Water Resources Management Plan 2019

Annex 9: Strategy for the Western area

December 2019

Version 1

from Southern Water

Contents

1. Executive summary

1.1 Western supply area at a glance

Western Supply Area

SUMMARY

The Western Area supplies 366,000 homes and 867,000 people across 7 water resource zones. During the course of the next 50 years we anticipate that each of these zones would face a water shortage if we did nothing at all.

SCHEMES WE ARE PROPOSING TO MEET THE FUTURE CHALLENGES

Reduce leakage by 50% by 2050
This will reduce the need to generate more water by using what we have more efficiently

Work with customers to save more water
Our customers are already some of the most efficient in England and Wales. Over the next couple of decades we will work with them to help save more water so that average water use falls to 100 l/h/d.

Drought plan measures
In the short term the EA and SWS have put in place a legal agreement, which sets out a modified drought permit process and the inclusion of force majeure clauses in proposed licence changes to ensure supplies are maintained in the western area. This agreement has been incorporated into our Drought Plan. The agreement terminates in 2030

Catchment management
Develop additional nitrate and pesticide treatment at identified sources and implement catchment management activity at these sources, together with in stream catchment management in the upper Test and the River Itchen.

Additional metering
Undertake extension of the universal metering programme to achieve 92% metering of households through implementation of a compulsory metering programme in AMP7.

Water transfers
- Work with Portsmouth Water to secure the additional bulk supplies in a phased manner - 9Ml/d by 2024, and a further 21Ml/d, relying on the development of Havant Thicket reservoir.
- Develop the 20Ml/d bulk supply from South West Water from the Bournemouth area by 2027
- Develop increased transfer capacity between our water resources zones, with development of a new reversible link main in Southampton, and the development of the Hampshire grid scheme to provide greater system resilience to the Western area.

Desalination
Plan for implementation of a 75Ml/d desalination scheme at Fawley by 2027, including the potential for a larger or smaller scale plant in combination with water reuse schemes, and direct industrial water re-use.

Water reuse
Plan and develop a 9Ml/d water reuse scheme at Sandown by 2027

Asset enhancement
Investigate a scheme to reinstate and provide additional treatment for the WSW near Cowes

INCREASING DROUGHT RESILIENCE

This WRMP, coupled with our Drought Plan, seeks to put in place measures to ensure a continuity of supplies during severe and extreme droughts.

While climate change and population growth put further pressure on water supplies, our proposed infrastructure developments coupled with our leakage reduction programme, water efficiency campaigns and drought interventions would be sufficient to ensure we can maintain supplies during severe and extreme droughts.

The Western area has the biggest sustainability reductions to licences. By 2029 we anticipate there will be a deficit of approximately 190Ml/d. In the short term we solve this using our drought plan measures. In the medium term we will import more water from neighbouring water companies (partially from the Havant Thicket reservoir) and we will continue to use water efficiently by reducing leakage and helping customers save water. In the longer term we will also use a desalination plant to treat sea water to drinking water standards.

Reduce leakage by 50% by 2050

Consume 100l/h/d by 2040

Improve water quality

Regional water supply grid

Produce over 75Ml/d of desalinated water

Sandown water reuse

1.2 What has changed since the draft plan was submitted in November 2017?

The following developments have been taken into account in the derivation of our final Water Resources Management Plan (WRMP). They have occurred since we submitted our draft WRMP in December 2017:

1) HM Government published their 25 year Environmental Plan (2018);
2) The National Infrastructure Commission published a report entitled: Preparing for a drier future (April 2018);
3) Updated WRMP guidelines were issued (July 2018);
4) WRSE group publication entitled: From source to tap: the south east strategy for water (2018);
5) Environment Agency (EA) entitled: The State of the Environment (2018);
6) The Global Risks Report 2018: highlighting that extreme weather reports are the highest risk to occur;
7) Consultation on our Drought Plan (2018), and publication of the final Drought Plan (July 2019);
8) Section 20 Water Resources Act 1991 agreement (the s20 agreement) with the EA which accepts sustainability reductions to licences and sets out a modified Drought Permit process; a force majeure clause in the River Test licence; a commitment for Southern Water to be Drought Permit ready (for the River Test licence); and monitoring and mitigation measures to be put in place and compensation habitat to be created (where applicable)(March 2018);
9) Confirmation of the support of the Secretary of State to the Inspector's recommendations and directing the EA to make the licence changes to the Test and Itchen licences (25 February 2019). These licences were consequently amended on 15 March 2019;
10) Defra letter (dated 19 March 2019) requesting further information in support of the statement of response;
11) Accompanying Defra's letter of 19 March 2019 was the EA's Statement of Response Review Annex: setting out issues that the EA do not consider material to the plan, but which they feel could improve it.
12) Ofwat's strategic water resources solutions process that was proposed at the Intermediate Assessment of Plans (IAP) stage (January 2019) and further updated at Draft Determination (July 2019)
13) West Country Water Resources Group (South West Water, Bristol Water and Wessex Water) proposal (issued August 2019) focussed on the opportunities to provide a bulk transfer to Southern Water through Ofwat's Strategic regional water resource solutions gated process.

We have also been consulting with the public and our customers (over 3000) to understand what they liked and did not like about our plan.

The consultation responses and the publications have all been reflected in our final WRMP; consequently, we have made some changes to our preferred plan from the draft WRMP.

These key changes, which have not been viewed as material by Defra, are:

1) **Stronger leakage reduction targets**: The company has now adopted a targeted reduction in leakage of 15% by 2025; 40% by 2040 and 50% by 2050. These targets reflect the challenge set by Ofwat, which was reflected in the 25 year Environmental Plan, and the NIC report;
2) **Increase trading**: We have incorporated another bulk supply, on top of the additional 30Ml/d from Portsmouth Water, from South West Water of 20Ml/d;

3) **Decrease the amount of water from desalination**: Due to the extra water we save and the increased bulk supply from South West Water we are able to reduce the size of the desalination plant;
4) The interim use of **Drought Permits and Orders in the Western area**, as agreed with the EA in the section 20 agreement, to meet our supply duties during drought conditions as an interim abstraction scheme;
5) Amendment of assumed DO of the Test and Itchen drought intervention options to account for climate change benefits;
6) Inclusion of an additional unconfirmed sustainability reduction on the Itchen in 2024 with other uncertain sustainability reductions (although noting that it could be implemented as early as 2024, following evidence presented by the EA at the Western area Public Inquiry in March 2018).

But we have kept:

1) **Target 100**: our water efficiency programme of work to help customers save water and money;
2) The **bulk supplies** from Portsmouth Water by helping them build a new reservoir at Havant Thicket and putting more cross connections in between the two companies;
3) Our proposed **water grid** for Hampshire. This is the first phase in the development of a water grid across the South East of England;
4) **Water reuse** on the Isle of Wight (IOW) water resource zone (WRZ) and in the Test Estuary though the timing of the latter scheme is now at the end of the planning period;
5) **Catchment management** in Hampshire and the IOW to improve the quality of the water in the rivers and aquifers we abstract water from. We are also improving the habitats in stretches along some of the Chalk streams in Hampshire to help improve their resilience to drought;
6) The **desalination scheme** in Hampshire.

1.3 What is driving the changes and how do all these schemes fit together to solve it?

This chapter sets out, in detail, how we solve the supply-demand deficits we face over the next 50 years. Figure 1, below, shows in red the deficit (primarily as a result of the changes to our licences from sustainability reductions) and in blue what we are proposing to develop by 2030 (AMP8) in order to solve the deficits created by the adoption of the licence changes and the estimated amount that each measure will contribute. While we develop these schemes we will rely on Drought Permits and Orders to maintain public water supplies. This strategy was set out in the section 20 agreement with the EA, referred to as the interim abstraction scheme.

Table 1 below shows the potential impact of uncertain sustainability reductions faced within the Western area and the sources impacted. We have considered three sustainability reduction scenarios, which we have called ‘cases’ (this is described in more detail in annexes 3 and 5). The three cases were as follows, including the relative probability that was applied to each case:

- A Lower case that includes only green sustainability changes; assumed to have a 25% probability
- A Middle case that includes green and amber sustainability changes and a pragmatic estimate of the red sustainability changes; assumed to have a 25% probability
- An Upper case that includes green, amber and red sustainability changes and a pragmatic estimate of any further sustainability changes that may be required following investigations

and options appraisals, or driven by future legislation or requirements assumed to have a 50% probability

These potential sustainability reductions are incorporated with other uncertainties relating to climate change impacts and demand growth to develop the supply-demand balance distribution from which the different 'futures' are selected.

The key thing to note is the scale of potential sustainability reductions that are, at present, uncertain; which are over and above the very significant sustainability reductions on the Test and Itchen which were enacted on 15 March 2019. The possible, yet uncertain, sustainability reductions have yet to be investigated and confirmed; this must be undertaken in discussion with the EA and agreed as soon as possible to allow sufficient time to design and implement the potential solutions to resolve the deficits caused by the sustainability reductions.

Table 1 Summary of Western area branches based on sustainability reduction assumptions (in severe drought conditions) under minimum deployable output (MDO) and peak deployable output (PDO) planning conditions

Water resource zone	Lower case	Middle case	Upper case
Hampshire Andover	None	Andover to recover to EFI MDO: 11.5Ml/d PDO: 15.4Ml/d	As middle
Hampshire Kingsclere	None	None	MDO: 2.9Ml/d PDO: 2.9Ml/d
Hampshire Rural	None	None	MDO: 0.3Ml/d PDO: 0.3Ml/d
Hampshire Southampton East	Itchen, Twyford. Included in baseline DO figures. Varies by return period. Severe MDO:60.7Ml/d Severe PDO: 47.1Ml/d	Additional Itchen sustainability reduction in 2024 – to HoF 224Ml/d From 2017-18: As lower. 2024-25 onwards: Severe MDO: 86.7Ml/d Severe PDO: 73.1M/d	As middle
Hampshire Southampton West	Lower Test. Included in baseline DO figures. Varies by return period. From 2017-18: Severe MDO: 105.0Ml/d Severe PDO: 78.3Ml/d From 2027-28: Severe MDO: 105.0Ml/d Severe PDO: 105.0Ml/d	As lower	As lower
Hampshire Winchester	None	Winchester and Alresford limited to recent actual abstraction MDO: 11.2Ml/d PDO: 12.3Ml/d	As middle
Isle of Wight	None	Newport and Lukely Brook to recover to EFI Varies by return period Severe MDO: 7.7Ml/d Severe PDO: 10.6Ml/d	Varies by return period Severe MDO: 10.5Ml/d Severe PDO: 17.5Ml/d

Water resource zone	Lower case	Middle case	Upper case
Western area total	Itchen, Twyford, Lower Test. Included in baseline DO figures. Varies by return period. 2017-18 to 2026-27: Severe MDO: 165.7Ml/d Severe PDO: 125.4Ml/d 2027-28 onwards: Severe MDO: 165.7Ml/d Severe PDO: 152.1Ml/d	As lower scenario, plus additional Itchen sustainability reduction, Andover, Newport, Lukely Brook, Winchester and Alresford Varies by return period 2017-18 to 2023-24: Severe MDO: 165.7Ml/d Severe PDO: 125.4Ml/d 2024-25 to 2026-27: Severe MDO: 191.7Ml/d* Severe PDO: 151.4Ml/d* 2028-29 onwards: Severe MDO: 222.0Ml/d* Severe PDO: 216.4Ml/d*	Varies by return period 2017-18 to 2023-24: Severe MDO: 165.7Ml/d Severe PDO: 125.4Ml/d 2024-25 to 2026-27: Severe MDO: 191.7Ml/d* Severe PDO: 151.4Ml/d* 2028-29 onwards: Severe MDO: 228.0Ml/d* Severe PDO: 226.5Ml/d*

*Includes additional sustainability reduction on the Itchen from 2024

At the end of the Hampshire abstraction licences Public Inquiry in March 2018 the EA referred in their closing statements to the prospect of a further review of the proposed hands off flow conditions on the River Itchen licences at the point of intended licence renewal in 2024. Whilst these revisions still have to be investigated during the next AMP (2020-2025) the last independent review (in 2010 by R. Wilby on behalf of WWF) of the hands-off flow conditions proposed a flow condition of 224Ml/d, which is higher than the current condition of 198. Therefore, in order to have long-term regard to an anticipated further reduction in abstraction, we used this estimate of 224Ml/d as the potential new hands-off flow condition on the River Itchen licence in order to assess the likely impact on the supply forecast post-2024. We included the impact of this additional sustainability reduction on the River Itchen from 2024 in the baseline supply forecast in our revised draft WRMP. It was deemed prudent to do so, given that it was raised in evidence during the Public Inquiry.

The rationale was to ensure that the solutions we are developing for the Western area are capable of accommodating this additional change to the licence over and above those which have now been implemented, as of 15 March 2019. This additional change could occur as soon as the next AMP and there may therefore be limited time to develop and implement an alternative source to address the licence change. We felt it was critical that this was included in the analysis and planned for as not including it could delay the programme for developing a long-term solution for the area, as agreed with the EA in the s20 agreement, because it may require a later revision to planning application documentation, or trigger entirely different schemes.

However, as instructed by Defra in its letter dated 19 March 2019, we have revised this assumption, and have instead included the uncertainty associated with this further sustainability reduction. This is consistent with the consideration of other uncertain and unconfirmed sustainability reduction in our plan, across all supply areas.

We have had to make a pragmatic assumption of the possible hands-off Flow (HoF) that could be imposed by the EA, based on best available evidence, but as Defra's letter (of 19 March 2019) states, this is not yet confirmed. Hence, we are planning in the face of uncertainty. Our approach aims to ensure our plans are as robust as possible in the face of that uncertainty. It is important to remember

that many decisions do not lie entirely with Southern Water – many will require timely decision-making by regulators, including Ofwat, the EA, Natural England, DWI and Defra.

It should be noted that, until we reach the point at which the branches diverge (from 2027 onwards), there is a common supply-demand deficit based on the middle (50th percentile) branch. This is described in detail in Annexes 8 and 9. Therefore, due to the assumed distribution for incorporating the unconfirmed sustainability reductions, we are effectively including and planning for the additional Itchen sustainability reduction in 2024, even where we have allowed only for the uncertainty associated with this change as opposed to including it in the baseline supply forecast. The only difference is that there then may be a reduction in the deficit from 2027 onwards in some of the lower deficit branches (reflecting the potential that the additional Itchen sustainability reduction may not materialise).

The distribution used for the three different sustainability reduction cases reflects our experiences of the EA's National Environment Programme (NEP) and Water Resources Planning Guidance over the last few AMP cycles. For example, we were unable to include a sustainability reduction for the River Test in our draft WRMP14 (published in May 2013), yet by the time of the next draft plan for WRMP19, we faced the prospect of a licence change leading to the full loss of Deployable Output of this source, which was confirmed following the Public Inquiry held in March 2018. This had a significant impact on the supply-demand balance (SDB) for the Hampshire Southampton East (HSE) and Hampshire Southampton West (HSW) WRZs within a short 5 year timeline. We believe our approach is therefore a reasonable and pragmatic attempt to account for the uncertainty around the potentially very significant impacts of sustainability reductions on our supply-demand balance.

The timing of most of the sustainability reductions is another critical factor. Except for the confirmed, and the additional, sustainability reduction on the Itchen, the other sustainability reductions are assumed to occur in 2027. This does not allow much time to plan for and develop new resources to address the deficits that would result. Through our real options modelling, we can assess how these and other uncertainties related to growth and climate change, may affect the plan, and select a preferred plan that can address whichever "future" materialises.

The two figures below show a 'snapshot' of the initial supply-demand balance (SDB) situation and the types of options that are selected to address the deficits at the end of AMP8 (2029-30) across a range of states of the world. Figure 1 presents these for the highest deficit branch (the 10th percentile), whilst Figure 2 shows the case for the middle branch (50th percentile). Each figure also shows the typical lead in time in moving from 'normal conditions' to severe and extreme drought conditions, although this will not be the case in every drought – these figures are indicative only.

Note that because these plots are presented at area level, they do not necessarily reflect the detail for selection of all the options – for example, it may be that an option is needed to meet a deficit in a given WRZ, for which there is otherwise limited connectivity to the rest of the supply area, yet there may be surpluses in other WRZs. That is, the surplus/deficit at area level is not always reflective of the driver behind the need for an option being selected.

Figure 1 Deficits and solutions plot for Western area at the end of AMP8 in the highest deficit future

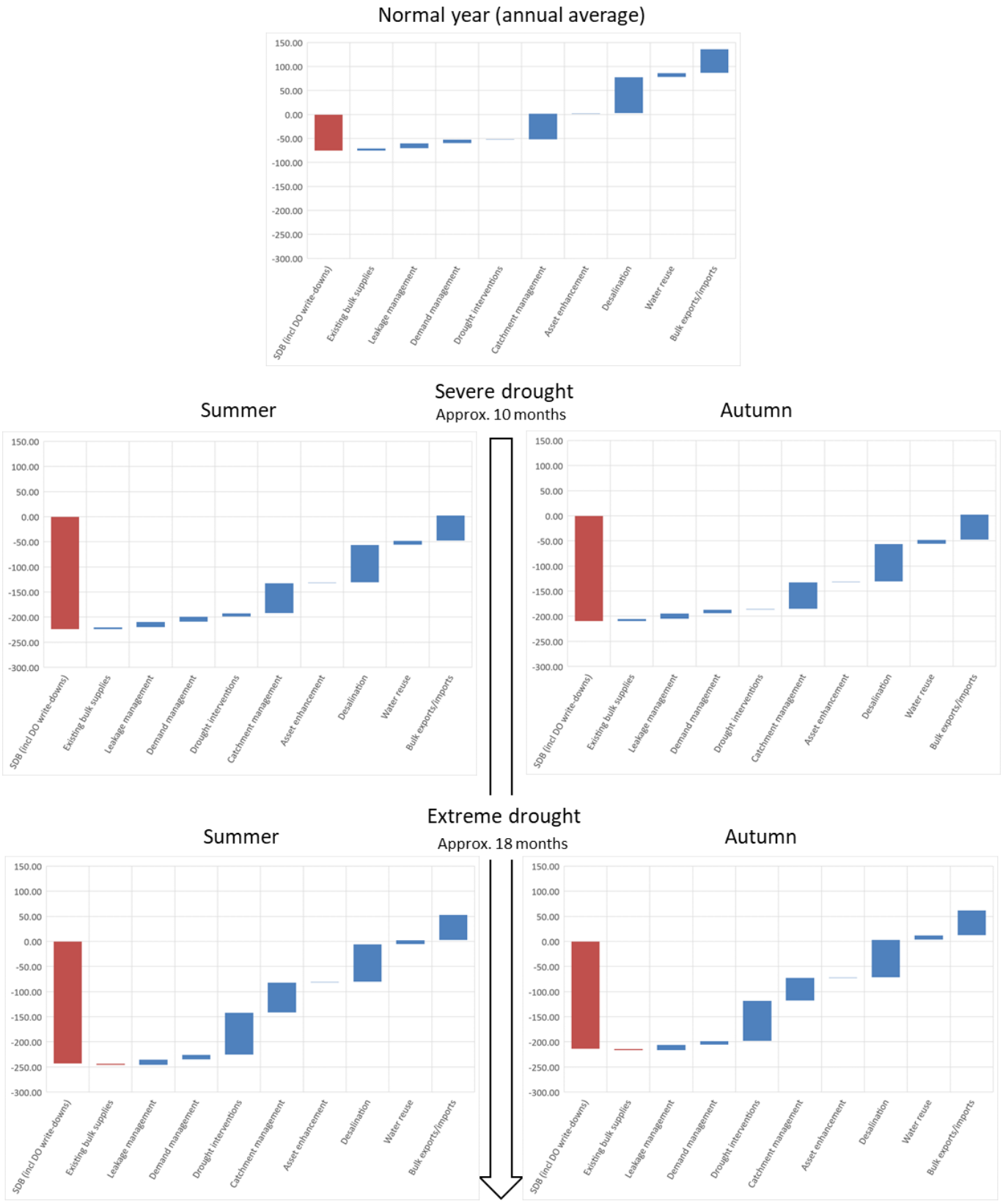
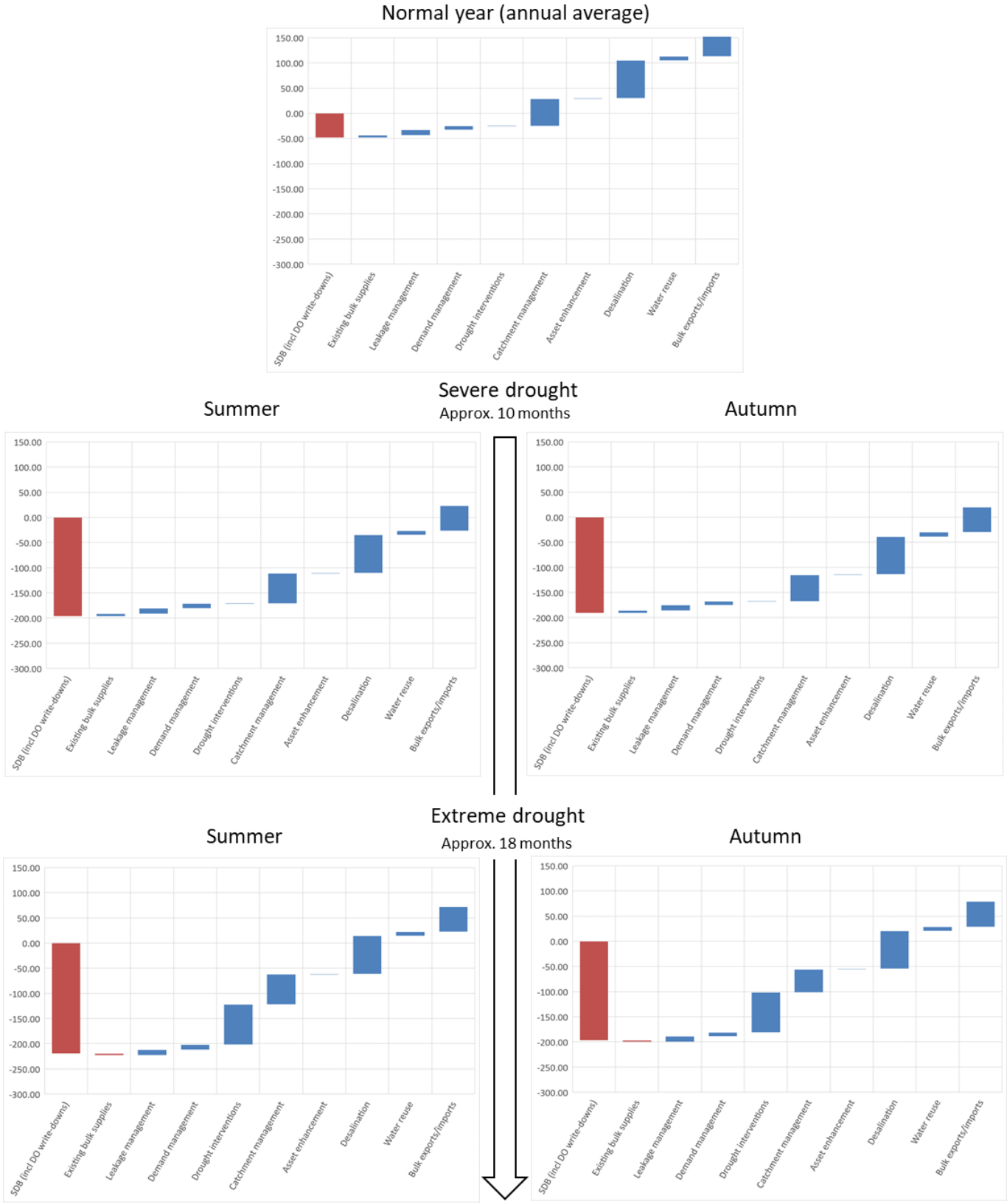


Figure 2 Deficits and solutions plot for Western area at the end of AMP8 in the middle deficit future (50th %ile)



In the rest of the chapter we describe how we derived our preferred solution, looked at different scenarios that could occur in the future, and undertook some sensitivity testing of our preferred plan.

1.4 Summary of the strategy for the Western area

Our Western area has traditionally not experienced water shortages like our other supply areas, and has not had a hosepipe ban imposed to restrict customers' supplies. There has, to date, been sufficient water available within our abstraction licences to provide secure supplies to customers. However, the changes to abstraction licences on the River Itchen, the River Test and the Candover Stream, which came into force on 15 March 2019, together with future as yet uncertain further abstraction licence changes that may be identified, have fundamentally changed the water resources position in Hampshire and the IOW WRZs

Our strategy for securing public water supplies in the Hampshire and the IOW WRZs is thus driven by the scale of the sustainability reductions (licence changes) on the River Itchen and River Test as now enacted by the EA. Without these sustainability reductions, Southern Water would not have a supply-demand deficit and would not need to promote new water resource developments. However, the scale of the sustainability reductions is such that we will have to promote large scale new water resource developments alongside demand management measures in order to meet our obligations under the Habitats Regulations, the Water Industry Act, the Water Framework Directive (WFD) and the Water Resources Management Plan Regulations.

The Western supply area will see the most significant changes to its supply arrangements over the next ten years. This plan sets out the series of interventions that will be required to meet these future challenges. Whilst there are some core solutions that feature in a number of scenarios there are also some key choices that could influence the scale of some of the solutions, such as desalination. These are explored in the following sections of this Annex.

A Real Options approach has been used to inform the strategy for this plan. This approach solves the supply-demand deficits simultaneously for seven different 'states of the world' (these are planning scenarios which represent a snapshot of different climatic conditions and intra-annual pressures on water resources) across five different 'futures' or 'branches' (which represent a plausible set of future supply-demand balances for a range of possible future scenarios, for which different solutions may be appropriate or necessary). The futures are built up from a combination of possible demand growth scenarios, climate change impacts on water supplies, and sustainability reductions.

Annex 8 describes the rationale for selecting and using a Real Options modelling approach to support the decision making for this plan. It is important to review this Annex, which explains the development of the strategy for the Western area, alongside Annex 8 (which provides more detail about the Real Options modelling process).

Our approach solves the supply-demand deficits simultaneously for the different 'states of the world' across the different 'branches'. The investment decisions are optimised to ensure we can meet our target level of service across a range of drought severities at different times of the year, whilst still considering the operation of schemes during normal climatic conditions.

The objective of our approach is to ensure that the plans cover a wide, yet appropriate, range of futures to ensure that all the key strategic options are identified, which is particularly important given the large deficits faced immediately as a result of the licence changes on the Test and Itchen implemented in March 2019, and where the scale of the uncertainties is large (for example from potential future 'sustainability reductions' of licensed abstractions). This approach is critical because there may not otherwise be sufficient time from when the sustainability reductions or other uncertainties are confirmed for implementation to develop appropriate schemes.

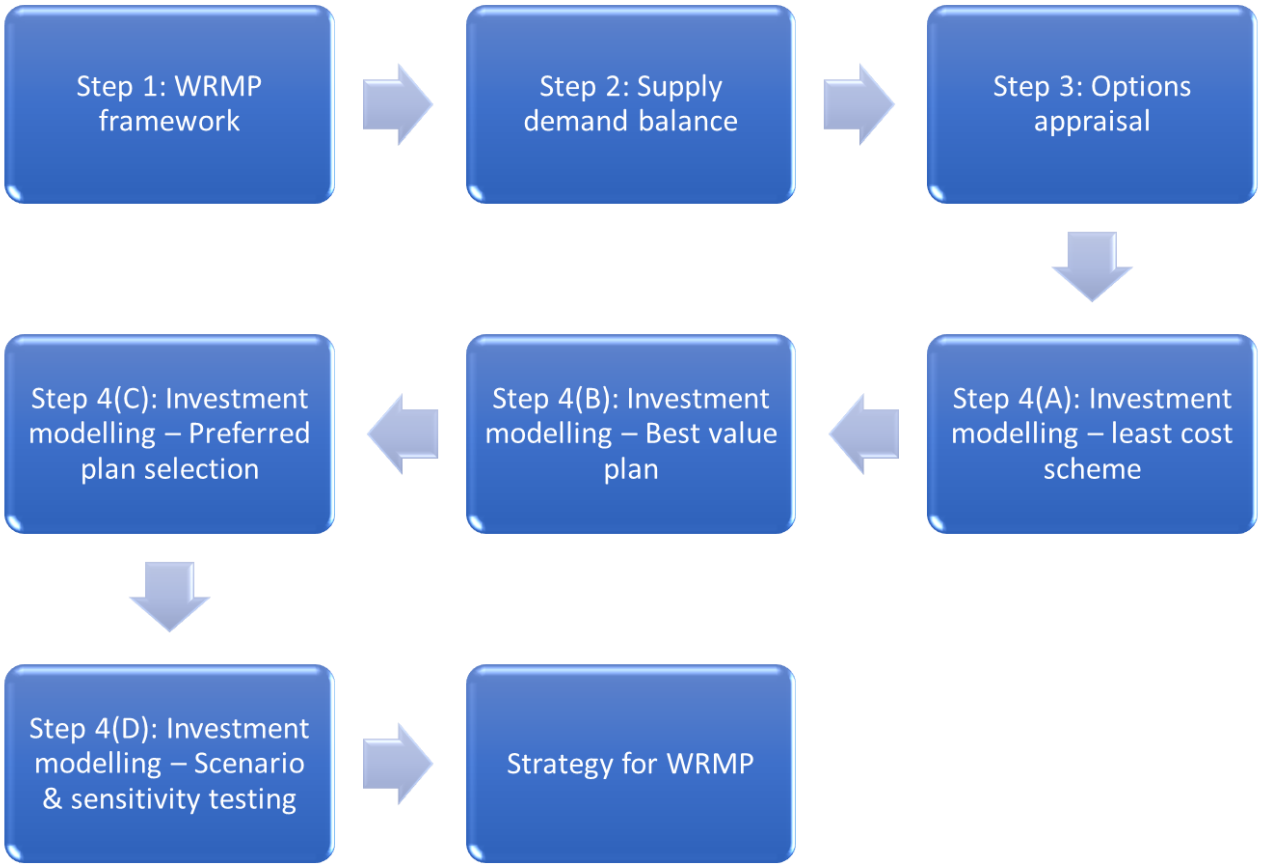
The use of different futures in the Real Options approach effectively recognises that the future is not certain, particularly around climate change, population growth and additional sustainability reductions. This technique identifies how solutions may change through time in the face of different

possible future water resource pressures, and also identifies a common set of 'no regrets' options in the short term which should be developed regardless of which future may materialise.

This approach identifies the key schemes and alternatives which could address these current and potential future deficits so they can be investigated and progressed in parallel to the preferred plan. Should the magnitude of the future uncertainties be less severe, then some of the schemes would not need to proceed past feasible investigation and planning / promotion stages. However, the company has little choice but to conduct these investigations of alternative and preferred schemes in parallel through AMP7 (and AMP8), given the scale of potential deficits and uncertainties the company faces in the next 10 years.

The 'futures' are selected from the probabilistic combination of scenarios, and so it is not possible to identify exactly what is contributing to a given future. The **key point of the branches is that they represent plausible potential future deficits in the face of uncertainty, and we try to solve these, without needing to know exactly what component or combination of components is driving a future deficit**. We have purposefully not chosen the most extreme combination of futures (which would represent the worst case for all of the drivers combined); instead we have curtailed the selection to 'plausible' futures within the 10th (largest deficit) and 90th (smallest deficit) percentile ranges.

Figure 3 A summary of the WRMP approach



To develop a strategy for this area, an **initial 'least cost'** run was undertaken in the Real Option investment model to develop a 'basic solution', without further consideration of potential constraints (Step 4(A) in Figure 3). This was then tested by modifying assumptions about the availability of certain options to progress our understanding of the impacts these assumptions might have on the strategy. From examination of the various model run outputs, and taking into account the pre-consultation discussions with regulators and stakeholders, consultation representations, and policy

decisions, refinements were introduced to reflect **a 'constrained' least cost strategy or the best value plan** (Step 4(B) in Figure 3).

The constrained least cost strategy was further tested against environmental criteria, outcomes from regional planning exercises (Water Resources in the South East), and the preferences arising from customer engagement activity. Following this review, any refined decisions on the feasible options were fed into the Real Options model to derive the **strategy for the WRMP** (Step 4(C) in Figure 3).

The strategy was then subjected to scenario and sensitivity testing to understand how sensitive the plan is to certain assumptions and what alternative strategic schemes may be needed, should it not be possible to implement the schemes in the preferred plan (Step 4(D) in Figure 3). This is particularly important for those schemes in the strategy that are required early in the planning period, in AMP7 or AMP8.

For the draft plan on which we consulted, we had four alternative scenarios, each making different assumptions about the timing and scope of the EA's proposed licence changes (also referred to as sustainability reductions). These were defined before the Public Inquiry was held and so before the outcome of that Public Inquiry was known. This was to enable us to explore the sensitivity of the strategy to these different assumptions. Strategy A, our core strategy for the Western area, assumed the EA's proposed licence changes would be implemented in full and immediately. This was identified, during preparation of our statement of response and revised draft WRMP, as the most likely outcome. Scenarios B, C and D were considered as alternative scenarios to demonstrate the impact on option selection and the relative costs of the different solutions based on alternative licence change assumptions.

The licence changes on the Test and Itchen have now been implemented (as of March 2019), and so scenarios B, C and D serve only to show how the strategy would have looked if more time had been given to implement the sustainability reductions.

Our preferred plan in our final plan is therefore based on what was previously known as 'Strategy A' in the draft WRMP.

The strategy for the Western area is **dominated by the recently introduced and potential future sustainability reductions**. This is highlighted by comparing the two strategies with and without the potential sustainability reductions (see section 4.2). **As the potential future sustainability reductions still have to be investigated and confirmed then both the investigations and the feasibility/design of the potential solutions to resolve any deficits caused by the sustainability reductions will need to be developed at the same time**.

The **key strategic schemes selected in the next 10 years** under our preferred plan are described in detail in section 6.1, and summarised below as:

- A drought intervention option is needed for the River Test in the drought state of the world in the early years of AMP7 only, which if such an event were to occur would mean that we would be at risk of not meeting our target level of service for implementing Drought Permits and Drought Orders to increase supplies
- The Test Drought Permit / Order is required in the severe and extreme drought states of the world in the period 2020-28, and then in the extreme drought state of the world only from 2029 onwards through the planning period in all branches
- The Candover Drought Order is required in the period from 2020-26 in the severe and extreme drought states of the world. This Drought Order is then used in the extreme droughts in 2027 and 2028, but is not available to be used after that (in accordance with the s20 agreement)

- The Itchen Drought Order is required in the period from 2020-26 in the severe and extreme drought states of the world. This Drought Order is not selected from 2027 onwards, and is not available from 2029, even in extreme droughts
- The Drought Permits / Orders for sources on the IOW WRZ are needed in the early part of AMP7 (2020-21);
- We have adopted a very strong focus on demand management activity through implementation of the Target 100 water efficiency policy, the adoption of a leakage reduction profile to achieve reductions from current levels of 15% by the end of AMP7, and 50% by 2050, and extension of the Universal Metering Programme to take household meter penetration from 88% to 92%
- A large 75Ml/d desalination scheme is needed in the Hampshire Southampton West (HSW) WRZ. The magnitude of this scheme could be reduced if Itchen water reuse options are developed, however, these, like the desalination scheme, have associated risks which may make them harder to implement than the desalination scheme itself
- A bulk supply from South West Water from the Bournemouth area is implemented in 2027 (the earliest assumed start year)
- HSW WRZ is currently able to support Hampshire Southampton East (HSE) WRZ through existing transfers and, from 2027, a new Southampton link main will be required to allow increased support. This new link main will be reversible, which provides greater resilience in the face of outage events and other localised issued such as freeze-thaw events
- The HSE WRZ is also supported by bulk supplies:
  - The existing bulk supply of 15Ml/d from Portsmouth Water (which is assumed to be limited to 7.5Ml/d in the extreme drought states of the world)
  - A new 9Ml/d bulk supply from Portsmouth Water in 2024;
  - A new 21Ml/d bulk supply from Portsmouth Water in 2029 (dependent on development of Havant Thicket reservoir
  - The new bulk supplies from Portsmouth were assumed to be implemented at their earliest start years
- The HSW WRZ also provides support to the IOW WRZ through the existing cross-Solent main, up to a maximum of 18Ml/d
- In addition to the cross-Solent main, there is the need for a new scheme on the IOW WRZ – the preferred option is the Sandown water reuse scheme (8.5Ml/d), which is needed from 2027
- The Hampshire grid option is selected in 2027, providing reversible links between the HSE, Hampshire Winchester (HW) and Hampshire Andover (HA) WRZs. The grid option is not extended to Hampshire Kingsclere (HK) as a WRMP scheme (though may be considered for resilience benefits alone)
- The Newbury asset enhancement scheme is selected in the HK WRZ in 2027
- An improvement of the Romsey Town and Broadlands valve, providing increased connectivity between HSW and Hampshire Rural (HR) (reversible) is selected in 2024
- There are a number of sources which are at risk of exceeding nitrate thresholds, and so options to recover the lost deployable output (DO) from these are selected – including treatment and also importantly catchment management to improve the situation over the longer term
- Catchment management schemes addressing pesticide issues are also implemented in 2024 for the Test and Sandown surface water sources
- In-stream river restoration works on the Itchen and Test (upper reaches), aimed at improving the resilience of the environment, and are planned to be completed by 2027; Undertake investigations of key strategic alternative schemes

For new resource developments, it will be necessary for detailed engineering and environmental assessments to be undertaken, for planning and other consents to be secured and for the schemes to be constructed and commissioned. For transfers from other water companies there may be a need for asset enhancements, and/or for the development of new water resources within those companies

in order to free up water to make the transfer available. The timings within this plan are our best estimates for delivery at this point in time.

If the future turns out to have limited demand growth, limited climate change impacts and/or limited sustainability reductions (the lower deficit 'futures'), then a number of these options may not be required. As we prepare for our next plan in 2024, it may be possible to confirm that the implementation of some of the AMP8 options will not actually be required. However, the timescales are such that we will need to have done much of the feasibility and environmental investigations and the preparation of planning documentation in AMP7 (before it can be confirmed whether the schemes are necessary) even if the scheme is not ultimately needed in AMP8.

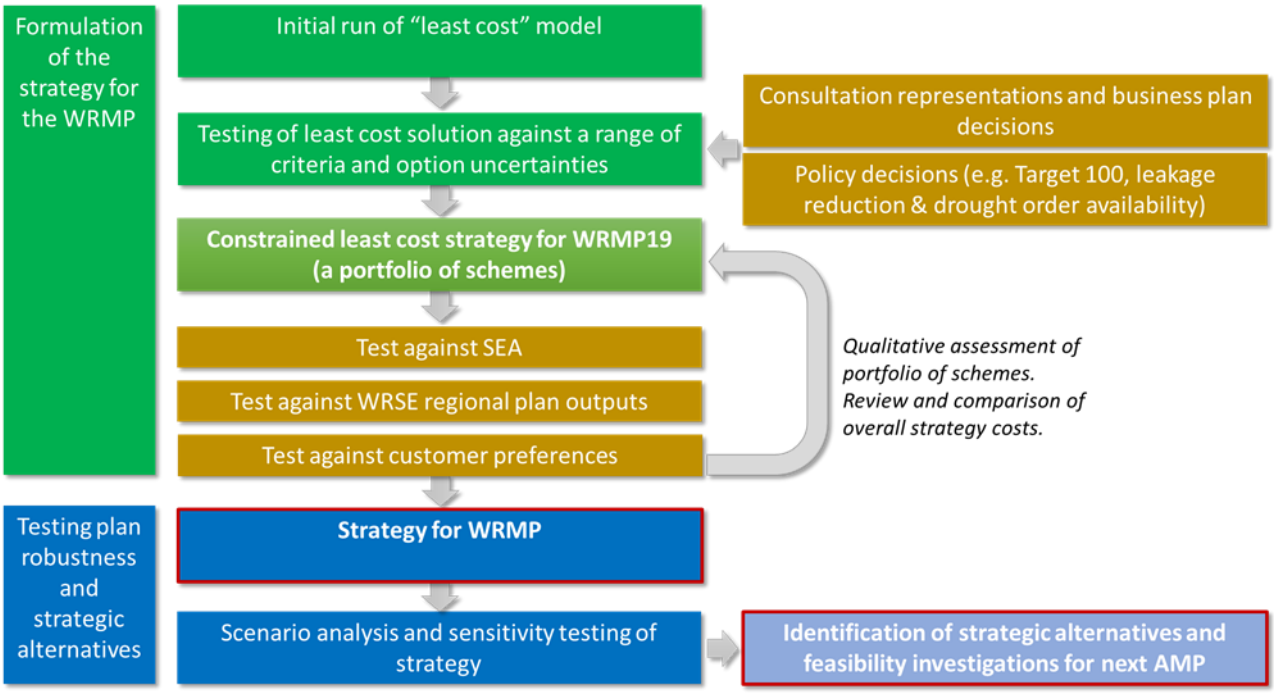
2. Development of the preferred plan

As described in Annex 8, an initial phase of scenario testing was conducted to help understand the sensitivity of the strategy to various possible constraints. The purpose of this testing was ultimately to inform the selection of our plan.

As shown in Figure 4, an initial 'least cost' run was undertaken to develop a 'basic solution', without further consideration of potential constraints. This was then tested by, for example, modifying assumptions about availability of certain options to progress our understanding of the impacts these assumptions might have on the strategy.

From examination of the various model outputs, and taking into account our policies, business planning decisions and pre- and post-consultation discussions with regulators and stakeholders, policy decisions and refinements were introduced to reflect a **'constrained' least cost strategy**. The policy decisions were in regard to the inclusion of water efficiency assumptions, the policy of leakage reduction (aiming to achieve a 15% reduction by 2025 and 50% reduction by 2050) and the availability of Drought Permits/Orders in severe and extreme drought events.

Figure 4 Development of final WRMP strategy



As discussed in detail in Annex 8, the constrained least cost strategy was then examined and tested against:

- Strategic Environmental Assessment (SEA) criteria
- Outcomes from regional planning exercises (Water Resources in the South East - WRSE)
- The preferences for different option types arising from customer engagement activity

Overlaying the environmental, regional planning and customer preference considerations on the constrained least cost strategy does not necessarily mean it will need to be changed – i.e. it may already adequately address key considerations from these criteria. Additionally, although some schemes may score less favourably against the SEA, regional plans or customers' preference considerations, the non-availability of suitable, better alternatives or the size and timing of the deficit faced may mean that some options nevertheless need to be retained in the feasible list. It is also possible that these criteria could sometimes contradict each other – e.g. a scheme identified from

WRSE may not align with, say, customer preferences; in which case, the company must exercise its judgement to weigh the pros and cons of a given scheme and the alternatives that would otherwise be needed. This represents a process of **qualitative multi-criteria assessment**.

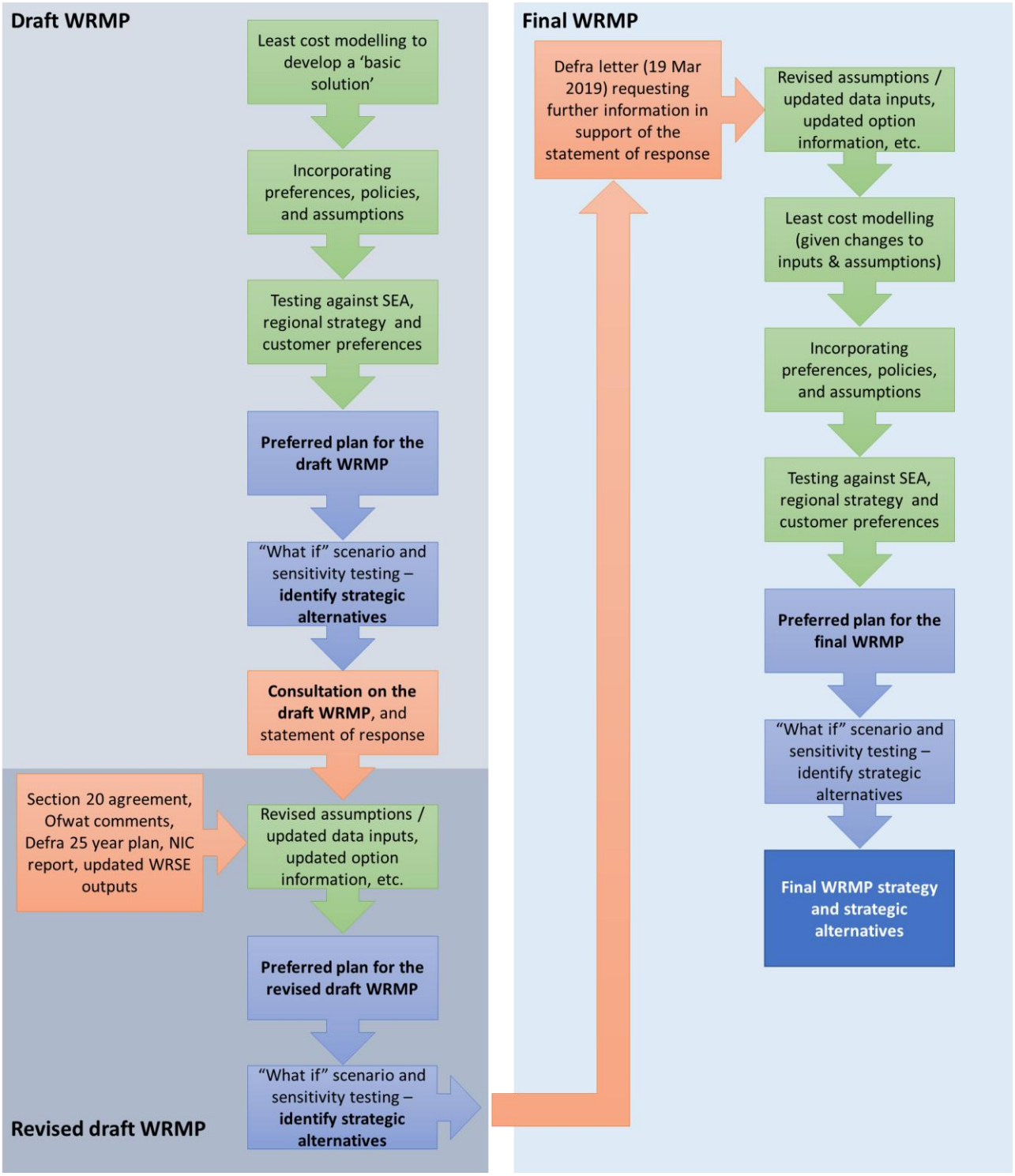
The process of testing the constrained least cost plan against the environmental, regional and customer preferences criteria was therefore iterative. The other key element considered was the relative impact of the changes influenced by testing against criteria in terms of the overall strategy cost, compared to the least cost model and to the constrained least cost strategy. For example, where there is little cost difference and the change of option provides a more positive outcome to one or more of the testing criteria, then there is a stronger case for including the option change as part of the strategy.

Following this review, any refined decisions on the feasibility or applicability of options was fed back into the Real Options Appraisal model to solve the supply-demand balances for each future to derive the **strategy for this plan**.

The strategy for this plan was then subjected to scenario and sensitivity testing to understand whether there were key alternative strategies that we should seek specific feedback on during consultation on the plan, and also to understand what alternative strategic schemes may be needed, should it not be possible to implement the schemes in the plan. This is particularly important for those schemes in the strategy that are required in AMP7 or AMP8. Where there may be some uncertainty around the delivery of these schemes, we may need to conduct feasibility investigations of alternative schemes (and potentially environmental surveys and planning activities) in parallel to developing the portfolio of schemes selected in the preferred strategy.

The draft WRMP strategy was published for consultation with customers, stakeholders and regulators. The responses received during consultation helped us to adjust the assumptions or inputs used to derive the SDBs, as well as to the set of options that are available to meet forecast deficits. The development of the plan as presented in the final WRMP has therefore been an iterative process, in which the above decision making approach was repeated and refined in production of the final WRMP following consultation on the draft WRMP. The process that we followed for the production of our WRMP is summarised below.

Figure 5 Development of the strategy from draft to final WRMP



2.1 Outcomes from the 2018 Inquiry

The 2018 Public Inquiry was instigated following a challenge by Southern Water to the EA's proposed variations to a series of its abstraction licences. The need for licence changes for more sustainable abstraction was never a principle that was opposed by Southern Water. Southern Water's concern was that, particularly during times of drought, the conditions were such that they had the potential to impede the ability for the company to meet its statutory duties to supply public water.

The Inquiry hearing opened on March 13, 2018. It focused on a proposed operating agreement between Southern Water and the EA under Section 20 of the Water Resources Act 1991 ("The s20 agreement"). The s20 agreement had been drafted following submissions of evidence to the Inquiry in the preceding weeks and as a result of both parties reaching a better understanding of the critical issues presented by the other.

During the course of the Inquiry the s20 agreement was finalised and an outline package of monitoring, mitigation and Habitats Regulations compensation measures prepared. The s20 agreement was signed and presented to the Inquiry at its closure on 29 March 2018. The determination of the Secretary of State on the Inquiry was received on 25 February 2019.

The s20 agreement enables a new, positive way forward for both parties, for public water supplies and for the habitats and ecology of the River Itchen and River Test. Southern Water accepts the abstraction licences changes. The EA commits to procedural reassurances around how Southern Water can utilise the Drought Permit and Drought Order process to maintain public water supplies pending the implementation of new reliable water supplies to replace the water resources lost by the licence changes. This is therefore a short to medium solution for the duration of the s20 agreement. It is not a permanent arrangement and is referred to within the s20 agreement as the "interim abstraction scheme".

Southern Water also commits to a significant package of environmental monitoring and mitigation measures associated with the potential Drought Permits and Drought Orders that may be needed over the next ten years or so. It has been agreed that many of these measures will be carried out in advance of (and irrespective of the implementation of) any Drought Permit or Drought Order meaning that there is an overall positive benefit to the environment.

The main elements of the s20 agreement have now been incorporated into both our final Drought Plan and this final WRMP.

The final WRMP has also been updated to reflect the commitments we gave in the s20 agreement. In particular, we agreed to use “all best endeavours” to implement measures to develop alternative water resources to replace water that is effectively “lost” through the licence changes, which came into force on 15 March 2019, and to respond to other factors influencing our forecast future supply-demand balance (SDB).

At the end of the Public Inquiry the EA referred in their closing statements to the prospect of further review of the proposed hands-off flow (HoF) conditions on the River Itchen licences at the point of intended renewal in 2024. Whilst these revisions still have to be investigated during the next AMP (2020-2025, referred to as AMP7) the last independent review of the HoF conditions proposed a flow condition of 224Ml/d, which is higher than the current proposed conditions of 198Ml/d. Therefore, in order to have long-term regard to an anticipated further reduction in abstraction, we used the estimate of 224Ml/d as the potential new HoF condition on the River Itchen licence in order to assess the likely impact on the supply forecast post-2024. We included the impact of this additional sustainability reduction on the River Itchen from 2024 in the baseline supply forecast in our revised draft WRMP. It was deemed prudent to do so, given that it was raised in evidence during the Public Inquiry.

The rationale was to ensure that the solutions we are developing for the Western area are capable of accommodating this additional change to the licence over and above those which were proposed and agreed during the Inquiry (and which have now been implemented, as of 15 March 2019). This additional change could occur as soon as the next AMP and there may therefore be limited time to develop and implement an alternative source to address the licence change. We felt it was critical that this was included in the analysis and planned for as not including it could delay the programme for developing a solution for the area, as agreed with the EA in the Section 20 agreement, because it may require a later revision to planning application documentation, or trigger entirely different schemes.

However, as instructed by Defra in its letter dated 19 March 2019, we have revised this assumption, and have included the uncertainty associated with this further sustainability reduction. This is consistent with the consideration of other uncertain and unconfirmed sustainability reduction in our plan, across all supply areas.

We have had to make a pragmatic assumption of the possible HoF that could be imposed by the EA, based on best available evidence, but as Defra's letter (of 19 March 2019) states, this is not yet confirmed. Hence, we are planning in the face of uncertainty. Our approach aims to ensure we are as robust as possible in the face of that uncertainty. It is important to remember that many decisions do not lie entirely with Southern Water – many will require timely decision-making by planning authorities and regulators, including Ofwat, the EA, Natural England, DWI and Defra.

It must be noted that, until we reach the point at which the branches diverge (from 2027 onwards), there is a common supply-demand deficit based on the middle (50th percentile) branch. This is described in detail in Annexes 8 and 9. Therefore, we are effectively including and planning for the additional Itchen sustainability reduction in 2024, even where we have allowed only for the uncertainty associated with the unconfirmed sustainability reduction on the Itchen in 2024. The only difference is that there then may be a reduction in the deficit from 2027 onwards in some of the lower deficit branches (reflecting the potential that the additional Itchen sustainability reduction may not materialise).

The distribution used for the three different sustainability reduction cases reflects our experiences of the sustainability reductions process over the last few AMP cycles. For example, we were unable to include a sustainability reduction for the Test in our draft WRMP14 (published in May 2013), yet by the time of the draft plan for WRMP19, we faced the prospect of a licence change leading to the full loss of deployable output (DOO of this source, which was confirmed following a Public Inquiry held in March 2018. This had a significant impact on the SDB for the Hampshire Southampton East (HSE) and Hampshire Southampton West (HSW) water resource zones (WRZs) within a short 5 year timeline. We believe our approach is therefore a reasonable and pragmatic attempt to account for the uncertainty around potentially very significant impacts of sustainability reductions on our supply-demand balance.

The timing of most of the sustainability reductions is another critical factor. Except for the confirmed and the additional sustainability reduction on the Itchen, the other sustainability reductions are assumed to occur in 2027. This does not allow much time to plan for and develop new resources to address the deficits that would result. Through our real options modelling, we can assess how these and other uncertainties related to growth and climate change, may affect the plan, and select a preferred plan that can address whichever "future" we actually end up with.

2.1.1 Impact on the bulk supplies from Portsmouth Water

We have reviewed our assumptions around future unconfirmed sustainability reductions and the reliability and alignment of our yield assessments for sources close to the River Itchen and with those carried out by Portsmouth Water for their surface water abstraction on the River Itchen. The approach to assessing DO on the River Itchen is reflected in Annex 3.

An important consideration is to align our assumptions on the sustainability reductions and potential sensitivity to DO on the Lower Itchen such that both companies are consistent in their approach. This may consequently have a bearing on assumptions around the resilience and reliability of bulk supply arrangements between Portsmouth Water and Southern Water.

We recognise that we have employed a different methodology to Portsmouth Water for our DO assessments in the Lower Itchen catchment. As our Lower Itchen DO assessment methodology is readily adaptable, we carried out an initial yield assessment for the Portsmouth Water source consistent with our modelling methodology, and have shared this assessment with Portsmouth Water, and both companies were in agreement over the conclusions of that analysis.

We have assumed that the DO from the Portsmouth Water bulk supply (dependent on them having developed Havant Thicket reservoir) can be maintained at the proposed bulk supply volume of 21Ml/d for our preferred planning model runs. Portsmouth Water and Southern Water are committed to meeting on a regular basis to discuss ongoing investigations and the delivery of schemes in order to keep each other informed of emerging risks to each company's respective water resources strategies. This bilateral liaison will be in addition to discussions at a regional scale through the WRSE group of companies. We will continue to work towards a common assessment approach to resource assessment on the River Itchen.

2.2 Policy decisions to reflect a 'constrained' least cost strategy

2.2.1 Application of 'Target 100' water efficiency policy

In the draft WRMP the company outlined its commitment to delivering its 'Target 100' water efficiency policy, which aims to achieve a per capita consumption (PCC) of 100l/h/d by 2040 (for clarity, this relates to average household PCC under normal year annual average conditions). This is well-aligned with Defra's 25 Year Environment Plan (Defra, 2018) which states that "*We will work with the industry to set an ambitious personal consumption target and agree cost effective measures to meet it*".

This policy formed a key component of the draft strategy, yet has been made more explicit in the subsequent revisions to the plan, by drawing it out from the baseline demand forecast as a costed option. The Target 100 option developed for this WRMP supersedes many of the discrete demand management options that were included in the draft WRMP. It now comprises a basket of measures that Southern Water will need to adopt in order to deliver the highly ambitious reduction in PCC it is aiming for. The details of the option are described in Annex 6.

The least cost plan did actually select the 'Target 100' options in some WRZs, but our policy decision was to ensure it was implemented in all WRZs to form a key part of the preferred strategy.

2.2.2 Application of leakage reduction policy

Managing leakage is an important part of our water resources strategy. A low level of leakage is desirable, both for the environment, and because it defers the need to invest in new resources which would otherwise be required to meet increases in demand over time. However, it is not necessarily economic to reduce leakage to very low levels, because to do so could involve very large additional costs for relatively small savings of water. Our approach, and that of our regulators, is to set leakage at a level that meets the expectations of our customers and society as a whole, but is not necessarily optimal in terms of least cost. Our draft WRMP set out a combined strategy of further active leakage control in the short term followed by mains replacement programmes in the medium to longer term to ensure that we continue our drive down on leakage by 15% by 2025. We have maintained this commitment to meet Ofwat's leakage reduction target of 15% (from current levels) by the end of the next AMP in this revised plan. We have also now increased this commitment in the final WRMP,

following recommendations in the recently published National Infrastructure Commission (NIC) report that companies should aim to be much more ambitious in terms of potential leakage reduction; as a result, we have committed to meeting the aspirations of that report to achieve a 50% reduction in leakage from current levels by 2050.

We also had developed, prior to the NIC report being issued, our own target of achieving 40% reduction from current levels by 2040, and so we have adopted this as an interim target as part of our leakage reduction policy.

The leakage reduction activity proposed to achieve these profiles of reductions are described more fully in Appendix C of Annex 6.

In order to meet our new leakage targets we will require investment in new and innovative activities, such as using artificial intelligence to control pressure reduction valves to reduce leakage and bursts, and installation of new smart meter devices to help customers both reduce demand and reduce supply side leakage. In common with other companies we have been set very stretching efficiency challenges by Ofwat to deliver all AMP7 targets, but we are committed to making a material reduction in leakage

We have adopted a policy decision that the leakage profile described above should form part of the preferred strategy. The preferred plan has therefore been set up to ensure that 15% reduction is achieved by 2025, and 50% by 2050.

2.2.3 Application of drought interventions

Section 39B(2) of the Water Industry Act, requires the company when planning for drought, to plan to supply adequate quantities of wholesome water, with as little recourse as reasonably possible to drought orders or Drought Permits. In ensuring compliance with this, previous Water Resource Planning Guidance (WRPG) only required planning to be based on the worst historic event and water resource planning was not required to take into account wider severe drought conditions. The WRPG for WRMP19 has changed to now recognise the need for resilience in a severe drought condition (a 1 in 200 year drought event). Our previous WRMP14 already planned to a severe drought (1 in 200 year drought event) without any recourse to Drought Permits and Orders. **Planning in line with the WRPG therefore already reflects a continuation of our level of service**. We have therefore chosen our States of the World to carefully reflect the levels of service.

However, in this WRMP, we have also sought to understand the impacts of more extreme drought events (1 in 500 year drought event), as this aligns with the latest thinking around drought resilience (e.g. as reported in the recent National Infrastructure Commission report which highlighted the need for increased drought resilience to reduce or minimise the significant economic impacts of 'level 4' drought restrictions (stand pipes and rota cuts)).

In line with our continued practice of moving water resource planning forward, we have **only allowed Drought Permits and Orders to be selected in the investment model in an extreme drought event** (1 in 500 year drought event) so as to ensure that the WRMP can be resilient to a level in line with guidance, in line with our levels of service and in line with the requirement to plan with as little recourse as reasonably possible to drought orders and Drought Permits. It also means that the selection does not drive excessive infrastructure; but it still allows a progressive and pragmatic approach to exploring extreme drought events.

However, adopting this approach where we do not allow Drought Permits/orders in the severe drought (1:200) condition could result in unsolvable deficits in the short term if there are no supply-side options that could be developed quickly enough to solve any initial deficits in the severe drought condition. This occurs in this area in particular as a result of the scale of the supply-demand deficit from the implementation of the Test and Itchen sustainability reductions, which means that there are

no suitable options to solve the planning problem in the short term. It could also result in a non-optimal plan, where an option is only selected because of its availability early in the planning period, rather than it being an optimal longer-term option. Under the EA's Water Resource Planning Guidelines, allowing Drought Permits / Orders in a 1:200 level of drought is acceptable. The only constraint specified is that companies' plans must set out a reference level of service that would ensure resilience to a 1:200 year drought event, where resilience means only avoiding emergency drought orders that allow restrictions such as standpipes and rota cuts. Our approach of allowing Drought Permits / Orders in our severe drought condition would therefore compliant with the WRP Guidelines.

A policy decision was therefore made to **allow an interim period where Drought Permits/Orders would be used in both severe and extreme drought conditions**.

For the Western area **this interim period is set out in the Section 20 agreement**, which is valid until 2030. The aim of the agreement was to ensure that the Company could meet its statutory duty through a combination of a modified Drought Permit process, the inclusion of a force majeure clause in the River Test licence and the delivery of infrastructure, aiming for 2027. On review of the results, it was also apparent that size of the solution was also highly dependent on the deficits in AMP8, before options such as the Portsmouth Water bulk supply (dependent on Havant Thicket reservoir development) become available. As a result, a policy decision was made to **continue to allow the Test Drought Permit to be available in the severe drought condition until 2028-29** (inclusive). Therefore, it is only from the last year of AMP8 (2029-30) that the model solves the severe drought condition without the benefit from any Drought Permits / Orders.

After the interim period end point, Drought Permits/Orders would only be available for selection under the extreme droughts. This compromise ensures that the target Level of Service is met and that we continue to work to improve our resilience to drought. The model was therefore allowed to select Drought Permits and Orders on this basis.

It is important to recall that all the states of the world must be solved simultaneously in the Real Options model. What we are examining when we look at both the severe and extreme states of the world is thus the balance in the solutions between the portfolio of options needed in severe droughts without drought interventions (except in the short term), with that same portfolio of options in combination with drought interventions in extreme droughts. We are effectively examining whether we have sufficient options to meet differing levels of drought when considering that drought interventions would also be available to be used in extreme droughts. But we are also recognising that these drought interventions may not be available in all WRZs in a supply area, and that the connectivity between WRZs may be limited. Our analysis therefore considers the resilience of transfers between the WRZs, and the potential need for increased connectivity.

In regard to the demand-side drought interventions, we have added a dependency to the selection of a Drought Permit / Order in the model, such that it must have also selected the TUBS and Non-Essential Use restrictions.

2.3 Influence of testing criteria on the constrained least cost strategy

2.3.1 Environmental assessment

This assessment is used to address whether the combination of options and timing of the need for them presents particular risks or have planning and promotional issues that might affect the deliverability of the scheme or schemes. It represents a second stage of the environmental screening that is a key part of the options appraisal process to develop a feasible set of options; however, timing of option implementation and cumulative impacts are clearly important additional considerations, as well as feedback from consultation responses on certain options.

For the Western area, the constrained least cost strategy (as previously described in the start of section 2 and also in Annex 8) was reviewed and the following decisions made in relation to the development of the preferred plan due to applying environmental assessment criteria were:

- **Itchen water reuse schemes**: there was some concern about the potential objection risks associated with application of the Combined Standards Monitoring Guidance (CSMG) which may be applied as policy by Natural England, and which would potentially govern not just WQ levels but also the range of flows around a “natural” range. Fisheries is another key environmental area at risk of possible objection from the EA.
  As a result, the Itchen water reuse options were excluded in comparison to desalination options, which although they also have risks on environmental grounds, were felt to pose less of an implementation risk than the Itchen water reuse schemes.
  Both the Itchen water reuse and the desalination options sets are able to provide, either separately or in combination, the water needed to satisfy the large deficits associated with the Itchen and Test sustainability reductions. There are limited alternative options, that are not already selected and available in the timescales needed

2.3.2 Regional planning

A cross-check was conducted against the outputs from the Water Resources in the South East (WRSE) modelling scenarios along with a review against bi-lateral discussions we have held, and continue to have, with neighbouring water companies covering bulk supply needs and timing / need for any schemes that could be jointly developed.

For the Western area, the constrained least cost strategy was reviewed and the following decisions made in relation to the development of the preferred plan from a regional planning perspective:

- **Additional import from Portsmouth Water (additional 9Ml/d)**: Option for import from Portsmouth Water, which increases connectivity across the region and aligns with regional water trading drivers (making use of spare resources in neighbouring areas)
- **Additional import from Portsmouth Water (Havant Thicket reservoir)**: Option for further import from Portsmouth Water, based on development of the Havant Thicket reservoir, which increases connectivity across the region and aligns with regional water trading drivers (making use of spare resources in neighbouring areas)
- **Import from Bournemouth Water**: Option for import from Bournemouth Water, which increases connectivity across the region and aligns with regional water trading drivers (making use of spare resources in neighbouring areas)

A decision was made to implement all of the above three supplies at their earliest start dates. These options provide increased strategic regional connectivity with the consequential benefit of increased regional resilience. The design of these schemes could also consider (though were not for the purpose of this plan) reversibility of inter-company connections to increase resilience against outage and events such as extreme droughts, heatwaves, freeze-thaw, pollution or even terrorism.

2.3.3 Customer preferences

As discussed in Annexes 1 and 8, the company has undertaken quantitative and qualitative research into customer preferences relevant to the WRMP. Representations were also received from customers, stakeholders and regulators in response to the consultation on the draft WRMP.

The customer preference studies and representations, and those from the previous WRMP (published in 2014), have informed the development of the company's stance on appropriate levels of service and, together with feedback from stakeholders, has helped us to understand views and preferences on the supply and demand management options that make up our options set. It has been applied to the development and formulation of our preferred strategy by excluding options that were not likely to meet customer or regulator expectations in the options appraisal. Where there are some differences in the outcomes from different customer research we have set out our proposed way forward which either involves aligning with Government ambition, regional strategies or the informed customer position with a provision to gain further insight to help deliver some of these options.

For the Western area, the constrained least cost strategy was reviewed and the following decision made in relation to the development of the preferred plan from a customer preference perspective:

- **Target 100 water efficiency policy and leakage reduction policy**: both broadly supported by customers, which in turn supports the company's decision to implement these policies

2.4 Other decisions to conclude development of the preferred plan

A number of other decisions were also made to derive the preferred plan as part of the iterative and qualitative process of reviewing and updating the constrained least cost plans.

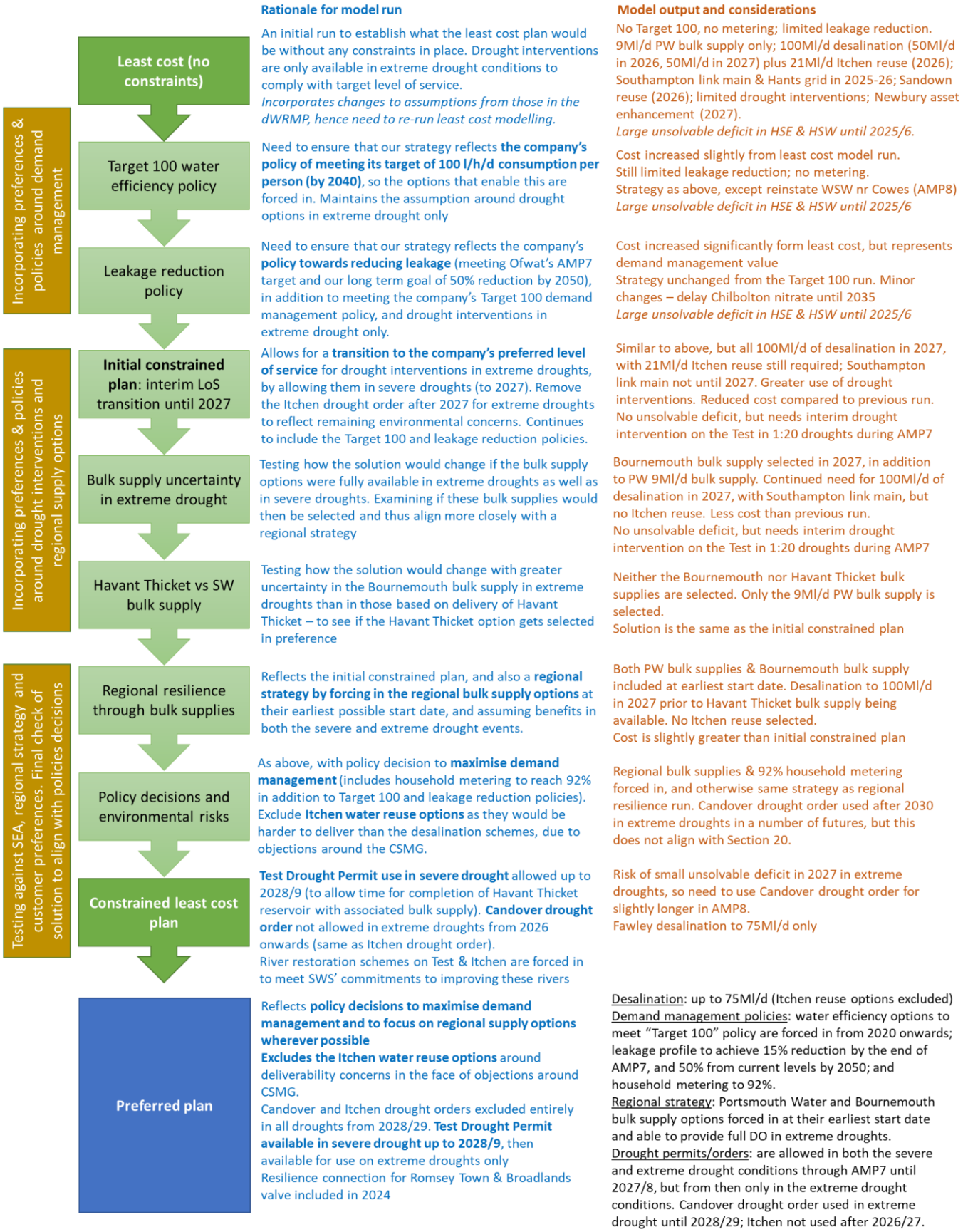
- **Extension of the Universal Metering Programme to take household meter penetration from 88% to 92%**: A policy decision was made that, where a desalination option was selected in the short to medium term (i.e. before 2030), then the company would try to maximise its demand management activity. As a result, we 'forced' the option to be selected to extend the compulsory meter programme to take household meter penetration from 88% to 92%. This option commences in 2020, with the aim of reaching 92% metering in each WRZ in the supply area by the end of AMP7. It also aligns closely with our Target 100 water efficiency policy
- **New bulk supplies from Portsmouth**: the availability of the water from these sources in an extreme drought is uncertain. We looked at various scenarios around assuming that the full benefits available in the severe drought would also be available in the extreme drought, as well as assumptions where the benefit was assumed to be (arbitrarily) 50% of the severe drought volume. For the preferred plan, we have assumed that the benefit in the extreme drought will be the same as the severe drought
  The rationale for this was that it should be possible to optimise the conjunctive use operation of sources to provide greater resilience of supplies, and we are planning to work with Portsmouth to investigate this further. We have also explored the uncertainties around the availability of water from Portsmouth in the scenario and sensitivity testing of the preferred plan, as described in section 4 below
- **Bulk supplies from Bournemouth**: Analysis of water available to us was that the supply would be available up to the severe drought only. The scheme benefit in the extreme drought was therefore initially assumed to be zero; however, we also included scenarios where the full amount from the severe drought would be available in the extreme drought. For the preferred plan, we have assumed that the benefit in the extreme drought will be the same as the severe drought

The rationale for this was that the source for the supply is likely to be from the Avon, and therefore, we believe that the low flow characteristics are likely to be similar to the Test and the Itchen. From our experience of the reliability of these sources of water, we estimate the vulnerability of the Avon would be relatively low. Further work will be undertaken to explore this assumption with South West Water, as well as looking to optimise the operation of the two systems to increase resilience. We have explored the uncertainty around the availability of water from the south west in the scenario and sensitivity testing of the preferred plan, as described in section 4 below

2.5 Summary of modelling process to support selection of preferred plan

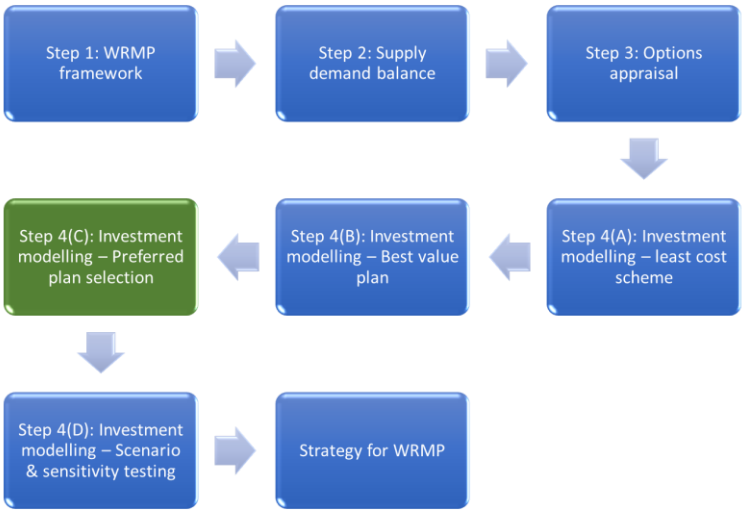
The figure below presents a summary of the modelling undertaken to support the selection of the preferred plan. The components of the preferred plan are described in more detail in section 3 below.

Figure 6 Summary of modelling runs to support selection of the preferred plan



3. Strategy for the WRMP (preferred plan)

3.1 Portfolio of options selected in the strategy



This section is structured to provide an overview on each of the key option categories from the feasible list of options.

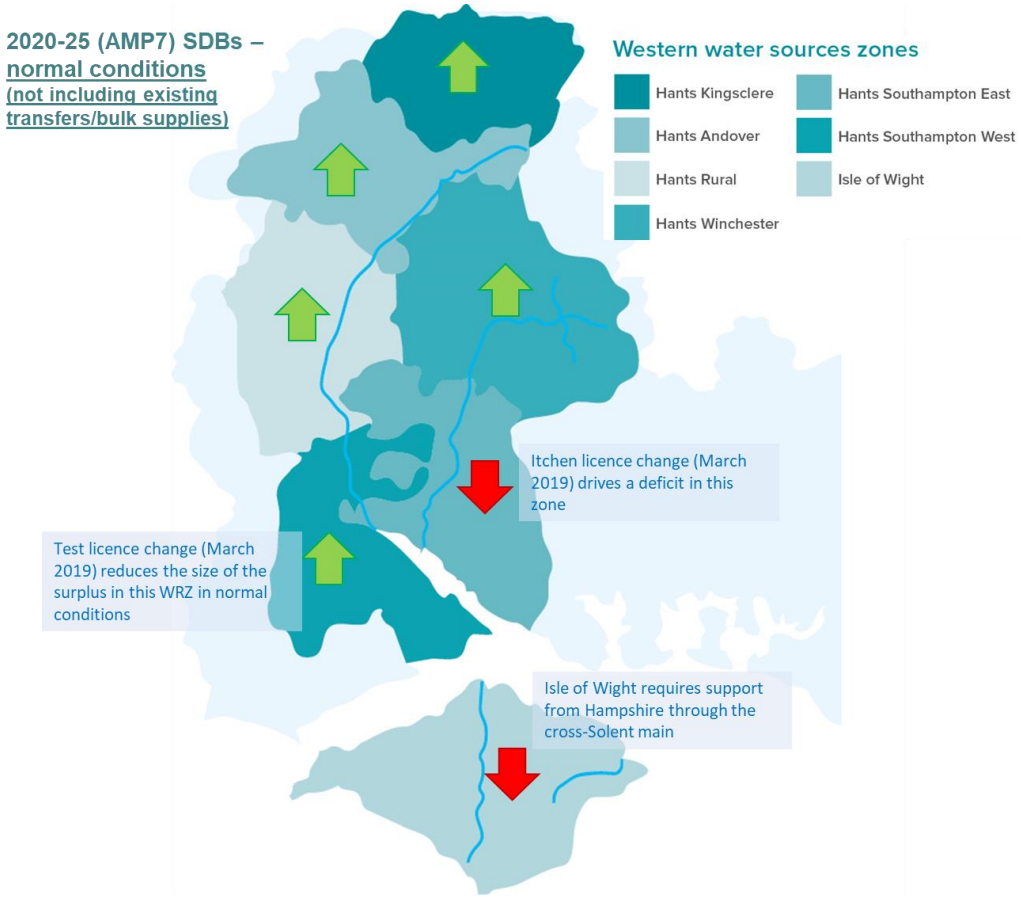
For new supply-side options such as desalination and water reuse, it will be necessary for pilot plants, detailed engineering and environmental assessments to be undertaken and for planning and other consents to be secured to allow the schemes to be constructed and commissioned. For transfers from other water companies there may be a need for asset enhancements, and/or for the development of new water resources within those companies in order to free up water to make the transfer available. The timings within this plan are our best estimates for delivery at this point in time.

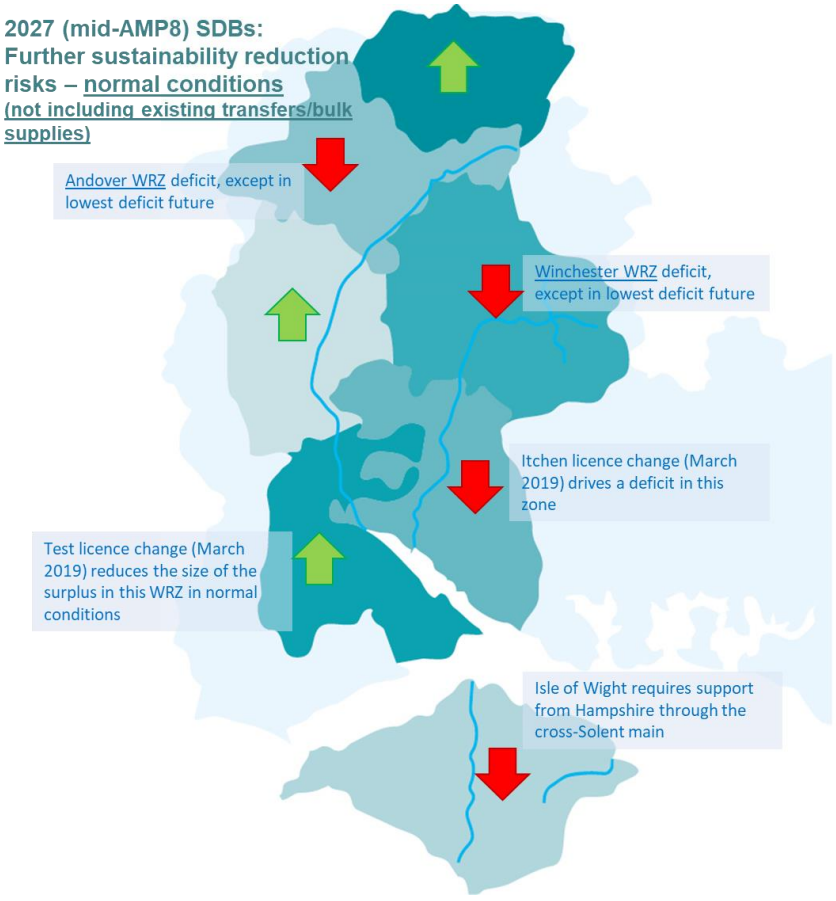
3.1.1 What is driving the need for investment?

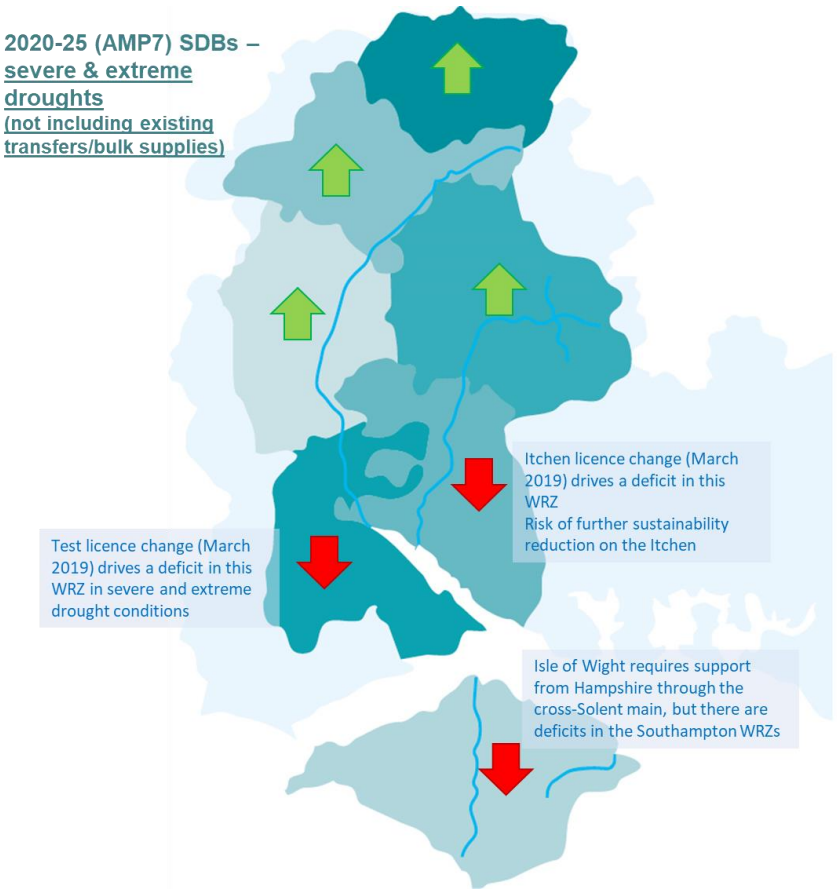
- Our Western area has traditionally not experienced water shortages like our other supply areas and has not had a hosepipe ban imposed to restrict customers' supplies. There was historically sufficient water available within our abstraction licences to provide secure supplies to customers. However, the changes to abstraction licences on the River Itchen, the River Test and the Candover Stream, which came into force on 15 March 2019, together with further abstraction licence changes that may be identified, have fundamentally changed the water resources position in Hampshire and the IOW WRZ.
- Our strategy for securing public water supplies in the Hampshire and the IOW WRZs is thus driven by the implementation and scale of the sustainability reductions on the River Itchen and on the River Test, which results in significant deficits in the supplies available to meet demand for water – affecting the HSE and HSW WRZs respectively. Without these sustainability reductions, Southern Water would not have a supply-demand deficit and would not need to promote new water resource developments. This also means that drought interventions are needed prior to new resources being available;
- The deficits faced in the other Hampshire WRZs (Hampshire Rural (HR), Hampshire Winchester (HW), Hampshire Andover (HA) and Hampshire Kingsclere (HK)) tend to be smaller initially (or these WRZs are in surplus), although under some of the sustainability reduction scenarios faced under the different 'futures', the deficit can become significant from 2027.
- The IOW WRZ is in deficit but has traditionally been supported by the HSW WRZ through the existing cross-Solent main. However, as the Test (and Itchen) sustainability reductions have been implemented, the support to the IOW WRZ has become constrained.

The baseline position over AMP7 and 8 for each WRZ is shown in the series of plots in Figure 7. These provide a simple visual representation of the zones with a surplus (green arrow) or deficit (red arrow), without allowance for any bulk supplies or inter-zonal transfers.

Figure 7 Supply-demand balances over AMP7 and AMP8 in normal and drought conditions (excluding existing inter-zonal transfers and bulk supplies)






2020-25 (AMP7) SDBs – severe & extreme droughts (not including existing transfers/bulk supplies)
Itchen licence change (March 2019) drives a deficit in this WRZ
Risk of further sustainability reduction on the Itchen
Test licence change (March 2019) drives a deficit in this WRZ in severe and extreme drought conditions
Isle of Wight requires support from Hampshire through the cross-Solent main, but there are deficits in the Southampton WRZs

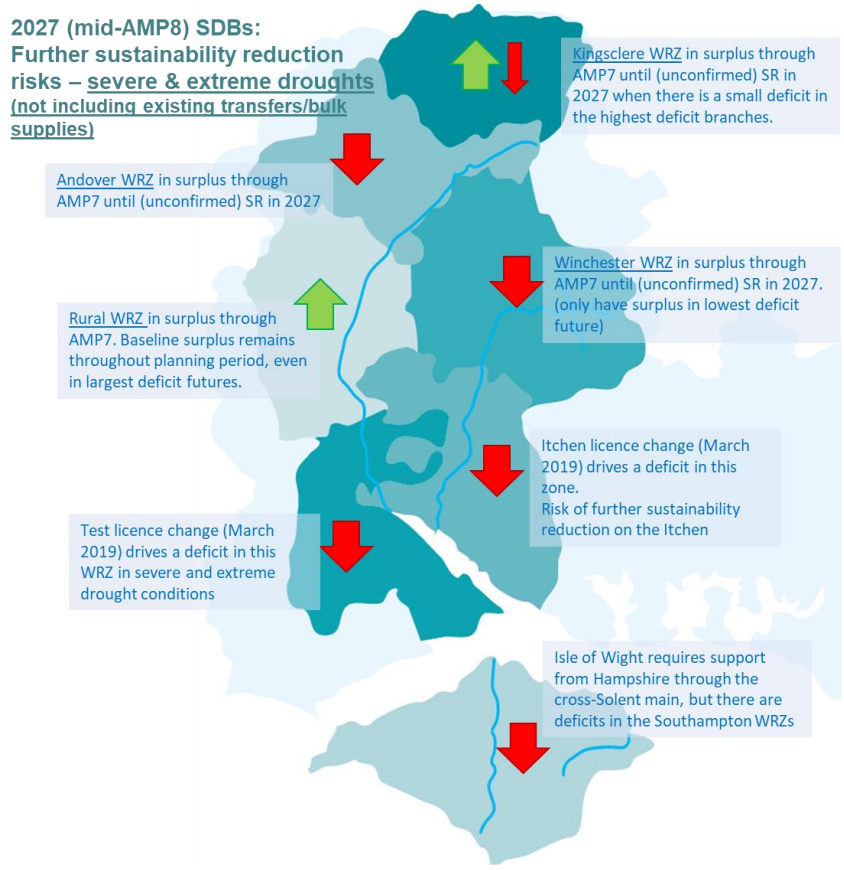

2027 (mid-AMP8) SDBs: Further sustainability reduction risks – severe & extreme droughts (not including existing transfers/bulk supplies)
Kingsclere WRZ in surplus through AMP7 until (unconfirmed) SR in 2027 when there is a small deficit in the highest deficit branches.
Andover WRZ in surplus through AMP7 until (unconfirmed) SR in 2027
Winchester WRZ in surplus through AMP7 until (unconfirmed) SR in 2027. (only have surplus in lowest deficit future)
Rural WRZ in surplus through AMP7. Baseline surplus remains throughout planning period, even in largest deficit futures.
Itchen licence change (March 2019) drives a deficit in this zone.
Risk of further sustainability reduction on the Itchen
Test licence change (March 2019) drives a deficit in this WRZ in severe and extreme drought conditions
Isle of Wight requires support from Hampshire through the cross-Solent main, but there are deficits in the Southampton WRZs

Table 2 below summarises the supply-demand deficit that needs to be solved (for the severe MDO planning condition) across the Western area, and how this varies in the different branches.

Table 2 Initial supply-demand deficit in the severe MDO state of the world

Western: Preferred Plan	Initial supply-demand deficit (end of AMP) (Ml/d) (Severe drought MDO)					
	2020-25 (AMP7)	2025-30 (AMP8)	2030-35 (AMP9)	2035-40 (AMP10)	2040-45 (AMP11)	2045-2070
10th %ile branch	-125	-205	-207	-210	-213	-228
30th %ile branch		-195	-197	-199	-201	-214
50th %ile branch		-186	-188	-189	-191	-202
70th %ile branch		-174	-175	-176	-177	-185
90th %ile branch		-125	-127	-128	-130	-140

3.1.2 Summary of strategy

The cost of this strategy (which is referred to as Strategy A in our draft plan, and which we will need to deliver under the terms of our Section 20 agreement) over the planning period, expressed in net present value terms, is £1,035m. The **key elements of the strategy** are:

- A drought intervention option is needed for the River Test in the drought state of the world in the early years of AMP7 only, which if such an event were to occur would mean that we would be at risk of not meeting our target level of service for implementing Drought Permits and Drought Orders to increase supplies
- The Test Drought Permit / Order is required in the severe and extreme drought states of the world in the period 2020-28, and then in the extreme drought state of the world only from 2029 onwards through the planning period in all branches
- The Candover Drought Order is required in the period from 2020-26 in the severe and extreme drought states of the world. This Drought Order is then used in the extreme droughts in 2027 and 2028, but is not available to be used after that (in accordance with the s20 agreement)
- The Itchen Drought Order is required in the period from 2020-26 in the severe and extreme drought states of the world. This Drought Order is not selected from 2027 onwards, and is not available from 2029, even in extreme droughts;
- The Drought Permits / Orders for sources on the IOW WRZ are needed in the early part of AMP7 (2020-21)
- We have adopted a very strong focus on demand management activity through implementation of the Target 100 water efficiency policy, the adoption of a leakage reduction profile to achieve reductions from current levels of 15% by the end of AMP7, and 50% by 2050, and extension of the Universal Metering Programme to take household meter penetration from 88% to 92%
- A large 75Ml/d desalination scheme is needed in the HSW WRZ. The magnitude of this scheme could be reduced if Itchen water reuse options are developed, however, these, like the desalination scheme, have associated risks which may make them harder to implement than the desalination scheme itself
- A bulk supply from South West Water from the Bournemouth area is implemented in 2027 (the earliest assumed start year)
- HSW WRZ is currently able to support HSE WRZ through existing transfers and, from 2027, a new Southampton link main will be required to allow increased support. This new link main will be reversible, which provides greater resilience in the face of outage events and other localised issued such as freeze-thaw events
- The HSE WRZ is also supported by bulk supplies –

  - The existing bulk supply of 15Ml/d from Portsmouth Water (which is assumed to be limited to 7.5Ml/d in the extreme drought states of the world);
  - A new 9Ml/d bulk supply from Portsmouth Water in 2024
  - A new 21Ml/d bulk supply from Portsmouth Water in 2029 (dependent on development of Havant Thicket reservoir)
  - The new bulk supplies from Portsmouth were assumed to be implemented at their earliest start years
- The HSW WRZ also provides support to the IOW WRZ through the existing cross-Solent main, up to a maximum of 18Ml/d
- In addition to the cross-Solent main, there is the need for a new scheme on the IOW WRZ – the preferred option is Sandown water reuse scheme (8.5Ml/d), which is needed from 2027;
- The Hampshire grid option is selected in 2027, providing reversible links between the HSE, HW and HA WRZs. The grid option is not extended to HK as a WRMP scheme (though may be considered for resilience benefits alone)
- An improvement of the Romsey Town and Broadlands valve, providing increased connectivity between HSW and HR (reversible) is included in 2024
- The Newbury asset enhancement scheme is selected in the HK WRZ in 2027;
- There are a number of sources which are at risk of exceeding nitrate thresholds, and so options to recover the lost DO from these are selected – including treatment and also importantly catchment management to improve the situation over the longer term
- Catchment management schemes addressing pesticide issues are also implemented in 2024 for the Test surface water and Sandown sources
- In-stream river restoration works on the Itchen and Test (upper reaches), aimed at improving the resilience of the environment, and are planned to be completed by 2027
- Undertake investigations of key strategic alternative schemes

This strategy is summarised below in Table 3. For new resource developments, it will be necessary for detailed engineering and environmental assessments to be undertaken and for planning and other consents to be secured and for the schemes to be constructed and commissioned. For transfers from other water companies there may be a need for asset enhancements, and/or for the development of new water resources within those companies in order to free up water to make the transfer available. The timings within the WRMP are our best estimates for delivery at this point in time, but may be updated to reflect further investigations and the outcomes of public consultation in the final WRMP. It is important to note that **slippages in the assumed timings of schemes may result in the extended use of Drought Permits/Orders at Test Surface Water and/or Candover than is otherwise intended**.

Table 3 Summary table of schemes preferred strategy

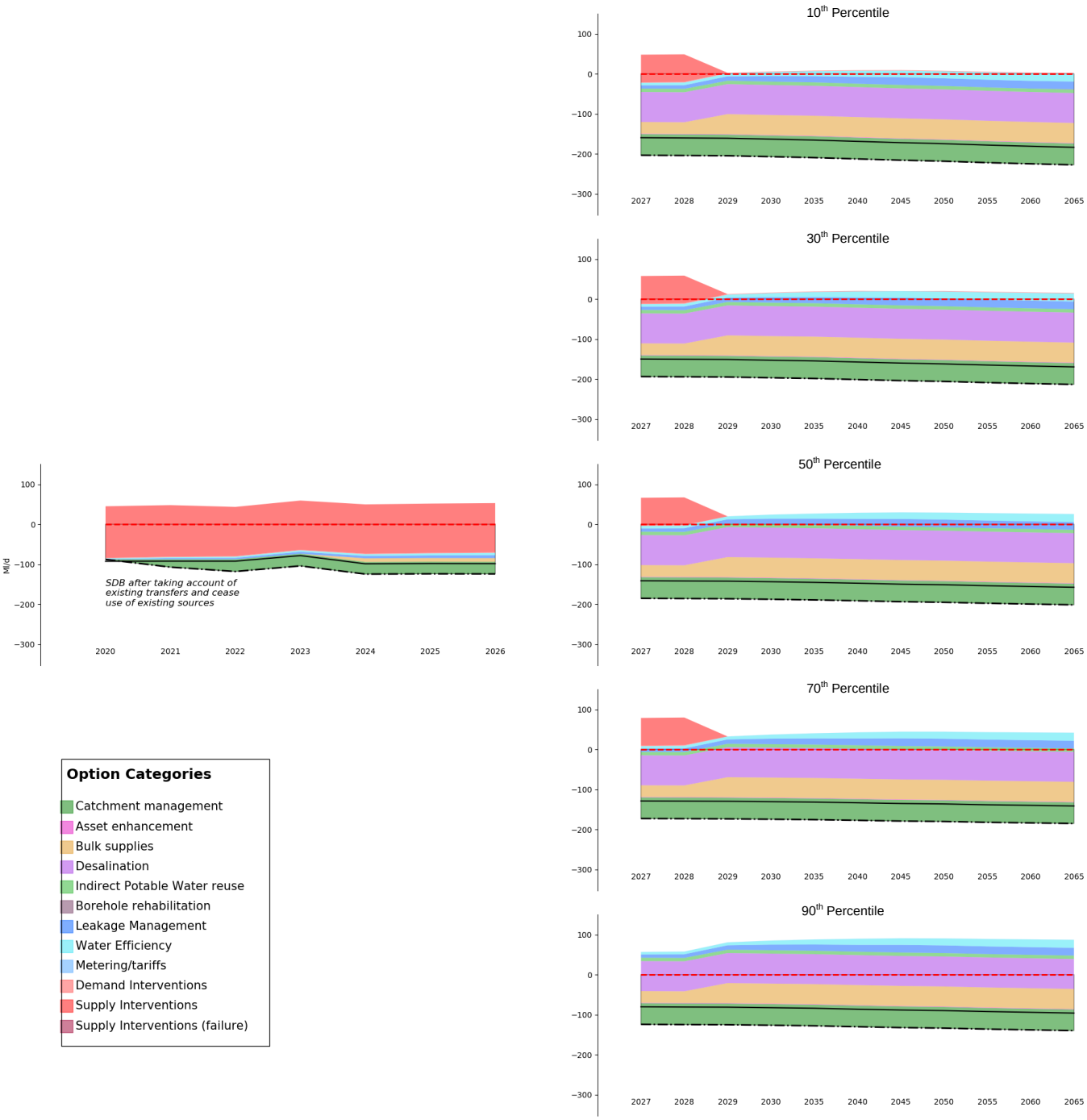
Schemes	WRZ	Main strategy (year selected)	Branches
Demand management			
Target 100 water efficiency activity	All	**2020 onwards**	Forced
Leakage reduction (15% reduction by 2025; 50% by 2050)	All	**2020 onwards**	Forced
Extension of UMP to take HH meter penetration from 88% to 92%	All	**2020 onwards**	Forced
TUBS and NEU Ban	All	**2020 onwards**	All branches
Resource development and bulk supplies			
Additional import from Portsmouth Water (additional 9Ml/d)	HSE	**2024**	Forced
Import from Bournemouth Water	HSW	**2027**	Forced
Additional import from Portsmouth Water (Havant Thicket reservoir development)	HSE	**2029**	Forced
Fawley desalination (modular to 75Ml/d)	HSW	**2027**	All branches
Sandown WwTW Indirect Potable Reuse (8.5Ml/d)	IW	**2027**	All branches

Schemes	WRZ	Main strategy (year selected)	Branches
Hampshire grid (reversible link HSE-HW)	HW & HSE	**2027**	All branches
Hampshire grid (reversible link HW-HA)	HA & HW	**2027**	All branches
Southampton link main (reversible link HSW-HSE)	HSW & HSE	**2027**	All branches
Romsey Town and Broadlands valve (HSW-HR reversible)	HR & HSW	**2024**	All branches
Newbury WSW asset enhancement	HK	2027	All branches
WSW near Cowes - reinstate & additional treatment	*IW*	*2065*	*1 branch*
Catchment management			
In-stream river restoration works on the Itchen	HSE & HW	2027	Forced
In-stream river restoration works on the Test (upper reaches)	HA & HR	2027	Forced
Pesticide catchment management / treatment – Sandown	IW	2024	Forced
Pesticide catchment management / treatment – Test Surface Water	HSW	2024	Forced
Nitrate catchment management – Chilbolton	*HA*	*2035*	*2 branches*
Nitrate catchment management / treatment – Winchester	HW	2027	All branches
Nitrate catchment management / treatment – Romsey	HR	2022	All branches
Nitrate catchment management / treatment – Twyford	HSE	2021	All branches
Drought Permits/Orders in severe and extreme droughts			
Test surface water Drought Permit / Order in drought conditions (interim measure only)	HSW	2020-22	All branches
Mitigation and monitoring activities on the Itchen (enabling option, no DO benefit)	HSE	2018	Forced
Mitigation and monitoring activities for Candover (enabling option, no DO benefit)	HSE	2018	Forced
Mitigation and monitoring activities on the Test (enabling option, no DO benefit)	HSW	2018	Forced
Test surface water Drought Permit (2020-28)	HSW	2020-28	All branches
Test surface water Drought Order (2020-26)	HSW	2020-26	All branches
Candover Drought Order (2020-26)	HSE	2020-26	All branches
Lower Itchen (g/w and s/w sources) Drought Permit / Order (for 2020-26)	HSE	2020-26	All branches
Combined IW sources Drought Permits/Orders	IW	2020-21	All branches
Drought Permits/Orders in extreme droughts only			
Test surface water Drought Permit / Order (from 2027 onwards)	HSW	2027 onwards	All branches
Candover Drought Order (from 2027-28)	*HSE*	*2027-28*	*4 branches*
Strategic alternatives and investigations			
Itchen water reuse options	HSE	AMP8	
Fawley desalination (modular 75-100Ml/d)	HSW	AMP8	
Test Estuary WTW Industrial reuse	HSW	End AMP7	
Woodside transfer valve (HSW to HSE)	HSE	AMP8	

The figure below sets out the initial SDB situation and the types of options that are selected to address the deficits. These are presented at area level over the planning period – with the common branch up until 2027 presented on the left hand side, and the 2027-2070 time period on the right hand side, presented for each of the branches (10th being highest deficit' 90th being lowest deficit). Note that because these plots are presented at area level, they do not necessarily reflect the detail for selection of all the options – for example, it may be that an option is needed to meet a deficit in a given WRZ, for which there is otherwise limited connectivity to the rest of the supply area, yet there may be surpluses in other WRZs. That is, the surplus/deficit at area level is not always reflective of the driver behind the need for an option being selected.

Nevertheless, this figure provides a useful way of presenting the deficits at key points in time and the composition of the solution to address those deficits.

Figure 8 Deficits and solutions plot for Western area through the planning period (severe drought MDO)



3.1.3 Drought Permits / Orders

Drought Permits / Orders are required to avoid deficits in the early part of the planning period from 2020 to 2026 (inclusive) in both the severe and extreme drought conditions. This is driven by the recent implementation of the sustainability reductions on the Itchen and on the Test by the EA in March 2019.

From AMP8 onwards, the approach to Drought Permits / Orders changes, in line with the principles discussed previously in section 2.2.3:

- The Itchen Drought Orders are not available in any drought event from 2028 onwards. This reflects the EA's position
- The Candover Drought Order is available to be used only in extreme drought events in 2027 and 2028 (i.e. not in severe drought events). However, as with the Itchen Drought Orders, it is not available in any drought event from 2029 onwards (in accordance with the s20 agreement, which states that the infrastructure that enables the Candover Drought Order must be decommissioned following development of the long term water resources scheme(s))
- Drought Permits/Orders at Test surface water are available to be used in both severe and extreme drought events for an interim period up to 2028, at which point the second new bulk supply from Portsmouth Water (dependent on the development of Havant Thicket reservoir) should be available
- From 2029 onwards (i.e. the last year of AMP8) the Drought Permits/Orders at Test surface water are only available to be used in extreme drought events (i.e. not in severe drought events)
- All other Drought Orders are only available to be used in 'extreme' drought events from 2027 onwards (i.e. not in 'severe' drought events)

Under **our proposed strategy** (previously referred to as Strategy A), a Drought Permit / Order is required in the HSW WRZ to recover the lost DO from Test surface water source. This is needed in the first three years of AMP7 (before new schemes are available) in the 'drought' states of the world. This presents a risk that, should these conditions occur in AMP7, we will not meet our stated target level of service for Drought Orders.

Under a severe drought, the Test surface water Drought Permit / Order is used up to and including 2028, after which point we no longer allow the Drought Permit / Order option to be available in severe drought conditions. This reflects an increase in drought resilience from 2029 onwards.

The Test surface water Drought Permit / Order is utilised in the extreme drought conditions throughout the planning period in all branches.

The Candover Drought Order is used in both the severe and extreme drought conditions up to and including 2026, and then in the extreme drought condition only in 2027 and 2028 (but not in the lowest deficit branch). This minimises the amount that the Fawley desalination scheme is actually used in the extreme drought prior to the Havant Thicket bulk supply coming online in 2029. In practice, under any drought events, the desalination scheme (once implemented) would be used fully, to minimise the need for and scale of any Drought Permit/Order, particularly the Candover Drought Order.

The Itchen Drought Orders (both Portsmouth Water's and our sources on the Itchen) are required up to and including 2026 in both the severe and extreme drought states of the world. It is not used from 2027 onwards in either the severe or extreme states of the world, reflecting discussions with regulators throughout the development of this plan.

In the early part of AMP7 (the first two years), drought options are also needed on the IOW WRZ in both the severe and extreme drought conditions.

Neither the Candover nor Itchen sources Drought Orders are available from 2029 onwards, as the Test Drought Permit / Order and the resource developments are sufficient to meet the deficits. Table 4 provides a summary of the availability and use of the Drought Permits and Orders in the first 10 years of the planning period, and Figure 9 summarises the use of the Drought Permits/Orders over the planning period under each branch.

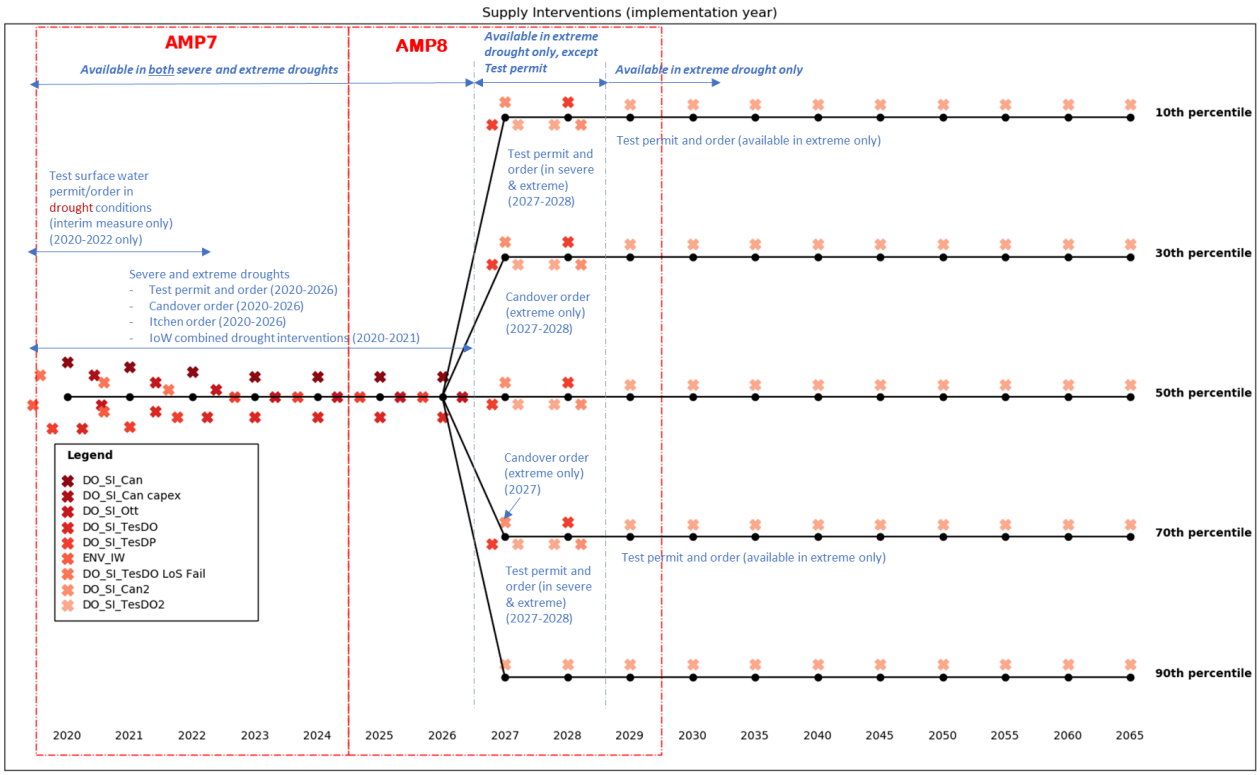
Table 4 Summary of availability and use of drought orders in first 10 years of planning period

Drought intervention	2020/21			2021/22			2022/23			2023/24			2024/25			2025/26			2026/27			2027/28			2028/29			2029/30 onwards		
	D	S	E	D	S	E	D	S	E	D	S	E	D	S	E	D	S	E	D	S	E	D	S	E	D	S	E	D	S	E
Test drought permit and order	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	×	✓	✓	×	✓	✓	×	✓	✓	-	✓	✓	-	✓	✓	-	-	✓
Candover drought order	×	✓	✓	×	✓	✓	×	✓	✓	×	✓	✓	×	✓	✓	×	✓	✓	×	✓	✓	-	-	✓	-	-	✓	-	-	-
Lower Itchen drought order	×	✓	✓	×	✓	✓	×	✓	✓	×	✓	✓	×	✓	✓	×	✓	✓	×	✓	✓	-	-	×	-	-	×	-	-	-
Combined IoW drought interventions	-	✓	✓	-	✓	✓	-	×	×	-	×	×	-	×	×	-	×	×	-	×	×	-	-	×	-	-	×	-	-	×
Test Valley drought interventions	-	×	×	-	×	×	-	×	×	-	×	×	-	×	×	-	×	×	-	×	×	-	-	×	-	-	×	-	-	×

Key:
- ✓ Selected (in all or some branches)
- × Not selected (in any branches)
- - Not available for selection

- D Drought event - an interim measure only
- S Severe drought event
- E Extreme drought event

Figure 9 Summary of Drought Permits/Orders by branch



3.1.4 Demand management

A number of demand management options have been selected in the preferred plan (previously referred to as Strategy A) and are assumed to commence at the start of AMP7, but run over a number of AMP periods delivering longer term demand savings.

- Extension of the Universal Metering Programme to provide coverage to around 92% of customers – this was included as a policy decision to maximise demand management, in light of the fact that major resource developments (including desalination) may be required in this area (as discussed in section 2.4)
- Implementation of the 'Target 100' policy, to reduce average per capita consumption in normal climatic years to 100 litres per day. This policy decision was described in section 2.2

The programme of metering which has been selected as part of our Western area strategy is set out below, with greater detail on the options provided in annex 6.

Extension of compulsory metering programme

This is an extension of our Universal Metering Programme (UMP) that involves installation of AMR meters at unmetered properties and moving them over to a metered charging regime. This option aims to increase domestic meter penetration from current levels (88%) up to 92% in each WRZ by the end of AMP7.

Consistent with our findings from implementing the original UMP, we have made an assumption that extending our metering campaign will also generate a small number of optant requests, which have been incorporated in the overall meter penetration target of option MAMR1 (92%). This is in recognition of our statutory obligation to continue to provide optant meters to customers when requested.

The total numbers of meters to be installed in each WRZ as part of this option are summarised in Table 5. At this strategic stage of the planning process, for the purposes of estimating costs and benefits of the option (as detailed in annex 6), a linear installation programme has been assumed across AMP7, with an equal number of meters being installed in each of the 5 years of AMP7 across each of the WRZs in the relevant areas. There are currently no priority areas which have been identified to be targeted first. As we move towards more detailed planning of the scheme, it is likely we will draw upon our experiences in designing and implementing our UMP. However, because there are relatively few meters being installed compared to our UMP, we will need to undertake geospatial analysis of where these customers are located, and design the implementation strategy accordingly, initiating customer contact in a systematic way.

Table 5 New meter installations under the preferred plan

Area	WRZ	Total number of meters to be installed during AMP7	Total installation cost (£k) [1]	Total cost of operation of meters (£k/yr)
Western area	Hampshire Kingsclere	857	316	6
	Hampshire Andover	999	369	7
	Hampshire Rural	307	113	2
	Hampshire Winchester	731	270	5
	Hampshire Southampton East	3,632	1,340	25
	Hampshire Southampton West	0	0	0
	Isle of Wight	0	0	0
Western area total		*6,527*	*2,409*	*46*
Company total [2]		33,864	12,497	237

[1] Note that these costs are all classified as operational for consistency with Business Plan classifications.

[2] Other activity to extend compulsory metering will be targeted in the Western area.

Target 100

As well as additional metering in our Western and Central areas, our preferred plan also includes implementation of our Target 100 option across all three of our supply areas. Whilst this option does not include installation of new meters at previously unmetered households, it does include, but may not be limited to, the following metering-related enhancement activities (more details are provided in Annex 6):

- During AMP7: Increasing the meter reading frequency from six-monthly to monthly in all supply areas (including replacing the 45,500 visual meter reading (VMR) meters that are expected to remain after the end of AMP6 across the company) (detailed in Table 6)
- During AMP8: Company-wide smart metering roll-out, involving replacing 780,000 existing meters (those already in place at the start of AMP7) with smart meters and installation of the associated technology (detailed in Table 7)
- During AMP9: Completion of company-wide smart metering roll-out, installing 320,000 smart meters company-wide at existing metered households by 2032 (detailed in Table 7)

These activities, and the numbers of households that will be included in each activity, are summarised in the tables below.

Table 6 Number and cost of VMR meters that will be replaced with AMR meters during AMP7, and cost of increasing meter reading frequency, both part of Target 100

Area	WRZ	VMR meter replacements during AMP7*	Total installation cost of VMR meters (£k)	Total operational cost of increasing meter reading frequency from 6-monthly to monthly over 25-year planning period (£k)
Western area	Hampshire Kingsclere	342	25	25
	Hampshire Andover	1,647	122	126
	Hampshire Rural	606	45	54
	Hampshire Winchester	1,295	96	142
	Hampshire Southampton East	6,419	475	794
	Hampshire Southampton West	1,892	140	374
	Isle of Wight	6,042	447	84
Western area total		*18,243*	*1,351*	*1,598*
Company total		45,333	3,357	4,746

** An equal number of replacements has been assumed in each year of AMP7 within each WRZ.*

Table 7 Number of smart meters that will be installed over AMP8 and AMP9 as part of Target 100

Area	WRZ	Number of smart meters installed each year of AMP8 (2025-26-2029-30)	Number of smart meters installed each year for the first 3 years of AMP9 (2030-31-2032-33)	Total installation cost of smart meters (£k)
Western area	Hampshire Kingsclere	943	645	1,081
	Hampshire Andover	4,497	3,075	5,155
	Hampshire Rural	1,667	1,140	1,911
	Hampshire Winchester	4,453	3,045	5,105
	Hampshire Southampton East	23,735	16,229	27,207
	Hampshire Southampton West	9,565	6,540	10,965
	Isle of Wight	9,686	6,623	11,102
Western area total		*54,547*	*37,297*	*62,527*
Company total		156,000	106,667	178,821

Meters installed at new properties

It is important to recognise that new household properties will also contribute to the levels of household meter penetration achieved as part of our WRMP strategies, because all new properties are metered. Table 8 below summarises the forecast number of new properties in each WRZ across each 5-year period (AMP) over the planning period, estimated as part of our WRMP demand forecast (details of which are provided in annex 2).

Table 8 New household meters installed over the 25-year planning period

Area	WRZ	Total number of new properties				
		AMP7	AMP8	AMP9	AMP10	AMP11
Western area	Hampshire Kingsclere	486	329	300	299	297
	Hampshire Andover	1,779	1,742	1,760	1,772	1,779
	Hampshire Rural	574	564	533	512	511
	Hampshire Winchester	2,864	896	482	507	512
	Hampshire Southampton East	9,597	7,449	5,545	6,288	6,194
	Hampshire Southampton West	3,598	3,257	2,805	3,028	2,968
	Isle of Wight	2,505	2,494	2,500	2,500	2,504
Western area total		*21,402*	*16,730*	*13,926*	*14,906*	*14,765*
Company total		61,589	49,774	44,581	46,347	46,233

Cost information

The cost of installing meters at new properties forms part of our base expenditure, rather than enhancement, so these costs are not presented in the WRMP. All meter installations and ongoing operation of these meters are classified in our Business Plan as operational (opex) costs, therefore are treated as such in our WRMP (i.e. total costs are included in WRP Table 5 as variable opex).

3.1.5 Leakage reduction

We have committed to meet Ofwat's leakage reduction target of 15% (from current levels) by the end of the next AMP in this revised plan. We have also increased this commitment over the longer term to achieve a 50% reduction in leakage from current levels by 2050, which aligns with recommendations in the recently published National Infrastructure Commission report.

The leakage reduction activity proposed to achieve these profiles of reductions are described more fully in Appendix C of Annex 6.

3.1.6 Resource developments

One of the key developments in the Western area is the need for a **large scale (up to 75Ml/d) desalination plant in Fawley in 2027** to ensure there are adequate supplies for customers following the significant sustainability reductions for the Test and Itchen abstractions.

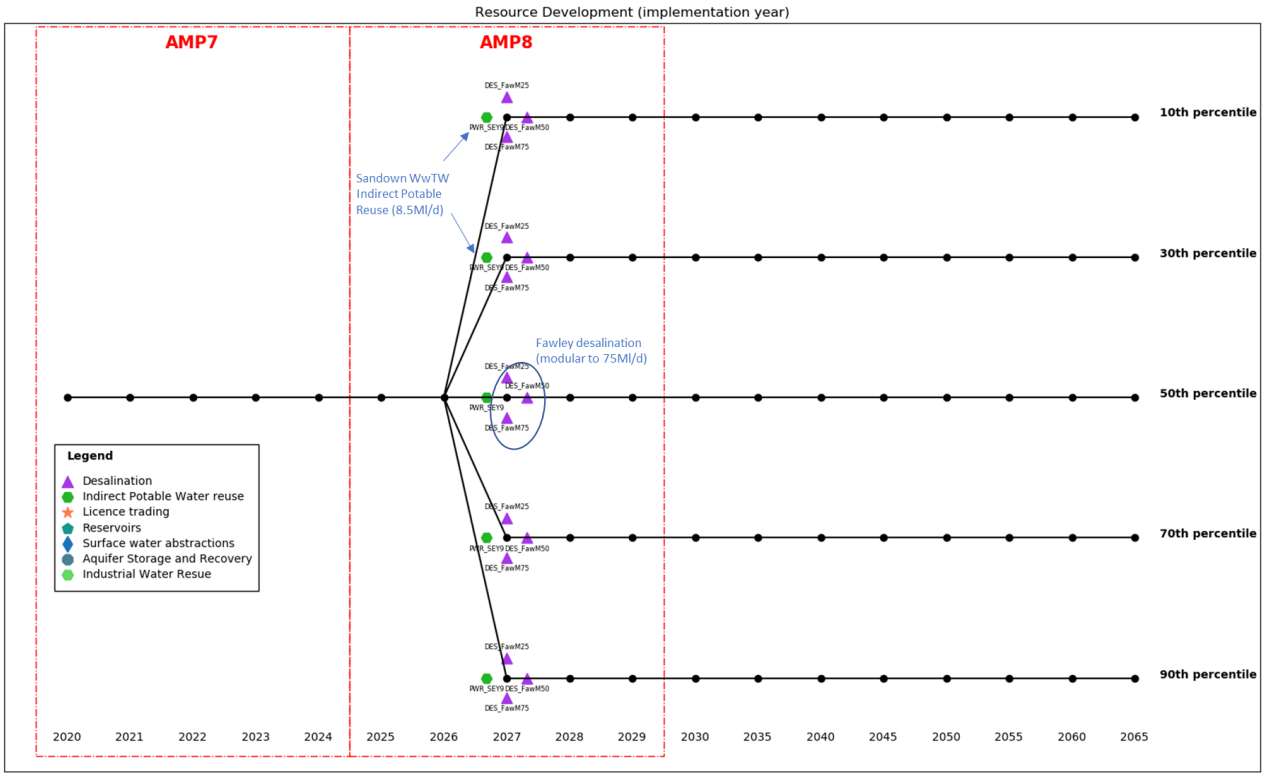
The driver for this scheme is the severe drought condition. It is utilised under the severe drought states of the world in the higher and middle deficit futures, although in the lower deficit futures the scheme is utilised less. The desalination scheme is also utilised in the higher deficit branches under drought conditions, particularly during the MDO condition.

Under the extreme states of the world, the desalination scheme does not need to be fully utilised – it is generally used at its minimum sweetening flow (one quarter of its capacity) – i.e. a total of just under 20Ml/d. This is because, for the purposes of investment modelling, the Test surface water Drought Permit / Order is required in addition to the Fawley desalination scheme, so the model minimises the overall solution cost by minimising the use of desalination water. Although it is utilised less than in severe droughts due to availability of drought interventions, in practice it would be operated to maximise output and minimise use of drought interventions. The Candover Order is also used in the first four years of AMP8. In practice, under any drought events, the desalination scheme (once implemented) would be used fully, to minimise the need for and scale of the Drought Permit / Order, particularly the Candover Order.

On the IOW WRZ, there is the need for a **water reuse scheme from 2027 at Sandown**. It is used particularly in the severe drought states of the world, and extreme drought states of the world in the higher deficit branches. It is also utilised at full capacity in the drought conditions, in all but the lowest deficit future. It is not utilised under normal annual average conditions, as there is sufficient surplus and capacity in the cross-Solent main to allow Hampshire to support the island.

Figure 10 below provides a summary of the resource development options selected in the preferred plan, previously referred to as Strategy A, under each branch and their timing.

Figure 10 Summary of resource development options selected by branch



3.1.7 Bulk supplies

Imports

The investment modelling assumes an existing bulk import from Portsmouth Water to HSE WRZ of 15Ml/d which was implemented in 2018-19. This is assumed to reduce by 50% to 7.5Ml/d under the extreme drought states of the world to reflect uncertainty in what Portsmouth would be able to supply in extreme droughts – e.g. whether there may be reduced abstractions or the need for drought orders relating to Portsmouth Water's Lower Itchen abstraction, and consequently their ability to provide a full supply to us.

Our preferred plan, previously referred to as Strategy A, will implement a number of new additional bulk imports. There are two additional bulk supplies from Portsmouth Water to the HSE WRZ. The first is **selected in 2024, and provides an additional 9Ml/d**. It is reliant on the yield of one of Portsmouth Water's sources on completion of a scheme to maximise the DO. The EA has indicated that the deliverability of this scheme may be uncertain. The bulk supply is also expected to be partially delivered through demand management and leakage reduction activity by Portsmouth Water in AMP7.

Portsmouth Water's preferred plan selects the option to maximise the DO of this source in 2024-25 (Option R022a in the Portsmouth Water plan). Portsmouth Water have advised that although the existing boreholes at the source are currently being investigated for water quality (nickel) reasons, Option RO22a involves maximising the DO of the source within existing licence limits by constructing a satellite borehole. This option does not involve any increase in licensed quantity. Whilst a licence variation will be required for the satellite borehole, the average licence volume will remain the same. The source originally produced the full licence volumes by abstraction from two boreholes. The satellite borehole will replace one of the existing boreholes where yield has been proven. Portsmouth Water have advised that it believes it may face opposition to developing Source J further due to the potential impact on the sustainable flows in the area. However, Portsmouth Water have advised that investigations undertaken by them have confirmed that Source J was sustainable because it is on the confined chalk. Further, Portsmouth Water has advised that is has already reduced its licence at its Source I to protect the River Wallington and Portsmouth Harbour and therefore believes the proposal is appropriate. The option will require supportive work with the EA to progress, and we understand that informal discussions have begun.

Nevertheless, we have considered the risks associated with this bulk supply option through inclusion of a scenario whereby this option is not considered. This will help us to understand the sensitivity of the strategy to the 9Ml/d bulk supply from Portsmouth Water and whether alternative schemes need to be considered. This is discussed in Section 4.2.

The **second Portsmouth Water bulk supply is implemented in 2029, with a capacity of 21Ml/d**. This is **based on development of the Havant Thicket reservoir**. Portsmouth have indicated that they believe that their new reservoir can be developed by 2029. We would mitigate the risk that Havant Thicket is not completed by 2029 by working closely with Portsmouth Water to develop the additional resources it needs in order to provide us with this additional bulk supply. For instance, there could be a possible interim solution before Havant Thicket is completed, whereby surplus resource from Havant and Bedhampton Springs is transferred directly to our supply area. This would need further discussion and investigation with Portsmouth Water.

These three bulk supplies from Portsmouth Water (existing, plus two additional supplies) form a key component of the strategy for meeting the Itchen sustainability reduction in HSE WRZ. We have undertaken analysis to understand the reliability of these bulk supplies in the face of the Itchen licence change and potential (though unconfirmed) further adjustment of the Hands Off Flow on the Itchen. We have also explored the sensitivity of the plan to these assumptions, as described in section 4.2. We have concluded that our plan can adapt to the uncertainty around the potential additional sustainability reduction, subject to potential risks to the delivery programme that could

arise if the associated investigation is not agreed early in AMP7, or the result of the investigation is a higher HoF than we have allowed for.

In addition to these, there is a further **bulk supply to HSW WRZ from the Bournemouth area (South West Water)** in 2027. The scheme provides up to 20Ml/d of water and it is generally fully used.

In response to the Strategic regional water resource solutions Appendix to the Draft Determination published by Ofwat in July and the email inviting further proposals from companies, the water company partners in the West Country Water Resources Group (South West Water, Bristol Water and Wessex Water) have developed a proposal focussed on the opportunities to provide additional bulk transfers to Southern Water (issued August 2019). One of their primary areas of focus is exploring the opportunities to provide a bulk transfer to Southern Water's Hampshire zone to help meet the deficits we face in that area.

The West Country Water Resources Group propose to develop additional strategic source capacity, transfers and solutions of up to 95Ml/d, and that these will feed into Ofwat's strategic water resource solutions gateway process. They have assumed this work will commence in April 2020 and will include the schemes that have not been costed before to a detailed level. We will work with the West Country Water Resources Group to understand the level of potential bulk supplies, the costs associated with those supplies, and the expected availability of those supplies in severe and extreme drought events, for which we plan. Any new options will be identified and included in the next plan in WRMP24 where they have been assessed to be feasible. However, these potential schemes are not currently developed to a level to provide sufficient certainty to be included within our current preferred plan.

Exports

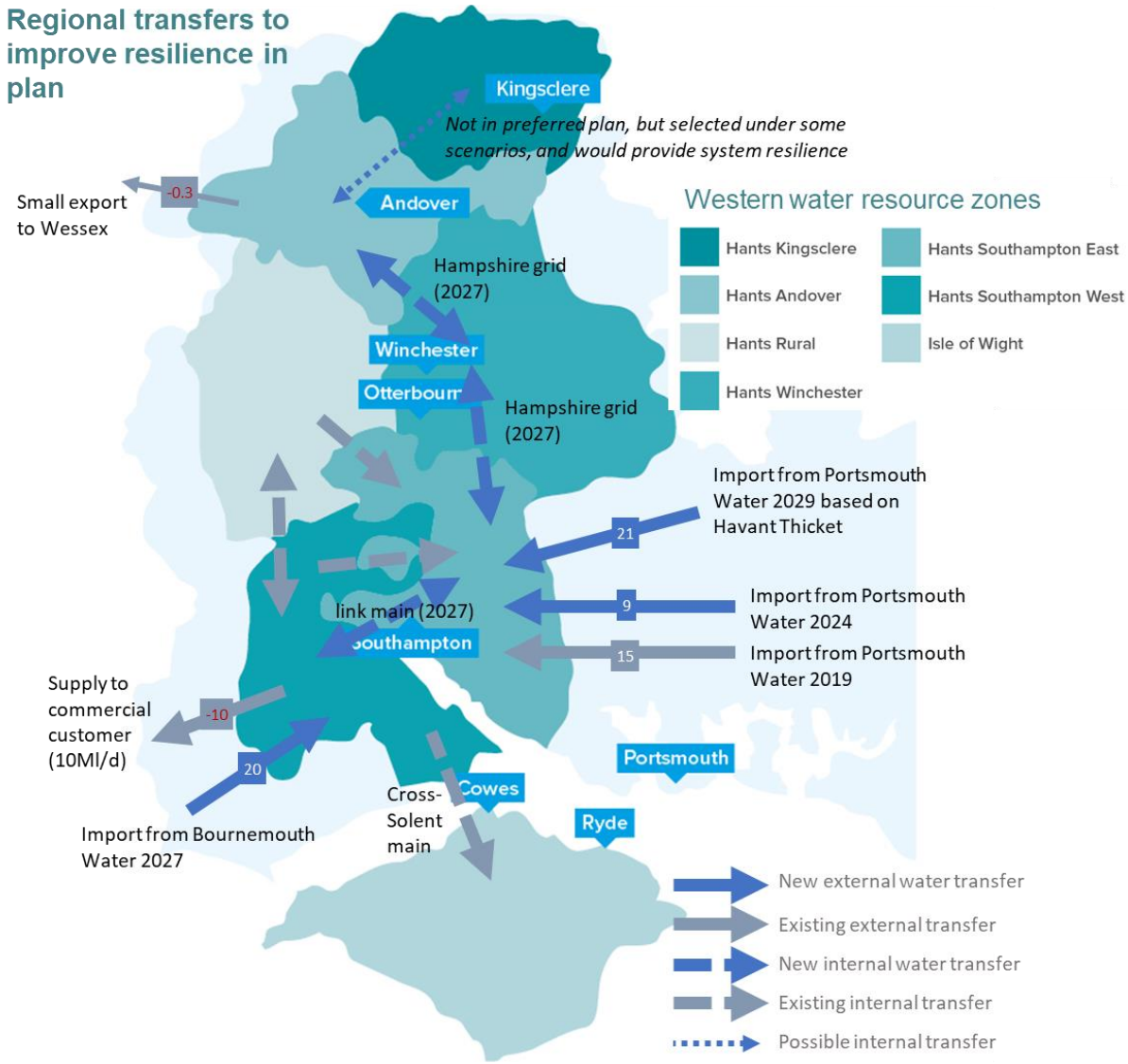
There are no additional options to provide bulk supplies to neighbouring water companies from the Western area WRZs. There are a number of existing bulk supplies which are assumed to continue throughout the planning period:

- Small supply to Wessex Water from HA WRZ (less than 0.5Ml/d)
- Supply to commercial customer from HSW WRZ (10Ml/d)

3.1.8 Enabling transfers (inter-zonal transfers)

The Western area has a number of existing inter-zonal transfers, and a number of options for increasing the connectivity between the WRZs. Figure 11 presents a summary of these inter-zonal transfers and the key bulk supplies for the Western area.

Figure 11 Schematic of inter-zonal transfers and bulks supplies for the Western area

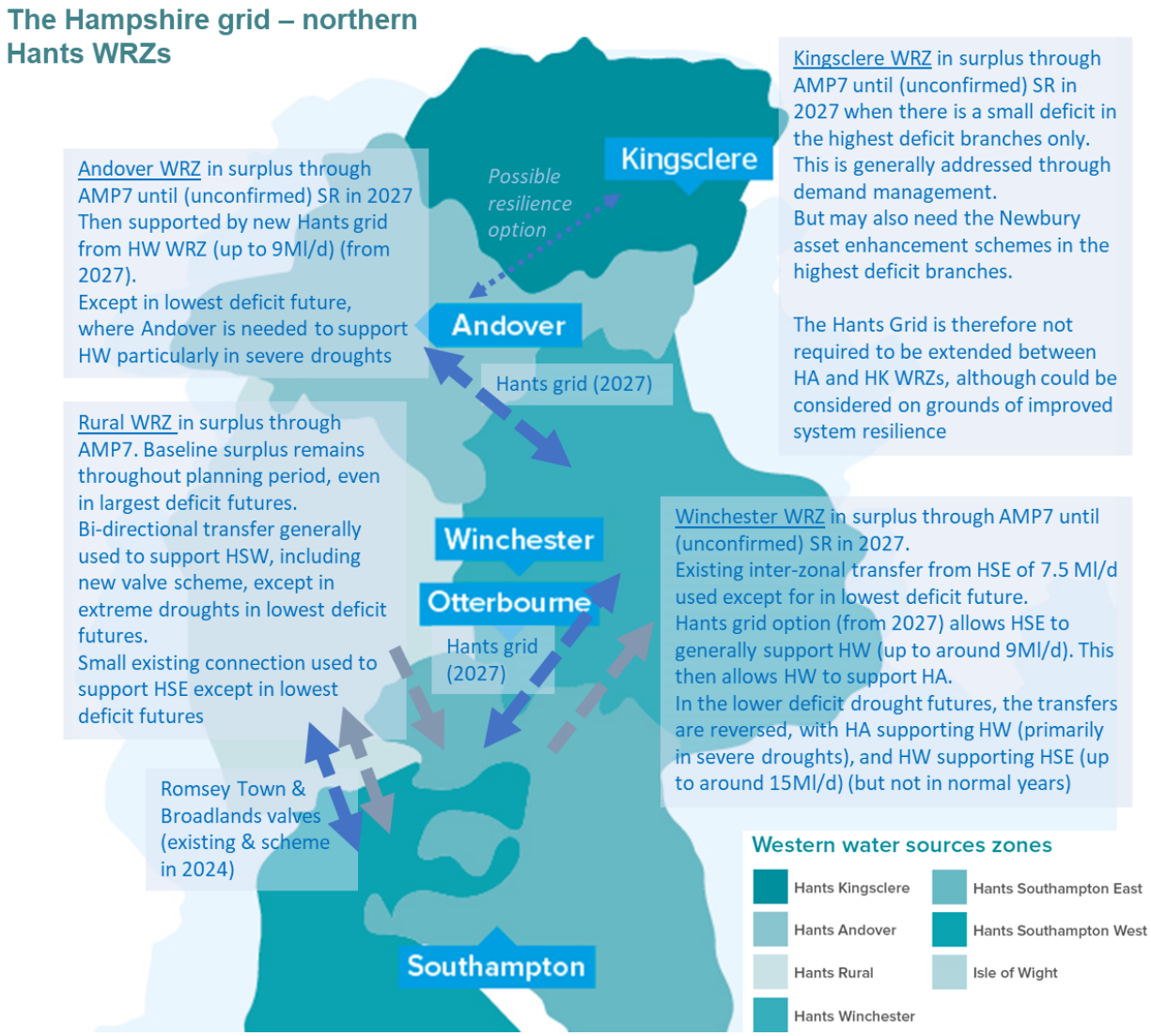


The two critical elements of the preferred plan are:

- That there is improved connectivity between **HSW WRZ and HSE WRZ**, which is achieved through continued use of the existing transfers between the two WRZs, and the **development of a new reversible link main in Southampton in 2027**;
- That a **Hampshire grid option linking HSE, HW and HA** WRZs is needed in 2027.

The use of the Hampshire grid in our preferred strategy is presented below in Figure 12. Note that there is the option for the Hampshire grid to also be extended from HA WRZ to HK WRZ, however, this is not required, as HK is either in surplus or any deficit is addressed through demand management and asset enhancement at the Newbury source. However, the extension of the Hampshire grid could be pursued for resilience purposes.

Figure 12 Use of Hampshire grid in the preferred plan



The new Southampton link main is utilised up to a maximum of around 35Ml/d, and hence the maximum total transfer from HSW WRZ to support HSE WRZ is around 60Ml/d (when the existing transfers are taken into account). The main is normally used with HSW supporting HSE WRZ, although in the lowest deficit branch a small supply the other way is sometimes needed. The reversibility of this transfer should provide greater resilience in the face of outage events and other localised issued such as freeze-thaw events.

The HSW WRZ also provides support to the IOW WRZ through the existing cross-Solent main, up to a maximum of 18Ml/d. There is an option to allow this capacity to be increased, however it is not selected.

3.1.9 Asset enhancements

There is one asset enhancement schemes are selected over the planning period.

- Newbury WSW asset enhancement in HK WRZ selected in 2027.

There is also the borehole rehabilitation near Cowes on the IOW WRZ, which is selected in the highest deficit future, but not until the 2060s.

3.1.10 Catchment management options

There are two sets of water quality-driven catchment management options in the Western area. The first are options to address water quality issues associated with nitrates; while the second set address water quality issues associated with pesticides.

The pesticide options are not assumed to provide a DO benefit, but instead provide resilience in the event of a pesticide issue.

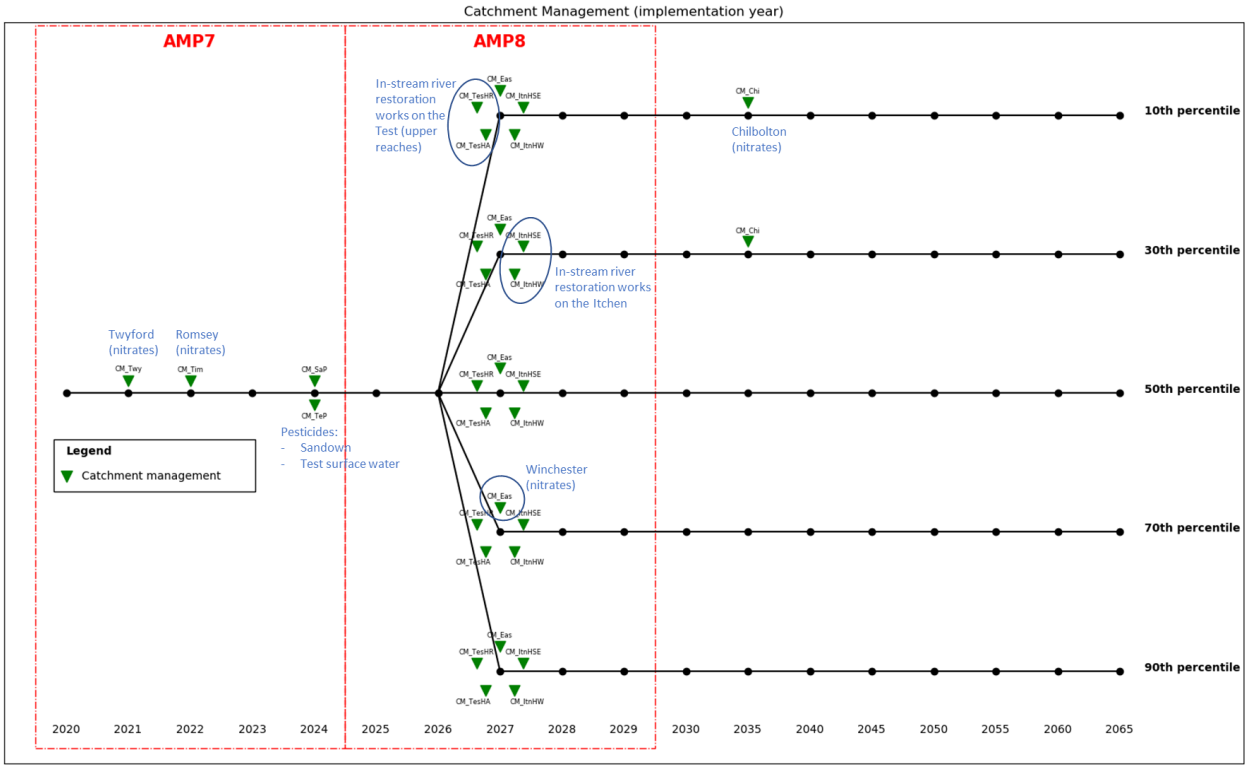
However, the nitrate water quality issues are assumed to effect sources resulting in a DO write-down, with a catchment management and treatment option that can recover that lost DO (where it is economic to do so). The table below provides a summary of the sources at which there has been a DO write-down to account for water quality risks from nitrates, and also the year in which a scheme is implemented to recover that lost DO by installing treatment alongside catchment management activity.

Table 9 Summary of catchment management option for nitrates

Source	WRZ	DO write-down (year)	Scheme to recover DO
Chilbolton	HA	Not currently operational	2035-39 (highest deficit branches only)
Winchester	HW	2027	2027
Romsey	HR	2022	2022
Twyford	HSE	2021	2021

Figure 13 below provides a summary of the catchment management options selected under each branch and their timing, for the preferred plan, previously referred to as Strategy A.

Figure 13 Summary of catchment management options selected by branch



In addition to the above catchment management options to address water quality issues, there are two in-stream river restoration options that are selected on the Itchen and upper reaches of the Test, and are aimed at improving the resilience of the environment.

3.2 Changes from the draft strategy

The draft strategy was published on 5 March 2018 and consulted on over the period 5 March to 28 May 2018.

This final plan differs from the draft strategy (which was referred to as strategy A) in the following ways:

- The approach to leakage has changed significantly with a new profile being applied for this plan.
- The incorporation of the Target 100 policy has been applied explicitly rather than as part of the baseline demand forecast
- The bulk supply from Bournemouth is implemented earlier in 2027
- There are minor date changes for the two additional imports from Portsmouth Water. The critical change is related to a delay until 2029 (from previously assumed 2027 availability) for the 21Ml/d import based on timescales for the development of Havant Thicket reservoir
- The scale of the Fawley desalination scheme is slightly smaller at 75Ml/d in the final plan (rather than 100Ml/d). This is driven, in part by the acceptance of the Test Drought Permit in 2027 and 2028, to reduce the size of the scheme before Havant Thicket reservoir comes on line allowing the 21Ml/d bulk supply from Portsmouth Water
- The Western Yar scheme is not required (it was only selected in 2045-49 in one branch previously)
- A reversible link between HSW and HR is selected in 2024. This further effectively extends the strategy of a Hampshire grid that was introduced in the draft plan and is maintained in this final plan. In addition, the Southampton link main (between HSW and HSE WRZs) has been considered reversible to improve connectivity and resilience, adding further to the Hampshire grid concept
- The Test Estuary WTW industrial water reuse scheme is not now required in AMP7 in the preferred plan – it is only selected as a strategic alternative.
- The Test Lake scheme is not required in the revised plan (it was anyway only selected at the end of the planning period in the draft plan).
- The Newbury WSW asset enhancement scheme is required earlier in 2027.
- There are new options for in-stream catchment management of the Test and Itchen, and pesticide schemes for the Test and Sandown.

What is driving the changes from the draft WRMP?

Analysis of the changes to the SDB inputs from the draft plan to this final plan is presented and discussed in detail in Annex 5. (Note that a higher relative SDB means that the SDB is greater in the revised plan when compared to the draft plan, not that the revised plan is itself in surplus). The key changes to note are:

- Hampshire Southampton East has higher relative SDB prior to 2024 driven by higher DO (following reassessment after the draft plan). It then has a lower relative SDB from 2024 onwards driven by the unconfirmed additional Itchen sustainability reduction assumed to be implemented in 2024
- Hampshire Southampton West has a lower relative SDB prior to 2023 driven by higher initial outage. It then has a higher relative SDB from 2023-2026 driven by a larger DO gain due to climate change. Post 2027 the additional licence change is implemented and there are no significant changes from this point
- HR WRZ, HW WRZ and HA WRZ lower relative SDB driven by higher demand and have only minor differences driven by relatively small changes in outage forecast, DO and demand forecast

- HK WRZ has a lower relative SDB driven by higher demand forecast and lower DO
- The IOW WRZ has higher relative SDB driven by higher DO and lower outage forecast due to outage reduction activity.

3.3 Climate change assessment of the preferred plan

A quantitative assessment of the impacts of climate change on the DOs or demand savings expected to be obtained from each of our identified supply and demand measures has been undertaken in accordance with section 37A(3)(b) of the Water Industry Act, 1991. The results of this assessment are presented in the table below.

This table sets out the specific assumptions we have made when assessing the climate change impact of each of the schemes in our preferred plan. We have also applied the following general assumptions to all estimated climate change impacts:

- We have excluded our “Strategic Alternative” options from this assessment after receiving clarification from the EA that only the preferred schemes needed to be included
- We have assumed and stated the full impacts of climate change to 2085 consistent with our modelling assumptions in annex 3
- We have applied the same dry, medium and wet possible future climate change scenarios used in our annex 3 modelling of climate change impacts for our baseline supply forecast
- The climate change impacts on schemes are stated in a consistent manner with our baseline supply forecast for a severe drought (1:200) unless the option specifically states benefits under extreme droughts (1:500) or drought conditions (1:20)
- Unless otherwise stated, the climate change impacts are the same for both our critical period (PDO) and minimum or average period (MDO/ADO) states of the world. Generally, this means that where there are no forecast impacts, a single figure of 0Ml/d is reported and applies to all states of the world

Table 10 Assessment of the impacts of climate change on the strategy

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Demand management				
Target 100 water efficiency activity	0Ml/d	0Ml/d	0Ml/d	We have assumed that the benefits of demand management are not sensitive to impacts from climate change as they are dominantly controlled by behavioural or infrastructure change. The impacts of our water efficiency activities within our demand forecasts already reflect the impacts of hot, dry weather, so any additional effects of climate change are expected to be small. Therefore, in our WRMP we assume that climate change has no impact on water efficiency measures
Leakage reduction (15% reduction by 2025; 50% by 2050)	0Ml/d	0Ml/d	0Ml/d	
Installation of automated meter reads (AMR) meters to take household meter penetration from 88% to 92%	0Ml/d	0Ml/d	0Ml/d	
Temporary Use Ban (TUB) and Non Essential Use (NEU) ban	-1.3Ml/d at MDO -7.3Ml/d at PDO	0Ml/d	0Ml/d	We have quantified the DO benefits of TUBs and NEU bans as a percentage of baseline DO. To determine the impacts of climate change on these DO benefits for the Dry scenario we have assumed the same percentage factors and applied those to the total area DO. For the Mid and Wet Scenarios the impacts of climate change have minor water resource benefits and so we have assumed there would be no change in the DO benefit of demand restrictions.
Resource development and bulk supplies				
Hampshire grid (reversible link Hampshire Winchester-Hampshire Andover)	0Ml/d	0Ml/d	0Ml/d	This is an infrastructure scheme and the capacity of the transfer is insensitive to climate change. We have separately considered the impacts of climate change on the DO of contributing sources in our baseline assessment.

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Newbury WSW asset enhancement	-0.6Ml/d at MDO -0.6Ml/d at PDO	0Ml/d at MDO 0Ml/d at PDO	0Ml/d at MDO +0.04Ml/d at PDO	Source may become groundwater level constrained under dry climate change scenario. We have applied the same shift in baseline DO to the scheme but capped the impact at the forecast scheme yield.
Romsey Town and Broadlands valve (Hampshire Southampton West-Hampshire Rural reversible)	0Ml/d	0Ml/d	0Ml/d	This is an infrastructure scheme and the capacity of the transfer is insensitive to climate change. We have separately considered the impacts of climate change on the DO of contributing sources in our baseline assessment.
Additional import from Portsmouth Water (additional 9Ml/d)	0Ml/d	0Ml/d	0Ml/d	Impacts of climate change on the benefits of bulk supplies should be accounted for as part of the donor company's assessment. We have assumed the yield of this scheme is reliable under all climate change scenarios.
Additional import from Portsmouth Water (Havant Thicket Reservoir Development)	0Ml/d	0Ml/d	0Ml/d	Impacts of climate change on the benefits of bulk supplies should be accounted for as part of the donor company's assessment. We have assumed the yield of this scheme is reliable under all climate change scenarios.
Import from South West Water	0Ml/d	0Ml/d	0Ml/d	Impacts of climate change on the benefits of bulk supplies should be accounted for as part of the donor company's assessment. We have assumed the yield of this scheme is reliable under all climate change scenarios.
Fawley desalination - (modular to 75Ml/d)	0Ml/d	0Ml/d	0Ml/d	We have assumed that the DO benefits of desalination are not sensitive to climate change as dependency is on seawater availability. We have assumed there will be no change in water quality or environmental standards as a consequence of climate change that may affect our desalination options.
Southampton link main (reversible Hampshire Southampton West-Hampshire Southampton East)	0Ml/d	0Ml/d	0Ml/d	This is an infrastructure scheme and the capacity of the transfer is insensitive to climate change. We have separately considered the impacts of climate change on the DO of contributing sources in our baseline assessment.

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Hampshire grid (reversible link Hampshire Southampton East-Hampshire Winchester)	0Ml/d	0Ml/d	0Ml/d	This is an infrastructure scheme and the capacity of the transfer is insensitive to climate change. We have separately considered the impacts of climate change on the DO of contributing sources in our baseline assessment.
Sandown WwTW Indirect Potable Reuse (8.5Ml/d)	0Ml/d	0Ml/d	0Ml/d	We have assumed that the DO benefits of water reuse are not sensitive to climate change as dependency is on wastewater availability. We have assumed there will be no change in water quality or environmental standards as a consequence of climate change that may affect our water reuse options.
WSW near Cowes - reinstate & additional treatment	0Ml/d	0Ml/d	0.00Ml/d	The scheme draws upon a deep confined aquifer and hence is unlikely to be sensitive to drought or climate change.
Catchment management				
Nitrate Option – Chilbolton	0Ml/d	0Ml/d	0Ml/d	Our Catchment Management and Nitrate schemes provide an equal DO benefit to that lost as a consequence of Water Quality impacts. The impacts of climate change on the DO from individual schemes has therefore been assessed as the same as the climate change impacts on baseline DO of each source. Some measures do not have DO benefits and are for resilience purposes only. We have assumed there will be no climate change impacts on these measures. Agricultural practices may change in response to climate change and there could be shifts in the patterns of nitrate / pesticide usage. Catchment management schemes would still be required, and the schemes would need to dynamically respond to such changes in practices. For our in-stream catchment management options our modelling has shown that surface water flows may be significantly lower than present in both the River Test and River Itchen. Consequently, we have assumed that for a dry climate
Nitrate catchment management / treatment – Romsey	0Ml/d	0Ml/d	0Ml/d	
Nitrate catchment management / treatment – Twyford	-19.6Ml/d at MDO -4.4Ml/d at PDO	+0.3Ml/d at MDO 0Ml/d at PDO	+0.8Ml/d at MDO 0Ml/d at PDO	
In-stream river restoration works on the Itchen	-1.1Ml/d at MDO -1.2Ml/d at PDO	0Ml/d	0Ml/d	
Pesticide catchment management / treatment – Test Surface Water	0Ml/d	0Ml/d	0Ml/d	
Nitrate catchment management / treatment – Winchester	0Ml/d	0Ml/d	0Ml/d	

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Pesticide catchment management / treatment – Sandown	0Ml/d	0Ml/d	0Ml/d	change future these schemes, which are assumed to partially offset future sustainability reductions, will not deliver any DO benefits.
Drought Permits/Orders in severe and extreme droughts				
Mitigation and monitoring activities on the Itchen	0Ml/d	0Ml/d	0Ml/d	This scheme is an enabling option and has no DO benefit and hence is insensitive to climate change
Mitigation and monitoring activities for Candover	0Ml/d	0Ml/d	0Ml/d	This scheme is an enabling option and has no DO benefit and hence is insensitive to climate change
Candover Drought Permit / Order (2020-27)	-9.1Ml/d at MDO -8.2Ml/d at PDO	5.3Ml/d at MDO 1.3Ml/d at PDO	7.2Ml/d at MDO -2.0Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here.
Lower Itchen (g/w and s/w sources) Drought Permit / Order (2020-27)	-6.6Ml/d at MDO0 0Ml/d at PDO	-4.5Ml/d at MDO -5.3Ml/d at PDO	-13.8Ml/d at MDO -24.6Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here. Note this scheme delivers less DO benefit under all climate change scenarios, either because flows are lower (dry scenario) or baseline flows are greater (mid and dry scenarios) hence the yield of the drought order up to the daily licence limit is reduced.
Test surface water Drought Permit / Order in drought conditions (interim measure only)	0Ml/d	0Ml/d	0Ml/d	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here. Our analysis shows that the full yield of the Drought Permit or Order would be available under all climate change scenarios.
Mitigation and monitoring activities on the Test	0Ml/d	0Ml/d	0Ml/d	This scheme is an enabling option and has no DO benefit and hence is insensitive to climate change.

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Test surface water Drought Permit (2020-27)	-58.5Ml/d at MDO -28.9Ml/d at PDO	0Ml/d at MDO 0Ml/d at PDO	0Ml/d at MDO 0Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here. This shows that under a dry climate change scenario yield would be substantially reduced but would be available under a mid or wet scenario.
Test surface water Drought Order (2020-27)	0Ml/d	0Ml/d	0Ml/d	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here. Our analysis shows that the full yield of the drought order would be available under all climate change scenarios.
Drought Permits/Orders in extreme droughts only				
Candover Drought Permit / Order (from 2027 onwards)	-4.9Ml/d at MDO -7.0Ml/d at PDO	7.1Ml/d at MDO 5.8Ml/d at PDO	16.2Ml/d at MDO 8.2Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here.
Test surface water Drought Permit / Order (from 2027 onwards)	-52.7Ml/d at MDO -54.1Ml/d at PDO	+24.1Ml/d at MDO +27.7Ml/d at PDO	+24.1Ml/d at MDO +27.7Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here.

3.4 Greenhouse gas emissions

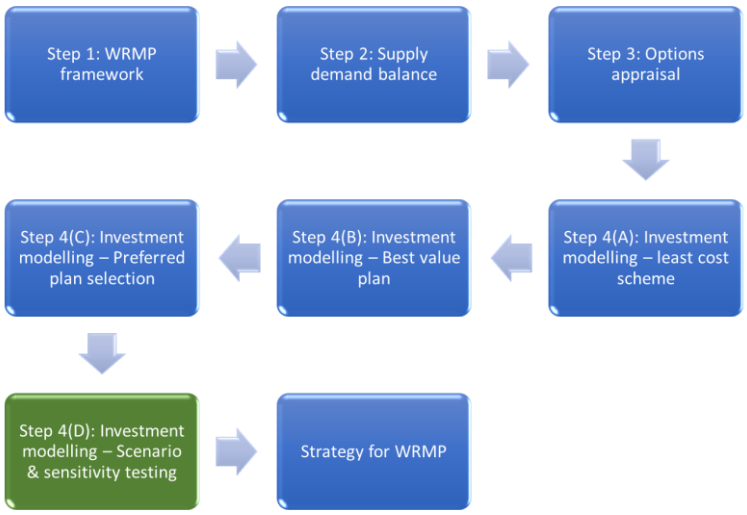
The impact of the strategy on potential greenhouse gas emissions has been assessed for this plan. The SEA (Annex 14) considers this specifically as one of the SEA objectives, as part of the overall environmental assessment of the feasible options.

The table below presents a summary of the carbon equivalent emissions expected from the strategy (assuming utilisation at full capacity). The emission of greenhouse gases from usage of our existing sources is presented in our business plan return to Ofwat (table WS18). For the base year (2017-18) this was 65 ktCO2e.

Table 11 Summary of carbon emissions associated with strategy for this plan

Strategic Schemes	Embodied carbon (KgCO2e)	Operational Carbon (KgCO2e/a)
Demand management		
Target 100 water efficiency activity	*Negligible*	*Negligible*
Leakage reduction (15% reduction by 2025; 50% by 2050)	*Negligible*	*Negligible*
Installation of AMR meters to take HH meter penetration from 88% to 92%	*Negligible*	*Negligible*
TUBS and NEU Ban	*Negligible*	*Negligible*
Resource development and bulk supplies		
Additional import from Portsmouth Water (additional 9Ml/d)	1,254,000	512,000
Import from Bournemouth Water	4,423,000	1,261,000
Additional import from Portsmouth Water (Havant Thicket reservoir development)	1,627,000	2,454,000
Fawley desalination (modular to 75Ml/d)	17,003,000	34,816,000
Sandown WwTW Indirect Potable Reuse (8.5Ml/d)	2,208,000	1,588,000
Hampshire grid (reversible link HSE-HW)	1,757,000	3,254,000
Hampshire grid (reversible link HW-HA)	5,101,000	1,971,000
Southampton link main (reversible link HSW-HSE)	7,962,000	2,004,000
Romsey Town and Broadlands valve (HSW-HR reversible)	70,000	130,000
Newbury WSW asset enhancement	855,000	295,000
WSW near Cowes - reinstate & additional treatment	1,538,000	41,000
Catchment management		
In-stream river restoration works on the Itchen	*Negligible*	*Negligible*
In-stream river restoration works on the Test (upper reaches)	*Negligible*	*Negligible*
Pesticide catchment management / treatment – Sandown	1,033,000	291,000
Pesticide catchment management / treatment – Test Surface Water	1,033,000	5,897,000
Nitrate catchment management – Chilbolton	-	-
Nitrate catchment management / treatment – Winchester	639,000	422,000
Nitrate catchment management / treatment – Romsey	554,000	252,000
Nitrate catchment management / treatment – Twyford	471,000	440,000
Drought Permits/Orders in severe and extreme droughts		
Test surface water Drought Permit / Order in drought conditions	-	-
Mitigation and monitoring activities on the Itchen (enabling option, no DO benefit)	-	-
Mitigation and monitoring activities for Candover (enabling option, no DO benefit)	-	-
Mitigation and monitoring activities on the Test (enabling option, no DO benefit)	-	-
Test surface water Drought Permit (2020-28)	-	-
Test surface water Drought Order (2020-26)	-	-
Candover Drought Permit / Order (2020-26)	-	-
Lower Itchen (g/w and s/w sources) Drought Permit / Order (for 2020-26)	-	-
Combined IW sources Drought Permits/Orders	-	-
Drought Permits/Orders in extreme droughts only		
Test surface water Drought Permit / Order (from 2027 onwards)	-	-
Candover Drought Permit / Order (from 2027 onwards)	-	-

4. Scenario and sensitivity testing of the strategy



Having developed the strategy for the WRMP, as described above, we then carried out sensitivity testing of the strategy.

A Real Options modelling approach already incorporates uncertainty around how different futures may evolve and thus trigger the selection of different options. Our approach therefore already provides some evaluation of alternatives in the strategy and thus reduces the requirement for sensitivity analysis to some degree (UKWIR 2016).

Nevertheless, sensitivity testing was performed on the plan. The purpose of sensitivity testing is twofold:

- To ensure the plan is robust as possible in the face of uncertainties. This provides confidence in the portfolio of schemes selected, and may also help to highlight key queries to raise in the consultation exercise on the draft plan
- To understand the range of potential alternative options if the preferred options cannot be delivered/implemented for whatever reason. These alternative options may require feasibility studies, investigations or planning activity to be carried out in parallel to the main portfolio of options in the strategy, particularly where they may be needed in the next 5-10 years

We developed a range of sensitivity testing model runs to compare against the strategy. The rationale for the sensitivity tests, and the key outputs from the modelling runs, are described in section 4.1. We provide additional commentary on the key findings from sensitivity testing in section 4.2. We also provide a comparison of the preferred strategy with a conventional Economics of Balancing Supply and Demand (EBSD) approach (section 4.3) and with our previous WRMP (published in 2014) (section 4.4).

Our Western area has traditionally not experienced water shortages like our other supply areas, and has not had a hosepipe ban imposed to restrict customers' supplies. There has, to date, been sufficient water available within our abstraction licences to provide secure supplies to customers. However, the EA's recently implemented licence changes on the River Itchen and River Test, together with future as yet uncertain further licence changes that may be required, fundamentally change the water resources position in Hampshire.

At the time of developing our draft plan, we did not know the outcome of the licence changes for the Test and Itchen. Therefore, we considered four alternative scenarios, each making different assumptions about the timing and scope of the EA's licence changes (also referred to as sustainability reductions). This enabled us to explore the sensitivity of the strategy to these different assumptions and to understand which of the licence changes were driving the investments. Strategy A, our core strategy for the Western area, assumed that the EA's proposed licence changes would be implemented in full and immediately. EA

The licence changes on the Test and Itchen have now been implemented (as of March 2019), and so scenarios B, C and D are now only considered as alternative scenarios to demonstrate the impact on option selection and the relative costs of the different solutions based on alternative licence

change assumptions. The assumptions for each of the four scenarios used in the draft plan are summarised in Table 12.

Table 12 Summary of assumptions for the 4 scenarios within the Western area

Strategy/scenario	Description	Itchen sources sustainability reduction	River Test sustainability reduction
Main model runs (previously referred to as scenario A)	Both sustainability reductions (SRs) are implemented as soon as possible	Implemented now.	Implemented now
Alternative sustainability reductions, Scenario B	Both SRs are implemented but the licence conditions are not introduced on the Test until there is time to develop new resources	Implemented now.	Implementation delayed until 2027
Alternative sustainability reductions, Scenario C	Implementation of both SRs is delayed until there is time to develop new resources and ensure an optimum strategy	Implementation delayed until 2027.	Implementation delayed until 2027
Alternative sustainability reductions, Scenario D	The licence changes are not imposed at Test surface water, so abstraction continues at current levels	Implemented now.	No sustainability reduction

Our preferred plan effectively reflects the Strategy A scenario presented in the draft WRMP. Whilst we kept Scenarios B, C and D as part of our scenario testing set, to demonstrate the impact of the timing and scale of the sustainability reductions, they are no longer plausible alternatives given that the licence changes on the Test and Itchen came into force in March 2019. We do not therefore present Scenarios B, C or D in the results of the sensitivity testing below, as they do not contribute further to the understanding of the implications of the sustainability reductions.

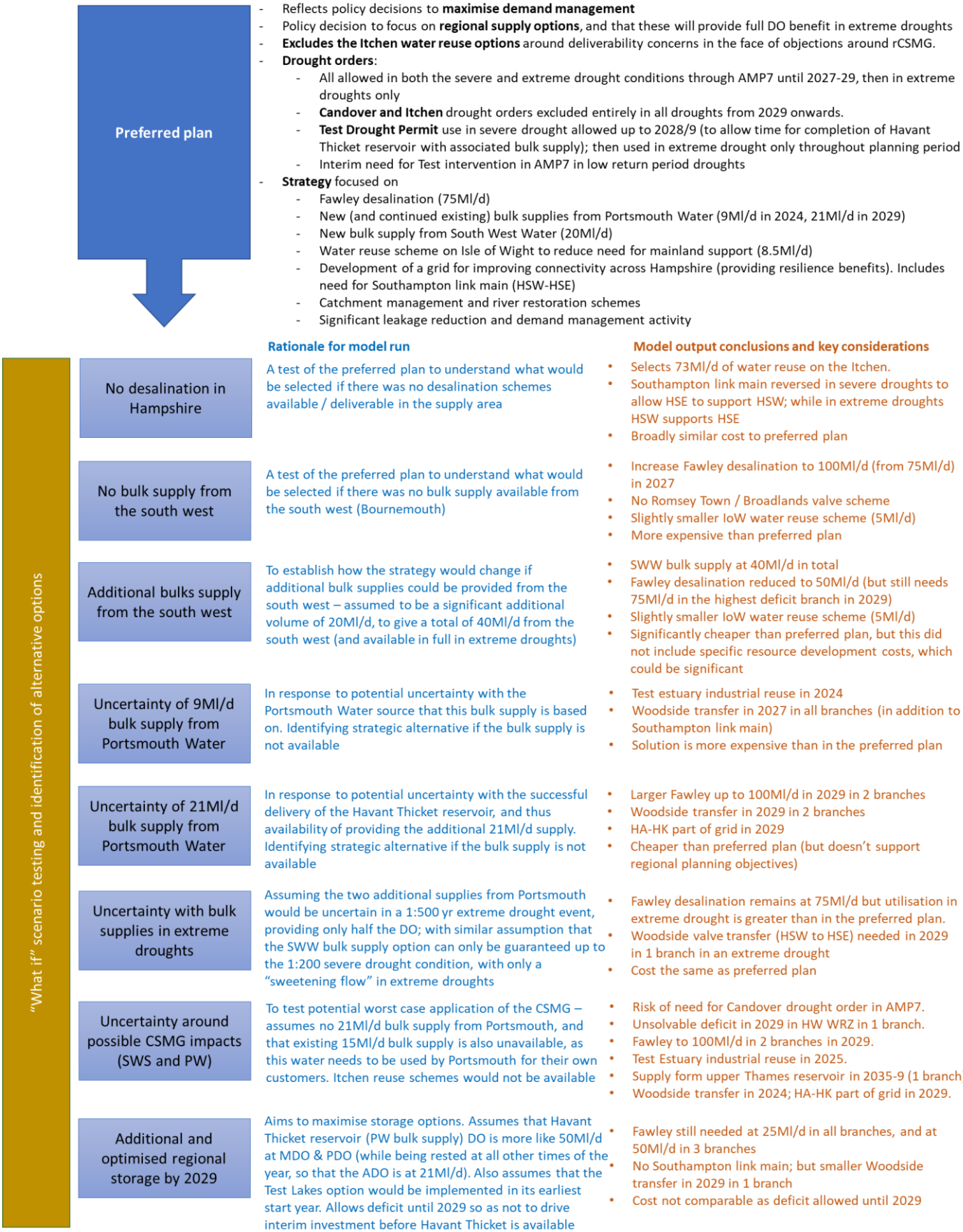
4.1 Results of sensitivity testing

We have run a wide range of scenario and sensitivity tests in order to help formulate the preferred plan for the WRMP, to test the robustness of that plan, and to identify key strategic alternatives. The table below provides a description of the scenario and sensitivity tests undertaken and the rationale for these.

The results of the sensitivity testing are presented in the figure below. One key thing to note is that the **options that get selected are reasonably stable in the face of the sensitivity tests**. The main changes relate to how the selected schemes are utilised, although there are some alternative schemes that are selected in some tests.

Section 6 provides the overarching summary of the strategy, key alternatives and investigations that we will need to focus on over the next two AMP periods.

Figure 14 'What if' scenarios and sensitivity testing of the preferred plan



		Rationale for model run	Model output conclusions and key considerations
Sensitivity to the sustainability reductions	Test sustainability reduction delayed until 2030-34	To understand how sensitive the strategy is to a hypothetical delay in the Test SR, and whether an alternative strategic option would be selected. This is a variant of Scenario D from the draft WRMP (which assumed the Test SR was not implemented at all)	• Fawley selected in 2030-4 – 25Ml/d in all branches, up to 50M/d in 4 branches, and up to 75Ml/d in 2 branches • Bulk supplies stay forced in at earliest date • There is no need for Test drought intervention in AMP7 in low return period droughts
	No additional Itchen sustainability reduction	To understand how the timing and scale associated with the additional unconfirmed Itchen sustainability reduction presented by the EA in the Inquiry evidence affects the strategy. Assume no additional SR and no allowance for that SR uncertainty either	• Fawley reduced to 50Ml/d in 2027, but with 1 branch needing 75Ml/d in 2029 • Smaller Sandown water reuse scheme selected • Cost is significantly less than for the preferred plan
	Additional Itchen sustainability reduction in the baseline supply forecast	Test to examine the strategy if the additional Itchen SR occurs in 2024, rather than being included only in the uncertainty component	• No significant difference in the strategy • Because additional SR occurs in 2024, and up until 2027 only the middle 50th percentile branch is used anyway
	No unconfirmed sustainability reductions	To understand how the large uncertainty on timing and scale associated with the possible sustainability reductions may affect the strategy. Note that this scenario still assumes that the Test and Itchen SRs are in place, as these licenses have been changed.	• Fawley needed at 25Ml/d in all branches in 2027, but then 50Ml/d in 2029 in 1 branch only • Woodside transfer replaces Southampton link main • Bulk supplies stay forced in at earliest date • Grid not required for HW-HA • Cost is significantly less than the preferred plan
	Environmental forecast output – additional future reductions	Assumes there could be additional sustainability reductions in future, over and above those assumed in the baseline supply-demand balances in the late 2020's, due to future environmental changes or policies	• Increase in Fawley to 100Ml/d in 2 branches from 2045 • Test Estuary industrial reuse scheme in 2035 in 3 branches • Brings forwards IoW reinstatement scheme at WSW near Cowes
Sensitivity to earliest start date assumptions – is the strategy optimal?	Accept deficits to 2029	Hypothetical sensitivity test where we accept deficits for the initial part of the plan to confirm that the options selected in the strategy are not driven purely by them being available for delivery before other options - i.e. it is a test of whether the plan remains optimal	• Fawley desal at 25Ml/d in 2029 in all branches, with need for 50Ml/d in 4 branches and 75Ml/d in 3 branches • Bulk supplies stay forced in at earliest date • Cost not comparable as deficit allowed until 2029.
	Accept deficits to 2039	Hypothetical sensitivity test where we accept deficits for a much longer part of the plan to test whether the plan remains optimal, but noting that the interim risk of supply failures would not actually be acceptable. We do not assume bulk supplies will be in place, and we allow the Itchen water reuse schemes to be available for selection.	• The two Portsmouth and the Bournemouth bulk supplies selected from 2040 • Fawley desalination to 25Ml/d in 4 branches, and to 50Ml/d on 3 branches - not in lowest deficit future • Itchen reuse in highest deficit branch only • Industrial water reuse in 3 branches • Cost not comparable as deficit allowed until 2039
Sensitivity of the approach to extreme drought assumptions	Not allowing drought orders in 1:500 droughts	What would happen if there were no drought permits / orders available in extreme drought conditions after 2025, which represents an attempt to understand the additional investments this extra drought resilience would drive, building on the recent NIC report	• Fawley desalination of 50Ml/d in 2027, but combined with 73Ml/d of Itchen water reuse schemes (which were excluded from the preferred plan) – so effectively 125Ml/d of new strategic resource in 2027 • Bulk supplies stay forced in at earliest date • Broadlands Lake surface water storage also in 2027 • Cost of strategy would be significantly more expensive
	Remove the 1:500 year states of the world	The run removes the 1:500 states of the world. Planning only up to a severe drought to examine the influence that the extreme drought has on the preferred plan and on investments	• Little change from preferred plan – 75Ml/d of desalination still required • Bulk supplies stayed forced in at earliest date • Cost of strategy unchanged
	Solving a 1:1000 extreme drought	A hypothetical test of whether planning to a more extreme drought (of the order of 1:1000) with drought permits / orders available would require significant additional investments.	• Strategy broadly the same • Woodside transfer selected (in addition to Southampton link main) in 2 branches in 2029 • Cost of strategy largely unchanged

		Rationale for model run	Model output conclusions and key considerations
Comparison to single future runs (the conventional EBSD model runs)	Single middle branch (50th percentile EBSD run)	To allow a comparison of our preferred plan against a conventional EBSD approach for a medium deficit future (assuming it is solving a supply-demand balance based on our 50th percentile)	• 50Ml/d of desalination selected in 2027 • Bulk supplies stayed forced in at earliest date • Hampshire grid still selected in 2027 • No asset enhancement in HK • Industrial water reuse scheme in 2029
	Single high deficit branch (10th percentile EBSD run)	To allow a comparison of our preferred plan against a conventional EBSD approach for a higher deficit future (assuming it is solving a supply-demand balance based on our 10th percentile)	• Desalination remains at 75Ml/d in 2027 • Bulk supplies stayed forced in at earliest date • Hampshire grid still selected in 2027
	Single low deficit branch (90th percentile EBSD run)	To allow a comparison of our preferred plan against a conventional EBSD approach for a lower deficit future (assuming it is solving a supply-demand balance based on our 90th percentile)	• No desalination selected • Bulk supplies stayed forced in at earliest date • Hampshire grid still selected in 2027 & extended to HK • No Sandown reuse scheme required • Asset enhancement in HK delayed to 2029
Cost sensitivity	Cost uncertainty with large schemes (desalination & water reuse)	To understand whether alternative schemes would be selected if the costs of schemes for which we have less confidence (i.e. those for which the company has little previous experience of implementing) are scaled proportionally higher than those schemes that we have greater cost confidence in (e.g. which the company has successfully delivered in the past)	• Strategy remains largely the same
	Sustainable economic level of leakage	To understand what would be selected if the model were allowed to select the combination of leakage reduction options at least cost (i.e. representing an economic level of leakage), rather than a forced profile. (this hypothetical run does not constrain the amount of leakage reduction that can be delivered in any one year).	• 50Ml/d of desalination in 2027 in all branches, with 75Ml/d needed in 2 branches • Bulk supplies stayed forced in at earliest date • Industrial reuse scheme selected in 2027 • Cost of strategy is reduced, albeit implementation of leakage reductions may not be practicable

Strategic alternatives

- Itchen reuse schemes (of which there are a number of possible variants)
- Test Estuary industrial reuse scheme – in AMP8 (or even as early as the end of AMP7 in scenario without 9Ml/d Portsmouth Water bulk supply)
- Woodside transfer – needed where there is limited new resource/bulk supplies into HSE, so more water needs to be moved from HSW, and could provide additional resilience
- Fawley desalination of different capacity – could be smaller or larger than in the preferred plan ranging from 25Ml/d-100Ml/d

Key considerations:

- Key driver is the need to meet range of uncertain futures in AMP8, and the lead-in times for scheme development. Needs ongoing monitoring through AMP7 to understand the most likely path, at different distinct decision points – many of which are externally driven
- The timing of a decision on the unconfirmed additional Itchen SR in AMP7 will be critical to the adaptive plan
- Confirmation of the scale and impact of other, as yet unconfirmed, sustainability reductions in 2027 – decision needed as early as possible in AMP7
- Ongoing dialogue with neighbouring companies/regions to secure and agree bulk supplies, and understand risks to those supplies in severe and extreme droughts
- Would generally aim to utilise Fawley desalination once constructed in preference to drought permits / orders, in practice
- Delivery and monitoring of Target 100 programme will be important
- Delivery and monitoring of Leakage reduction programme (in particular 15% reduction by 2024/25) will be important
- Catchment management programme needs to be rolled out to secure those sources at risk from nitrates and pesticide
- Parallel progression of preferred plan scheme with strategic alternatives to ensure delivery of the plan by 2030

4.2 Additional commentary on key findings from sensitivity testing

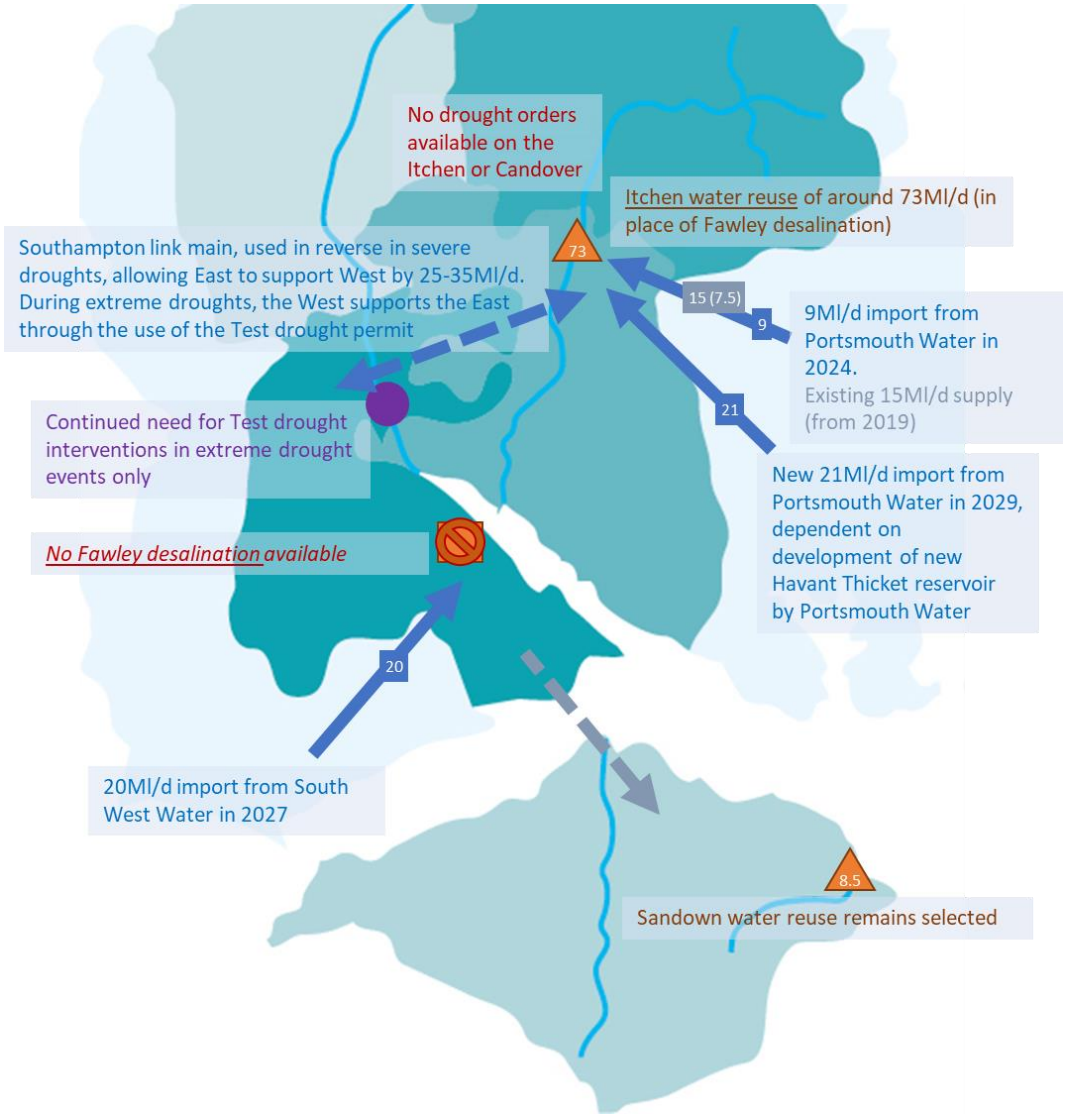
We have selected a few key sensitivity tests from the figure above to comment on. The first set involve scenarios where we exclude key strategic schemes in turn to understand what alternative schemes would be selected instead. The second set are more concerned with the robustness of the preferred plan.

4.2.1 Alternatives if desalination cannot be delivered

This scenario provides a test of how the preferred plan would change if the Fawley desalination option could not be delivered.

The difference in costs, in NPV terms, was not particularly significant (it was actually a minor reduction from the preferred plan), as the Itchen water reuse schemes have costs that are comparative to the Fawley desalination ones. However, as previously discussed in section 2.3.1, there are potentially greater risks associated with development of the Itchen water reuse options than with the Fawley desalination scheme at present.

Figure 15 Strategic alternative to Fawley desalination, in 2029-30



The key strategic changes are:

- Selection of water reuse to replace the 75Ml/d of Fawley desalination. This comprised
  - The 60Ml/d Portsmouth Harbour WwTW indirect reuse scheme in 2027
  - The Portswood WwTW indirect reuse scheme in 2027
- The Southampton link main remains selected, but it is used in reverse compared to the preferred plan in severe droughts with the East supporting the West

4.2.2 Alternatives if Bournemouth Water supply cannot be delivered

This scenario provides a test of how the preferred plan would change if the Bournemouth water supply option could not be delivered.

The scenario has a greater cost, in NPV terms, it was around £35m more expensive.

The key strategic changes are:

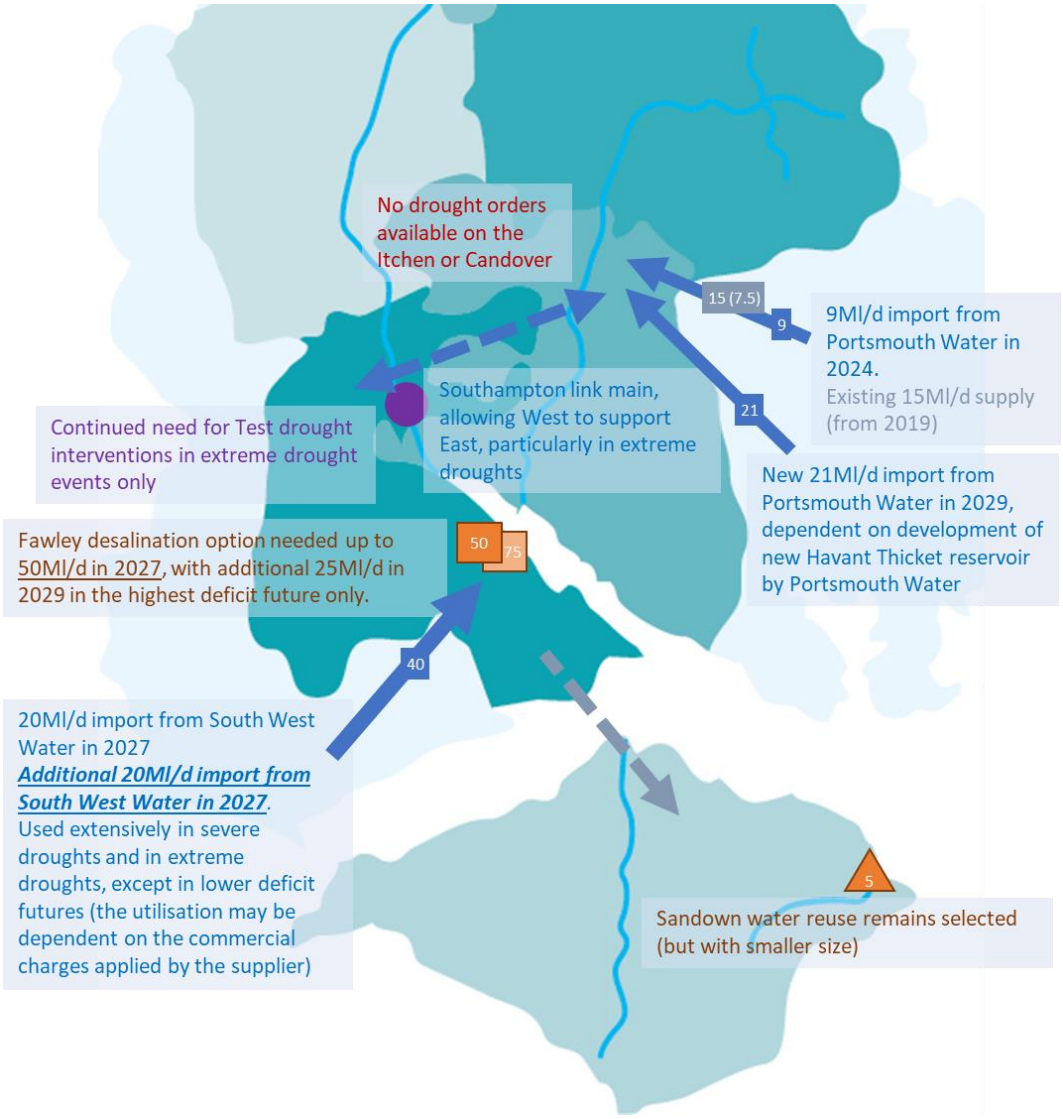
- The potential need for a larger desalination plant at Fawley – compared to the 75Ml/d in the preferred plan, this scenario needs 100Ml/d in 2027, but driven by the severe drought states of the world (where there are not drought interventions available), and by the higher deficit branches
- Reinstate & additional treatment at the WSW near Cowes in 2027

4.2.3 Additional bulk supply from the South West

This scenario examines how the strategy would change if additional bulk supplies could be provided from the South West. This is currently hypothetical, but we have examined the case if the 20Ml/d option selected in the preferred plan could be doubled to give a significant additional volume of 20Ml/d, i.e. a total of 40Ml/d from the south west (which was also assumed to be available in full in extreme droughts).

Whilst this scenario run was significantly cheaper than the preferred plan, it is important to understand that it did not include specific resource development costs, which could be significant. They key consideration with this scenarios is what happens to the rest of the strategy if there is additional water from the south west, noting the discussion from section 3.1.7 that the West Country Water Resources Group were currently looking at the potential options for supplying additional water to us. However, any new options would need to be identified and included in the next plan in WRMP24 where they have been assessed to be feasible, these potential schemes are not currently developed to a level to provide sufficient certainty to be included within our current preferred plan.

Figure 16 Alternative strategy if bulk supplies from the south west could be doubled, in 2029-30



The key strategic change is that the size of the Fawley desalination scheme could be reduced to 50Ml/d, although if may need to be increased to 75Ml/d in 2029 under the highest deficit branch only.

4.2.4 Alternatives if the 9Ml/d Portsmouth Water bulks supply cannot be delivered

Portsmouth Water's preferred plan selects the option to maximise the DO of a groundwater source in 2024-25 (Option R022a in the Portsmouth Water plan). As discussed previously in Section 3.1.7, the EA have identified that the implementation of Portsmouth Water's R022a option, which is needed to enable the 9Ml/d bulk supply to Hampshire, is uncertain. This scenario was raised by Defra in its letter dated 19 March 2019.

As a result of this, we have considered the risks associated with this bulk supply option through inclusion of a scenario whereby this option is not considered. This will help us to understand the sensitivity of the strategy to the 9Ml/d bulk supply from Portsmouth Water and whether alternative schemes need to be considered. The results of this scenario suggest the following impacts on the strategy:

- The Test Estuary WTW industrial reuse scheme (with a capacity of 9Ml/d) would be selected in 2024-25 in place of the 9Ml/d bulk supply from Portsmouth Water. Whilst this could be delivered within AMP7, it would be reliant on a decision on the viability of the Portsmouth

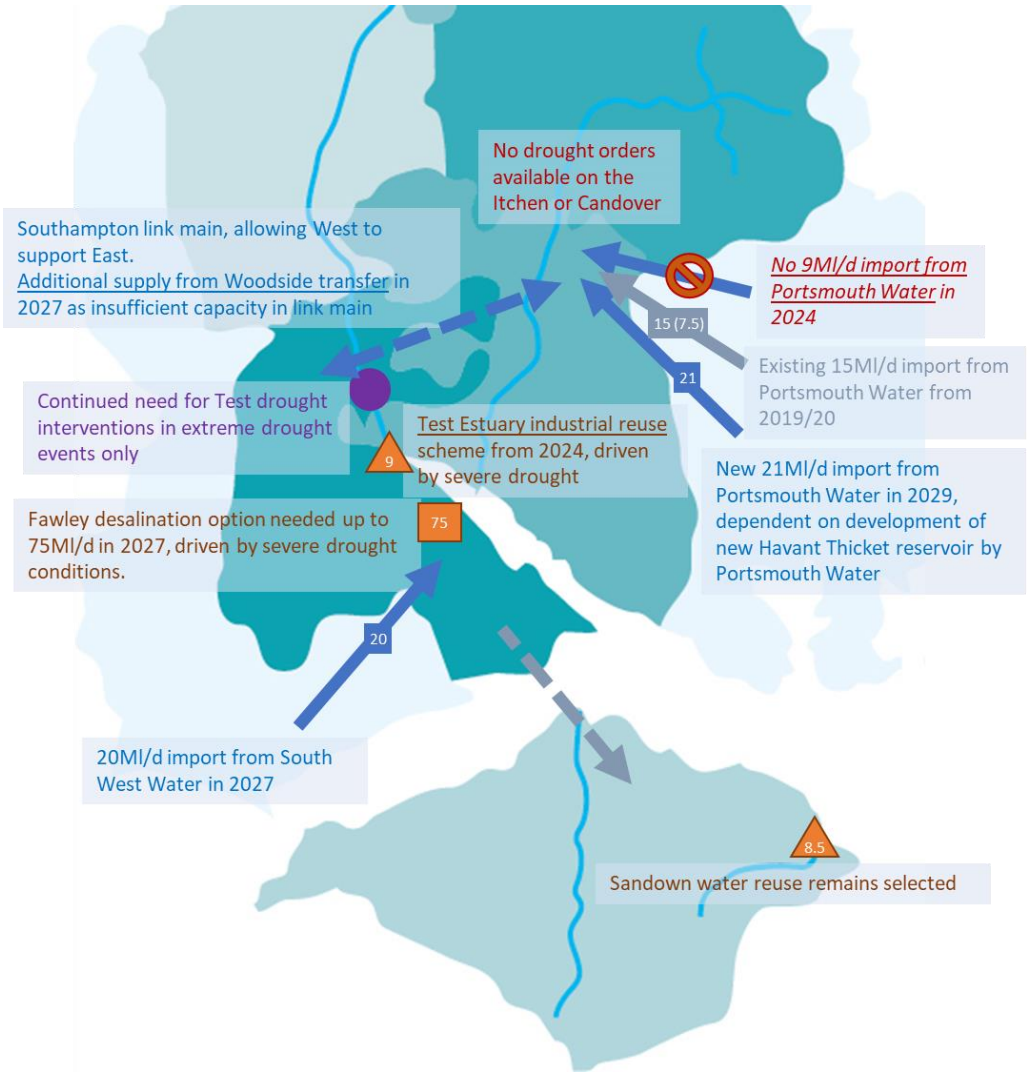
Water transfer by the EA and Portsmouth being made at the start of AMP7. However, if the investigation is not completed until later in AMP7, then delivery of the Test Estuary industrial reuse scheme would be delayed into AMP8. We commit to work closely with Portsmouth Water to ensure timely decisions are made to progress this alternative scheme if necessary

- The Woodside transfer (from HSW WRZ to HSE WRZ) would be needed in 2027 (in addition to the Southampton link main) to allow water from the Test Estuary industrial reuse scheme to be transferred across to HSE WRZ, where the Portsmouth Water bulk supply would have entered the supply system
- There would be no other major changes to the strategy; although there would be minor changes to the way supplies are balanced across the Hampshire grid

A second alternative option to the introduction of the industrial reuse scheme could be to increase the size of the Fawley desalination scheme to compensate for the loss of the 9Ml/d bulk supply, with the associated Woodside transfer to allow the additional volume to be transferred to the Hampshire Southampton East WRZ. Although there would be a programme delay to implementation of such a scheme, as the Fawley scheme would not be available until 2027.

It is also worth noting that, if the Portsmouth Water's R022a scheme cannot be progressed, there may still be scope for a bulk supply that is less than the 9Ml/d preferred scheme which would still provide some additional water into the Hampshire Southampton East WRZ.

Figure 17 Strategic alternative to the 9Ml/d Portsmouth Water bulk supply, in 2029-30



4.2.5 Alternative if Portsmouth Water 21Ml/d bulk supply (dependent on Havant Thicket) cannot be delivered

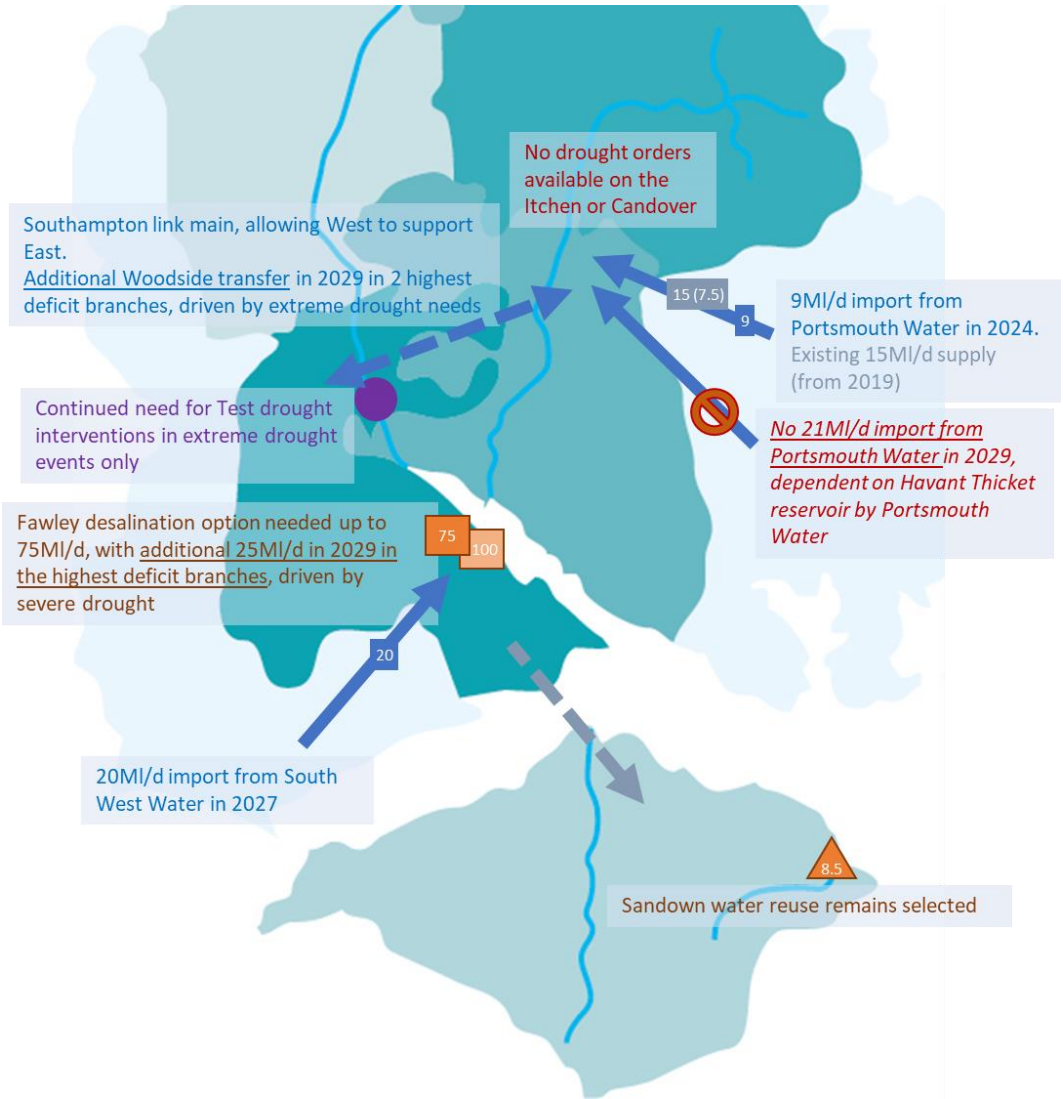
This scenario has been included to understand the potential strategy changes if the Havant Thicket reservoir cannot be developed and delivered by Portsmouth Water, which then impacts on their ability to provide a 21Ml/d bulk supply to our HSE WRZ.

The key changes are summarised in the figure below, but can be stated as:

- Larger Fawley desalination scheme up to 100Ml/d in 2029 in 2 branches (75Ml/d in the lower deficit branches)
- Woodside transfer in 2029 in 2 branches
- Extension of the Hampshire grid between HA-HK in 2029

Whilst it is slightly cheaper than the preferred plan (by around £25m in NPV terms), it does not support our regional planning objectives. The bulk supply could also provide resilience to different events.

Figure 18 Strategic alternative to the 21Ml/d Portsmouth Water bulk supply (dependent on Havant Thicket reservoir), in 2029-30



4.2.6 Storage optimisation

This scenario provides a test of how the strategy would change if storage options could be maximised. This scenario assumes that the Havant Thicket reservoir (PW bulk supply) is implemented in 2029, and that the DO available during the MDO and PDO periods is 50Ml/d (while being rested at all other times of the year, so that the ADO is at 21Ml/d). This would require that the reservoir was always operated to maximise the transfer to Southern Water. The scenario is hypothetical only, to examine how maximised storage with consequently larger DO in the critical planning periods may impact the preferred strategy. Such a scheme has not been developed or costed to date – e.g. the costs of the larger diameter pipelines needed for a 50Ml/d sized transfer (rather than 21Ml/d) have not been calculated for this run.

The scenario also assumes that the Test Lakes option would be implemented in its earliest start year to maximise the DO during the critical period where possible.

For the purposes of this hypothetical scenario we also allowed deficits until 2029 (the year at which Havant Thicket is anticipated to be implemented), to avoid timing issues around the selection of other options.

The key strategic changes are:

- Additional storage from Test Lakes (minor DO increase to meeting the deficit) and additional 29Ml/d in MDO and PDO from the Portsmouth Water Havant Thicket bulk supply
- The Fawley desalination scheme can be reduced to 50Ml/d in the highest 3 deficit branches, although if the future deficit is lower, the scheme could be reduced to 25Ml/d
- The Southampton link main would not be required, although the smaller Woodside transfer would be needed in the highest branch in 2029

4.2.7 No additional Itchen sustainability reduction in 2024 scenario

At the end of the Itchen, Candover and Test Water Abstraction Public Inquiry in March 2018 the EA referred in their closing statements to the prospect of further review of the proposed hands off flow conditions on the River Itchen licences at the point of intended renewal in 2024. Whilst these revisions still have to be investigated during the next AMP (2020-2025) the last independent review of the hands off flow conditions proposed a flow condition of 224Ml/d, which is higher than the current proposed conditions of 198Ml/d. Therefore, in order to have long-term regard to an anticipated further reduction in abstraction, we used this estimate of 224Ml/d as the potential new hands off flow condition on the River Itchen licence in order to assess the likely impact on the supply forecast post-2024.

The rationale was to ensure that the solutions we are developing for the Western area are capable of accommodating this additional change to the licence over and above those which were proposed and agreed during the Inquiry (and which have now been implemented, as of 15 March 2019). The additional change to the Itchen licence could occur as soon as the next AMP and there may therefore be very limited time to develop and implement an alternative source to address the licence change. We felt it was critical that this was included in the analysis and planned for as not including it could delay the programme for developing a solution for the area, as agreed with the EA in the s20 agreement, because it may require a later revision to planning application documentation, or trigger entirely different schemes.

In our preferred plan we included the uncertainty associated with the further sustainability reduction. However, we have also included a scenario where the additional sustainability reduction on the Itchen is not included, to allow for comparability to the draft WRMP and to understand the impact that this additional sustainability reduction on the Itchen has on the plan.

There is a significant cost saving of £140m in NPV terms over the planning period.

The key strategic changes are:

- A smaller Fawley desalination scheme is needed in 2027 (50Ml/d), with 75Ml/d needed in 2029 but only in one branch (highest deficit).

This suggests that the preferred plan is broadly stable – to address the other drivers of deficits in the Western supply area (e.g. the sustainability reductions already enacted on the rivers Test and Itchen) a large scale scheme is still required. Whilst the capacity of that scheme may be reduced if the additional Itchen sustainability reduction does not occur, it does not otherwise fundamentally change the strategy. In order to ensure we comply with the s20 agreement to use 'all best endeavours' to ensure the delivery of the 'Long Term Water Resources Scheme' as set out in the final WRMP, we must undertake the investigation and promotion of our preferred schemes (and strategic alternatives). This must, on the basis of the above analysis, include the 75Ml/d Fawley desalination scheme. In addition, in the face of other uncertainties (around sustainability reductions and bulk supply options, for example) we should also consider a larger desalination scheme as a strategic alternative to some of our preferred schemes, along with other strategic alternatives such as the Itchen water reuse schemes.

4.2.8 No impacts from unconfirmed sustainability reductions

The purpose of this scenario is to understand how the large uncertainty on timing and scale associated with the unconfirmed sustainability reductions may affect the strategy. Note that this scenario still assumes that the Test and Itchen sustainability reductions are in place, as these licenses have already been changed (as of March 2019).

The key strategic changes are:

- The size of the Fawley desalination scheme is reduced. It remains selected, but at a smaller 25Ml/d in all branches in 2027, and a slightly larger 50Ml/d in 2029 but in the highest deficit branch only
- The smaller capacity Woodside transfer replaces the Southampton link main
- Bulk supplies stay forced in at their earliest date
- The Hampshire grid is not required for HW-HA, although this may then reduce the resilience benefits for the preferred plan

However, as already noted in section 4.2.7, we need to ensure we are complying with the s20 agreement to use 'all best endeavours' to ensure the delivery of the 'Long Term Water Resources Scheme' as set out in the final WRMP, and in the face of other uncertainties (e.g. around sustainability reductions) which could occur in the next AMP and in AMP8, we need to plan for these uncertainties. There may be very limited time to develop and implement alternative schemes to address the possible but unconfirmed sustainability reductions.

4.2.9 What if the River Test Sustainability Reduction (SR) had been delayed until 2030-34?

The purpose of this run is to understand how the strategy would change had the Test SR been delayed until such a time when all strategic options would have been available. This is a variant of the alternative sustainability reduction scenario D which we presented in the draft WRMP, which assumed that, whilst the Itchen sustainability reduction is implemented, the licence changes are not imposed at Test surface water, so abstraction continues at current levels. The difference from Strategy D, is that we do assume the Test SR happens, but not until further in the future – in 2035.

The Test licence change has already been implemented (March 2019), and so this scenario is purely hypothetical. However, the rationale for including it is to help understand and demonstrate the impact on the preferred plan if there had been more time to implement the sustainability reduction.

We assumed that the bulk supply schemes would remain in place at their earliest start date. As such, the key strategic points to note were:

- The Fawley desalination scheme would still be selected in 2030-4 – it is required at 25Ml/d in all branches, up to 50M/d in 4 branches, and up to 75Ml/d in 2 branches
- There is no need for a Test drought intervention in AMP7 in low return period droughts (as there is no licence reduction on the Test to address in AMP7)

This scenario therefore provides confidence in our strategy.

4.2.10 What if there were future environmental effects?

This sensitivity run assumes that there could be additional sustainability reductions in future, over and above those assumed in our baseline supply-demand balances in the late 2020's – i.e. what if there were further reductions to water available for abstraction due to future environmental changes or policies?

We have developed a possible future environmental forecast (see Annex 4) which has been used to estimate a future where there are further DO reductions. This run should identify how this would change the strategy and whether it would trigger significantly different options or highlight that there would not be sufficient options available at present to solve additional possible sustainability reductions later in the planning period.

The results suggest the following may be necessary if these environmental forecasts occurred:

- Increase in Fawley desalination to 100Ml/d in 2 branches from 2045;
- Test Estuary industrial reuse scheme in 2035 in 3 branches
- Brings forwards IoW reinstatement scheme at WSW near Cowes to 2030-34

4.2.11 Allow deficits until 2029

A useful hypothetical sensitivity test is to accept deficits for the initial part of the plan to confirm that the options selected in the strategy are not driven purely by them being available for delivery before other options. If we do not force the model to solve any deficits until the end of AMP8 (i.e. until 2029), would the options selected in the strategy change and if so, is this optimal or is time a critical element to the strategy?

The results were as follows:

- Fawley desalination was reduced in size to 25Ml/d in all branches, and 50Ml/d in the four branches (10th to 70th percentile branches), while 75Ml/d was still required in the middle and higher deficit branches (i.e. in the 10th to 50th percentile branches); The three bulk supply options were assumed to be selected in their earliest start years
- The other parts of the strategy do not change – which suggests the strategy is stable. (The trade-off between Itchen water reuse and desalination was not explored as part of this run)
- The Test Drought Permit/Order is needed in all branches from 2029 to the end of the planning period

4.2.12 Allow deficits until 2039

This was a further hypothetical scenario variant of the one above. In this case we allowed deficits for the first 20 years of the plan, to test our preferred plan against one which was definitely not being driven by time constraints. This would also allow inclusion of one other strategic sized option which is not available until the late 2030s – the Thames Water bulk supply on the basis of development on the new upper Thames reservoir.

In this variant, we did not assume the three preferred plan bulk supplies would be in place (but they were available for selection if needed), and we also allowed the Itchen water reuse schemes to be available for selection.

The key strategic considerations were:

- The Portsmouth and the Bournemouth bulk supplies were selected from 2040
- Fawley desalination was still selected in 2040 to 25Ml/d in 4 branches, and to 50Ml/d on 3 branches – but not in the lowest deficit futures
- A 21Ml/d Itchen reuse scheme was selected in the highest deficit branch only in 2040. Although the potential issues with Itchen water reuse schemes remain to be resolved. If reuse could not be delivered, then the Fawley scheme would need to be 21Ml/d larger in the highest deficit branch
- The Test Estuary industrial water reuse scheme was also selected in 3 branches in 2040

Clearly this is not a realistic scenario – we could not leave deficits created by the implementation of the Itchen and Test licence changes unsolved for 20 years, and we are committed under our Section 20 agreement to use 'all best endeavours' to ensure the delivery of the 'Long Term Water Resources Scheme' as set out in the final WRMP by 2030. Nevertheless, it is a useful hypothetical scenario to examine and understand the context of the schemes in the preferred plan and the potential strategic alternatives that should be considered, within the constraint of the Section 20 agreement.

4.2.13 Solving the plan without the extreme drought branches

The purpose of this sensitivity test is to help understand the influence that the extreme drought states of the world have on the investment needed. This will depend on the balance between deficits faced in extreme droughts, the drought intervention options that are available, and the ability to transfer water between WRZs to minimise deficits.

This scenario is very similar to the preferred plan which needs to solve the extreme drought states of the world, as follows:

- The regional plan (the three bulk supplies from Portsmouth and Bournemouth) were kept in place at their earliest start date
- The 75Ml/d Fawley desalination is still required
- The only minor change is that the reversible Romsey Town and Broadlands valve improvement in delayed until later in the planning period
- There is no significant cost difference to the preferred plan

This effectively helps to identify that for the circumstances we face in the Western area, there is broadly a balance between the severe drought (without the availability of Drought Permits / Orders after an interim period) and the extreme drought (which allows for the use of ongoing Drought Permits / Orders) in driving the investment in water resources options.

4.2.14 'Sustainable Economic Level of Leakage' (SELL) run

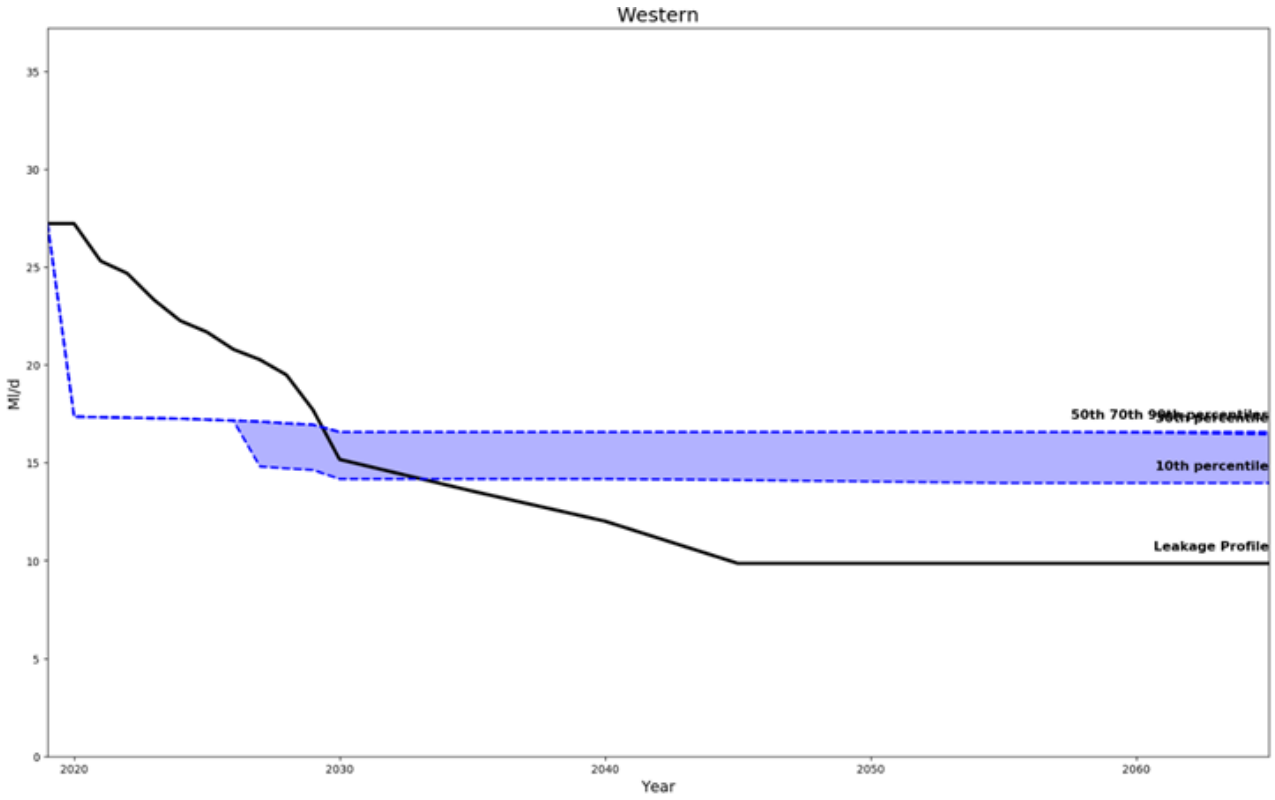
We have undertaken a sensitivity run in which we allowed the model to select the optimum amount and timing of leakage reduction activity – i.e. effectively the 'SELL' run. The preferred plan adopts a leakage reduction profile to ensure that we meet our policy objectives to achieve a 15% leakage reduction by the end of AMP7 and a 50% reduction by 2050. This run is a hypothetical one, in so far as we have not placed any constraints on the amount of leakage reduction that could be delivered in any one year, which clearly may make the SELL output challenging or unrealistic to deliver.

Noting this important caveat, the key differences were:

- The cost of the SELL strategy is less than the preferred plan, suggesting that the costs of the leakage reduction policy are quite significant
- A greater amount of leakage reduction is implemented towards the start of the planning period (see the blue dotted lines in Figure 19 below). However, undertaking significant leakage reduction activity in only one or two years does not necessarily reflect a technical or practicably feasible approach to leakage reduction, so the effort to drive down leakage in the early part of AMP7, may not actually be achievable
- By the end of AMP8 our leakage reduction profile used in the preferred plan (the black line in the figure below) reaches the SELL range before exceeding it significantly over the course of the planning period

The comparison of our preferred plan leakage reduction profile to an unconstrained leakage profile is shown in the figure below.

Figure 19 Comparison of leakage profile against range of SELL reductions



4.3 Comparison of strategies with conventional 'EBSD' approach

Following best practice as outlined in the UKWIR decision making process guidance (2016), we have undertaken traditional EBSD modelling runs to compare against the strategy resulting from a Real Options approach. This provides a useful benchmark against the more advanced Real Options decision making approach. By 'EBSD' we mean the traditional way of solving a single supply-demand balance through the planning period, as described originally in the *Economics of balancing supply and demand* guidance from UKWIR.

The 'EBSD' run involves using the Real Options model but with only one branch. The 50th percentile branch has been run as this is the supply-demand balance that is used up to the branching point in 2027. We have also run the 10th and 90th percentile branches to show how the EBSD approach of scenario testing of high and low forecasts might also be applied and compared to the Real Options approach.

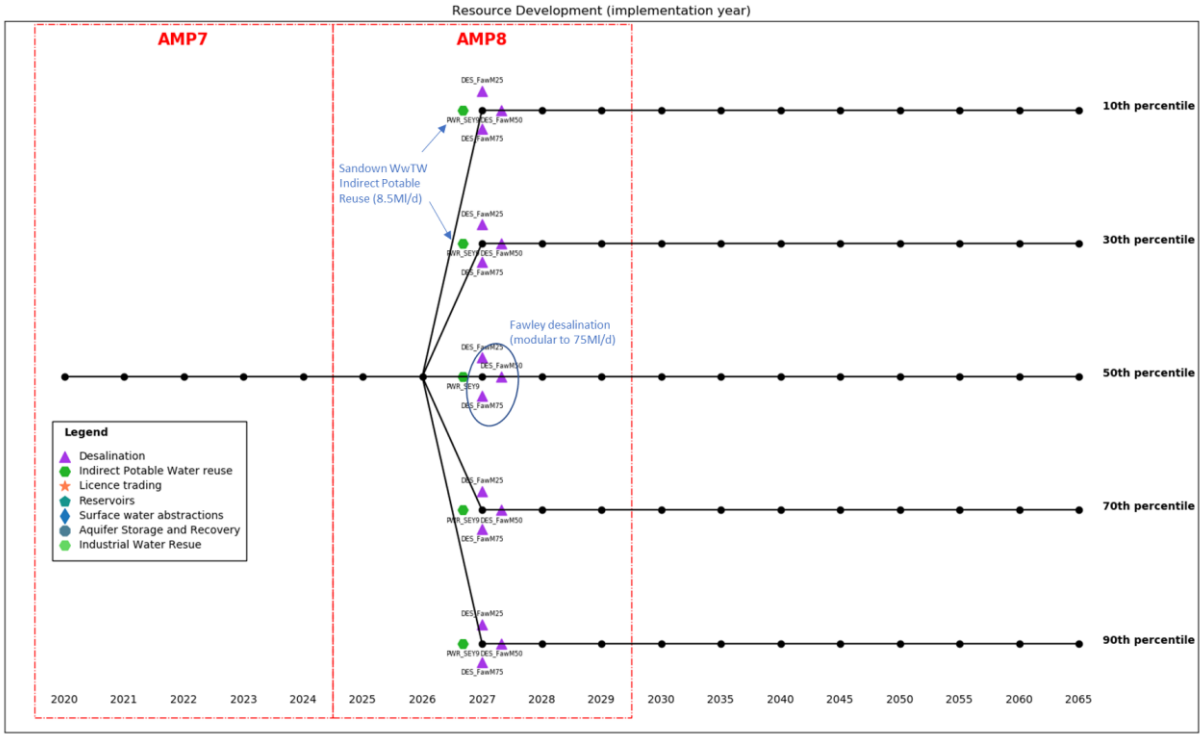
Figure 14 (in section 4.1 above) presents the comparison of the Real Options model to the EBSD approach for the 50th and for the upper deficit 10th and lower deficit 90th percentile branches.

In order to meet the uncertainties with different plausible futures, our plan has had to select a wider range of options that need to be investigated and promoted, in order to meet the 22 December 2027 deadline relating particularly to the Water Framework Directive (WFD), specified by the EA. With a smaller range of more certain futures, the array of options could be reduced. This is shown by the EBSD 50th percentile sensitivity test, and also the 90th percentile (lowest deficit branch). However, if the uncertain sustainability reductions were to materialise, and we were to have planned only on the basis of the conventional EBSD approach, we would not have a plausible plan to meet and deliver those sustainability reductions in the timescale required, given that confirmation of the sustainability reductions with the EA is unlikely until the middle of AMP7 at the earliest.

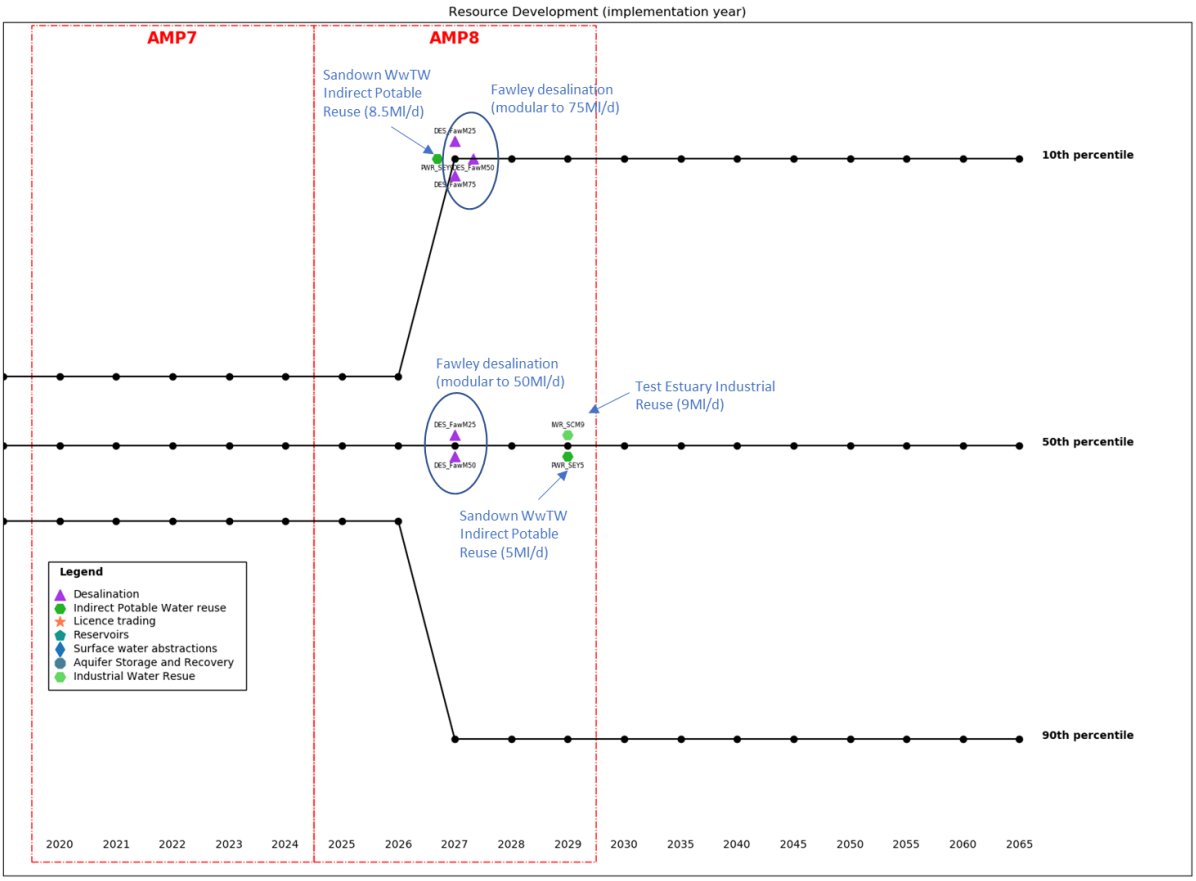
Figure 20 below presents a summary of the resource developments for each of the three EBSD scenario runs, and for the preferred plan (using the Real Option multiple branches approach).

Figure 20 Comparison of the resource developments in the Real Options approach with the three EBSD runs

Real Options approach (define preferred plan)



EBSD runs at 90th, 50th and 10th percentile branches



4.4 Comparison of strategy with WRMP14

It can be instructive to compare the results with the last WRMP that was developed in AMP5 and published in 2014 – referred to as WRMP14.

The strategy for WRMP14 was based upon the need to implement a sustainability reduction for the River Itchen, however there was no proposed licence change for the River Test at the time of producing WRMP14. Scenario D for sustainability reductions, which was presented in the draft WRPMP19, is therefore most closely aligned with the assumptions used for WRMP14.

In addition, for the current plan, we have developed a Real Options approach – so rather than considering only one future, with some testing around uncertainties of some forecast components, this time we have solved for a wide range of futures simultaneously.

We are also solving for a wider range of states of the world: previously we solved for the normal year and a drought of around 1 in 125 drought return period. This time, we are solving for drought, severe drought and extreme drought conditions, which equate approximately to 1 in 20, 1 in 200 and 1 in 500 year drought events, although we do allow Drought Permits / Orders for the extreme droughts, which were not available to the WRMP14 plan for use in the severe drought.

The strategy for WRMP14 incorporated the following elements described in Table 13, with commentary of similarities with the current plan scenario D, and our preferred strategy, previously referred to in the draft WRMP19 as Strategy A (which includes Test sustainability reductions) based on the real options approach of solving 5 possible futures simultaneously.

Table 13 Common strategic elements between WRMP14, our preferred strategy (formerly known as Strategy A) and scenario D (from the draft WRMP)

Scheme	**WRMP14** (SR on Itchen only)	**draft WRMP 19 scenario D** (SR on Itchen only)	**WRMP19 preferred plan (formerly known as Strategy A in draft WRMP19** (SR on Itchen and Test)
Bulk supply from Portsmouth Water for 10Ml/d	In AMP6	*n/a – has been implemented as 15Ml/d bulk supply*	*n/a – has been implemented as 15Ml/d bulk supply*
Candover groundwater scheme for river augmentation (20Ml/d)	In AMP6	The permanent scheme envisaged for WRMP14 is not available as part of the feasible list of options following discussions with regulators. Instead there is a Candover Drought Order option that is selected	The permanent scheme envisaged for WRMP14 is not available as part of the feasible list of options following discussions with regulators. Instead there is a Candover Drought Order option that is selected
Southampton link main	In AMP6 (not implemented)	Selected in AMP8	Selected in AMP8
Increase bulk supply from Portsmouth by 5Ml/d	In AMP7	Existing bulk supply is 15Ml/d, so already implemented. Further bulk supplies from Portsmouth of 9Mld in AMP7 and 21Ml/d in AMP8 (i.e. total supplies from Portsmouth of 45Ml/d supplies)	Existing bulk supply is 15Ml/d, so already implemented. Further bulk supplies from Portsmouth of 9Mld in AMP7 and 21Ml/d in AMP8 (i.e. total supplies from Portsmouth of 45Ml/d supplies by end of AMP8)

Scheme	WRMP14 (SR on Itchen only)	draft WRMP 19 scenario D (SR on Itchen only)	WRMP19 preferred plan (formerly known as Strategy A in draft WRMP19 (SR on Itchen and Test)
Desalination scheme of 20Ml/d (Test Estuary) (Fawley option if 25Ml/d had been required)	In AMP8	No desalination scheme needed.	Desalination of 75Ml/d at Fawley in AMP8.
Utilise full capacity of cross-Solent main + Borehole rehabilitation near Cowes scheme	In AMP8	*Upgraded to 18Ml/d capacity in AMP6*. Borehole rehabilitation selected but not until 2027 Also needs another IoW scheme – water reuse at Sandown (5Ml/d) in AMP8.	*Upgraded to 18Ml/d capacity in AMP6*. Borehole rehabilitation selected in 2065. Also needs another IoW scheme – water reuse at Sandown (9Ml/d) in AMP8.
Demand management – focused on leakage activity (active leakage control) Enhanced water efficiency activity	Various	Much greater water efficiency through implementation of the 'Target 100'. Also included leakage reduction.	Much greater water efficiency through implementation of the 'Target 100'. Significant leakage reduction policy to reduce leakage by 15% at the end of next AMP and by 50% by 2050.
Not in WRMP14	n/a	Nitrate catchment management and treatment (limited). Addition of catchment management for pesticide issues New bulk supplies from Bournemouth (20Ml/d) in AMP8. Hampshire grid option linking HSE-HW-HA Increased connectivity (reversible between HSW & HR WRZs) Newbury WSW asset enhancement in 2027	Nitrate catchment management and treatment – AMP7-AMP9. Addition of catchment management for pesticide issues, and in-stream restoration measures New bulk supplies from Bournemouth (20Ml/d) in AMP8. Hampshire grid option linking HSE-HW-HA in AMP8 Increased connectivity (reversible between HSW & HR WRZs) Newbury WSW asset enhancement in 2027

5. Summary WFD, HRA & SEA assessment

5.1 Environmental cumulative impact assessment and programme appraisal

A detailed environmental assessment, covering Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA) and WFD assessment, was carried out of a wide range of feasible options considered for inclusion in the Western area strategy to help inform decision making on the final strategy and inform development of the this plan. In particular, the findings of the feasible option assessments were used to evaluate the environmental and social performance of a range of alternative strategies and scenarios for maintaining a supply-demand balance in the Western area, with each alternative strategy comprising a different mix of options and option types.

For each alternative strategy or scenario, the likely scale of adverse and beneficial environmental and social effects for each option was considered, both on its own but also in combination with the other options included in that strategy. The potential effects in combination with any other relevant projects, plans or programmes (for example, any planned major infrastructure schemes that may be constructed and/or operated at the same time and affecting the same environment and/or communities) was also assessed. This appraisal of each alternative strategy also included consideration of the potential for any regulatory compliance risks associated with the HRA and WFD.

The environmental and social performance of each alternative strategy or scenario was used to help make decisions on which strategies to explore further through the programme appraisal modelling process and to finally determine the appropriate strategy for inclusion in this plan. Due to the scale of the forecast supply deficit in the Western area, it was not considered appropriate to remove any of the feasible options from consideration for inclusion in the final strategy All options were therefore considered and the SEA findings (along with the HRA and WFD assessments) were actively used in reaching a decision on the WRMP strategy. A number of alternative options and option combinations were explored in developing the preferred strategy as well as a wide range of scenario testing model runs - the SEA, HRA and WFD assessments were used to compare the environmental performance of these alternative combination of options to inform and contribute to the decision-making process which also took into account other factors including cost, resilience and customer preference information. We also took account of the consultation responses on the draft WRMP19. This assessment and decision-making process led to the development of our preferred strategy for the Western area.

The ability to achieve our aim of restricting Drought Orders / Permits to extreme drought conditions only to reduce the risk of adverse environmental effects was examined as part of developing the strategy taking account of the costs, risks, feasibility and environmental effects of the measures required to deliver this objective. The assessment concluded that the objectives were achievable in the longer term, but in the short term Drought Orders and Permits in the Western area may be required in severe drought conditions as well as extreme drought conditions in the period up to 2024 as several strategic schemes need to be developed first including the Fawley desalination scheme and three new bulk water imports from South West Water (Bournemouth Water) and Portsmouth Water. For the Test Drought Permit only, this may be still be required in severe drought conditions up to 2028-29 when the Portsmouth Water Havant Thicket Reservoir bulk import scheme is delivered. However, the other schemes will be delivered earlier than 2029 to progressively reduce the volume of water required from any Drought Permit / Order in the period from 2024 onwards

As well as the adverse effects of options, we looked at the beneficial effects of options to decide whether any options should be prioritised in view of the environmental or social benefits they may bring. This led to our decision to preferentially include in our strategy the early implementation of further measures to reduce demand for water in the Western area:

- Reduce leakage by a further 15% by 2025 and by 50% by 2050
- Water efficiency activities to help our customers reduce their consumption to an average of 100 litres per head per day by 2040 ('Target 100' programme). This involves an intensive media and engagement campaign as part of an initial phase of the 'Target 100' programme, concentrated throughout the period 2020-2025, but helping to influence customers' water use behaviour over the longer term
- Metering of more household properties to increase meter penetration from 88% to 92% which will support the achievement of the 'Target 100' programme

Once the final strategy had been determined, environmental assessment (SEA, HRA and WFD assessment) was carried out to examine any cumulative effects from construction and/or operation.

5.2 Environmental assessment of Western area strategy

The SEA summary of the WRMP19 strategy for the Western area is presented in Table 14. The HRA of this strategy has concluded that there would be no likely significant effects on any European site with appropriately agreed mitigation measures in place to address any identified risks during construction and/or operation. Similarly, the WFD assessment has concluded that this strategy would not result in any deterioration of WFD status of any water body, with the exception of the Sandown indirect water reuse scheme where there is currently some uncertainty as to the potential effect on WFD status due to the effects of additional flow discharges to the River Eastern Yar on top of the existing river flow augmentation scheme, thereby further modifying the low flow regime of the river.

Table 14 SEA effects summary for the Western area

Option name	Residual Effects Significance	SEA objective																
		Biodiversity, flora and fauna		Population and human health			Material assets and resource use		Water				Soil, geology and land use	Air and Climate			Archaeology and Cultural Heritage	Land-scape and Visual
Romsey Town and Broadlands valve (HSW-HR reversible)	Adverse																	
	Beneficial																	
Import from Bournemouth Water	Adverse																	
	Beneficial																	
Additional import from Portsmouth Water (additional 9Ml/d)	Adverse																	
	Beneficial																	
Additional import from Portsmouth Water (Havant Thicket reservoir development)	Adverse																	
	Beneficial																	
Hampshire grid (reversible link HSE-HW)	Adverse																	
	Beneficial																	
Hampshire grid (reversible link HW-HA)	Adverse																	
	Beneficial																	
Sandown WwTW Indirect Potable reuse (8.5 Ml/d)	Adverse																	
	Beneficial																	
WSW near Cowes - reinstate & additional treatment	Adverse																	
	Beneficial																	
Newbury WSW asset enhancement	Adverse																	
	Beneficial																	
Southampton link main (reversible link HSW-HSE)	Adverse																	
	Beneficial																	
Fawley desalination (modular to 75Ml/d)	Adverse																	
	Beneficial																	
In-stream river restoration works on the Test (upper reaches)	Adverse																	
	Beneficial																	
In-stream river restoration works on the Itchen	Adverse																	
	Beneficial																	
Pesticide catchment management / treatment – Sandown	Adverse																	
	Beneficial																	
Pesticide catchment management / treatment – Test Surface Water	Adverse																	
	Beneficial																	
Nitrate catchment management / treatment – Twyford	Adverse																	
	Beneficial																	
Nitrate catchment management / treatment – Romsey	Adverse																	
	Beneficial																	
Nitrate catchment management / treatment – Winchester	Adverse																	
	Beneficial																	
Nitrate catchment management / treatment – Chilbottom	Adverse																	
	Beneficial																	
Leakage reduction (15% reduction by 2025; 50% by 2050)	Adverse																	
	Beneficial																	
Installation of AMR meters to take HH meter penetration from 88% to 92%	Adverse																	
	Beneficial																	
Target 100 water efficiency activity	Adverse																	
	Beneficial																	

Key:

- Major adverse
- Moderate adverse
- Minor adverse
- Negligible beneficial or adverse
- Minor beneficial
- Moderate beneficial
- Major beneficial

The strategy includes six catchment management options (excluding the two in-stream restoration options) to improve nutrient management and land-use practices as well as in-stream river restoration works for the lower River Itchen and lower River Test (in particular providing increased environmental resilience to the abstraction of water from these rivers in times of drought under Drought Order powers). The SEA assessment findings for the catchment management options are very similar. The effects of these options are assessed as beneficial in relation to many of the SEA objectives with predominately negligible or no adverse effects, except for minor adverse effects associated with carbon emissions for the extra water treatment necessary for the additional water made available by these schemes. These schemes also provide a beneficial effect in respect of WFD objectives to achieve good ecological status and wider environmental objectives for terrestrial ecosystems.

The in-stream river restoration works for the River Itchen and the upper reaches of the River Test, have been included in particular to provide increased environmental resilience to the abstraction of water from these rivers in times of drought. These measures are **additional** to those previously agreed with the EA and Natural England in connection with the Test Drought Permit / Order and the Candover and Lower Itchen Drought Orders. The effects of these two options are assessed as beneficial in relation to many of the SEA objectives with only negligible adverse effects

Demand management measures are a core feature of the strategy, reflecting their environmental benefits and include: installation of Automatic Meter Reading (AMR) meters as part of increasing household meter penetration from 88% to 92%; further leakage reduction1 5% by 2025 and 50% by 2050);; and the 'Target' 100 water efficiency activities to reduce average per capita consumption to 100 litres per head per day by 2040. These demand management options have been grouped to summarise the environmental and social effects of these options. The effects are mainly beneficial but with some minor temporary adverse effects in respect of materials required for water leak repairs and metering, as well as the risk of temporary traffic disruption and associated carbon and air quality effects of street works for leak repair activities.

The eleven supply-side options in our strategy includes one water reuse scheme which provides beneficial effects relating to the provision of additional reliable water supplies by reusing treated effluent and thereby increasing resilience to the future effects of climate change. The SEA identified a number of adverse effects for this scheme:

- The **Sandown indirect potable water reuse scheme** could result in adverse effects regarding the Isle of Wight Area of Outstanding Natural Beauty (AONB) due to the construction of a pipeline across part of the AONB which cannot be avoided. We will work closely with planners and Natural England to optimise the precise routing of the pipeline to minimise effects on landscape and ecology as part of the detailed design of the pipeline.

  Further investigations are needed to confirm the magnitude of adverse effects on the ecology and geomorphology of the River Eastern Yar from discharges to the river of highly treated effluent at times of low flows. Although flow augmentation of this river already occurs, the WFD assessment indicated some uncertainty in respect of the risk of deterioration in WFD status class and that additional mitigation measures may be required to protect the environment. The nature of these mitigation measures (e.g. operational controls and possibly treatment processes) will be determined from the further environmental investigations to be carried out for this option. We will work closely with the EA to scope the necessary environmental investigations and discuss the need for mitigation measures in light of the findings

  The HRA of this option concluded there would be no adverse effects on the Solent and Southampton Waters SPA and Ramsar site. No adverse effects are anticipated to the associated Brading Marshes to St. Helen's Ledges SSSI

The **Fawley desalination scheme** brings major beneficial effects in respect of provision of a reliable water supply that is very resilient to the future effects of climate change. Some major adverse effects have been identified in relation to the operational use of non-renewable materials and generation of wastes in the treatment process, as well as carbon emissions. Additionally, there are a range of risks to the marine environment which we have considered at a strategic level and the necessary mitigation measures that may be required to protect the marine environment. Since the draft WRMP19, we have further reviewed the design of the scheme and the mitigation measures that are likely to be required such that the assessed residual effect is reduced to no greater than moderate adverse effects on the marine environment. For example, we have ensured provision of screening of the intake and outfall structures to avoid entrainment of aquatic fauna and included for on-site treatment to deal with non-brine chemical waste products from the treatment process

With careful application of mitigation measures, there should be no adverse effects on the marine European sites on the landward side of the outfall and abstraction pipeline construction activity.

Potential major adverse effects relating to biodiversity, fauna and flora as well as landscape and visual amenity may arise from construction of pipelines for the desalination scheme within or near to the New Forest National Park and associated designated European conservation sites. We have assumed on a precautionary that a pipeline is potentially required for the Fawley desalination plant to move water northwards to the distribution system of Southampton. A section of the pipeline will need to be routed either within or close to the New Forest SAC, SPA and Ramsar and the National Park. Discussions are ongoing with the Highways Agency about the viability of construction within the A326. However, if construction in the road is not permitted, we have also assessed a pipeline route that will utilise a less favourable area of habitat within the European sites and National Park boundary using an existing wayleave for overhead power cables. This wayleave is also the proposed routing for the Test Estuary Industrial Reuse pipeline described above. Further route optimisation will be carried out at the detailed planning stage to utilise the existing road network if possible.

The import from **Bournemouth Water** involves a proposed long-distance pipeline to bring water into our distribution system. Since the draft WRMP19, we have revised the pipeline route to avoid the New Forest National Park and associated designated European conservation sites so as to minimise the environmental effects of this scheme. The route avoids Whiteparish Common SSSI (a component of the SAC) and Cranborne Chase and West Wilshire Downs AONB, as well as avoiding potential impacts to offsite habitat use of woodlands by woodlark. Further route optimisation and site investigations will be required at the detailed design stage to ensure no interruption of floodplain dynamics, localised lowering of groundwater table, or impedance of surface and groundwater flows, thereby avoiding adverse effects to the River Avon SAC and water dependent habitats.

The **Southampton Link Main scheme** has the potential to result in adverse effects relating to biodiversity, flora and fauna due to the possible adverse effects to a designated European conservation site, but we have sought to minimise these effects through re-routing of the pipeline (including to avoid Ancient Woodland) wherever feasible and, where not feasible, developing mitigation measures. The launch and receptor pits will be set up in the least impactful locations avoiding lowland fens, and wherever possible avoiding coastal and floodplain grazing marsh assuming this does not compromise the ability to directionally drill.

A suite of mitigation and compensation measures have been developed to avoid adverse effects of the Southampton Link Main option to the Solent and Southampton Water SPA and Ramsar, and River Test SSSI and Lower Test Valley SSSI. Further detailed assessment, including a hydrology assessment, will be required at the detailed design stage to confirm the mitigation proposed is sufficient to avoid adverse effects.

For the **Hampshire Grid Main option**, we have routed the pipeline to avoid areas of ancient woodland and other irreplaceable priority habitat (e.g. chalk grassland). However, approximately 10km of pipeline will be required within the North Downs AONB given the destination of the pipeline. This cannot be avoided as the existing water supply asset is located within the AONB and therefore detailed route optimisation will be required at the planning stage to minimise impacts to the character of the area by utilising the local road networks and areas of poorer quality habitat. The pipeline will cross the River Test SSSI between Chilbolton and Wherwell. To minimise impacts, the crossing will be directionally drilled. No land-take is proposed within the River Test SSSI, or the adjoining Chilbolton Common SSSI and Bransbury Common SSSI. Further details about the SSSI mitigation measures for this option are provided in Appendix G.

For all of these pipelines included in our strategy, careful design, planning and site environmental surveys to inform mitigation measures will be needed to minimise environmental effects.

The **borehole rehabilitation scheme near Cowes** is assessed as having predominantly negligible adverse effects. Minor to moderate adverse effects relate to energy and materials use and associated carbon emissions for materials for construction activities plus operational water pumping and treatment. Minor beneficial effects arise from making optimal use of existing water sources.

Cumulative effects of the Western area strategy have been identified in relation to:

- Beneficial effects for all the demand management options in relation to these measures acting in combination to increase the overall demand savings, thereby contributing to sustainable abstraction
- Potential construction related cumulative effects due to the proximity and overlap of likely construction periods between the Hampshire grid system options (2026 and 2027) and the Test to Lower Itchen pipeline (2024-2027). The potential effects are limited to temporary effects to the local population and are considered low risk
- Potential adverse effects on Southampton Water from abstraction for the Test Estuary WwTW industrial water reuse scheme (if required, see Section 6.1) and the Fawley desalination scheme, or Itchen indirect potable reuse schemes. These potential cumulative adverse effects are considered of being no greater than minor magnitude given the volume of water in the tidal prism of Southampton Water relative to the volumes of water being abstracted, or effluent diverted
- Potential minor risk of cumulative effects with respect to three options that would be partly constructed within the New Forest National Park (Test Estuary WwTW industrial reuse; Fawley desalination; and Bournemouth Water import). Careful planning, design and mitigation will be needed in relation to the pipeline construction activities to minimise impacts to habitats, heritage features and landscape features that provide the basis for the National Park designation

Overall, the environmental assessment has concluded that the preferred programme has predominately minor to moderate adverse effects and negligible to minor beneficial effects. However, given the scale of the schemes required to address the supply deficit, a small number of potential major adverse effects may arise – most are related to construction in or near to sensitive environments, but there are also some permanent effects, notably in respect of high energy use and carbon emissions associated with the large desalination scheme at Fawley. We have considered a range of mitigation measures to reduce the effects on the environment and these will be further developed as part of the detailed planning and design of the schemes.

Six strategic alternative options are being considered for the Western area. The Fawley desalination (100Ml/d) option is an alternative scheme in case some of the water import schemes could not be delivered to the full volume assumed; Sandown desalination (8.5Ml/d) scheme would be an

alternative to the Sandown WTW indirect potable water reuse scheme. The Itchen indirect potable reuse schemes (Portsmouth Harbour and Fareham WwTWs indirect potable reuse (90Ml/d) or Woolston and Portswood WwTW indirect potable reuse (20.5Ml/d)) would be an alternative to a Fawley desalination scheme. The Test Estuary WwTW Industrial Reuse would be used with the Woodside transfer valve as an alternative to the Portsmouth bulk supply (9Ml/d).

We will initially commence further environmental, planning and design studies for these alternative options in the short term so as to minimise the risk of any delays to delivery of the strategy.

These alternative options have been assessed and the SEA (alongside the HRA and WFD assessments) concluded that these schemes have overall slightly greater adverse environmental effects (after consideration of mitigation measures) compared to the schemes that form Strategy A.

- The **Fawley desalination 100Ml/d scheme** has marginally greater adverse effects than those for the 75Ml/d desalination scheme in respect of the increase in brine discharge to the Solent. Greenhouse gas emissions and the use of materials to operate the scheme would be slightly higher. The pipeline construction would follow the same routes as the 75Ml/d option and therefore there are no discernible environmental difference to the effects. The same design considerations apply equally to this scheme in respect of protecting the marine environment
- The **Itchen Indirect Potable Reuse** options would require long-distance pipelines, notably for the Portsmouth Harbour and Fareham WwTW indirect potable reuse option, would require a long-distance pipeline and more pumping of water than for the Fawley desalination scheme and therefore greater greenhouse gas emissions and use of materials. There is a risk of greater adverse effects on the freshwater environment compared to the desalination scheme, but conversely there may be a beneficial effect on the marine environment by removing a significant discharge of treated sewage effluent that is currently high in nutrients
- The **Sandown desalination scheme** is considerably smaller than the Fawley scheme and consequently has a lower magnitude of adverse environmental effects. Effects on the marine environment are low due to the blending of the brine discharge with the existing treated sewage effluent. There are similar adverse effects associated with the pipeline route crossing an AONB to the Sandown WTW indirect potable reuse scheme. Greenhouse gas emissions and material use would be marginally higher than the reuse scheme
- The **Test Estuary WwTW industrial use scheme** has a lower magnitude of adverse effects on the environment. The pipeline route for this scheme has been revised since the draft WRMP19 to minimise the potential effects on the New Forest National Park and New Forest SAC and SSSI. The route now follows an existing power line wayleave within the SAC, SSSI and National Park on dry grassland habitat. There will be no adverse effects on the Test Estuary and associated European sites and SSSIs.

- The **Woodside transfer valve (HSW to HSE WRZs)** has limited environmental impacts as it is an existing transfer with the requirement for an additional booster station within the existing boundaries of the working site within a built up area

6. Summary of strategy and strategic alternatives

This section summarises the strategic options that need to be developed in the next 10-15 years, along with alternative options identified through the Real Options modelling and sensitivity testing. It summarises the feasibility investigations that are needed in the next few AMPs.

Our Western area has traditionally not experienced water shortages like our other supply areas, and has not had a hosepipe ban imposed to restrict customers supplies. There has, to date, been sufficient water available within our abstraction licences to both protect the environment and to provide secure supplies to customers. However, the EA's recently implemented licence changes on the River Itchen, River Test and Candover Stream, together with future as yet uncertain further licence changes that may be required, fundamentally change the water resources position in Hampshire.

Our strategy for securing public water supplies in the Hampshire and the IOW WRZs is thus driven by the scale of the sustainability reductions (licence changes) on the River Itchen and River Test (and in the draft WRMP, by the potential timing of these). Without these sustainability reductions, we would not have a supply-demand deficit at the start of the planning period and would not need to promote new water resource developments. However, the scale of the sustainability reductions is so large that we have no choice but to promote large scale new water resource developments in order to meet our obligations under the Habitats Regulations, the Water Industry Act and the WRMP Regulations.

Southern Water is setting a bold and UK leading demand reduction target to reduce per capita consumption to 100 litres per person per day across our region by 2040. The South East of England is officially declared as 'water stressed' and with population growth and future climate scenarios suggesting lower water availability then balancing supply and demand is in even greater focus. Having been a leader in water efficiency and successfully delivered an ambitious Universal Metering Programme we are in a unique position to carry on setting the standard in demand reduction. However, Target 100 is not just about reducing water consumption; it is about shifting society to value water. Southern Water is aiming to be at the forefront of taking action to effectively manage water resources, keep bills affordable, drive innovation and support our customers. Southern Water has therefore outlined four key areas of focus in its 'Let's Talk Water' strategy, with Target 100 being fundamental to delivering against each of these themes.

6.1 Strategic options and investigations in next 10-15 years

Our strategy, which was previously referred to as Strategy A in our draft WRMP, has been examined and tested against environmental assessments, the outcomes of regional planning exercises and customer preferences for different option types (section 2). We have undertaken sensitivity and scenario testing of the strategy to understand what would happen if we cannot develop some of our preferred solutions and to explore what happens if something changes that is beyond our control.

As part of this plan:

- We have implemented the 'Target 100' water efficiency policy, which aligns with customers' preferences for helping them to use water more wisely. We are also planning to extend our universal metering program to cover 92% of households
- We have selected a substantial amount of leakage reduction over the planning period, which again aligns with customer preferences, and aims not only to meet Ofwat's ambition of reducing leakage by 15% (from current levels) by the end of AMP7, but also to reduce leakage by 50% by 2050. This and the water efficiency scheme are also well supported by the environmental assessments

- We have adopted a policy to improve the resilience of our supply system by aiming to use Drought Permits/Orders only in more extreme droughts, after an interim period to allow sufficient time to develop appropriate options to avoid the risk of a shortfall in the severe drought conditions. (This was discussed in detail in section 2.2.3)
- We have sought to utilise bulk supplies from neighbouring water companies in line with the outcomes of regional planning exercises, to help us to address part of the large deficits we face in this region. Even so, we still need to develop some large scale water resource schemes to solve the deficits. This includes a large scale desalination scheme of up to 75Ml/d at Fawley. We have examined the balance of alternatives between a reduced desalination plant and water reuse options on the Itchen
- We have identified the need to undertake further investigations to establish the need for and optimal amount of desalination and water reuse options that are being driven in part by uncertain future sustainability reductions (as well as the recently implemented licence changes on the Test and Itchen rivers)
- A number of options will only be progressed once we have confirmed the changes required to our abstraction licences. Nevertheless, we anticipate conducting feasibility investigations and planning and promotional activity through AMP7 so we have a plan which can adapt to the wide range of supply-demand balance possibilities

We have identified the key schemes that need to be implemented in AMP7/AMP8 and the main steps that the company will need to undertake to deliver them. We have also identified through scenario and sensitivity testing, the alternative schemes that may be required if the main ones cannot be delivered in the timescales required. These **alternative options will need to be investigated in parallel with the development of the main options** in AMP6, AMP7 (and AMP8).

The **key strategic options and investigations in the next 10-15 years for the Western area** in our preferred plan (which was previously referred to as Strategy A in the draft WRMP) are:

- **Work with Portsmouth Water to secure the additional bulks supplies** (of up to 30Ml/d) in a phased manner – additional supplies in AMP7, and then further supplies in AMP8;
  - If the implementation of the further supplies is delayed, then extension of Drought Orders in the severe drought condition may be needed through to the end of AMP8
  - Liaise with Portsmouth Water in relation to the joint investigation it is due to carry out with the EA in relation to its Source J, and consequently the viability of providing the 9Ml/d bulk supply in 2024. We will continue discussions with Portsmouth Water and the EA on the progress of their investigation so that we can take a view as early as possible as to whether we need to progress a strategic alternative to the 9Ml/d bulk supply. We shall seek key investigation milestones from Portsmouth and the EA, so that we can incorporate these into our delivery programme for the Western area. If the investigation by Portsmouth Water and the EA cannot be concluded until later in AMP7, it will clearly affect the deliverability of an alternative scheme, although it should still be deliverable in AMP8
  - We have undertaken analysis to understand the reliability of these bulk supplies in the face of the Itchen licence change and potential (though unconfirmed) further adjustment of the Hands Off Flow (HoF) on the Itchen. Through our sensitivity testing of the plan to these assumptions, we have concluded that our plan can adapt to the uncertainty around the potential additional sustainability reduction, subject to potential risks to the delivery programme that could arise if the associated investigation is not agreed early in AMP7, or the result of the investigation is a higher HoF than we have allowed for
  - We would also work with Portsmouth Water to develop a backup plan, should Havant Thicket be delayed or cannot be delivered, to identify alternatives, such as a supply directly from the Bedhampton springs
  - There is an assumption that these supplies will be able to provide a consistent amount of water in severe and extreme drought. But there is a risk that this may not be achievable.

We therefore plan to work with Portsmouth to consider how we might optimise the use of our resources

- Develop the **bulk supply from South West Water from the Bournemouth area** by 2027**;**
  - We aim to conduct investigations into alternative ways of securing this bulk supply. For example, both companies currently have a supply to the same commercial customer (we supply 10Ml/d, Bournemouth supply 40Ml/d). The Fawley desalination plant could therefore aim to supply the full amount required by this customer, which would free up 40Ml/d that could then be available primarily through their existing pipeline to the commercial customer. This could have the benefit of requiring less blending than would be the case with desalination water going directly into our supply system. (Note that this may reduce the rationale for the strategic alternative Test Estuary industrial water reuse scheme as that water cannot go into supply)
  - The West Country Water Resources Group (South West Water, Bristol Water and Wessex Water) are also planning to investigate further potential resource and transfer options to support our Western area. We will work with the West Country Water Resources Group to understand the level of potential bulk supplies, the costs associated with those supplies, and the expected availability of those supplies in severe and extreme drought events, for which we plan. Any new options will be identified and included in the next plan in WRMP24, where they have been assessed to be feasible. However, these potential schemes are not currently developed to a level that provides sufficient certainty to be included within our current preferred plan
- Plan for implementation of a **desalination scheme at Fawley in AMP8**. Need to undertake more detailed feasibility investigations, condition survey of the existing discharge tunnels, undertake environmental surveys and monitoring (including detailed discharge modelling as a function of discharge design), prepare planning application documentation, secure land purchases, etc
  - Examine, particularly in light of consultation feedback to the draft WRMP, whether a reduced capacity for the Fawley desalination plant would be preferable, achieved through parallel development of a water reuse scheme on the Itchen
  - The design of the scheme can be modular so the capacity can be altered in response to changes in the SDB deficit that we need to address (in the short and longer term). However, this could add risk to the delivery programme where different capacities have different built footprints or require different associated infrastructure, as this may impact on the planning case that must get secured prior to construction of the scheme. The earlier we can agree the deficit that must be addressed the lower the risk to the delivery programme to address our s20 agreement commitments. This is likely to require key decisions and inputs from external organisations – particularly the EA in relation to finalising decisions on the unconfirmed sustainability reductions
  - A strategic alternative under certain futures is to potentially need a slightly larger desalination plant – up to 100Ml/d. Designs and investigations should consider the potential for this potential larger capacity scheme
  - Our scenario and sensitivity testing showed that costs of **water reuse schemes on the Itchen** were broadly comparable to the desalination option costs, and can therefore be considered as plausible strategic alternatives. This will be in part dependent on the decision from Defra, the EA and Natural England regarding whether the application of the revised Common Standards Monitoring Guidance (rCSMG) is to be implemented. This, along with monitoring, modelling and environmental assessments will need to inform the technology and design of the treatment and discharge arrangements for the reuse options, and development of necessary mitigation measures. This is likely to involve an iterative modelling process as the design is optimised to minimise adverse effects
  - Therefore, need to progress more detailed feasibility investigations, secure discharge consents, undertake planning and promotion of the water reuse schemes in parallel with the Fawley desalination option, and also need to progress discussions with the EA and Natural England to understand whether, or the extent to which, issues surrounding water

reuse on the Itchen may affect their deliverability – for example, the revised Combined Standards Monitoring Guidance, or fisheries

- Develop **increased transfer capacity between HSW WRZ and HSE WRZs**, with development of a **new reversible link main in Southampton** in AMP8. This will entail further environmental surveys and monitoring, and submission of planning application documentation
  - In parallel investigate smaller scale options, such as with the **Woodside transfer** (providing additional capacity of 10Ml/d from HSW WRZ to HSE WRZ)
- Plan and develop the **Hampshire grid scheme** between HSE, HW and HA WRZs in AMP8. This also provides greater system resilience to the Western area
  - There is the option for the **Hampshire grid to also be extended from HA WRZ to HK WRZ**, however, this is not required, as HK WRZ is either in surplus or any deficit is addressed through demand management and the development of the Newbury WSW asset enhancement in AMP8
  - However, we could **consider the extension of the Hampshire grid to the HK WRZ** from a resilience perspective
  - Implement the reversible **Romsey Town and Broadlands valve** (HSW-HR) scheme by the end of AMP7
- Plan and develop a **water reuse scheme at Sandown** by AMP8. Need to undertake more detailed feasibility investigations, undertake environmental surveys and monitoring, prepare planning application documentation, secure discharge consents, secure land purchases, etc.
  - Investigate a **small desalination scheme at Sandown** as an alternative, or in combination with a smaller water reuse scheme to achieve the targeted capacity
  - As part of feasibility investigations, further consider **an Isle of Wight independent resource resilience solution** – i.e. what option / sets of options would mean the IOW WRZ could operate largely independently from the mainland, with the cross-Solent main therefore providing backup resilience only
- Plan and develop the **asset enhancement scheme at Newbury** in the HK WRZ in AMP8.
- Investigate the **scheme to reinstate and provide additional treatment for the WSW near Cowes**, which although not required until 2065 in the preferred plan, is selected in AMP8 in various scenario and sensitivity tests
- Develop additional **nitrate** treatment at identified sources and implement catchment management activity at these sources
  - Consider applicability of starting catchment management activity and monitoring in early AMP7
- Develop treatment for **pesticides** at surface water works potentially at risk and implement catchment management activity at these sources
  - Consider applicability of starting catchment management activity and monitoring in early AMP7
- Develop programme of works, monitoring, engagement, etc to allow successful delivery of **in-stream catchment management measures on the Itchen and Test (upper reaches)**, providing environmental resilience benefits
- Work with regulators and stakeholders to identify and implement (where possible) **river restoration measures on the Test and Itchen** that may help to mitigate the potential impacts of Drought Orders in low flow conditions
- Implement the '**Target 100' water efficiency campaign**. It should help to minimise the risk that the demand forecast could be higher than the central estimate
  - Significant engagement of customers, development and promotion of the 'basket of measures', and monitoring of success of the targeted PCC reduction profile will be critical through AMP7 (and AMP8) to minimise the risk that the target is not achieved and there is a subsequent potential supply shortfall
  - Associated with this is the need to develop appropriate trials of customer offerings or propositions to encourage efficient use of water during AMP7 to better understand how

these could work, and give greater confidence in the savings that could be achieved. This will include both incentives, and also potentially alternative tariff structures

- Progress **leakage reduction activity** throughout AMP7 (to achieve 15% reduction from current levels) and AMP8 and beyond (to achieve reductions from current levels of 40% by 2040 and 50% by 2050), across all leakage options identified
- Undertake **extension of the universal metering programme** to achieve 92% metering of households through implementation of a compulsory metering programme in AMP7
- Undertake investigations of **key strategic alternative schemes and uncertainties**, including
  - Work with the EA to agree as early as possible in AMP7 the sources that are actually likely to require licence changes to delivery sustainability reductions. The scale of uncertain sustainability reductions is driving the selection of a number of schemes in AMP8. If the sources that are actually likely to require sustainability reductions can be formally agreed with the EA, we may be able to cease or limit the cost of feasibility investigations and planning preparation needed in AMP7
  - Work with Portsmouth Water to understand the risks to the current 15Ml/d bulk import to Hampshire under an extreme drought. There may be a short-term risk under extreme drought conditions if the bulk supply is not available at its full amount of 15Ml/d
  - The design of the bulk supply schemes could also consider (though were not for the purpose of this plan) reversibility of inter-company connections to increase resilience for the region
  - Investigation of the Test Estuary WwTW industrial reuse scheme, for potential delivery in AMP8, as a possible alternative solution (e.g. if the size of the Fawley desalination option needs to be constrained, or if the Portsmouth 9Ml/d bulk supply cannot be delivered). Need to undertake more detailed feasibility investigations, undertake environmental surveys and monitoring, prepare planning application documentation, secure discharge consents, consider land purchases, etc.
  - . . We recognise that **water storage within south Hampshire may have a role to play** in protecting supplies to customers during different potential drought events, and that storage could increase the overall resilience of our water resources in this area. As a result, we are committing to further investigating all potential storage options within south Hampshire during the initial part of AMP7 (the 2020-2025) period), to enable additional feasible options to be incorporated within our next WRMP
  - The above could be supported or enhanced by **optimising the operation of the Havant Thicket reservoir scheme**, which may allow greater DO benefits to be realised during the critical period (summer peak demand) and minimum DO period, whilst maintaining the average output at the planned for 21Ml/d

Neither of the large bulk supply options from Thames Water (based on development of the upper Thames reservoir) is selected as part of the preferred plan runs. However, these represent a potentially significant strategic resource, which could be a large-scale strategic alternative, should it not be possible to implement either desalination schemes in Hampshire or water reuse schemes on the Itchen.

A key issue is that a large-scale bulk supply is dependent on the development of a large scale resource by Thames Water, in addition to an 80km pipeline from the Thames Water supply area to Southern Water's Lower Itchen treatment works.

This leads to some significant uncertainty around the deliverability of these bulk supply schemes – in particular whether the bulk supply could be available in AMP8, when it is required by us to help address our s20 agreement obligations. Our analysis for this plan has been based around an assumption that the deficit resulting from the implementation of the Test and Itchen sustainability reductions will be addressed by 2027-29, but the Thames Water bulk supply is not going to be available by then – Thames have indicated that earliest start date would be the mid-2030s. We have

nevertheless committed to keep this option as a feasible one and maintain ongoing dialogue with Thames Water.

6.1.1 River Itchen, River Test and Candover abstraction licence Public Inquiry – incorporation of s20 agreement commitments into our plan

The WRMP has been updated to reflect the commitments we gave in the s20 agreement (as discussed previously in section 2.1). In particular, we agreed to use 'all best endeavours' to implement measures to develop alternative water resources to replace water that has effectively been lost through the licence changes on the Test and Itchen rivers, and to respond to other factors influencing our forecast future SDB.

This WRMP sets out our preferred strategy and also alternative strategies. The alternative strategies are intended to be developed concurrently with the preferred strategy during the early part of AMP7. The reason for this is simple. The s20 agreement dictates that the 'interim abstractions scheme' (which is the name for the procedural reassurances around how Southern Water can utilise the Drought Permit and Drought Order process to maintain public water supplies pending the implementation of new reliable water supplies to replace the water resources lost by the licence changes) will only be available until 2030. Ideally, with as little reliance on the interim scheme past 2027 as possible. Sufficient measures therefore need to be capable of delivery within this timeframe to avoid a significant risk to the supply of water to the area, but there are a number of factors that can influence the timing of the measures becoming fully operational (e.g. planning consent timeframes, third party delivery, etc.). To address this uncertainty and to be confident of having measures operational within the timeframe, the need to concurrently progress a number of measures that can "step-in" if needed, is essential.

The scale of securing alternative supplies following the abstraction changes is massive, involving multi-million pound investment in large scale new developments to provide supplies to customers because the new licences on the Test and Itchen will prevent us from abstracting from existing sources. For the most part, the schemes we will need to develop are complex engineering projects, with considerable environmental investigations required in advance of planning and other permissions being able to be secured. Until we have secured those permissions, and built the new schemes, our supplies to customers will remain at risk.

Pursuing a single strategy which has those inherent complexities and hoping that there will no issues during implementation, we believe would be irresponsible given the threat to supply. Progressing alternatives initially in the short term allows us to best use the time where the interim abstraction scheme will operate to adapt to any obstacles or delay and still be confident that a long term solution can be delivered within the timeframe. Once a measure is sufficiently secured (and the risks to delivery therefore significantly less) the need to substantively progress certain alternatives reduces. We will still favour the progression and implementation of the preferred strategies as the best value plan but this approach allows adaptation. Similarly, once alternative sources of water are built and become operational, the level of reliance on Drought Permits and Drought Orders under the interim abstraction scheme reduces in tandem with the rate the new schemes are able to provide water.

Not all of our proposed new resource developments can be implemented by us alone, as they involve the transfer of water from other water companies through existing or new transfer pipelines. Some of these transfers are reliant on the other water company making improvements to their own sources, or developing new ones. This can also involve significant investigations and applications for consents of their own, increasing the potential risk that they could be delayed. While we will work with those companies to try to reduce this risk, for the purpose of this plan, again we need to act responsibly and anticipate, account for and be ready to respond to any obstacles or delays.

The WRMP schemes that form our preferred strategy for the Western area are informed by engineering, environmental and planning assessments, and consideration of the potential risks relating to scheme delivery..

We will work closely with RAPID (the Regulators Alliance for Progressing Infrastructure Development), the EA, Natural England, other environmental partners and stakeholders including the relevant local planning authorities through our detailed technical work and to progress our WRMP preferred strategy. We propose to maintain regular liaison and engagement through steering group meetings, and technical working groups relating to each of the individual schemes. Within the s20 agreement we have also committed to regularly reporting on progress with the implementation of our preferred strategy and our assessment and promotion of the alternatives. While this is primarily to keep Drought Permits/Orders under review (so as to remain application ready) it will also act as an update on progress so as to reduce the level of reliance on the interim abstraction scheme as early as practicable.

In addition to our regulatory reporting requirements, we will regularly report progress on our WRMP publicly on our website and proactively with stakeholders and regulators (NE, EA, Ofwat, Defra). In particular, given the strategic nature of the Western area solution, we will update for that solution at key milestones (e.g. approval, planning approval, procurement, construction start) and as part of our annual performance report. This will include where external influences / other transfers are progressing or could be at risk of delay (planning delays, construction in other companies etc).

6.2 Deliverability of the plan

Southern Water committed in the s20 agreement to use ‘all best endeavours’ to ensure the delivery of the Long Term Water Resources Scheme as set out in the final WRMP. We will be investigating and promoting the WRMP preferred schemes and strategic alternatives for the Western area, to ensure that we can meet this commitment and successfully deliver the necessary solutions. This will include the strategic alternatives, such as the Test Estuary industrial reuse scheme, the Woodside transfer, consideration of different capacities for Fawley desalination, and the potential for Itchen water reuse.

It is important to note that various decisions do not lie entirely with Southern Water – many will require timely decision-making by regulators, including Ofwat, the EA, Natural England, DWI and Defra.

Our scenario and sensitivity testing described in section 4 suggests that the preferred plan is broadly stable – to address the drivers of deficits in the Western supply area (e.g. the sustainability reductions already enacted on the rivers Test and Itchen, and the future uncertainties associated with unconfirmed additional sustainability reductions) a number of large scale schemes will be required. For some, such as the Fawley desalination scheme, the capacity of the scheme could be reduced if the uncertainties do not occur, but these schemes remain fundamentally part of the strategy. We **need to plan for the uncertainties and the range of deficits that could occur in the next AMP and in AMP8, as there may otherwise be very limited time to develop and implement alternative schemes** to address the range of futures if we focused too exclusively on a lower deficit future.

As explained through this Annex, the strategic options were selected through use of our Real Options model which solves multiple states of the world, including a range of drought conditions, across ‘futures’ representing a range of different potential supply-demand balances. This model is sufficiently and appropriately robust for planning water resource management on this scale.

If the future turns out to have limited demand growth, limited climate change impacts and limited or no further sustainability reductions reflecting a future supply-demand balance more like those modelled in the 70th or 90th percentile branches – then a number of the strategic options in our preferred plan may not be required. For example, the company's 'Target 100' policy could limit the future uncertainty around demand growth and should (if customer water use savings are sustained) increase the likelihood that the company SDBs head more towards the lower 50th-90th percentile branches, rather than the 10th or 30th percentile branches (assuming that other drivers of uncertainty relating to climate change impacts and sustainability reductions do not push the company back towards the higher deficit branches).

As we prepare for our next plan, it may be possible to confirm that the implementation of some of the AMP8 options will not actually be required. However, **the timescales are such that we will need to have done much of the feasibility and environmental investigations and the preparation of planning documentation in AMP7 (before it can be confirmed whether the schemes are not necessary) even if the scheme is not ultimately needed in AMP8**.

For new resource developments, it will be necessary for detailed engineering and environmental assessments to be undertaken and for planning and other consents to be secured and for the schemes to be constructed and commissioned. For transfers from other water companies there may be a need for asset enhancements, and/or for the development of new water resources within those companies in order to free up water to make the transfer available. The timings within the WRMP are our best estimates for delivery at this point in time.

Some of the schemes needed to meet the water resource issues in the Western area may be challenging to deliver in the timescales envisaged. It is important to note that slippages in the assumed timings of schemes may result in the extended use of Drought Permits and Orders on the Test and Itchen than would otherwise be the case.

It is also important to understand that bulk supply agreements cannot be completely reliable in all drought events, as the donor company has a duty to maintain supplies to its own customers. It is not possible to be prescriptive as to how volumes available for bulk transfers will vary during any specific drought as this depends on a number of factors. These factors will include such issues as: the relative status of available supplies, both at the time and expected in the future; and demand restrictions in place for each water company. We adopt the policy that the general principles of the provision of inter-company bulk supplies rely on mutual support and equitable 'pain share' with regards to the provision of supplies during a drought.

Figure 21, Figure 22, and Figure 23 present some of these key decision points and uncertainties in general terms, and the impact that this can have on the plan.

Figure 21 Indicative timeline showing key decision points and external influences

Investigations, planning and promotion

- *Commence as soon as possible (end AMP6 / start of AMP7)*
- *Parallel investigations of preferred options and key alternatives*

Drought permits and orders

- *Available in severe droughts for an interim period, after which these are assumed to only be available in extreme drought events, as this aligns with customer preferences from WRMP14*
- *The interim period is needed to allow time to develop options to replace permits/orders in severe droughts to avoid the risk of a supply failure if a severe drought were to occur*

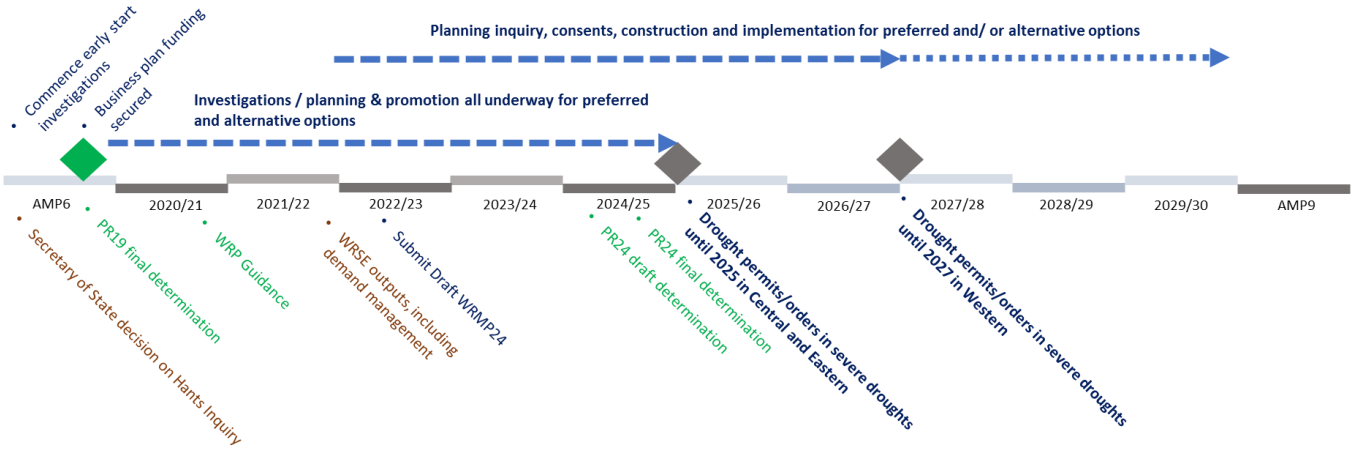


Figure 22 Indicative timeline showing the impact of the uncertainty of future sustainability reductions on the plan in the 2020s

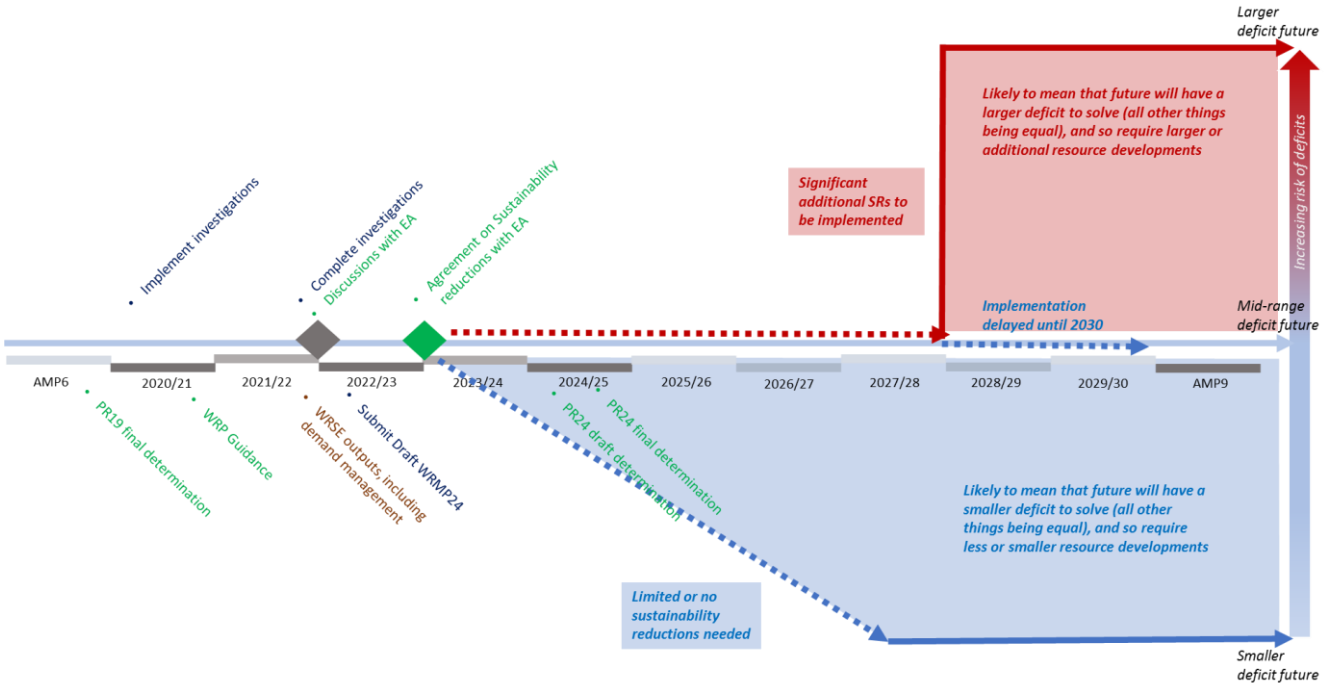
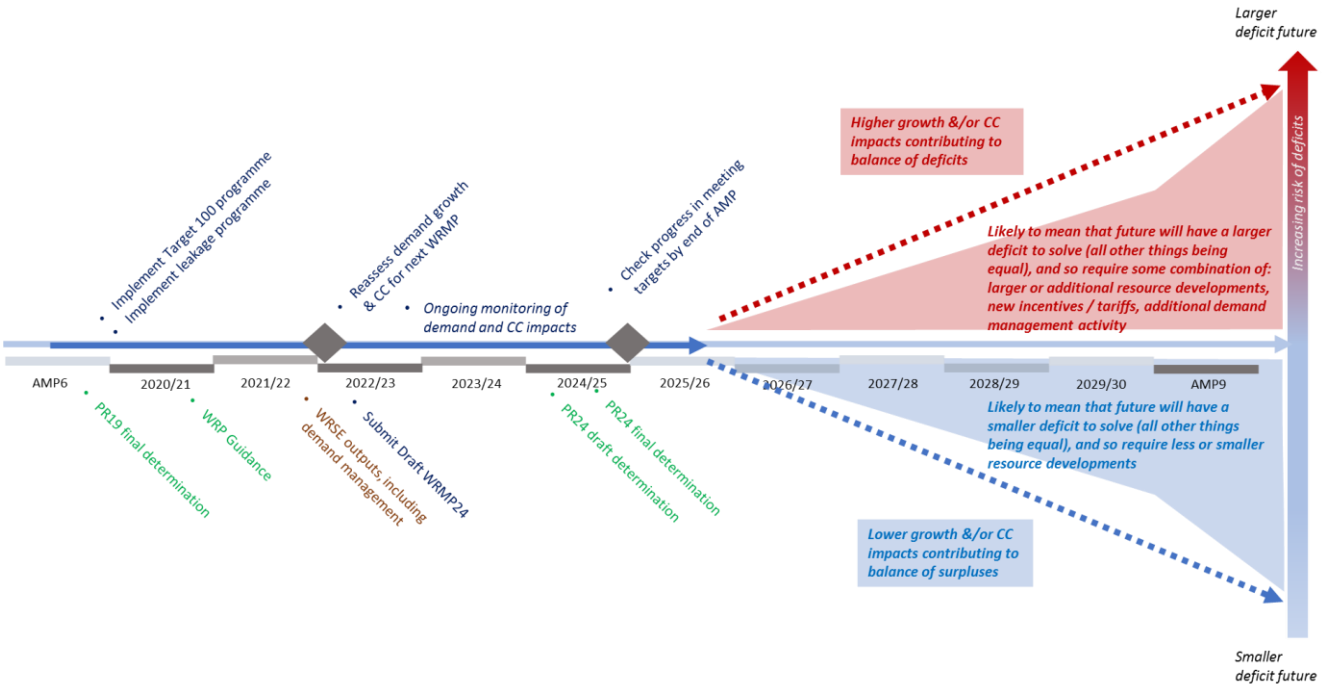
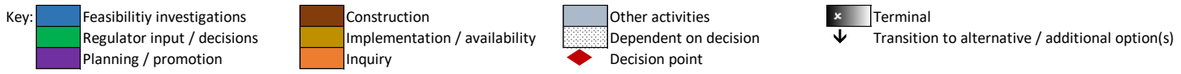


Figure 23 Indicative timeline showing the impact of the uncertainty of demand growth and climate change on the plan

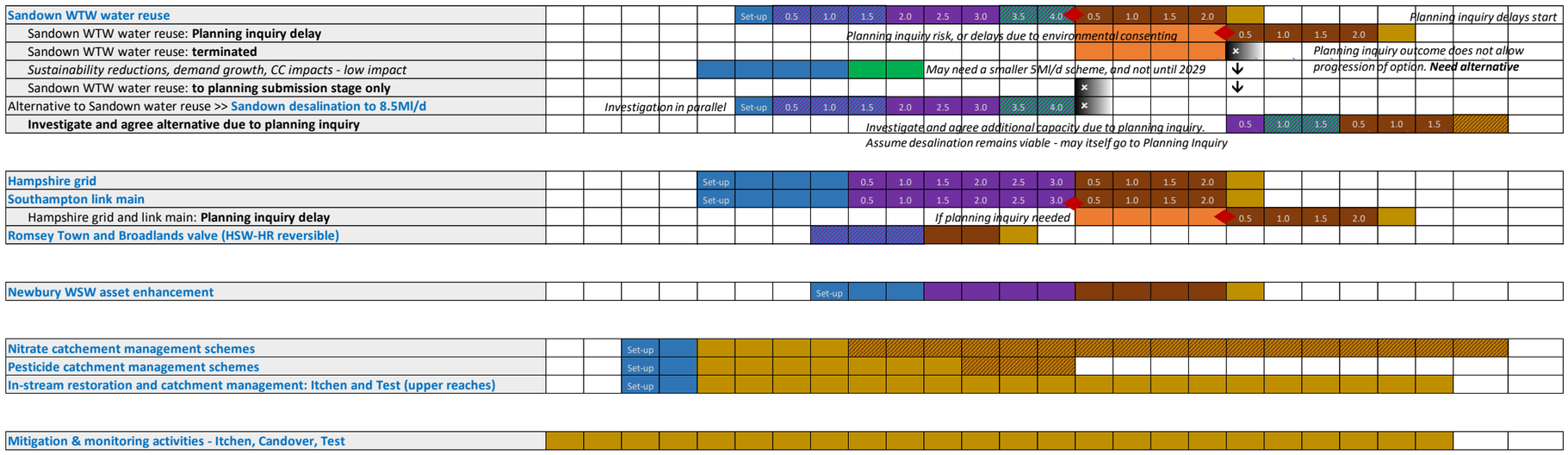


The deliverability of the plan in the next two AMPs is shown below in Figure 24. This describes the main strategic schemes and key alternative schemes, and aims to present, at a simplified level, the potential impact that sustainability reduction uncertainty, planning inquiries etc could have on the plan. This programme is indicative only at this stage, we are developing a detailed programme for delivery of our Section 20 commitments through AMP7 and AMP8.

Figure 24 Indicative programme of proposed works for AMP7 and 8 to deliver the preferred plan and / or key strategic alternative



	AMP6				AMP7										AMP8										AMP9	
	2018/19		2019/20		2020/21		2021/22		2022/23		2023/24		2024/25		2025/26		2026/27		2027/28		2028/29		2029/30		2030-35	Ongoing
	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar	Apr-Sep	Oct-Mar		
Publish Final WRMP19																										
Business Plan determination (assume funding for WR schemes is secured)																										
Set up investigations programme for AMP7 (scope, etc)																										
Sustainability reductions confirmed																										
Regional planning																										
WRSE: Finalise consistent planning asumptions across all companies																										
Prepare and finalise inputs for regional planning																										
Regional planning (WRSE) outputs																										
Components of WRMPs																										
Updated SDBs - population growth, demand, leakage, dry year events, etc.																										
Updated Options and consultation																										
Hants public inquiry - Secretary of State ruling																										
Licence changes to Test & Itchen sources					*Follows "Strategy A" assumptins from the draft WRMP*																					
Leakage reduction implementation and monitoring			Set-up		*Is target leakage reduction on track?*										*Additional leakage activity to achieve 15% in AMP8*											
15 % leakage not on target - additional leakage reduction activity																										
Further leakage reductions to meet profile to 2040 and 2050																										
Target 100 implementation and monitoring			Set-up		*Is target 100 reduction on track?*												*Implement tariffs and incenvies to reduce PCC*									
Additional demand mgmt if not on target: **Tariff / incentives**					*Tariff trials*																					
Target 100 ongoing activity (to 2040)																										
Contact customers and plan programme																										
Extend universal metering programme to achieve 92% metering			Set-up																							
Additional import from Portsmouth Water (additional 9Ml/d)					Set-up	*Agreement with PW*																				
Supply: **PW unable to deliver**					*Investigation by Porstmouth/ EA*										*Continuing dialogue with PW /EA on their investigation of PW source, to allow development to support this supply*											
Alternative if supply not available >> **Test Estuary WTW industrial reuse**					*Investigation in parallel*	Set-up	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	*Or alternative could be a larger desalination scheme to compensate*									
Import from Bournemouth water		Set-up	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
Bournemouth supply: **Planning inquiry delay**					*Planning inquiry risk in regard to abstraction*										0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0			*Planning inquiry delays start*	
Bournemouth supply: **to planning submission stage only**		*Scheme not feasible - e.g. Bournemouth cannot guarantee water etc.*																								
Bournemouth supply: **terminated**		*Prepare for larger desalination scheme if Havant Thicket goes to Inquiry - already have feasibility and planning / promotion planned through AMP7*													*Planning inquiry outcome does not allow progression of option. **Need alternative***									
Alternative if supply not available >> **Larger Fawley desalination (to 100Ml/d)**											0.5	1.0	1.5	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0		*Longer delay if also have*			
Alternative if supply not available >> **Test Estuary WTW industrial reuse**						Set-up	0.5	1.0	1.5	2.0	2.5	3.0			0.5	1.0	1.5	0.5	1.0	1.5	2.0		*Planning Inquiry*			
Agreement with PW. Investigate scheme operation to maximis																										
Additional import from Portsmouth Water (Havant Thicket reservoir development)					*Planning inquiry for PW reservoir development*								0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0				
Havant Thicket bulk supply: **Planning permission not secured**											*Planning inquiry for PW reservoir; outcome not favourable*															
Alternative if supply not available >> **Larger Fawley desalination (to 100Ml/d)**					↓																					
Prepare for larger desalination scheme if Havant Thicket goes to Inquiry					↓																					
Fawley desalination		Set-up	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
Fawley desalinaton: **Planning inquiry delay**							*Planning inquiry needed*								0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0			*Planning inquiry delays start*	
Sustainability reductions, demand growth, CC impacts - low impact																										
Fawley desalination: **to planning submission stage only**																										
Fawley desalination: **alter size of plant required**					*Confirmed SR's mean desalination plant size needed is different, requiring alternative designs*					4.0	4.5	5.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0			*Longer delay if also have Planning Inquiry*			
Fawley desalinaton: **terminated**															*Planning inquiry outcome does not allow progression of option. **Need alternative***											
Alternative to any desalination >> **Test Estuary WTW industrial reuse**		*Investigation in parallel*			Set-up	0.5	1.0	1.5	2.0	2.5	3.0		↓														
Investigate and agree alternative due to planning inquiry					*Progress alternative (initial investigations already commenced - need revision)*								0.5	1.0	1.5	0.5	1.0	1.5	2.0							
Alternative to any desalination >> **Itchen water reuse**	*Investigation in parallel*		Set-up	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0		↓														
Investigate and agree alternative due to planning inquiry					*Progress alternative (initial investigations already commenced - need revision)*								0.5	1.0	1.5	0.5	1.0	1.5	2.0	2.5	3.0					
Itchen water reuse: **terminated due to environmetnal issues**					*Potential objection on grounds of CSMG, fisheries, etc.)*																					
Alternative to any Itchen water reuse >> **to be investigated**. In the interim >> **continued use of drought interventions**											*Continued need for use of drought permits/orders until suitable alternative is consented and implemented*															


Sandown WTW water reuse
Set-up
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Planning inquiry delays start
Sandown WTW water reuse: Planning inquiry delay
Planning inquiry risk, or delays due to environmental consenting
Sandown WTW water reuse: terminated
Planning inquiry outcome does not allow progression of option. Need alternative
Sustainability reductions, demand growth, CC impacts - low impact
May need a smaller 5Ml/d scheme, and not until 2029
Sandown WTW water reuse: to planning submission stage only
Alternative to Sandown water reuse >> Sandown desalination to 8.5Ml/d
Investigation in parallel
Investigate and agree alternative due to planning inquiry
Investigate and agree additional capacity due to planning inquiry.
Assume desalination remains viable - may itself go to Planning Inquiry
Hampshire grid
Southampton link main
Hampshire grid and link main: Planning inquiry delay
If planning inquiry needed
Romsey Town and Broadlands valve (HSW-HR reversible)
Newbury WSW asset enhancement
Nitrate catchement management schemes
Pesticide catchment management schemes
In-stream restoration and catchment management: Itchen and Test (upper reaches)
Mitigation & monitoring activities - Itchen, Candover, Test

6.3 Regional strategy

Figure 25 presents a summary of the inter-zonal connections and the regional water trading options that comprise our strategy. There are a number of existing bulk supplies – a 15Ml/d supply from Portsmouth Water has come on line in this current AMP, there is a supply to a commercial customer of 10Ml/d, and a minor supply to Wessex. There are also various planned additional water trading schemes identified in our plan.

A key part of our strategy is the bulk supply from Portsmouth Water that is based on the development of Havant Thicket. We are also planning to develop other trading options: a smaller supply from Portsmouth in AMP7, and a new supply from Bournemouth in AMP7. These water trading options were selected in most WRSE modelling scenarios.

We have also selected the development of interconnections across our WRZs to provide a Hampshire grid by AMP8, including also improved connectivity across the Southampton area.

With these additional trading and inter-zonal options in our strategy we significantly contribute to the development of a regional coastal grid to greatly enhance the strategic regional costal connectivity and resilience (for the region). The design of these schemes could also consider (though were not for the purpose of this plan) reversibility of inter-company connections to increase resilience for the region.

Southern Water was the first company to chair the WRSE regional planning group in the mid 1990's. Since then it has played an active role in developing regional solutions for all customers in the south east. We have promoted and constructed a number of strategic transfers between companies, and this current plan continues to improve the connectivity in the South East. It is proposing new inter-regional transfers through AMP7 and 8.

Figure 26 shows an indicative grid system that could be developed for the south east region:

- Taking existing connections between the water companies
- Developing joint schemes or schemes that provide benefits to multiple companies
- Adding to the current network to provide an increased number of connections and to **make these and existing connections bi-directional** to allow water to flow in either direction
- This **provides greater system resilience and redundancy** which will help to reduce risks from outage and events such as extreme droughts, heatwaves, freeze-thaw, pollution or even terrorism, across the region as a whole

The company is committed to continuing to play a leading role in the development of a regional plan. The remit of the WRSE is being extended such that it will derive a regional plan in a timely way that will form the basis of the next set of water company WRMPs.

Figure 25 Water trading in the plan

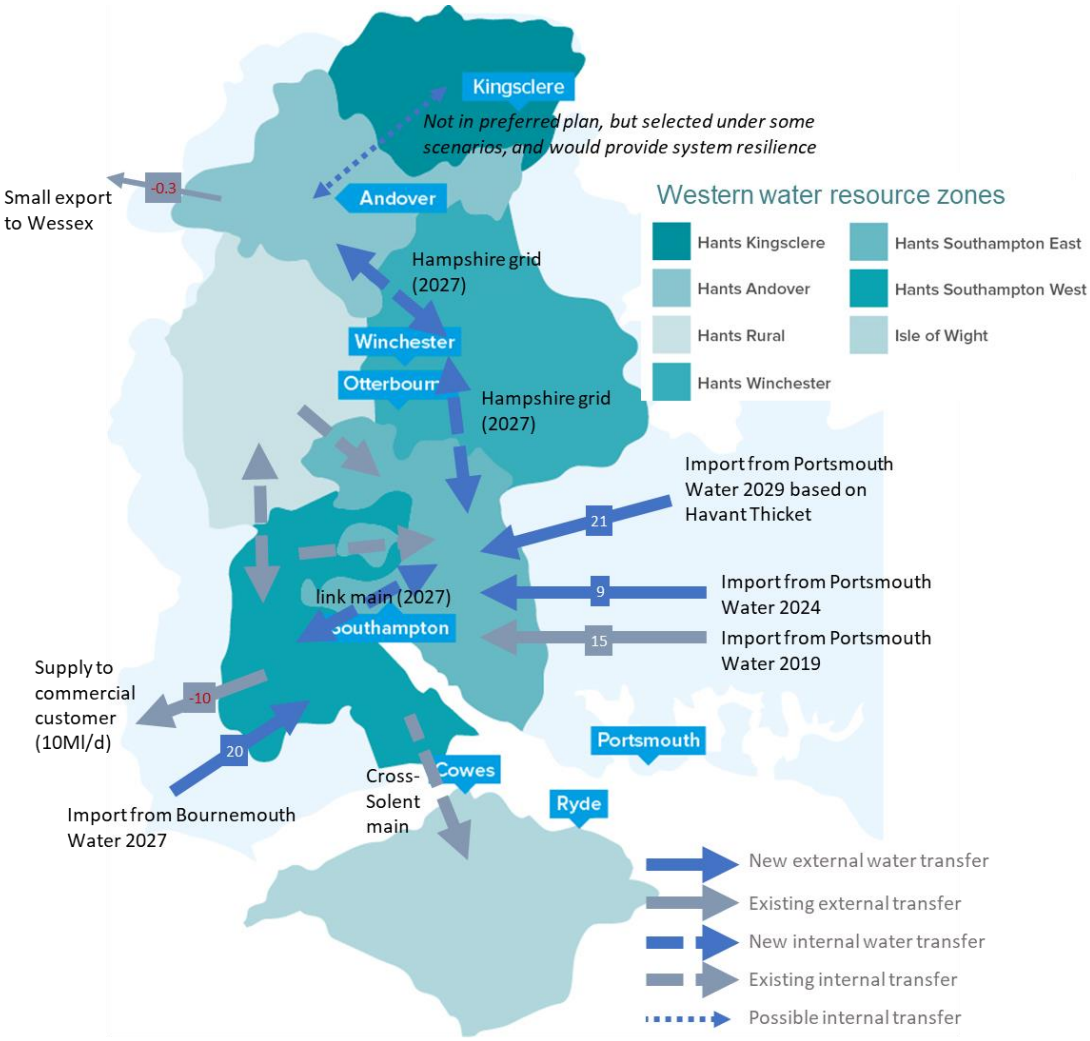


Figure 26 Indicative grid system for south east region by 2050s

7. Resilience

7.1 Resilience benefits of our preferred plan

The EA's Water Resource Planning Guideline instructs companies to consider options to increase resilience as part of the options appraisal, even when some options that provide resilience benefits may not necessarily provide readily identifiable water volumes. Ofwat also has a duty to further the long-term resilience of the water sector.

As a result, this section summarises the consideration we have given to aspects of resilience in this WRMP. The options detailed in Table 15 are likely to provide resilience benefits on top of any WRMP driver, so may provide the company with greater flexibility to respond to a range of unforeseen events.

Table 15 Resilience options

Source or scheme	Description	Resilience benefits
Hampshire grid option	Linking HSE, HW and HA WRZs (and then on up to HK). The HK spur is not selected in the WRMP	Improved system resilience to outage events. Although not selected as part of the preferred plan, there may be system resilience benefits from completing the grid through to HK WRZ, which would provide additional benefits in the face of outage or pollution events
Southampton link main	Improved connectivity between the Southampton WRZs	Greater system resilience to drought events The smaller Woodside transfer may also be developed in addition to, or as an alternative to the above (depending on the strategic options developed). This would similarly provide additional resilience benefits.
Bulk supplies	Additional bulk supplies from Portsmouth Water and from Bournemouth	These increase connectivity across the region and therefore improve system resilience to outage, drought and non-drought events. These options, together with the internal Hampshire grid and Southampton link main, provide greater strategic regional costal connectivity and resilience (for the region). The design of these schemes could also consider (though were not for the purpose of this plan) reversibility of inter-company connections to increase resilience for the region
Desalination and/or water reuse options	Various selected in AMP8	Allow resting of existing groundwater sources plus resilience to other outage-type events
Newbury asset enhancement	Generally selected under the higher deficit futures in AMP8	Provides greater WRZ resilience in the event of the Kingsclere source being unavailable

Source or scheme	Description	Resilience benefits
Nitrate scheme	Catchment management scheme to reduce susceptibility to nitrate pollution	Increase resilience of groundwater sources to nitrate pollution risks
Pesticide scheme	Catchment management scheme to reduce susceptibility to pesticide pollution	Not expected to provide DO benefit, but implemented in the WRMP plan to ensure resilience of surface water sources to these WQ events
In-stream catchment management on the Itchen and upper reaches of the Test	Catchment management and in-stream restoration scheme	Allows increased environmental resilience and may limit the scale or need for sustainability reductions
Drought permits / orders	Mitigation measures included with Drought Permits/Orders	Aims to provide measures that will improve environmental resilience during periods of dry-weather related stresses in the environment, and optimise recovery from drought events

In addition, as discussed in Annex 8, our approach to planning whereby we solve for multiple drought events and inter-annual variability simultaneously, includes assessment of extreme drought conditions to ensure we have a plan that is resilient to drought events and minimises the potential for 'level 4' type restrictions such as standpipes and rota cuts. These can have significant impacts on society and the economy.

Our demand management activity, both in the last AMP and proposed as part of this current plan, will also contribute to our resilience to drought events, particularly periods of peak summer demand for water in hot, dry weather events. Our plan includes policy decisions to drive demand for water down through the Target 100 water efficiency programme, the extension of the Universal Metering Programme, and to reduce the water lost from our pipes through a policy of leakage reduction that is targeting a 50% reduction in leakage (from current levels) by 2050.

We have adopted a profile of outage for this WRMP which aims to minimise outage through activity identified in the business plan. This will increase system resilience to outages and water quality risks.

7.2 Non-drought resilience

7.2.1 Freeze-thaw analysis

Recent freeze-thaw events resulted in higher than usual demands between October and March in some of our supply areas. The aim of this section is to explore the prevalence and geographical distribution of freeze-thaw impacts across our supply area, and to understand the potential impact of freeze-thaw events on the resilience of our supply system, by examining a number of representative supply-demand balances.

For the supply side of the supply-demand balance, we have used the data for the MDO scenario in the Western and Central areas, and the ADO scenario for the Eastern area (because it doesn't have an MDO scenario). Whilst MDO represents potential available supplies in the autumn, rather than providing a view of the whole winter, we have analysed this because there is a possibility that freeze-thaw events could occur during this time period, therefore it constitutes a conservative or worst-case approach (in general, one might expect that the company could run their sources at a higher rate for a short period in the event of a freeze-thaw event).

Different freeze-thaw events are characterised by different demands, depending on the severity of the event. A particularly severe freeze-thaw event is likely to result in a higher demand for a short duration, and so we have considered the average day peak week (rolling 7-day peak week) during the winter period for each WRZ from 1997-98 to 2017-18. With a supply area the size of Southern Water's, and with the discrete geographic nature of our three supply areas, there will likely be variation in the timing and severity of freeze-thaw events.

Our analysis showed that the peak week demands do not occur simultaneously in all WRZs: in many years, the peak week demand occurred in winter for some WRZs while occurring in summer for other WRZs in that year. This needs to be acknowledged when designing potential freeze-thaw supply-demand balances – a situation where all WRZs experience their peak week demand simultaneously is likely to be a worst-case scenario, one that has not yet been experienced in our company area.

The plots below present our supply-demand balance analysis for two freeze-thaw years: 2010-11 and 2017-18 aggregated to the area-level.

Figure 27 Western area 2010-11 Oct-Mar peak demand plotted against MDO WAFU for Drought scenario

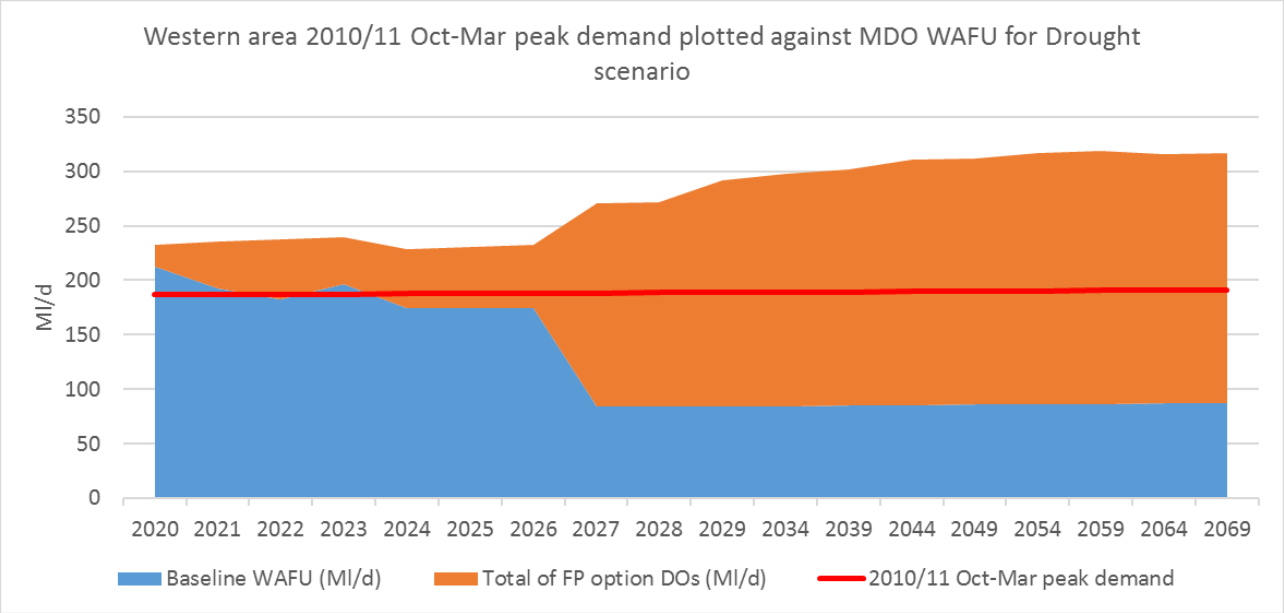
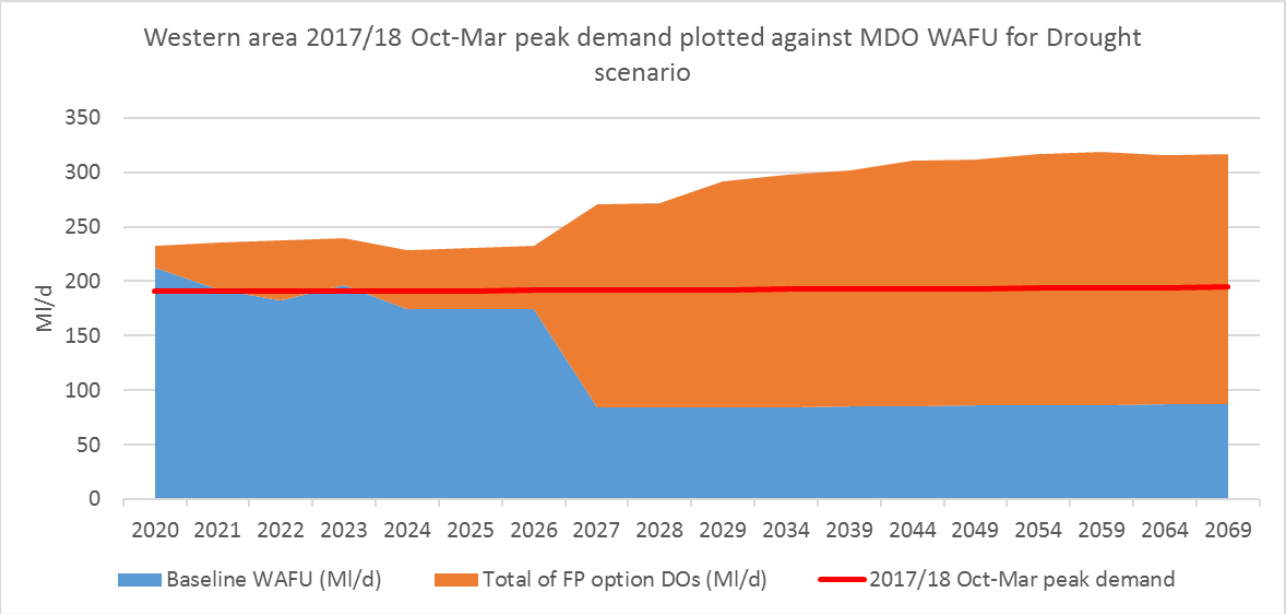


Figure 28 Western area 2017-18 Oct-Mar peak demand plotted against MDO WAFU for Drought scenario



From a supply-demand balance perspective, from 2020 onwards, the company can be considered largely resilient to the range of freeze-thaw events examined, in that there is sufficient water available at area level to meet potential winter demands in all areas.

Our preferred plan also provides solutions that deliver additional water available in the winter period, demonstrating that our preferred plan increases our resilience to freeze-thaw events from a water resources perspective.

Risks to supply from freeze-thaw events are not, however, limited to the overall availability of water, but also to the ability of the water supply system to convey water to where it is required. For example, if a demand centre is supplied by a single water main, which bursts during a freeze-thaw event, then water availability in the rest of the WRZ is unlikely to be relevant – the issue becomes one of network connectivity. Analysis of this nature is beyond the scope of what we have undertaken in this WRMP, which is primarily focused on drought events. However, we are keen to explore this aspect of resilience further ahead of the next plan for the 2020-25 period (WRMP24).

8. References

- UKWIR, 2016, 'WRMP 2019 Methods – decision making process: guidance' UKWIR Report Ref 16/WR/02/10.