meet the regional need for water by allowing additional exports.

The cost of the plan would be higher but the results indicate the non-monetised benefits of the plan are greater and the plan has a better programme appraisal score.

The following section summarises our preferred plan.