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DISCUSSION PAPER FOR WWF's ITCHEN INITIATIVE

IMPROVEMENTS TO CURRENT METHODS FOR WATER SUPPLY-DEMAND PLANNING

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Background

The Itchen Initiative is a WWF project that aims to develop solutions that will enable England and Wales to meet the challenges of water scarcity, to benefit both people and nature. The Initiative is named after the River Itchen, one of the world's most beautiful and iconic rivers, now threatened with over-abstraction of water, a growing population, and climate change. The Initiative is intended to inform, in particular, Defra's 2011 Water White Paper and Ofwat's review of the regulatory arrangements.

WWF commissioned a number of discussion papers to inform the Itchen Initiative process, including this discussion paper, authored by Colin Fenn, which considers potential improvements to water supply-demand planning methodologies.

Contents

1. INTRODUCTION

This paper suggests some specific improvements to the methods used in water supply-demand balance planning in England and Wales. It is believed that their adoption would deliver better estimates of supply and demand quantities, and more reliable statements of the balance between supply and demand. The assessment of the need for any new supply and/or demand schemes designed to address such forecast shortfalls – and the selection of the best option(s) to do so - would be better based, accordingly.

The mere mention of improvements or changes carries an undertone of criticism as to the methods now practised. Not all of such criticism as is made applies to all involved in water planning, though some of it does apply to all, and most of it to some. In any event, the suggested changes are made for the good intention of improving matters in the round.

Some of the proposed changes may have the effect of increasing estimates of supply, and carry the prospect of potential cost saving (against the cost of new schemes that might otherwise be judged to be needed). Some of them bring demand-side measures onto a more level playing field with supply-side measures, in the appraisal of options for meeting a forecast shortfall (by better reflecting the value of water taken from the environment, and by quantifying the volume and cost of water delivered by new supply schemes and new demand schemes consistently, at the customer tap, net of production and distribution losses and costs). Because all of the proposed changes could be made without undue difficulties, and at no great cost, they are considered to be 'quick wins'.

Seven specific improvements are suggested. They cover:

1. the estimation of Deployable Output (DO), which forms the basis of water supply planning in England and Wales, and which is now made inconsistently between water companies, and arguably, on too conservative a basis by some companies;

2. re-stating the gains and the costs of new supply-side options, which are now made at the point of abstraction[1] or the point of production (at the treatment works)[2], to account for losses in and the costs of treatment and distribution, to bring cost-benefit estimates of supply-side and demand-side options onto a level playing field (in that regard, at least);

3. the use of a shadow cost of water taken from the environment, to better reflect the environmental externalities of abstraction and the cost of taking water from the environment, which is probably under-stated by the methods used in options appraisal;

4. the determination of supply, demand and supply-demand balance values in individual resource zones (RZs) on a time-consistent basis for a range of potentially critical periods, to ensure that the period of greatest criticality for the supply-demand balance has been properly determined (cf. the assumption that the period of peak demand generates the lowest supply-demand balance); and analysis, levelling and aggregation of critical period supply, demand and supply-demand balance values across the various RZs in a company

[1] At the point of abstraction from the environment, prior to production (treatment) and distribution to customers, which add costs and reduce volume (in treatment and distribution use and losses).
[2] At the point of production, prior to distribution, which adds costs and reduces volume (in distribution losses).

area on a time-consistent basis, as opposed to on the basis that the critical periods of all zones coincide (which can lead to false inflation of shortfalls and needs, and sub-optimal solutions to the real planning problem);

5. the use of both capacity-based and output-based average incremental social costs (AISCs) when appraising and ranking options for addressing a forecast supply-demand balance shortfall, prior to least Net Present Value (NPV) optimisation analysis of constrained options, to guard against over-favourable assessments of schemes that are to be used intermittently rather than continuously;

6. the inclusion of Level of Service (LoS) to customers as an option for determination within the options selection process, as opposed to determining it in advance and outwith the process (exogenously), thereby enabling the cost of providing security of supply to different levels of service to be determined, and facilitating an informed judgement (with customers) as to the LoS which should be adopted;

7. where not done so now, the inclusion of leakage rates as a variable to be determined within the options selection process, rather than being determined exogenously, through free-standing economic level of leakage (ELL) or sustainable level of leakage (SLL) calculations, to improve the probability of finding the true global least cost solution to a forecast deficit in the supply-demand balance.

Of the seven recommendations made, those numbered 1, 2, 3, 6 and 7 are considered to be the most crucial.

Appendix 1 to this paper summaries the way in which supply, demand and supply-demand balance planning is now conducted, in England and Wales, to provide background for those who may be unfamiliar with present practice, and to provide the context for the changes proposed herein. A list of abbreviations used is given as Appendix 2. A glossary of terms is provided as Appendix 3.

Section 2 of this paper sets out the basis and case for each of the suggested improvements to current practice. Some readers may wish to look at Appendix 1 before considering the recommendations given in section 2 below.

2 RECOMMENDATIONS FOR CHANGE

<u>Recommendation 1</u>: Water Companies should estimate Deployable Output (DO) consistently across sources and resource zones, for a range of return periods, and should report the reliability and the provenance of the DO values they use. The Level of Service DO reported by a company should be that obtainable in the return period corresponding to the frequency of its use of specified (Level 1, Level 2 etc) restrictions on demand.

Deployable Output (DO) is the yield from a set of sources under defined hydrological conditions, subject to licence, infrastructure and water quality constraints. It is a variable quantity, not a single fixed quantity. Generally speaking, and subject to other constraints too, DO reduces as the return period (RP) of the hydrological event for which it is determined lengthens. It follows that to mix DOs of different RPs creates error. It also follows that to report DOs without declaring their provenance is poor practice; since because the size and the reliability (calculated as 1-(1/RP)) of (say) a 1 in 100 years DO is different from that of (say) a 1 in 20 years DO, we need to know the severity of the event to which the figure relates. We also need to know the length and range of the record used to calculate the quoted value, because the length and the representativeness of the governing period affects the value of DO, too.

At present, water companies in England and Wales report annual average and peak period DOs as single values for each sourceworks (or integrated system) and, by aggregation, for each resource zone. The Environment Agency's (EA) Water Resources Planning Guideline (WRPG) indicates that a company's DO should be determined for its proposed LoS. [3] In practice, however, it is commonplace for companies to use hydrological drought events of different severity to determine the DO of their surface water and groundwater sources, and to aggregate and report DOs of different reliabilities as though they were internally consistent. It is also common for companies to use DOs corresponding to high RP (rare drought) events, whilst at the same time stating a LoS for the use of restrictions of a much shorter RP (e.g. 1:100y for DO, and 1:20y for the use of hosepipe bans). This has the effect of under-stating the true supply-demand balance, since the dry year demand used in the balance corresponds (in this example) to a 1:19y event, while the DO corresponds to the (lower value, higher reliability) 1:100y event. The net effect is that supply-demand balance shortfalls may be over-stated, and new schemes may be considered to be needed more than they really are. Another corollary is that the new schemes selected on the presumed basis of need may not be the ones that would be selected were the balance to be correctly stated.

It is recommended that water companies should estimate and plot their DOs for a range of return periods, as is already standard practice in Scotland. This will provide them with more information about the characteristics of their resource base, and will enable them to aggregate data on a consistent basis. It will also shed light on the LoS consistent value to be used for DO. Results could be computed to show DO with demand restrictions being used at their target frequency, and with their presumed effect on demand (and thence the rate of drain on the resource base), and without, to provide yet more information of value. Given the availability of DO for different return periods, the DO (and Water Available for Use (WAFU)) values of different companies could be aggregated on

[3] Water Resources Planning Guideline, November 2008, s5.1, p5-1.

a consistent basis, to deliver meaningful regional totals (cf. the addition of DOs of different RP/reliability by the Water Resources in the South East (WRSE) Group, to date).

It is further recommended that all DO values be quoted alongside data revealing their reliability and provenance, to enable those considering the DO value to take account of its RP and provenance. A reporting format of the following type is recommended:

> DO (R) $_{(L, yy\text{-}yy)}$ = X Ml/d
>
> where R is the reliability of the value, calculated as 1-(1/RP); L is the length of the record from which the estimate is derived, in years; yy is the starting year of the record; YY is the last year in the record.

Alternatively, (RP) may be substituted for R, to facilitate comparison between the RP of the hydrological event and the LoS for restrictions.

It is further recommended that companies should report their LoS DO as that DO value which has the same return period as the target use of restrictions of a specified level (such as the use of hosepipes). An explicit requirement to this effect would prevent the practice of quoting a (low) DO for a considerably more severe event than that of the LoS for the use of demand restrictions.

<u>**Recommendation 2**</u>**: The gain in Water Available for Use (WAFU) from new supply-side and demand-side schemes, and the costs of delivering those gains, should be stated at the same point in the delivery chain. The gain in WAFU from new supply-side schemes should be adjusted to reflect the loss of water in treatment and in leakage to the point of consumption[4], thereby bringing the gains from new supply-side schemes and from new demand-side schemes into consistent comparison, at the point of consumption. The cost of distributing water to the point of consumption should also be included in the cost data used in options appraisals of new supply-side schemes.**

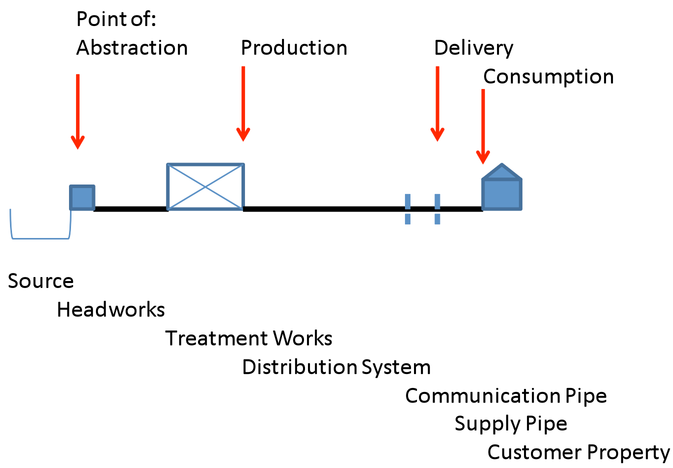
Figure 1 below is a simple schematic of the water supply chain, from the point of abstraction to the point of consumption. Definitions of each of the points of abstraction, production, delivery and consumption are given in the Glossary provided as Appendix 3 to this paper.

To date, the volume of water factored into consideration when appraising the yield of new supply-side options in options appraisal studies has generally been the yield at the point of abstraction or production (on leaving the water treatment works), without deduction for water lost in distribution. The point at which the volume of savings from demand-side schemes is judged is, in contrast, the point of consumption. By determining the cost of candidate new supply-side schemes at the point of abstraction or production, the cost of distributing the supply-side option has also been under-stated in options appraisal studies. Compared to customer demand-side options that deliver savings at the point of consumption, and to leakage reduction options that deliver savings at the point of

[4] The point of consumption is the customer's internal stop tap. It excludes the customer supply pipe, and hence underground supply pipe losses (uspl), which occur between the point of consumption and the point of delivery, at the boundary of the customer's property (between the company's communication pipe and the customer's supply pipe).

delivery or consumption, the attractiveness of supply-side options has been exaggerated (in higher yield, and in lower cost).[5] The yield loss could be around 20%. The cost factor could be significant, too.

Figure 1: Schematic of the water supply chain, showing the points of abstraction, production, delivery and consumption



It is recommended that for options appraisal work, the yield of candidate new supply-side schemes be reduced by reference to the appropriate rate of leakage in the company's distribution system, and the distance over which the new water is distributed to customer properties. It is also recommended that the cost of the new water provided be increased by an appropriate amount, by reference to the cost of distributing water to customer properties. Losses (and costs) in treatment also need to be fairly accounted for, if they are not already.

It is believed that re-stating volumes and costs of options at a consistent point in the water supply chain (whether at the point of delivery, or the point of consumption) would make for a more equitable choice between new supply-side and demand-side options than has been the case to date.

Recommendation 3: A shadow cost of water taken from the environment should be used to better reflect the environmental externalities of abstraction and the cost of water taken from the environment. Using a shadow cost of water that is closer to its 'all-in' value and higher than the monetised environmental cost determined through current approaches (like the EA's Benefits Assessment Guide (BAG)) will increase the cost of new supply-side options considered in the options appraisal process, and will bring demand-side options into more favourable comparison.

It is widely acknowledged that abstraction licence charges do not reflect the full cost of water taken from the environment. It is equally appreciated that present methods to monetise and incorporate environmental costs into AISC and NPV assessments – the EA's Benefits Assessment Guide (BAG) included – fall short, and fail to properly reflect the full non-use value of water in the environment.

[5] To take a simple example, whilst 10 Ml/d from demand savings provides a 10 Ml/d saving at customer taps, a 10 Ml/d gain from a new resource scheme would provide only 8 Ml/d at the point of delivery, if the leakage losses in the system are 20%.

The net result is that the environmental costs included in cost benefit appraisals make little material difference to decisions that would be made on financial cost grounds alone, such are the relative scales of the two values.

The situation bears resemblance to early attempts to factor carbon emission costs into construction programmes. The introduction of a shadow cost of carbon of a sizeable scale proved beneficial in stimulating action to reduce carbon emissions, and it has now been included as a means to incorporate the cost of carbon into water supply-demand balance planning. It is recommended that a shadow price for taking water from the environment should be determined for use in options appraisal of all new supply-side schemes. The shadow price could be set as a fixed value, or, more realistically, as a value that varies geographically (or by catchment) according to water stress or abstraction status. An appropriate methodology for setting a base shadow cost, and a sliding scale of multipliers to be applied in areas of serious water stress should be developed as a matter of urgency, consulted upon and adopted in time for use in the preparation of the next round of Water Resources Management Plans (WRMPs); final versions of these plans are scheduled for completion in 2014, and draft versions a year earlier, to allow time for consultation and response..

Consideration might also be given to using the shadow cost approach for factoring environmental externalities into play in setting a price for abstraction of water from the environment (by companies), and in turn for the price of water supplied to customers. It may be argued that existing arrangements for setting abstraction charges are sufficiently flexible and focussed in this regard, but the cap on charges set by the cost recovery only principle applied to date means that the cost of abstraction is much lower than the all-in value of water taken. It is recommended that the level of charges for abstraction be reconsidered by government, with a view to abandoning the cost recovery cap and determining charges that better reflect the true cost of water taken from the environment, and the true value of that which is left. Charges above the cost recovery threshold should be ring-fenced for use in restoring abstraction to sustainable levels. The merits of the shadow cost approach should be considered within this general remit. Due care and attention will need to be paid to dealing with vulnerability and distributional issues.

Recommendation 4: Supply, demand and supply-demand balance values in individual resource zones should be determined on a time-consistent basis for all potentially critical periods, to ensure that the period of greatest criticality for the supply-demand balance has been properly determined; and analysis, levelling and aggregation of critical period supply, demand and supply-demand balance values across the RZs in a company area should be made on a time-consistent basis, as opposed to on the basis that the critical periods of all zones coincide (which can lead to false inflation of shortfalls and needs, and sub-optimal solutions to the real planning problem).

The EA's WRPG indicates that supply-demand balances are to be evaluated for the dry year annual average (DYAA) condition and, should the balance be worse at some other (shorter) period in the year, at that time too. To date, companies have tended to analyse the situation in the period of peak demand as well as over the year as a whole, using the specific demand and DO values for that period (albeit with peak demand often being calculated using a crude peak to average factor approach, which bears re-examination)[6]. Little attention appears to have been given consideration of the supply-demand balance at other times of the year, with Southern Water appearing to be the only company that computes DO in the period of minimum resource availability (the MDO), for calculation of supply-demand balance risk in that period as MDO/annual average demand.

Companies have also tended to analyse, level and aggregate the critical period data from individual resource zones as though the critical period of all zones is the same, apparently without testing (or showing) that it is so. Aggregating worst case conditions when they might not in fact occur simultaneously has the potential to over-state the magnitude of any shortfall, and/or to mask opportunities for transferring water between zones to address critical period issues. The practice also has the capacity to deliver sub-optimal solutions.

It is recommended that the timing and the duration of the period of minimum supply-demand balance for individual resource zones in a company area should be determined by reviewing the balance in all possible periods in which it may be at a minimum, zone by zone. This process could reveal that the timing of the period of maximum criticality differs from that previously considered.

It is also recommended that companies determine their aggregate criticality, and the potential to level resources between zones, on an actualistic, time-consistent basis, rather than on an assumed basis of co-incidence of the critical period across resource zones. Calendar-consistent analysis of balances and the options for redeeming shortfalls should be undertaken.

It is acknowledged that the distinction between critical periods in different resource zones becomes reduced and blurred as greater connectivity between zones occurs. But so long as resource zones are kept separate (as opposed to being merged into an integrated zone), the timing of the critical periods of each one should be determined, and levelling of resources and the assessment of need for new supply-side and/or demand-side schemes to address should be made on a time-consistent basis.

Recommendation 5: Output-based average incremental social costs (AISCs) as well as capacity-based AISCs should be reported for supply-schemes intended for intermittent use rather than continuous use. Capacity-based AISCs should be differentiated from output-based AISCs when they are included in AISC-ranked lists of schemes in options appraisal studies.

Unit cost of water measures, whether based on capital and operating costs alone (AICs) or on capital, operating, social and environmental (AISCs), or on AISCs plus carbon costs, provide a useful means of ranking and considering available options for redressing a supply-demand balance shortfall, prior to detailed mathematical optimisation analysis to find least cost NPV solutions. In computing AICs and AISCs, the NPV WAFU numerator may be based on the (maximum) capacity of a supply-side option and/or on the (often lower) output that the particular scheme is expected to produce over its lifespan. Both are valid approaches when used appropriately. The capacity-based method indicates the unit cost of the Deployable Output contribution of the scheme, which can be delivered on-call. The output-based method indicates the unit cost of the actual volume of water

[6] See the Waterwise contribution to the Itchen Initiative for recommendations on improvements to be made to forecasting annual average and peak period demand values.

delivered by the scheme, over its lifespan, under its intended operating regime. If a scheme is intended to provide failsafe security of supply, but not continuous output at its capacity level over its lifespan (as might be the case for a desalination scheme, for example), using the capacity-based AIC or AISC to represent the unit cost of water delivered by the scheme would under-represent the true unit cost (since in this case the capacity value would be greater than the output value). In such circumstances, it is recommended that if AIC and AISC values are to be quoted (as the WRPG requires), both capacity-based and output-based values should be provided and used to rank the attractiveness of the scheme against other candidate schemes on both bases, prior to detailed NPV modelling.

In any event, the capacity-based AISC of schemes intended for use on an intermittent basis should not be mixed in rank ordered listings with the output-based AISCs of schemes intended for continuous use, without being clearly marked as to intended use.

Recommendation 6: Level of Service to customers should be included as a variable for determination within the options selection process, as opposed to determining it outwith the process (exogenously). This will enable the relative costs of providing security of supply to different LoS' to be determined, and will facilitate an informed judgement as to the LoS which should be adopted.

One possible way of achieving a more effective, more efficient and lower cost planning solution to (forecast) supply-demand balance deficits is to include the Level of Service (LoS) to customers and the environment as an endogenous rather than as an exogenous consideration. To date, companies have tended to set a target LoS for the use of restrictions on demand and for relaxations of abstraction licence terms and conditions with their customers and with the EA, respectively, before and outwith the options selection process. Thus, for example, if a company opts for a LoS for restrictions on demand of (say) no more than four hosepipe bans per century (1 in 25 years, on average), it would (or should) determine its DO as that it is able to sustain with no more than four failures per century, and then proceed to define its supply-demand balance deficit and its final planning solution on the basis of that fixed DO (and LoS). Were the company, on the other hand, to treat LoS as a variable rather than a fixed value, it could find the set of planning solutions able to provide Security of Supply (SoS) in different ways, at different cost for a range of different LoS.

It is recommended that companies should determine planning solutions for a variety of LoS standards, to enable them to consider the implications of choice of LoS in the round. The composition and the total NPV cost of the various possible solutions contingent on the use of different LoS standards could then be put in front of customers, as the basis for a comprehensive discussion and determination of preferences.

Recommendation 7: Leakage levels should be determined within the options selection process, as another of the variables to be optimised, rather than being determined exogenously, through free-standing economic level of leakage (ELL) or sustainable level of leakage (SLL) calculations.

Whilst some companies include future levels of leakage to be achieved as one of the options to be determined on comparative cost-benefit grounds through optimisation modelling, other companies pre-determine their economic and sustainable levels of leakage (ELL and SLL, respectively, the later including for the social and environmental costs of leakage management as well as the financial (capital and operating) costs included in the former). It is recommended that different rates (and costs) of leakage control be included in optimisation analysis, with the rate to be achieved being co-determined with other options on a global NPV basis. To do otherwise is to isolate leakage management as a exogenous consideration, at risk of selecting a sub-optimal final planning solution.

3 CONCLUSIONS

It is believed that adoption of the recommendations listed above would move water supply-demand balance planning in England and Wales onto a better footing, and would deliver more reliable estimates of supply, demand and supply-demand balance quantities and consequently better-based final planning solutions. Moving supply-side and demand-side options appraisal onto a more level playing field is one of the chief benefits envisaged.

It is hoped that the recommendations made herein are taken up by the EA in their proposed revision of the Water Resources Planning Guideline (WRPG), which sets out the approaches which it expects water companies to adopt in preparing their Water Resources Management Plans (WRMPs).

REFERENCES CITED IN THIS REPORT

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Ofwat, Setting Price Limits for 2010-15, Framework and approach.
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WWF-UK, 2010: Riverside Tales. Lessons for water management reform from three English rivers.

APPENDIX 1: WATER RESOURCES PLANNING PRACTICE IN ENGLAND AND WALES

Overview

1. At present, any forecast shortfall in the quantity of water available to meet unrestricted demand[7] has to be met by the long-run all-in[8] least cost mix of demand-side[9] and supply-side[10] measure(s) able to do so.[11] Reliability, resilience, flexibility, deliverability and sustainability considerations are factored into what is essentially an economic assessment process, albeit one in which environmental costs (including carbon costs) are monetised insofar and as accurately as is possible, and to which environmental and social 'stop-go' filters[12] are applied.

2. This note summarises the prevailing (legislative, regulatory and institutional governance) arrangements for reconciling water supply and demand in normal, dry, drought and extreme drought years. It identifies the measures that may be used to bring supply and demand into (planning) balance, and describes the methodologies that are now used to select between them, so as to ensure the use of the net best option (or set of options) from the whole (unconstrained) list of demand-side and supply-side options that exist. The resultant (final planning) option(s), selected through the Economics of Balancing Supply and Demand (EBSD) approach[13], coupled to the use of Strategic Environmental Assessment (SEA)[14] of the available options should, in theory,

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[7] Unrestricted demand is defined as the demand for water that occurs when there are no appeals for restraint or restrictions on the use of water in force. Restrictions include bans on the use of unattended sprinklers and hosepipe, bans on the use of hosepipes, bans on the use of water for non-essential uses, planned interruptions to supply, and supply by standpipes or water bowsers.

[8] The term "all-in" is used here to mean the inclusion of capital, operational, social, environmental and carbon costs, not just financial costs.

[9] Including customer-side water efficiency measures designed to reduce the frequency and unit volume of use of water-using appliances and devices like toilets, showers, hosepipes etc, and losses from customer supply pipes; and distribution-side leakage reduction from company owned mains and distribution pipes.

[10] Including production-side measures, based on the reduction and re-use of process water, and resource-side measures for increasing the output from and the efficiency of use of water from existing sources, and the development of new sources and infrastructure, including surface water sources, groundwater sources, reservoir storage, aquifer storage, desalination, re-use of treated effluent, inter-zonal transfers and inter-company transfers.

[11] Unless the shortfall occurs only in an event of such rarity and severity that the management of supply and demand during that event falls within the terms of Drought Management as opposed to Water Resources Management provisions.

[12] If a particular option or scheme may be judged to have so adverse an impact on the environment as to be highly unlikely to be granted planning permission, notwithstanding the use of all possible means to avoid, reduce, mitigate or adequately compensate for the impact, that option (scheme) may be filtered out from further consideration. Over-riding public interest and 'no other option' considerations may apply, however, and the exclusion of options on environmental grounds is in the end a judgement call that is often made late in the options selection process.

[13] The Economics of Balancing Supply and Demand, UKWIR, 2002a,b.

[14] Strategic Environmental Assessment (SEA) is the process through which the potential environmental impacts of the measures considered for use in the development of plans, projects and programmes are assessed in accordance with the Environmental Assessment of Plans and Programmes Regulations 2004. The process includes consideration of the ways in which any impacts may be avoided, mitigated and compensated for. Water companies typically undertake an SEA of the measures considered for adoption in their Water Resources Management Plans (WRMPs) in parallel to the production of those WRMPs, and publish the results of the SEA in an Environmental Report (ER) issued alongside their WRMPs.

be those that provide the required security of supply[15] at least total cost to customers, society and the environment, without unacceptable impact upon the environment.

3. The extent to which this turns out to be the case in respect of 'new' options selected for use depends on the extent and accuracy to which environmental factors are incorporated into the process[16], particularly in regard to the estimation of all-in environmental costs and the all-in savings from demand management options.[17] The extent to which the whole set of supply and demand measures in play at any given time is all-in optimal under present acceptability terms also reflects differences between the acceptability terms of today and yesteryear. That around one third of catchments in England & Wales are now deemed to be either over-abstracted or over-licensed[18] is just one such legacy issue.

4. Any loss of resource that does arise from licence amendments designed to address over-abstraction and over-licensing problems – and not all variations do necessarily produce a loss of resources[19] - requires consideration of the same set of measures available to address supply-demand balance shortfalls arising from:

   (a) a reduction in supply due to other causes (including climate change, pollution and environmental protection) or;

   (b) a growth in demand (including from population growth, demographic change, lifestyle preference change and economic change).

5. The following section sets out those measures, and the prevailing rational economic process for choosing between them.

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[15] Security of Supply (SoS) is used here to mean the existence of sufficient water available for use (WAFU) to meet unrestricted demand plus a margin of safety to cater for unavoidable uncertainties and inaccuracies in estimates of supply and demand (Target Headroom, TH), to a defined Level of Service (LoS) for the use of demand restrictions and licence relaxations. WAFU is Deployable Output (DO) less an allowance for unrecoverable loss of resources (Outage). DO is the output of a single source or a group of sources (e.g. in a Resource Zone, RZ) in an event of defined hydrological frequency or severity, subject to prevailing licence, water quality and infrastructure constraints.

[16] e.g. in including or excluding options that have significant environmental impact, from the standpoint (on the one hand) that those options that have significant adverse impact should be excluded, to (on the other hand) the view that options should only be excluded from full EBSD consideration if the scale or severity of the impact is such that planning consent is highly unlikely to be obtained (taking account of, as appropriate, the circumstance of overriding public interest, when no other feasible option exists).

[17] The long-run reliability of the savings from water efficiency measures has been a source of uncertainty that has weighed against the incorporation of demand side measures in company WRMPs. So too has been the practice of comparing the volume of savings from demand side measures (including leakage management) at the point of consumption with the resource gains from new resource schemes at the point of abstraction or production, without making adjustment for the loss of resources in distribution to customers. Recommendations in this regard are made herein.

[18] Riverside Tales, WWF-UK, 2010, p4.

[19] While many licence variations might lead to a reduction in abstractable volume, and in deployable output (DO), not all amendments to licences need necessarily incur a loss of resource to the operating company. One of the work streams of the Itchen Initiative seeks to explore, examine, test and propose 'smart licensing' solutions that solve the over-abstraction environmental problem without creating a water resources one in its place. The measures that appear to be promising in this regard are identified in Discussion Paper #4 of this set.

Key aspects of the current approach to supply-demand balance planning in England and Wales

6. Water Companies have a statutory duty to provide water to those who demand it.

7. Water Companies also have a statutory duty to promote the efficient use of water by their customers. At present, the obligation is limited to fulfilling Ofwat's Base Service Water Efficiency (BSWE) requirement, which mandates that each Company must undertake such input activities (such as advertising, providing or subsidising water efficiency devices, and providing water audits) so as to achieve an on-going reduction in household consumption of 1 litre per property per day per annum (1 l/pr/d/a). All other demand management activities undertaken by water companies (including leakage reduction) are subject to the economic efficiency criterion: that is, that they constitute part of the least cost means of balancing supply and demand.

8. Water Companies are entitled to abstract water from the environment under terms and conditions set out in abstraction licences granted by the Environment Agency (EA). All licences prescribe maximum permitted annual and daily abstraction quantities. Some licences have seasonally varying abstraction limits designed to protect in-river ecology during critical periods. New licences, and those amended in recent years, have been subject to time validity limits (time limited licences, TLL), to enable the EA to vary the terms and conditions of the licence thereafter, to protect the water environment as may be judged necessary. Some licences have particular abstraction limitation or prescribed flow conditions, including hands-off flow (HOF) provisions and maintained flow provisions: a HOF condition (otherwise known as a Minimum Residual Flow (MRF) condition) defines a threshold flow below which abstraction is prohibited; a maintained flow condition defines a minimum flow that must be maintained in a defined length of river, typically supported by releases from upstream reservoir or groundwater reserves. Were all licence terms and conditions effective in terms of protecting the environment, on the one hand, and efficient in terms of delivering maximum possible volumes of 'safe' water into supply, on the other, the over-abstraction and over-licensing problems that do exist would not exist. That over-abstraction does exist, to the extent it does, indicates that the current licensing regime is neither effective nor efficient in regard to present needs, and that at least some licences require amendment. The Itchen Initiative proposes 'smart' (effective and efficient) variations to licences as one means to address damaging abstractions, alongside the use of environmentally-sensitive demand and supply-side measures to address any reductions in resources associated with over-abstraction management that cannot be resolved by varying licence terms and conditions alone, or through the use of 'smart' regulatory and market-based mechanisms.

9. Water companies have to produce Water Resources Management Plans (WRMPs) that contain forecasts of the demand for and supply of water in their appointed areas, and in each of their constituent Resource Zones (RZs) over prescribed 25 year planning horizons. Forecasts are provided on the basis that each year of the planning period could be a dry year.[20] Supply and demand forecasts are provided for the annual average day and, typically, for the average day

[20] The design dry year is a warm, dry year in which unrestricted demand can only just be met from available resources, without resort to any restrictions on demand. It follows that if a company's Level of Service for the use of demand restrictions is say 1 in 10 years, its design dry year will be that which occurs once every 9 years, on average; whereas if a company's LoS is 1:20 years, its dry year will have a return period of 1:19 years.

during the period of peak demand during the year[21]. Each WRMP must set out how the Company plans to provide Security of Supply (SoS) to its customers, to a defined Level of Service (LoS) for the use of restrictions on demand and on the use of drought permits and orders for varying abstraction from licensed sources. The Company must show how its plans and choices are the net best options for doing so, considering all of the possible (unconstrained) options that exist, at least Net Present Cost (NPC) in terms of the financial, operating, social, environmental and carbon costs of the most feasible combinations of options. Under the terms of the Water Act 2003, and from 2007 in practice, water companies must publish, consult upon, respond to, publish and implement their WRMPs, following approval by the Secretary of State for the Department of the Environment, Food and Rural Affairs (Defra). WRMPs are produced at five year intervals, and are reviewed annually. Provisions exist for revision of plans at other times as may be required.

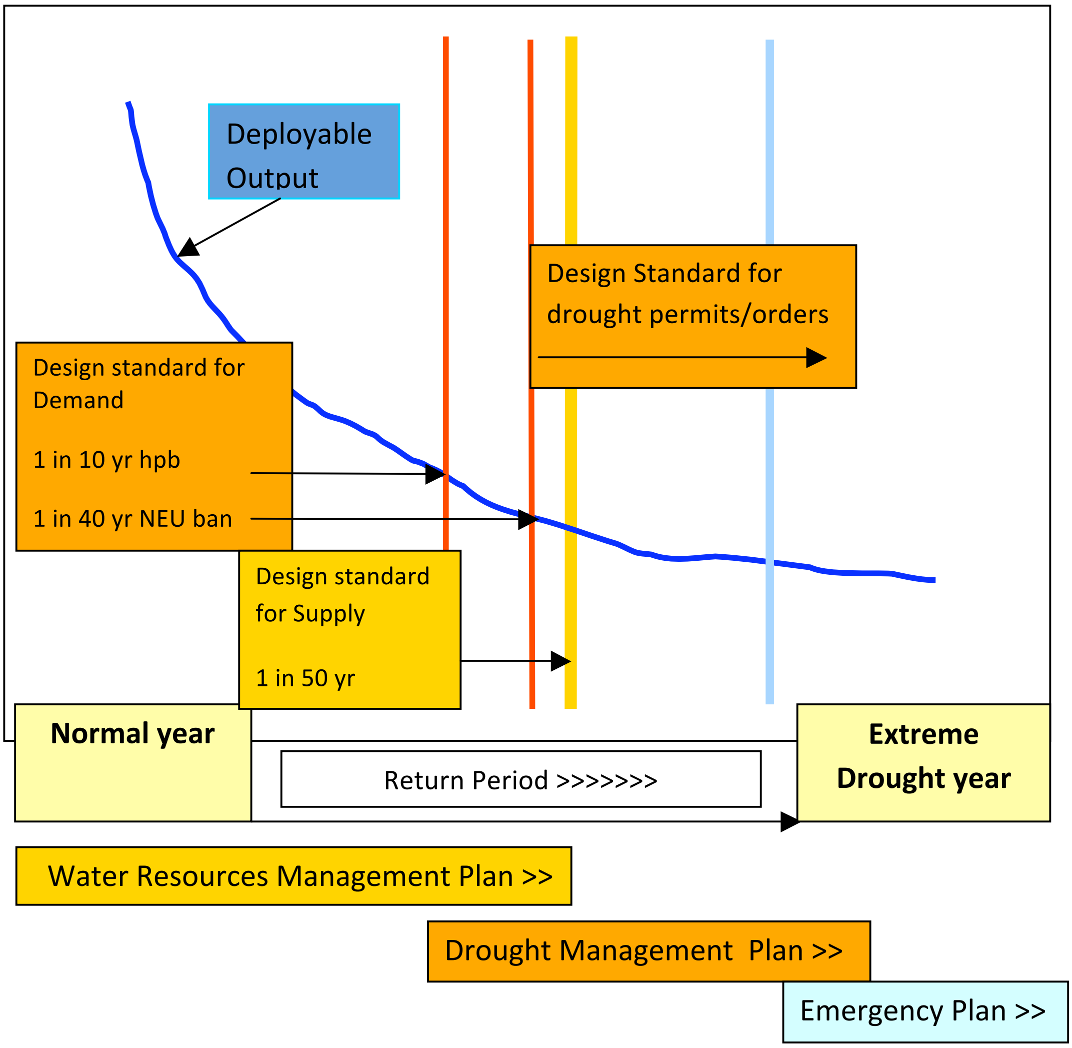
10. WRMPs seek to provide plans for ensuring that sufficient supplies exist to meet unrestricted demands in events of a frequency up to and including the design dry year. By using restrictions that reduce demand in dry and drought years of progressively longer return periods, a company is also able to maintain sufficient supplies in drought and extreme drought years. Water companies produce Drought Management Plans (DMPs), whose purpose is to define the hierarchy of measures (including restrictions on customer demand[22], and relaxations on abstraction licence terms and conditions[23]) that are intended to be used to ensure security of supply in the event of droughts of increasing severity. A company's DMP sets out the short-term operational steps it will take to control demand to manageable levels as a drought progresses, from the point at which the dry year scenario it uses for long-term planning is exceeded, through to extreme drought events. Companies now also produce Emergency Plans (EPs), which detail how they will respond during the most severe events (not just droughts). WRMPs, DMPs and EPs are accordingly complementary (and overlapping) devices for managing the supply-demand balance over normal, dry, drought and extreme drought years. Figure 1 below illustrates the intended relationship between a company's WRMP, DMP and EP.

[21] Forecasts of supply and demand during the period of peak demand – which may last one week, one month, or more – must be provided where this condition is more critical in supply-demand balance terms, and as a driver of investment needs, than is the annual average condition. Strictly speaking, the critical period is that in which the supply demand balance is at its minimum, and whilst this often occurs at the time of peak demand, it could occur at other times instead – at the time of minimum resources availability (DO), for example. Southern Water, alone, determines DO in the period of minimum resource availability over the year, as its Minimum Deployable Output (MDO), and assesses its supply-demand balance position in this period as MDO divided by annual average demand, for comparison against the annual average and peak period balances.

[22] Including appeals for restraint, bans on the use of unattended sprinklers, bans on the use of hosepipes, bans on the use of water for non-essential purposes, and, in principle though increasingly not in practice, rota cuts and the use of standpipes and bowsers for supply.

[23] As authorised by drought permits and orders to temporarily relax limitations in abstraction licences.

<u>Figure 1</u>: The relationship between a company's WRMP and its DMP (adapted from South East Water's revised WRMP, January 2010).



11. Ofwat[24] and the EA[25] together mandate the use of the UKWIR EBSD methodology for the appraisal and selection of options for providing security of supply to defined levels of service over a 25 year planning horizon. The approach involves the consideration of all (unconstrained) options for removing a forecast shortfall in the supply-demand balance, to determine first, a shorter constrained list and then a final short list of feasible schemes from which a final planning solution package of specific schemes able to meet forecast deficits is selected on least net present value (NPV) grounds through mathematical optimisation analysis. Due weight is given to deliverability, reliability and flexibility considerations in drawing up the final short list of feasible options. The average incremental cost (AIC) and average incremental social and environmental cost (AISC) of individual schemes are invariably used to sort schemes into priority

[24] As set out in guidance provided for each periodic review; most recently in 'Setting prices limits for 2010-15, Framework and approach' and the 'Part B5 Reporter guidance information requirements, section B5 Maintaining the Supply-Demand Balance'.

[25] As set out in the EA's Water Resources Planning Guideline (WRPG), November 2008.

order prior to detailed optimisation analysis, which takes account of combination dynamics to determine the net best package of options (which may not be the highest ranked individual schemes whose combined yield could meet the forecast deficit in a given RZ, over a given forecast period). Notwithstanding, AICs and AISCs – the former being the financial cost of a unit of new water (typically given in p/m^3, or £/m^3), the latter being the all-in financial, social and environmental cost[26] of a new unit of water (again in p/m^3 or £/m^3) – are, together with yield (the total volume of water available from each scheme) highly informative measures of the attractiveness of one scheme compared to another.

12. Table 1 sets out the types of options which typically feature in a company's unconstrained list. It is divided into customer-side, distribution-side, production-side and resource-side options. A company's unconstrained list will typically feature many hundreds of individual schemes, ranging from fitting tap valves to towing icebergs from the Arctic. The EA's Water Resources Planning Guideline, and the EBSD process it recommends, seeks to enable companies to identify the optimal set of options for bridging any deficit in the supply-demand balance, according to the scale, location and timing of forecast deficits. It is recognised across the industry that the periodic investment and price-setting review (periodic review, PR) process established by Ofwat since privatisation in 1989 may unintentionally have created a bias towards the selection of capital-intensive supply-side schemes and against demand side schemes (including both leakage reduction and water efficiency schemes) that typically have low capital and high operational costs.[27] In theory, the EBSD process should limit any such bias insofar as the selection of supply-side or demand-side schemes is concerned. As noted above, however, uncertainties surrounding the scale and the longevity of savings from water efficiency measures have undoubtedly prejudiced the adoption of demand side solutions to date. And as also noted above, the practice of rating the WAFU benefit of demand side schemes at the customer tap, but supply-side schemes at the point of production, without deduction for leakage losses, has also counted against the selection of demand-side schemes to date.

[26] AISCs, or a variant of them, may also include carbon costs, too.

[27] The argument here is that capital intensive schemes may have been favoured (against lower capital cost and high operating cost schemes) by the practice of allowing companies to earn a return on their regulatory capital value above the cost of capital. Given unhindered choice, a company would be incentivised to maximise its capital asset base.

<u>Table 1</u>: Typology of the measures available for redeeming a supply-demand imbalance

The table shown below summarises the main categories and types of options that may be used to redeem a supply-demand imbalance. Note the distinction between 'options', which define a generic measure (like desalination, or a surface water reservoir, or universal metering), and 'schemes', which define specific instances of such options (such as the Beckton desalination plant, or Broad Oak reservoir or universal metering of South Swindon).

Type of total water management option

Type of option

DEMAND-SIDE OPTIONS		
	Customer-side management (options that affect customer use & supply pipe losses)	
		Metering (universal, optant, selective)
		Smart metering (improved frequency & visibility of readings)
		Tariffing (flat, rising block, seasonally varying etc)
		Water audits (household & non-household)
		Advertising/raising awareness about water efficient devices & appliances
		Provision of water saving devices
		Retrofitting of water efficient devices
		Specifying water efficient devices/appliances in new homes
		Labelling of water using appliances
		Subsidising water efficient devices and appliances
		Providing information & advice to customers to persuade and enable them to reduce consumption
	Distribution-side management (options targeted at activities between the point of distribution and the point of consumption)	
		Passive leakage mangement (find & fix)
		Active leakage management (incl use of small DMAs etc)
SUPPLY-SIDE OPTIONS		
	Production-side management (options targeted at activities between the point of abstraction and the point of distribution)	
		Treatment capacity improvement
		Treatment process improvement
		Process water reduction
		Process water reuse
	Resource-side management (options that affect deployable output)	
		Licence variation
		Operational management improvement
		Infrastructure improvement
		Pump capacity improvement
		Groundwater source development
		Groundwater storage/recovery
		Groundwater augmentation of streamflow
		Surface water source development
		Reservoir development
		River regulation
		Desalination
		Direct reuse of treated effluent
		Indirect reuse of treated effluent
		Inter-company transfer/bulk supply
		Large-scale inter-basin transfer
		Importing water from overseas (ice, water bags, tankers etc)
		Licence trading
		Water trading

13. The transfer of water between different zones of a single company is now well developed. The practice provides significant resource levelling and resilience benefits, particularly where the pattern of demand varies from zone to zone across a company, and where the resource characteristics of a company vary across its area (e.g. with groundwater reserves providing supplies in some parts, reservoir resources in another, and run of river resources in another). Company to company and long-distance inter-basin transfers are much less common, with bulk supplies of water between companies constituting a maximum of 20% of a company's distribution input, but over 5% of distribution input for only three companies (Severn Trent, Northumbrian and South East Water, in turn). This situation reflects the high (all-in) cost of moving water over significant distances. It also, no doubt, reflects prevailing institutional and regulatory factors, including the capital return incentive, the self responsibility motive[28] and each company's primary duty to meet the needs of its own customers and shareholders first and foremost, rather than meeting regional or national efficiency objectives. To that extent, the prevailing level of inter-company and inter-basin transfers is a reflection of the structure and management of the industry as it now exists. Modelling undertaken by the Water Resources in the South East Group (WRSE) suggests that security of supply could be provided across the eight companies in the south east of England at a much lower cost were those companies to harmonise their WRMPs and transfer water amongst themselves more than they plan to do in their current WRMPs. That situation, too, reflects the facts of operation under existing structural, institutional and governance arrangements, rather than those that would favour other behaviours and actions. That, of course, indicates the potential for achieving different outcomes through institutional, regulatory and market changes, and such considerations are part of the remit of the Itchen Initiative.

14. The over-abstraction and over-licensing problem is being addressed by the EA's Restoring Sustainable Abstraction (RSA) Programme. Abstraction licence variations have been proposed for sites with European designations that have been damaged by or are deemed to be at risk of damage by over-abstraction in Stage 4 Assessments of the Habitats Directive (HD) Review of Consents (RoC) process followed by the Environment Agency, insofar as those Stage 4 Assessments have progressed. The Deployable Output (DO) consequences of proposed licence changes were included in the revised and final versions of some affected companies' WRMPs, under instruction from the EA, under assurance that the lost resources will be made good by new supply and/or demand side schemes funded in price limits through the Ofwat PR process[29]. Compensation for redeeming any loss of resources from variations to the licences of nationally-designated sites, in contrast, falls upon the EA's Environmental Improvement Unit Charge (EIUC) scheme, which is feared to be under-funded, and from which compensation is uncertain[30]. The situation for sites which have neither European nor National designations is bleaker still; here,

[28] i.e. having matters within one's own control

[29] The sustainability reductions proposed for the Itchen were dealt with by proposing that Southern Water's Otterbourne licences (surface and groundwater) be subject to a hands off flow of 198 Ml/d, with abstraction quantities from May through to September being limited in such a way as to reflect in-river species' needs. ADO is expected to be reduced by 104 Ml/d, MDO by 107 Ml/d and PDO by 86 Ml/d. As set out in a Memorandum of Understanding (MoU) between the company and the Environment Agency, Defra, Ofwat, CC Water and Portsmouth Water, the lost resource is to be met by a combination of measures, including significant supply-side and universal metering measures, with costs being funded through prices to customers.

[30] See the case study of the Mimram and Beane in Riverside Tales, WWF-UK, 2010, p15-22.

the water company cannot obtain funds to pay for replacement resources or demand savings from the Environment Agency's EIUC fund, or – unless there is a savings to customers' benefit – from price limits approved by Ofwat. Given the unit cost of water from new schemes is almost invariably more expensive than that of existing ones (especially from entirely legal but nonetheless environmentally damaging abstraction from rivers), the situation is one of an inescapable Catch 22, as was highlighted in Riverside Tales[31].

[31] Riverside Tales, WWF-UK, 2010, p28.

APPENDIX 2: ABBREVIATIONS USED IN THIS REPORT

ADO	Average Deployable Output
AIC	Average Incremental Cost
AISC	Average Incremental Social Cost
BSWE	Base Service Water Efficiency
DMP	Drought Management Plan
DO	Deployable Output
EBSD	Economics of Balancing Supply & Demand
EIUC	Environmental Improvement Unit Charge
EP	Emergency Plan
ER	Environmental Report
HD	Habitats Directive
HOF	Hands off Flow
LoS	Level of Service
MDO	Minimum Deployable Output
Ml/d	Megalitres per day
MoU	Memorandum of Understanding
MRF	Minimum Residual Flow
NPV	Net Present Value
Ofwat	The Water Services Regulatory Authority (formerly the Office of Water Services)
PDO	Peak Deployable Output
SEA	Strategic Environmental Assessment
SoS	Security of Supply
RoC	Review of Consents
RSA	Restoring Sustainable Abstraction
RZ	Resource Zone
TH	Target Headroom
UKWIR	United Kingdom Water Industry Research Limited
WAFU	Water Available for Use
WRMP	Water Resources Management Plan
WRPG	Water Resources Planning Guideline
WRSE	Water Resources in the South East group

APPENDIX 3: SELECT GLOSSARY OF TERMS USED IN THIS REPORT

Abstraction	The removal of water from a source, under licence.
Abstraction licence	The authorisation granted by the EA to allow the removal of water from a source.
Average Deployable Output (ADO)	The annual average daily Deployable Output of a sourceworks or group of sourceworks (the average daily DO, in Ml/d, over a year)
Average incremental Cost (AIC)	The unit cost (usually expressed in p/m^3 or £/m^3) of the supplies or savings of a particular supply-side or demand-side option, calculated as the Net Present Value of the capital and operating costs of the option divided by the Net Present Value of the water produced by it.
Average Incremental Social Cost (AISC)	The unit cost (usually expressed in p/m^3 or £/m^3) of the supplies or savings of a particular supply-side or demand-side option, calculated as the Net Present Value of the combined capital, operating, social and environmental costs (and sometimes also the carbon cost) of the option divided by the Net Present Value of the water produced by it.
'All in' cost	The total cost, calculated as the sum of the economic cost (capital and operational costs), social and the environmental cost (monetised) and carbon costs (monetised) unless otherwise specified.
Annual average	The total quantity (of demand, or supply) in a year, divided by the number of days in the year.
Deployable Output (DO)	The output from a source of set of sources under defined hydrological conditions, subject to licence, infrastructure and water quality constraints.
Drought order	An authorisation granted by the Secretary of State under drought conditions, which imposes restrictions upon the use of water and/or allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis
Drought permit	An authorisation granted by the EA under drought conditions, which allows for abstraction / impoundment outside the schedule of existing licences on a temporary basis.
Dry Year	The year in which unrestricted demand can only just be met by available supplies. The dry year is the standard design condition used in water resources planning. It is defined as a year in which (unrestricted) demands (from households plus non-households plus leakage from company pipes) can just be met from available supplies, without resort to restrictions on demand (from hosepipe bans and bans on the non-essential use of water).
Environment Agency (EA)	The Environment Agency is the Government appointed environmental regulator for the water industry.
Economics of Balancing Supply & Demand (EBSD)	The set of procedures developed by UKWIR to enable the selection of the least long run cost mix of demand-side and supply-side options able to resolve a forecast supply-demand balance deficit. The EBSD process is based on the evaluation of the AIC and AISC of options, and of the NPV of option combinations.

Environmental Impact Assessment (EIA)	A formal assessment process for determining the likely impact of a given action or intervention on the environment, and for assessing the effectiveness of the reduction and/or mitigation of impacts.
Environmental improvement unit charge (EIUC)	The charge applied by the EA to all abstraction licence charges which can be directed by the EA for funding compensation to abstractors for the reduction or loss of licences for environmental improvements.
Environmental Report	A report containing the results and conclusions of a Strategic Environmental Assessment.
Final planning scenario	The scenario of existing and future water available for use and final planning demand forecast which constitute the company's best estimate for planning purposes, and which is consistent with information provided to Ofwat for the Periodic Review.
Level of Service (LoS)	The target frequency (once in N years) (or annual average probability, from 0 to 1.0) with which a company may need to impose restrictions to reduce demand in times of drought so as to ensure that drought period supplies can meet (restricted) drought period demand. Water Companies define their own specific levels of service.
Level 1 restriction	The first restriction on demand imposed during times of water scarcity. Generally speaking, the Level 1 restriction is often an appeal to customers for special restraint in the use of scare supplies during a drought period.
Level n restriction	The nth level restriction on demand during a drought spell. The 2nd Level of restriction may be a ban on the use of sprinklers and unattended hosepipes. The 3rd Level may be a ban on the use of hand-held hosepipes. The 4th may be a ban on the use of water for non-essential uses. The 5th may be a rota cuts or supplies through water bowsers. Water companies specify the nature of restrictions, as well as the frequency of their use in their LoS.
Ml/d	Megalites per day (a Megalitre is a million litres, l x 10^6)
Minimum Residual Flow (MRF)	The rate of flow (discharge) that must be left in a watercourse supporting abstraction. Effectively, a predefined rate of flow at which abstraction from a watercourse must cease. Also known as a hands-off flow.
Net Present Cost (NPC)	The present day equivalent cost of an expenditure stream incurred over some forward period, with future costs discounted at a defined discount rate.
Net Present Value (NPV)	The difference between the discounted sum of all of the benefits arising from a project and the discounted sum of all the costs arising from the project.
Ofwat	The Water Services Regulatory Authority (previously the Office of Water Services), the Government appointed economic regulator of the water industry.
Outage	A temporary loss of DO from planned or unplanned events. (Note that an outage is temporary in the sense that it is retrievable, and therefore Deployable Output can be recovered. The period of time for recovery is subject to audit and agreement. If an outage lasts longer than 3 months, analysis of the cause of the problem would be required in order to satisfy the regulating authority of the legitimacy of the outage).
Peak Deployable	The average daily DO (Ml/d) at the time of peak demand, whether over a period of

Output (PDO)	a week (the Peak Week), a month (the Peak Month) or some longer period.
Peak Demand (PD)	The average daily demand (Ml/d) over a period of a week (PD7), or a month, or some longer period
Periodic Review (PR)	The review of water company investment requirements and charges to customers conducted by Ofwat every five years.
Point of Abstraction	The point at which water is permitted and taken from the environment.
Point of Delivery	The point at which water is delivered to a customer property, at the property boundary and between the company communications pipe and the customer supply pipe.
Point of Consumption	The point at which customer water use commences, after (and excluding losses from) the customer supply pipe.
Point of Production	The point at which treated water leaves the treatment works and enters the distribution system
Resource Zone (RZ)	The largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall.
Return Period (RP)	The average frequency of occurrence of an event of a given magnitude, usually expressed in ratio form as 1:RI.
Strategic Environmental Assessment (SEA)	A formal process through which environmental considerations are factored into the formulation of plans and programmes, such that those plans and programmes take account of the environmental effects they may cause. A SEA is a legally required assessment procedure required by Directive 2001/42/EC (the SEA Directive) to the extent that it applies to a particular plan or programme.
Source	A named input to a resource zone. A multiple well/spring source is a named place where water is abstracted from more than one operational well/spring.
Sustainability Reduction (SR)	A reductions in Deployable Output required by the EA to meet statutory and/or environmental requirements.
Target Headroom (TH)	The threshold of minimum acceptable headroom, which would trigger the need for water management options to increase water available for use or decrease demand. It is a planning allowance to cover unavoidable uncertainties in estimates of supply-side and demand-side quantities. TH is added to Demand and balanced against TWAFU to determine the supply-demand balance for water resources planning purposes, so as to take prudent account of uncertainties in estimation. Thus when TWAFU > (Demand +TH), planning surplus exists (and AH > TH), whereas when TWAFU < (Demand + TH), planning deficit exists (and AH is < TH).
Total Water Available for Use (TWAFU)	WAFU plus imports and minus exports from the RZ
United Kingdom Climate Impacts Programme (UKCIP)	The Government funded body responsible for disseminating climate change and climate change impacts projections to stakeholders, including water companies
United Kingdom Water Industry Research (UKWIR)	The collaborative research body of the water companies of England & Wales.

Unrestricted demand	The demand for water when there are no restrictions in place (this definition can be applied at any point along the chain of supply).
Water available for Use (WAFU)	The value calculated by deducting sustainability reductions and allowable outages from deployable output.
WRMP	Water Resources Management Plan: the statutory 25 year plans that the Water Companies in England & Wales are required to produce at five year intervals to show how they intend to provide security of supply at least all-in cost to customers, society and the environment, whilst meeting environmental obligations.
Water Resources Planning Guideline (WRPG)	The guidance document published by the EA to provide advice to water companies on the contents of their WRMPs.
Water Resources in the South East (WRSE)	A collaborative group composed of the water companies of the South East Region, the EA and Ofwat, established in 1997 to examine the potential for sharing water resources across the region.