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South West Water

Bournemouth Water

South West Water Bournemouth Water

Draft Water Resources Management Plan

March 2018

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Introduction

This report is South West Water's Draft Water Resources Management Plan. It sets out how we propose to maintain the balance between supply and demand for the next 25 years.

In doing so, this report sets out our forecasts for how we expect demand to change due to changes in demographics and how we expect supply to change taking into account factors such as the impact of climate change.

This report sets out our most likely forecasts and how these have been stress tested for a range of possible scenarios to assess the robustness of our supply demand balance. It also sets out the options that we could implement to maintain the supply demand balance under these scenarios and their costs and benefits.

This report ends by presenting our overall water resources strategy for the next 25 years along with the supporting activity that we plan to undertake to fulfill this strategy. That plan sets stretching targets in key areas to ensure we deliver upper quartile industry performance whilst also balancing affordability and reliability.

In developing the overall proposed strategy, we have taken into account government and regulatory policy in this area including relevant legal requirements, followed national guidelines on best practice and also taken into account the findings of our extensive customer research on how our customers would like us to maintain a resilient supply demand balance in the future.

Our Water Resources Management Plan (WRMP) covers the period up until 2044/45 and has a base year of 2016/17.

The published version of the Draft Water Resources Management Plan is required to exclude any matters of commercial confidentiality and any material contrary to the interests of national security. There were no matters of commercial confidentiality. In the published version of the Plan we have excluded information relating to the location of key assets on the advice of our certifier for emergency planning and in the interests of national security.

Summary of draft Water Resources Management Plan

It is our priority to ensure we operate a resilient water supply system for our customers by maintaining the balance between supply and demand over the next 25 years and beyond. This Water Resources Management Plan (WRMP) lays out our approach to mitigating the uncertainties we face, such as population growth and climate change, whilst listening to our customers and addressing their preferences.

This is the technical report and is accompanied by a shorter, non-technical customer and stakeholder document.

This summary is set out as follows:

- Overview of South West Water
- Customer research undertaken for this Plan
- Stakeholder engagement undertaken for this Plan
- Overall approach to water resource planning
- Our forecast of water supply
- Our forecast of the demand for water
- The impact of climate change and more extreme droughts
- Target headroom
- Baseline position and possible options
- Scenario analysis
- Our proposed water resource strategy and plan
- Alternative plans and conclusion
- Assurance

Each of these topic areas is set out in more detail within this report. The work undertaken for the Plan shows that whilst the most likely forecasts show no deficit between supply and demand for the next 25 years, a ‘do nothing’ approach is not the best performing strategy when customer preferences, government and regulatory policy, and risk management are taken into account.

Overview of South West Water

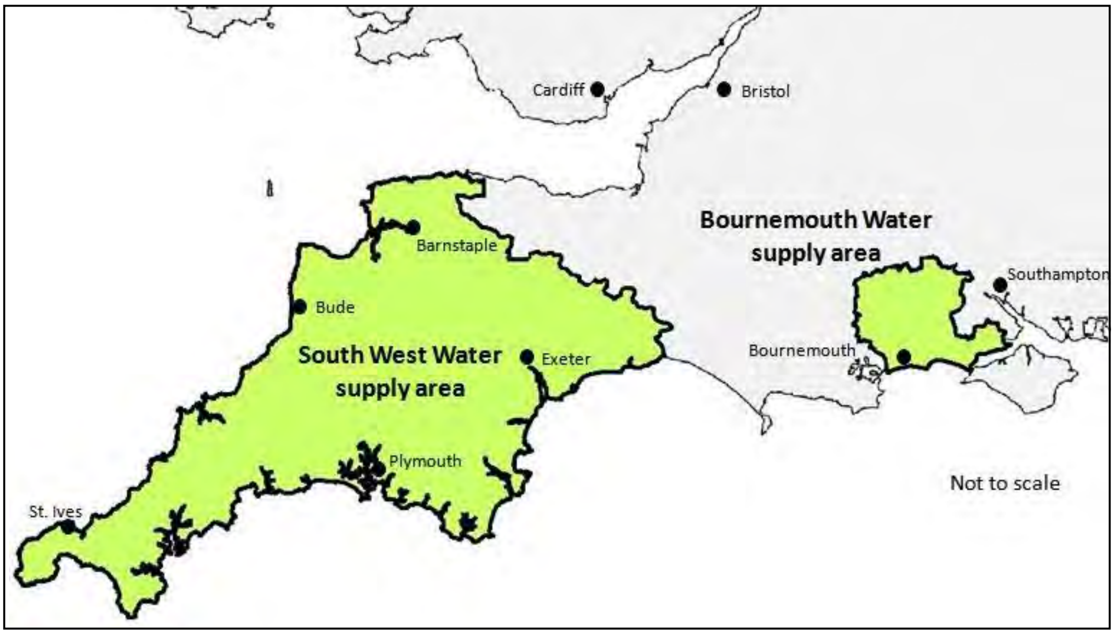
South West Water (SWW) provides drinking water to a population of 1.7 million across Devon and Cornwall and parts of Dorset and Somerset. Our water resources in this area consist of three large reservoirs, a number of smaller reservoirs, river intakes and some groundwater sources which are predominantly in East Devon. To the east, SWW operates the Bournemouth Water (BW) area in Hampshire and Dorset. Water resources in this area are largely made up from river abstraction with some groundwater, and supply approximately 0.45 million customers.

The South West Water area is split into three Water Resource Zones (WRZs). Within these zones we operate our sources in conjunction with one another to maximise the water available for supply. The Bournemouth Water area is a single WRZ but again we operate our sources to maximise the water available. In total we have four WRZs across our whole operational area – see Figure A.

This Plan is designed to meet the Level of Service in each of our WRZs as set out in Table A below. We are currently meeting our Levels of Service and there have been no demand restrictions imposed across the area for over 20 years.

Figure A: Our water supply area

a) Overall water supply area



b) Water Resource Zones (WRZs)

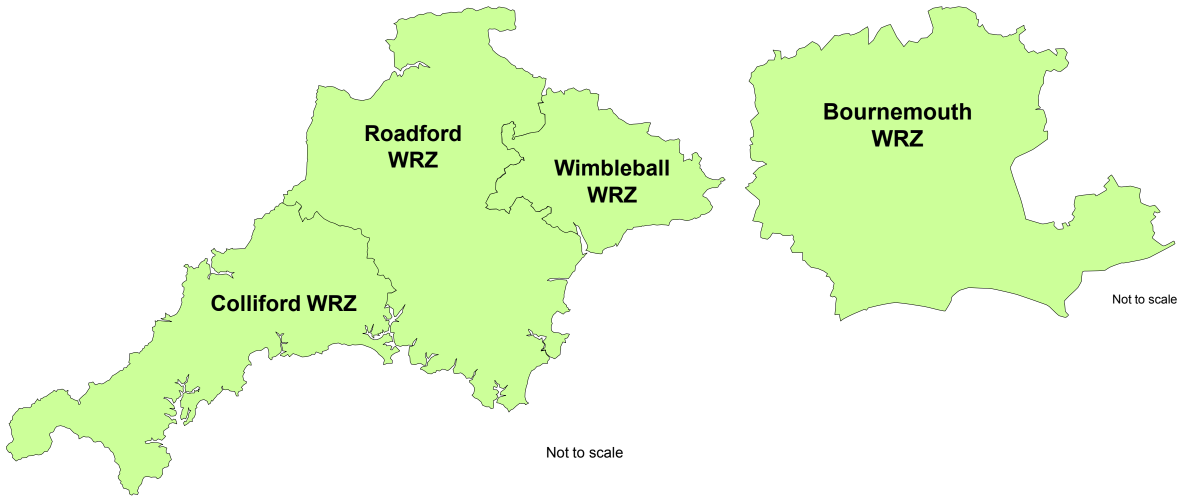


Table A: Planned Levels of Service

Drought Action	Average Frequency
Publicity, appeals for restraint and water conservation measures	1 in 10 years
Temporary Use Bans (TUBs)[0.1]	1 in 20 years
Supply side Drought Orders or Drought Permits	1 in 20 years
Demand side Drought Orders[0.2]	1 in 40 years
Emergency Drought Orders – partial supply, rota cuts or standpipes	1 in 200 years

Customer research undertaken for this Plan

A full range of qualitative and quantitative customer research was undertaken when developing this Plan to understand customer preferences. The research showed:

- Customers support the current Levels of Service
- Customers support the current frequency of Drought Orders and Drought Permits
- Customers' preferences for mitigating against any supply demand deficits are for leakage reduction, water efficiency and metering before resource development
- Customers have a high Willingness to Pay for leakage reduction

[0.1] Formerly termed hosepipe bans
[0.2] Formerly termed bans on non-essential use

An innovative, personalised customer video was developed for this Plan. This was undertaken to further understand customer preferences with regard to what and when we should invest to maintain the balance between supply and demand. It also gave greater reach on engagement than traditional focus groups or stakeholder events. It showed:

- Customers support starting early, rather than late, to mitigate future risks
- Customers support demand reduction over resource development
- There is a slight age bias, with younger customers preferring to see early mitigation of risks and older customers later mitigation

Over 2,500 customers have been contacted to understand their views and preferences for our planning decisions.

The report sets out how we have used the customer research in developing our Plan to ensure we are meeting the wants and needs of our customers.

Stakeholder engagement undertaken for this Plan

The activity we do in our water resource planning is important for a range of stakeholders. As our Plan developed we shared our work with the Environment Agency teams. We also shared progress with our Customer Challenge Group which represents key stakeholders in our region.

We undertook a pre-consultation survey with stakeholders in our region and have used their feedback in shaping our Plan.

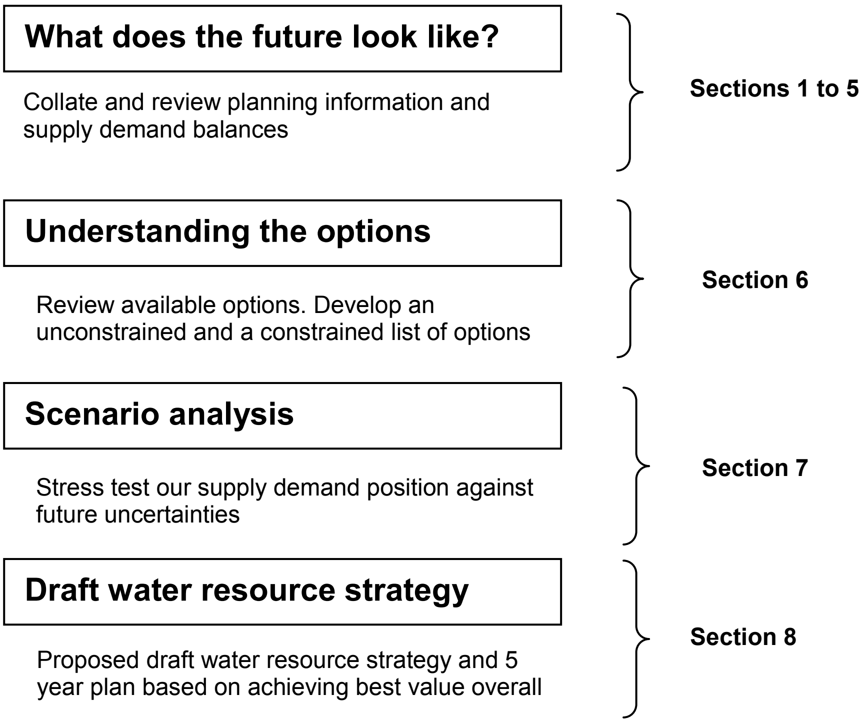
Early on in this Plan we recognised the opportunity for a possible water transfer to Southern Water from our Bournemouth Water supply area. We worked positively with them to understand the opportunity and the work needed.

Overall approach to water resource planning

Figure B below sets out the overall approach we adopted for developing this Plan. This follows the same structure as in national guidelines[0.3]. Our area is classified as low risk[0.4] for water resources purposes and we have adopted methods commensurate with the level of risk we face. The technical methods in each area that make up our Plan are set out in the report. Notwithstanding our low risk, we have investigated a range of planning scenarios to stress test our Plan to gain a greater understanding of the robustness of our system to future uncertainties.

[0.3] UKWIR (2016), *WRMP 2019 Methods – decision making process: guidance*
[0.4] See Appendix 1

Figure B: Overall approach to water resource planning



What does the future look like?

Our forecast water supply

Our supply capability has been calculated using a behavioural network water resource model. This uses historic river flow data to calculate the maximum demand we can meet whilst still achieving our Levels of Service, subject to our licensed abstraction and operational constraints.

Any known changes in supply have been built into the supply forecast, for example through any abstraction licence changes. The impact of climate change on supply has also been calculated and included in our forecasts.

The supply forecast has taken into account the reliable treatment works capacity and a separate assurance statement is given to confirm that our Plan can meet drinking water quality standards.

This report shows we do not expect any material change in our supply capability over the planning period.

Our forecast of the demand for water

Our forecast demand for water has been calculated using a range of new tools for this Plan. The report sets out details of our micro-component model used for household demand and our econometric model used for non-household demand. The demand forecasts include expected savings from water efficiency measures within new homes and also appliance replacement.

In producing our demand forecasts we have used data on population forecasts from the Office of National Statistics and data on property forecasts from local plans. The results show that we expect population to grow by approximately 0.4 million over the next 25 years. However, we expect demand to be relatively steady due to the expected water savings and leakage reductions we already have planned, as a result of appliance replacements and from customers voluntarily switching to a metered supply. A central estimate of all forecast data has been used to ensure forecasts are the most likely case – the Plan does not forecast on a worst case scenario. We term this our baseline forecast and the underlying assumptions in this are given in the report.

The demand forecast is a key element of our Plan and therefore this report also considers a high demand forecast to understand how this would affect our supply demand balance predictions.

All water companies are also moving to a new reporting method for leakage following liaison with Ofwat and the Environment Agency. Our demand forecasts in this Plan are based on our current approach, however we have also produced a forecast using the new method to understand what impact this would have on our supply demand balance forecasts.

The impact of climate change and more extreme droughts

The impact of climate change on supply and demand forecasts has been taken into account following national guidelines. The report sets out the results of the analysis and how they have been embedded into our forecasts. The results show that the average impact of climate change on our forecasts is small.

We have also produced scenarios for more extreme droughts than we have seen historically to understand how these would affect our supply demand balance.

Target headroom

We have included an allowance for uncertainties in our forecasts. The allowance used is termed our target headroom. The probability percentile of uncertainty included in different years of our Plan is given in Table B.

The target headroom levels of confidence for the period to 2025 have been chosen to align to the Periodic Review 2019 Draft Methodology drought risk performance measure. The long term percentile values were chosen so as not to plan on a worst case scenario but also not to plan on too low a level of risk which could result in the possibility of levels of service failure.

Table B: Target headroom uncertainty – percentiles selected

Forecast period	Target headroom percentile (WRMP19)
2017 – 2020	95th
2020 – 2025	95th
2025 – 2030	90th
2030 – 2035	90th
2035 – 2040	85th
2040 – 2045	85th

Baseline position and possible options

Baseline supply demand balance

We used the water supply and demand forecasts together with climate change and target headroom values to forecast our baseline supply demand position for the next 25 years. This forecast is the supply demand balance should no new interventions to be undertaken. The results show that all of our WRZs are in surplus with a very small deficit in Colliford WRZ that occurs around 2044/45 – see Figure C.

The surplus position shows there are no significant concerns in the base case. In light of the supply demand position, longer-term forecasts beyond 25 years were not adopted for this Plan but will remain under review for future plans.

As there is no projected supply demand deficit over the planning period, the lowest cost plan would be to not undertake any interventions i.e. to ‘do nothing’. However, in the report we show that this plan would perform poorly when wider aspects of planning are taken into account.

Understanding the options

Notwithstanding the projected supply demand surplus, we have costed and assessed possible water resource, water transfer, leakage and water efficiency options that could be implemented if needed.

We believe it is prudent to plan on this basis in order to understand what options could be implemented if the future does not follow our most likely forecasts.

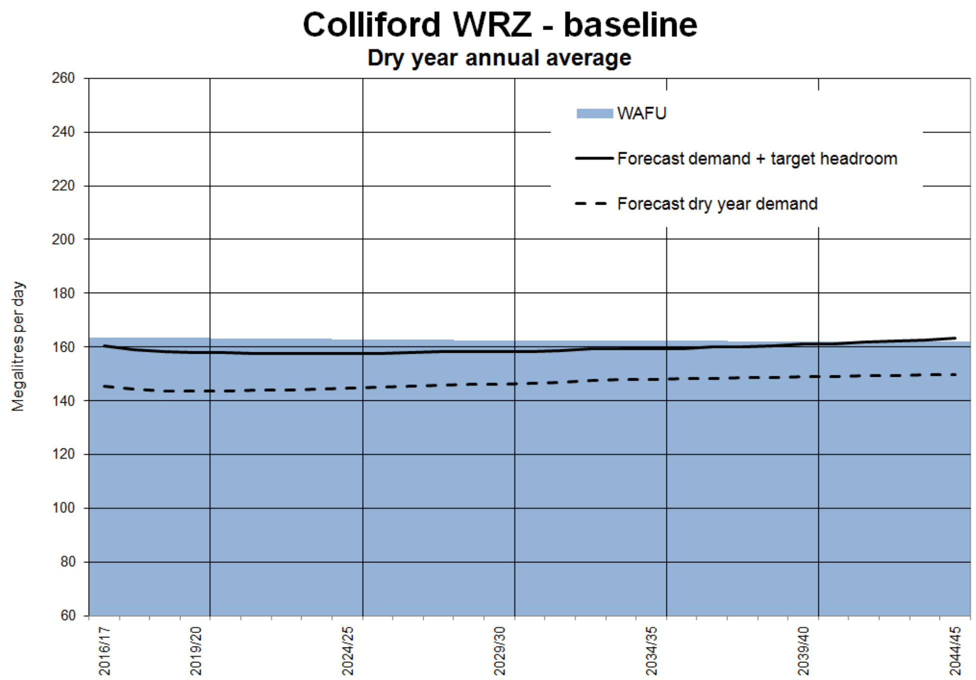
Details of the options and costs are given in this report. This includes specific review of a possible water transfer from Bournemouth WRZ to Southern Water to help address supply demand deficits in their area.

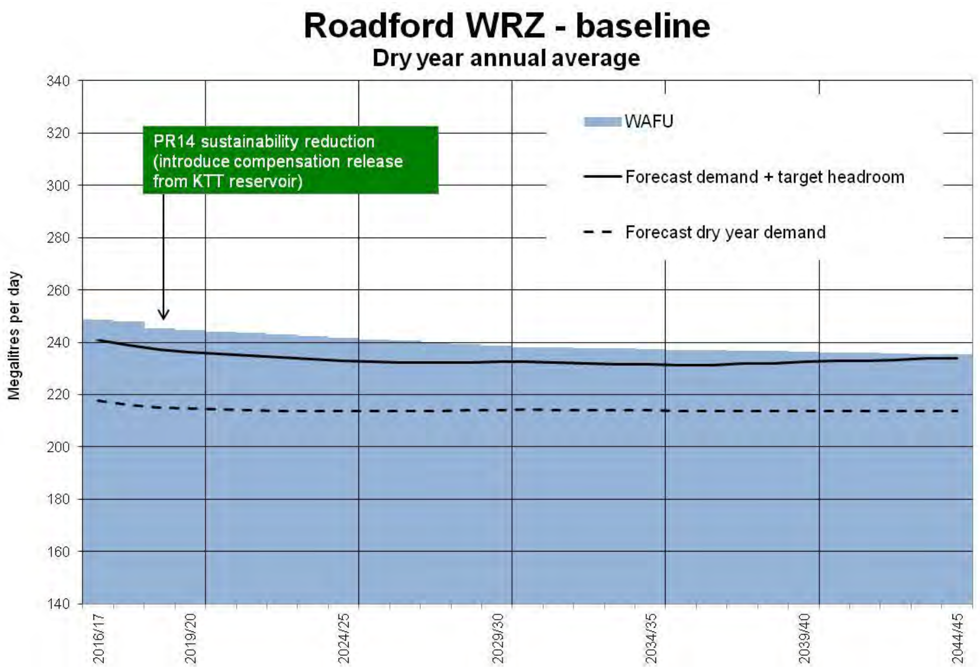
In total 260 options were assessed. These were shortlisted to 98 based on a set of screening criteria looking at cost and performance.

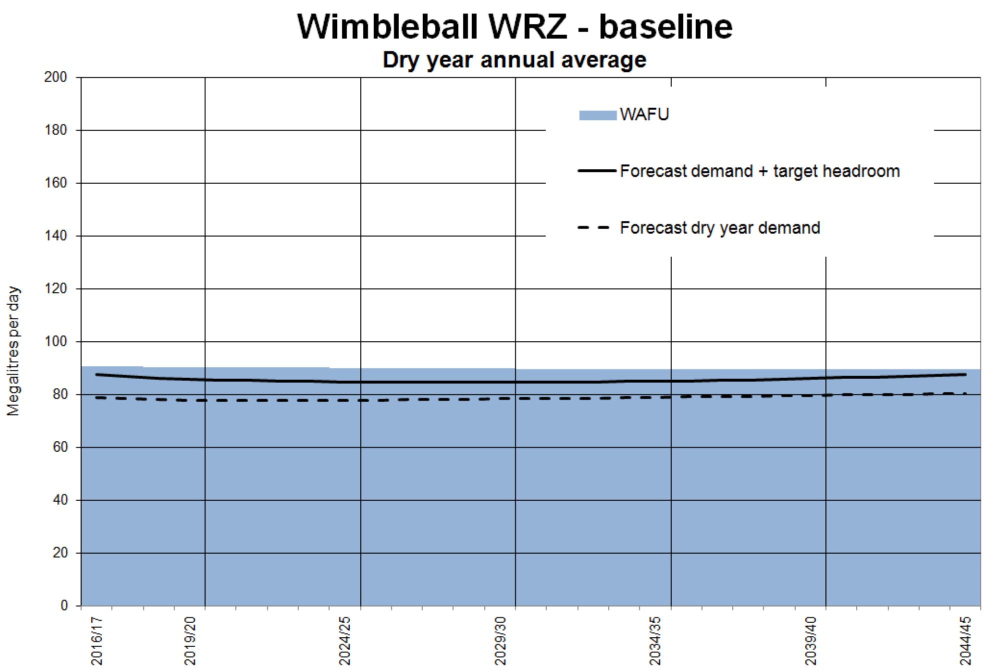
In understanding the options particular focus was given to demand management measures and leakage reduction. This was in recognition of our customer preferences and to improve our analysis of these areas from previous plans.

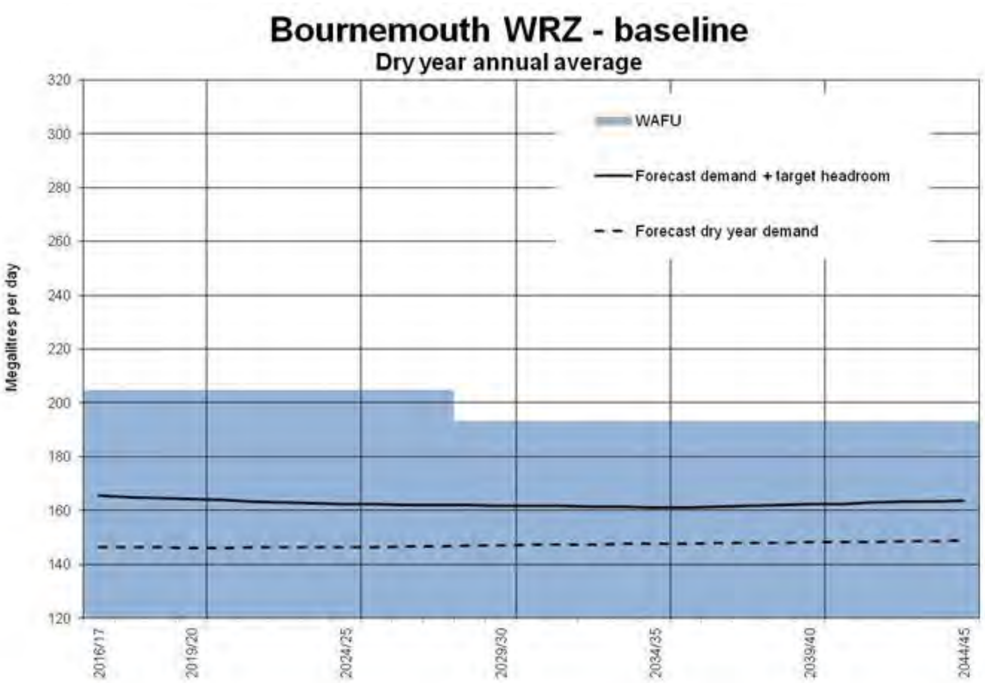
As we have high meter penetration, low per capita consumption and no significant forecast supply demand deficit, our scenario analysis focused on the policy decisions between leakage reduction and new water resource options. We then brought in wider decision making around demand management options using the results of this analysis.

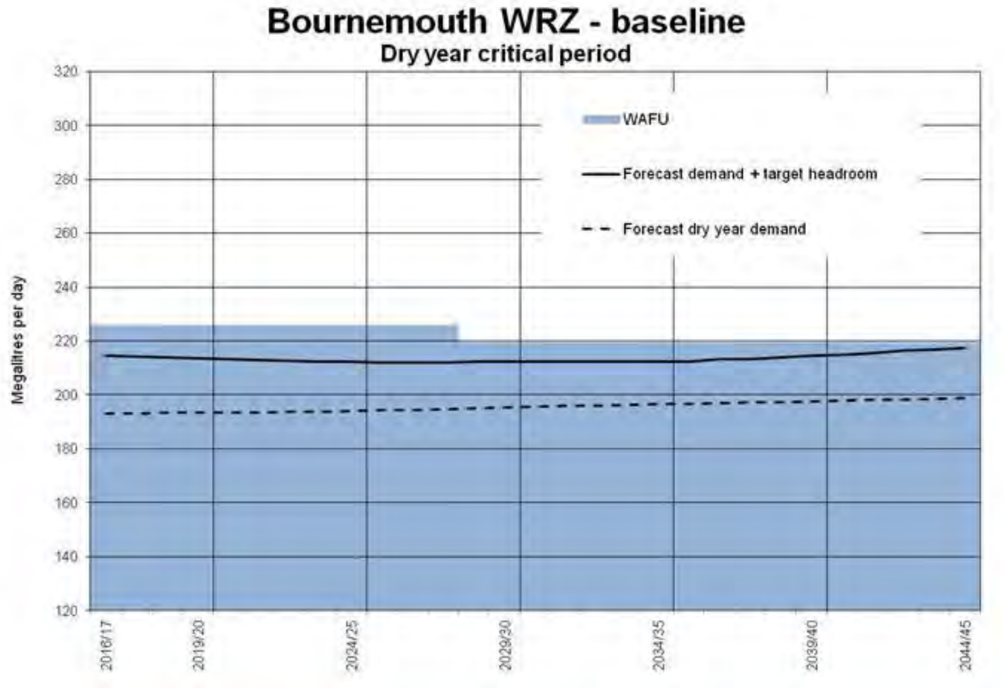
Figure C: Forecast baseline supply demand balance






Wimbleball WRZ - baseline
Dry year annual average
Megalitres per day
200
180
160
140
120
100
80
60
40
20
0
WAFU
Forecast demand + target headroom
Forecast dry year demand
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Bournemouth WRZ - baseline
Dry year annual average
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
WAFU
Forecast demand + target headroom
Forecast dry year demand
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45



Scenario analysis

A range of sensitivity tests were performed on our baseline supply demand forecasts to understand how robust the supply demand position is to future uncertainties or policy decisions. Eleven different tests were performed on each WRZ covering uncertainties in the supply demand forecasts or to explore the impact of different policy decisions – see Figure D. This included the impact of moving to a new industry methodology for calculating leakage and the implication of the PR19 draft methodology performance commitments on leakage reduction.

The results of the analysis showed that the Bournemouth WRZ supply demand balance is not sensitive to the scenarios tested. The South West Water WRZs supply demand balances are not sensitive to changes in the short-term (2020-2030) but have some small sensitivity in the medium to long-term (post 2030) to:

- More extreme droughts (return periods > 1 in 200 years) – more extreme droughts than seen historically
- New environmental needs – loss of supply for future new environmental needs
- Higher household demand – household demand significantly higher than our central forecast

The likelihood of these scenarios is assessed as low. Modelling was however undertaken to understand the cost to resolve any supply demand deficit that occurred in the scenario analysis or the cost of a particular policy decision. A multi-criteria scoring approach[0.5] was used to assess the performance of the different scenarios under five categories:

- Financial
- Customer and affordability
- Deliverability
- Resilience
- Markets and innovation

The scores are summarised in Table B. Each scenario was compared to the baseline 'do nothing' scenario as a reference.

The results showed:

- For the baseline scenario, the lowest cost solution is to not undertake any intervention. This however performs poorly in other performance areas
- Where the scenarios show we have a shortfall between supply and demand, solutions based on leakage reduction perform well
- Water resource based solutions are higher overall cost than demand management options and are less flexible, but they have greater cost certainty and perform better on improved resilience
- Customer support for leakage reduction is high. Leakage rates using willingness to pay were cost beneficial in the range:
    - SWW: 50-70 Ml/d
    - BW: 16-19 Ml/d

  However, large short-term reductions in leakage would lead to significant bill increases in AMP7
- A 15% reduction in leakage in line with the PR19 draft methodology would increase our supply demand surplus in the short term but would also lead to higher bills than would otherwise be necessary
- There is water available in the Bournemouth WRZ which could be used to supply Southern Water but the volume is currently limited by water treatment infrastructure constraints at peak demands when it may be required. A connecting pipeline would also be needed.

Full results of the analysis are given in the report. The overriding conclusion from the analysis is that acting early to mitigate future uncertainties performed best, and programmes that included reduced leakage performed better than those with new water resource development. Leakage reduction reduces the total demand on the supply system and the scenario analysis shows that this is important if we are to mitigate future uncertainties.

[0.5] UKWIR (2016), *WRMP 2019 Methods – Decision Making Process: Guidance*, Section 12.5

The analysis undertaken also highlighted a number of development areas for our future plans with regard to data and decision making tools around those areas where the supply demand balance is most sensitive. Further details are given in the report.

Figure D: Supply demand balance sensitivity

a) Colliford WRZ

Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	🟢	🟢	🟢	🟢	🟢	🟢	🟡
2	Customer willingness to pay	🟢	🟢	🟢	🟢	🟢	🟢	🟢
3a	Plausible droughts	🟢	🟢	🟢	🟢	🟢	🟢	🟡
3b	1 in 200 year drought	🟢	🟢	🟢	🟢	🟢	🟢	🟡
4a	Resource only plan	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4b	Demand only plan	🟢	🟢	🟢	🟢	🟢	🟢	🟢
5a	Southern Water transfer	-	-	-	-	-	-	-
5b	Environmental needs	🟢	🟢	🟢	🟡	🟡	🟡	🟡
6a	Leakage consistency measures	🟢	🟢	🟢	🟢	🟢	🟢	🟢
6b	PR19 draft methodology	🟢	🟢	🟢	🟢	🟢	🟢	🟢
7a	High household demand	🟢	🟢	🟢	🟢	🟡	🟡	🟡
7b	High non-household demand	🟢	🟢	🟢	🟢	🟢	🟢	🟡

b) Roadford WRZ

Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	🟢	🟢	🟢	🟢	🟢	🟢	🟢
2	Customer willingness to pay	🟢	🟢	🟢	🟢	🟢	🟢	🟢
3a	Plausible droughts*	🟡	🟡	🟡	🟡	🟡	🟡	🟡
3b	1 in 200 year drought	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4a	Resource only plan	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4b	Demand only plan	🟢	🟢	🟢	🟢	🟢	🟢	🟢
5a	Southern Water transfer	-	-	-	-	-	-	-
5b	Environmental needs	🟢	🟢	🟢	🟡	🟡	🟡	🟡
6a	Leakage consistency measures	🟢	🟢	🟢	🟢	🟢	🟢	🟡
6b	PR19 draft methodology	🟢	🟢	🟢	🟢	🟢	🟢	🟢
7a	High household demand	🟢	🟢	🟢	🟡	🟡	🟡	🟡
7b	High non-household demand	🟢	🟢	🟢	🟢	🟢	🟢	🟢

c) Wimbleball WRZ

Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
2	Customer willingness to pay	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
3a	Plausible droughts*	● (amber)	● (amber)	● (amber)	● (amber)	● (amber)	● (amber)	● (amber)
3b	1 in 200 year drought	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
4a	Resource only plan	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
4b	Demand only plan	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
5a	Southern Water transfer	-	-	-	-	-	-	-
5b	Environmental needs	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (amber)
6a	Leakage consistency measures	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
6b	PR19 draft methodology	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
7a	High household demand	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (amber)
7b	High non-household demand	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)

d) Bournemouth WRZ

Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
2	Customer willingness to pay	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
3a	Plausible droughts*	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
3b	1 in 200 year drought	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
4a	Resource only plan	-	-	-	-	-	-	-
4b	Demand only plan	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
5a	Southern Water transfer	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)	● (blue)
5b	Environmental needs	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
6a	Leakage consistency measures	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
6b	PR19 draft methodology	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
7a	High household demand	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (amber)
7b	High non-household demand	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)

Note: green = no supply demand deficit; amber = small supply demand deficit (<3%); red = large supply demand deficit (>3%); blue = can be met with infrastructure improvements

Table B: Overview of multi-criteria scoring of sensitivity analyses

Ref	Theme	Scenario title	Colliford WRZ	Roadford WRZ	Wimbleball WRZ	Bournemouth WRZ	Total score
1a	Baseline	Baseline	24	24	24	24	96
2	Customer preferences	Customer willingness to pay	24	24	24	25	97
3a	Resilience	Plausible droughts	24	26	26	24	100
3b	Resilience	1 in 200 year drought	24	24	24	24	96
4a	Long-term balance	Resource only plan	28	29	28	-	-
4b	Long-term balance	Demand only plan	27	28	25	24	104
5a	Environment and markets	Southern Water transfer	-	-	-	28	-
5b	Environment and markets	Environmental needs (WINEP2)	28	28	28	24	108
6a	Data	Leakage consistency measures	27	27	24	24	102
6b	Data	PR19 methodology (15% leakage reduction)	25	24	26	25	100
7a	Demand uncertainty	High household demand	30	29	28	24	111
7b	Demand uncertainty	High non-household demand	24	24	24	24	96

Note: for a given scenario, the scores may differ in each Water Resource Zone. This is because the impacts of the scenario can affect each zone differently.

Our proposed water resource strategy and plan

We have built our proposed strategy by combining the findings from our customer research, the scenario analysis and regulatory and government policy considerations.

Our previous Water Resources Management Plan set out a strategy to 'do the right thing'. We still think this fundamental ethos holds true but in light of the results of the work in this report, we believe this strategy needs to be focused on specific outcomes to manage future risks.

Our proposed strategy for maintaining the balance between supply and demand, taking all information into account, is:

- **Reduce leakage and the future demand for water** – this is consistent with the results that show leakage reduction to be the better performing future option. It meets customer preferences and has alignment to government and regulatory policy.
- **Optimise our water resources and ensure they are resilient to future droughts** – this is consistent with ensuring that we can mitigate future more extreme droughts and make best use of existing supplies.
- **Develop our planning tools and understanding of future options** – this is consistent with managing future risks and continuous development of our analyses for decision making for future Plans

This three pillar strategy balances future risks across different interventions and is flexible and adaptable to future changes.

This report then sets out detailed activities in both a short-term and medium to long-term plan. These are summarised below and in Table C. The final supply demand forecasts are given in Figure E.

Through the selection of a balanced set of activities, the proposed plan has an overall performance score across all WRZs of 121; this compares to 96 for the baseline plan (see Table D). We have also undertaken a natural capital assessment of our plan to assess the value it delivers more widely. The results show a net benefit to natural capital of between £11m-£43m over the planning period.

Short-term plan (2020-2025)

The proposed plan is to undertake a series of small actions in each of these strategic areas in the next five years. It seeks to balance undertaking some activity now in order to protect future generations, with ensuring we do not plan on a worst case scenario which could result in customers paying for activities they do not need to pay for. The report recommends the following plan for the next five years:

- <u>**Reduce leakage and future demand for water**</u>
  - **Reduce leakage by 8 Ml/d (8% lower than current levels)** – this will mitigate some, but not all, of our future uncertainties. It sets a stretching target and places

our leakage levels in industry upper quartile performance based on current data. The level of reduction is balanced against affordability and deliverability. Reducing leakage is a key customer priority, but greater levels of reduction would give rise to higher bills in the short-term than would otherwise be necessary.

- **Reduce our consumption of water** - we will reduce our operational use by 2.8 Ml/d at five of our large sewage treatment works. This will help mitigate future risks on demand growth and environmental needs.
- **Help customers reduce their water use** – support customers through community based water efficiency initiatives, social norms feedback and social housing retro fits. We will target an overall per capita consumption of 129 l/p/d which would give industry upper quartile performance based on current data. We will also support the tourism sector with a targeted programme for water efficiency.
- **Continue to increase meter penetration** - continue to promote optant metering and replace end of life meters with Automatic Meter Reading (AMR) technology in line with our current policy.

- <u>**Optimise our use of water resources and ensure we are resilient to future droughts**</u>
  - **Investigate the resilience of existing drought management options to more extreme droughts** – we will investigate the performance of our emergency drought options to understand how they will perform in droughts more extreme than we have experienced historically. This will ensure we have a better understanding of how they would operate against the more extreme droughts that could be expected in the future.
  - **Update our understanding of more extreme droughts** – we will continue to investigate what future, more extreme, droughts we could experience and how they could affect our water supply capability.

- <u>**Develop our planning tools and understanding of future options**</u>
  - **Undertake a detailed feasibility study on a Bournemouth WRZ to Southern Water transfer (see box below)** – we will work with Southern Water to develop this option in more detail with a view to potential delivery in the 2025 to 2030 period.
  - **Undertake a high level feasibility study on a Roadford pumped storage scheme and costings of future resource options -** as the only strategic reservoir in our region with no pumped storage scheme, this study would examine the feasibility of such an option should leakage and demand management savings not fully materialise. We would also do more detailed costings of other feasible options. For the avoidance of doubt, the work on a Roadford pumped storage scheme is to understand its feasibility to aid future decision making and is not intended as a scheme promotion.
  - **Develop our demand forecasting tools to take more account of future uncertainties -** we will develop our existing demand forecasting tools to give a

better understanding of the likelihood of different possible future demands. This will allow a more detailed assessment of the likelihood of a future supply demand deficit (or surplus) for future plans.

- **Develop a new financial decision making tool** - whilst current tools are considered appropriate for our planning problem, we consider that we should transition to more enhanced methods for decision making for use in future plans to ensure we continually maintain the supply demand balance at the lowest possible cost.
- **Increased understanding of demand management savings in drought conditions** - we will undertake a study to update our understanding of possible demand management savings during drought conditions.

The Plan we propose pushes our performance in a number of key areas. The proposed combination of activity will deliver:

- Upper quartile industry performance on leakage in the SWW and BW supply areas based on current data
- Upper quartile industry performance on per capita consumption based on current data
- Sector leading performance in terms of resilience to future droughts with the ability to deliver service to at least a 1 in 200 year drought

It also sets a glide path for the additional tools and analysis we will develop to inform our future plans and ensure we continue to maintain the balance between supply and demand.

Bournemouth WRZ to Southern Water Transfer

The work in this Plan has highlighted a potential option to transfer water from the Bournemouth WRZ to Southern Water to help ameliorate a supply demand deficit in their area post 2025.

The work undertaken shows water is available to transport but the volume is limited by current infrastructure constraints at peak demands when it may be required.

We have made significant progress over the last 12 months in understanding potential availability of this supply but there remain a number of aspects to investigate and understand further.

These include the short, medium and long-term availability of water relative to existing infrastructure and future infrastructure enhancements (and their costs). They also include the frequency and seasonality of reliable supply required by Southern Water, relative to other potential demand fluctuations within the overall demands on supplies on our Water Treatment Works.

We intend to undertake further investigation with Southern Water so that this transfer can be more fully considered in our next plan. We intend to progress this in the remainder of AMP6 and complete early in AMP7.

Medium to long-term plan (2025-2045)

As our most likely view of the future shows we are forecast to be in surplus over the medium to long-term, we think it is important to keep the Plan flexible and review again at our next update in 2025.

However, in the meantime we should continue to plan to:

- **Reduce leakage and the future demand for water**
  - **Reduce leakage further** – continue to reduce leakage in the long-term to 64 Ml/d in SWW and 16 Ml/d in BW. This is consistent with customers' willingness to pay to reduce leakage.
  - **Continue to help customers reduce water consumption** – continue rollout of metering to a long-term meter penetration of 90% and continue water efficiency support to help customers reduce the demand for water.
- **Optimise our use of water resources and ensure we are resilient to future droughts**
  - **Continue to ensure our assets can perform as needed during drought conditions**
- **Develop our planning tools and understanding of future options**
  - **Continue to develop risk based approaches to water resource planning –** this is consistent with better understanding of future risks such as higher than expected demand or more extreme droughts.
  - **Implement a Bournemouth WRZ to Southern Water transfer** – this would be implemented in the 2025 to 2030 period subject to infrastructure improvements and a detailed feasibility study in the 2020 to 2025 period.

Alternative plans and conclusion

The report does not recommend a 'do nothing' plan even though this could be justified by the baseline forecast which shows no supply demand deficit with the exception of a very minor deficit in Colliford WRZ t the end of the planning period.

A 'do nothing' plan could be justified on the grounds of lowest cost, but we rejected this as it does not mitigate future risks or deliver the priorities of our customers or government policy.

The Plan does not recommend an extensive water resource development programme because the current supply demand surplus does not justify new large scale water resource development. The Plan, however, does recommend examining a strategic scheme in detail in the 2020-25 period and developing our understanding of new options for our next Plan. These will help future decision making. Water resource options can act as a contingency should they be needed in the future and should, for example, leakage and demand reduction not achieve the benefits expected.

The Plan recommends further leakage reduction in both the short and long-term. The short-term leakage reduction level is balanced against cost, affordability and deliverability. Leakage reductions beyond those included in the Plan would have a more significant cost implication to customers than would otherwise occur. Instead we think our Plan, which continually reduces leakage and keeps performance in upper quartile levels, is the right balance overall.

Whilst there are higher or lower cost plans mitigating more or less risk, the proposed plan is considered to be the best overall balance to customers and the environment and will ensure that we continue to deliver a safe and reliable supply to customers for future generations.

Assurance

Progress on the WRMP and its approach to developing the Plan was regularly presented at the company Customer Challenge Group (CCG) with comments and feedback brought into the process.

The WRMP itself was led by a senior manager and sponsored by an Executive Management Team Director. Monthly Board updates on progress were given during the development of this Plan and critical components of the Plan were presented to and challenged by Executive Management Team and Board members. The Plan reported into the PR19 Steering Group governance.

This Plan was produced within the same overall Directorate as the PR19 Business Plan to ensure alignment in future delivery. The technical team developing the Plan also produces the Drought Plan and manages day-to-day resource management.

This integrated approach means the draft WRMP is a central part of our overall plans for service delivery in our water service. It has considered the linkages with drinking water quality as well as areas such as improving affordability or protecting vulnerable customers.

External assurance was completed on the Plan by CH2M. We also undertook self assurance using the EA checklist and Senior Management review. No material issues were found but areas to develop for our future plans were identified. We have included these in our Plan (see “our proposed water resource strategy and plan” above). We believe this makes our Plan more comprehensive than one which just identifies actions to maintain the supply demand balance as it also signals where we will be developing our approaches for future plans.

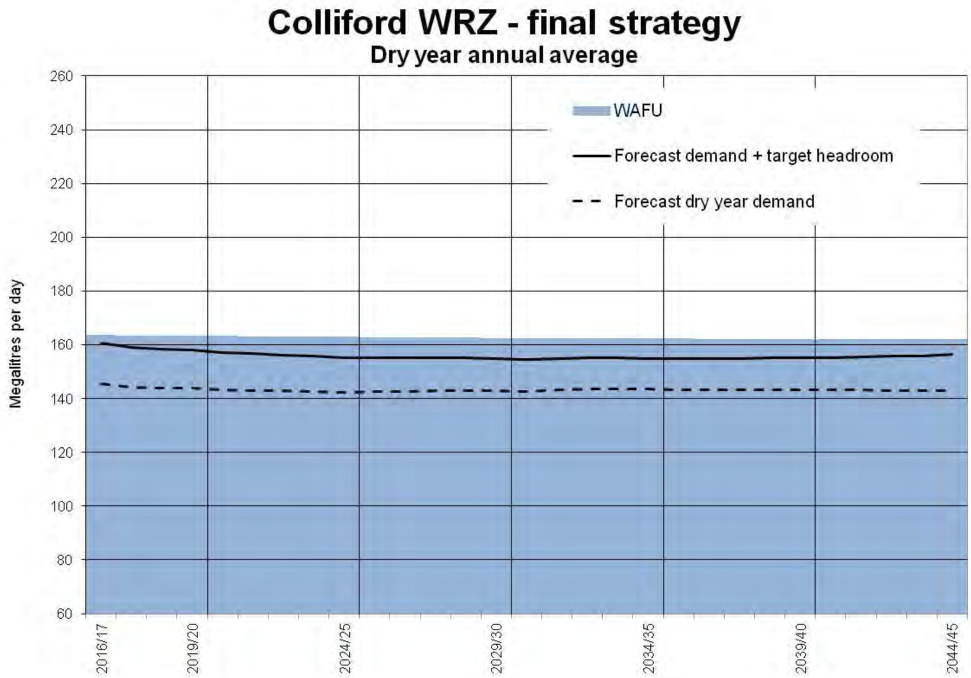
Table C: Summary of water resource strategy and plan

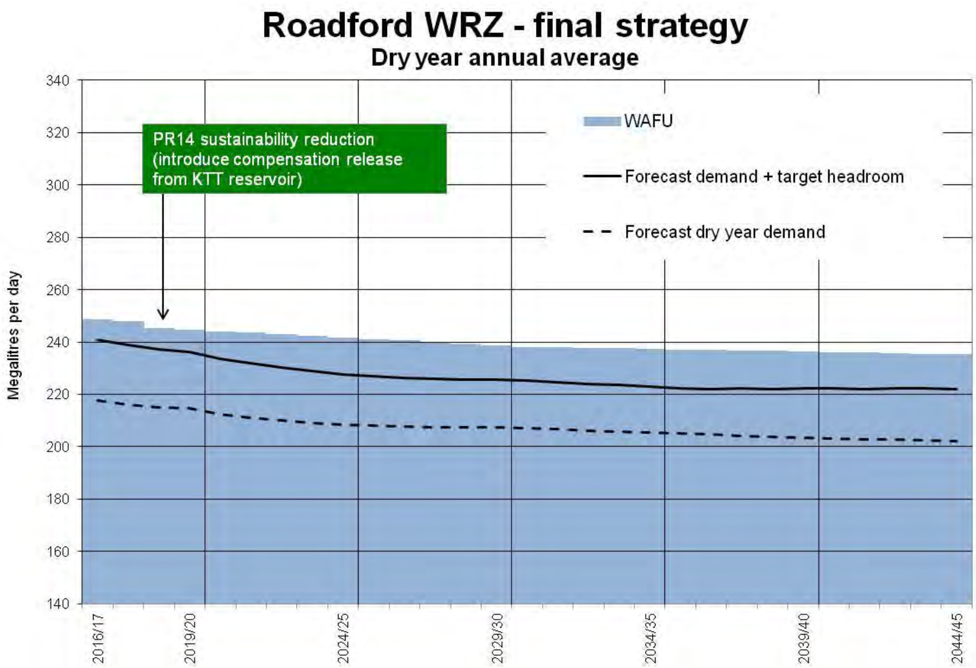
Strategy	Why	Short-term (2020-2025)				
		Resources	Leakage	Demand Management	Transfers	Other
Reduce leakage and the future demand for water	Low cost options to manage future risks Consistent with customer preferences Consistent with Government and regulatory policy	-	Reduce leakage by 8 Ml/d (8%) to 77 Ml/d in SWW and to 18 Ml/d in BW	Support customers to reduce average per capita consumption to 129 l/p/d on average through community based schemes and improved bill information Promote water efficiency for non-household tourist businesses Continue to promote optant metering and replace end of life meters with AMR technology Reduce our consumption of water at 5 large sewage treatment works	-	-
Optimise existing water resources and ensure they are resilient to future droughts	Consistent with ensuring that we can mitigate future more extreme droughts and make best use of existing supplies	Investigate the resilience of existing drought management options to more extreme droughts Update our understanding of future drought impacts	-	-		-
Develop our planning tools and understanding of future options	Consistent with managing future risks and improving our forecasting tools. It will ensure we are in a good position for future plans particularly in the event demand savings are less than expected.	High level feasibility study on a Roadford pumped storage scheme* Undertake a feasibility study on a possible water transfer to Southern Water	-	Increase understanding of potential demand management savings in drought conditions	Explore options for transfers with neighbouring companies	Develop uncertainty based demand forecasts Produce new financial decision making tools Produce annual outage report

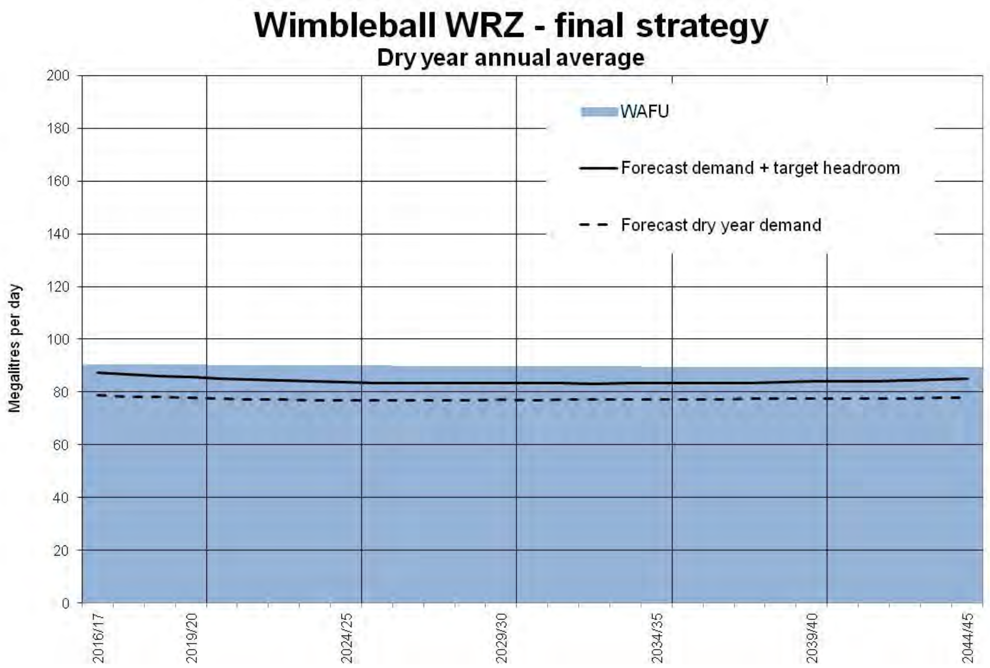
** For the avoidance of doubt this is not a promotion of this scheme.*

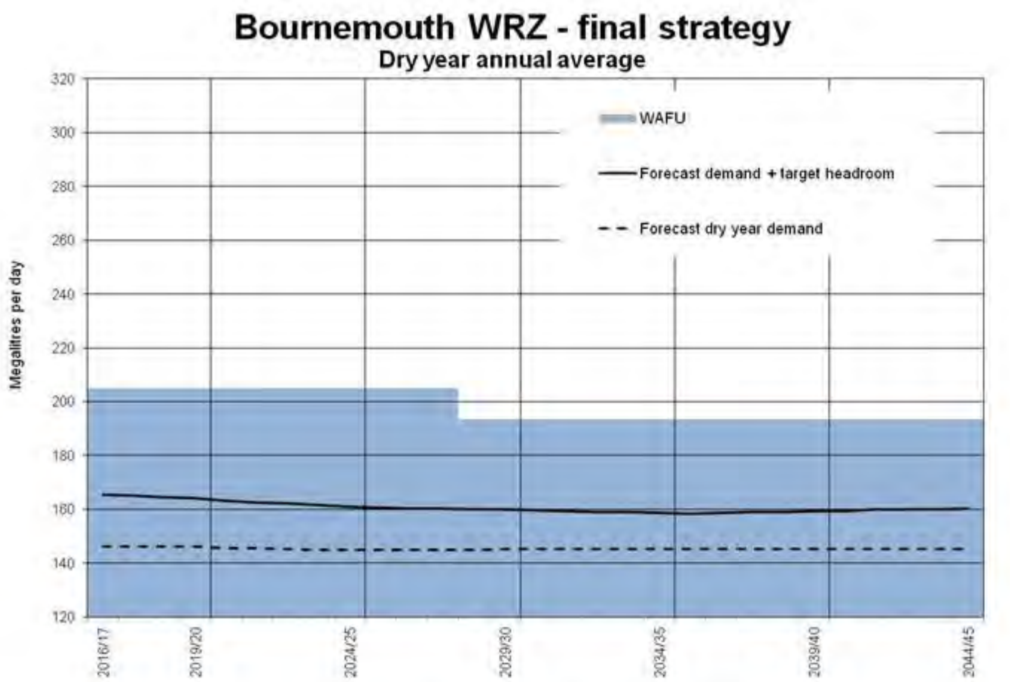
Strategy	Why	Medium to Long-term (2025-2045)				
		Resources	Leakage	Demand management	Transfers	Other
Reduce leakage and the future demand for water	Lowest cost options to manage future risks Consistent with customer preferences Consistent with government and regulatory policy	-	Reduce leakage by a further 15 Ml/d (16%) to 64 Ml/d in SWW and to 16 Ml/d in BW	Continue to promote water efficiency and metering	-	-
Optimise existing water resources and ensure they are resilient to future droughts	Consistent with ensuring that we can mitigate future more extreme droughts and make best use of existing supplies	Continue to ensure our assets perform as needed in a drought	-	-		-
Develop our planning tools and understanding of future options	This is consistent with managing future risks and improving our forecasting tools. It will ensure we are in a good position for future plans particularly in the event demand savings are less than expected.	As needed at next plan update in 2025	-	As needed at next plan update in 2025	Continue to seek opportunities for inter-company transfers including the possible delivery of a transfer to Southern Water in the 2025 to 2030 period	Continue to develop risk based approaches

Figure E: Final supply demand forecasts






Wimbleball WRZ - final strategy
Dry year annual average
WAFU
Forecast demand + target headroom
Forecast dry year demand
Megalitres per day
200
180
160
140
120
100
80
60
40
20
0
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Bournemouth WRZ - final strategy
Dry year annual average
WAFU
Forecast demand + target headroom
Forecast dry year demand
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

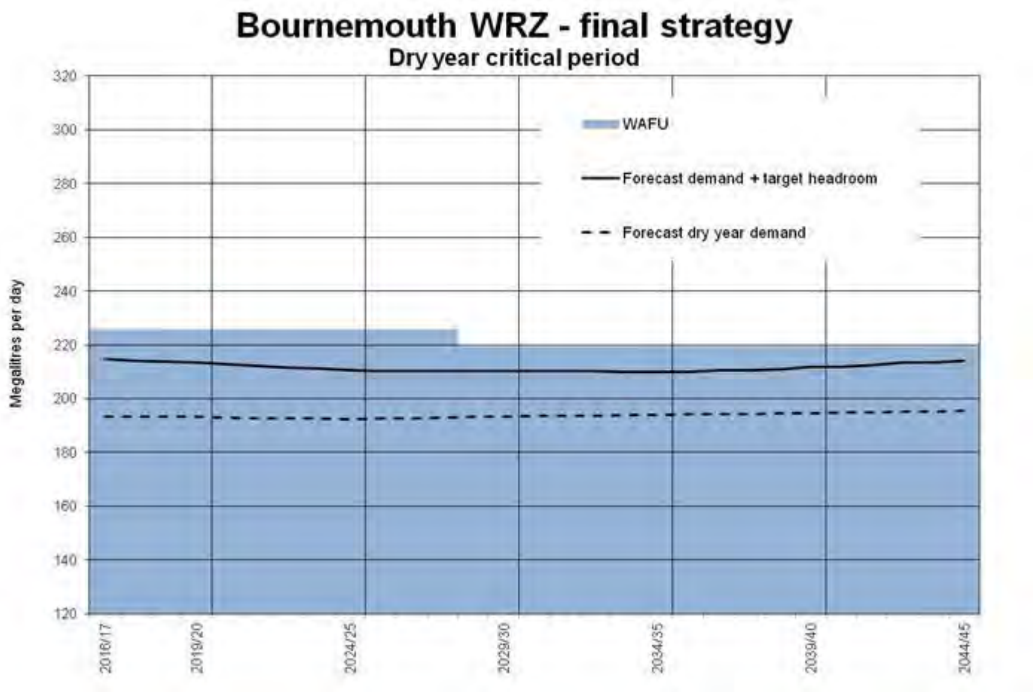


Table D: Overall Draft Plan performance

Ref	Theme	Scenario title	Colliford WRZ	Roadford WRZ	Wimbleball WRZ	Bournemouth WRZ	Total
1a	Baseline	Baseline	24	24	24	24	96
8	Draft Plan	Draft Plan	30	31	31	29	121

1. General information on plan content and development

1.1 Our water supply area

South West Water (SWW) and Bournemouth Water (BW) merged in 2016. This is a combined WRMP for both areas.

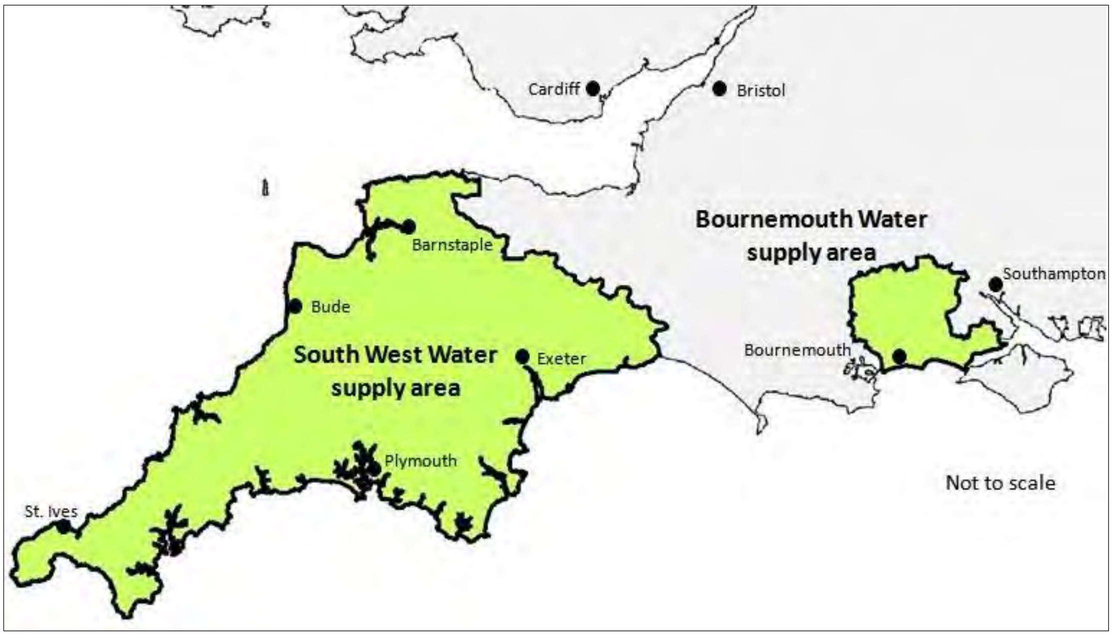
SWW provides drinking water to a population of 1.7 million across Devon and Cornwall and parts of Dorset and Somerset (SWW supply area) and since our merger with BW in 2016, we also supply approximately 0.45 million customers in the Bournemouth area (BW supply area).

Within the SWW supply area, we provide on average about 430 million litres of water each day (Ml/d). Rivers and reservoirs are our main resources in this area providing about 90% of our water. The remainder comprises groundwater sources (boreholes, wells and springs), which are predominantly in East Devon.

Within the BW supply area, covering parts of Hampshire and Dorset, we provide on average 145 Ml/d. The water resources in this area are principally river abstractions supporting by groundwater sources.

Our total water supply area is presented in Figure 1.1.

Figure 1.1: Our water supply areas



1.2 Water resource zones

1.2.1 Introduction

We have four Water Resource Zones (WRZs).

WRZs are defined as:

> *"the largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall"*[1.1]

Our WRZs are defined in accordance with the *Water resources planning guideline*[1.2].

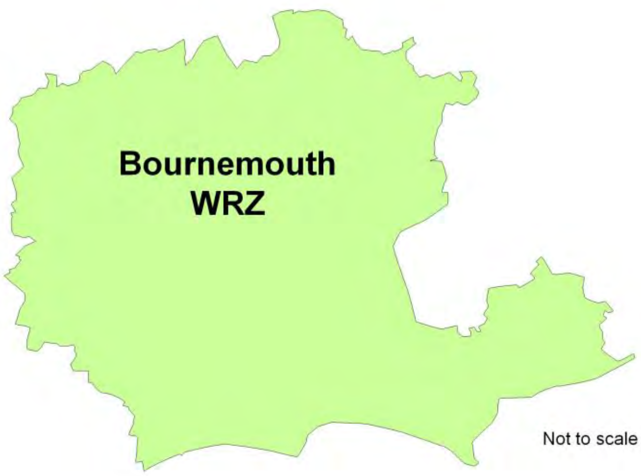
Within our SWW supply area, we use three WRZs, each centered around a strategic reservoir – Colliford WRZ, Roadford WRZ and Wimbleball WRZ. To optimise our performance, we operate our sources in conjunction with one another. The Bournemouth Water supply area is defined as a single WRZ, the Bournemouth WRZ. All our WRZs remain the same as in our previous WRMP (2014)[1.3].

Figures 1.2 and 1.3 below show our WRZs.

[1.1] Environment Agency (2016), *Water resources zone integrity. July 2016*
[1.2] Environment Agency and Natural Resources Wales (2017), *Water resources planning guideline – April 2017*
[1.3] South West Water (2014), *Water Resources Management Plan.* https://www.southwestwater.co.uk/environment/a-precious-resource/water-resources-management-plan/
Sembcorp Bournemouth Water (2014), *Water Resources Management Plan* http://www.bournemouthwater.co.uk/company-information/economic-regulation/water-resources-plan.aspx

Figure 1.2: WRZs in our South West Water supply area

Figure 1.3: WRZs in our Bournemouth Water supply area



All of our WRZs are conjunctive use systems as defined in Water Resources Planning Tools (WR27)[1.4] and benefit from a high level of connectivity within our distribution network.

A complete list of all our sources within each WRZ is given in the WRP1a tables.

Sections 1.2.2 to 1.2.5 below give a brief description of our Colliford, Roadford, Wimbleball and Bournemouth WRZs. Appendix 1 provides more details of our WRZs, including information on imports and exports between them and our WRZ integrity assessment.

1.2.2 Colliford WRZ

The Colliford WRZ covers most of Cornwall except the north east of the County. The Colliford WRZ includes Penzance, Falmouth, Newquay, Truro and Bodmin.

The strategic Colliford Reservoir is our second largest impounding reservoir and we operate it conjunctively with our local impounding reservoirs, two groundwater fed lakes and river intakes. These sources are supplemented by a bulk transfer from Roadford WRZ. We can also supplement Colliford Reservoir storage by pumping from the River Fowey.

We release water from these reservoirs within this zone to either directly supply water treatment works, or we can release water into the local river system to support abstractions further downstream.

The distribution mains throughout Cornwall provide a high level of connectivity between our Colliford WRZ resources.

A schematic of the key components is shown in Figure 1.4 below. Figure 1.5 shows Colliford Reservoir in east Cornwall.

[1.4] UKWIR (2012), *Project WR27. Water Resources Planning Tools*

Figure 1.4: Key components of Colliford WRZ

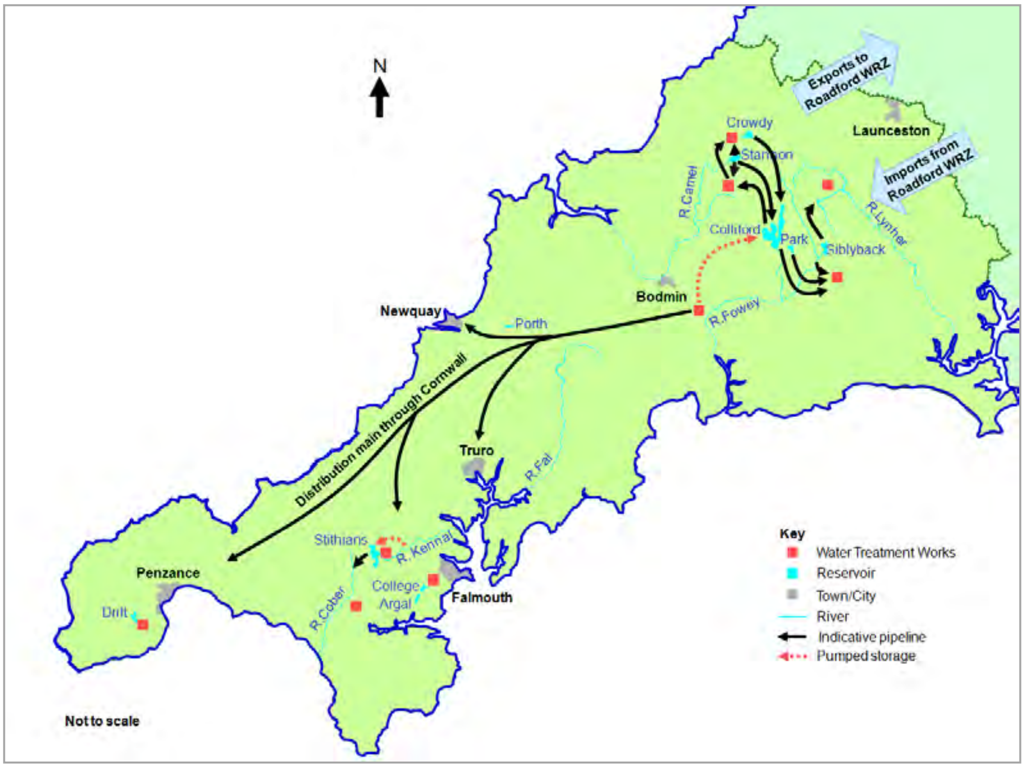


Figure 1.5: Colliford Reservoir

South West Water
Bournemouth Water

1.2.3 Roadford WRZ

The Roadford WRZ covers a large part of Devon, from Plymouth, the South Hams and Torbay in the south to Bideford and Barnstaple in the north. It also includes parts of north east Cornwall.

The strategic Roadford Reservoir is our largest impounding reservoir and we operate it conjunctively with our local impounding reservoirs, river intakes and groundwater sources. These sources are also supplemented by a bulk transfers between the neighbouring Colliford and Wimbleball WRZs.

We release water from these reservoirs within this zone to either directly supply water treatment works, or we can release water into the local river system to support abstractions further downstream.

A schematic of the key components is shown in Figure 1.6 below. Figure 1.7 shows Roadford reservoir.

Figure 1.6: Key components of Roadford WRZ

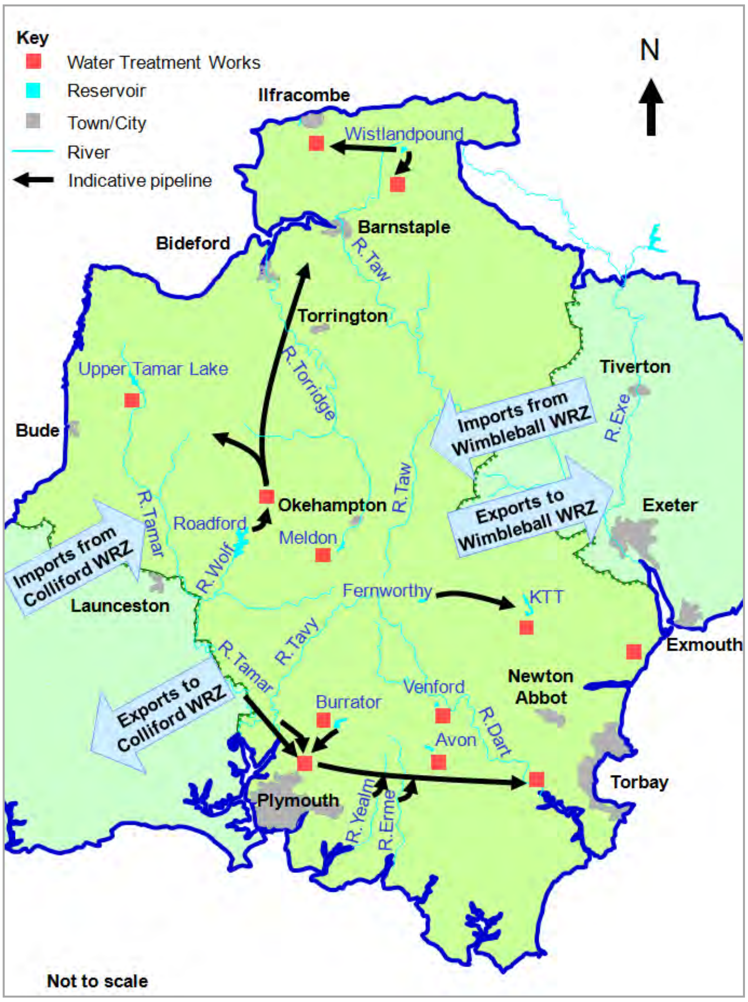


Figure 1.7: Roadford Reservoir

1.2.4 Wimbleball WRZ

The Wimbleball WRZ covers parts of north Devon, the whole of east Devon and extends into parts of Somerset and Dorset. The area includes Tiverton, Exeter, Exmouth and Crediton.

The strategic Wimbleball Reservoir is our third largest impounding reservoir and we operate it conjunctively with the majority of our groundwater sources. We use the reservoir principally for releases to the River Exe to support abstraction downstream. We can also supplement Wimbleball Reservoir storage by pumping from the River Exe.

Wimbleball Reservoir is also an important source of water for Wessex Water, who abstract from it all year around.

A schematic of the key components is shown in Figure 1.8 below. Figure 1.9 shows Wimbleball Reservoir.

Figure 1.8: Key components of Wimbleball WRZ

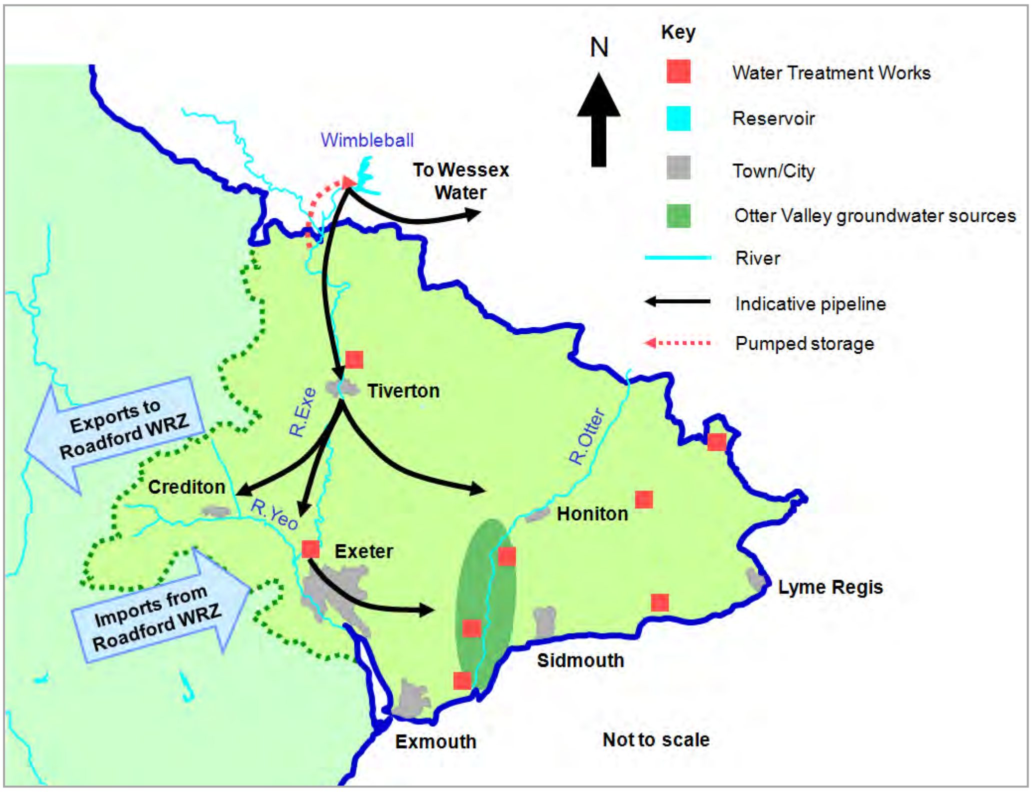


Figure 1.9: Wimbleball Reservoir

1.2.5 Bournemouth WRZ

The Bournemouth WRZ covers parts of Dorset, Hampshire, and Wiltshire, supplying Bournemouth, Christchurch, Lymington and Fordingbridge,

The principal water sources are the Hampshire Avon and Dorset Stour. There are also two small lakes, which provide short term bankside storage.

Groundwater abstractions provide water to the more rural parts of the WRZ.

A schematic of the key components is shown in Figure 1.10 below. Figure 1.11 shows the Dorset Stour.

Figure 1.10: Key components of Bournemouth WRZ

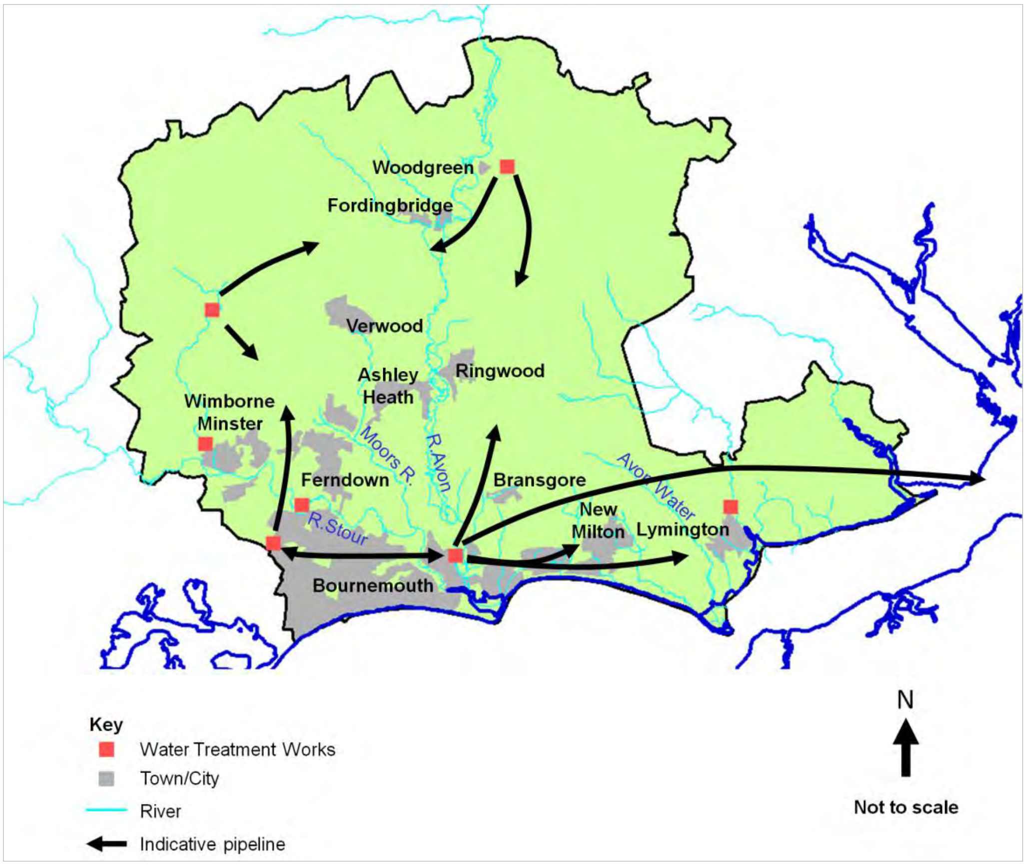


Figure 1.11: River Stour (Dorset)

1.2.6 Water resource zone integrity

As specified in the Environment Agency guideline[1.5], water companies are required to assess their WRZs to ensure their integrity.

We have reviewed the integrity of our WRZs following the guideline and we discussed the outcomes with the Environment Agency. We have produced a report for our SWW supply area, which provides evidence of our WRZ integrity within this area, and we have shared this report with the Environment Agency.

In our Bournemouth Water supply area, WRZ integrity was assessed rigorously as part of the previous WRMP (2014)[1.6] in order to provide evidence for establishing a single WRZ (merging from two former WRZs).

Extracts from our WRZ integrity reports can be found in Section A.1.1.

Our WRZ assessment confirmed that there are no changes to our WRZs from those used in our previous WRMP (2014)[1.7].

[1.5] *Ibid. 1*
[1.6] Sembcorp Bournemouth Water (2014), *Water Resources Management Plan* http://www.bournemouthwater.co.uk/company-information/economic-regulation/water-resources-plan.aspx
[1.7] *Ibid. 3*

1.3 Overall approach to water resource planning and problem characterisation

Our overall approach to developing our WRMP is set out in Figure 1.12. This follows the overall process in the WaterUK "*Water Resources long term planning framework (2015-2065)".*

Figure 1.12: Overall approach to water resource planning

What does the future look like?	Collate and review planning information and supply demand balances	**Sections 1 to 5**
Understanding the options	Review available options. Develop an unconstrained and a constrained list of options	**Section 6**
Scenario analysis	Stress test our supply demand position against future uncertainties	**Section 7**
Draft water resource strategy	Proposed draft water resource strategy and 5 year plan based on achieving best value overall	**Section 8**

We have used the problem characterisation process described in the UKWIR (2016) report[1.8] to identify the scale and complexity of our planning problem and our vulnerability to various strategic issues, risks and uncertainties. This approach allows us to develop a proportional response for our long-term planning.

We documented the problem characterisation steps we undertook for our WRZs and shared this with the Environment Agency. See Section A.1.2 for more detail.

For all our WRZs, the process concluded that our current decision making approaches were appropriate for WRMP19.

Our methods include the use of our MISER water resources model and the current Economics of Balancing Supply and Demand (EBSD) methods, as referenced in Section 6.3.2 of the UKWIR (2016) report. In addition, however, we have also looked at scenario analysis and used multi-criteria decision making to assess the

[1.8] UKWIR (2016), *WRMP 2019 Methods - Decision Making Process: Guidance.* Report Ref. No. 16/WR/02/10 performance of future choices. This goes beyond our approach at WRMP14 and as shown in Section 8 is a forerunner of further development of our planning tools.

1.4 Drought risk assessment

As specified in the Environment Agency guideline[1.9], we have followed the UKWIR Risk based planning guidance[1.10] to determine the most appropriate method for our water supply forecast.

Following the guidance, we have evaluated our water supply areas as having a low level of vulnerability, as we operate our sources conjunctively and both our water supply areas are in surplus. This means that our system is regarded as falling within the Conventional Plan category (i.e. risk composition 1). We therefore base our supply forecast on the worst drought on record, which is the 1975-1976 drought for all of our WRZs. We have taken into account our planned levels of service and stakeholder engagement (as outlined in Sections 1.8 and 1.10).

Our water resources modelling shows that our WRZs are resilient to our design drought. We have assessed the risks and uncertainty involved with this approach within our assessment of target headroom (detailed in Section 4).

Have used the Conventional Plan approach, we have also tested our system against more challenging, plausible droughts as part of our scenario testing. More detail is presented in Section 7 (Scenario testing).

1.4.1 <u>Drought resilience statement</u>

The Environment Agency guidelines require us to include a drought resilience statement reflecting the hydrological risks that drought may impose on our supply system. Our supply system can withstand the drought patterns and severities that we have seen over the last 60 years. This includes the drought of 1975/76 (see Section A.7.4.1 for return periods for this drought for each of our WRZs). Within this work we included estimated impacts of climate change.

The work has demonstrated that should the area experience a drought of this severity, we may need to impose demand restrictions in line with our levels of service. However, we are unlikely to need to introduce any of our supply options listed in the Drought Plan. Our supply options (e.g. use of licensed emergency sources) are not included in our calculation of WAFU in the WRMP. Within our Drought Plan our options do not include any Drought Permits to increase supply, nor do they include any Drought Orders to increase supply or reduce demand.

Our WRZs are resilient to severe events up to the reference level of service of a 1 in 200 year drought.

[1.9] *Ibid. 1.2*
[1.10] UKWIR (2016), *WRMP 2019 Methods – Risk Based Planning*. Report Ref. No. 16/WR/02/11

1.5 Planning scenario

Based on the design drought of 1975-76 and the drought risk assessment described above, we have produced forecasts for supply and demand as follows:

- South West Water Water Resource Zones (WRZs) – dry year annual average (DYAA)
- Bournemouth Water WRZ – dry year annual average (DYAA) and dry year critical period

In the South West Water area, none of our three WRZs is solely dependent on groundwater, run of river abstractions or limited storage. They are not particularly sensitive to peak demand but we do carry out detailed modelling of the water resource system which implicitly considers these peaks. The dry year annual average (DYAA) is therefore considered the appropriate planning forecast.

In contrast, the Bournemouth WRZ is largely dependent on run of river abstraction and has limited storage. Because there is limited storage, the period when supply and/or demand constraints will be experienced is the peak demand period which coincides with the lowest flow period. Hence it is more appropriate to use the dry year critical period forecast for this WRZ. A dry year annual average forecast has however also been developed.

More detailed information on the demand forecasts is given in Section 3.

1.6 Links to other plans, government policy and aspirations

Our WRMP is not produced in isolation, but takes account of, and is linked to, a number of different plans and policy requirements.

1.6.1 <u>PR19 Business Plan</u>

The forecasts and activities in this Plan are consistent with those that will be submitted in the PR19 Business Plan in September 2019.

Performance commitments in areas such as leakage, per capita consumption and drought resilience in this Plan will feed into the PR19 Business Plan. This Plan has taken into account PR19 draft methodology guidance in these areas in developing the final water resource strategy.

Cross-checks with maintenance plans have also been undertaken to ensure the assumptions in terms of asset performance in this Plan are consistent with those in the overall Business Plan. This was also shared with the Board.

The activities identified in Section 8 (our final water resource strategy) are included in the relevant lines of the PR19 Business Plan tables.

As the WRMP directly feeds into the overall PR19 Business Plan, relevant changes made through the determination process for the PR19 Business Plan would need to be built back into our Plan. For example, if an industry standard level of leakage reduction were applied to all companies, this would have corresponding change on the forecasts in the WRMP.

As the PR19 Final Methodology will be published after the submission of this Plan, we are unable to take such factors into account in this Draft. We will however be able to include any changes in the Final Plan.

1.6.2 Strategic Environmental Assessment and Habitats Regulations

Government expects a water company to produce a WRMP that is informed by a Strategic Environmental Assessment (SEA). It is important that through the SEA process there is a high level of protection of the environment which can contribute to the integration of environmental considerations in the development of plans and programmes.

Our WRMP shows a projected supply demand surplus in all WRZs over the planning period and does not propose any options for future water resource development or transfers. This is consistent with previous plans and is aligned to previous SEA assessments, which were produced separately for the SWW and Bournemouth Water supply areas (see Section A.1.3). On this basis, there are no further requirements for specific work as part of this Plan in connection with an SEA.

However, as set out in the proposed water resource strategy and Plan (Section 8) we consider a full review of options is needed before the next WRMP (2024) to inform future decisions should options be needed. In preparation for this, we have commissioned a scoping SEA for both the South West Water and Bournemouth Water supply areas, which will inform the full review. A summary of the scoping report is included in Section A.1.3. The full review is included as part of our proposed Plan.

Regarding the Habitats Directive, our current abstraction licences have been reviewed as part of the current Water Industry National Environment Programme (WINEP). There are no proposed changes to any of our licences and therefore there is no requirement for further work in connection with the Habitats Directive.

1.6.3 Government policy and aspirations

Our Plan has taken into account government policy as set out in the guiding principles for developing a Water Resource Management Plan (WRMP)[1.11]. In summary these principles are:

- Take a long-term, strategic approach to protecting and enhancing resilient supplies

[1.11] Defra (2016), *Guiding Principles for developing a water resources management plan*

- Consider every option to meet public water supply needs
- Protect and enhance our environment, acting collaboratively
- Promote efficient water use and reduce leakage

We have assessed the different choices in our Plan against these principles to see how well they perform[1.12]. Full details are given in Section 7.

1.6.4 Drought Plan

Our Drought Plan sets out the operational process and activities we would undertake during a drought. It complements the WRMP which is the strategic planning document for maintaining the balance between supply and demand.

In developing the WRMP we have linked it directly to the Drought Plan – for example, the tools used for assessing the impact of future more extreme droughts in the Drought Plan are the same tools used in the WRMP.

As shown in Section 7, our WRZs have some, albeit small, sensitivity to future uncertainties. Some of these, such as more extreme droughts, would have a bearing on future Drought Plan responses and content.

As set out in Section 8, this Plan includes a number of actions over the 2020-2025 period to develop tools that will support future WRMPs and future Drought Plan analyses, and mitigate the long-term risks faced.

1.6.5 WRMP Annual Review 2016/17

We have considered the findings from the WRMP 2016/17 review and embedded these into our WRMP. Further details are given in Section A.1.4.

We will continue to review our WRMP annually in accordance with Environment Agency Guidelines.

The work in this report also highlights a number of tools we will develop over the 2020 – 2025 period to help decision making at future plans.

1.6.6 Drinking Water Inspectorate (DWI) statement

Our Plan has considered the guidance from the DWI Information Letter 03/2017, dated 12th September 2017. This requires a statement from a Board Level Contact that the Company's draft WRMP takes into account all statutory drinking water obligations and plans to meet all drinking water legislation. This statement is included in Section A.1.5.

[1.12] A detailed feasibility study on a BW to Southern Water transfer is planned but we have not included this as a specific scheme.

1.6.7 Upstream competition

We reviewed our Plan and there are no known requirements with regards to reforms relating to competitive services for supply to/removal from your network following the Water Act 2014.

1.7 National security and commercial confidentiality

The published version of this Plan is required to exclude matters of commercial confidentiality and any material contrary to the interests of national security.

There are no matters of commercial confidentiality. In the Plan we have excluded information relating to the location of key assets on the advice of our certifier for emergency planning and in the interests of national security.

1.8 Levels of Service

Our policy is always to avoid imposing demand restrictions or seeking increased abstraction from the environment and this is reflected in our Plan.

Consultations with both household and non-household customers on our service levels prior to the production of this Plan show:

- Households and non-households are strongly averse to levels of service lower than current levels
- Households and non-households had a slight preference for better service although not statistically significant
- The frequency of Drought Permits is considered an acceptable maximum.

We have had no demand restrictions imposed for over 20 years in our SWW supply area and there have never been any restrictions in the BW supply area. This Plan shows that our supplies are resilient to a repeat of the weather events for our design drought (1975/76). Whilst the most severe drought of 1975/76 would cause a need for temporary-use demand restrictions in some of our WRZs, we would not need to invoke supply-side drought orders or emergency drought orders[1.13] (such as rota cuts). We estimate that, on average, these would not have to be imposed more than once every 100 and 200 years, respectively. Table 1.1 sets out these current levels of service and for comparison the minimum level that we plan for in our strategic planning within our Water Resource Management Plan.

For Temporary Use Bans (TUBs), we assume a 5% demand reduction and a 6 month maximum duration. For demand side Drought Orders we assume a further 5% reduction in demand with a 4 month maximum duration.

[1.13] Under current demand the reservoir drawdown or demand levels, do not enter the appropriate trigger area or below thereby negating the need for Drought Orders or Permits.

Details on customer research on levels of service are given in Section A.1.6.

Table 1.1: Company levels of service

Drought action	Company minimum service level for long-term planning	Company current service levels SWW supply area	Company current service levels BW supply area
Publicity, appeals for restraint and water conservation measures	1 in 10 years (10%)*	> 1 in 10 years (< 10%)*	> 1 in 10 years (< 10%)*
Temporary Use Bans (TUBs)[1.14]	1 in 20 years (5%)*	> 1 in 40 years (< 2.5%)*	> 1 in 100 years (< 1%)*
Supply-side Drought Orders or Drought Permits[1.15]	1 in 20 years (5%)*	> 1 in 100 years (< 1%)*	> 1 in 100 years (< 1%)*
Demand-side Drought Orders[1.16]	1 in 40 years (2.5%)*	> 1 in 100 years (< 1%)*	> 1 in 100 years (< 1%)*
Emergency Drought Orders – partial supply, rota cuts or standpipes[1.17]	> 1 in 200 years (< 0.5%)*	> 1 in 200 years (< 0.5%)*	> 1 in 200 years (< 0.5%)*

**Annual percentage risk of occurrence*

1.9 Climate change

The impacts of climate change have been included in both the supply and demand forecasts that have been used in this Plan. Full details are given in Sections 2 and 3, respectively.

1.10 Customer research

Before developing this Plan we undertook a broad range of customer research to understand customer preferences and attitudes to water resource planning. Qualitative and quantitative research was undertaken. For brevity, the findings from the research are summarised below but are given in detail in Section A.1.6. The customer engagement spanned both the SWW and BW supply areas.

[1.14] Formerly termed hosepipe bans. Return period calculated based on historic droughts.
[1.15] The use of drought orders or permits of this nature are not envisaged in the lifetime of this plan as can be seen in our analysis of historic droughts.
[1.16] Formerly termed bans on non-essential use. All resource zones do not currently enter the Zone C of our drought triggers based on our worst historical drought of 1975/76. This has a return period of at least 1 in 100 years across all zones.
[1.17] Previously service level listed as unacceptable. Following further guidelines from the Environment Agency we have included an estimated return period for this service level based on our drought analysis. Drought return periods of this magnitude are inherently uncertain, but the events that would cause these interventions are rare.

1.10.1 Outcomes

- A safe and reliable supply of drinking water was the number 1 priority of customers
- Water resource resilience in extreme conditions was ranked 6th out of 18 companywide priorities
- Reducing leakage was ranked 7th out of 18
- Avoiding water restrictions was ranked 10th out of 18
- Smart metering was ranked 16th out of 18
- Education on water saving was ranked 17th out of 18

1.10.2 Interventions

- Household and non-household preferences in water resource planning were leakage reduction, metering and water efficiency before transfers and land management. New water resources were the lowest preference
- Household customers recognised that metering is fair but less than half thought it should be compulsory
- Moving from dumb to smart meters was supported by ¾ of household and non-household customers (but has low priority amongst all customer priorities)
- Over 80% of customers supported more water efficiency
- Over 70% of customers supported re-use schemes, provided they were safe
- Approximately 50% of customers supported land management interventions
- Only 15% of customers supported new ground or surface water sources

1.10.3 Willingness to pay

- Customer willingness to pay for leakage reduction was nearly twice that of the next best option and over four times that of new sources
- Customers valued a 1% change in non-essential use bans and Drought Permits at £88/property[1.18]

We have used these data to develop a plan based on customer willingness to pay and also to assess the value customers place on service charges compared to the cost of delivery. Customer willingness to pay is presented in Table 1.2.

[1.18] i.e. a move from 1 in 20 (5%) to 1 in 25 (4%) was valued at £88/property

Table 1.2: Customer willingness to pay[1.19]

Option	£/Ml/day
Leakage (reduce from 20% to 16%)	540,000
(Dumb) meters	330,000
Smart meters	300,000
Helping customers save water	300,000
Catchment management	180,000
Transfers	180,000
Re-use	160,000
Groundwater schemes	150,000
River schemes	100,000

1.10.4 Engage One Video

In addition to traditional customer research we also developed an interactive personal video that allowed all our customers to set out how they would like us to balance our Plan. This was completed by over 2,500 customers and is the first of its type in the UK water sector.

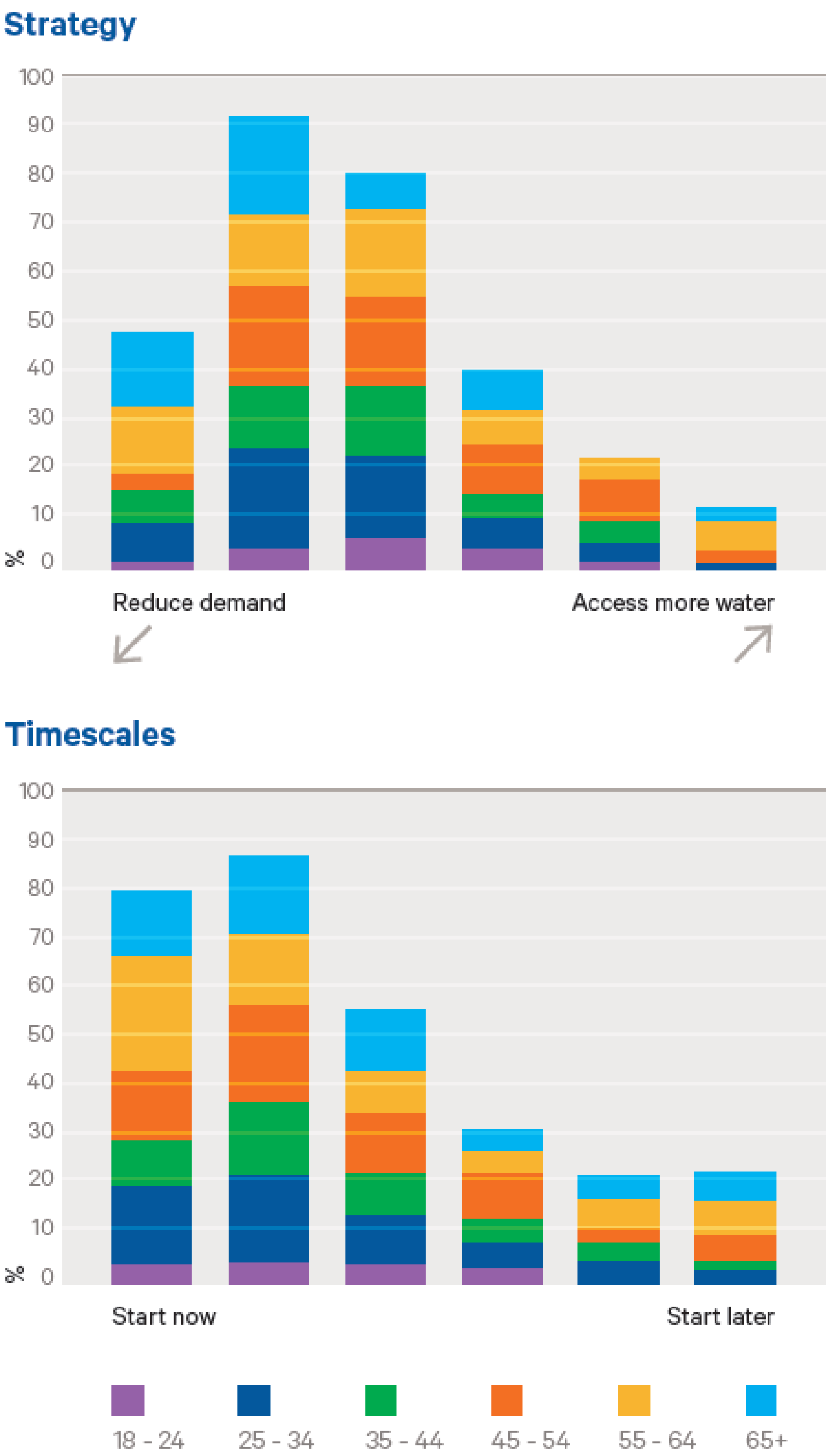
This was well received by customers and the greater reach and data richness of this approach to normal surveys gave further insight into how customers would like us to develop our plans.

Key results are presented in Figure 1.13. The results show:

- Plans that include reducing demand are preferred over accessing more water
- The preference was that plans are started now or within 5 – 10 years over waiting for service deterioration to occur
- There were some intergenerational differences in timing, with few young people/future bill payers seeking to wait to invest

[1.19] ICS (2017), 170914 ICS Eftec Presentation v1 WR Results

Figure 1.13: Engage One Video results



1.11 Stakeholder engagement

All key stakeholders were contacted prior to the development of our Plan for comments on our previous WRMP and for feedback on this future Plan. This included stakeholders across both the South West Water Resource Zones as well as Bournemouth Water. It also set out the timings for the publication of our Plan.

One response was received from Devon County Council and we have built their comments into our Plan. One response was received from the Environment Agency.

Engagement with all new non-household retailers was also undertaken as part of the development of the Plan. This included retailer views on the forecast demand of their customers. This was built into our Plan.

We also helped initiate a new Water Resources in the West Country Water Resources Group. The group has been set up to support a co-ordinated approach to water resources planning in the south west of England and neighbouring water company areas and understand opportunities for water trading. The Terms of Reference are given in Section A.1.7.

With the South West region as a whole in surplus, the formation of this group will help identify opportunities to act as a donor to other regions. Specific details of a possible transfer from Bournemouth Water to Southern Water are given in this Plan.

Continuous and positive dialogue with the Environment Agency local and national teams was undertaken in producing this Plan.

Unlike other regions in the country, the strong supply demand position in the South West means the Plan historically has not had any controversial schemes or any significant supply risk to resolve. However, we used our daily stakeholder contact to understand broader issues in our region outside of water resource planning to determine how the WRMP could help ameliorate those; for example, to improve river habitats for fishing.

1.12 CCG, Board and Executive engagement

Progress on the WRMP and its approach to developing the Plan was regularly presented at the company Customer Challenge Group (CCG) with comments and feedback brought into the process. A challenge log is kept for all comments that were made.

The WRMP itself was led by a senior manager and sponsored by an Executive Management Team Director. Monthly Board updates on progress were given during the development of this Plan and critical components of the Plan were presented and challenged at the Executive Management Team and Board. The Plan reported into the PR19 Steering Group governance.

This Plan was produced within the same overall Directorate as the PR19 Business Plan to ensure alignment in future delivery. The technical team developing the Plan was the same as that which produces the Drought Plan and manages day-to-day resource management.

This integrated approach means the draft WRMP is a central part of our overall plans for service delivery for our water service. It has considered the linkages with drinking water quality as well as areas such as improving affordability or protecting vulnerable customers. In doing so, the final strategy set out in Section 8 supports wider Company outcomes to give better value overall.

1.13 Assurance

Three stages of assurance were undertaken for this Plan:

- Self assurance – against the EA checklist (see Appendix 9)
- Senior Manager review – review of each key element of the Plan, the assumptions and any issues
- Third party assurance – CH2M were commissioned to review the supply and demand forecasts and the decision making process. This used the EA checklist as a basis and gave an independent view of the quality of the Plan.

The findings of the assurance are given in Appendix 9 and were used to help develop the Plan in areas such as future developments in our analysis - see Section 8.

Our Plan is not risk free, but is considered to provide the best balance overall. This balance was discussed and challenged at our PR19 Steering Group, our Executive Management Team and at Board level.

2. Developing our water supply forecast

- Water resources modeling was used to determine resources deployable outputs
- The modeling used is consistent with our Drought Plan and our operational planning
- Our deployable output is based on our planned levels of service
- Our forecasts assessed the impacts of plausible, extended droughts, climate change and potential licence changes linked to environmental sustainability
- SWW outage allowance has been calculated using the 1995 UKWIR methodology[2.1], which is recommended by the Environment Agency in their WRMP19 methods paper[2.2].
- Bournemouth WRZ outage assessment is lower than past estimates due to fewer events occurring in recent years at key WTWs
- We have considered a future possible Abstraction Incentive Mechanism scheme

2.1 General information

In developing our water supply forecast we show our supply of water in the base year (2016/17) and what it is likely to be throughout the planning period (ie 2016/17 to 2044/45).

As prescribed by the Environment Agency guideline[2.3], we developed our supply forecast by taking into account how our water resources systems respond to droughts, the current constraints and any potential future changes including changes to abstraction licences, climate change and infrastructure changes, for example.

There are small potable water transfers both between our WRZs and between us and our neighbouring water companies. However, there are no raw water transfers and therefore there is no impact on any receiving area in terms of water quality.

We have developed our supply forecast for the dry year annual average (DYAA) for the Colliford, Roadford and Wimbleball WRZs (ie the South West Water supply area) and both for DYAA and the dry year critical period (DYCP) in our Bournemouth WRZ (for more details see Section 1.5). We use a water network model (developed in the MISER software) to calculate our Deployable Output (DO) for the SWW supply area and a separate spreadsheet model to calculate our DO for the Bournemouth Water supply area.

[2.1] UKWIR (1995), *Outage allowances for water resource planning: operating methodology*
[2.2] Environment Agency (2016), *WRMP19 methods: outage allowance*
[2.3] Environment Agency and Natural Resources Wales (2017), *Water Resources Planning Guideline: Interim Update. April 2017*

We have not included the contributions from any supply drought measures in the baseline DO of our Plan.

This Plan does not cover our actions during a civil emergency. This is covered separately in our emergency plan.

We have discussed our approach to developing our water supply forecast with the Environment Agency.

2.1.1 Links to our Drought Plan

Our WRMP is not produced in isolation, but is influenced by and linked to other plans and policy requirements. Our WRMP is closely linked with our Drought Plan, which sets out how we will operate our systems during a drought, and we discuss this in Section 1.6.4.

As specified in the Environment Agency guideline[2.4], below we provide details on how our WRMP and Drought Plan have been developed to meet our planned levels of service and the effect they will have on our available supply.

2.1.1.1 Levels of service

We have assessed our Deployable Output (DO) assuming our planned level of service as set out in Section 1.6 of this Plan.

2.1.1.2 Plausible droughts

To better understand the resilience of our water supply system, we have analysed how our water resources might be affected by droughts outside of the historic record; we term these ‘plausible droughts’. The methodology adopted is consistent with that used during the development of our Drought Plan. We derived a series of plausible droughts, which have been incorporated into our MISER modelling to test the flexibility and resilience of our systems. Details of the plausible droughts, why they were chosen and their likelihood of occurrence are discussed in detail as part of our wider scenario testing, the results of which are presented in Section 7 of this WRMP.

We commissioned the Met Office to assign return periods to the plausible droughts for each WRZ. The results indicate a possible range from 350 to over 5,000 years depending on plausible drought and location. A summary of the return periods assigned to each plausible drought is presented in Appendix 7.

We investigated the impact of plausible droughts on water available for use (WAFU)[2.5] as this directly reflects any impacts on DO. The outcomes of the scenario testing are presented and discussed in Section 7.

[2.4] *Ibid. 2.3*
[2.5] See Section 2.7 for definition of WAFU

2.2 Deployable output (DO)

2.2.1 Introduction

As specified in the Environment Agency guideline[2.6], DO is the output of a commissioned source or group of sources for the chosen design drought as constrained by hydrological yield, licensed quantities, key pumping equipment, well/aquifer properties, raw water main capacities, key treatment capacities and constraints and water quality. We included these key constraints in our calculation of DO.

We have determined our DO in line with the UKWIR (2014)[2.7] handbook and the UKWIR (2016) risk based planning guidance[2.8]. More detail is included in Sections 1.2 and 1.3.

2.2.2 Water resources modelling

We have assessed DO using our detailed knowledge of our water resources systems and have a suite of water resources modelling tools, including a modelling software tool called MISER[2.9].

MISER is a water network management advisory tool for operational and strategic resource planning. It is widely used in the water industry to assist with operational and investment planning decisions. Our MISER model is based on a water balance of the whole of our SWW supply area. It is a complex model representing both our raw water systems and our treated water system and distribution network, to demand zone level.

It therefore includes all of our water supply sites (ie includes all of our reservoirs, river abstraction points and groundwater sources), links between these sources, links between sources and WTWs, pumped storage schemes and fisheries enhancement schemes, for example. All of our WTWs are included, as well as the treated water distribution and links between water demand zones. Our MISER model includes over 1200 elements and allows us to represent our conjunctive use system fully.

We use specific demand patterns within the distribution network in our model to ensure that we simulate a representative demand for water in each of our WRZs across the year. These demand patterns account for increased water use due to tourism and warm dry weather during summer months, for example. The model takes into account how demand would change under any restrictions (such as temporary use bans). In doing so it calculates the total volume of water we can supply and meet our standard service levels.

[2.6] *Ibid. 2.3*
[2.7] UKWIR (2014), *Handbook of source yield methodologies.*
[2.8] UKWIR (2015/16), *WRMP 2019 Methods – Risk Based Planning*. Report Ref. No. 16/WR/02/11
[2.9] MISER is a product of Tynemarch, part of the Servelec Technologies Group

In our Bournemouth WRZ, our water supply is predominantly derived from two river systems and there are no impounding reservoirs. We therefore use a less complex modelling approach. We use our spreadsheet model to assess our supply demand balance. This included a full review of any treatment constraints.

These models are key tools in analysing and planning water resources availability and are used for both short-term operational and long-term strategic decision making.

2.2.3 Determining flow series for DO calculation in each WRZ

For our SWW supply area, we have calculated our dry year annual average (DYAA) DOs using historic recorded flow series for the period of 1957 to 2015 for Wimbleball and Roadford WRZs and 1962 to 2015 for the Colliford WRZ. These are the earliest periods when reliable flow records are available. These flow records include a variety of droughts eg 1959, 1975/76, 1978, 1984, 1989 and 1995.

As part of the preparation for our previous WRMP (2014)[2.10], we worked with the Environment Agency on available rainfall records prior to these periods as well as extended flow sequences previously derived by the Agency, to investigate if the dry conditions experienced within the period of the reliable flow record are representative. The work indicated that the South West Water supply area does not seem to have experienced any droughts more significantly severe than those represented in the above flow record periods. The work has also concluded that using the current historic period of flow records is reasonably representative of any longer theoretical flow sequences that are available. We have therefore continued to use the flow sequences for the periods as listed above.

For our Bournemouth WRZ, we have calculated both our DYAA DO and the dry year critical period (DYCP) DO using reliable historic recorded river flows for the period of 1973 to 2015, which includes the historic drought 1975/76.

Within the previous WRMP (2014)[2.11], a river flow analysis using hind cast flow series back to 1883 was undertaken in order to determine the severity of historic droughts, including for example the 1934 drought. This analysis confirmed that the 1975/76 drought was the most severe historic drought experienced in Bournemouth WRZ and justified our use of the flow period as mentioned above.

2.2.4 DO assessment

We have assessed DO for each of our WRZ and presented the results in our WRMP tables. The DOs shown in the WRMP tables do not take account of the various recognised losses within the systems, such as WTW losses. We have

[2.10] South West Water (2014), *Water Resources Management Plan*. https://www.southwestwater.co.uk/environment/a-precious-resource/water-resources-management-plan/
[2.11] Sembcorp Bournemouth Water (2014), *Water Resources Management Plan. Final Water Resources Management Plan-2014. Technical report.(page 36)* http://www.bournemouthwater.co.uk/company-information/economic-regulation/water-resources-plan.aspx

shown these separately in the tables and taken account of them within our calculation of WAFU.

The sections below provide more detail on the key elements of DO calculation for each of our four WRZs.

Section 1 and Appendix 1 provide details of our WRZs, including information about water transfers between them.

2.2.5 DO for Bournemouth WRZ

2.2.5.1 Water transfer

The Bournemouth WRZ has a strategic link with Wessex Water. However, this scheme is used to provide mutual resilience and there is zero Ml/d impact in terms of WAFU for either the Bournemouth WRZ or Wessex Water. This transfer option is therefore not included in our WRMP tables.

. In addition, a direct link exists to export water from the Bournemouth WRZ to Wessex Water, which supplies up to 1.27 Ml/d.

No other major infrastructure exists connecting our Bournemouth WRZ to any of the other water companies to which it borders. Discussions with Southern water on a possible bulk supply exporting water from the Bournemouth WRZ have taken place to establish the potential for any such scheme. This is discussed more fully in Section 6.4.2.

2.2.5.2 Critical year(s)

We used our water resources model to simulate the system through the complete record of flow sequences.

We chose 1975/76 as the design drought because it is the most severe historic drought on record in this WRZ (as described in Section 2.2.3).

2.2.5.3 Constraint on DO

Bournemouth WRZ DO for the dry year critical period is determined by infrastructure constraints (including treatment) (see Section 1.5). The planning scenario is the dry year annual average and dry year critical period.

2.2.6 DO for Colliford WRZ

2.2.6.1 Colliford Reservoir emergency storage

There are no significant changes to the value for the total emergency storage in the Colliford WRZ from our previous WRMP (2014)[2.12]. Our current emergency storage

[2.12] *Ibid. 2.11*

in Colliford Reservoir is 2,854 Ml (calculated in line with the UKWIR (2012) Project WR27[2.13] and the UKWIR (2017) Handbook[2.14]).

2.2.6.2 Water transfer

Our water resources model incorporates the very small export from Colliford WRZ to Roadford WRZ in the Bude area and the import from Roadford WRZ to Colliford WRZ in the Saltash area.

2.2.6.3 Colliford fisheries bank

We have made an allowance in these calculations for releases from the Colliford Fisheries Bank in accordance with the provisions of the Colliford and Siblyback Reservoirs Operating Agreement.

2.2.6.4 Critical year(s)

We used our water resources model to simulate the system through the complete record of flow sequences. We found that similar severe drawdowns occurred in Colliford Reservoir in several years, including 1976 and 1984.

We chose the 1975/76 drought as the design drought event, because Colliford does not refill in 1976 and for a number of years after.

2.2.6.5 Constraint to DO

Colliford WRZ DO is determined by infrastructure (including treatment) and abstraction licence constraints. The planning scenario is the dry year annual average.

2.2.7 DO for Roadford WRZ

2.2.7.1 Roadford Reservoir emergency storage

There are no significant changes to the value for the total emergency storage in the Roadford WRZ from our previous WRMP (2014)[2.15]. Our current emergency storage in Roadford Reservoir is 5,370 Ml (calculated in line with the UKWIR (2012) Project WR27[2.16] and the UKWIR (2017) Handbook[2.17].

2.2.7.2 Water transfer

Our water resources model incorporates the imports and exports for the Roadford WRZ, which include:

[2.13] UKWIR (2012), *Project WR27, Water Resources Planning Tools 2012*
[2.14] UKWIR (2017), *Project WR27a, Handbook of source yield methodologies*
[2.15] *Ibid. 2.11*
[2.16] *Ibid. 2.14*
[2.17] *Ibid. 2.15*

- Saltash transfer from Roadford WRZ to Colliford WRZ
- Imports / exports from Wimbleball WRZ to Roadford WRZ
- Tiverton to North Devon transfer from Wimbleball WRZ to Roadford WRZ

2.2.7.3 Roadford fisheries bank

We have made an allowance in these calculations for releases from the Roadford Fisheries Bank in accordance with the provisions of the Roadford and Burrator Reservoirs Operating Agreement.

2.2.7.4 Critical year(s)

We used our water resources model to simulate the system through the complete record of flow sequences.

We found that the most severe drawdown occurred in Roadford Reservoir during the 1975/76 drought event and chose this as our design drought.

2.2.7.5 Constraint on DO

Roadford WRZ DO is determined by water available and infrastructure constraints (including treatment). The planning scenario used is dry year annual average.

2.2.8 DO for Wimbleball WRZ

2.2.8.1 Wimbleball Reservoir emergency storage

There are no significant changes to the value for the total emergency storage in the Wimbleball WRZ from our previous WRMP (2014)[2.18]. Our current emergency storage in Wimbleball Reservoir is 2,320 Ml (calculated in line with the UKWIR (2012) Project WR27[2.19] and the UKWIR (2017) Handbook[2.20]).

2.2.8.2 Conjunctive use of groundwater sources in the Wimbleball WRZ

Our MISER water resources model uses monthly output profiles derived from DO figures for the groundwater sources which were updated in 2017. This approach has been supported by the Environment Agency for all of our Water Resources Management Plans post 1999.

2.2.8.3 Water transfer

Our water resources model incorporates the imports and exports from the Wimbleball WRZ, which include:

[2.18] *Ibid. 2.11*
[2.19] *Ibid. 2.14*
[2.20] *Ibid. 2.15*

- Wessex Water abstractions from Wimbleball Reservoir for direct piped transfer
- Treated water transfers between the Roadford WRZ and the Wimbleball WRZ
- Treated water transfers into the Roadford WRZ in the Tiverton area
- Small exports of treated water to Wessex Water.

2.2.8.4 Wimbleball fisheries and conservation water bank

We have made an allowance of 900 Ml per annum for the Wimbleball fisheries and conservation water bank (in accordance with Clause 22 on licence number 14/45/02/2388) in all calculations.

2.2.8.5 Critical year(s)

We used our water resources model to simulate the system through the complete record of flow sequences. We found that similar severe drawdowns occurred in Wimbleball Reservoir in the 1975/76 and 1990 droughts.

We have selected the 1975/76 drought event as the design drought, which is the same as the design drought in the Roadford WRZ. This is appropriate because of the linkage between Roadford WRZ and Wimbleball WRZ. Using identical design droughts in both Roadford WRZ and Wimbleball WRZ also simplifies representation of the imports and exports between the WRZs.

2.2.8.6 Constraint on DO

Wimbleball WRZ DO is determined by infrastructure constraints (including treatment). The planning scenario is dry year annual average.

2.2.9 DOs for our WRZs (baseline profile without reductions)

Our baseline DOs for all our WRZs are presented in the WRMP tables (specifically Table 2. BL Supply, row reference 7BL). Table 2.1 below provides a summary of these baseline DOs for 2016/17 per WRZ.

Table 2.1: Baseline DOs (baseline profile without reductions) for the 2016/17 base year in each WRZ

Submission	Baseline DO (2016/17) in each WRZ (Ml/d)				
	Colliford	Roadford	Wimbleball	Bournemouth	
	DYAA	DYAA	DYAA	DYAA	DYCP
WRMP14	158.76	259.19	103.61	230.30	268.43
dWRMP19	163.68	252.54	104.25	226.13	249.32

The changes in baseline DO in the SWW supply area WRZs result mainly from changes in the weekly demand profiles and forecast Water Into Supply (WIS) zone demands relative to each other.

In Colliford WRZ, changes in the weekly demand profiles and forecast WIS zone demand relative to each other have reduced the peak to average demand ratio in south and west Cornwall. As part of the system modeling to determine WAFU/DO, we reviewed all assumptions and constraints (e.g. reservoir control curves) to see if we can better optimize our operations. This showed that we could increase our capacity in this WRZ.

In Roadford WRZ, these demand changes, together with sustainability reductions that came into effect during the previous planning period, have resulted in a reduction in baseline DO.

In Wimbleball WRZ, these demand changes have led to a slight increase in baseline DO.

In the BW supply area both the DYAA and DYCP baseline DOs have decreased between WRMP14 and dWRMP19. For this Plan, we did a full review of WTW capacities and WTW losses and operational use. This showed that during the peak demand period infrastructure constraints limit our DO. As shown in Section 7, DO could be increased if these infrastructure constraints can be removed.

2.3 Future changes to deployable output

2.3.1 Abstraction licence changes and renewals

In the Colliford WRZ, the time-limited abstraction licences for our Park Lake and Stannon Lake sources are due for renewal in 2028. Both sources are subject to a programme of investigation into their environmental impact, which will inform the renewal process. As of 2017 significant environmental monitoring and analysis have already taken place. As required by WRMP planning guidelines, it has been assumed in this Plan that both licences with be renewed.

In the Wimbleball WRZ two key groundwater time-limited licences covering six boreholes in the Otter Valley were renewed in 2017. The licences, along with a third licence in the same area, are due to be renewed again in 2025 following discussions to identify options for minimising their environmental impact. We have assumed the licences will be renewed.

In the Bournemouth WRZ, the abstraction licence at Longham includes a time limited licence condition, which takes effect in 2028 and will reduce the permitted abstraction.   We have accounted for this in our calculation of future WAFU.

2.3.2 Sustainable abstraction

Through the Water Industry National Environment Programme (WINEP), the Environment Agency have provided water companies with information on actions that companies need to complete to contribute towards meeting environmental obligations. The latest release of WINEP (WINEP2) includes information on measures which could impact on deployable output (DO).

WINEP2 has identified a number of studies or improvements at some of our surface water abstraction intakes to assist fish passage and fish screening. We will take account of these in preparing our 2019 Business Plan. For the purposes of our WRMP19, we assume that there are appropriate engineering solutions for these improvements and therefore these schemes are assumed to have no impact on DO.

The Environment Agency have not identified any abstraction sites in WINEP2 with a risk of deterioration, and therefore we have assumed there is no impact of this on our estimates of DO.

For our area, WINEP2 has not identified any required changes to our abstraction licences in the period 2020-2025, and therefore, in line with Environment Agency guidelines[2.21], we have not included any sustainability reductions of this nature in our baseline DO.

However, WINEP2 has identified a number of sites which require further investigation in the period 2020-25 and these could result in potential future impacts on DO. We have explored the potential impacts and described them in more detail in Section 7 and Appendix 7. Although there are uncertainties with regards to sustainability changes, we have not included them in our headroom calculations as advised by Environment Agency guidelines. These schemes are listed in Table 2.2.

Other further actions to address potential Water Framework Directive (WFD) issues (including Heavily Modified Water Bodies (HMWB)), such as habitat restoration, have been identified and we are discussing details with the Environment Agency. Where appropriate, we will take account of these schemes in the preparation of our PR19 Business Plan. These are shown in Table 2.3. Note that these schemes are shown here for completeness and they have no impact on DO.

[2.21] *Ibid. 2.3*

Table 2.2: Water resources schemes identified in WINEP2

WRZ	Scheme Description	Estimated reduction in baseline DO (Ml/d)
Colliford	College and Argal – investigation and option appraisal	0.00
	rCSMG investigation and options appraisal - Camel catchment	0.00
	Stithians – investigation and option appraisal	0.00
Roadford	Burrator – investigation and option appraisal	0.00
	Burrator - adaptive management trials	0.00
	Fernworthy - fishbank proposal and appropriate implementation	0.00
	KTT - adaptive management trials	0.00
	Venford – investigation and option appraisal	0.00
	Wistlandpound – investigation and option appraisal	0.00
	Willsworthy Brook investigation and options appraisal	0.00
Wimbleball	Otter catchment options appraisal	0.00
Bournemouth	None required	-

Table 2.3: Schemes in 2020-25 to address potential WFD issues, which will be taken account of in the preparation of our PR19 Business Plan

WRZ	Scheme Description	Estimated reduction in baseline DO (Ml/d)
Colliford	Habitat restoration works in St Neot	0.00
	Continuation of Colliford Hatchery	0.00
	Engineering studies regarding use of pumps storage pipeline for water supply releases	0.00
Roadford	Habitat improvements Avon	0.00
	Habitat Improvements Fernworthy	0.00
Wimbleball	Habitat Improvements Wimbleball	0.00
Bournemouth	None required	0.00

We believe that the above actions support the WFD and River Basin Management Plans (RBMP) for our supply areas in relation to water resources.

We have not proposed any voluntary reductions in DO for environmental benefit within this plan. We have however recently voluntarily revoked a number of unused licences to the Environment Agency.

All actions identified in PR14 National Environment Programme (NEP) in relation to water resources are on target for completion by the end of the current Business Plan period.

2.3.3 Abstraction reform

In line with WRMP guidelines[2.22], we are not planning for any changes to deployable output as a result of abstraction reform. We await further information on how abstraction reform is to be implemented before we are able to identify if there could be any risk of a reduction to our deployable output.

2.3.4 Abstraction Incentive Mechanism (AIM)

There are currently no AIM schemes within the SWW or Bournemouth Water supply areas.

However, we recognise the national stress on water resources and a desire to see a growth in the number of schemes including in the south west. We are examining all our abstractions to identify if there is potential for AIM schemes to be introduced and we are currently in discussions with the Environment Agency.

Section A.2.5 describes our approach following Ofwat guidelines on the identification, operation and reporting of AIM schemes. This describes, by way of an example, how a scheme could be established in the Otter Valley where we currently abstract groundwater to supply East Devon without having any impact on WAFU within the Wimbleball WRZ.

The Lower River Otter catchment is assessed as having Poor Ecological Status in the EA River Basin Management Plan for the South West covering the Otter catchment (under the Water Framework Directive umbrella), to which the level of abstractions may contribute. We are assessing options for the development of alternative sources, either within the Otter catchment or in other local catchments. These could be used within an AIM scheme to offset possible reductions in those Otter Valley abstractions which have a greater impact on the environment.

Whilst there is no formal requirement for an AIM site in our operational area, we consider that if an appropriate scheme could be found we should trial its operation.

[2.22] *Ibid. 2.3*

2.3.5 Impacts of climate change on water supply

We have considered the impact of climate change on our water supply forecast. This assessment has been undertaken in accordance with the Environment Agency guideline[2.23].

We have assessed the likely implications of climate change on the Deployable Output (DO) of our resources by the 2080s. In doing so, we have followed the Environment Agency[2.24] guideline on estimating impacts of climate change on water supply.

2.3.5.1 Climate change vulnerability

To ensure that the depth of our climate change analysis is proportionate to the risks each of our Water Resource Zones (WRZs) is facing, a climate change vulnerability assessment was first undertaken. As advised in the Environment Agency (2017)[2.25] briefing, this assessment has been based on the most up-to-date information available from our previous WRMPs and Drought Plans. It has involved the creation of two decision-making tools:

- A magnitude versus sensitivity plot of future change in supply; and,
- A tabular summary of the information used to determine the final climate change vulnerability of each WRZ.

Using these decision-making tools, all four of our WRZs were assessed as LOW vulnerability to the impacts of climate change.

Further details on the vulnerability assessment are provided in Section A.2.1. This information was shared with the Environment Agency during the pre consultation phase of this Plan.

2.3.5.2 Assessment of the impacts of climate change on river flows

Since all four of our WRZs are assessed as having low vulnerability to climate change, we have chosen the Tier 1 approach to calculating river flows in the 2080s, as recommended in the Environment Agency[2.26] guideline. This approach involves the use of monthly change factors from the Future Flows and Groundwater Levels (FFGWL) project to perturb historical flow sequences.

The FFGWL project[2.27] provides a consistent assessment of the impact of climate change on river flows and groundwater levels across England, Wales and Scotland. The assessment is based on the latest projections from the UK Climate Impact Programme (UKCIP), including the UKCP09 probabilistic climate projections. Using

[2.23] *Ibid. 2.3*
[2.24] Environment Agency (2017), *Estimating the impacts of climate change on water supply*
[2.25] *Ibid. 2.24*
[2.26] *Ibid. 2.24*
[2.27] The FFGWL project was co-funded by the Environment Agency, Defra, UK Water Industry Research, the Centre for Ecology & Hydrology, the British Geological Survey and Wallingford HydroSolutions; it ran from March 2010 to Spring 2012

output from the Met Office Regional Climate Model (HadRM3-PPE), the FFGWL project has developed an 11-member ensemble projection of daily river flow time series (1951-2098) for 282 river flow gauging stations. The 11 plausible realisations (all equally likely) of nearly 150 years of river flow regime provide a means for water companies to evaluate the impact of climate change on water availability.

The Environment Agency has processed the daily river flow time series to provide station-specific monthly flow factors for the 2080s. As recommended in the Environment Agency guideline[2.28], we have used these monthly change factors to perturb our baseline flow records and create flow sequences characteristic of possible conditions in the 2080s. As specified in the guideline[2.29], we have selected the change factors for the river flow gauging stations nearest our target sites but still within the same catchment and with similar baseflow index (BFI) where possible.

Examples of the monthly change factors we have used are presented in Section A.2.1.

2.3.5.3 Assessment of the impacts of climate change on groundwater resources

The majority of our groundwater abstraction occurs from the Otter Sandstone aquifer in East Devon (Wimbleball WRZ) and the Chalk aquifer of Hampshire and Dorset (Bournemouth WRZ). The majority of our sources are constrained by abstraction licence due to the high storage capacity of the Otter Sandstone and the close proximity of the Chalk sources to the Stour and the Avon. The impact of climate change on Deployable Output from these sources is considered insignificant. This was confirmed in their latest modelling which is described in Section A.2.1.

Amec Foster Wheeler (previously ENTEC) assessed the impact of climate change on our groundwater sources in 2014 for our last WRMP using both groundwater modelling and a flow factors approach recommended in the previous WRMP guidelines. For our new plan, we commissioned them to update their estimates taking into account hydrological data from the last five years and in the light of the current Environment Agency's (2017) Water Resources Planning Guideline[2.30].

Otter sandstone

Using groundwater modelling and recent groundwater level data from EA monitoring boreholes in the Otter Valley, these results have shown that the majority of our Otter Sandstone sources are not significantly impacted by climate change.

2.28 *Ibid. 2.3*
2.29 *Ibid. 2.24*
2.30 *Ibid. 2.3*

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Dorset/Hampshire Chalk

In our Bournemouth WRZ groundwater abstractions, groundwater level change factors for the West Woodyates Manor observation borehole have shown they remain licence constrained.

Upper Greensand springs

We tasked AMEC Foster Wheeler Ltd with assessing climate change upon our Upper Greensand springs in the east of our Wimbleball WRZ.

Recharge estimates used in The Otter Valley Groundwater modelling, which includes the response of Upper Greensand strata in the Blackdown Hills, were also used to inform the analysis of our Upper Greensand groundwater sources, which include the East Devon Springs. Spring flows are estimated to impact on Deployable Output between 0.8 and 1.6 Ml/d.

Saline intrusion risk

We specifically tasked AMEC with assessing climate change impacts upon a key abstraction site close to the East Devon coast which is at risk of saline intrusion through potential sea level rise and reduced recharge to the aquifer.

A key source on the Otterton peninsula vulnerable to climate change impacts was assessed from groundwater modelling data reported by the EA in 2014 specifically as part of a detailed examination of the implications of climate change in the Otter Valley[2.31]. The model used the 11 UKCP09-based Future Flow climate sequences 1950 to 2098 and the associated median estimate of rising sea level in line with the current WRMP guidelines. The potential impact of sea level rise and lower groundwater levels indicates a reduction in Deployable Output ranging from 2.5 to 3.1 Ml/d. Whilst the predictions of recharge show high variability from scenario to scenario, the underlying impact of rising sea levels results in only reductions in Deployable Output.

A detailed description of the assessment of climate change impacts on our groundwater sources can be found in Section A.2.1.

2.3.5.4 Assessment of the impacts of climate change on WRZ DO

Following the Environment Agency guideline[2.32], we used the perturbed historical time series and the groundwater resources assessment to assess the impact of climate change on our water supply forecast for the 2080s. In particular, we have routed the flow sequences through our water resource simulation model to calculate the Water Available for Use (WAFU) in each of our WRZs for each of the 11 plausible climate change realisations. We used the same period of record for this assessment as we used to determine the baseline WAFU for each WRZ.

[2.31] Environment Agency (2014), *Combined report – Groundwater abs reform-FINAL*
[2.32] *Ibid. 2.24*

Although the Environment Agency briefing[2.33] suggests calculating deployable output, as in our previous Plan[2.34], we have used WAFU since it allows us to take account of climate change impacts on the imports and exports between our WRZs.

Using the model results we assessed the risk and vulnerability of our sources to climate change. The results showed us that all our WRZs remain in the LOW vulnerability to climate change category.

As identified in the guideline[2.35], we need to choose the preferred modelled climate change projection in each WRZ to represent the best estimate of the impacts of climate change on our baseline WAFU. However, the climate change guideline[2.36] does not include any recommendations as to how a suitable "central estimate" of DO should be derived.

We believe that the mean of the WAFU estimates resulting from the climate change projections is the most appropriate estimate of the impact of climate change on our sources in 2080s. The results are summarised in Table 2.4.

The range of impacts of climate change on WAFU resulting from the other climate change projections are presented in Section A.2.1.

As specified in the guideline[2.37], we used the other model outputs to develop the climate change uncertainty distribution, which was used in our target headroom uncertainty assessment (Section 4).

Table 2.4: Impact of climate change on DO/WAFU by the 2080s

WRZ	Reduction of WAFU as a result of climate change by the 2080s (%)
Colliford	1.9
Roadford	8.9
Wimbleball	2.4
Bournemouth	0.0

2.3.5.5 Scaling

In order to estimate the impact of climate change for every year in the planning period, we have scaled the WAFU estimates for each year by applying the WRMP14 scaling method from the base year until 2029/30 and then applying the 2017 EA method from 2030/31 until the end of the planning period. This is one of the suggested scaling options in the guideline[2.38].

2.33 *Ibid. 2.24*
2.34 *Ibid. 2.10*
2.35 *Ibid. 2.24*
2.36 *Ibid. 2.24*
2.37 *Ibid. 2.24*
2.38 *Ibid. 2.24*

There is no climate change impact for Bournemouth WRZ. The climate change impact for Colliford and Wimbleball WRZ is very small. For Roadford WRZ, using the 2017 EA method from the start of the planning period gives a WAFU estimate for 2016/17 of 243.1 Ml/d. Using the WRMP19 scaling method gives a WAFU estimate for 2016/17 of 248.5 Ml/d. Roadford WRZ is in surplus over the whole planning period regardless of scaling method used, however we feel that it is more appropriate to use the WRMP19 method, because it provides a more gradual move to the climate change projection than using the EA 2017 method from the start of the WRMP19.

2.3.5.6 Uncertainty in climate change

In the consideration of climate change, there is inevitably a degree of uncertainty. This is accounted for within the target headroom calculations.

Details on how climate change uncertainty has been included in the headroom are given in Section 4.

2.3.5.7 Impact on supply demand balance

We have calculated the impact of climate change on demand and this is presented in Sections 3.3.5 and 3.4.5.

Using the estimates of the impact of climate change on our water supply and demand, we have calculated the impacts of climate change on our DO / WAFU and included these in the relevant WRMP tables.

2.3.6 Risk of pollution or contamination

Within our modeling of water supply forecast, we take account of the risk of pollution and contamination. The flexibility of our conjunctive use systems allows us to switch sources depending on water quality issues.

We use our detailed understanding of risks at specific sites to inform our modelling of our water resources systems.

For example, when the River Exe is in spate after heavy rainfall we need to stop abstracting for the Wimbleball pumped storage due to quality concerns, until the spate has passed. We model this by setting up the model to cease abstraction at flows above a specified rate. This rate has been determined through experience of operating this intake and the relationship between river flow and water quality.

At other river abstraction sites where past experience has shown that quality concerns prevent us from abstracting the daily licensed quantity throughout the year, we can set the model up so that it cannot abstract the full daily licensed volume.

Setting up the water resources model in this way to make allowance for abstraction constraints due to water quality concerns ensures that the model does not over-optimise.

Short-term pollution or contamination incidents would come under emergency / contingency planning and are unlikely to impact on our WAFU although they will have short-term (hours or days) impacts operationally.

2.3.7 Development and infrastructure changes

We have accounted for significant development and infrastructure changes in our water supply forecast modeling, for example our new water treatment works (WTW) for Plymouth (Mayflower WTW). The new treatment works is being supplied from the same sources as the current works (Crownhill WTW) and therefore there is no impact on WAFU from including the new WTW.

In Section 7 we test a possible Bournemouth WRZ to Southern Water transfer. We show that whilst the water is available hydrologically we have current infrastructure limitations that would restrict such a transfer in a drought. We have not included this infrastructure change in our Plan as it requires more detailed review of a possible transfer.

2.3.8 Abstraction – treatment process losses and operational use

We have calculated our treatment works losses within each WRZ for a dry year and show these values in our WRMP tables. It should be noted that in wetter years these values can be higher for operational and water quality reasons.

Losses are identified by both comparison of abstraction and WTW output data to identify which sites may have losses and then by consultation with operational site staff to identify losses in specific processes.

Table 2.5 provides a summary of abstraction-treatment process losses (including operational use) per WRZ.

Table 2.5: Losses and operational use in base year - by WRZ

WRZ	Losses and operational use (Ml/d)			
	WRMP14		dWRMP19	
	Raw water	WTWs	Raw water	WTWs
Colliford	0.00	1.23	0.00	1.23
Roadford	1.80	2.40	1.80	2.40
Wimbleball	0.00	1.00	0.00	1.00
Bournemouth DYAA	0.00	13.40	0.00	18.09
Bournemouth DYCP	0.00	13.40	0.00	20.35

2.4 Invasive non-native species (INNS)

There is growing awareness that the arrival of aquatic and riparian invasive non-native species (INNS) between catchments poses risk of deterioration of the environment. The use of raw water transfers by water companies has been highlighted as a potential pathway for movement of such species.

In light of this, we have carried out a detailed investigation of our existing assets and identified 58 sites in our SWW supply area (Figure 2.1) and 17 sites in the Bournemouth Water supply area where an INNS risk may be significant. Detailed risk assessments have therefore been carried out for these sites.

A summary of this investigation is provided in Section A.2.4. It is important to highlight that there are no new raw water transfers being proposed in our Plan.

Our Plan is also aligned to our broader INNS work within the Water Industry National Environment Programme (WINEP). This work area examines our companywide approach of which our WRMP is an integral component.

Figure 2.1: SWW supply area with sites identified as having significant INNS risk

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2.5 Drinking water quality

Our drinking water is of a high quality and meets the standards of the Drinking Water Directive. We comply with all principal legislation concerning the water quality of publicly supplied water including Section 68(i) of the Water Industry Act 1991 and Water Supply (Water Quality) Regulations 2000.

To safeguard our resources our Plan supports the objectives for drinking water protected areas. We have developed our Plan in accordance with our overall Business Plan to meet our statutory drinking water obligations in full and ensure alignment across our work areas.

As part of ensuring long-term protection and sustainability of our drinking water quality, we have identified all our sources and applied a consistent approach[39] across all WRZs to protect and improve the quality of our drinking water supplies. This includes how we intend to prevent any potential deterioration of water quality and reduce losses where possible.

For example, in our South West Water supply area, our Upstream Thinking initiative encourages and supports tackling water pollution at the source by working with farmers and land owners in upstream areas of our water sources. This initiative also helps deliver the WFD objectives for our watercourses and groundwater bodies.

In our Bournemouth Water supply area, we have carried out detailed investigations as part of the National Environmental Programme to identify the factors contributing to the risk of *Cryptospiridium* at a groundwater source. This has highlighted land use activities within Groundwater Protection Zones as the most likely contributors and we are developing a strategy to mitigate the risk from farming activities and domestic wastewater systems

More information on our drinking water quality strategy and long-term plan can be found in Section A.2.3.

2.6 Outage

It is necessary to make allowance for the non-availability of deployable output, which can occur at any time due to planned or unplanned events at water sources or water treatment works. Such events are termed outage and are defined as 'short-term losses of supply and source vulnerability'.[2.40]

We contracted consultants AECOM Ltd to carry out an outage assessment on our behalf using current best practice methodologies[2.41] recommended by the Water

[2.39] South West Water (2015), *Drinking Water Safety Planning (DWSP) Methodology Update 2015*
[2.40] *Ibid. 2.3*
[2.41] *Ibid. 2.1*

Resources Planning guidelines[2.42,2.43], the Environment Agency WRMP19 methods paper[2.44] and supporting guidance in the UKWIR WR27 deployable output report (2012)[2.45]. The final outage report is provided in Section A.2.2 which includes a detailed description of the approach used.

Outage values have been calculated for each individual WRZ based on the effect of outages events experienced at individual sources/WTW in recent years. Outages have been classified as one of two principal types:

- Planned outages
- Unplanned outages

Planned outages, along with their impact on water availability, were taken from records of scheduled activities at sources or water treatment works. These include short term routine maintenance as well as larger scale, usually longer-term asset improvement projects. Any other events affecting water resource availability were considered unplanned.

2.6.1 Outage Categories

The outage categories adopted for the analysis covering all four WRZ are listed in Table 2.6 below.

Table 2.6: Outage categories

Category	Description
Power failure	Temporary loss in power resulting in reduced output or complete works shutdown
Plant failure	Failure in the treatment process resulting in reduced output or complete works shutdown
Turbidity	Source water turbidity resulting in reduced output or complete works shutdown
Maintenance	Planned maintenance of assets resulting in reduced output or complete works shutdown
Low flows	Low flows in surface water sources resulting in lower abstraction rates hence reduced outputs

In addition, a specific category was included for the Wimbleball WRZ reflecting a significant, temporary loss of groundwater resource availability which occurs when the River Otter is in a spate.

2.42 *Ibid. 2.3*
2.43 Environment Agency (2012), *Water Resources Planning Guideline*.
2.44 *Ibid. 2.2*
2.45 *Ibid. 2.14*

2.6.2 Total outage allowance for each WRZ

Outage values are generated by Monte Carlo analysis which calculates values for differing levels of confidence as shown in Table 2.7.

Table 2.7: SWW outage allowance

WRZ	Probability									
	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Colliford (Ml/d)	0.30	0.32	0.34	0.35	0.37	0.39	0.41	0.44	0.47	**0.51***
Roadford (Ml/d)	1.94	1.98	2.03	2.09	2.14	2.20	2.27	2.34	2.44	**2.57**
Wimbleball (Ml/d)	2.48	2.61	2.75	2.89	3.05	3.21	3.4	3.62	3.87	**4.19**
Bournemouth (Ml/d)	1.66	1.68	1.70	1.73	1.75	1.78	1.80	1.84	1.88	**1.93**

** As in our calculated outage in the Colliford Zones is very small, as for WRMP14, we have adopted a de minimus value of 1 Ml/d.*

The outage values to be taken forward into South West Water's supply/demand balance analysis for the dWRMP 2019 are based on the 95th percentile, i.e. values with a 5% risk of exceedance.

As in our previous plan, the calculated outage for the Colliford WRZ is less than 1 Ml/d. We have therefore adopted the same approach of using a *de minimus* value of 1 Ml/d.

2.6.3 Comparison with previous water resources plans

Table 2.8 below compared the current level of outage assessed with from the previous WRMP for both SWW and Bournemouth Water.

Table 2.8: South West Water outage allowance at the 95th percentile - comparison with previous results

Submission	Outage allowance at the 95th percentile, DYAA (Ml/d)	
	South West Water supply area	Bournemouth Water supply area
WRMP14	7.00	5.58
dWRMP19	6.84*	1.93

**For dWRMP19, for the SWW supply area, outage was calculated for the individual WRZs and for the SWW supply area as a whole. Because the outage calculation (Monte Carlo analysis) produces a joint probability distribution, the outage calculated for the SWW supply area will not be equal to the sum of the outage values calculated for the individual WRZs.*

Overall, the level of outage calculated for each of the three original SWW WRZs is in line with that identified in our last Plan. However, of three specific types of outage associated with groundwater sources previously taken into account in the Wimbleball WRZ, two are no longer considered relevant due to company initiatives. These are:

- *Turbidity events associated with our Greatwell boreholes 1, 2 and 3*. Major remedial works have been carried out since 2012 with the consequence that the severity of such events has been greatly reduced.
- *An abnormally high borehole pump failure rate experienced between 2007 and 2012*. The close monitoring of pump performance following a change of supplier indicates pump life is now in line with expectations.

The outage rate calculated for Bournemouth WRZ is lower than reported in the previous Plan. This is largely a result of a reduction in significant events experienced at the two principal water treatment works.

2.6.4 Improving our understand of outage events

Given the underlying levels of general unplanned outage and the flexibility of our system, outage is currently not a material water resources planning risk. However, as shown in Section 7 our supply demand balance has some medium to long-term sensitivity to future uncertainties. Outage may become a more material water resources planning risk in the future.

To address this we are continuing to develop a new in-house tool to record all water resource and treatment works outage events. The Site Reliability Tracker (Section A.2.2) which has been under development and partly operational since early 2017, captures daily events by type, duration and impact on water treatment works output capacity. It will be expanded and refined to verify our current outage estimates and inform our water resources planning through to the next planning cycle.

As part of this detailed analysis of outage, we will be generating an annual outage report to describe our current outage level and interpret how asset reliability is influencing water availability.

2.7 Water available for use (WAFU)

We have calculated our total WAFU in each WRZ taking into account changes to DO, transfers, operational use and outage as outlined throughout this section.

We have not included benefits drawn from supply drought measures (e.g. drought permits and orders) in our baseline supply forecast.

We have presented the total WAFU in the relevant tables of this WRMP. Table 2.9 gives an overview of the total WAFU per WRZ for our base year.

Table 2.9: Total baseline WAFU for the 2016/17 base year in each WRZ

WRZ	Baseline WAFU (2016/17) in each WRZ (Ml/d)	
	WRMP14	dWRMP19
Colliford	157.87	163.58
Roadford	248.66	248.48
Wimbleball	89.17	90.52
Bournemouth DYAA	211.08	204.84
Bournemouth DYCP	249.46	225.77

DYAA: Dry Year Annual Average. DYCP: Dry Year Critical Period

In the SWW supply area the changes in WAFU between WRMP14 and dWRMP19 result from the combination of changes to weekly demand profiles, dry year demand forecasts by WIS zone and climate change impacts, all of which have been reviewed and revised for dWRMP19.

In the Roadford and Wimbleball WRZs there has been very little change in WAFU between WRMP14 and dWRMP19. In Colliford WRZ, changes in the weekly demand profiles and forecast WIS zone demand relative to each other have reduced the peak to average demand ratio in south and west Cornwall. As part of the system modeling to determine WAFU, we reviewed all assumptions and constraints (e.g. reservoir control curves) to see if we can better optimize our operations. This showed that we could increase our capacity in this WRZ.

In the BW supply area both the DYAA and DYCP WAFU have decreased between WRMP14 and dWRMP19. For this Plan, we did a full review of WTW capacities and WTW losses and operational use. This showed that during the peak demand period infrastructure constraints limit our WAFU. As shown in Section 7, WAFU could be increased if these infrastructure constraints can be removed. This review has significantly improved our understanding of how our system would perform in a drought. This is important, because this WRZ is constrained by peak demand and has limited storage.

3. Developing our demand forecast

- Property forecasts have been produced to incorporate local development plans
- Population forecasts are based on Office for National Statistics data, with growth focussed on planned housing development locations
- We have used a micro-component model to forecast household consumption
- Non-household consumption forecasts have been produced using econometric modelling approach
- Forecast demand is higher than predicted in our 2014 WRMP

3.1 Introduction

This section sets out our approach to forecasting:

- Housing development, population growth, and average household size
- Household consumption
- Non-household consumption
- Leakage
- Other components of demand

3.2 Background

3.2.1 Planning scenarios modelled

When ensuring that we have the ability to meet the demand for water we consider dry years, as it is during these that the pressure on our resources is at its greatest. Therefore the supply demand analysis on which this Plan is based used forecasts of demand under a dry year scenario. We did not include any restrictions in usage that may be required during a drought, as it is important to understand the unconstrained demand[3.1].

We also produced a peak week (critical period) forecast for the Bournemouth WRZ. As explained in Section 1, our water resources systems in the Colliford, Roadford and Wimbleball WRZs are not constrained by a critical period. However, the reliance upon direct river abstractions in the Bournemouth WRZ and the lack of strategic storage make the peak period an important consideration in this area. Like the dry year annual average forecasts, the peak week forecast considers unconstrained demand.

[3.1] The impact of demand restrictions is accounted for in the Deployable Output calculation

3.2.2 Water balance and demand in the base year

Before producing forecasts of future demand, it is important to have robust estimates of water consumption in the base year of the Plan (2016/17). A water balance is completed each year. This includes an assessment of the amount of water that we output from our treatment works compared with eight different components of demand listed below:

- Measured household consumption
- Unmeasured household consumption
- Measured non-household consumption
- Unmeasured non-household consumption
- Leakage
- Distribution system operational use
- Water taken legally unbilled
- Water taken illegally unbilled

The difference between the sum of the estimated components and the output of our treatment works leaves a residual. This must be accounted for in order to produce robust estimates for future forecasts.

To account for the residual (termed the ‘water balance gap’) and reconcile our estimates of demand with works outputs, we used the Maximum Likelihood Estimation (MLE) methodology. MLE is a statistical technique which redistributes the WBG to the components of demand, with more of the gap being assigned to the large, less certain components. It is these reconciled estimates that were used as the basis of our Plan.

Prior to the merger in 2016, South West Water and Bournemouth Water submitted separate plans, and we will continue to report against these separate plans until 2019/20. The base year reconciliations for the two areas were therefore undertaken individually. South West Water’s water balance gap (WBG) for 2016/17 of 18.90 Ml/d has been redistributed as shown in Table 3.1. Bournemouth Water’s WBG was 5.82 Ml/d, with the reconciliation detailed in Table 3.2.

Table 3.1: Reconciliation of South West Water demand components in the base year

Demand component	Estimate (Ml/d)	WBG adjustment (Ml/d)	Reconciled estimate (Ml/d)
Measured household consumption	144.58	2.30	146.87
Unmeasured household consumption	83.78	1.33	85.11
Measured non-household consumption	75.80	3.61	79.41
Unmeasured non-household consumption	2.82	0.22	3.05
Leakage	81.80	2.60	84.40
Distribution system operational use	2.68	0.21	2.89
Water taken legally unbilled	17.52	1.39	18.92
Water taken illegally unbilled	5.46	1.73	7.20
Sum of components	414.46	13.39	427.85
Distribution input	433.35	-5.50	427.85

Note that values in this table may not sum exactly due to rounding.

Table 3.2: Reconciliation of Bournemouth Water demand components in the base year

Demand component	Estimate (Ml/d)	WBG adjustment (Ml/d)	Reconciled estimate (Ml/d)
Measured household consumption	38.55	0.55	39.10
Unmeasured household consumption	56.10	0.81	56.91
Measured non-household consumption	21.85	1.57	23.42
Unmeasured non-household consumption	1.05	0.14	1.19
Leakage	18.63	0.41	19.04
Distribution system operational use	0.99	0.14	1.14
Water taken legally unbilled	0.88	0.13	1.01
Water taken illegally unbilled	0.02	0.01	0.03
Sum of components	138.08	3.75	141.83
Distribution input	143.90	-2.07	141.83

Note that values in this table may not sum exactly due to rounding.

3.2.3 Metering policy

We currently have high levels of customer metering, with around 81% of South West Water's and 70% of Bournemouth Water's household customers paying by metered billing. 96% of non-household customers are metered. Household customer user is low, Per Capita Consumption is between 136 (SWW) and 140 (BW), compared to an industry average of 144 l/p/d.

3.2.3.1 Current household metering policy

For around 20 years our unmeasured household customers have had the option of switching to pay according to the amount of water that they use, without being charged to make this change. This option remains popular, with 9,000 households switching during 2016/17. In the Bournemouth area we also exercise our right to install a meter on change of occupancy. During 2016/17 850 meters were installed through this programme. These strategies have helped the level of metering to increase rapidly to its current level.

Under regulations published by the Secretary of State for the Environment we have the right to install meters at household properties with high discretionary use. In the South West Water area we have exercised this right since 1990 when we asked sprinkler and swimming pool owners to register with us, resulting in meters being installed at 5,700 properties. We continue to install meters at properties having sprinklers or swimming pools but with the majority of such properties now metered, the number of customers being metered for this reason is now very small.

3.2.3.2 Determining future household metering policy

Our high level of meter penetration and low consumption means the benefits from additional metering are small.

We undertook modelling however to help understand the most appropriate metering policy for the future. This modelling considered a number of factors to inform our decision:

- **Meter type** – We currently install meters that support automated meter reading (AMR). Traditional meters depend on someone reading the consumption from the face of the meter, which involves lifting meter box lids, and entering the reading onto a handheld device. AMR technology allows readings to be taken remotely from a short distance away, for example by a meter reader walking or driving down a street. This makes meter reading much quicker, and also removes the danger of a meter being misread, or the reading being transcribed incorrectly, removing this as a source of billing errors. AMR meters lead to reductions in the cost of reading, but do cost more than traditional meters.
- **Meter replacement schedule** – As meters age, they can get less accurate and reliable, which makes replacement of older meters necessary. Replacing meters more regularly leads to improvements in the average accuracy of meters, but costs are higher.

- **Customer supply pipe leakage** – The AMR meters that we currently deploy have alarms built in, which inform us if there is a continuous flow on the supply. This can help with the early identification of leaks on customers' underground supply pipes.
- **Additional policies** – We currently operate a meter optant policy, which allows household customers to switch to metered billing free of charge. We evaluated additional policies, such as installing a meter whenever a property is sold, and installing meters in all properties within an area, rather than doing so on an ad hoc basis as customers opt.
- **25 year whole life cost** – The overall cost of our policy needs to be considered against the benefits that it provides over the long term.

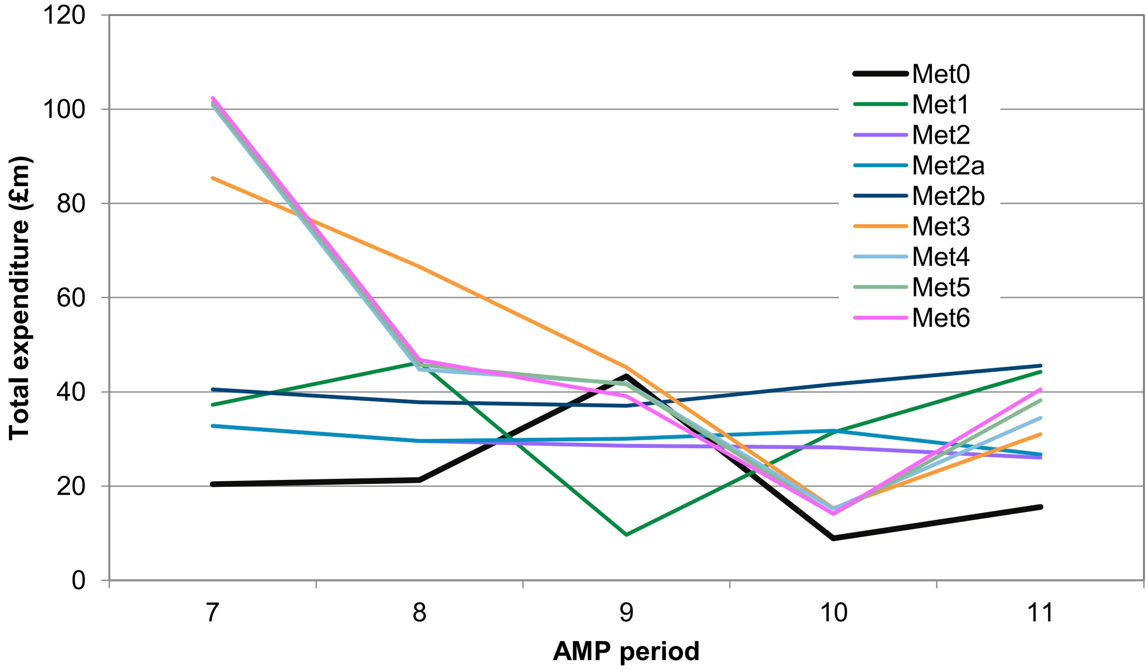
In addition to our modelling, we also consulted with customers to understand their views of metering. We found that customers are supportive of metering, but consider it a lower priority in comparison to other areas such as resilience or leakage reduction. Smart metering was ranked 16th out of 18 company-wide priorities.

From our modelling we determined that the lowest cost programme is to retain the current policy of optant metering, using AMR meters. Figure 3.1 shows some example output from our metering model. The options shown in this chart are described in Section 6.7, but it's possible to see that our current policy (shown as 'Met0' in the chart) has the lowest whole life cost. We forecast that our current metering strategy will require a capital expenditure of £20.4 million over the 2020/21 to 2024/25period, with operating costs of £2.1 million per year.

While we could accelerate metering or accelerate meter replacement, we do not currently think this will give best value overall. It would incur additional cost to customers on a relatively low priority area. In addition, as shown in Section 5 our baseline plans show no supply demand deficit. As such there is no driver for additional metering at the current time. We have therefore built our demand forecasts and plan assuming a continuation of our existing optant and high user metering policy.

The impact of continuing with our existing metering policy for the period to 2044/45 is shown in Figure 3.1.

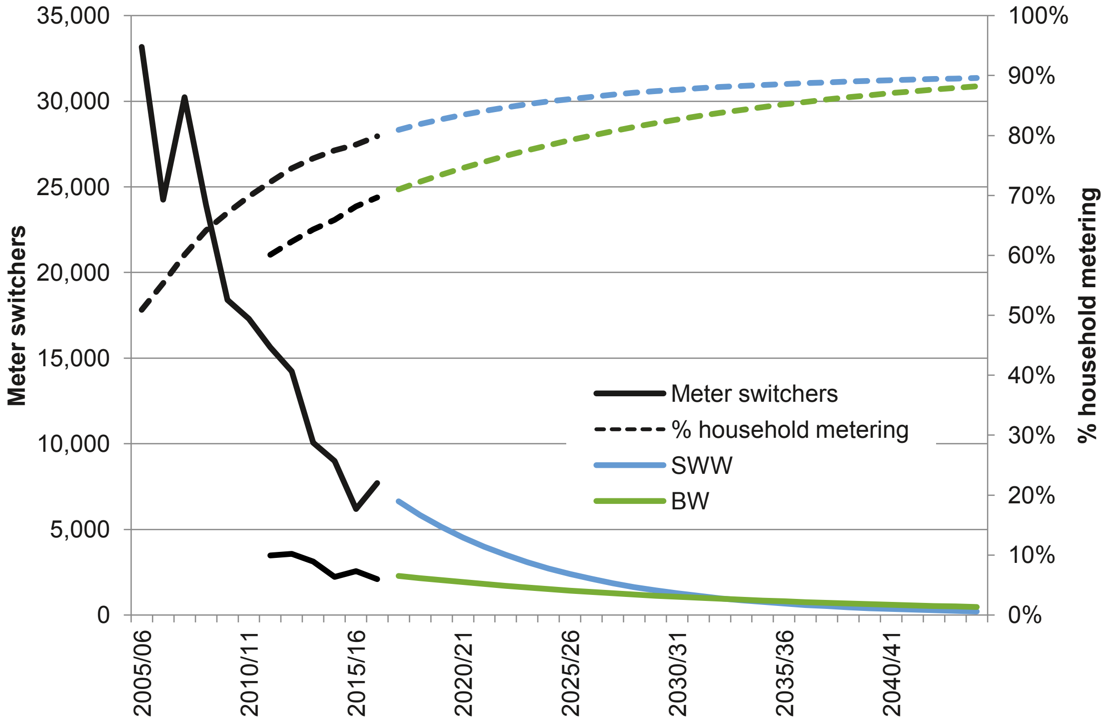
Figure 3.1: Example output from metering strategy model showing forecast total expenditure of different metering options against the current strategy



It is not always possible to install a meter at a property, and where this is the case the customer is put on an assessed charge. Previous studies show it is too difficult or uneconomic to install meters at around 10% of household properties[3.2]. In building our demand forecasts we have assumed that only around 90% metering will be achieved by 2044/45.

[3.2] Ofwat (2011), *Exploring the costs and benefits of faster, more systematic water metering in England and Wales*

Figure 3.2: Rate of switching from unmeasured to measured billing and the impact on percentage metering



3.2.3.3 Non-household metering policy

Non-household customers have to the option to switch to metered billing, although some of the costs of doing so may be passed on to them.

The proportion of non-households at which it is too difficult or uneconomic to install meters is lower than it is for household properties. This is illustrated by our current non-household metering level of around 96%, which we forecast will reach 97% by 2045.

3.2.4 Tariffs

We consider affordability to be an essential consideration in building our plans for the future, and in 2013 we were one of the first companies to introduce a social tariff. The WaterCare tariff provides a discount on metered bills of between 15% and 50% for customers on a very low income.

Tariffs designed to promote water saving can impact affordability for lower income customers, and without a large deficit in our supply demand balance we do not have strong driver to promote such tariffs. While we considered alternative tariffs in our unconstrained options analysis, we have not included them as an option for reducing demand. They will be considered as part of our 2019 Business Plan to address issues such as affordability.

We have however selected a package of water efficiency measures that we think will give better value overall to our Plan and our customers. Details are shown in Section 8.

3.3 Demographic forecasts

3.3.1 Our region

Our South West Water region consists of Cornwall, Devon and small parts of Somerset and Dorset, an area which is largely rural with much of the population living in small communities. In total we supply 1.7 million people, with close to a third of the population living in the three major urban areas; Plymouth, Exeter and Torbay, which are all located in Devon.

The Bournemouth Water area covers parts of Dorset, Hampshire and Wiltshire, and is around a tenth the size of the South West Water area. The population of the Bournemouth Water area is around a quarter of that living in the South West Water area. The town of Bournemouth is home to around 40% of the total population of the WRZ, with much of the rest of the population living in more rural areas.

Properties and population are a key driver of water demand and this section sets out how we expect population to change over the planning period.

3.3.2 Demographic forecasts

Our forecast of population and housing growth up to 2044/45 was developed in-house using a number of different sources:

- **Local authority plans**: We reviewed published plans from all of the 14 local authorities in the South West Water supply area and five in the Bournemouth supply area. Development sites from these plans were used to help populate a development database, which includes GIS data, expected extents and timescales. As local council and neighbourhood plans feed directly into local authority plans, the future demand resulting from these have been incorporated within our forecasts.
- **Local authority contacts:** As part of our water and waste water planning activities, we are in regular contact with local authorities in the South West Water area. This contact provides us with a better understanding of likely development than could be obtained from published plans alone. As with the information contained in published plans, this information has been entered into our development database.
- **Developer contacts**: Details of planning enquiries received from developers are also entered into our development database. These contacts allow us to understand sites which are likely to be developed in the near future, adding further detail to the information available from local authority plans.

- **Department for Communities and Local Government (DCLG) household projections**: These forecasts give less geographical detail than is provided by local plans, but provide a useful check to ensure that the level of development contained within each plan is realistic when considered with the plans of neighbouring authorities.
- **Office for National Statistics (ONS) population data**: We use two types of population data from the ONS: mid-year estimates of current population, and projections of population change in the future.

Our projections of properties and population were produced following the approach in the *Population, household property and occupancy forecasting*[3.3] report.

3.3.3 Housing

To ensure consistency of this Plan with other returns to our regulators, we used the same Ofwat definition of households as we do for annual reporting, which is slightly different to that used by the DCLG in their projections. To overcome this difference, we first took base year property numbers from our billing system using Ofwat definitions. As all new properties are now metered individually, we then applied the year-to-year increases from our forecasts of household numbers and to the base year numbers.

Our development database contains geographical information, which allows us to assign planned development to a ‘water into supply’ (WIS) zone. All properties currently in our billing system are assigned to a WIS zone. These individual areas were then aggregated to give properties and forecast growth for each water resource zone.

We compared the historic rate of housing growth in the South West water region with that predicted by both the local authority plans and DCLG projections, see Figure 3.3. Local authority plans show a much higher pace of development over the next decade than have been achieved historically, while DCLG projections appear low in comparison to the current level. New connections data for 2017/18 to date indicates that outturn figures are likely to be similar to those for the base year.

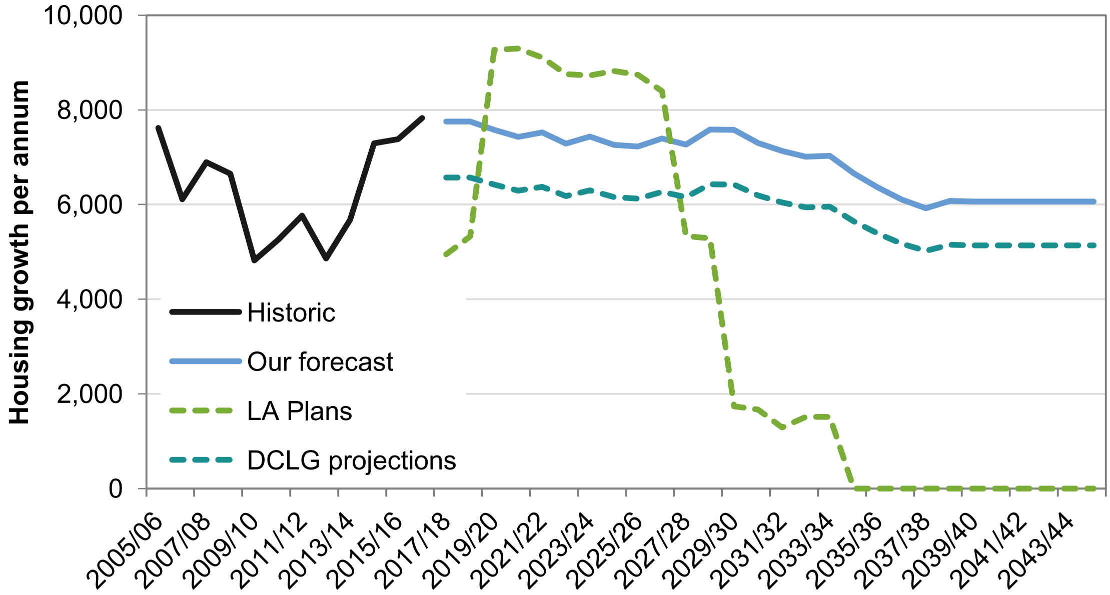
As the rate of development indicated by local authority plans between 2019/20 and 2026/27 is significantly higher than has been achieved historically, we expect the timescale of these plans may not be fully met. The forecast rate of development beyond this is lower than is likely, although this drop is largely related to the timeframe of the local plans, which do not extend to the end of the water resource planning period. Our view of the most likely rate of development is that some of the units planned to be built in the period to 2026/27 will be delayed into the period beyond.

While the profile of the DCLG forecasts seems achievable, the numbers are lower than might be reasonably expected given historic performance.

[3.3] UKWIR (2015), *WRMP19 methods: Population, household property and occupancy forecasting*, Ref 15/WR/02/8

In producing a forecast of the likely development trend in the South West Water region, we assumed that all the properties contained in the local authority plans will be built over the period to 2029/30. However, we have assumed that these will be delivered according to the DCLG projection profile, which we have scaled up by 18% to encompass the required number of units. This forecast is shown in Figure 3.3, while the cumulative forecasts are shown in Figure 3.4.

Figure 3.3: Comparison of housing growth projections for the South West Water area



The resultant forecast is a central estimate with a growth rate similar to the most recent history. As the forecasts of demand are important to our projections we tested the sensitivity of our supply demand balance to higher demands (see Section 7).

Our proposed plane in Section 8 is flexible to deal with the uncertainty of growth forecasts being lower or higher than the current projection.

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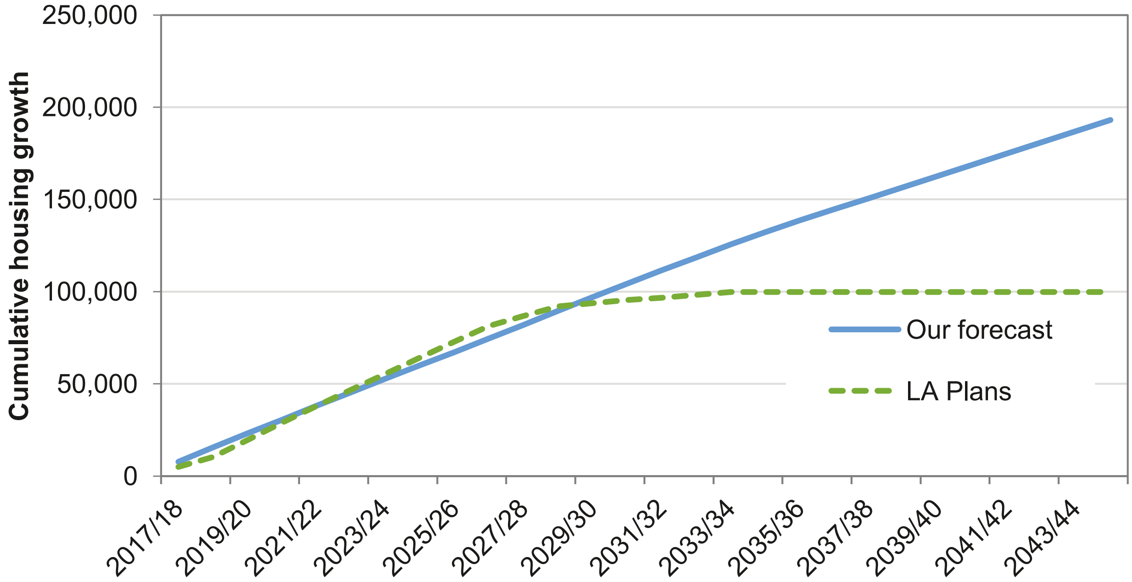
Figure 3.4: Cumulative housing growth projections for the South West Water area



Housing forecasts for the Bournemouth Water area were produced in a similar way. As plans from the five local authorities covering the region are in varying levels of completeness, we consolidated all of the development contained in them into the period to 2026/27. While this overstates the likely development rate, it does enable us to ensure that all sites have been included in our forecasts.

DCLG projections significantly overstate development levels in comparison with historic new connections.

To derive our forecast of new connections we combined information from these sources and assumed that the local plans take until 2036/37 to build out, with the DCLG projection profile applied to these figures. This forecast is shown in Figure 3.5, while the cumulative forecasts are shown in Figure 3.6.

Figure 3.5: Comparison of housing growth projections for the Bournemouth Water area

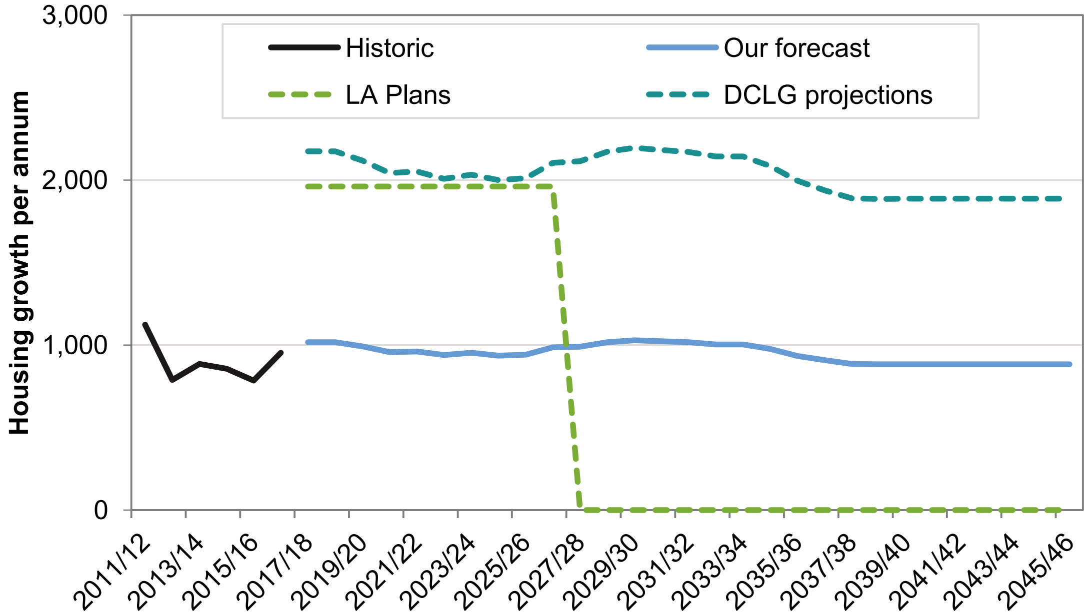
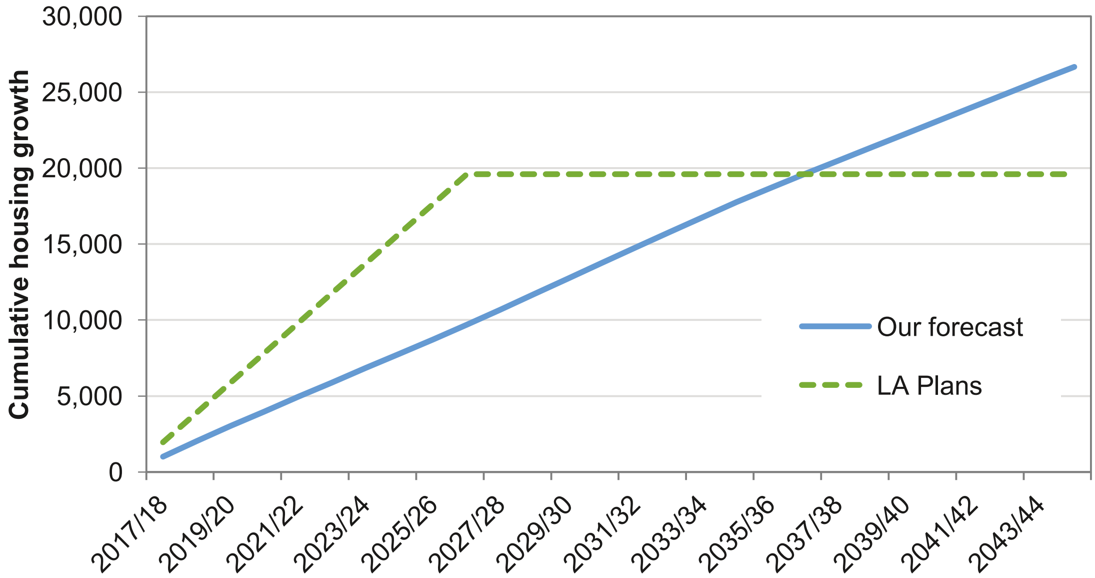


Figure 3.6: Cumulative housing growth projections for the Bournemouth Water area



As shown in Section 7, the Bournemouth water resource zone is not sensitive to higher demands due to its current surplus.

Figure 3.7 and Figure 3.8 show our forecast of the number of household properties connected to the South West and Bournemouth supply systems for the planning period. In 2016/17 there were 749,000 household properties connected to our

South West Water network and 191,000 connected to the Bournemouth network. This is forecast to reach 939,000 and 217,000 respectively in 2044/45.

Figure 3.7: Stacked line chart showing the number of household properties connected to the South West Water supply system

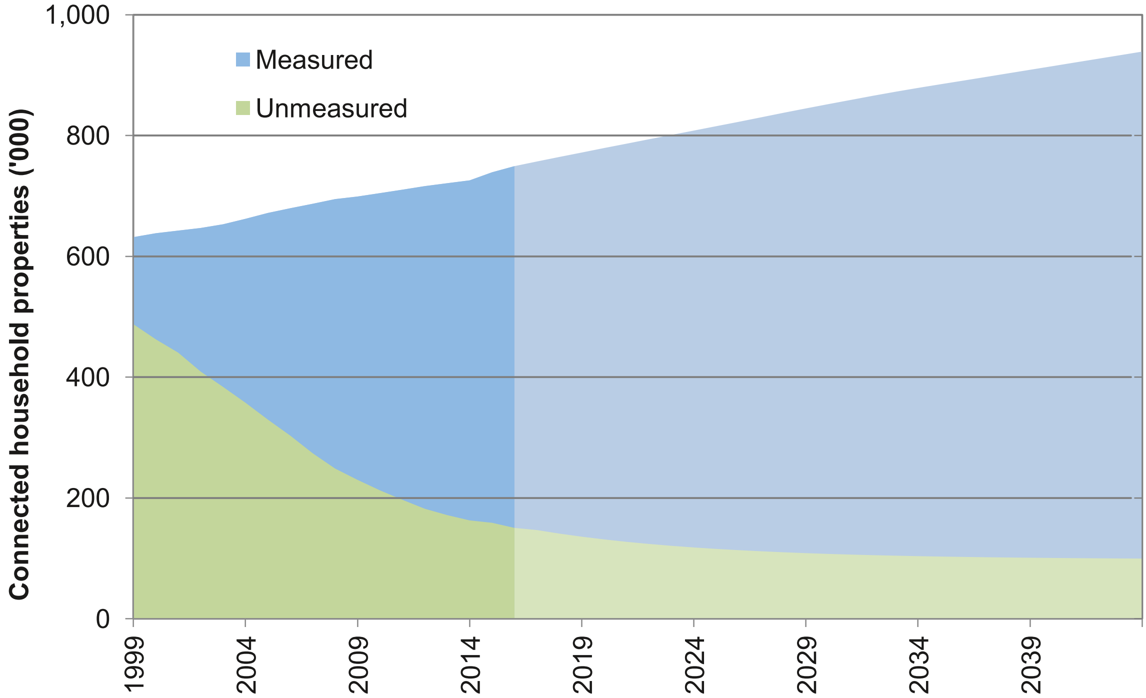
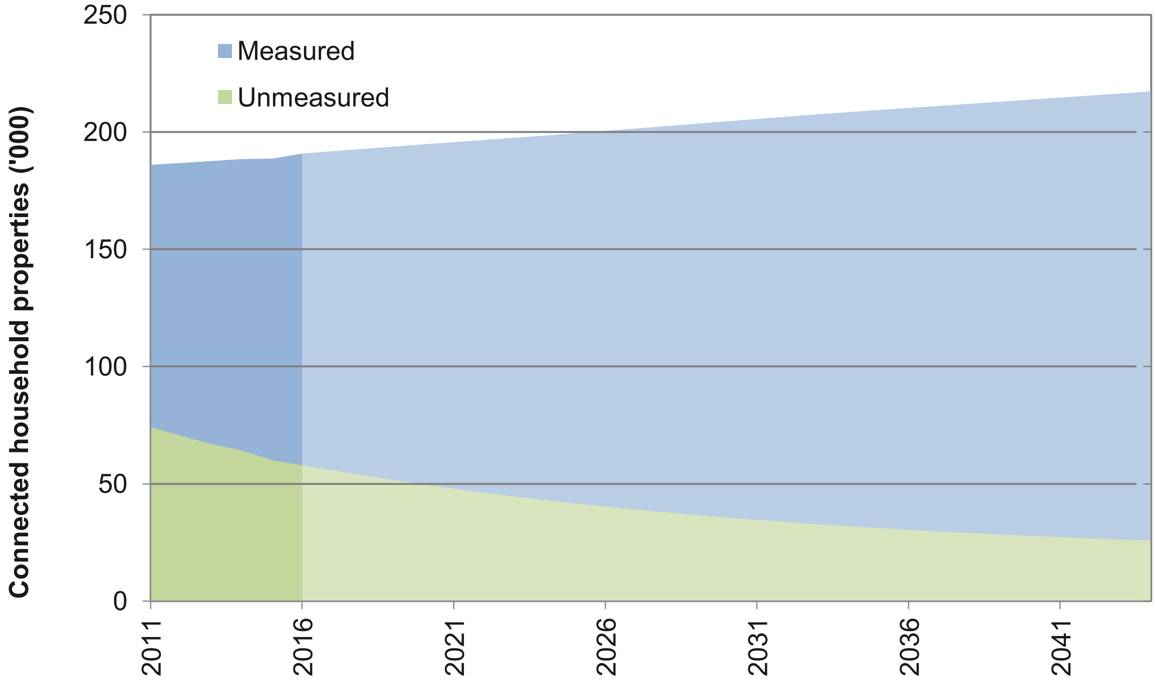


Figure 3.8: Stacked line chart showing the number of household properties connected to the Bournemouth Water supply system



At any one time, a number of the properties connected to our supply system are not billed because they are unoccupied. We obtained the number of these void properties in the base year from our billing system, and in 2016/17 1.0% of metered households were void compared to 2.9% of unmeasured households, an overall household void rate of 1.4%. We assumed a continuation of the measured and unmeasured void rates, but as meter opting and new connections add to the measured customer base, the overall household void rate is projected to fall slightly to 1.2% in 2044/45.

Figure 3.4 and Figure 3.6 show that our property growth forecasts include more properties than are included in the local authority plans, assigned to the appropriate WIS zones. The timescale of development has been changed to produce a build profile that is more realistic based on a range of data. As our resource zones are in surplus, availability of water is not expected to constrain the development contained within local authority plans.

We will continue to monitor published local plans, and update our development database for our final Water Resources Management Plan.

3.3.4 Population

The primary source of data for our population projections was the Office of National Statistics, which we consider to be the most appropriate information available. Projections have been developed from two sets of ONS data:

- **2015 mid-year populations**: We use small-area population estimates for our planning, which are provided at output area (OA) level, which contain on average around 125 properties. We have used the latest data available from the ONS, which are the estimated populations on 30th June 2015
- **2014-based population projections**: The ONS provide population projections at local authority level. The 2014-based projections are the latest available, but we have rebased these forecasts to the 2015 mid-year population estimates to reflect the latest available data.

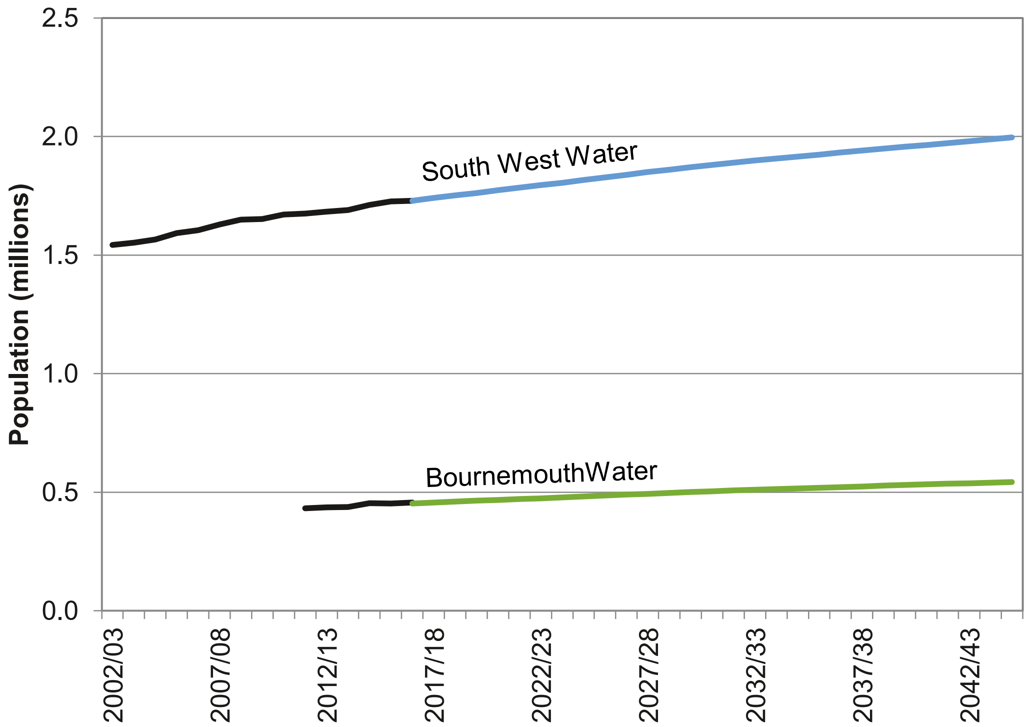
We have mapped the OAs to WIS zones, and hence to WRZs, and our billing system contains location information for the properties we serve. This allows us a detailed understanding of the population distribution now, and in the future. Because the ONS population forecasts do not contain the detailed location of proposed development contained within local authority plans, we use information from our development database to refine them. This is done by focussing the ONS projected population growth into the areas we expect development to occur.

A report produced for us by the School of Geography at the University of Leeds identified some categories of population in the South West Water area that are not covered by ONS population estimates, and which are important for us to consider. These categories are EU accession country migrants, visitors overstaying their permitted time in the Country, those entering the Country clandestinely and victims of human trafficking. The University of Leeds' medium estimate of this additional population in our region was 15,464. We have added this to the estimate of resident population obtained from the ONS data. No analysis of the Bournemouth WRZ has been undertaken, so we have not made any addition for that area.

Some of the resident population will be connected to private water supplies and will not be reliant on our supply. Local Authorities have a responsibility to monitor private water supplies, so have information on the number of properties connected to them. We contacted the authorities in the South West Water area prior to our 2014 plan to obtain summary data on the number of private water supplies. We do not believe that the numbers will have changed significantly since we undertook this research, so have continued to use this data. This allowed us to produce an estimate of the South West Water population that is not served by us of 1.3%. No analysis of private water supplies in the Bournemouth WRZ has been made, so we have assumed that all population in that area is connected to our network.

The population we serve for water supply in the South West Water area was estimated to be 1.73 million in 2016/17, and 0.45 million in the Bournemouth area. Using the data described above, these populations are forecast to grow to 2.00 million and 0.54 million respectively in 2044/45. Our forecast of population growth is shown in Figure 3.9.

Figure 3.9: Growth of the resident population in the area we supply with water



We estimate that currently 2.1% of the population connected to our water supply reside in non-household communal properties, such as barracks, nursing homes, boarding schools, etc. We have used ONS estimates of the communal population which were provided at OA level, allowing us to assign this population to the appropriate WIS zone and hence to its parent WRZ.

3.3.5 Average household size

In recent decades the Average Household Size (AHS) has fallen; nationally it has dropped from 3.0 people per household in 1961 to 2.4 currently. We expect this trend to continue, predicting that AHS in the region we serve will drop slightly from its current value of 2.2 people per household to 2.1 in 2044/45.

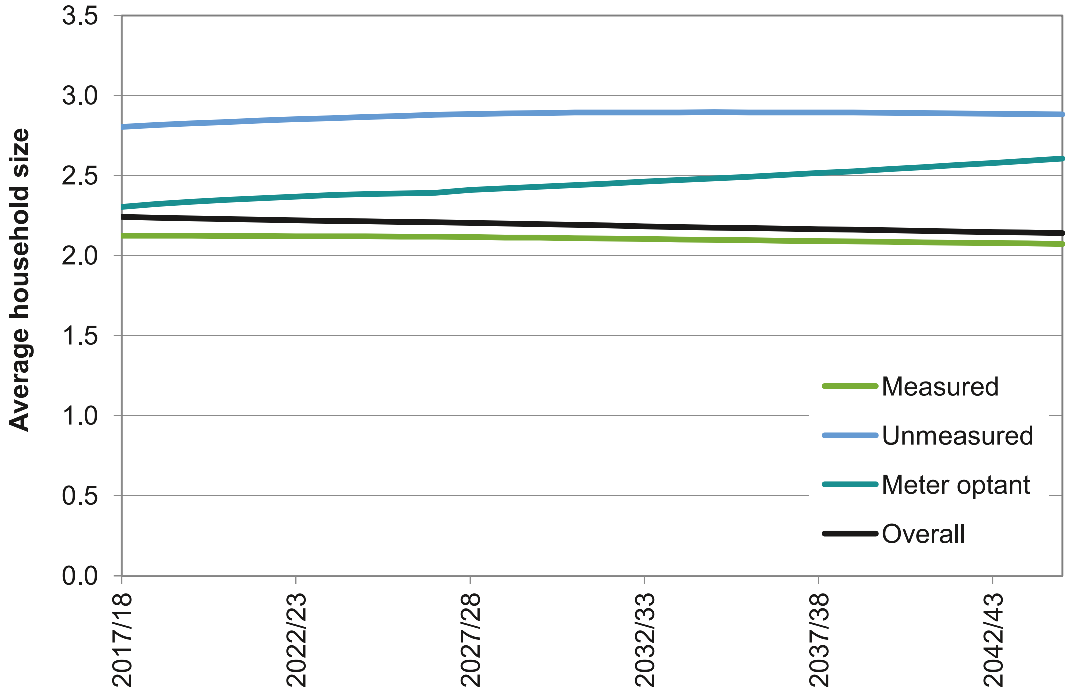
To estimate the AHS of measured and unmeasured properties within the South West Water supply area in the base year, we used data obtained from our household consumption monitor. Each year we ask members of the measured and unmeasured surveys for the number of people resident in their household, and use this information to calculate averages for these categories. The surveys have been designed to be representative of the wider customer base, so it is reasonable to base our AHS estimates on these data. Using these AHS estimates in combination with property numbers from our billing system gave an estimate of the measured and unmeasured populations, which we then reconciled against the ONS regional estimate by applying a correction factor. For the base year a correction of -0.3% was required to be applied to the survey AHSs to match the ONS estimate. AHS is calculated for our region as a whole rather than for each WRZ individually, as the area we serve does not differ enough demographically to justify individual estimates.

AHS estimates for the Bournemouth WRZ area have been based on the forecasts produced for the 2014 Water Resources Management Plan. Again, these estimates have been combined with property numbers from our billing system, and the resultant measured and unmeasured population estimates reconciled against ONS population data by applying a correction factor. A correction factor of 3.2% was applied to the previous AHS forecast to match the ONS estimate. Options to improve understanding of the measured and unmeasured AHS in the Bournemouth WRZ will be investigated during 2018 and, as set out in Section 8, form part of our overall approach in producing risk based demand forecasts for future plans.

In producing these forecasts we have assumed that the AHS in new build properties is the same as the overall measured household AHS.

Forecasts of the AHSs for the different population categories are shown in Figure 3.10 below. The AHS of meter optant properties is currently close to the overall AHS but is expected to rise as it becomes financially advantageous for larger households to switch to metered billing. The AHS of unmeasured properties initially rises as the smaller of these households migrate to the metered category, but the small number of optants in later years results in the trend following that of the overall AHS. As meter penetration is already high, and we forecast that it will reach around 90% by 2044/45, measured AHS is similar to the overall level.

Figure 3.10: Forecast change in average household size



3.4 Household consumption

3.4.1 Historic PCC

One of the most useful sources of information in understanding current consumption is historic data and we have made extensive use of such information in preparing this Plan. Unmeasured household PCC has been obtained from our unmeasured consumption monitor, whilst measured data comes from our billing system.

Our household consumption monitors are very important to our understanding of customer consumption, and we will continue to operate these to allow us to collect data for the next planning period.

Historic average PCCs for the South West Water area and Bournemouth WRZ are shown in Figure 3.11 and Figure 3.12 respectively.

The national average PCC is currently 144 l/p/d. In our South West Water resource zones we are below average and in Bournemouth Water we are in line with the national picture.

Figure 3.11: Historic PCC for South West Water measured and unmeasured households

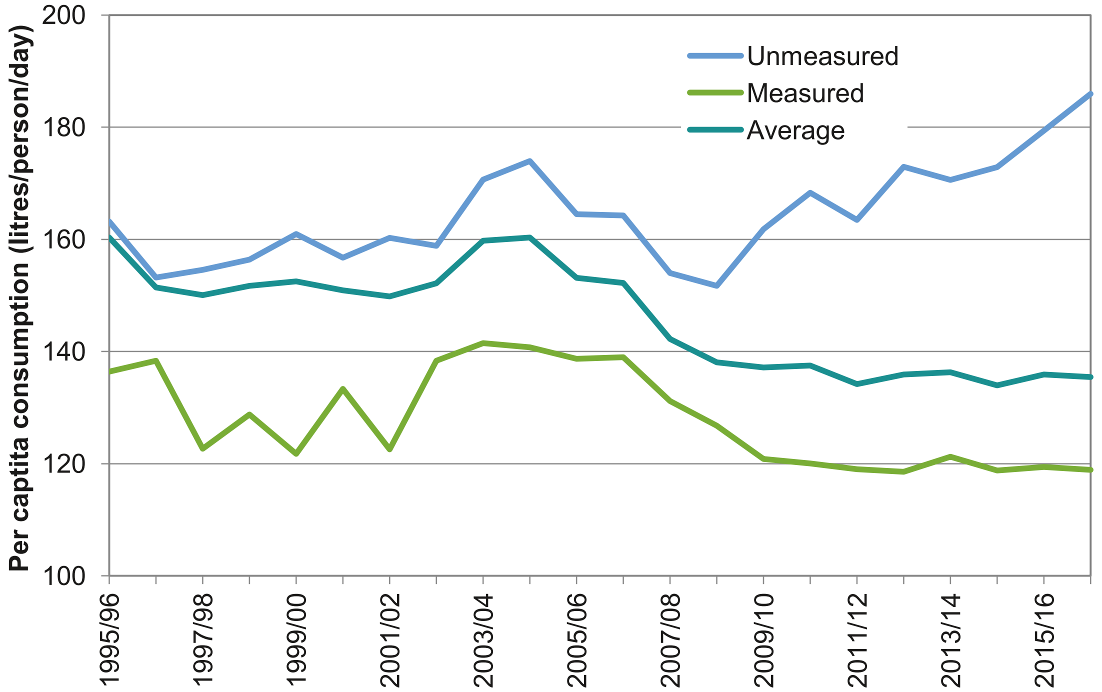
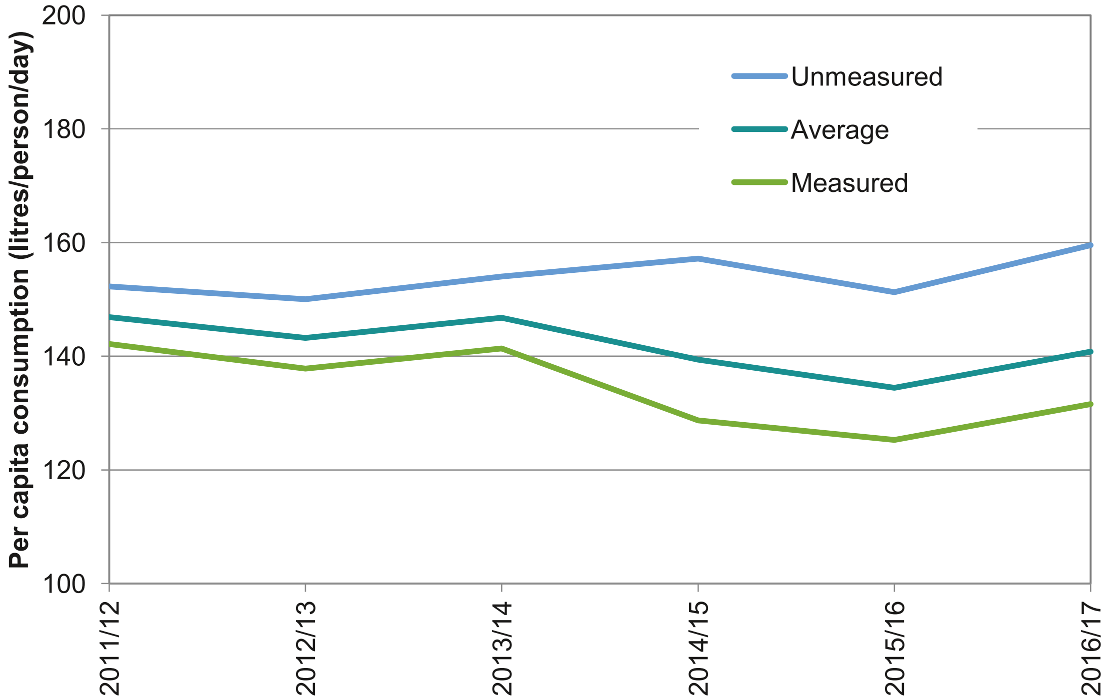


Figure 3.12: Historic PCC for Bournemouth WRZ measured and unmeasured households



South West Water Bournemouth Water

3.4.1.1 Estimation of historic unmeasured PCC in the South West Water area

We have run an unmeasured household consumption monitor since the 1970s. This was set-up to include around 1,000 properties that were selected to be representative of the unmeasured customer base in our region. Properties in the survey had a meter fitted, but they continue to receive an unmeasured bill. Given that the area we serve does not differ greatly in terms of demographic or geographic factors and consumption patterns are similar throughout, it was not necessary to stratify the sample by resource zone. Over time many of the original sample decided to leave the survey or opted to switch to metered billing, requiring us to periodically recruit more properties.

Up until recently survey property meters were read twice a year, and questionnaires were sent to some survey members asking about how they use water around in their homes. This was one of our key sources of information for estimating water used for purposes such as personal washing, appliance ownership and garden watering. Each year we also ask members of both our unmeasured and measured surveys for occupancy data, allowing us to derive per capita consumption data from the usage data we collect.

In 2016 we started to deploy loggers on both unmeasured and measured survey properties, and currently over 900 loggers are returning detailed consumption data on a daily basis. One of the advantages of this improved source of data is that we are able to use it to identify individual water use events and assign them to the appropriate usage category. We are now using this data rather than the self reported information collected by questionnaire, leading to a vastly improved understanding of consumption. The number of properties for which we had this detailed data in time to use in this plan was limited, but as deployment continues we will have access to more data sets.

3.4.1.2 Estimation of historic unmeasured PCC in the Bournemouth WRZ

Since 1996/97 we have used a cul-de-sac monitor to estimated unmeasured household consumption. The monitor comprises 27 individual areas, comprising over 1,700 properties. Progress has previously been made on setting up an individual household monitor for the Bournemouth WRZ, but the sample currently exhibits bias due to the under-representation of certain customer types. We intend to expand the logger deployment currently underway in the South West Water area into the Bournemouth WRZ, correcting for this bias, while collected more detailed data.

3.4.1.3 Estimation of historic measured PCC

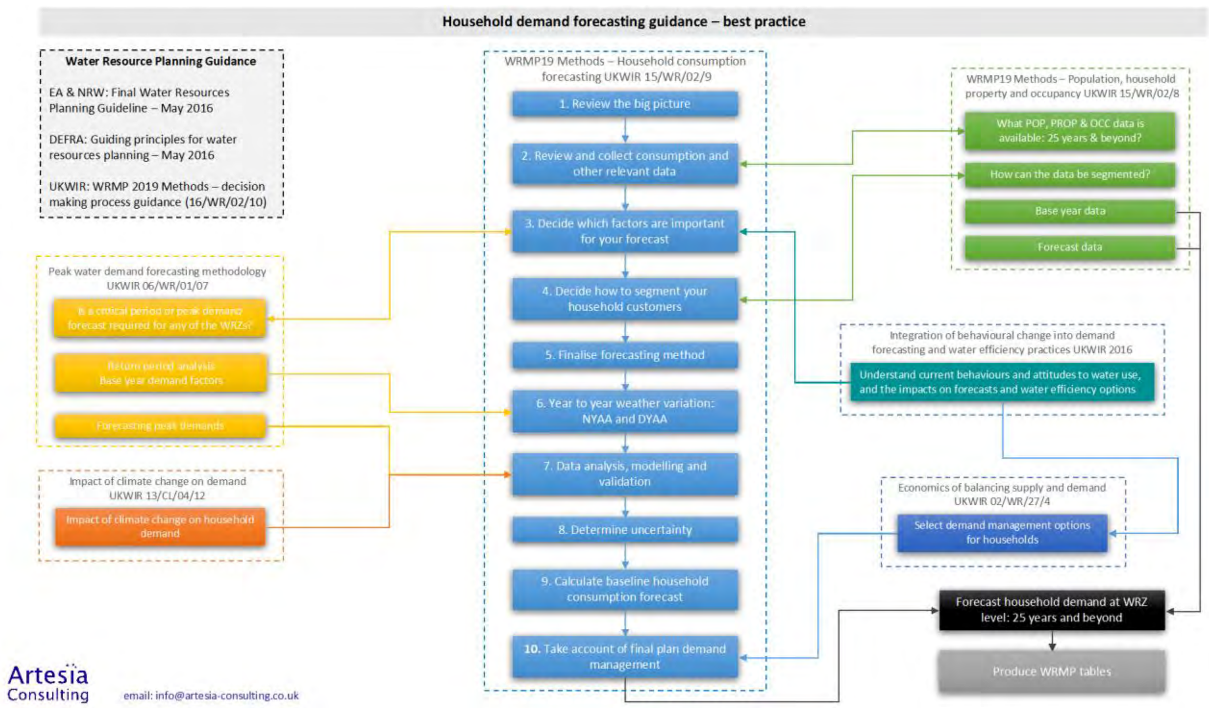
Over recent years the proportion of household customers paying measured bills led us to start a measured household consumption monitor in the South West Water area, which we now operate in parallel with the long-running unmeasured one. Loggers are currently being installed at survey properties on the unmeasured survey.

While the data we obtain from the measured household consumption monitor is very useful in understanding the way in which customers use water, it is not the best source from which to obtain average measured PCC. Instead we use our billing data for this purpose, as this enables us to account for the consumption of the entire measured household population rather than the limited sample that are members of the consumption monitor. We know the total consumption of all the measured households from meter readings, and by dividing this by the estimated population of these properties, we obtain average PCC.

3.4.2 Our approach to forecasting baseline household consumption

Our household consumption forecasts were produced for us by Artesia Consulting, and their report, which contains full details of how these were produced, is included in Section A.3.1. Best practice guidelines have been followed in deriving the forecast, with the approach shown in Figure 3.13. This section gives a brief summary of the approach taken, and the key findings. A continuation of existing water efficiency has been assumed in the baseline consumption forecasts. Section 8 sets out our final plan and the additional water efficiency measures we propose.

Figure 3.13: Best practice guidelines for household consumption forecasting



3.4.2.1 Selecting our household forecasting methodology

As detailed in Appendix 1, the problem characterisation for the company's water resources zones shows them to be of low concern. An assessment of suitable household consumption forecasting methods was carried out based on this characterisation. This indicated that micro-component forecasting and regression modelling would be suitable approaches. Currently we do not have sufficient data on individual household consumption and property characteristics for regression modelling to be robust, so we have used the micro-component modelling approach for our plan.

Micro-component models quantify the water used for different activities within the home, for example showering, bathing, toilet flushing, dishwashing, and garden watering. They then forecast how each of these components is likely to change in the future.

3.4.2.2 Segmenting our household customers

Different types of household properties will exhibit different behaviours and consumption levels. To help capture these differences we segmented our household customers into four distinct categories:

- Existing measured: Properties that were already metered in the base year of the Plan. A property in this category will remain in it for the duration of the planning period.
- Unmeasured: Properties that remain unmetered. Due to the optional metering programme that is assumed will run for the duration of the Plan, members of this group will migrate to the meter optant category. The unmeasured group will therefore reduce in size.
- Meter switchers: In the base year there are no properties in this group as all customers having a meter at this time are included in the 'existing measured' category. When a household switches to metered billing it joins this group, where it remains until the end of the Plan. As unmeasured households with lower consumptions are more likely to save money by switching to metered billing, these meter optants will tend to have lower consumption than the unmeasured average.
- New build: As with meter optants, there are no properties in this group in the base year. New build houses are more likely to have more water efficient fixtures and appliances, therefore their average consumption is likely to be lower than the 'existing measured' average.

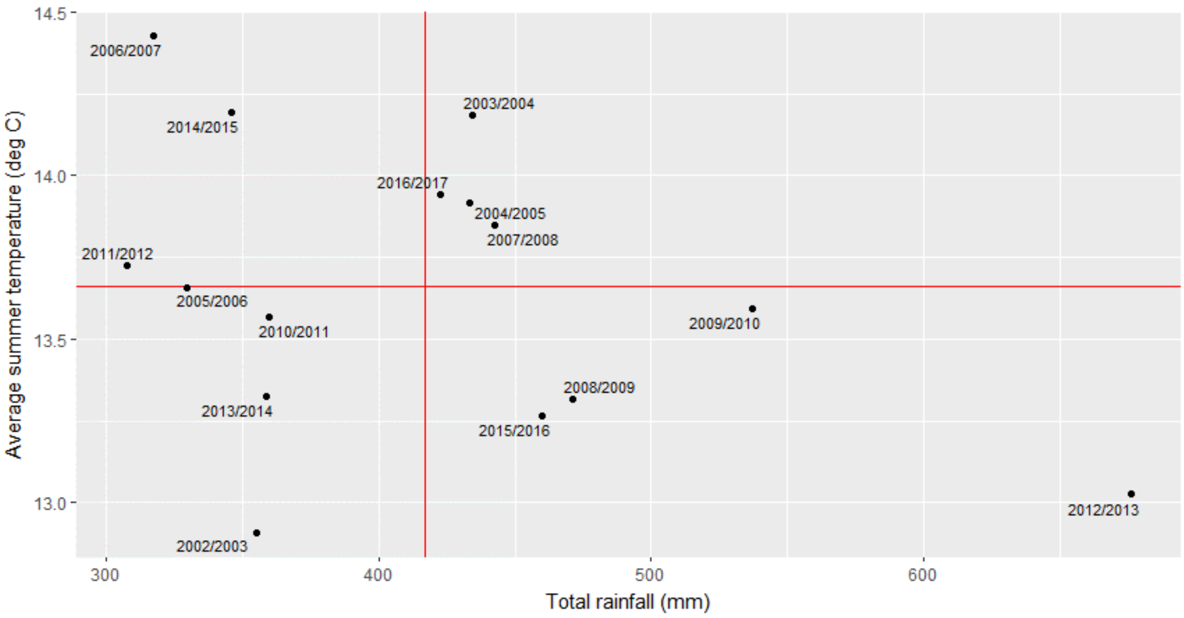
3.4.2.3 Understanding how weather affects household consumption

It's important to understand how the weather affects household consumption, particularly in a dry year, when pressures on water resources are at their most acute. To do this we followed the guidance in the *Household consumption forecasting*[3.4] report.

[3.4] UKWIR (2015), *WRMP19 methods: Household consumption forecasting*, Ref 15/WR/02/9

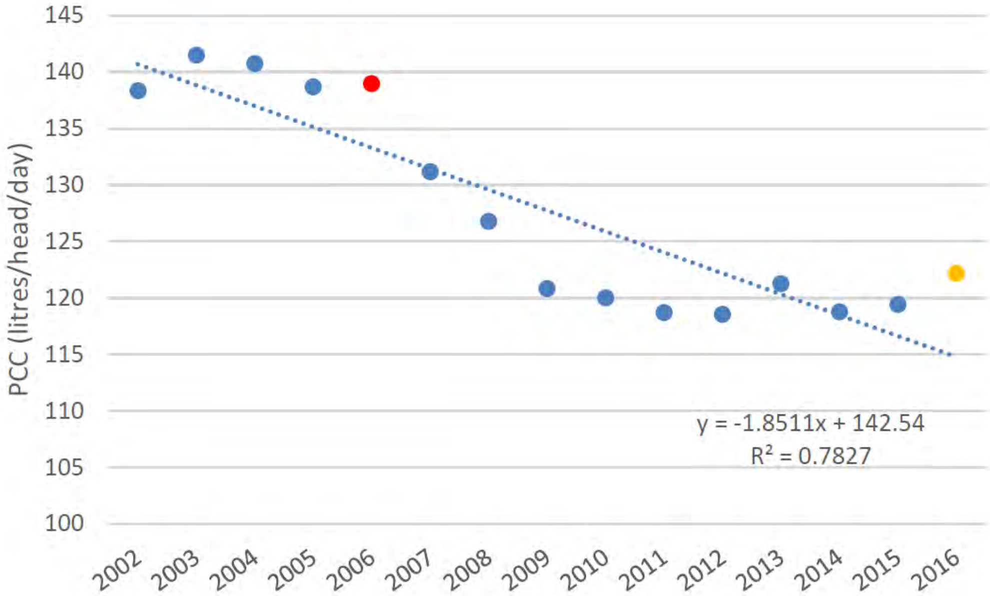
Firstly we looked at how the summers in recent years compared to average, Figure 3.14 shows how the summer rainfall and average temperatures have varied recently against the average. This indicates that the base year of 2016/17 was slightly warmer than average at the Met Office's Chivenor weather station, with fairly typical rainfall, and that 2006/07 was the warmest and driest year in the recent record. This analysis was also undertaken at three other sites within, or close to, our supply areas: Chivenor, Yeovil and Hurn. Similar results were obtained from all four sites.

Figure 3.14: Quadrant analysis of recent summers for data from the Met Office's Cambourne weather station. The red cross indicates the average for the period from 2002/03 to 2016/17.



To calculate the uplift that would be expected in a dry year compared to a normal one we removed 2006/07 PCC data from the historic trend, and fitted a trendline through the remaining data. This trendline gave us an estimate of how PCC has changed recently, with the effect of varying weather in each year averaged out. By looking at the level of the trendline in 2006/07, we get an estimate of what PCC would have been had it been a year with average weather conditions. Comparison of this value with the observed PCC allows us to estimate the uplift factor between an average year and a dry one such as 2006/07. This analysis estimated that factor to be 5.27%. This is illustrated in Figure 3.15.

Figure 3.15: Chart showing recent reported measured PCC in the South West Water supply area. The red data point shows the dry year of 2006/07.



Statistical analysis of base year data against what might be expected in a normal year was confounded by changes to the definition of what is included in the household properties category. In preparation for the opening of the non-household retail market in April 2017, Ofwat issued revised guidance on the kind of properties that should be counted as households. In the South West Water area the biggest impact was that properties such as family farms, which are both a home and a business premises, were reclassified as household, rather than non-household. These properties have higher consumption than normal households, so increased PCC significantly over that in previous years, this increase can clearly be seen in Figure 3.15. A similar increase was seen in the Bournemouth WRZ.

This increase in PCC made normalisation of the base year figure to what might have been expected in 2016/17, had average weather conditions been experienced, very difficult. Weather conditions in 2016/17 were relatively normal, and inspection of the consumption data showed no evidence that it varied significantly from what might be expected in a normal year. We have therefore assumed that base year consumption was at the same level as we would have expected in a normal year, and applied no normalisation factor.

Analysis of the household consumption data for the Bournemouth WRZ showed that the WRMP 2014 peak period uplift factor of 1.49 was still appropriate.

3.4.2.4 Understanding base year household consumption

To help our understanding of base year micro-component consumption, we used two sources:

- A national survey of micro-component consumption of 62 properties, collected during the 2016 UKWIR behaviour integration study[3.5].
- Micro-component data obtained by logging some of our own household consumption monitor properties. These properties were mostly unmeasured, which was very helpful as unmeasured properties weren't included in the behaviour integration study.

The base year data showed that some micro-components are strongly related to the number of people in the household (for example toilet flushing), while others (such as garden watering) aren't. To correctly capture both of these types of micro-component, we combined the consumption data with population and property numbers. This allowed us to estimate average consumption for each of the micro-components in each of the four household categories shown in section 3.3.2.2. Finally we calibrated this data to overall average per household consumption (PHC) in the base year of 2016/17.

3.4.2.5 Forecasting future micro-component consumption

Once an understanding of micro-component consumption in the base year was obtained, we looked at how this might change in the future. To help us do this we used a number of different data sources, including:

- Defra's Market Transformation Programme, which provides forecasts of how the ownership and consumption of different water using fittings and appliances may change in the future.
- Historic trends in micro-component consumption, which give an idea of how things have changed in recent years, as this may help to understand the changes that will occur in the future.
- Customer survey data giving customers views on how often water using appliances are replaced, kitchens and bathrooms are refurbished, and the importance of water efficiency in guiding future purchasing decisions.

The forecast changes in household occupancy rates were integrated within the model to ensure that those micro-components which vary with occupancy could reflect any expected changes. Results of our meter optant and new connection forecasts were also fed into the model to capture the movement of customers from unmeasured to measured billing, and the increase in newer, more water efficient homes.

[3.5] UKWIR, "Integration of behavioural change into demand forecasting and water efficiency practices", Ref 16/WR/01/15, 2016

3.4.3 Household consumption forecasts

Our baseline PCC forecasts for the South West Water area and Bournemouth WRZ are shown in Figure 3.16 and Figure 3.17 respectively. These forecasts show that under a continuation of existing water efficiency and metering activities, we expect average PCC to fall throughout the planning period. In the South West Water area we forecast that average PCC in a normal year will fall from 136 litres per person per day currently, to 121 in 2044/45. For the Bournemouth WRZ we expect to see a reduction from 141 to 123 litres per person per day.

Under leakage reporting consistency measures we will expect to see our base year PCC fall. The new reporting measures will see some of our water balance gap reassigned by leakage, meaning that there will be less of an adjustment to PCC, particularly unmeasured PCC. This is described further in Section 3.6.

Figure 3.16: Per capita consumption forecasts for the South West Water area

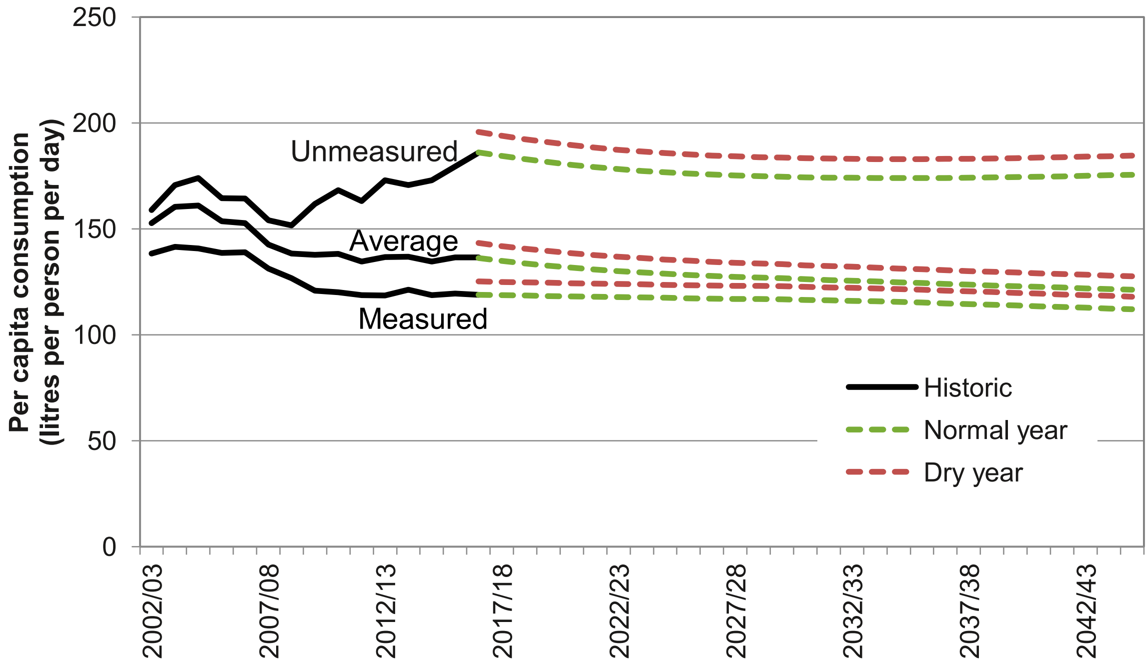
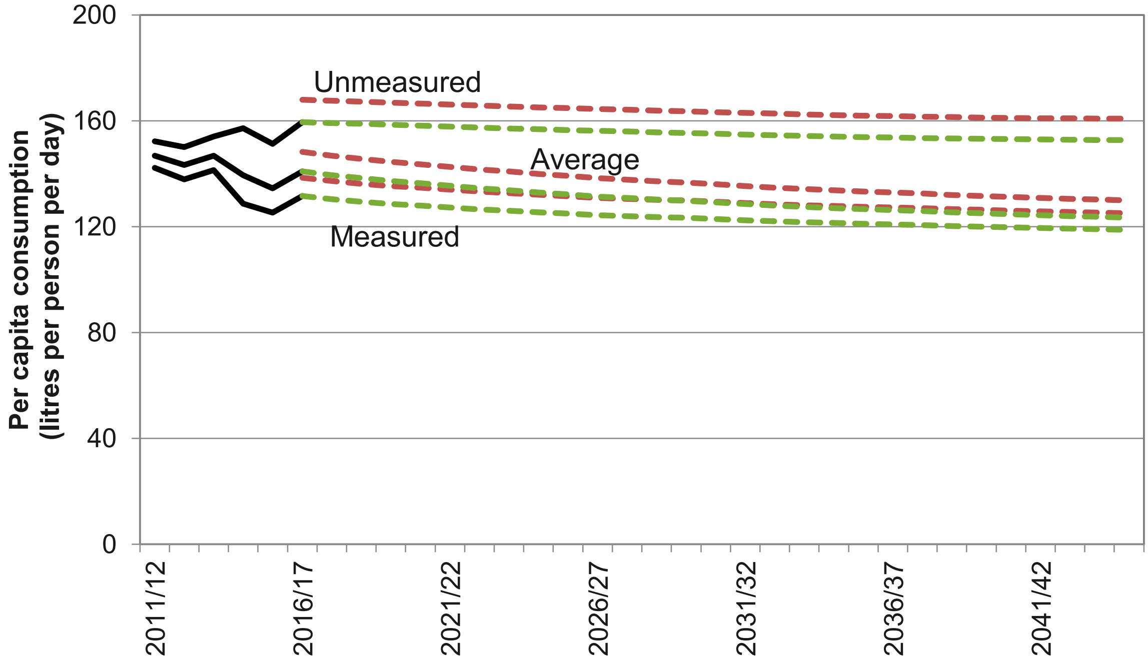


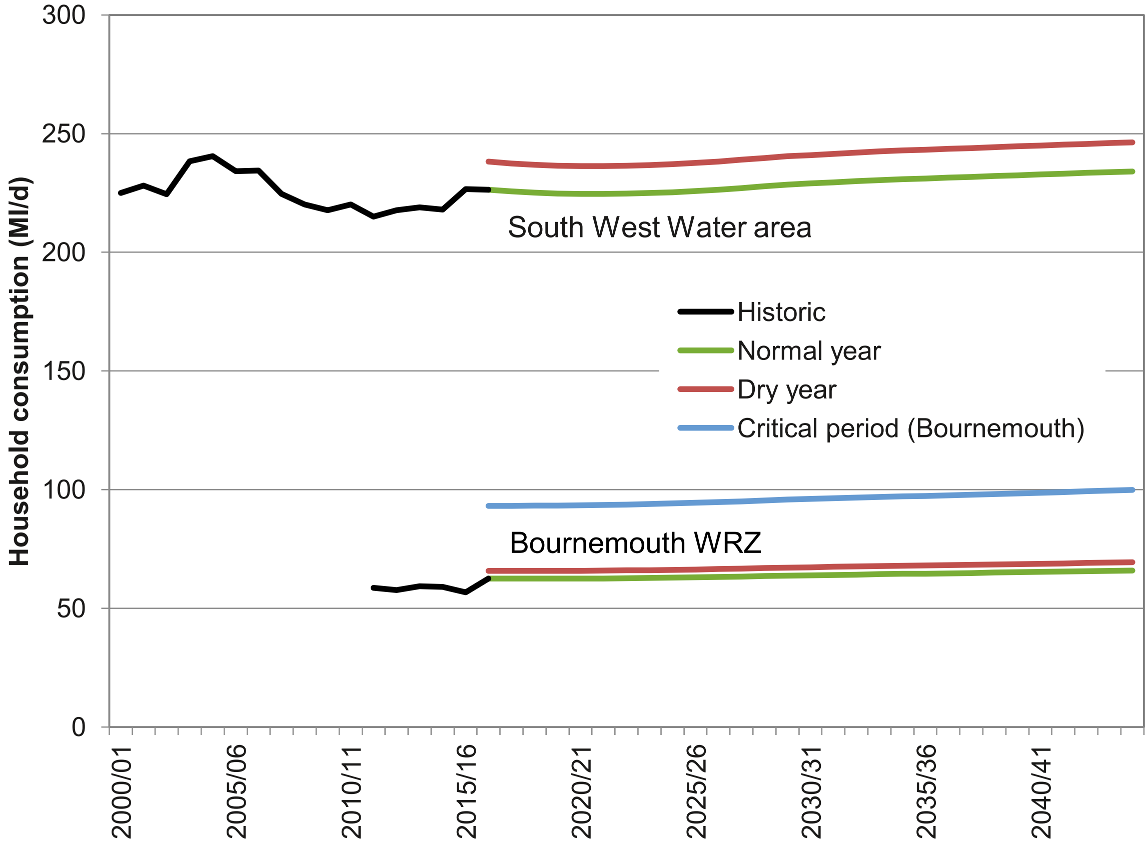
Figure 3.17: Per capita consumption forecasts for the Bournemouth WRZ



While we expect to see average PCC fall over the planning period, we forecast that total household consumption is likely to increase due to population growth. In a normal year we predict that household consumption in the South West Water area will rise from 226 Ml/d currently to 234 Ml/d in 2044/45. In the Bournemouth WRZ we expect it to rise slightly from 63 Ml/d to 66 Ml/d. Our forecasts are shown in Figure 3.18.

The large rise in household consumption seen in the South West Water area in 2015/16 resulted from the reclassification of some non-household properties as households, mostly small family farms. This change was prompted by a need to comply with definitions of household and non-household properties published to support the opening of the non-household retail market. A similar rise in the Bournemouth household consumption in 2016/17 was also related to this reclassification, but the main impact in this case was from the movement of blocks of flats supplied through a single billing meter.

Figure 3.18: Total household consumption



3.4.4 <u>The effect of metering on household consumption</u>

Our baseline forecasts have been prepared assuming that our current optional meter programme continues for the duration of the planning period. As metered customers have a financial incentive to reduce their water consumption, those who opt to have a water meter installed generally reduce their consumption.

The data we obtain from our unmeasured household consumption monitor allows us to compare total water use before and after a household switches to metered billing. The household consumption model has been calibrated against this data, and shows a reduction in per household consumption of around 18% compared to pre-metering levels.

In addition to the benefit of reducing customer consumption, measured households on average suffer a lower level of leakage from their underground supply pipes than unmeasured ones. This is because any leaks on the section of underground supply pipe downstream of a meter are noticeable through the meter. In our forecasts we have therefore assumed that underground supply pipe leakage is reduced when customers switch to metered billing. Based on 2016/17 data from our annual performance report we assume that when a customer switches to metered billing, underground supply pipe leakage is reduced by 35% in the case of households and 42% for non-households.

3.4.5 The effect of climate change on household consumption

The impact of climate change was built into our forecasts in accordance with the *Impact of Climate Change on water demand*[3.6] report. Median forecast climate change impacts on household demand in the South West England river basin in 2040 relative to 2012, show a 0.99% increase. As the base year is now 2016/17 and the final forecast year is 2044/45 the percentage change has been scaled accordingly.

The impact of climate change on the critical period in the Bournemouth WRZ is higher than for the annual average figure described above. The estimated impact on household demand during the critical period is 2.63% in 2044/45, compared with the 0.99% applied to the annual average estimates.

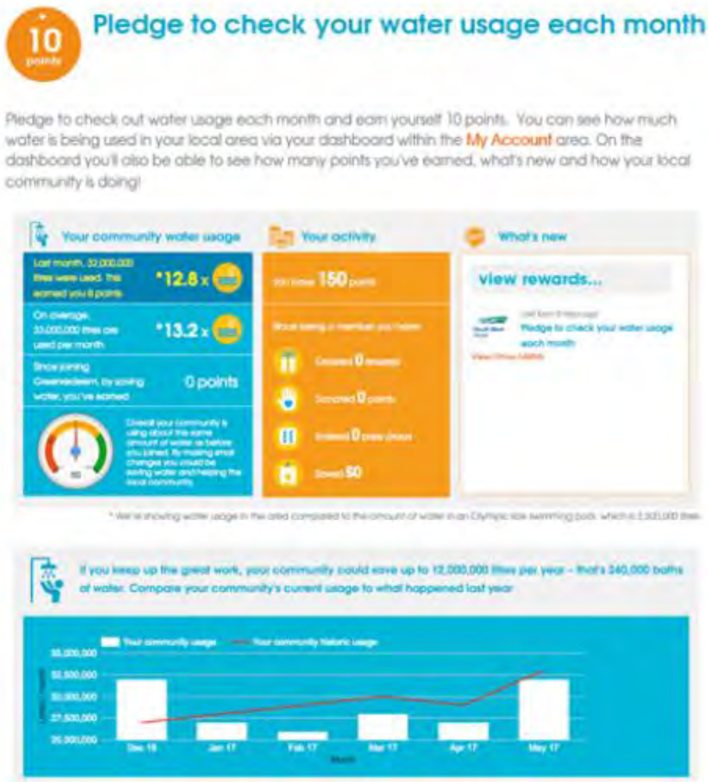
3.4.6 Water efficiency activity

The forecasts we have produced assume a continuation of our water efficiency activity, and the savings this is likely to achieve are included in our baseline forecast. Our current water efficiency activities include:

- Guidance via our website, talks to special interest groups and events such as country and county shows.
- Supporting schools with educational water efficiency tools available via our website and with talks on request.
- Targeted promotions to our region's gardeners of water butts advertised through our web site and bill message promotions.
- The promotion of free water saving devices for household customers to self select via our water conservation website.
- A number of tools, available on our website, to help customers understand how their consumption compares to that of similar households and how much water and energy they might be able to save by making changes
- While the economic incentive to save water is greater for metered customers, the services listed above are also available to unmeasured customers to help reduce their consumption. We also provide a calculator tool to help unmeasured customers evaluate their water use. This is particularly helpful for those considering switching to a meter.
- We are currently piloting a community water saving incentive scheme in a part of Exeter. A group of 3,200 South West Water customers will be invited to join Greenredeem and be rewarded for using less water at home. Householders will be given points for reducing the amount of water they use at home. Householders can then earn further points by taking pledges,

[3.6] UKWIR, "Impact of Climate Change on water demand", Ref 13/CL/04/12, 2013 quizzes or watching short films to understand how to use water more efficiently. Example scheme feedback is shown in Figure 3.19.

Figure 3.19: Community water saving scheme example dashboard



In addition we work to enhance the national evidence base for water efficiency by our involvement in water efficiency research and trials, and engagement with appropriate industry bodies.

Section 6 sets out future feasible options to further improve our water efficiency, while Section 8 describes our future plan.

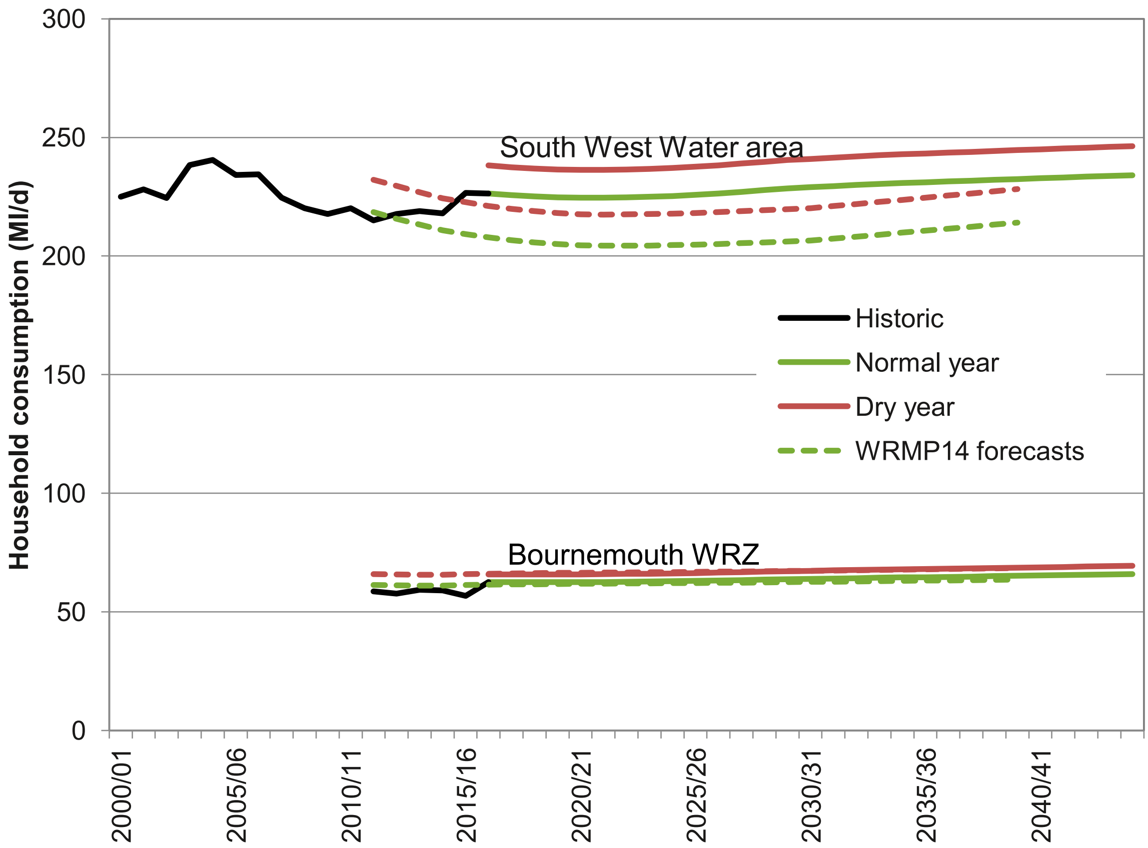
3.4.7 Comparison with 2014 WRMP household consumption forecasts

Figure 3.20 shows a comparison of our new household consumption forecasts with those from our 2014 plan.

The previous forecast for South West Water was too low compared to our historic reported figures. The first reason for this difference is that, the historic trend up until 2011/12 was for gradually declining household demand, and we expected to see this continue. However that year marked a turning point in the trend, with consumption starting to rise. Then in 2015/16 some properties were moved from the non-household to the household category. This lead to a step-change increase in household consumption.

The Bournemouth WRZ historic trend shows a similar step-change increase as in the South West Water area, but in this case the changes were made in 2016/17. Until the non-household properties were moved into the household category, household consumption forecasts were generally above outturn data. In the 2014 WRMP, the critical period demand was calculated by applying a factor to the total demand, rather than by building it up from the different categories of consumption. Therefore there isn't a household consumption critical period demand for us to compare our latest forecast to, so critical period demands are not shown in Figure 3.20.

Figure 3.20: Comparison of household consumption forecasts with those in our last plan



3.4.8 <u>Improvements over 2014 WRMP household consumption forecasting</u>

We have made several improvements over the household consumption forecasting methodology used for our 2014 WRMP, which give us additional confidence in our forecasts compared to previous plans.

The first of these is a better understanding of micro-component consumption. Our previous plan was based on national data, some of which was over a decade old. Our latest forecasts are based on two sources of micro-component data: a national sample undertaken of 62 properties which took place in 2015, and a smaller sample of properties in the South West Water supply area, which are members of our household consumption monitor.

The modelling itself was more advanced than in 2014, using a composite approach where some components of consumption are applied at a per capita level, while others are applied per household. This allows changes in consumption due to changing occupancy rate among the different types of household property to be better modelled.

Section 3.9 and Section 8 set out the further development that we plan to undertake to support our future plans.

3.5 Non-household consumption

3.5.1 Background

We have defined our non-household customers according to part 17C of the Water Industry Act 1991. However in 2016 Ofwat published new guidance[3.7] on the types of properties that would eligible to switch their water provider with the opening of the non-household retail market in April 2017. Complying with this guidance required the movement of some properties from the non-household to household categories. This movement was undertaken in 2015/16 in the South West Water region, and 2016/17 for the Bournemouth WRZ. Properties affected included family farms and blocks of flats billed through a single meter.

During 2017 we contacted all of the retailers supplying non-household properties within our supply areas, and asked for details of:

- Water efficiency initiatives planned by retailers so that we can include any forecast savings data in our demand forecast;
- Significant changes in customer consumption which we may need to plan for;
- Anything else that retailers think we should be aware of whilst preparing our plan.

Comments were received from three retailers, but no significant changes in demand were raised.

3.5.2 The economy of our supply area

The regional economy is dominated by service industries, the most important of which is tourism, which is essential to the region's prosperity. Agriculture forms a large part of the non-service sector, with livestock and smaller arable farms prevalent. There is little reliance on agricultural irrigation within the region, so while

[3.7] Ofwat, "*Eligibility guidance on whether non-household customers in England and Wales are eligible to switch their retailer*", 2016 farms moving to potable water irrigation are placing additional demand on public water supply in some areas, this is not considered likely to affect us.

None of the WRZs in the South West Water area have a strong reliance on other non-service industries, but the Bournemouth WRZ contains a very large industrial customer which accounts for around two-thirds of the non-household consumption. Due to the significance of this customer in terms of total non-household demand in the Bournemouth WRZ, we forecast its consumption independently.

3.5.3 Our approach to forecasting non-household consumption

The level of metering in our non-household customers has been high for many years and currently stands at around 96% across our four WRZs. Because of this we have a good set of data from which we can gain an understanding of non-household consumption.

Non-household consumption is heavily influenced by economic factors. As one of our improvements from WRMP14 we have made use of econometric data to explain historic data and use the relationship for forecasting future consumption.

Our non-household consumption forecasts were produced for us by Servelec Technologies, and their report, which contains full details of how these were produced, is included in Appendix 3. Best practice guidelines have been followed in deriving the forecast.

Econometric models were produced for each of our four WRZs, to reflect the differing industrial composition within the areas. These models split our non-household customers into seven categories:

- Service 1: Including sectors in accommodation and food, wholesale and retail trade, distribution, transport and storage, which are focused on both public and private sectors
- Service 2: Including sectors in professional and business service activities, real estate, financial and insurance activities, information and communication, which tend to be more focused on providing professional services
- Service 3: Including sectors in education, health and public administration, which are public sectors and tend to be more related to household population
- Service 4: Including sectors in arts and entertainment, other services and household activities, which are more private sector focused and tend to be related to household population
- Non-service 1: Including sectors in agriculture and production other than manufacturing
- Non-service 2: Including sectors in construction, engineering and remaining sectors in manufacturing

- Unknown: Industries without a known sector.

These sectors were modelled independently against a number of explanatory factors:

- Employment: The number of employees in the sector
- Gross value added (GVA): The GVA in £million for the relevant groups.
- Population: The population resident in the relevant area.
- Rainfall: The total rainfall in the year
- Year: The year, which is used to give an absolute trend to the model

We have assumed a continuation of existing metering policy and water efficiency activity within our baseline consumption forecasts.

Due to the size of the large non-household customer that we supply in the Bournemouth WRZ, and the potential impact that changes in their consumption could make to our plan, we regularly liaise with them. As a result of this liaison, we do not envisage any significant change in their consumption over the planning period and have assumed a continuation of their 2016/17 consumption.

Currently less than 3% of non-household consumption is by unmeasured customers. To forecast future unmeasured non-household consumption we assumed that usage by current unmeasured customers would change at the same rate as that of the measured ones. Based on recent trends, we have assumed that 1.3% of remaining unmeasured non-household customers will opt in to metering each year.

The proportion of unmeasured non-households that were void was 18.4% during 2016/17, much higher than the 3.7% void rate in measured properties. We have assumed these void rates for the duration of our forecasts but, due to the continuing migration of unmeasured properties to the measured category, the overall void rate drops slightly from 4.4% in the base year to 4.3% in 2034/45.

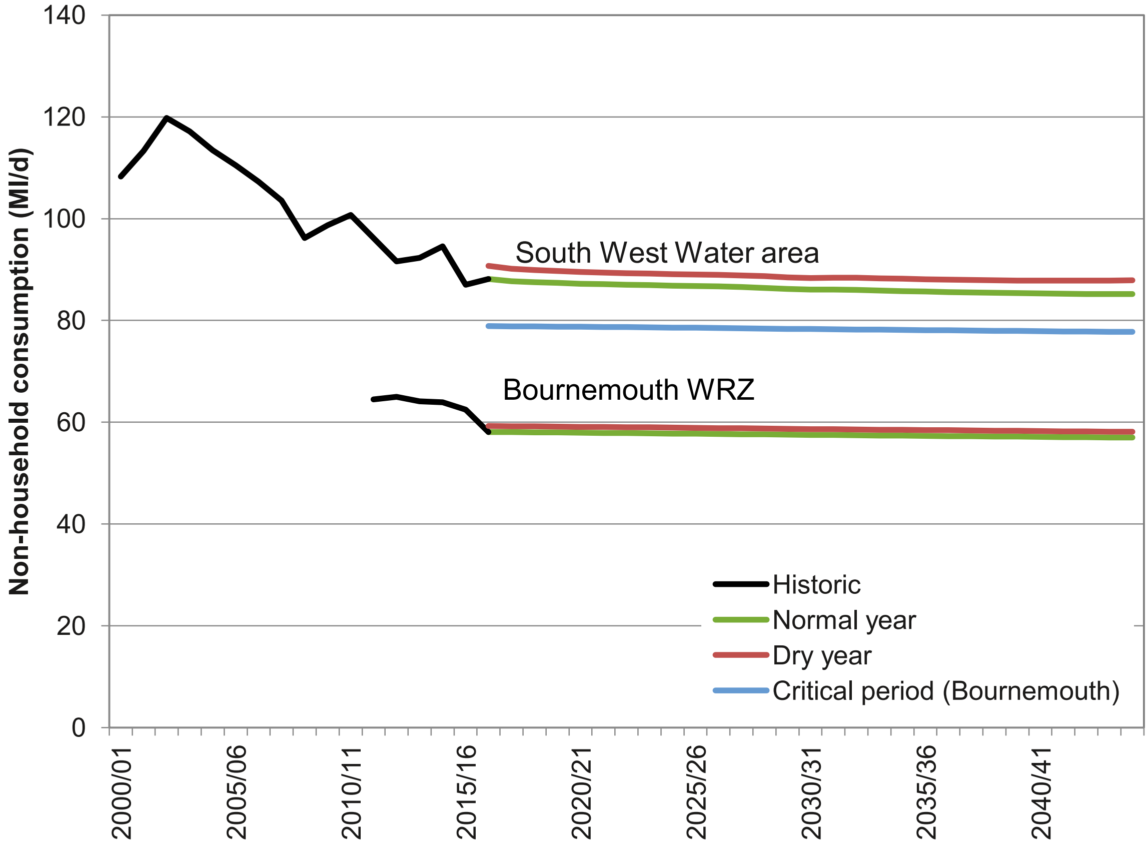
We tested the sensitivity of our supply demand balance to higher non-household demand in Section 7 to understand if it is material to our plan.

3.5.4 Forecasts of non-household consumption

Our forecasts show demand in the service sector is forecast to increase, but this is offset by non-service sector demand, which is forecast to decrease. Overall non-household normal year demand in the South West Water area is forecast to fall slightly from 87 Ml/d currently to 85 Ml/d in 2044/45. In the Bournemouth WRZ, we also expect a slight fall from 58 Ml/d to 57 Ml/d. Our forecasts are summarised in Figure 3.21.

The large reduction in non-household consumption seen in the South West Water area in 2015/16 and in the Bournemouth WRZ in 2016/17 resulted from the reclassification of some non-household properties as households described in section 3.4.1 above.

Figure 3.21: Forecast non-household consumption



3.5.5 <u>The effect of climate change on non-household demand</u>

The most recent evidence on how climate change will affect non-household demand is contained within the report *Impact of climate change on water demand*[3.8]. One of the conclusions of this report was that:
"*The analysis of non-household water demand concluded that, except in the case study of agriculture and horticulture in South East England, there is inadequate consistent evidence to justify making any allowance for climate change impacts on non-household demand*."
We have not therefore made an adjustment to non-household demand for climate change in this draft plan.

3.5.6 <u>Comparison with 2014 WRMP non-household consumption forecasts</u>

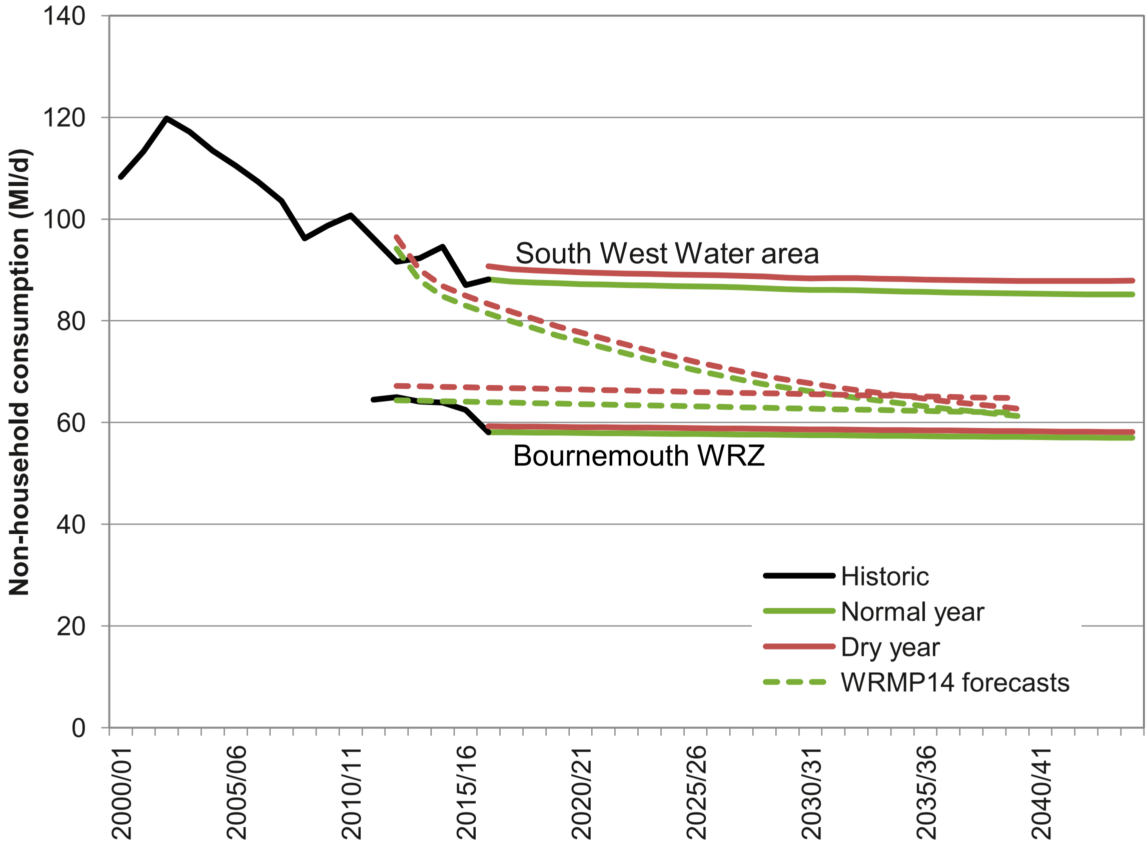
Figure 3.22 shows a comparison of our new non-household consumption forecasts with those from our 2014 plan.

[3.8] *Ibid.3.* 6

The previous forecast for South West Water was too low compared to our historic reported figures. The first reason for this difference is that the historic trend up until 2011/12 was for gradually declining non-household demand, and we expected to see this continue. However that year marked a turning point in the trend, with consumption starting to rise. Then in 2015/16 some properties were moved from the non-household to the household category, leading to a step-change decrease in non-household consumption.

The Bournemouth WRZ historic trend shows a similar step-change decrease as in the South West Water area, but in this case the changes were made in 2016/17. Until the non-household properties were moved into the household category, household consumption forecasts were generally in line with outturn data. In the 2014 WRMP, the critical period demand was calculated by applying a factor to the total demand, rather than by building it up from the different categories of consumption. Therefore there isn't a non-household consumption critical period demand for us to compare our latest forecast to, so critical period demands are not shown in Figure 3.22.

Figure 3.22: Comparison of non-household consumption forecasts with those in our last plan



3.5.7 Improvements over 2014 WRMP non-household consumption forecasting

The methods that we have used to forecast non-household consumption are significantly improved over those used for our 2014 WRMP.

We have modelled non-household demand at WRZ level, compared to at a regional level in 2014. This allows us to better capture the different features of the non-household customer base in each of our WRZs.

In 2014, our models only looked at a service/non-service split of non-household consumption. We now use six different non-household categories, consisting of four service sector groupings and two non-service ones.

We have taken into account more explanatory factors compared to our 2014 WRMP, with the addition of demographic data in addition to the econometric and weather data.

3.6 Leakage

3.6.1 Leakage reporting consistency

Currently all water companies in England and Wales are working towards reporting leakage in a consistent way, as described in the *Consistency of reporting performance measures*[3.9] report. Complying with this new guidance requires significant investment in flow monitoring, and different management procedures.

While we have made initial assessments on the likely impact of these changes on our base year (2016/17) reported leakage, it is not possible to retrospectively calculate this reliably. We have therefore based this plan on our current leakage reporting methodology. We have included a scenario showing how the adoption of the new methodology is likely to impact our baseline position, and this is detailed in Section 7 of this report.

We have shown the estimated impact of the leakage consistency measured to both our water balance calculation components, and our PCC, in Table 3.3 and Table 3.4 respectively. These figures are based on our current best estimate, which will change as we move towards full compliance.

The use of our existing methodology to calculate base year leakage does not affect our ability to meet government aspirations to reduce leakage over the planning period. The leakage reduction options that we have considered as part of this plan are not dependant on the calculation method. These options are described in Section 6 of this report.

When preparing the final version of our Water Resources Management Plan, we will be able to use a full year of data (2017/18) calculated in a way that is more aligned

[3.9] UKWIR (2017), *Consistency of reporting performance measures* with the new guidance. The following years will see further movement of the reported leakage figures as we progress towards full compliance, but the 2017/18 position will be sufficiently developed to allow us to base our final Water Resources Management Plan on the new calculation methodology.

Details of our current position with regards compliance with the new guidance, along with our plan to attain full compliance, are shown in Section A.3.3.

Table 3.3: Estimated impacts of leakage consistency methodology on 2016/17 water balance components

Demand component (Ml/d)	South West Water		Bournemouth Water	
	Existing methodology	Leakage consistency methodology	Existing methodology	Leakage consistency methodology
Measured household consumption	146.87	145.18	39.10	41.52
Unmeasured household consumption	85.11	84.13	56.91	56.85
Measured non-household consumption	79.41	76.75	23.42	25.07
Unmeasured non-household consumption	3.05	2.88	1.19	1.18
Leakage	84.40	96.42	19.04	15.80
Distribution system operational use	2.89	2.74	1.14	1.08
Water taken legally unbilled	18.92	17.89	1.01	1.08
Water taken illegally unbilled	7.20	5.92	0.03	0.03
Distribution input	427.85	431.91	141.83	142.61

Table 3.4: Estimated impacts of leakage consistency methodology on 2016/17 per capita consumption

Per capita consumption (l/person/d)	South West Water		Bournemouth Water	
	Existing methodology	Leakage consistency methodology	Existing methodology	Leakage consistency methodology
Unmeasured	185.93	179.70	159.54	155.52
Measured	118.90	117.53	131.58	130.88
Average	136.12	133.51	140.82	139.02

Note: in Section 8 we set out our forecast improvements in PCC in our proposed Plan. These are based on our existing methodology. They will be updated for the leakage consistency methodology for the Final Plan.

3.6.2 Determining base year leakage

Our leakage control is based on continuous monitoring of night flow data in small areas of on average 1,000 properties known as District Metering Areas (DMAs). We calculate the level of leakage by analysing DMA night flows, from which we subtract the usage of large measured customers and assessed domestic and commercial night use of the properties in the area. We then take the 27th percentile value of all the overnight readings to calculate the leakage for a particular month. Our reported annual leakage is an average of all twelve months of the year, without the removal of summer months.

We have approximately 2,200 meters collecting continuous 15-minute data with more than 99% of this data being transmitted through telemetry. This allows us to quickly review data and reduce the time it takes us to become aware of network problems. The flow data is automatically imported into our Leakage Analysis Software System (LASS) which provides reports on DMA prioritisation, data collection problems and is the reporting tool for regulatory returns.

As part our leakage control strategy we monitor losses from service reservoirs annually by comparing inlet and outlet flows at each reservoir. This method has the benefit of recording all losses associated with the reservoirs, whether from overflows, structural seepage or leaks in the mains. It also avoids the operational disturbance and risk to security of supply involved in static drop testing (where inlet and outlet valves are closed and the reservoir level is monitored to see if it falls). We currently estimate losses from service reservoirs to be 3.9 Ml/d.

For leakage reporting DMAs are aggregated to WIS zones and then summed to a regional figure. As WRZs comprise a number of WIS zones it is also easy to report leakage within each of our three WRZs.

3.6.3 Our baseline leakage forecast

For our baseline leakage forecast we have assumed that we will maintain leakage at our targeted 2019/20 leakage level of 81 Ml/d in the South West Water area, and 19 Ml/d in the Bournemouth WRZ. We have considered leakage reduction options as part of our final planning scenario, and these are described in Section 6 of this report.

Our final plan includes further leakage reductions in the 2020 to 2025 period, even though we have a supply demand surplus, as shown in Section 8 of this report.

3.6.4 Sustainable economic level of leakage

We have continued to improve our leakage strategy model. For this plan we have used leakage detection and repair data at WIS level to produce cost curves for each local area. These were built from improved cost allocation data compared to previous plans.

As in previous plans the model still groups the WIS areas into leakage zones according to resources and treatment works.

We used the sustainable economic level of leakage to understand the cost of operating at different leakage levels. We used this model in our sensitivity analysis (reported in Section 7) to help inform what our short and long term leakage level should be to maintain our supply demand balance.

3.6.4.1 The SELL model methodology

The underlying economic principles incorporated in our Sustainable Economic Level of Leakage (SELL) model are:

- It is based upon the principal of a Natural Rate of Rise (NRR) of leakage which is an estimate of how quickly leakage would rise if no control activity was undertaken. The NRR in different areas will vary, and we have calculated an estimate of NRR for each WIS zone in our supply area. As property numbers change over time, the NRR will also change i.e. a rise in the number of connected properties will tend to increase leakage.
- As the level of leakage is reduced, the cost of leakage control activity increases.
- Lower leakage levels reduce demand and thus reduce marginal operating costs.
- Over time improvements in leakage detection and repair techniques are likely. Our model assumes a 1% per annum net reduction in these costs.

- Costs for carbon are fully included in our company unit production costs through the European Union Emissions Trading Scheme (EUETS) applied to the cost of energy, as recommended in the UKWIR report *A Framework for Accounting for Embodied Carbon in Water Industry Assets*[3.10].
- Other social and environmental costs have been included; however as they are linked to leakage repair activity which itself is largely related to the NRR, they tend to be constant with minor variations when transiting from one level to another.
- All costs/benefits have been scaled to their 2017 values using the Retail Price Index (RPI) measure of inflation.
- The model can thus estimate a cost for any level of leakage for a given year and WIS zone – and by extension, any combination thereof.
- For estimating the short run ELL, each WIS zone and year was set at the policy minimum, meaning the lowest level that can be achieved. The model then tested incremental variations (both positive and negative) of leakage by WIS zone and year; each time taking the largest (if any) cost benefit available. This iterative process continued with gradually smaller variations in leakage level down to 0.01 Ml/d, until no saving was available or a potential breach of the supply demand balance has been reached.
- A detailed running log of the iterations and their cost implications was kept for later analysis. These costs are broken down into the different elements (such as company costs and customer willingness to pay), to enable more detailed reviews for future options to be considered.
- Transitional costs were applied in reviewing the ‘long run’ costs both at a fixed RPI for each year based on 2017 and, for Net Present Value (NPV) costs across the 25 year profiles examined.
- The results gave the relationship between cost and leakage level for all resource zones.
- As shown in Section 7, additional supply demand scenarios were tested by varying the inputs of demand and/or water available for use (supply), followed by a full rerun of the model as described above.
- Other types of scenario, for example testing a particular profile of leakage reduction policy, were costed using the logged model results to set the optimum balance of WIS zone leakage levels for each given year. This optimised profile was then used to calculate the full suite of cost data required for review.
- Company cost variations from the base case for each scenario were applied in an external model (supplied by Oxera) to provide an estimate of the impacts on customer bills over the 25 year profile.

[3.10] UKWIR, “A Framework for Accounting for Embodied Carbon in Water Industry Assets”, Ref 12/CL/01/15, 2012

3.6.4.2 Sample result: the base case from the SELL model

Figure 3.23 and Figure 3.24 show the results for our baseline forecasts.

In the baseline scenario the least cost leakage levels for SWW and BW were constrained by available supply, rather than being at a point where total company costs have begun to increase with leakage. This is reflected on the charts by the sudden drop towards the higher end of the x-axis range. For SWW this represents a mean annual leakage level of 94 Ml/d, with a range from 100 Ml/d in the earlier years to 83 Ml/d at the end of the 25 year projection. For Bournemouth Water, the base scenario has a mean of 31 Ml/d and a range from 36 Ml/d to 26 Ml/d.

The current leakage level in South West Water is 84 Ml/d and 19 Ml/d in the Bournemouth Water resource zone. The model shows that it would currently be lower cost to operate at a higher leakage level.

Customers value leakage highly and Figure 3.23 and Figure 3.24 show the impact on the net cost if customer 'willingness to pay' (WTP) is included. This shows that the long-term economic level of leakage could be in the range of 50 to 70 Ml/d in the South West Water zones and 16 to 19 Ml/d in Bournemouth Water. This is discussed in more detail in Section 7.

Figure 3.23: SWW – costs over 25 years at a given mean leakage level

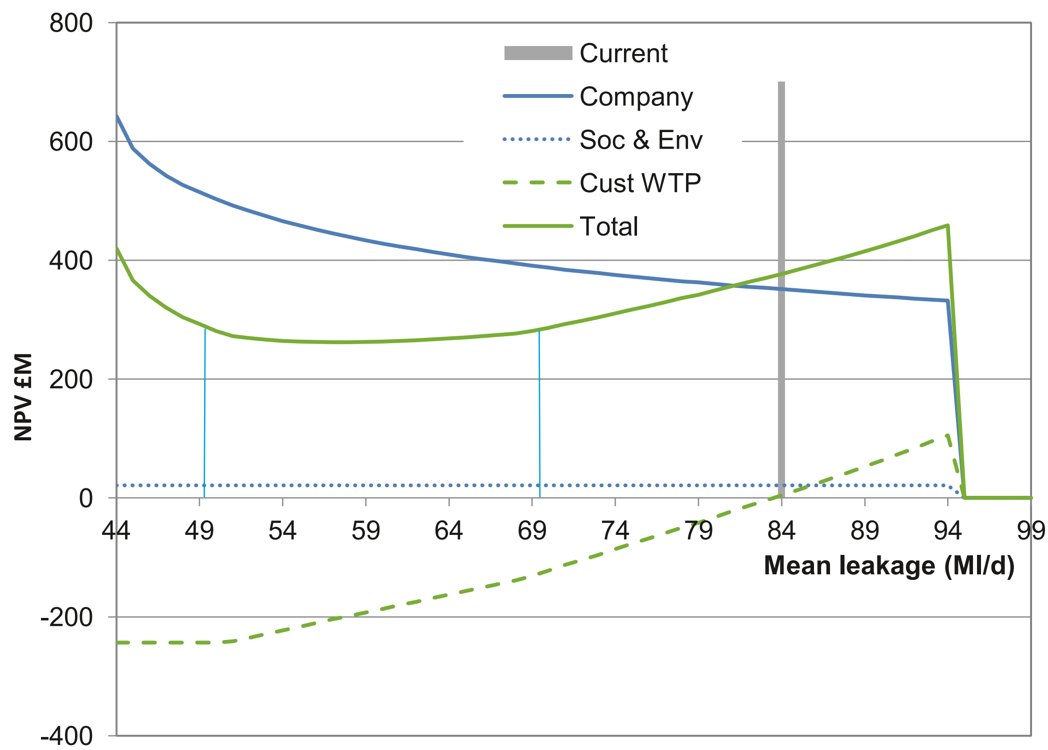
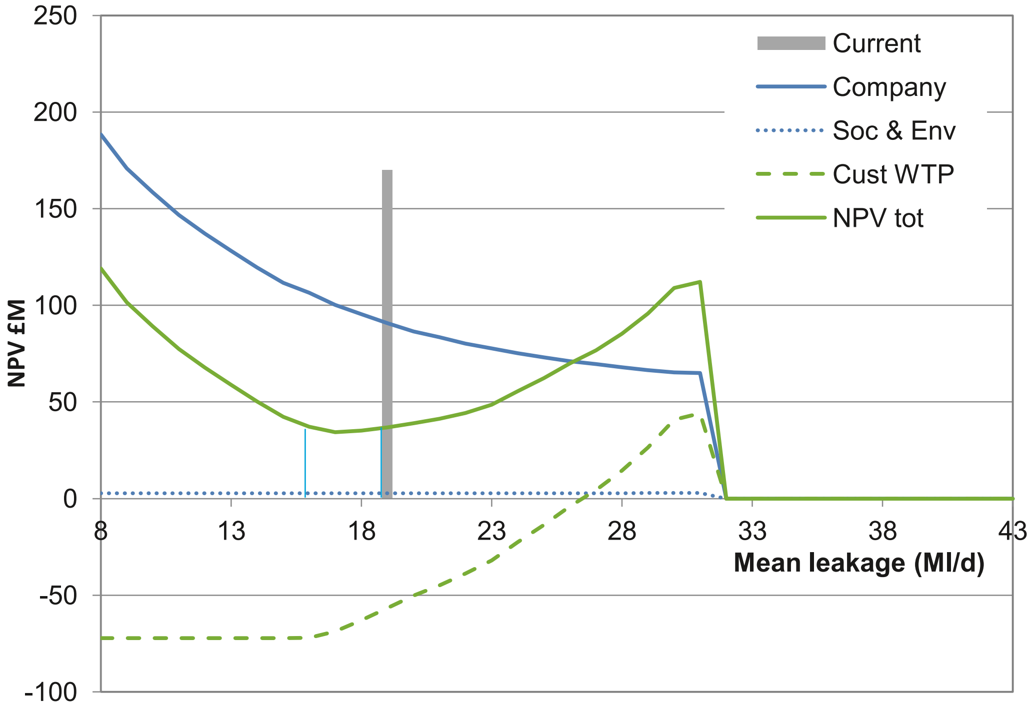


Figure 3.24: BW – costs over 25 years at a given mean leakage level



A full set of charts for scenarios at WRZ level, is supplied in Section A.3.4.

3.6.5 <u>Meeting our leakage target</u>

We have continually met our leakage targets in this AMP. Maintaining this level has been challenging and has required us to manage leakage control operations in the most efficient way. While our leakage target in the South West Water area remains at 84 Ml/d until 2019/20, we have an internal target to reduce to 81 Ml/d over this time. With the continued housing growth and the resultant expansion of our network, this requires reductions in both the average leakage per property served, and the average leakage per kilometre of main. As our target for the future remains below the economic level, this level of challenge will remain.

In the scenario analysis in Section 7 we explore different policy choices on leakage reduction and use the SELL modelling to understand cost, but we also assess the wider benefits of continual leakage reduction.

3.7 Other components of demand

3.7.1 Water taken unbilled

Water taken unbilled can be taken both legally and illegally. Close to 90% of the water taken legally unbilled is used in the operation of our waste water treatment works, the small remainder includes water used for fire fighting and highway washing. Examples of illegal use are connections that have been made to our distribution system without permission and consumption at void properties which have been occupied without us having been informed. Where we have evidence of water being taken illegally, we investigate and bring prosecutions where necessary.

We have assumed that there will be a slight drop in the amount of water taken illegally unbilled as consumption at void properties will fall. This is the result of more properties becoming measured, allowing us to easily identify and bill for water that has been used.

In Section 5 we present options for reducing our own water use at waste water treatment works.

3.7.2 Distribution system operational use

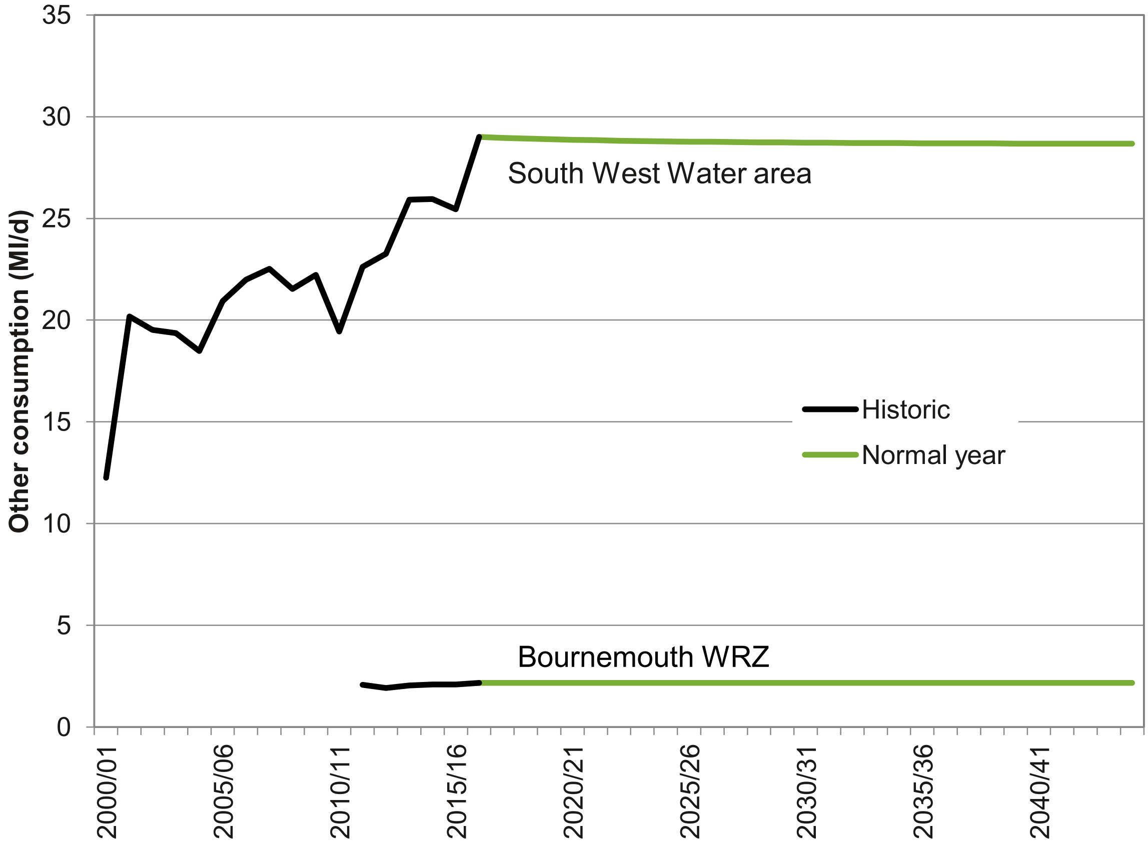
This component of demand covers the water that we use in the operation and maintenance of our distribution system for purposes such as mains flushing and service reservoir cleaning. We have assumed that the volume of water we use for these purposes will remain at the current level for the duration of the planning period.

3.7.3 Overall forecast of other components

The forecast of the total of these other components of demand are shown in Figure 3.25. The chart does not show both dry and normal year forecasts as the only difference between them is the additional consumption of occupied void properties during a dry summer, which is very small. Likewise the critical period forecast for the Bournemouth WRZ does not differ significantly from the normal year forecast, so is not shown separately either. The historic increase in consumption is the result of increased levels of metering at our waste water treatment works, which has shown that actual consumption was higher than we were previously estimating.

We have used this information to help develop the options for our plan. In Section 6 we set out feasible options to reduce water use at these wastewater treatment sites. In Section 8 we set out which ones of these we have included in our proposed Plan in order to reduce their consumption and reduce the overall demand for water on our system.

Figure 3.25: Forecast of other components of demand



3.8 Total demand

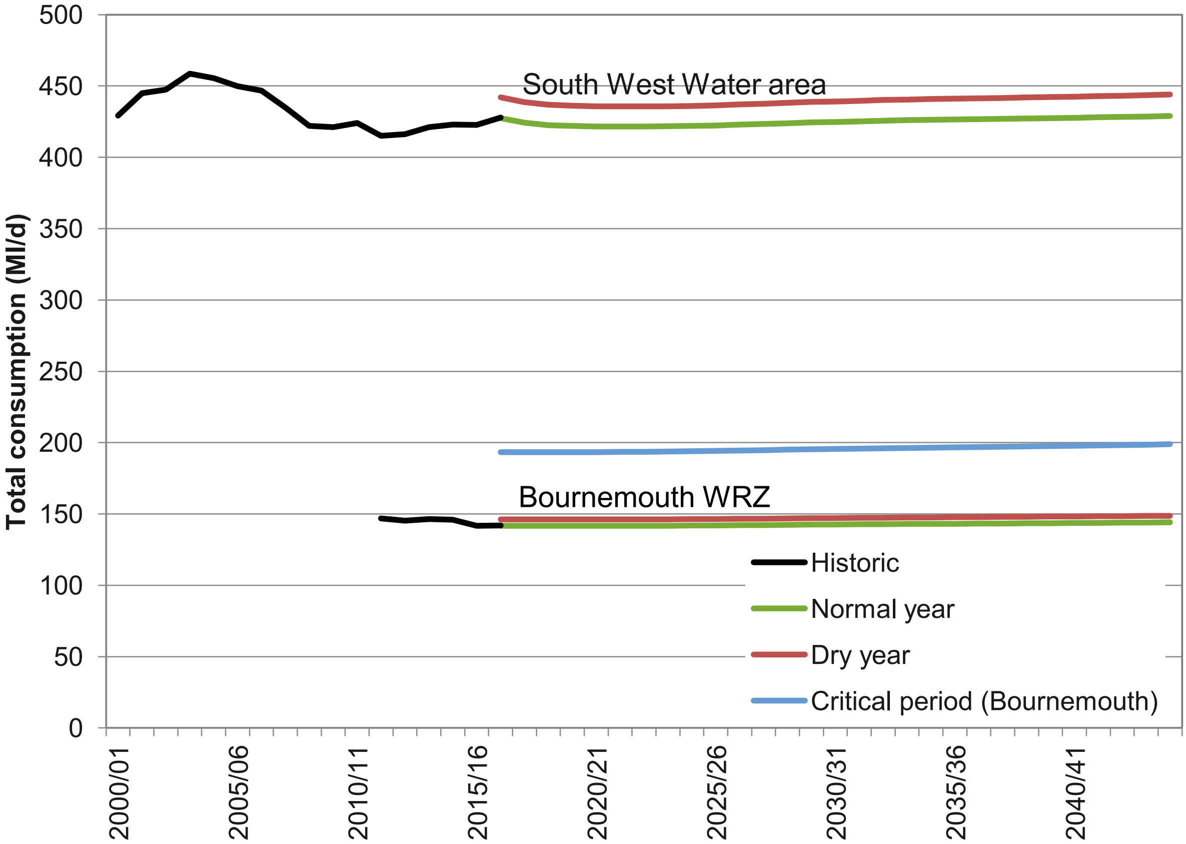
3.8.1 Summary of forecast demand

Our baseline demand forecast has been prepared assuming that we continue our current metering programme, water efficiency activity, and maintain leakage at our targeted 2019/20 leakage level of 81 Ml/d in the South West Water area, and 19 Ml/d in the Bournemouth WRZ. We have also assumed a continuation of our existing capital maintenance and mains renewal policies. We do not envisage that the total demand will be materially affected by any changes brought about by the non-household retail market or other possible market developments in our resource zones.

We predict that total demand will initially fall slightly, driven by household water savings. With a high level of metering in the base year, additional water savings will become more difficult without new promotion, leading to continued population growth driving demand upwards. We forecast that total normal year demand will rise from its current level of 428 Ml/d in the South West Water area, and 142 Ml/d in the Bournemouth WRZ, to 429 Ml/d and 144 Ml/d respectively. Our total forecast is shown in Figure 3.26.

The sensitivity of our supply demand forecast to higher demands is reported in Section 7.

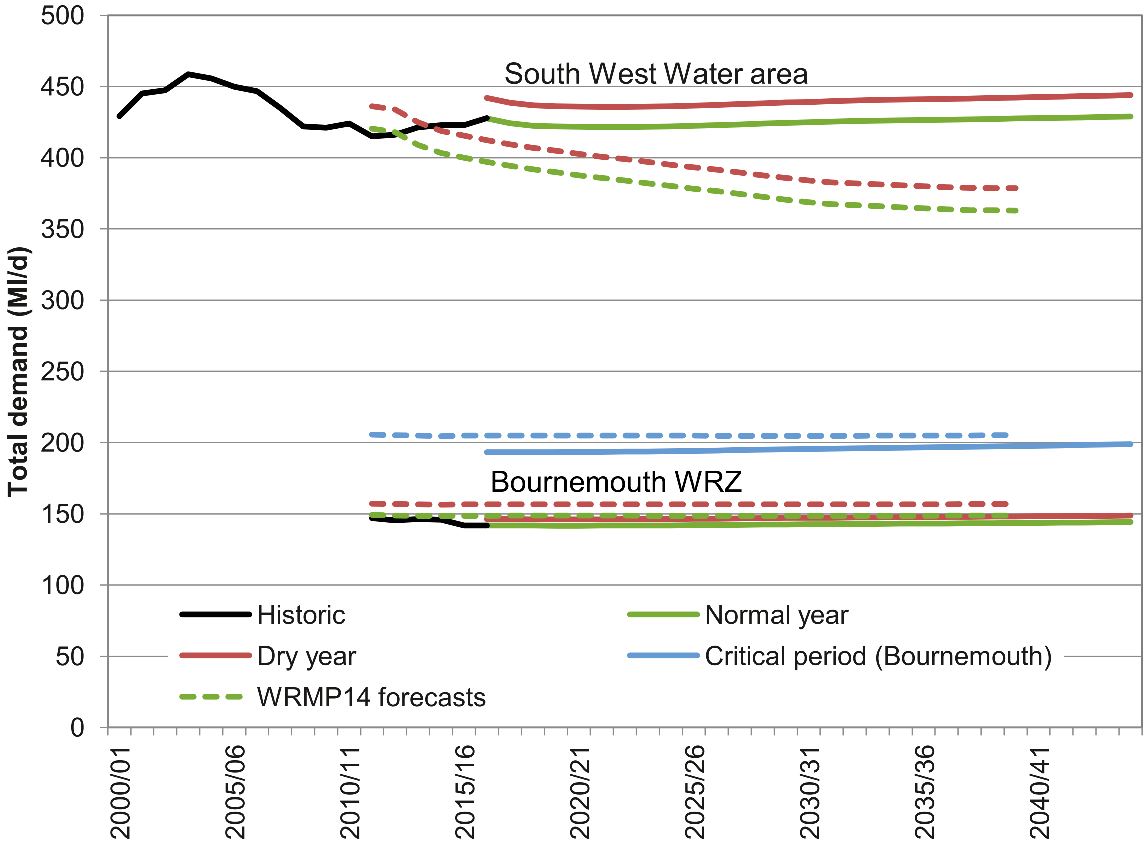
Figure 3.26: Total baseline demand forecast



For comparison purposes, Figure 3.27 shows our demand forecasts against those made in 2014 WRMPs. Some of the reasons for the differences between our current and previous forecasts are described in Sections 3.4.7 and 3.5.6, which describe differences in the household and non-household forecasts respectively.

In addition to these differences there is a further change between the current and previous baseline demand forecasts for South West Water. In our 2014 WRMP we included a reduction in leakage to 64 Ml/d in our baseline forecast. In this plan we have considered leakage reduction in our final planning scenario, not our baseline demands. This is to make it more transparent on the decision making process on leakage reduction.

Figure 3.27: Total baseline demand forecast shown against 2014 WRMP forecasts



3.8.2 <u>Profile of annual demand</u>

Our work to date does not show any large scale change in the annual profile of demand. The weekly demand profiles used in our calculation of water supply (Section 2) are therefore not expected to change materially over the planning period.

The Bournemouth WRZ is constrained by peak week demand. Detailed weekly demand profiles through the year are therefore not required for a full appraisal of the supply demand balance.

We can occasionally experience higher levels of demand for short periods during the winter as a result of freezing and subsequent leakage. However, in all of our resources zones, this level of demand has historically always been lower than the summer peak we plan for in a dry year. Given the nature of our water resources, these short periods of high winter demand have no impact on our estimation of Deployable Output (DO). Therefore for the purposes of this Plan we represent winter demand by more typical values.

3.9 Limitations of demand forecasts and plans for development

Forecasts of long-term demand changes will always entail uncertainty. Factors that can impact consumption include: population growth, housing development, customer behaviour, development of new technology, the state of the economy and a changing climate. It is important to produce a plan that considers these uncertainties inherent within our demand forecasts and is robust to a wide range of plausible futures.

We have approached this uncertainty in two ways:

- We have added headroom to our demand forecasts, providing a safety buffer should our forecasts underestimate future demand. This is described in Section 4 of this report.
- We have considered how our plan will cope should forecast demand differ significantly from our forecasts. Two different scenarios have been considered; one which covers household demand being higher than forecast, and a second that looks at higher non-household demand. These scenarios are shown in Section 7 of this report.

While there will always be significant uncertainty over future long-term demand, there are some things that we plan to do before our 2024 Water Resources Management Plan to develop our forecasting capability. Central to these plans is an expansion of our household consumption monitor, particularly in the Bournemouth WRZ where we are currently reliant on small area monitors.

Deploying more high-frequency loggers will provide a much improved understanding of the both the level and seasonality of household consumption. Additionally these loggers will provide sufficiently detailed consumption data to allow the identification of the purpose to which the water is put, providing excellent quality data for micro-component analysis.

We also intend to deploy further loggers on non-household properties, particularly those in the agriculture and tourism sectors, which are very important in our region.

The improvement in our understanding of seasonality, and the detail of consumption patterns, opens the opportunity of moving towards a stochastic (or risk based) understanding of demand. As presented in Section 8 of our proposed plan, we intend to move to risk based demand forecasting for WRMP 2024. This will give additional risk based data, providing more detail on the challenges higher (or lower) demand has on our future plans.

4. Target headroom

- We have calculated Target Headroom for each Water Resource Zone
- We have used a level of uncertainty from 95% declining to 85% through the planning period
- We have not included any uncertainty for vulnerable abstraction licences

4.1 Method

We have included an allowance for uncertainty in our forecasts by calculating target headroom. A water company's target headroom is defined as 'a buffer between supply and demand designed to cater for specified uncertainties' (Environment Agency, Water resources planning guideline, June 2012). The purpose of including a headroom allowance within the supply/demand balance is to include a margin between supply and demand to allow for the risk of variations in the forecast due to uncertainty in specific components. We commissioned consultants AECOM Ltd to assess an appropriate target headroom on our behalf. The target headroom assessment report is provided in Appendix 4.

4.1.1 Target headroom

Within the water resources planning guidelines there are two methods available for the calculation of target headroom, developed by UKWIR in 1998 and 2003 respectively:

- 'A Practical Method for Converting Uncertainty into Headroom' (UKWIR, 1998): a relatively simple, pragmatic approach which attempts to quantify uncertainty by a judgement-based proforma system; and
- 'An Improved Methodology for Assessing Headroom' (UKWIR, 2003): a more analytical approach to the determination of uncertainty through probabilistic simulation.

We have adopted the more improved approach of the 2003 methodology. In this approach, a probability distribution is assigned to each individual risk or uncertainty factor within the supply/demand balance. These are then combined and analysed using a Monte Carlo simulation. The approach used @RISK software in conjunction with the Microsoft Excel spreadsheet package. This assessment found that consistent results were obtained using 10,000 iterations.

We calculated target headroom separately for each WRZ.

Two planning scenarios have been considered in this headroom assessment:

- Dry year annual average (all WRZs); and
- Dry year critical period (Bournemouth WRZ only)

4.1.2 Calculation of target headroom

The types of uncertainty, relating to both supply and demand factors, as specified in the UKWIR methodology “An Improved Methodology for Assessing Headroom” (UKWIR, 2003) are shown in Table 4.1.

Table 4.1: Headroom Uncertainty Factors

Factor	Name
S1	Vulnerable surface water licences
S2	Vulnerable groundwater licences
S3	Time limited licences
S4	Bulk imports
S5	Gradual pollution
S6	Accuracy of supply side data
S8	Impact of climate change on deployable output
S9	New sources
D1	Accuracy of sub-component demand data
D2	Demand forecast variation
D3	Impact of climate change on demand
D4	Demand management measures

The assumptions used to inform the headroom analysis are summarized in Table 4.2. For comparison purposes, the assumptions made for the WRMP14 headroom analysis are also shown.

Table 4.2: Summary of assumptions informing the headroom analysis – WRMP14 and dWRMP19

Factor	WRMP14	dWRMP19
	Supply related	
S1 - Vulnerable surface water licences	No vulnerable surface water licences identified.	No change.
S2 - Vulnerable groundwater licences	No vulnerable groundwater licences identified.	No change.
S3 - Time limited licences	Environment Agency guidelines preclude these from the headroom analysis.	No change.
S4 - Bulk imports	No bulk imports into any WRZ's.	No change.
S5 - Gradual pollution causing a reduction in abstraction	No sources at risk in any WRZ.	No change.
S6 - Accuracy of supply-side data		
S6/1 - Uncertainty for yields constrained by pump capacity	No allowance included: groundwater DO assessments use actual pumping rates rather than nominal pumping capacities or groundwater sources are constrained by licence. BW main GW sources constrained by licence therefore this component does not apply	No change.
S6/2 - Meter uncertainty for licence critical sources	95% probability that the reading is within ±5%. Error is distributed normally around a mean of 0Ml/d. Standard deviation of ±2% of the total DO, distributed normally around a mean of 0Ml/d used in BW.	No change for SWW. Bournemouth WRZ uncertainty increased to +/- 5%.
S6/3 - Uncertainty for aquifer constrained groundwater sources	No allowance included: Wimbleball has some aquifer constrained sources however a high confidence in the ability of the drought curve to estimate the source performance meant it was not included. BW main groundwater sources constrained by licence therefore this component does not apply.	No change.
S6/4 - Uncertainty for climate and catchment characteristics affecting surface waters	95% probability that the value is within ±10%. Error is distributed normally around a mean of 0Ml/d. Not included in BW.	No change for SWW. Same uncertainty applied to Bournemouth WRZ.

Factor	WRMP14	dWRMP19
S8 - Uncertainty of impact of climate change on source yield	Triangular distribution with upper and lower bounds of the impact of climate on supply, and the best estimate is the difference between the two.	No change; however new methodology to determine the upper and lower bounds used.
S9 - Uncertain output from new resource developments S9	No allowance included.	No change.
	Demand related	
D1 - Accuracy of sub-component data	95% probability that the recording is within ±2.5%. Error is distributed normally around a mean of 0Ml/d. Standard deviation of ±2% distributed normally around a mean of 0Ml/d used in BW.	No change for SWW. Bournemouth WRZ uncertainty increased to ±2.5%.
D2 - Demand forecast variation	Triangular distribution starting with 0 variation in first year, leading linearly to ±15% at the end of the planning period. Uncertainty from the baseline demand forecast used in BW.	No change for SWW. WRMP14 SWW uncertainty applied to Bournemouth WRZ.
D3 - Uncertainty of impact of climate change on demand	Increase in consumption by 1% at the end of the planning period, ±20% for headroom – triangular distribution. Not considered by BW as was assumed to be included in the baseline demand forecast.	Increase in consumption by 0.71% in Colliford, 0.74% in Roadford, 0.72% in Wimbleball and 0.54% in Bournemouth.
D4 - Uncertain outcome from demand management measures	Assumed saving of 0.75Ml/d every year thought the planning period. Estimated pro rata on the basis of forecast DI between the three WRZs. Triangular distribution with 0 as most likely, ±10% Not included in BW.	Same saving and uncertainty applied; however saving is estimated pro rata on the basis of forecast distribution input, estimated from historical trends, between the four WRZs, to include Bournemouth WRZ.

4.1.3 Summary of key changes in assumptions from WRMP14

4.1.3.1 Bournemouth Water alignment with SWW

For some headroom factors, the WRMP14 for Bournemouth Water applied slightly different assumptions to those used in the SWW WRMP14. These were in the S6/2 and D1 components. For this analysis we reviewed these and have adopted a common approach in all zones

4.1.3.2 Climate Change methodology

The assessment is consistent with WRMP14 in all categories except for the categories assessing the impact of climate change on deployable output (S8). There has been a change in the methodology for estimating the impact of climate change on WAFU (including uncertainty) since WRMP14. Previously, UKCP09 monthly flow factors were used to obtain “dry” and “wet” predictions, which were used to give an estimate of uncertainty to include in the headroom.

The new guidance specifies that where a WRZ is classified as Low Vulnerability and rainfall-runoff models are available, a “Tier 2” analysis should be undertaken as a minimum[4.1]. This involves the use of 11 climate data scenarios from the UKCP09 Spatially Coherent Projections (SCPs) to generate monthly climate change factors for precipitation and PET to carry out rainfall-runoff modelling. This is the case for our groundwater sites and this methodology was used to produce monthly yields for our groundwater sources. These groundwater yield profiles were then input into our conjunctive use models in order to model climate change impacts on WAFU for each WRZ.

Our WRZs are predominantly surface water systems and hence our conjunctive use models are driven mainly by historic river flow and reservoir inflow sequences. The new climate change guidance specifies that where a WRZ is classified as Low Vulnerability and rainfall-runoff models are not available, a “Tier 1” analysis should be undertaken as a minimum[4.2]. We do not have rainfall-runoff models for our surface water inflows because our historic rainfall data is much less robust and reliable than our historic river flow and reservoir inflow data. This assessment therefore used a dataset consisting of 11 equally likely scenarios of hydrology to 2085/86 (Future Flows hydrology monthly change factors scenarios) to determine the minimum, mean and maximum climate change impacts on WAFU. These WAFU values were then scaled to produce estimates for each year in the planning period. See Section 2.3.5.5 for details on the scaling method used.

Further details of the methodology are provided in Appendix 4.

[4.1] Environment Agency, June 2016. *Estimating impacts of climate change on water supply*
[4.2] *Ibid. 4.1*

4.1.4 Available headroom

The available headroom in a WRZ is defined as the difference between the Water Available for Use (WAFU, which is Deployable Output (DO) including raw water imports less raw water exports, less outage) and the Dry Year Annual Average Unrestricted Daily Demand. If the available headroom is predicted to be less than the target headroom, then we should take action to avoid the risk of failing to meet our chosen level of service. Section 5 shows that all our WRZ have sufficient available headroom over the planning period.

4.2 Target headroom

4.2.1 Target headroom and the appropriate level of risk

The choice of the target headroom allowance requires that a balance is made between the costs and risks to customers and the environment afforded by a low allowance against those of a high allowance. This involves judgment of an appropriate level of risk to include in the forecasts.

For this plan we have determined the acceptable level of risk to be 95% in the beginning of the planning period, falling to 85% by 2045. This is considered to be appropriate in order to ensure headroom is not so large that it drives unnecessary expenditure, but equally not so small that it leaves the possibility that the planned level of service cannot be met. A higher level of risk is more acceptable in the future than in the early years (first 5 years) because as time progresses, the uncertainties for which headroom allows reduce and there is more time to adapt to any changes. This is in line with the Environment Agency's Planning guidelines[4.3] which promote the use of a glide path approach. The level of risk allowed for in the short term is consistent with Ofwat requirements[4.4] which state that for target headroom companies should use 95% uncertainty (or equivalent for complex methods) for the first five years of the planning period forecasts.

Our choice of allowance in the long term is our judgment on an appropriate level. Our customers consider a safe and reliable water supply as their number one priority. Our supply region economy is dominated by tourism and therefore we think it is appropriate to take a balanced view of whilst taking wider factors in to account. Lower or higher long term levels could be chosen, however, as shown in Section 8, we have chosen a flexible plan that can adapt and the choice of the percentile uncertainty in the long term does not drive new water resource schemes in our Plan.

Table 4.3 shows how the target headroom allowance changes for the level of uncertainty chosen, in this case for the end of the planning period in 2045. The 85% level of confidence, used in our supply-demand balance calculations, is highlighted.

[4.3] Environment Agency and Natural Resources Wales (2017) , *Interim WRPG update, FINAL-April 2017*
[4.4] Ofwat (2017), *Delivering Water 2020: consultation on PR19 methodology Appendix: Outcomes technical definitions*

Table 4.3: Target headroom at the end of the planning period (2044/45)

WRZ	Probability								
	55%	60%	65%	70%	75%	80%	85%*	90%	95%*
Colliford WRZ (Ml/d)	0.79	2.59	4.44	6.49	8.45	10.74	**13.31**	16.62	21.07
Roadford WRZ (Ml/d)	2.13	4.58	7.23	9.99	12.78	16.16	**19.90**	24.68	31.73
Wimbleball WRZ (Ml/d)	0.49	1.41	2.30	3.33	4.42	5.73	**7.15**	9.04	11.65
Bournemouth WRZ DYAA (Ml/d)	1.76	3.58	5.55	7.63	9.90	12.12	**14.89**	18.53	23.39
Bournemouth WRZ DYCP (Ml/d)	2.27	4.69	7.10	9.78	12.44	15.30	**18.71**	22.67	29.10

** Risk Percentile to be used at the end of the planning period (highlighted in bold)*

4.2.2 Target Headroom changes over the planning period

Figures 4.1a to 4.1e below summarise how the headroom uncertainty varies over time in each WRZ. These figures also show the target headroom we have included in our forecasts. It can be seen that generally the uncertainty increases with time however the glide path approach means that the headroom allowance is actually lower at the end of the planning period than it is at the start.

To prevent step changes in our forecasts, we smoothed the target headroom allowance across the planning period. Step changes would otherwise potentially give rise to discontinuities in decision making around the change point.

Figure 4.1a: Headroom uncertainty and varying risk percentiles and Target Headroom for Colliford WRZ

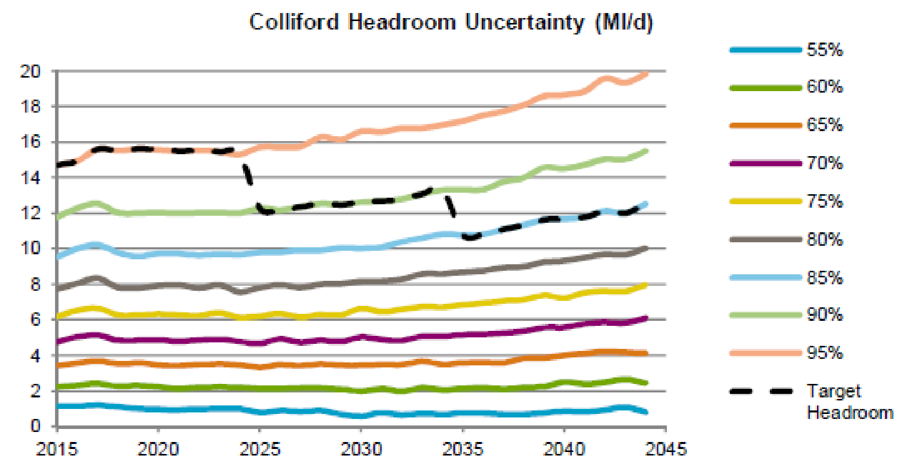


Figure 4.1b: Headroom uncertainty and varying risk percentiles and Target Headroom for Roadford WRZ

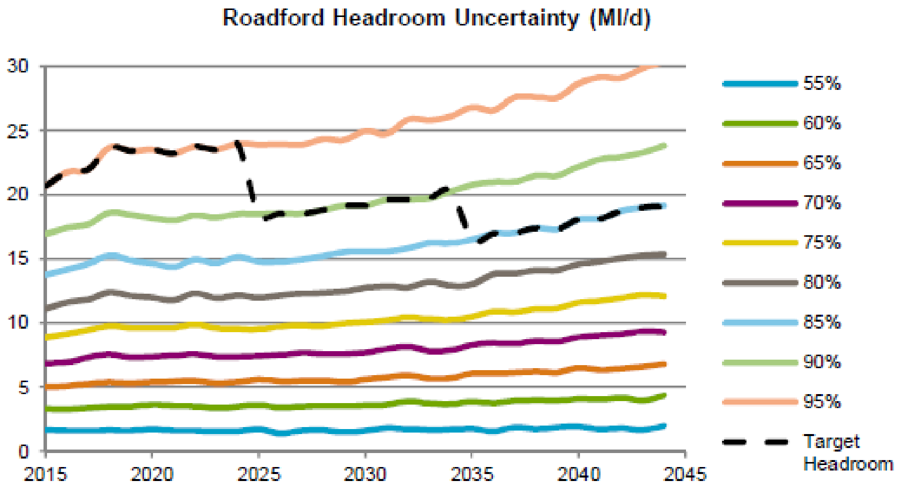


Figure 4.1c: Headroom uncertainty and varying risk percentiles and Target Headroom for Wimbleball WRZ

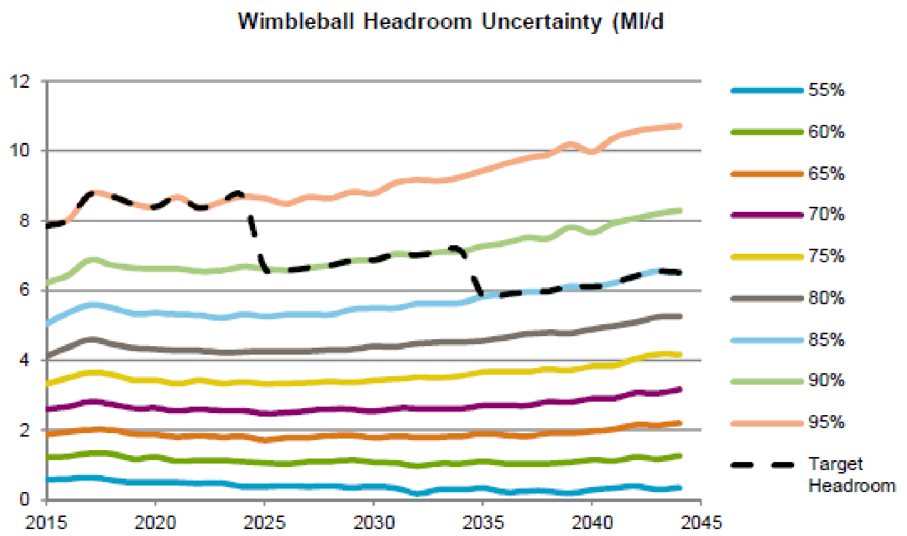


Figure 4.1d: Headroom uncertainty and varying risk percentiles and Target Headroom for Bournemouth WRZ DYAA

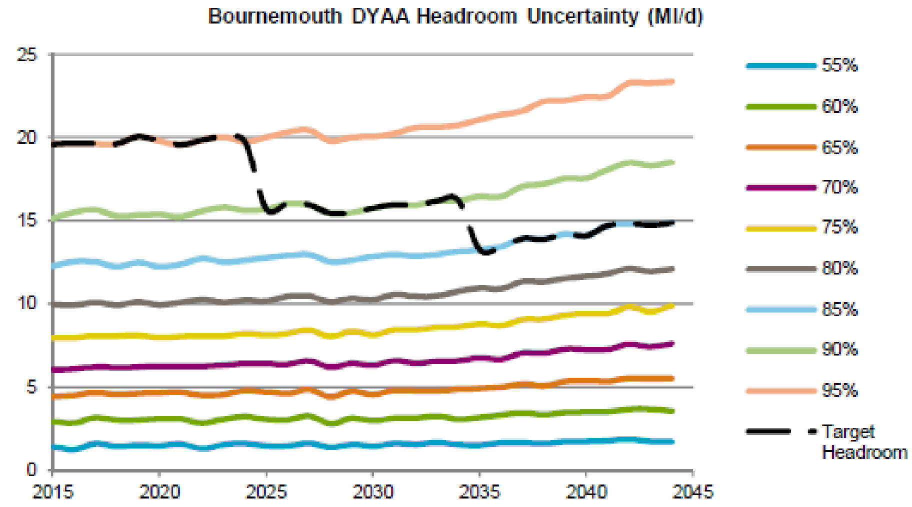
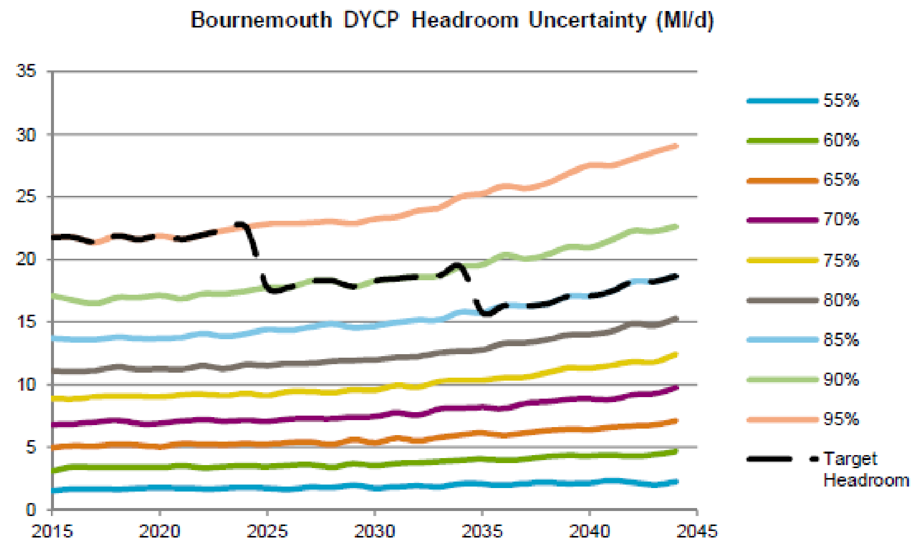


Figure 4.1e: Headroom uncertainty and varying risk percentiles and Target Headroom for Bournemouth WRZ DYCP



4.2.3 <u>Target headroom and the impact of individual components</u>

We have used a Monte Carlo approach to the assessment of target headroom in accordance with the guideline[4.5]. This produces a joint probability distribution by combining individual probability distributions in a stochastic manner. Therefore the isolation of an element of target headroom associated with an individual risk can be

[4.5] *Ibid.* 4.3

misleading. The sum of headroom values calculated from individual Monte Carlo simulations of sub-groups of headroom components is unlikely to be equal to one headroom calculation containing all the components. However, it is useful to show the scale of impact of the different components to highlight their relative significant in providing uncertainty.

The relative contribution of the different components of the target headroom assessment at the 85th percentile is shown below for each WRZ (figures 4.2a to 4.2e). Figures for both dry year annual average and dry year critical period are provided for the Bournemouth WRZ as this zone is assessed for the impact of high demands within a critical period as part of our supply demand balance analysis.

The uncertainty associated with the impact of climate and catchment characteristics on surface waters (S6/4) has the largest contribution to the headroom allowance across the whole planning period. As the forecast moves further into the future, uncertainties associated with the demand forecast variation and the impact of climate change on DO also increase.

Uncertainties associated with demand management measures and impact of climate change on demand also start to contribute to the headroom allowance towards the end of the planning period, with the latter contributing the least to the allowance in all WRZ's with the exception of Colliford.

Figure 4.2a: Relative contributions of different components to target headroom for Colliford WRZ

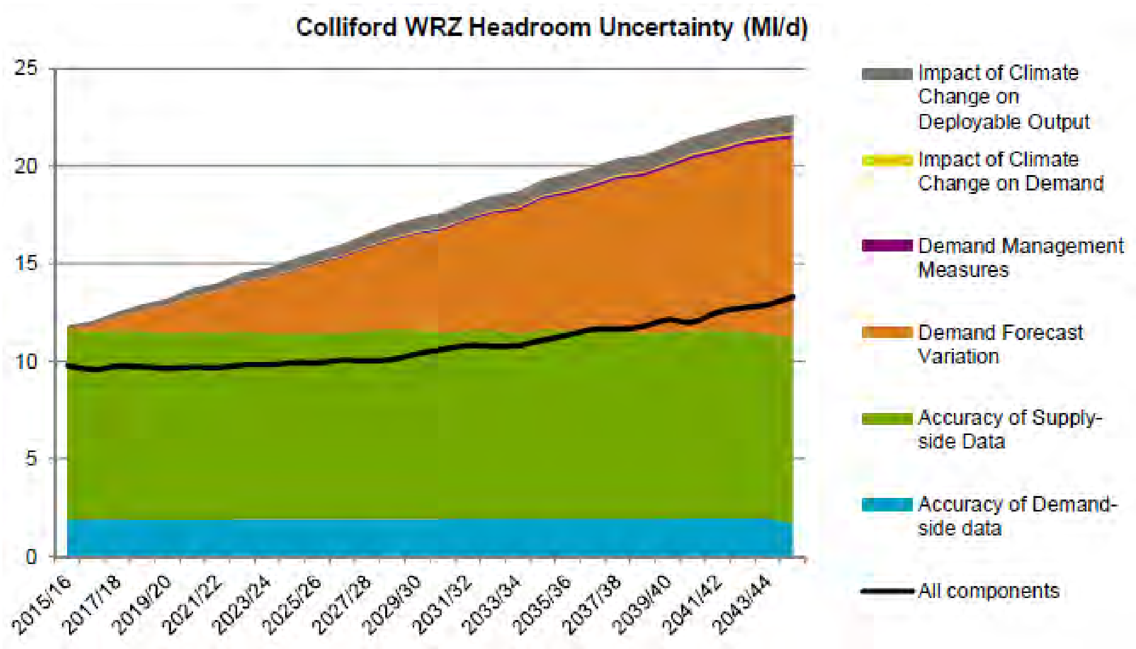


Figure 4.2b: Relative contributions of different components to target headroom for Roadford WRZ

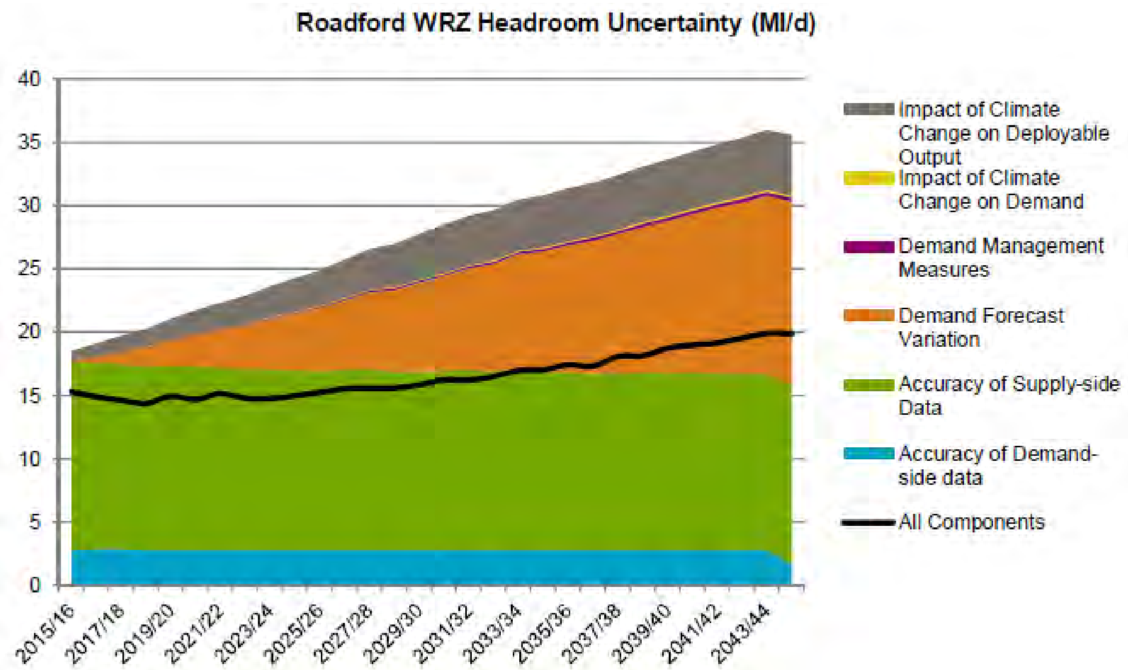


Figure 4.2c: Relative contributions of different components to target headroom for Wimbleball WRZ

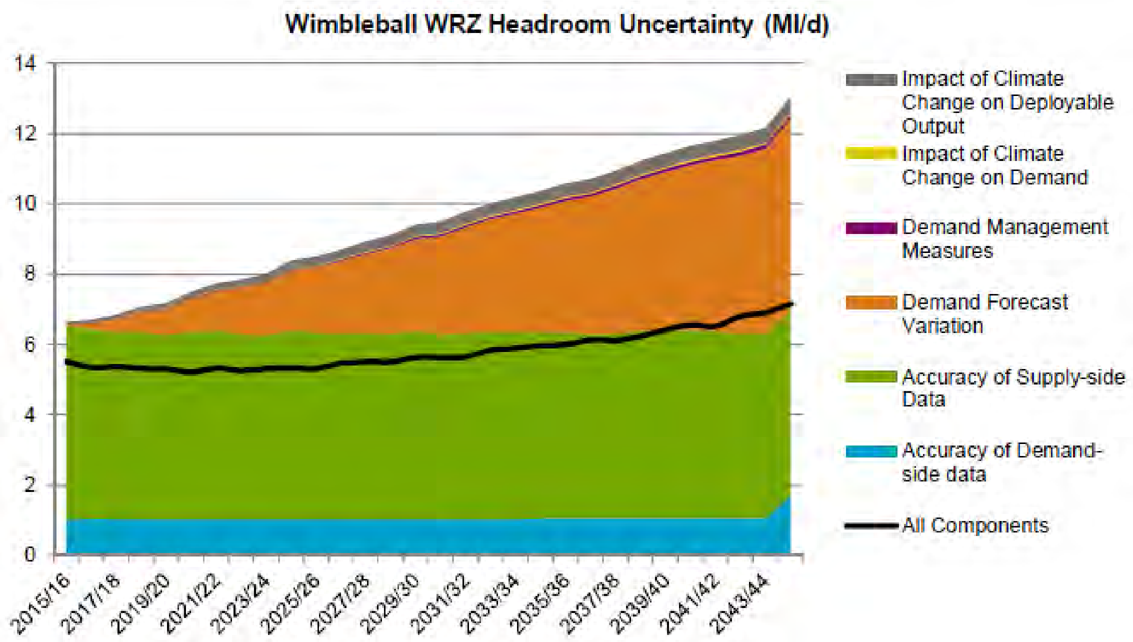


Figure 4.2d: Relative contributions of different components to target headroom for Bournemouth WRZ DYAA

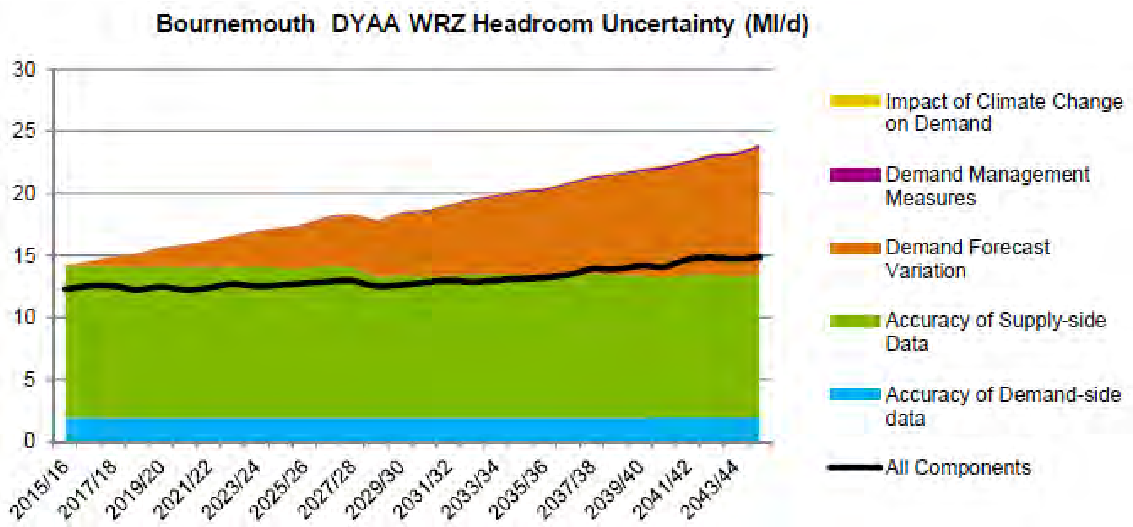
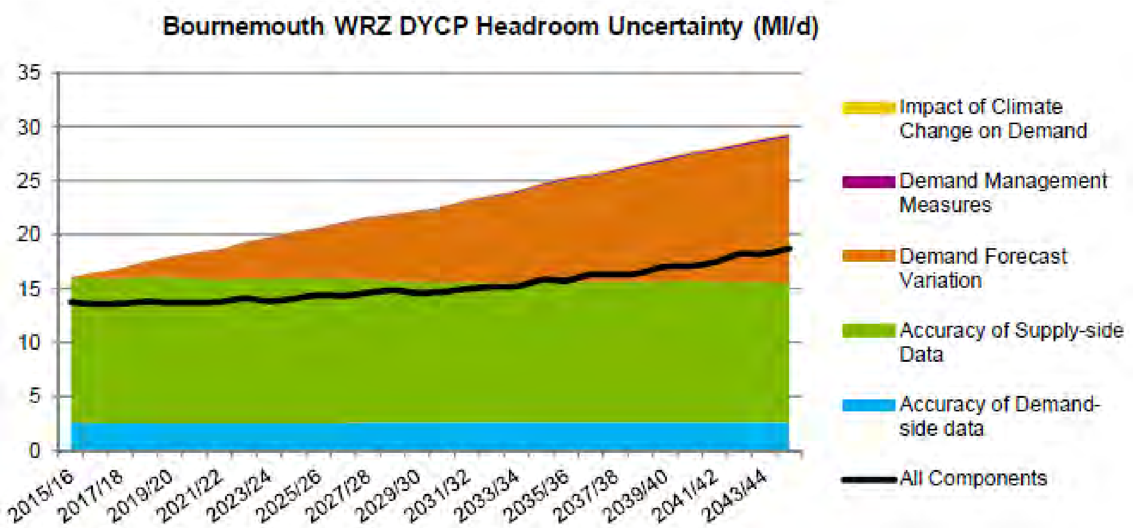


Figure 4.2e: Relative contributions of different components to target headroom for Bournemouth WRZ DYCP



4.2.3.1 Impact of Climate Change Uncertainty

The impact of climate change on the target headroom allowance has been assessed separately in accordance with the Environment Agency's WRPG (April 2017). The full results can be found in Appendix 4, whilst a summary of the results is shown in Table 4.5. It is clear the impact of uncertainty around the impact of climate change is small relative to some of the other headroom components. The impact of climate change in Bournemouth WRZ is particularly limited since there is no predicted impact on supply, only an impact of climate change on demand.

The relative importance of demand uncertainty and the impact of climate and catchment characteristics is significant in relation to our decisions in our final plan (Section 8).

The plan includes a small number of actions early in the planning period to help mitigate these risks. In doing so, we have used the target headroom analysis not only to plan appropriately for the future, but to also to inform the type of actions we should take.

4.3 Comparison with WRMP14

4.3.1 Changes to the risk profile

It should be noted that in WRMP14, the risk profile chosen was the 85th percentile at the start of the planning period, falling to the 70th by the end of the planning period. The chosen risk profile for the dWRMP19 assessment is the 95th percentile at the start of the planning period, falling to the 85th percentile by the end of the planning period.

Table 4.4 compares the 95th and 85th percentiles for the WRMP14 and dWRMP19 headroom analyses, in order to provide a like for like comparison.

Table 4.4: Headroom allowance summary and comparison with previous results

WRZ	Headroom allowance in WRMP14 (Ml/d)		Headroom allowance in dWRMP19 (Ml/d)	
	Start of planning period (95th Perc)	End of planning period (85th Perc)	Start of planning period (95th Perc)	End of planning period (85th Perc)
Colliford	15.53	15.50	15.53	13.31
Roadford	23.72	21.52	23.72	19.90
Wimbleball	6.66	7.50	8.71	7.15
Bournemouth (DYAA)	2.40*	3.90*	19.61	14.89
Bournemouth (DYCP)	2.80*	5.50*	21.80	18.71

** Only results from the 90th percentile were available for the Bournemouth WRZ headroom allowance for WRMP14.*

As can be seen in Table 4.4, when comparing the WRMP14 and dWRMP19 headroom values for the 95th and 85th percentiles, overall the headroom allowance for dWRMP19 at the start of the planning period is identical to the WRMP14 allowance for Colliford and Roadford WRZs and is similar for Wimbleball WRZ.

The dWRMP19 headroom allowance at the end of the planning period is lower than WRMP14 for the SWW WRZs. This is because the impact of climate change on the headroom allowance is much lower in this assessment than in WRMP14, as shown in Table 4.5. This is likely to be due to the change in the methodology for estimating the impact of climate change on DO (including uncertainty) since WRMP14.

For Bournemouth WRZ, the target headroom has increased between WRMP14 and this Plan, due to both the change to the acceptable level of risk selected (as described above and in Section 5) and to changes to assumptions for the S6/2, S6/4 and D1 target headroom factors (see Section 5). We have adopted a common approach in all WRZs for dWRMP19.

Table 4.5: Comparison of the contribution of climate change on the headroom allowance between WRMP14 and WRMP19

WRZ	Estimated contribution of climate change on headroom (%)		Estimated contribution of climate change on headroom (%)	
	Start of planning period WRMP14	End of planning period WRMP14	Start of planning period WRMP19	End of planning period WRMP19
Colliford	4.6	33.1	1.7	6.1
Roadford	3.9	28.7	4.9	19.7
Wimbleball	4.2	31.5	1.5	5.2
Bournemouth (DYAA)	N/a	N/a	0	0.5
Bournemouth (DYCP)	N/a	N/a	0	0.5

4.3.2 Allowing for climate change in the Bournemouth WRZ

It can be seen that the headroom allowance for Bournemouth WRZ is significantly higher than in WRMP14. This is because the WRMP14 assessment for Bournemouth did not take into account S6/4 as all their sources are licence-constrained and therefore they assumed that climate change would not impact supply. Following a review of the resource zone, it was decided that this approach was not appropriate in this assessment, as the purpose of the headroom assessment is to determine uncertainties regardless of whether the supply is considered to be sufficient. This combined with an increase in the uncertainty factors for S6/2 and D2 have resulted in a higher headroom allowance, since these three components have the largest impact on the headroom allowance as shown in the full analysis in Appendix 4.

By way of comparison, at PR14 the target headroom allowance was equal to approximately 5 Ml/d, or 1.5% of demand, to cover all uncertainties. As shown in Section 5, however, the baseline supply demand forecast is not sensitive to the choice of target headroom allowance in this zone.

5. Baseline position

- Our baseline forecasts show that Bournemouth, Roadford and Wimbleball WRZs are in surplus throughout the planning period
- Colliford WRZ is in surplus until the end of the planning period with a minor deficit of 1.1 Ml/d in 2044/45

5.1 Baseline supply demand balance

This section sets out our baseline supply demand balance forecast. It uses the data from Sections 2 to 4 and presents the results by WRZ.

The supply demand balance in all our WRZs has changed between WRMP14 and this Plan.

Changes in WRZ WAFU and demand between WRMP14 and this Plan are described in the relevant sub-sections below.

The changes in our baseline demand forecasts compared to WRMP14 are described in Section 3 of this report. In summary,

- Forecast demand in our South West Water WRZs is higher than previously forecast, due to the long-term trend of reducing household and non-household consumption that had been observed when we produced our last plan, levelling out
- We previously included planned leakage reduction in our baseline demand forecast, but in this Plan we have accounted for this in our final planning scenario instead to make our Plan more transparent
- Forecast demand in the Bournemouth WRZ is slightly lower than in WRMP14, which relates to non-household consumption being lower than expected.

Target headroom has increased between WRMP14 and this Plan for all WRZs. The main reason for this increase is the selected level of acceptable risk:

- For WRMP14 we determined this to be 85% at the beginning of the planning period, falling to 70% by 2040
- For this Plan, in line with Ofwat[5.1] and Environment Agency guidance[5.2], we have determined the acceptable level of risk to be 95% in the beginning of the planning period, falling to 85% by 2045.

[5.1] Ofwat (2017), *Delivering Water 2020: consultation on PR19 methodology Appendix: Outcomes technical definitions*
[5.2] Environment Agency and Natural Resources Wales (2017), *Interim WRPG update, FINAL-April 2017*

Other changes to target headroom between WRMP14 and this Plan are summarised in the relevant sub-sections below and described in more detail in Section 4.

The chapters below show our baseline supply demand balance position for each WRZ. Further detail is provided in Appendix 5.

5.1.1 Colliford WRZ

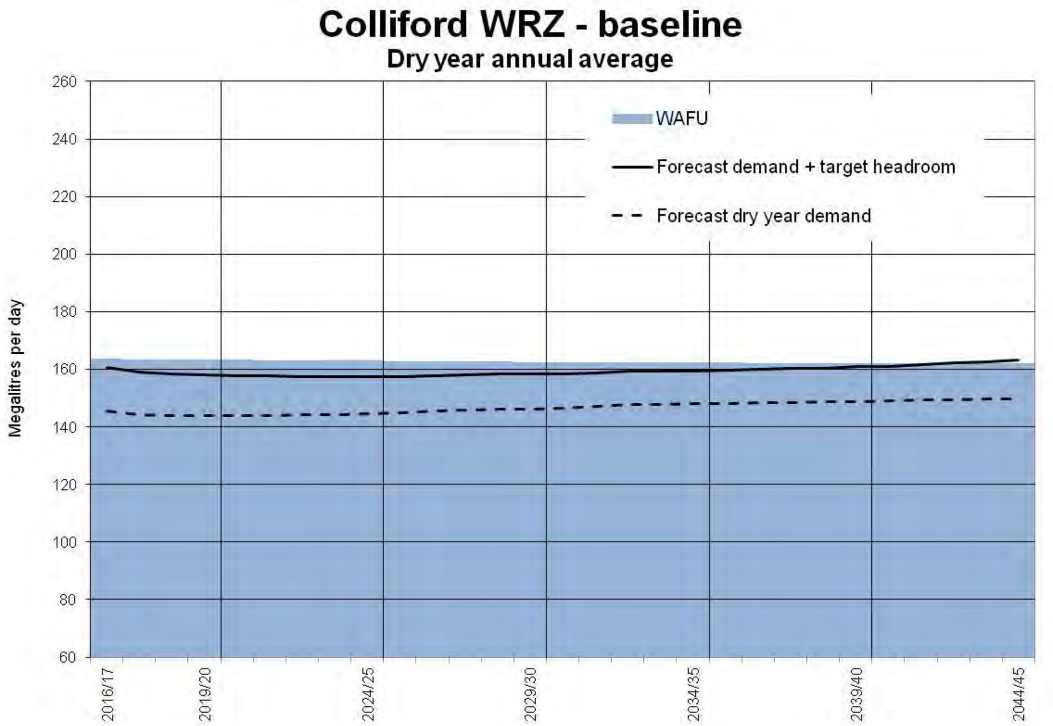
Figure 5.1 below shows how forecast demand plus target headroom in Colliford WRZ compares to the WAFU. WAFU falls slowly across the planning period due to climate change, whilst demand remains fairly flat, resulting in the WAFU remaining above demand plus target headroom throughout most of the planning period, with a minor demand deficit in 2044/45 (1.1 Ml/d).

WAFU has increased between WRMP14 and this Plan. Changes in the weekly demand profiles and forecast WIS zone demand relative to each other have reduced the peak to average demand ratio in south and west Cornwall. As part of the system modelling to determine WAFU, we reviewed all assumptions and constraints (e.g. reservoir control curves) to see if we can better optimise our operations. This showed that we could increase our capacity in this WRZ.

Target headroom has increased WRMP14 and this Plan, the main reason for this increase being the change to acceptable level of risk selected (as described in Section 5.1 above and in Section 4).

The increase in WAFU is offset by the increases in demand and target headroom, resulting in a much smaller supply demand surplus in this Plan.

Figure 5.1: Colliford WRZ baseline supply demand position



5.1.2 Roadford WRZ

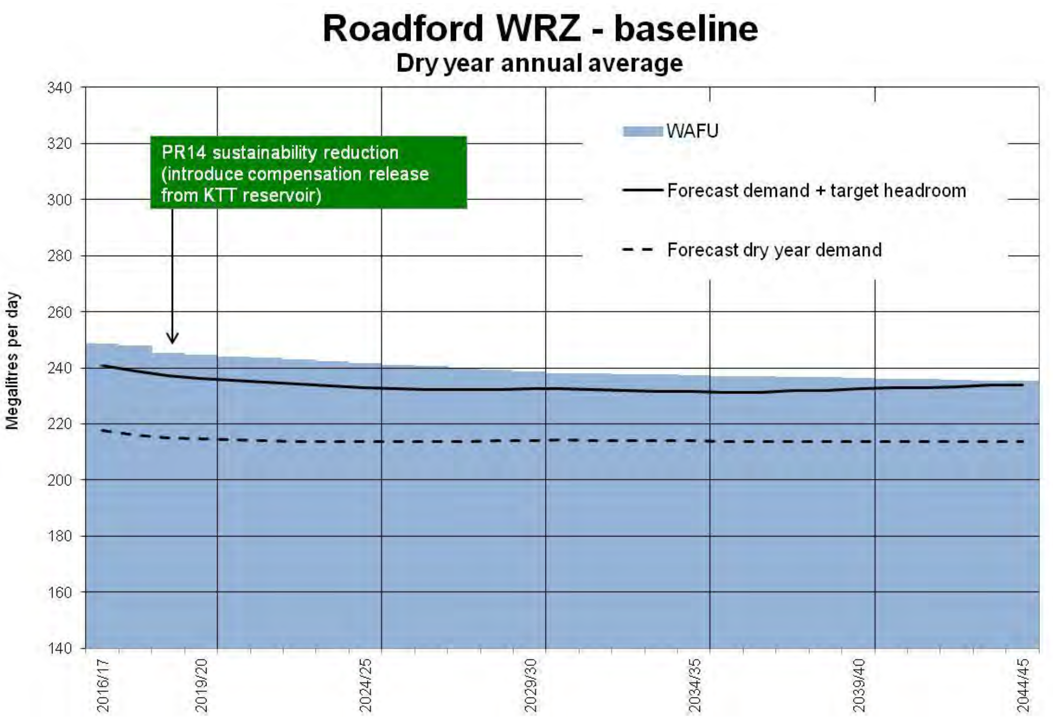
In addition to WAFU falling throughout the planning period as a result of climate change, a sustainability reduction of 2 Ml/d at one of our sources comes into effect in 2018/19. In spite of these reductions in WAFU, the WAFU in this WRZ remains above demand plus target headroom throughout the planning period (Figure 5.2).

WAFU across the planning period has changed very little WRMP14 and this Plan. Sustainability reductions that were forecast in WRMP14 have come into effect by 2016/17.

Target headroom has increased WRMP14 and this Plan, the main reason for this increase being the change to acceptable level of risk selected (as described in Section 5.1 above and in Section 4).

The increases in demand and target headroom have resulted in a much smaller supply demand surplus in this Plan.

Figure 5.2: Roadford WRZ baseline supply demand position



5.1.3 Wimbleball WRZ

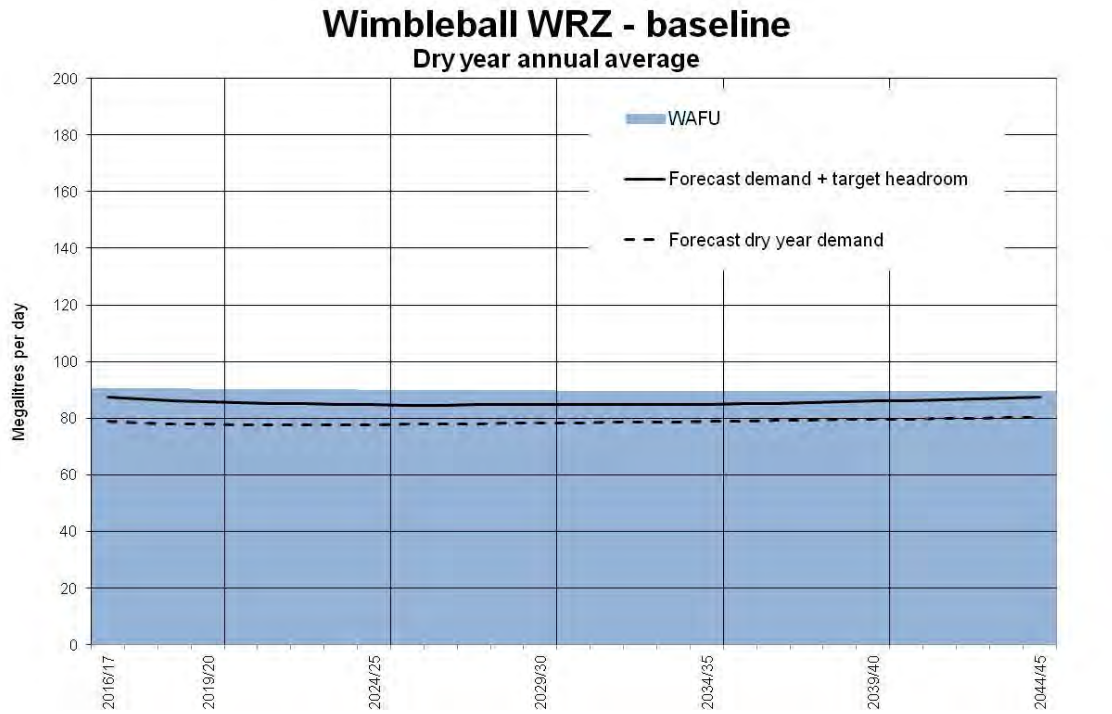
WAFU falls slowly across the planning period due to climate change, whilst demand remains fairly flat, resulting in the WAFU remaining above demand plus target headroom throughout the planning period (Figure 5.3).

WAFU across the planning period has changed very little WRMP14 and this Plan.

Target headroom has increased WRMP14 and this Plan, the main reason for this increase being the change to acceptable level of risk selected (as described in Section 5.1 above and in Section 4).

The increases in demand and target headroom have resulted in a much smaller supply demand surplus in this Plan.

Figure 5.3: Wimbleball WRZ baseline supply demand position



5.1.4 <u>Bournemouth WRZ</u>

In the BW supply area both the DYAA and DYCP WAFU have decreased between WRMP14 and dWRMP19. For this Plan, we did a full review of WTW capacities and WTW losses and operational use. This showed that during the peak demand period infrastructure constraints limit our WAFU. See Sections 2.7 and 7 for details.

Target headroom has increased WRMP14 and this Plan, due to both the change to the acceptable level of risk selected (as described in Section 5.1 above and in Section 4) and changes to assumptions for the S6/2, S6/4 and D1 target headroom factors. For these factors, the WRMP14 for BW applied slightly different assumptions to those used in the SWW WRMP14. For this Plan we reviewed these and have adopted a common approach in all WRZs. This has led to an increase in target headroom for both the Bournemouth WRZ DYAA and DYCP scenarios. Details of these changes are given in Section 4.

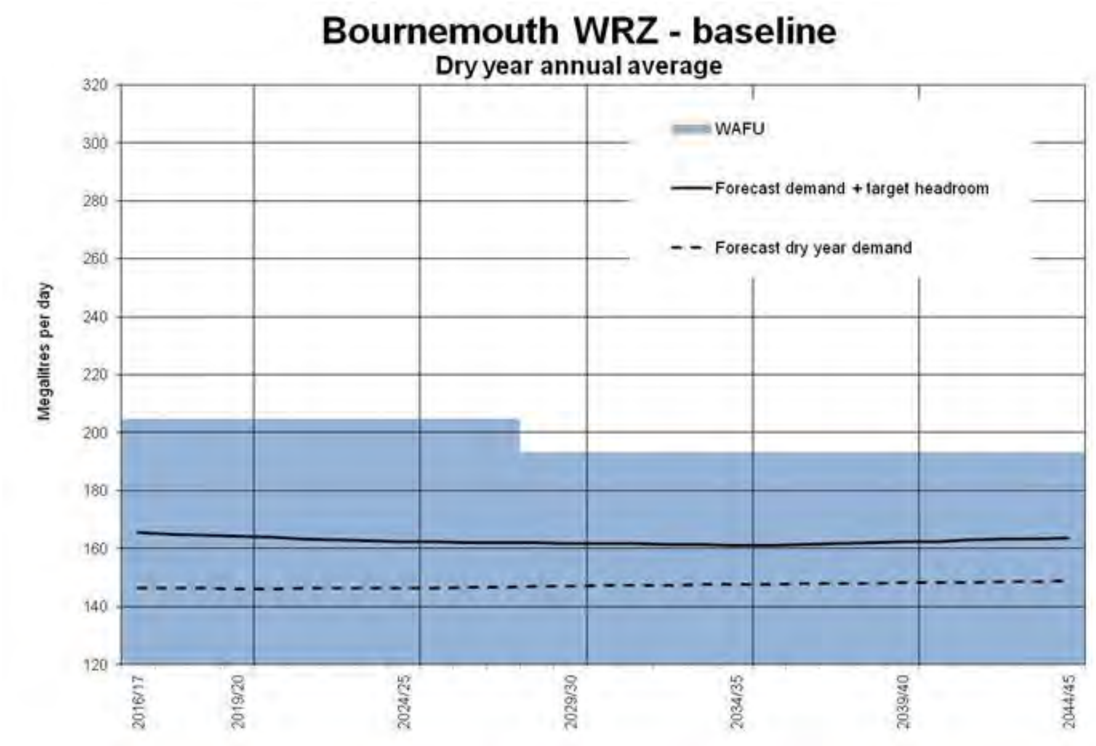
5.1.4.1 Dry year annual average (DYAA)

Figure 5.4 shows how forecast demand plus target headroom in Bournemouth WRZ compares to the WAFU, for the DYAA scenario.

There is no impact of climate change on WAFU throughout the planning period. There is a drop in WAFU in 2028/29 due to the weekly licence limit on one of the abstraction licences reducing.

The decrease in WAFU and the increase in target headroom have resulted in a smaller supply demand surplus in this Plan.

Figure 5.4: Bournemouth WRZ baseline supply demand position - DYAA



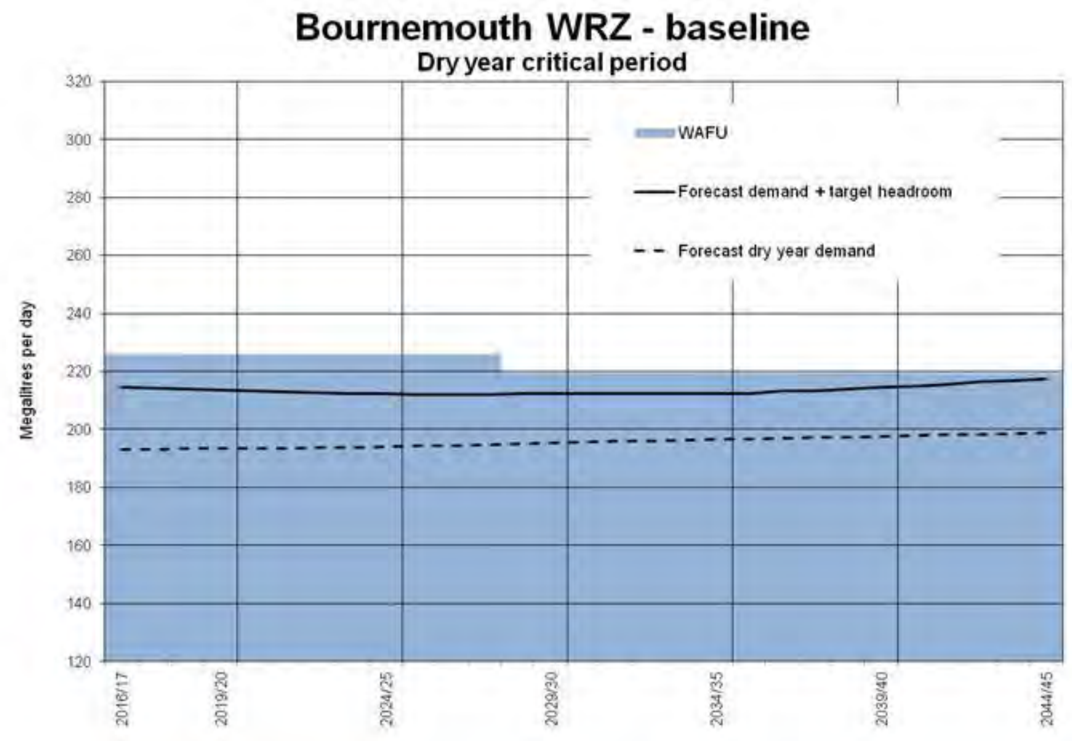
5.1.4.2 Dry year critical period (DYCP)

Figure 5.5 shows how forecast demand plus target headroom in Bournemouth WRZ compares to the WAFU, for the DYCP scenario.

There is no impact of climate change on WAFU throughout the planning period. There is a drop in WAFU in 2028/29 due to conditions on one of the abstraction licences changing.

The decrease in WAFU and the increases in demand and target headroom have resulted in a smaller supply demand surplus in this Plan.

Figure 5.5: Bournemouth WRZ baseline supply demand position - DYCP



5.2 Baseline plan performance

With the exception of a very small deficit at the very end of the planning period in Colliford WRZ, the baseline forecasts show all our WRZs are in surplus.

Our lowest cost plan will be to not undertake any new activity to maintain the supply demand balance.

In Section 7 we assess the performance of such a plan and compare it to other alternatives. We have done this through a range of scenario tests.

Even though our baseline position shows no significant supply demand deficits, we considered it prudent to assess options to ensure that our Plan is robust to a range of different future scenarios. Section 6 sets out what these options could be.

6. Future options

- We have considered both supply and demand-side unconstrained options and identified a list of feasible options which could be taken forward
- Our customer preferences are to focus on reducing leakage and demand, and we have therefore concentrated our work in this area
- We have considered water trading and options involving cross water company boundaries. We have identified a potential option which could transfer water from our Bournemouth WRZ to Southern Water's area of supply

6.1 Introduction

In the previous chapters we have assessed our available supply against our forecast demand to give an understanding of our baseline forecast for water supply and demand position.

In this section we consider and describe the options that are available for our water resources planning strategy.

Options could be used to remove a deficit in the supply demand balance in a WRZ or to take into account key policy priorities as referenced in the Water Resources Planning Guideline[6.1].

In all cases, we have considered options that would be of benefit to both the dry year annual average and critical period. There is therefore no need for us to distinguish between options in respect of this issue.

We have considered options that will allow us to improve our service to customers, provide long-term best value, to be of benefit to the environment as well as considering opportunities for collaboration with other water companies.

6.2 Process for developing unconstrained options

The starting point in developing options is producing an unconstrained list of water management options. In accordance with the EA guideline[6.2], the different types of options were based on the UKWIR WR27 water resources planning tools project[6.3].

We divided the different types of options into five categories: -

(i) Interconnection with neighbouring water companies and water trading options

(ii) Customer side management options (reducing demand)

[6.1] Environment Agency and Natural Resources Wales (2017), *Water resources planning guideline – April 2017*
[6.2] *Ibid. 6.1*
[6.3] UKWIR (2012), *Water Resources Planning Tools 2012 Economics of Balancing Supply and Demand (EBSD) Report*, Report: 12/WR/27/6

(iii) Distribution side management options (including managing leakage)

(iv) Distribution expansion and production side management options (increasing supply)

(v) Resource management options (increasing supply)

Further details of the types of option in each category are given in Section A.6.1.

For each type of option we developed a set of unconstrained options. The options were considered at an inter-water company, water company or WRZ level as appropriate.

These sets of options are termed the unconstrained list of options because they do not take account of factors such as environmental and planning restrictions, health and safety regulations, legal restrictions, promotability or risk.

6.3 Screening criteria

The unconstrained list of options provides a framework from which to identify a set of options which could be used to develop our WRMP.

In order to derive a set of options appropriate to the circumstances relevant to our WRZs, a screening criteria needs to be derived and applied.

This process is shown in the figure below. The screening criteria we have used are presented in Table 6.1.

Figure 6.1: Screening approach for feasible options

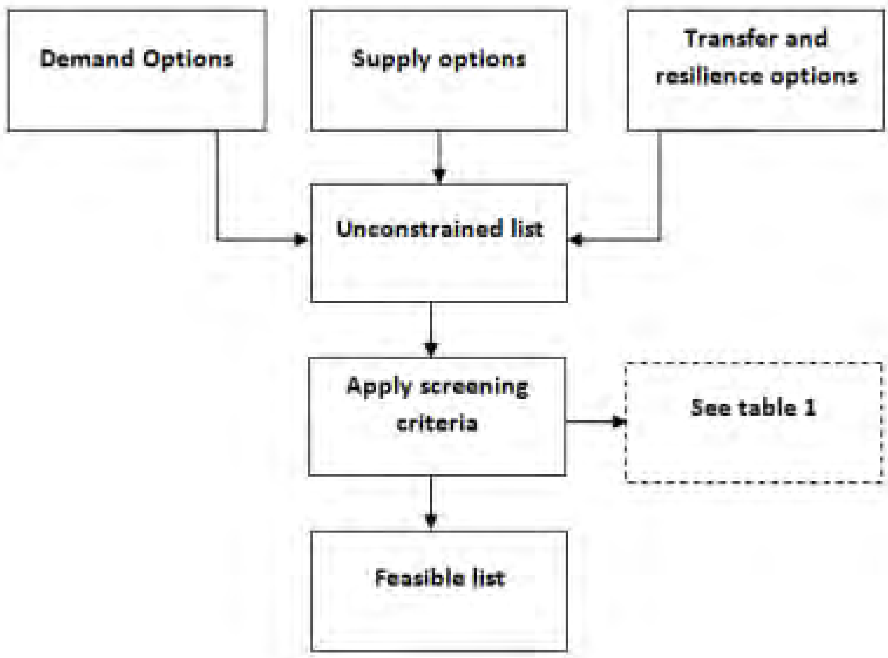


Table 6.1: Screening criteria

Theme	Screening criteria	Description
Demand, supply and transfer options	Yield/demand reduction	The option does not generate a significant additional yield or resource
	Cost	The option is unlikely to be attractive due to high costs with few other benefits
	Energy/carbon/environmental	The option is unlikely to be attractive due to high energy costs, carbon emissions, or environmental costs
	Promotion/reliability of delivery	The option is likely to be difficult to promote either because of known conflicts with a public policy or because of material likely objections from interested parties; or has highly known unreliable take-up from customers
	Flexibility	The option does not allow flexibility to deal with changing circumstances
Supply and transfer options only	Physical and geological	The physical geography or geology of the region means the option is unlikely to be technically feasible
	Environment	There are likely to be significant environmental problems related to the option
	Fisheries	There are likely to be significant fisheries problems with the option

Theme	Screening criteria	Description
	Water quality	There are likely to be significant water quality problems with the option
Demand options only	Customer relationship/participation	The option does not promote an enhanced relationship with customers
	Customer affordability	The option does not help customers with affordability or take control of their consumption and bills
	Peak tourist season	The option is unlikely to help reduce pressure on water and waste infrastructure during peak periods
	National or sector policy	The option is in conflict to national or sector policy guidelines
	Difference from baseline	The option is not sufficiently different from baseline activities
	Innovation	The option is not innovative

When assessing our feasible options, we looked at the alignment to customer preferences across the whole plan, rather than at the individual option level.

Our baseline supply demand position does not show any significant supply demand deficit, as shown in Section 5. Our unconstrained and feasible demand management options list is therefore able to include more innovative approaches than have been considered historically. This enabled us to objectively review options that may have significant customer benefits so that we can understand and develop solutions over the planning period without being constrained to more traditional options.

In reviewing our feasible demand management options we have also paid particular attention to how options link to multiple benefits, for example, overall customer service and affordability delivery. This is to ensure the links across the business plan drivers are embedded into our water resources planning. This is discussed in more detail in Section 8.

6.4 Interconnection with neighbouring water companies and water trading options

A key policy area within the WRMP19 is to consider the opportunities for further interconnection and trading across water company boundaries, as well as considering opportunities for new ways of working. This is largely as a result of water stress across parts of England and Wales. We have therefore considered the potential for these options further, taking into account the framework in the UKWIR WR27[6.4] report.

[6.4] *Ibid.* 6.3

6.4.1 Conjunctive use and interconnection options with neighbouring water companies

6.4.1.1 Introduction

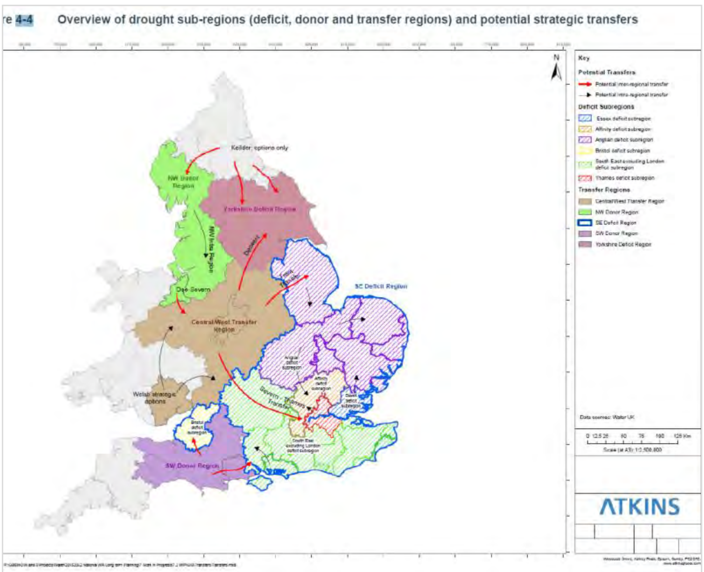
This section considers options for both increased conjunctive use for resilience purposes with neighbouring water companies, as well as options for imports or exports which could give WAFU benefit across water company boundaries. (Further development of strategic interconnections *between and within* our own WRZs is covered in Section 6.8).

There are no boundaries with other water companies for our Colliford and Roadford WRZs. Wimbleball WRZ has a boundary with Wessex Water; Bournemouth WRZ has a boundary with both Wessex Water and Southern Water.

6.4.1.2 Water Resources Long Term Planning Framework, Water UK Report [6.5]

Water UK's report[6.6] identified a number of sub-regions across England and Wales for strategic water resources planning purposes defining areas as deficit, donor and transfer regions. An extract of the report is shown in Figure 6.2 below.

Figure 6.2: Overview of drought sub-regions (deficit, donor and transfer regions and potential strategic transfers)



As can be seen above, the South West Donor region included our Wimbleball and Bournemouth WRZs, and indicated the potential to provide transfers to the South East Excluding London area (SEEL) as well as Bristol. SEEL includes Southern Water's area of supply.

[6.5] Water UK (2016), *Water Resources Long Term Planning Framework*
[6.6] *Ibid.* 6.5

6.4.1.3 Unconstrained options for interconnections with neighbouring water companies

As described in Section 6.2, the UKWIR WR27 report[6.7] gives a framework for options relating to interconnection between water companies and water trading.

In 2017, taking into consideration the findings in the above Water UK report, we worked with consultants[6.8] to analyse in more detail potential options for interconnection with neighbouring water companies.

Transferring water from Colliford WRZ to outside our area is currently assumed to be geographically impractical and not economically feasible. However, for completeness we also considered the potential for transfers from the Roadford WRZ.

Early on in the study, we identified that a number of options could be discarded for practical reasons or because the scheme formed part of another scheme. For completeness these options are included in Section A.6.2.

The potential options for interconnection are shown in Table 6.2. These include both options for increased resilience and options to transfer water to areas of the country potentially in deficit.

Table 6.2: Potential options for interconnection with neighbouring water companies

Potential Scheme	Donor WRZ	Reference number*	Description
Gunnislake to Wessex Water Bulk Supply Options (15 Ml/d)	R	Option G3	Raw water link to Pynes WTW and treated water link to Taunton
		Option G4	Raw water link to new WTW at Taunton
Northbridge to Wessex Water Bulk Supply Options (5 Ml/d)	W	Option N2	Raw water link to Allers WTW and treated water link to Taunton
		Option N4	Raw water link to Taunton and treatment at Taunton
		Option N5	Treatment at Pynes WTW and treated water link to Taunton
		Option N6	Treatment at Pynes WTW, enhancement of Pynes main and new treated water link to Bridport

6.7 *Ibid*. 6.3
6.8 Atkins (2017). *South West Water Bulk Supply Options Study Phase 2 Report South West Water*

Potential Scheme	Donor WRZ	Reference number*	Description
Combined Gunnislake and Northbridge Options (20 Ml/d)	R and W	Option GN1	Raw water link to Pynes and treated link to Taunton (20 Ml/d) (combined G3 and N5)
		Option GN2	Raw water link to Taunton (20Ml/d) (combined G4 and N4)
Wessex Water to SWW Resilience Schemes		Option R1	Maundown to Tiverton treated water link main (10 Ml/d)
		Option R2	Taunton to Tiverton treated water link main (10 Ml/d)
		Option R4	Chard to Axminster treated water link main and link to Pynes main (4.5 Ml/d)
		Option R6	Bridport to Axminster treated water link (10Ml/d)
		Option R7	Chard to Axminster treated water link (3 Ml/d) and 1.5 Ml/d link to Hook WTW
		Option R8	Chard to Hook WTW (1.5 Ml/d)
Bournemouth WRZ bulk supply options	B	Option B1	Bournemouth WRZ to Southern Water: via a pipeline through the New Forest (20 Ml/d)
		Option B2	Bournemouth WRZ to Wessex Water: Canford Bottom to Summerslade (20 Ml/d)
		Option B3	Bournemouth WRZ to Wessex Water: Ringwood to Codford (20 Ml/d)

Table note:

R Roadford WRZ
W Wimbleball WRZ
B Bournemouth WRZ

**As explained above, some initial options were discarded and hence non-sequential option reference numbers. Options were discarded for practical reasons or because the scheme formed part of another scheme.*

Each option was costed and further details are available in Section A.6.2.1.

A summary of the key conclusions from the study are given below, with further details in Section A.6.2.

Gunnislake and Northbridge bulk supply options

The Gunnislake options are the most expensive of the options considered within this study due to the longest transfer lengths of over 130km, with indicative AIC values of 234-243p/m3 for options G3 and G4 (15 Ml/d).

For the combined Gunnislake to Northbridge options the cost effectiveness of these schemes increases due to the increase in transfer volume from 15 Ml/d to 20 Ml/d, with indicative AIC values of 184-193p/m3 for options GN1 and GN2.

The consultants' report concluded:-

- *"the cost estimates for the Gunnislake and Northbridge options to provide a bulk supply to Wessex Water for onward transfer to Bristol Water, are substantially higher than available cost data for more local Bristol Water and Wessex Water resource options. This is likely to be due to the very large transfer distances from SWW to Wessex Water*
- *"Hence none of the Gunnislake or Northbridge options appear to be economically viable, when compared to more local resource options, noting that some of the differences between company AIC values will be due to differences in unit cost rates and allocation of risk*

SWW resilience options with neighbouring companies

The resilience schemes have high AIC values, mainly because the resilience schemes are likely to operate relatively infrequently, but will still incur maintenance costs.

The consultants' report concluded:-

- *"None of the considered resilience schemes appear to be economically viable, given the long transfer lengths required and the ongoing maintenance effort required for schemes that may only operate very infrequently. Further consideration of the Hook option R8 may be appropriate given that this has the shortest transfer distance (8km)"*

Options from Bournemouth WRZ

The available resources from the Bournemouth WRZ are currently constrained by the Water Treatment Works (WTWs) capacities. The available resource could be increased following significant investment at the WTWs, which is further covered in Section 7.

For the purposes of this section, it is assumed that the above investment has occurred and a potential transfer of the order of 20 Ml/d is available. Therefore, although 3 options were considered, it is likely to be feasible to implement only one of the supply options identified.

The consultants also considered the practical aspects of the pipeline routes and concluded for options B2 and B3 above that:-

> *"promotion of these two schemes could be very difficult in the short term with strong objections likely from landowners and other stakeholders".*

Option B1 has an indicative AIC value of 58 p/m3 and would involve 20 Ml/d transfer scheme to Southern Water. The pipeline route would involve laying a pipeline across the New Forest, and the consultant report notes:-

> *"Laying a pipeline through the New Forest National Park would be highly controversial and a very strong case would be required to obtain consent from the New Forest planning authority"*

It should also be noted that there will be additional costs for this option:-

- to allow for the cost of distributing the transferred water within the Southern Water network
- to allow for the increased investment in the WTW capability above the Bournemouth WRZ needs
- to allow for any changes in the way water needs to be moved around within the Bournemouth WRZ to support the transfer

Note – none of these potential additional costs were included within the AICs given above

6.4.2 Infeasible or rejected interconnection with neighbouring water companies options

All options were screened using the criteria in Table 6.3, to identify options that are considered not feasible for inclusion in our final planning scenario by either ourselves or a neighbouring water company.

A summary of these infeasible or rejected options is given below, along with the reasons for not being considered further.

Table 6.3: Summary of infeasible or rejected Interconnection with neighbouring water companies options

No*	Option	Water Resource Zone	Yield/demand reduction[1]	Cost[2]	Energy/carbon/environmental[3]	Promotion/reliability of delivery[4]	Flexibility[5]	Physical and geological[6]	Environment[7]	Fisheries[8]	Water quality[9]	Customer relationship/participation[10]	Customer affordability[11]	Peak tourist season[12]	National or sector policy[13]	Difference from baseline[14]	Innovation[15]
			Reason For Rejection														
G3 and G4	Gunnislake to Wessex Water Bulk Supply Options	R	✕	✕	✕	✕		✕	✕			-	-	-	-	-	-
N2, N4, N5 and N6	Northbridge to Wessex Water Bulk Supply Options	W	✕	✕	✕	✕		✕	✕			-	-	-	-	-	-
GN1	Combined Gunnislake and Northbridge Options	R and W	✕	✕	✕	✕		✕	✕			-	-	-	-	-	-
R1, R2, R4, R6, R7 and R8	Wessex Water to SWW Resilience Schemes	W	✕	✕	✕	✕		✕	✕			-	-	-	-	-	-

Table notes:

[1] ***Yield / demand reduction:*** *The option does not generate a significant additional yield or resource*

[2] ***Cost:*** *The option is unlikely to be attractive due to high costs with few other benefits*

[3] ***Energy / carbon / environmental:*** *The option is unlikely to be attractive due to high energy costs, carbon emissions, or environmental costs*

[4] ***Promotion / reliability of delivery:*** *The option is likely to be difficult to promote either because of known conflicts with a public policy or because of material likely objections from interested parties; or has highly known unreliable take-up from customers*

[5] ***Flexibility:*** *The options does not allow flexibility to deal with changing circumstances*

[6] ***Physical and geological:*** *The physical geography or geology of the region means the option is unlikely to be technically feasible*

[7] ***Environment:*** *There are likely to be significant environmental problems related to the options*

[8] ***Fisheries:*** *There are likely to be significant fisheries problems with the option*

[9] ***Water quality:*** *There are likely to be significant water quality problems with the option*

[10] ***Customer relationship / participation:*** *The option does not promote an enhanced relationship with customers*

[11] ***Customer affordability:*** *The option does not help customers with affordability or take control of their consumption and bills*

[12] ***Peak tourist season:** The option is unlikely to help reduce pressure on water and waste infrastructure during peak periods*

[13] ***National or sector policy:** The option is in conflict to national or sector policy guidelines*

[14] ***Difference from baseline:** The option is not sufficiently different from baseline activities*

[15] ***Innovation:** The option is not innovative*

**Options 9–15 relate to Demand options only and are not relevant to the proposed Supply and Transfer options.*

6.4.3 Feasible interconnection with neighbouring water companies options

Options that are feasible and we have determined could form part of either another water company's or our final planning scenario, are summarised in Table 6.4 below.

Table 6.4: Feasible interconnection with neighbouring water companies options

Ref.	Option description
B1	Bournemouth WRZ to Southern Water: pipeline route via New Forest (20 Ml/d)
B2	Bournemouth WRZ to Wessex Water: Canford Bottom to Summerslade (20 Ml/d)
B3	Bournemouth WRZ to Wessex Water: Ringwood to Codford (20 Ml/d)

Note: See Section 6.4 above regarding practical aspects of the pipeline routes

The above information has been shared with Southern Water to assist with the development of their WRMP19.

We have taken the findings from the above into account when considering our feasible options in Section 6.8 below and scenarios in Section 7.

6.4.4 Third party options and water trading

We are considering the potential for third parties to be able to provide solutions at a lower cost than our own solutions, both in terms of demand and supply-side options.

Ofwat's Market Information Platform, which will be introduced in 2018, will both assist third parties in developing bids and make water company data more accessible. We are fully engaged in this process. For example, we have met with the National Farmers Union (NFU) regarding this area of work.

However, our customer preferences are to focus on reducing leakage and demand, and we have therefore initially concentrated our work in this area before taking more water out of the environment.

With regard to water trading, as described above, we are engaging with Southern Water regarding the potential for using surplus water in our Bournemouth WRZ to help address supply demand deficits in the Southern Water supply area.

6.5 Customer side management options (reducing the demand for water)

The *Guiding principles for water resources planning*[6.9] ask companies to promote the efficient use of water within their plans, continuing the recent trend of declining per capita consumption. Options within this section help to achieve these objectives.

6.5.1 Unconstrained list of customer side management options

As described in Section 6.2, the UKWIR WR27 report[6.10] gives a framework for options relating to customer side management options, which are aimed at decreasing the demand for water. We used this framework, along with other work by our consultants, AMEC Foster Wheeler who worked with Waterwise, to produce an unconstrained list of potential demand-side options. This was completed by examining examples of current good practice from the UK and around the world, as well as examining innovative new approaches.

Details of this list as applied to our area are shown in Appendix 6.

6.5.2 Infeasible or rejected customer side management options

All options were screened using the criteria in Section 6.3 above to identify options that are considered not feasible for inclusion in our final planning scenario. A summary of these infeasible or rejected customer side management options is given in Section A.6.3.

6.5.3 Feasible customer side management options

Options that are feasible and we have determined could form part of our final planning scenario are summarised in Table 6.5 below.

Table 6.5: Feasible customer side management options

Ref.	Option description
CU20a	Retrofit (metered)
CU20b	Retrofit (unmetered)
CU20c	Retrofit (metered+leaky loos fix)
CU20d	Retrofit (unmetered+leaky loos fix)
CU21	Social housing retrofit

6.9 Defra (2016), *Guiding principles for water resources planning*
6.10 *Ibid.* 6.3

Ref.	Option description
CU26	Holiday home rental water efficiency
CU54	Reduced infrastructure charge
CU60a	Community incentives (5yr)
CU60b	Community incentives (10yr)
CU62	Social norms feedback on bills
CU65a	WWTW final effluent reuse (Ashford)
CU65b	WWTW final effluent reuse (Buckland)
CU65c	WWTW final effluent reuse (Brokenbury)
CU65d	WWTW final effluent reuse (Camborne)
CU65e	WWTW final effluent reuse (Camelshead)
CU65f	WWTW final effluent reuse (Cornborough)
CU65g	WWTW final effluent reuse (Countess Wear)
CU65h	WWTW final effluent reuse (Ernesettle)
CU65i	WWTW final effluent reuse (Marsh Mills)
CU65j	WWTW final effluent reuse (Plymouth Central)
CU65k	WWTW final effluent reuse (Radford)

A description of the each of the feasible options is given in Section A.6.3.3.

Information on the cost of each option is shown in the accompanying tables to this report. The cost information is also summarised in Section 6.12.

6.6 Managing leakage

The G*uiding principles for water resources planning*[6.11] ask companies to promote leakage control and would like to see the downward trend for leakage continue. Options within this section help to achieve these objectives.

Our analysis of leakage options examined the cost of different levels of reduction and the impact of different policy choices e.g. pressure management. Further information on leakage, including our Sustainable Economic Level of Leakage model (SELL) is described in Section 3.

We present leakage as an option by setting out the costs of different steps of leakage reduction by each WRZ.

We also considered leakage as part of our scenario analysis in Section 7.

[6.11] *Ibid.* 6.9

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6.6.1 Feasible leakage reduction options

In Section A.6.4, we present in Table A.6.18 the leakage reduction options in each WRZ in incremental 1 Ml/d steps from a representative current position, towards very low positions. These steps enable the assessment of the relative merits of leakage reduction profiles for each WRZ.

Two fully profiled options are also considered:

- the PR19 reduction of 15%
- 77 Ml/d for SWW supply area and 18 M/d for BW supply area in 2025

A summary of these options is given in Table 6.6 below.

Table 6.6: Feasible leakage reduction options

Reference Number	Option name	WRZ	Description
LC1- LC8	Steps 1 - 8 Colliford WRZ	C	Reduction of leakage from 30.3 to 22.3 Ml/d
LR1 – LR10	Steps 1- 10 Roadford WRZ	R	Reduction of leakage from 42.3 to 32.3 Ml/d
LW1 – LW4	Steps 1 - 4 Wimbleball WRZ	W	Reduction of leakage from 11.4 to 7.4 Ml/d
LB1 - LB4	Steps 1 - 4 Bournemouth WRZ	B	Reduction of leakage from 20 to 16 Ml/d
LCPR19 – LBPR19	PR19 Colliford WRZ, PR19 Roadford WRZ, PR19 Wimbleball WRZ, PR19 Bournemouth WRZ	C R W B	15% leakage reduction by 2025
LCLRP - LBLRP	Leak plan Colliford WRZ, Roadford WRZ, Wimbleball WRZ and Bournemouth WRZ	C R W B	SWW supply area at 77 Ml/d and BW supply area at 18 M/d by 2025

Information on the costs of the option is shown in the accompanying tables to this report. The cost information is also summarised in Section 6.12.

6.7 Metering

The DEFRA *Guiding principles for water resources planning*[6.12] ask companies to consider and demonstrate that we are supporting customers to manage demand. Our metering strategy contributes to this objective.

[6.12] *Ibid.* 6.9

6.7.1 Unconstrained list of metering side management options

As described above, the UKWIR WR27 report[6.13] gives a framework for the unconstrained list of options, which relate to metering. We used this framework, along with other work by our consultants AMEC Foster Wheeler, who worked with Waterwise, to produce an unconstrained list of options.

6.7.2 Infeasible or rejected metering side management options

We were able to reject several of these options for reasons such as customer acceptability and cost. The rejected options and the reasons for their rejection are shown in Section A.6.5.

The remaining metering options, which we considered to be feasible, were incorporated into a range of metering strategies, which were modelled as described in Section 3.2.3.2. These strategies are shown in Table 6.7.

Given the increased NPV of these options over the existing meter strategy, and that we only have a small supply demand deficit in one WRZ at the end of the planning period, we do not consider these metering strategies to offer value. We therefore rejected a change in our metering strategy, as other demand-side options are better suited to our position, with a lower impact on customers' bills.

Table 6.7: Feasible metering strategy options

Ref.	Meter replacement frequency	Average meter under-registration	Meter type deployed			Strategy			NPV difference from current strategy (£m)
			New connect-ions	Optants	Replacements	Optant	Change of occupier	Single urban area	
Met0 (current)	Unchanged	Unchanged	Dumb	AMR (where feasible)	Like for like	✓			-
Met1	Increased	Reduced	Dumb	AMR (where feasible)	Like for like	✓			+18.5
Met2	Increased	Maintained	Dumb	AMR (where feasible)	Like for like	✓			+11.3
Met2a	Increased	Maintained	AMR	AMR (where feasible)	Like for like	✓			+12.8
Met2b	Increased	Maintained	AMR	AMR (where feasible)	AMR	✓		✓	+28.3

6.13 *Ibid.* 6.3

Ref.	Meter replacement frequency	Average meter under-registration	Meter type deployed			Strategy			NPV difference from current strategy (£m)
			New connect-ions	Optants	Replacements	Optant	Change of occupier	Single urban area	
Met3	Unchanged	Unchanged	AMR	AMR (where feasible)	AMR	✓	✓		+50.9
Met4	Unchanged	Unchanged	AMR	AMR (all)	AMR	✓	✓		+49.3
Met5	Unchanged	Unchanged	AMR	AMR (all)	AMR	✓	✓	✓ (over 15yrs)	+50.0
Met6	Unchanged	Unchanged	AMR	AMR (all)	AMR	✓	✓	✓ (over 10yrs)	+51.0

6.8 Increasing the supply of water within our Water Resource Zones

This section considers options for increasing the supply of water within our WRZs. Options for increasing the supply of water through further interconnection with other water companies and water trading options is covered in Section 6.4.

6.8.1 Unconstrained list

As described above, the UKWIR WR27 report[6.14] gives a framework for the unconstrained list of options, which relate to increasing the supply of water within our WRZs. These options could be Distribution Expansion and Production Side Management Options or Resource Management Options.

Details of these options as applied to our area are shown in Section A.6.6.

6.8.2 Infeasible or rejected supply-side management options

All options were then screened using the criteria in 6.3 above, to identify options that are considered not feasible for inclusion in our final planning scenario. Further details are given in Section A.6.6. A summary of these infeasible or rejected supply-side management options is given below.

[6.14] *Ibid.* 6.3

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Table 6.8: Summary of infeasible or rejected supply-side management options

No	Option	Water Resource Zone	Reason For Rejection: Yield/demand reduction[1]	Cost[2]	Energy/carbon/environmental[3]	Promotion/reliability of delivery[4]	Flexibility[5]	Physical and geological[6]	Environment[7]	Fisheries[8]	Water quality[9]	Customer relationship/participation[10]	Customer affordability[11]	Peak tourist season[12]	National or sector policy[13]	Difference from baseline[14]	Innovation[15]
1	Infiltration galleries	All	×					×				-	-	-	-	-	-
2	Artificial storage and recovery wells	All	×					×				-	-	-	-	-	-
3	Aquifer recharge	All	×					×				-	-	-	-	-	-
4	Desalination	All		×	×				×			-	-	-	-	-	-
5	Tankering of water	All	×	×	×							-	-	-	-	-	-
6	Colliford Pumped Storage Scheme Stage 2	C				×			×	×		-	-	-	-	-	-
7	Raise Porth Dam	C	×	×	×	×					×	-	-	-	-	-	-
8	Raise Drift Dam	C		×	×	×			×			-	-	-	-	-	-
9	Stithians reservoir pumped storage scheme	C	×								×	-	-	-	-	-	-
10	Groundwater developments in Colliford WRZ	C	×					×			×	-	-	-	-	-	-
11	Bulk transfers in Collliford WRZ	C										-	-	-	-	-	-
12	Abstractions from the upper River Tavy	R	×			×			×	×		-	-	-	-	-	-
13	Further abstractions from Lopwell on the Tavy	R	×			×			×	×		-	-	-	-	-	-
14	Raise Avon Dam	R				×			×			-	-	-	-	-	-
15	Raise Meldon Dam	R				×			×			-	-	-	-	-	-
16	Raise Upper Tamar Dam	R	×			×			×			-	-	-	-	-	-
17	Further pumped storage of Wistlandpound from Bray	R	×			×				×		-	-	-	-	-	-
18	Pumped storage of KTT from the River Teign	R	×	×	×	×						-	-	-	-	-	-
19	Meldon Reservoir to Northcombe main	R	×	×	×							-	-	-	-	-	-
20	Groundwater	R	×								×	-	-	-	-	-	-

No	Option	Water Resource Zone	Yield/demand reduction[1]	Cost[2]	Energy/carbon/environmental[3]	Promotion/reliability of delivery[4]	Flexibility[5]	Physical and geological[6]	Environment[7]	Fisheries[8]	Water quality[9]	Customer relationship/participation[10]	Customer affordability[11]	Peak tourist season[12]	National or sector policy[13]	Difference from baseline[14]	Innovation[15]
	Reason For Rejection																
	developments in Roadford WRZ																
21	Bulk transfers in Roadford WRZ	R										-	-	-	-	-	-
22	New/refurbished Capel Lane WTW & Squabmoor		×	×	×	×					×	-	-	-	-	-	-
23	Variation to Northbridge & Bolham licences	W				×			×	×		-	-	-	-	-	-
24	Reduce Thorverton prescribed flow	W				×			×	×		-	-	-	-	-	-
25	Abstraction from the River Culm	W	×			×			×	×		-	-	-	-	-	-
26	Abstraction from the River Creedy	W	×			×			×	×		-	-	-	-	-	-
27	River Axe intake with reservoir storage	W	×	×	×	×		×	×			-	-	-	-	-	-

Table Notes

- *See Table 6.3 for table footnotes*
- *Options 9–15 relate to Demand options only and are not relevant to the proposed Supply and Transfer options.*

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6.8.3 Potentially feasible options relating to increasing the supply of water

Options that are feasible and we have determined could form part of our final planning scenario are summarised in Table 6.9 below.

Details of each scheme are given in Appendix 6, Section A.6.6.3.

It was identified early on in our WRMP process that we would not be facing a significant supply demand deficit. It was also identified that customer preference to address any deficits is for demand saving and leakage reduction options, and that there is no requirement for any supply-side options in the life time of this Plan.

However, even though no supply-side options are required in our Plan, we have provided indicative costs of the schemes for reference and to help inform studies in preparation for PR24.

During these studies, we will take into account the latest information available regarding WFD obligations and RBMP objectives.

Table 6.9: Feasible supply-side management options

Ref.	Option description	WRZ[1]	Type[2]
C1	Gunnislake to St Cleer and St Cleer to Fox Park	C	DP
C2	Restormel WTW capacity increase to 110 Ml/d	C	DP
C3	Re-introduce abstractions at Boswyn, Carwynen & Cargenwyn	C	DP
C4	Re-use of Rialton Intake/ Porth Reservoir	C	DP
C5	Restormel licence variation	C	R
C6	Stannon - increase in licence (groundwater developments)	C	R
R1	Duplication of distribution main through South Devon and Littlehempston WTW capacity increase to 100 Ml/d	R	DP
R2	Northcombe WTW output capacity increase to 60 Ml/d	R	DP
R3	River Taw and/or Torridge abstractions	R	R
R4	Roadford/Northcombe pumped storage from Gatherly (River Tamar)	R	R
R5	Re-introduce abstractions at small reservoirs in North Devon eg Slade, Gammaton	R	DP
R6	Uton source re-commissioning (with possible Coleford & Knowle licence transfer)	R	DP
W1	Increase Pynes WTW and Intake to 67 Ml/d	W	DP
W2	Re-commissioning of Stoke Canon & Brampford Speke boreholes	W	DP
W3	East Devon new source	W	R
B1	Significant investment at Bournemouth WTWs	B	DP
B2	Re-introduce Wimborne	B	DP
B3	Potential increases in WAFU eg innovative licence changes	B	R

Table notes:

1 WRZ	*B*	*Bournemouth WRZ*
	C	*Colliford WRZ*
	R	*Roadford WRZ*
	W	*Wimbleball WRZ*
2 Type	*DP*	*Distribution expansion and production management*
	R	*Resource scheme*

6.9 Catchment management

Pressures on land use and agriculture over the centuries have impacted on the quality of the raw water in our rivers, groundwater and reservoirs.

Some parts of our area, such as Exmoor and Dartmoor, have been changed significantly in the last hundred years as a result of ditch construction and various drainage schemes. At the time, land was drained for agricultural purposes, but the loss of natural water storage has led to significant erosion, carbon dioxide being released from drying peat, loss in biodiversity and increased downstream flood risks. In other parts of our area, rivers are being impacted by increased levels of pollutants such as pesticides, soils, silt and animal waste runoff from farmland.

For some years, SWW has promoted a catchment management programme to address water quality and problems at source, to assist with water treatment at our WTWs[6.15]. The programme includes restoring peatlands, advice and grants for farmers, help with obtaining enhanced environmental stewardship schemes, soil tests along with payments for ecosystems services.

In the 2015-2020 business planning period, our catchment management programme benefits water going through 15 WTWs across Devon and Cornwall, and involves work across 10 catchments[6.16.] The programme is being delivered through West Country Rivers Trust, Devon Wildlife Trust, Cornwall Wildlife Trust, the Exmoor Mires Partnership and the Exmoor National Park Authority. The partnership works closely with the Environment Agency, Natural England, University of Exeter, the Farming and Wildlife Advisory Group, the National Farmers Union and local catchment partnerships. Work in the Bournemouth WRZ is focusing on decreasing metaldehyde levels in the River Stour and is being delivered in partnership with Catchment Sensitive Farming (CSF). CSF is funded by Defra and the Rural Development Programme for England and is a joint initiative between the Environment Agency and Natural England. It has been established in a number of priority catchments, such as the River Stour, across England. The River Stour CSF officer is co-funded by SWW.

We are currently finalising our plans for the business planning period 2020-2025, and we intend to continue catchment management activity. Although these result in small increases in water quantity in rivers during low flows, the impacts are only at a

[6.15] *South West Water Upstream Thinking 2010-2015*
[6.16] *South West Water looking after the land to protect our rivers, 2015-20*

very local level, rather than being able to form part of any strategic water supply option. The long-term benefits to water resources in the context of the risks we face are difficult to quantity. However, our catchment management work in 2020-25 will focus on improving catchment resilience in terms of water quality and will form part of the Water Industry National Environment Programme (WINEP) activity.

We will include new schemes in 2020-25 for Drinking Water Protected Areas (DWPA) at risk. Investigations or projects focused on water quality in reservoirs such as Burrator, Roadford, Stithians, Wistlandpound, Avon, Venford and Meldon will form part of our plan.

Our plans also include continuing to work in the 10 current Upstream Thinking catchments across Devon and Cornwall, as described above. These schemes will be focused on a range of water quality issues, which includes phosphate, ammonia, sediment, nitrates, pesticides, dissolved organic carbon, colour and faecal coliforms. These schemes will also seek to promote good soil management and work to achieve natural flood risk management outcomes that will increase catchment storage and resilience.

In the Bournemouth WRZ, we plan to continue our metaldahyde work on the River Stour, as well as carry out new investigations on both the Stour, in response to rising acid herbicide levels, and the River Avon, regarding recent elevated raw water colour levels. These higher levels impact on the ultra violet treatability for cryptosporidium.

As the principle benefits in our areas from catchment management relate to water quality improvements in the short-term, we have not included these as specific feasible options in this Plan. They do, however, form an integral part of our overall programme of work to maintain a safe supply of drinking water.

6.10 Resilience schemes

The Environment Agency's Water resources planning guideline[6.17] advises us to consider whether we require solutions to increase resilience. These types of options, resilience options, are options that address vulnerabilities that are not being addressed as a result of a supply demand deficit (i.e. through a planned level of service). The Environment Agency's guideline[6.18] advises water companies to consider whether any identified risks would affect resilience sufficiently such that a scheme (or schemes) should be considered within a WRMP. However, the guideline also recognises that it may also be appropriate to justify resilience options in other parts of the PR19 business planning framework.

When developing our supply forecast, we therefore considered potential resilience risks, particularly during the design drought. However, we are also considering

6.17 *Ibid.* 6.1
6.18 *Ibid.* 6.1

resilience as part of our wider PR19 business planning work, taking into account the UKWIR's 'Resilience planning: Good practice guide summary report'[6.19].

There are some risks however which we consider are outside the scope of the WRMP and we have shared these with Ofwat as part of the pre-consultation process. For completeness, these risks are also shown in Table 6.10 below.

Table 6.10: Residual risks not included in our WRMP

Risk	Notes if applicable
Brexit	Unknown impact on population and house building forecasts
Abstraction Reform	Currently assumed this will have no impact on deployable output; operational flexibility or resilience
Major pollution in raw water sources	
Catastrophic failure of assets	e.g. Dams or at WTW
Unprecedented flooding outside design criteria	
Unprecedented droughts outside those considered within the plausible drought scenarios	

As described earlier in this report, our sources of supply are used conjunctively. Within each of our WRZs, there are different types of sources such as direct river abstractions, groundwater abstractions and reservoirs. This combination of different types of sources contributes to increased resilience to a drought. In previous chapters of this report, we also show how our area of supply is classified as low vulnerability to climate change, risk composition 1 (drought risk assessment) and as low level of concern (problem characterisation).

Resilience in our Bournemouth WRZ is increased through the use of a strategic treated water main shared with Wessex. This provides increased resilience to both water companies during many types of outage events.

We have concluded that we have no requirement for any specific resilience schemes within our WRMP19. However, as part of our wider resilience work within the PR19 Business Plan, we will be considering the resilience risks presented in Table 6.10. In particular, we will be undertaking specific work to increase our understanding of the way our currently disused licensed sources, such as those in West Cornwall, could be used particularly during more extreme droughts.

[6.19] UKWIR (2013), *Resilience Planning: Good Practice Guide - Summary Report*, 13/RG/06/2

We are also undertaking work to increase our understanding of how other currently disused licensed sources, such as Bramford Speke and Wimborne, could be used to increase resilience during incidents such as pollution events or intake failure(s).

We have also considered opportunities for resilience options with neighbouring water companies, further details are given in Section 6.4. However, at present such schemes do not appear to be economically feasible and have therefore not been considered further.

6.11 Upstream competition

Upstream competition will enable external organisations to supply raw or treated water into a water company's network to create an upstream water resources market. Implementation of this policy change will require changes in legislation.

Whilst we keep abreast of developments in this area, Ofwat and Defra are still to confirm timescales. It has therefore not been considered further in our WRMP19.

6.12 Summary

6.12.1 Options summary

A summary of our specific feasible options are shown in Tables 6.11 to 6.14 below.

In the Section 7 (scenario testing), we compare the performance of plans based on different levels of distribution side management options (i.e. leakage) and also how these compare to plans using new water resources options.

Table 6.11: Feasible interconnection and water trading options

Ref.	Option description	Indicative AIC p/m3
B1	Bournemouth WRZ to Southern Water: pipeline route via New Forest (20 Ml/d)	58
B2	Bournemouth WRZ to Wessex Water: Canford Bottom to Summerslade (20 Ml/d)	92
B3	Bournemouth WRZ to Wessex Water: Ringwood to Codford (20 Ml/d)	57

Note: See Section 6.4 above regarding practical aspects of the pipeline routes

Table 6.12: Feasible customer side management options (reducing demand)

No.	Option description	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
CU20	Retrofit and advice service	32 to 91	-50 to 9
CU21	Social housing retrofit	32	-50
CU26	Holiday rental home visitor advice pack and certification scheme	46	-36
CU54	Reduced infrastructure charge for water efficient developments	182	100
CU60	Community incentives	7	-74 to -73
CU62	Social norms feedback on bills	-5	-87
CU65	Waste water treatment works final effluent reuse	3 to 73	-79 to -9

Table 6.13: Feasible distribution management options (leakage)

No.	Option description	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
LC1- LC8	Reduction of leakage from 30.0 to 22.3 Ml/d	34 to 60	-113 to -88
LR1 – LR10	Reduction of leakage from 42.3 to 32.3 Ml/d	36 to 85	-112 to -63
LW1 – LW4	Reduction of leakage from 11.4 to 7.4 Ml/d	62 to 147	-86 to 0
LB1 - LB4	Reduction of leakage from 20 to 16 Ml/d	76 to 109	-22 to 109
LCPR19 – LBPR19	15% leakage reduction by 2025	34 to 63	-114 to -5
LCLRP - LBLRP	SWW supply area at 77 Ml/d and BW supply area at 18 Ml/d by 2025	39 to 69	-99 to -16

Table 6.14: Feasible options to increase the supply of water within our WRZs

Ref.	Option description	WRZ[1]	Type[2]	Indicative AISC p/m3
C1	Gunnislake to St Cleer and St Cleer to Fox Park	C	DP	48
C2	Restormel WTW capacity increase to 110 Ml/d	C	DP	11
C3	Re-introduce abstractions at Boswyn, Carwynen & Cargenwyn	C	DP	35
C4	Re-use of Rialton Intake/ Porth Reservoir	C	DP	43
C5	Restormel licence variation	C	R	11
C6	Stannon - increase in licence (groundwater developments)	C	R	11
R1	Duplication of distribution main through South Devon and Littlehempston WTW capacity increase to 100 Ml/d	R	DP	86
R2	Northcombe WTW output capacity increase to 60 Ml/d	R	DP	16
R3	River Taw and/or Torridge abstractions	R	R	30
R4	Roadford/Northcombe pumped storage from Gatherly (River Tamar)	R	R	16
R5	Re- introduce abstractions at small reservoirs in North Devon eg Slade, Gammaton	R	DP	35
R6	Uton source re-commissioning (with Coleford & Knowle re-commissioning)	R	DP	28
W1	Increase Pynes WTW and intake to 67 Ml/d	W	DP	34
W2	Re-commissioning of Stoke Canon & Brampford Speke boreholes	W	DP	15
W3	East Devon new source	W	R	25
B1	Significant investment at Bournemouth WTWs	B	DP	(i)
B2	Re-introduce Wimborne	B	DP	28
B3	Potential increases in WAFU eg innovative licence changes	B	R	11

Table notes:

1 WRZ C Colliford WRZ
R Roadford WRZ
W Wimbleball WRZ
B Bournemouth WRZ

2 Type DP Distribution expansion and production management
R Resource scheme

(i) Costs for options for this scheme are being finalised as part of the Business Plan process and will be made available to Ofwat

(ii) Includes both distribution expansion and production management and resource management options

6.13 Commercially confidential information on options

No options or information on specific options have been held back on the grounds of commercial confidentiality.

7. Scenario testing

- We stress tested each of our WRZs against a range of different future scenarios.
- The scenarios included the impact of moving to a common industry reporting methodology for leakage as well as the PR19 Draft methodology on leakage performance commitments.
- For each scenario, we produced a plan that would maintain the supply demand balance over the planning period.
- The results showed our WRZs are robust, but have some small sensitivity in the medium to long term to:
  - More extreme droughts (> 1 in 200 year return period) – more extreme droughts than seen historically (plausible droughts)
  - New environmental needs – a loss of supply for future new environmental needs
  - High household demand – household demand higher than our central case
- These uncertainties have a relatively low likelihood, but if they occur they would stress our supply demand balance.
- The results show there is a tension between undertaking activity early in the programme to improve resilience and mitigate the uncertainty, and the impact on customers' bills.
- Customer willingness to pay data on leakage shows reduction to 50-70 Ml/d[7.1] and 16-19 Ml/d are cost-beneficial for SWW and BW supply areas, respectively, but would have large bill increases if delivered in the near term.
- The results show that we consider there is opportunity for a treated water transfer from Bournemouth WRZ to Southern Water, but this would need infrastructure investment to remove current water treatment works constraints.

7.1 Introduction

Our baseline supply demand forecast shows no deficit over the planning period with the exception of a very minor deficit in Colliford at the very end of the planning period. This forecast is based on central assumptions and also current information. In order to understand the robustness of this forecast, we undertook a range of scenario tests covering different policy choices and changes to input data in our forecasts.

[7.1] Figures rounded. Colliford: 19-22 Ml/d; Roadford: 28-30 Ml/d; Wimbleball: 8-10 Ml/d. Total 55-62 Ml/d. Combined SELL curves for each Resource Zone give a company range of c50-70 Mld when the combined company cost curve is produced.

These scenarios were used to "*stress test*" the performance of the baseline position and understand what factors our forecasts are sensitive to and how different policy decisions affect the plan. Where a scenario gave rise to a supply demand deficit, a programme of intervention was calculated and its performance assessed.

The performance of the different policy choices and plans was assessed using a multi-criteria assessment approach following the UKWIR methods on decision making[7.2].

This includes an indicative bill impact in 2025 based on change in operating and capital costs. Actual bill impacts will depend on the rest of the PR19 Business Plan and PR19 methodology assumptions. The reference to bill impacts is therefore for comparison purposes only to assess how different strategies or policies perform against each other.

We then summarised the results and used this to inform the development of our proposed plan (see Section 8).

7.2 Scenarios tested

We stress tested our baseline plan against 11 different scenarios as set out in Table 7.1, with full details in Appendix 7. The likelihood of each scenario is given in Table 7.1. This is important in understanding both the level of risk to our supply demand balance and the level of mitigation we should undertake, if any, to mitigate the effect.

An additional scenario for Bournemouth WRZ was included to show the impact of a possible water transfer to Southern Water.

For each scenario a supply demand balance was produced reflecting the changed assumptions. Where a supply demand deficit occurred, solutions to address this were produced.

7.2.1 Leakage consistency scenario

Water companies have been working together, co-ordinated by Water UK, to improve the consistency of reporting of definitions of key measures of performance, so that performance can be compared between companies more easily.

This work is supported by Ofwat, the Environment Agency, Natural Resources Wales and the Consumer Council for Water.

Companies need to make changes to their current reporting to align with the new, more consistent, reporting definitions, and it is recognised that for some of these changes it will take some time to have robust data.

[7.2] UKWIR (2016), *WRMP 2019 Methods – Decision Making Process: Guidance*, Section 12.5

Leakage is one of the measures where this change in reporting has been identified. Section 3 explains how we are implementing the new reporting definition for leakage with our roadmap of activity in Appendix 3. In this scenario we explore what the impact on future plans for balancing supply and demand for water could be. The change in reporting of leakage is purely a change in reporting; it does not affect the actual amount of water lost through leakage.

Each water company will be making different changes to their current reporting to come into line with the more consistent definition, and so the impact will be different for each company.

Table 7.1: Scenarios tested

Ref	Theme	Scenario title	Description	Policy choice or data	WRZs	Likeli-hood*
1a	Baseline	Baseline	Baseline scenario with no intervention	-	All	M
2	Customer preferences	Customer willingness to pay	Customer willingness to pay applied to leakage reduction	Policy	All	-
3a	Resilience	Plausible droughts	Understand the sensitivity of the system to four future more extreme droughts	Data	All	R
3b		1 in 200 year drought	Understand the sensitivity of the system to a 1 in 200 year drought	Data	All	L
4a	Long-term balance	Resource only plan	Plan using only resource schemes to offset 10 years of demand growth	Policy	SWW only	M
4b		Demand only plan	Plan using only leakage reduction to offset 10 years of demand growth	Policy	All	M
5a	Environment and markets	Southern transfer	Impact of 20 Ml/d transfer to Southern Water	Policy	BW Only	H
5b		Environmental needs	Impact of potential changes in abstraction from National Environment Programme studies	Data	All	L
6a	Data	Leakage consistency measures	The impact on the supply demand balance of moving to a single, industry method for leakage	Data	All	H
6b		PR19 draft methodology	The impact on the supply demand balance of a 15% reduction in leakage by 2025	Policy	All	H
7a	Demand uncertainty	High household demand	High forecast for household demand (1 standard deviation from best estimate).	Data	All	L
7b		High non-household demand	Forecast built upon faster economic growth (GVA 2.5% p.a.; employment growth 0.6% p.a)	Data	All	L

** Likelihood: R = Remote (<2%), L = Low (2-20%); M = Medium (20 – 65%); H = High (85-90%); VH = Very High (>90%)*

7.3 Scenario analysis results

The results of the scenario analysis are presented below for each WRZ.

7.3.1 Colliford WRZ

The results of the scenario analysis on the supply demand balance are presented in Table 7.2 with the supply demand graphs in Figure 7.1. Full details of all the scenarios are given in Appendix 7.

7.3.1.1 Summary

Overall the WRZ is fairly robust. The WRZ is currently resilient to droughts with a return period greater than 1 in 200 years, and the supply demand balance is not sensitive to the higher non-household demand forecast.

This WRZ, however, does have some small sensitivity in the medium to long-term to:

- New environmental needs
- High household demand

The level of sensitivity is small at 4-6 Ml/d and does not occur until the end of the planning period.

With regard to policy decisions, customer willingness to pay data supports leakage reductions to 19 – 22 Ml/d from a current level of 30.6 Ml/d. If delivered in the period to 2025, this would have an estimated bill impact by 2025 of up to £6/property[7.3]. A policy decision to reduce leakage by 15% by 2025 as per the draft PR19 methodology would have an estimated bill impact by 2025 of £2-3/prop. Both of these policy decisions would create an additional supply demand surplus within the next five years.

The results of the scenario tested are discussed in detail below.

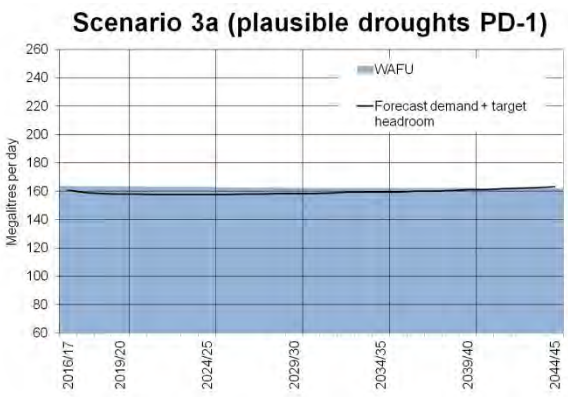
[7.3] Indicative bill impact in 2025 based on change in operating and capital costs. Bill impacts are for comparison purposes only. Actual bill impacts will depend on the rest of the PR19 Business Plan and PR19 methodology assumptions.

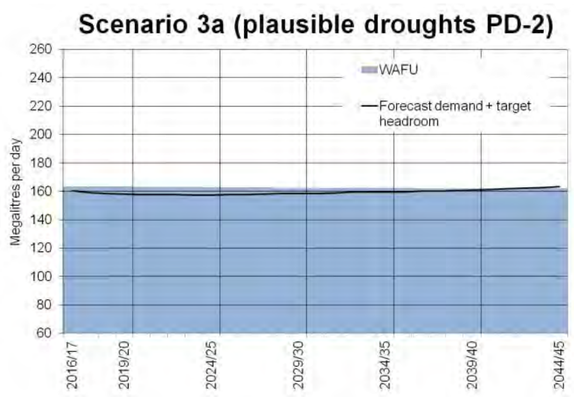
Table 7.2: Results of scenario analysis: Colliford WRZ

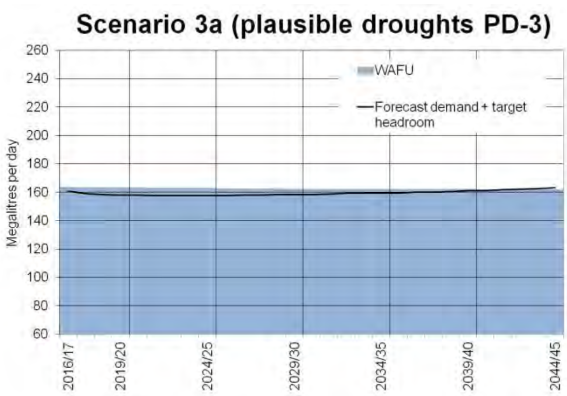
Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	green	green	green	green	green	green	amber
2	Customer willingness to pay	green	green	green	green	green	green	green
3a	Plausible droughts (4 droughts)	green	green	green	green	green	green	amber
3b	1 in 200 year drought	green	green	green	green	green	green	amber
4a	Resource only plan	green	green	green	green	green	green	green
4b	Demand only plan	green	green	green	green	green	green	green
5a	Southern transfer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5b	Environmental needs (WINEP2)	green	green	green	amber	amber	amber	amber
6a	Leakage consistency measures	green	green	green	green	green	green	green
6b	PR19 draft methodology (15% leakage reduction)	green	green	green	green	green	green	green
7a	High household demand	green	green	green	green	amber	amber	amber
7b	High non-household demand	green	green	green	green	green	green	amber

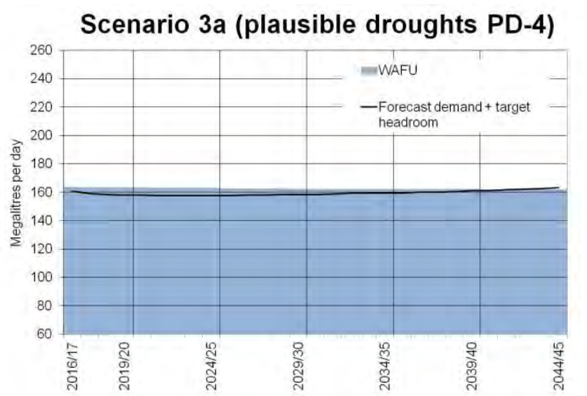
Note – green = no supply demand deficit; amber = small supply demand deficit (<3%); red = large supply demand deficit (>3%)

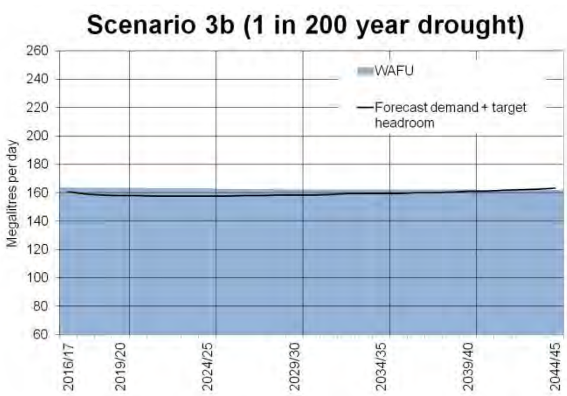
Figure 7.1: Results of scenario analysis: Colliford WRZ

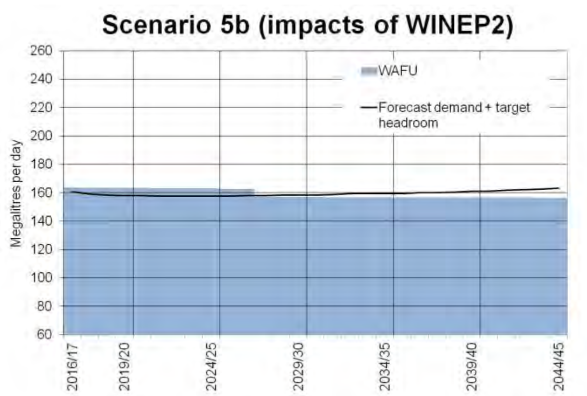


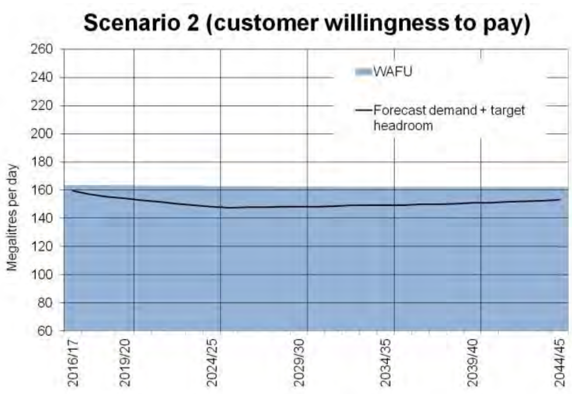


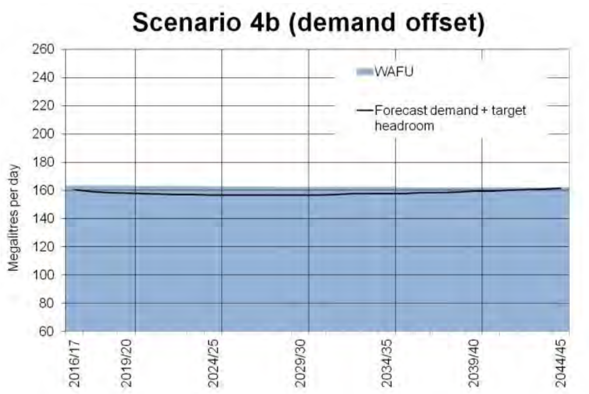

Scenario 3a (plausible droughts PD-3)
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
WAFU
Forecast demand + target headroom
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

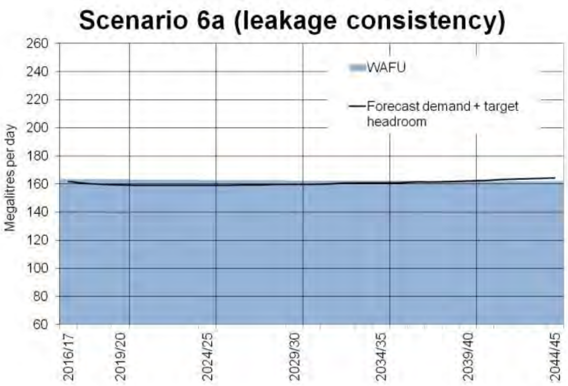

Scenario 3a (plausible droughts PD-4)
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
WAFU
Forecast demand + target headroom
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

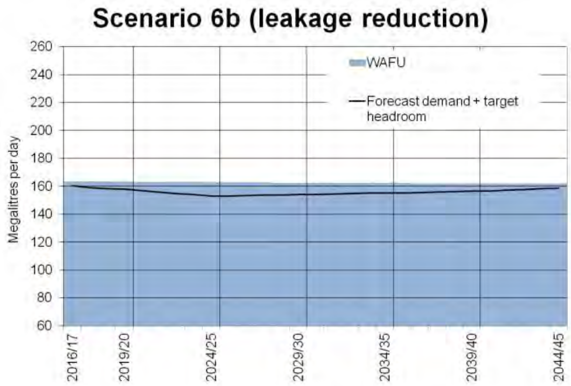

Scenario 3b (1 in 200 year drought)
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
WAFU
Forecast demand + target headroom
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

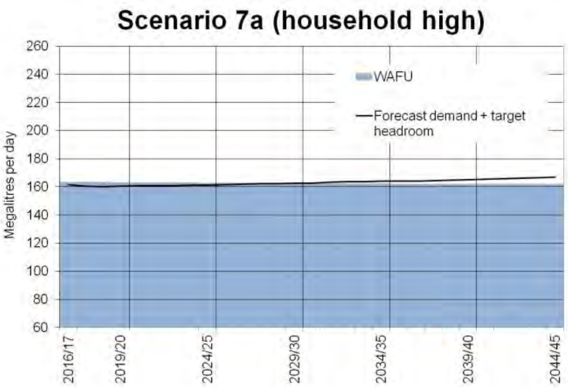

Scenario 5b (impacts of WINEP2)
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
WAFU
Forecast demand + target headroom
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

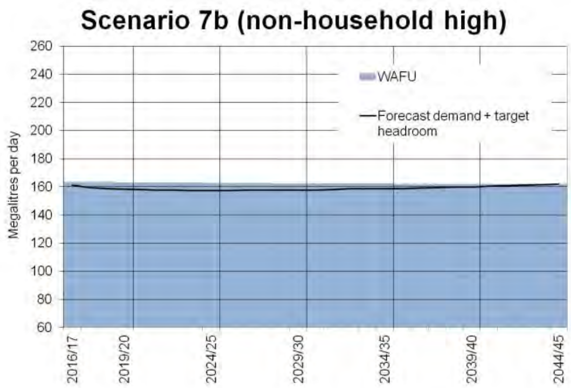

Scenario 2 (customer willingness to pay)
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
WAFU
Forecast demand + target headroom
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 4b (demand offset)
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
WAFU
Forecast demand + target headroom
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45









7.3.1.2 Scenario 2 – Customer preferences (customer willingness to pay)

This scenario used customer willingness to pay data (see Appendix 1) to calculate the cost-beneficial level of leakage reduction to customers.

Figure 7.2 shows the Net Present Value (NPV) of operating at different leakage levels in the Colliford WRZ. The figure presents the private costs (i.e. the costs to the company) and the net cost taking into account the customer willingness to pay[7.4].

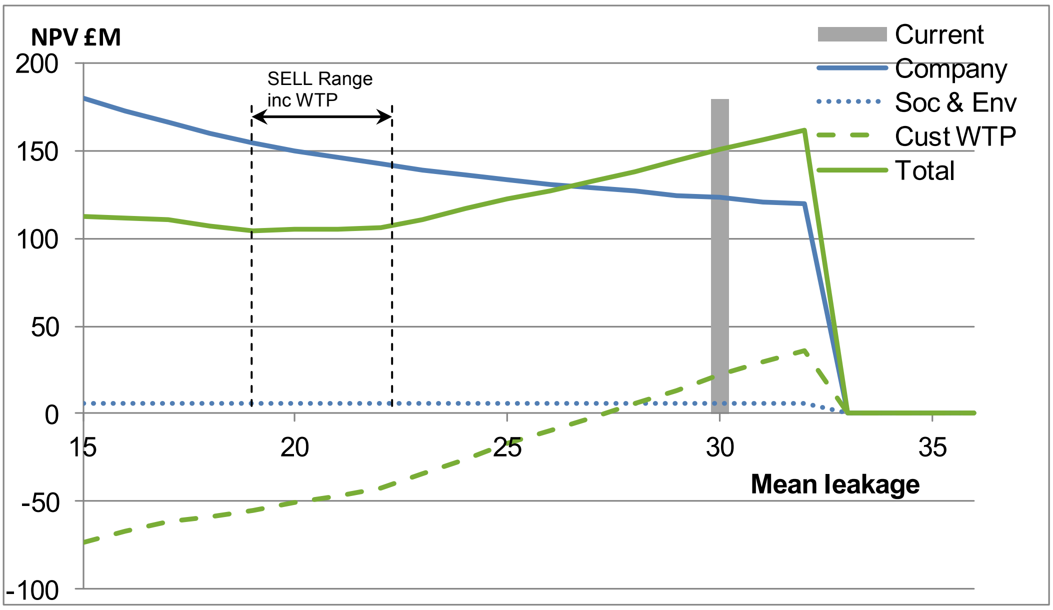
The results show that leakage reduction from current 30.6 Ml/d down to 22 – 19 Ml/d is cost-beneficial – shown by the NPV reducing as leakage reduces from present day levels. When leakage reduces below 19 Ml/d the NPV of the programme increases, indicating the cost of further reductions in leakage is higher than customer willingness to pay.

The results of this analysis show that whilst there is no supply demand driver for leakage reduction, the value customers place upon these reductions means further reductions are cost-beneficial.

[7.4] The net cost is given by the company costs minus the customer willingness to pay (i.e. the benefit)

Moving to a customer willingness to pay based leakage value by 2025 would generate additional supply demand surplus of around 8 to 11 Ml/d[7.5] but at an estimated increase in bills of up to £6/property. The overall performance of this programme looking at wider aspects including bill impacts is given in Section 7.5

Figure 7.2: Colliford WRZ scenario analysis – Scenario 2 – programme costs



7.3.1.3 Scenario 3 – Resilience (plausible droughts and 1 in 200 year droughts)

This scenario tested the performance of the system against more extreme droughts. For each drought, the WAFU was recalculated to determine the level of demand that the WRZ could support whilst still meeting the levels of service. The supply demand balance was then recalculated to understand the sensitivity of the system to additional water resource stress.

Two drought scenarios were tested. The first (Scenario 3a) used plausible droughts. These are four synthetic drought sequences that are more extreme than seen historically. These are the same drought sequences as used in our Draft Drought Plan[7.6]. These have return periods of up to 1 in 1000[7.7].

The second (Scenario 3b) considered a 1 in 200 year drought. Further details on these drought scenarios are given in Appendix 7.

[7.5] As leakage would reduce from 30.6 Ml/d down to 22 to 19 Ml/d (8.6 to 11.6Ml/d reduction)
[7.6] South West Water (2017), *Draft Drought Plan October 2017*
[7.7] See Table 2 in Section A7.2.2.

The results (see Figure 7.1) show that the WRZ can support these more extreme droughts without going into deficit until the very end of the planning period. The deficit then is only small (1.1 Ml/d in 2045).

The lowest cost plan for this scenario is for no intervention. This is the same as the baseline forecast.

7.3.1.4 Scenario 4 – Long-term balance (resource only plan and demand only plan)

This scenario tested a policy decision to do a water resource or a demand only plan (using leakage reduction) to offset a 10 year increase in demand. In doing so, this plan seeks to keep the supply risk to customers constant.

The results of the scenario are given in Table 7.3 and show:

- Compared to a baseline plan this policy decision would provide upwards of an additional 1.7 Ml/d of benefit to the system
- The demand led plan has a lower overall programme cost than a water resource led plan
- A water resource option led plan would give greater benefit to the supply-demand balance as the yield available for a given cost is higher than leakage reduction

Table 7.3: Colliford WRZ scenario analysis – Scenario 4 results

Ref	Description	Estimated bill impact in 2025 [£/prop]	Additional benefit (Ml/d)	Additional cost over base line plan (£m NPV)
4a	Resource only plan	<0.5	7	7.2[7.8]
4b	Demand only plan	0.5-1	1.7	3.5

The overall performance of this plan taking wider factors into account is given in Section 7.5.

7.3.1.5 Scenario 5 – Environment and markets (new environmental needs)

This scenario tested the performance of the system against future new environmental needs. Whilst this WRZ has no confirmed sustainability reductions, a number of investigations are planned in the 2020 to 2025 period as part of the National Environment Programme (WINEP2). For this scenario, in order to test the sensitivity of the supply demand balance it was assumed that half of the total estimated loss of supply from all of these studies occurs. A loss of supply of 5.5 Ml/d in the 2025 to 2030 period was assumed.

[7.8] Re-use Rialton Intake/Porth

The results show:

- the supply demand balance is sensitive to future sustainability reductions
- reductions of 5.5 Ml/d would just place the WRZ into deficit
- the deficit could be resolved by leakage reduction of an additional 5.5 Ml/d above the base case (6.6 Ml/d in total)

If left unresolved, the supply demand deficit would reduce current levels of service.

A worst case scenario was also examined, which assumed that all possible environmental needs would be implemented. This would lead to a material deficit in the 2025 to 2030 period of around 6.5 Ml/d, which would increase to nearly 12 Ml/d (7%) by 2045 if not mitigated. We have assessed this scenario as low likelihood, but we consider it is useful to understand the resilience of our system to large changes to the operation of our existing water resource supplies.

7.3.1.6 Scenario 6 – Data (leakage consistency and PR19 draft methodology)

This scenario examined the sensitivity of the baseline supply demand balance to two data changes:

- Leakage consistency – the change in leakage reporting methodology to a single industry wide approach
- PR19 methodology – the impact of a 15% (c.4.4 Ml/d) reduction in leakage by 2025 in line with the proposed draft PR19 methodology

The results are presented in Figure 7.1 and Table 7.4. The results show:

- The supply demand balance is not sensitive to a change in the leakage reporting methodology. The change in methodology gives a small increase in dry weather DI due to changes in the water balance, but does not have a material impact on the supply demand balance
- The PR19 draft methodology of a 15% leakage reduction by 2025 would increase the supply surplus from 5.4 Ml/d to 9.8 Ml/d. It would increase the total cost by £10.6m over the planning period and have an estimated bill impact in 2025 of £2-3/prop

A 15% leakage reduction by 2025 would provide further mitigation to long-term uncertainties due to the improvement in the supply demand balance. A 15% reduction by 2025 would offset 117%[7.9] of the total 25 year household growth in demand within the first five years of the programme. It would offset 69%[7.10] of the future risk on environmental needs. The benefit, however, would come at a larger increase in customer bills than would otherwise occur. The overall performance of this plan taking wider factors into account is presented in Section 7.5.

[7.9] Total growth in household demand over 25 years is 3.8Ml/d.
[7.10] Environmental needs of 5.5Mld.

Table 7.4: Colliford WRZ scenario analysis – Scenario 6 results

Ref	Description	Estimated bill impact in 2025 (£/prop)	Leakage reduction (Ml/d)	Additional Cost (£m NPV)	Customer WTP (£m/Ml/d)	Customer WTP (£m NPV)
6a	Leakage consistency	0	2.5	0.2	0.54	3.3
6b	PR19 draft methodology	2-3	4.4	10.6	0.54	26.5

Note – the timing of the leakage reduction is different in scenario 6a and 6b. This accounts for the large difference in the NPVs

7.3.1.7 Scenario 7 – Demand uncertainty (higher household and higher non-household demand)

This scenario examined the sensitivity of the baseline forecasts to increases in household and non-household demand. To prevent double counting of uncertainty, this scenario recalculated the target headroom allowance reducing the demand uncertainty included in the baseline scenario.

The results show:

- The supply demand balance has some sensitivity to higher household demand in the long-term
- Higher household demand could see the WRZ go into deficit in 2035 increasing from 1.1 Ml/d to 4.91 Ml/d if not mitigated
- The supply demand balance is not sensitive to higher non-household demand

To close the supply demand deficit, the most appropriate solution is for additional leakage control as this is flexible to the timing of the deficit.

The leakage reduction to offset the higher household demand risk is within the range identified as cost-beneficial in the willingness to pay analysis (Scenario 2).

7.3.2 Roadford WRZ

The results of the scenario analysis are presented in Table 7.5 and Figure 7.3 respectively. Full details of all the scenarios are given in Appendix 7.

7.3.2.1 Summary

Overall the WRZ is fairly robust. The WRZ is currently resilient to droughts with a return period greater than 1 in 200 years and the supply demand balance is not sensitive to the higher non-household demand forecast.

This WRZ however, does have some sensitivity in the medium to long-term to:

- More extreme droughts (> 1 in 200 year return period)
- New environmental needs
- High household demand

With the exception of most extreme droughts, the sensitivity to the supply demand balance is small (< 3%).

With regard to policy decisions, customer willingness to pay data supports leakage reductions to 28 – 30 Ml/d from a current level of 42 Ml/d. If delivered within the next five years this would have an estimated bill impact of up to £10/prop. A policy decision to reduce leakage by 15% by 2025 as per PR19 methodology would have an estimated bill impact of £2-3/prop. Both of these policy decisions would create additional supply demand surplus in the short-term.

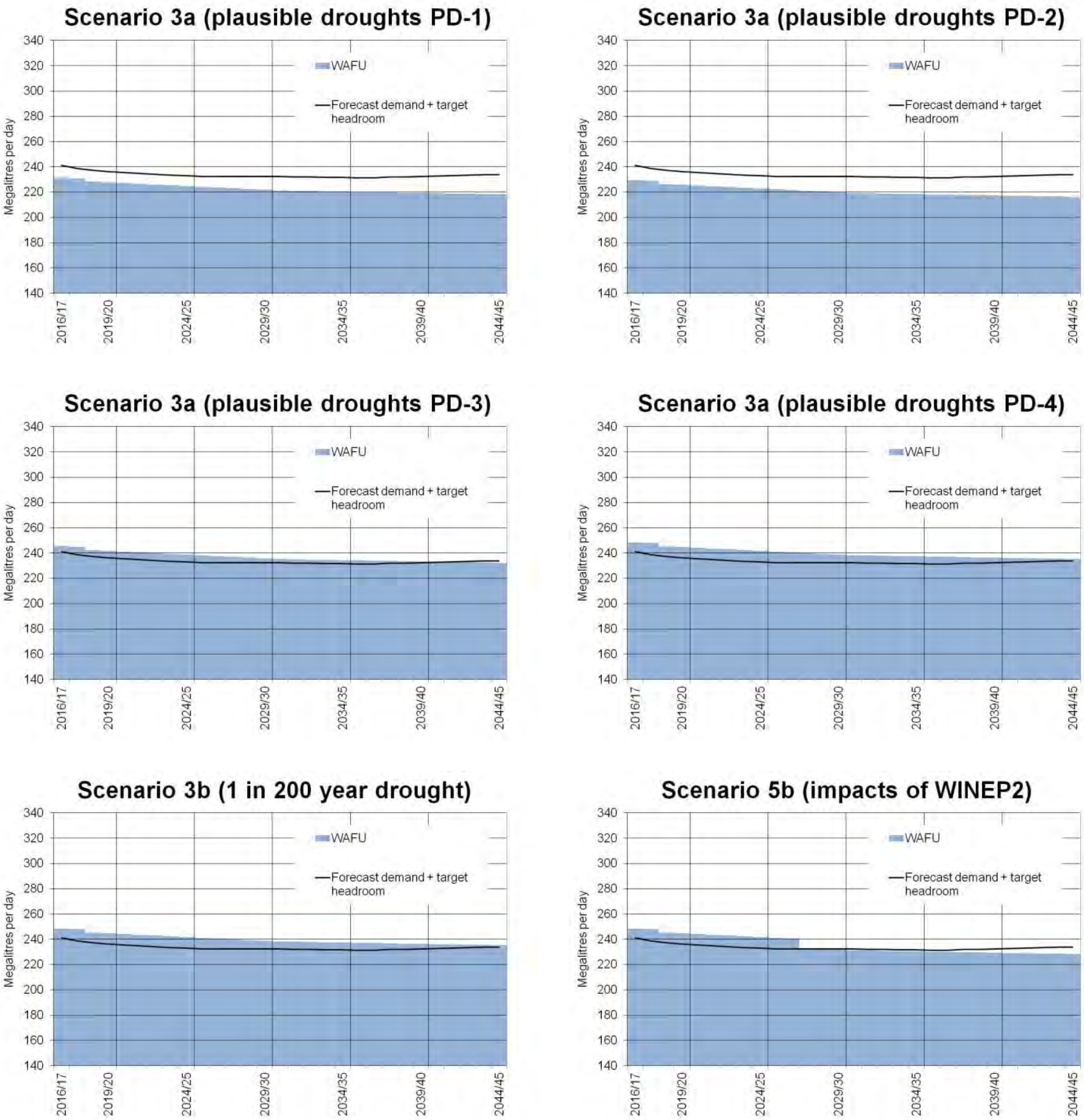
Each of the scenarios is discussed below.

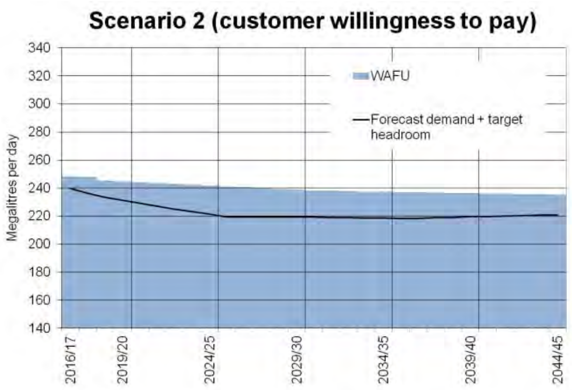
Table 7.5: Results of scenario analysis: Roadford WRZ

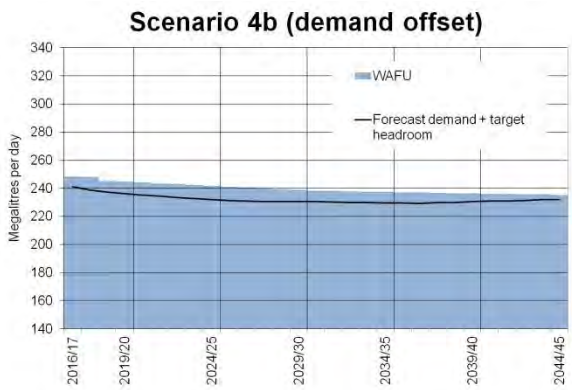
Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	● green	● green	● green	● green	● green	● green	● green
2	Customer willingness to pay	● green	● green	● green	● green	● green	● green	● green
3a	Plausible droughts (4 droughts)*	● amber	● amber	● amber	● amber	● amber	● amber	● amber
3b	1 in 200 year drought	● green	● green	● green	● green	● green	● green	● green
4a	Resource only plan	● green	● green	● green	● green	● green	● green	● green
4b	Demand only plan	● green	● green	● green	● green	● green	● green	● green
5a	Southern transfer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5b	Environmental needs (WINEP2)	● green	● green	● green	● amber	● amber	● amber	● amber
6a	Leakage consistency measures	● green	● green	● green	● green	● green	● green	● amber
6b	PR19 draft methodology (15% leakage reduction)	● green	● green	● green	● green	● green	● green	● green
7a	High household demand	● green	● green	● green	● amber	● amber	● amber	● amber
7b	High non-household demand	● green	● green	● green	● green	● green	● green	● green

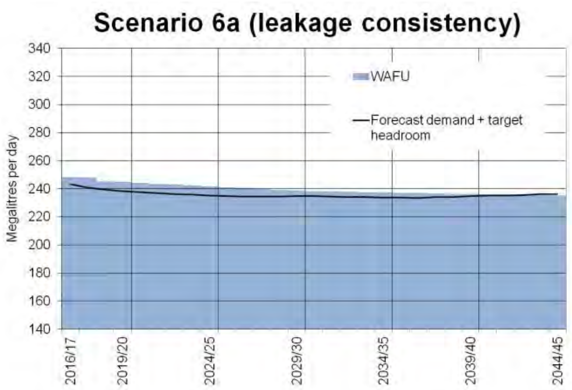
Note:
** Four different droughts were tested. Two showed a deficit; two did not. For presentation purposes an average is included here, but full details are given below.*
green = no supply demand deficit; amber = small supply demand deficit (<3%); red = large supply demand deficit (>3%)

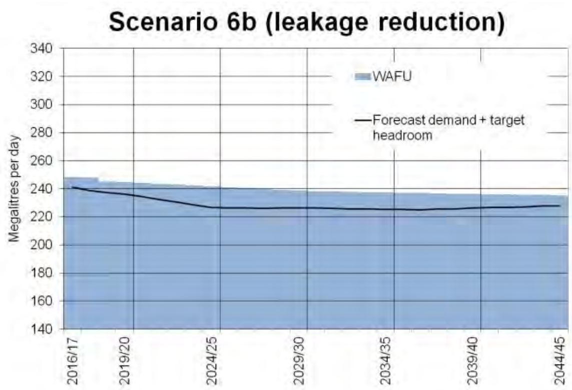
Figure 7.3: Results of scenario analysis: Roadford WRZ

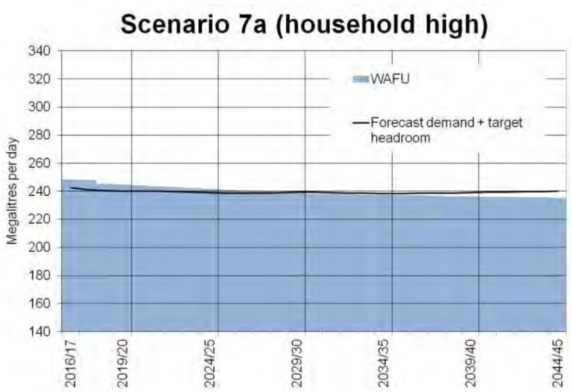


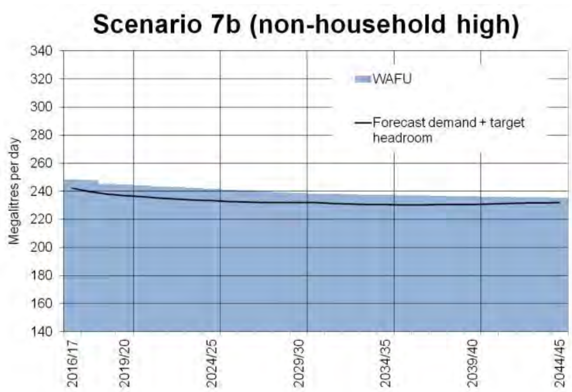












7.3.2.2 Scenario 2 – Customer preferences (customer willingness to pay)

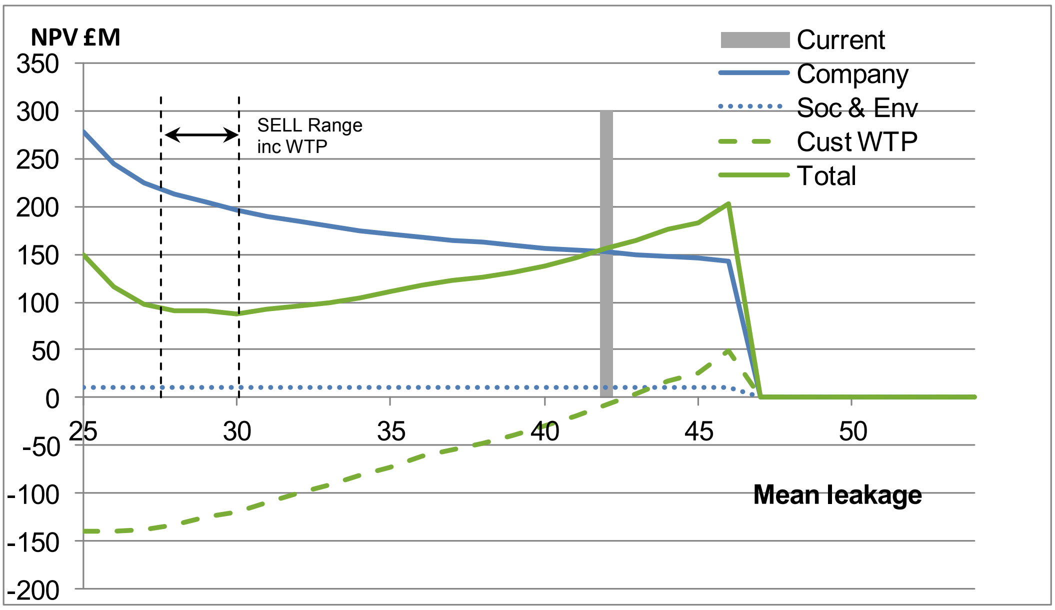
This scenario used customer willingness to pay data (see Appendix 1) to calculate the cost-beneficial level of leakage reduction to customers.

Figure 7.4 shows the NPV of operating at different leakage levels in the Roadford WRZ. The figure presents the private costs (i.e. the costs to the company) and the net cost taking into account the customer willingness to pay[7.11].

The results show that leakage reduction from the current 42 Ml/d down to 28 – 30 Ml/d is cost-beneficial. This is because the NPV including willingness to pay values reduces as leakage reduces from its present day value. When leakage falls below 28 Ml/d the NPV of the programme increases indicating the cost of further reductions in leakage is higher than customer willingness to pay.

The results of this analysis show that whilst there is no supply demand driver for leakage reduction, the value customers place upon these reductions means further reductions are cost-beneficial. Moving to a customer willingness to pay based leakage value in the short-term would generate additional supply demand surplus of around 12 to 14 Ml/d[7.12] and have an estimated bill impact of up to £10/prop. The overall performance of this programme, including the impact on customer bills, is given in Section 7.5

Figure 7.4: Roadford WRZ scenario analysis – Scenario 2 – programme costs



7.3.2.3 Scenario 3 – Resilience (plausible droughts and 1 in 200 year droughts)

This scenario tested the performance of the system against more extreme droughts. For each drought, the WAFU was recalculated to determine the level of demand that the WRZ could support whilst still meeting the levels of service. The

[7.11] The net cost is given by the company costs minus the customer willingness to pay (i.e. the benefit)
[7.12] As leakage would reduce from 42 Ml/d down to 28 to 30 Ml/d.

supply demand balance was then recalculated to understand the sensitivity of the system to additional water resource stress.

Two drought scenarios were tested. The first (Scenario 3a) used plausible droughts. These are four synthetic drought sequences that are more extreme than seen historically. These are the same drought sequences as used in our Draft Drought Plan. These have return periods of between 1 in 400 and 1 in 4,000[7.13].

The second (Scenario 3b) considered a 1 in 200 year drought scenario, which for this WRZ is the historic 1975/76 drought. Further details on these drought sequences are given in Appendix 7.

The results (see Figure 7.3) show the WRZ does not go into deficit for a 1 in 200 year drought but can go into deficit for some of the more extreme droughts. Table 7.6 shows a summary of the impacts of the more extreme droughts. Of these droughts, only one (PD-2) gives rise to a notable supply demand deficit. This has a small likelihood over the whole 25 year planning period. If mitigated through leakage reduction, this risk would cost >£100m for the 25 year planning period.

The additional resilience has a high customer benefit value although the precise benefit customers place on such extreme events is hard to quantify. The results should therefore be considered as indicative as to the importance of maintaining resilience to service. The performance of this plan taking wider factors into account is given in Section 7.5.

Table 7.6: Roadford WRZ scenario analysis – Scenario 3 results

Ref	Description	Return period (1 in X)	Likelihood within 25 year period[7.14]	Maximum supply demand deficit (Ml/d)	Cost of mitigation (£m)[7.15]	Implied service benefit	Customer valuation[7.16]
3a	Plausible drought: PD-1	1,500 – 4,000	0.6 to 1.7%	15.2	90.7	1%	£873m
	Plausible drought: PD-2	400 – 430	5.7 to 6.1%	17.4	119.6	1%	£873m
	Plausible drought: PD-3	900 – 1,500	1.7 to 2.7%	1.4	2.3	0	0
	Plausible drought: PD-4	-	-	0	-	-	-

Note – there is not a direct 1:1 relationship between drought return period and the impact on the system. This is because when the drought occurs can affect the impact on water available for use.

[7.13] See Table 2 in Section A.7.2.2.
[7.14] Based on at least 1 event in 25 years.
[7.15] Baseline total 25 year plan cost. Total cost here is used rather than NPV since the costs and benefits occur at the same rate throughout the period.
[7.16] Based on customer valuation for change in service levels of £88/property – see Appendix 1. Valuation is given by change in service level x 88 x property count (397k) x 25 years, where change in service level = 2% for PD-2, 3% for PD-3 and 4% for PD-1. The change in service level has been estimated based on the assumption that current service levels are 1 in 20 (5%) would be improved by at least 1% if planning for more extreme droughts

7.3.2.4 Scenario 4 – Long-term balance (water resource only plan and demand only plan)

This scenario tested a policy decision to do a water resource or a demand only plan (using leakage reduction), to offset a 10 year increase in demand. In doing so, this plan seeks to keep the supply risk to customers constant.

The results of the scenario are given in Table 7.7 and show:

- Compared to a baseline plan this policy decision would provide upwards of 1.9 Ml/d of benefit to the supply demand balance by the end of the planning period
- A demand led plan has a slightly higher cost to the company than a resource led plan, but this is not considered to be a material difference
- A water resource option led plan would give greater benefit to the supply-demand balance as the yield available for a given cost is higher than leakage reduction

Table 7.7: Roadford WRZ scenario analysis – Scenario 4 results

Ref	Description	Estimated bill impact in 2025 [£/prop]	Additional benefit (Ml/d)	Additional cost over base line plan (£m NPV)
4a	Resource only plan	<0.5	9.8	3.1[7.17]
4b	Demand only plan	<0.5	1.9	3.7

The overall performance of this plan, taking wider factors into account than just cost, is presented in Section 7.5.

7.3.2.5 Scenario 5 – Environment and markets (new environmental needs)

As for Colliford WRZ, this scenario tested the performance of the system against future new environmental needs. Whilst this WRZ has no confirmed sustainability reductions, a number of investigations are planned in the 2020 to 2025 period as part of the National Environment Programme (WINEP2). For this scenario, in order to test the sensitivity of the supply demand balance it was assumed that half of the total estimated loss of supply from all of these studies would occur. A loss of supply of 7 Ml/d in the 2025-2030 period was assumed.

The results show:

- The supply demand balance is sensitive to future sustainability reductions
- Reductions of 7 Ml/d would just place the WRZ into deficit

[7.17] Northcombe WTW output increased to 60Ml/d

- The deficit could be resolved by leakage reduction of 5.4 Ml/d by the end of the planning period, the remaining loss of supply would use the existing small surplus

If left unresolved, the supply demand deficit would give rise to a reduction in levels of service.

A worst case scenario was also examined. This assumed all possible environmental needs would be implemented. This would lead to a material deficit in the 2025 to 2030 period of around 6 Ml/d which would increase to nearly 14 Ml/d (6%) by 2045 if not mitigated.

As with Colliford WRZ, we have assessed this scenario as low likelihood, but we consider it is useful to understand the resilience of our system to large changes to the operation of our existing water resource supplies.

7.3.2.6 Scenario 6 – Data (leakage consistency and PR19 draft methodology)

This scenario examined the sensitivity of the baseline supply demand balance to two data changes:

- Leakage consistency – the change in leakage reporting methodology to a single industry wide approach
- PR19 draft methodology – the impact of a 15% (6.1 Ml/d) reduction in leakage by 2025 in line with the proposed PR19 methodology

The results are presented in Figure 7.3 and Table 7.8. The results show:

- The supply demand balance is not sensitive to a change in the leakage methodology. This gives a small increase in dry weather DI due to changes in the water balance which results in a small deficit of 0.7 Ml/d in the final year of the planning period
- A reduction in leakage of 15% by 2025 would further increase the current supply demand surplus from around 8 to 14 Ml/d in 2025
- This would increase costs to customers by £22.1m over the whole planning period compared to the baseline case and have an estimated additional bill impact of £2-3/prop by 2025

A 15% leakage reduction by 2025 would provide further mitigation to long-term uncertainties due to the improvement in the supply-demand balance. A 15% reduction by 2025 would offset nearly 100%[18] of the total 25 year household growth in demand within the first five years of the programme.

It would offset 80%[19] of the future risk on environmental needs. The benefit however would come at a larger increase in customer bills than would otherwise

[7.18] Total growth in household demand over 25 years is 6.4 Ml/d.
[7.19] Environmental needs of 7 Mld.

occur. The overall performance of this plan taking wider factors into account is presented in Section 7.5.

Table 7.8: Roadford WRZ scenario analysis – Scenario 6 results

Ref	Description	Estimated bill impact in 2025 (£/prop)	Leakage reduction (Ml/d)	Additional Cost (£m NPV)	Customer WTP (£m/Ml/d)	Customer WTP (£m NPV)
6a	Leakage consistency	0	0.7	0.8	0.54	0.9
6b	PR19 draft methodology	2-3	6.1	22.1	0.54	36.8

Note – the timing of the leakage reduction is different in scenario 6a and 6b.

7.3.2.7 Scenario 7 – Demand uncertainty (higher household and higher non-household demand)

This scenario examined the sensitivity of the baseline forecasts to increases in household and non-household demand. To prevent double counting of uncertainty, this scenario recalculated the Target Headroom allowance reducing the demand uncertainty.

The results show:

- The supply demand balance has some sensitivity to higher household demand
- Higher household demands could see the WRZ go into deficit in 2030 if not mitigated with a long-term deficit at the end of the planning period of 4.8 Ml/d
- The supply demand balance is not sensitive to higher non-household demand

To close the supply-demand deficit the most appropriate solution is for additional leakage control as this is flexible to the timing of the deficit.

The leakage reduction to offset the higher household demand risk is within the range identified as cost-beneficial in the willingness to pay analysis (Scenario 2).

7.3.3 Wimbleball WRZ

The results of the scenario analysis are presented in Table 7.9 and Figure 7.5 respectively. Full details of all the scenarios are given in Appendix 7.

7.3.3.1 Summary

Overall the WRZ is currently robust to future uncertainties. The WRZ is resilient to droughts with a return period of 1 in 200 years, and the supply demand balance is not sensitive to the higher non-household demand forecast or changes in leakage reporting methodology.

This WRZ however, does have some sensitivity in the long-term to:

- More extreme droughts (> 1 in 200 year return period)
- New environmental needs
- Higher household demand

With the exception of the most extreme droughts, the sensitivity to the supply demand balance from is both small (<3%) and not until the end of the planning period.

With regard to policy decisions, customer willingness to pay data supports leakage reductions to 8 – 10 Ml/d from a current level of 11.4 Ml/d. If delivered in the period to 2025 this would have an estimated bill impact of up to £10/property. A policy decision to reduce leakage by 15% by 2025 as per the PR19 methodology would have an estimated bill impact of £3-4 /property. Both of these policy decisions would create additional supply demand surplus.

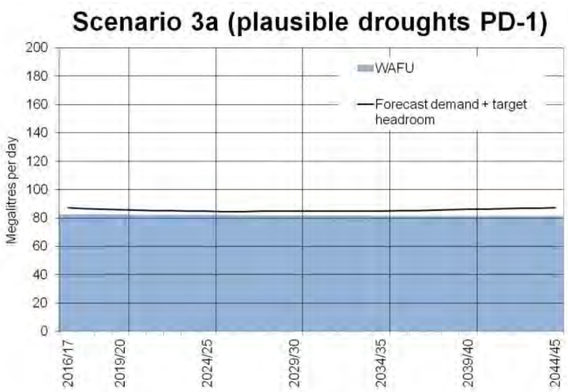
Each of the scenarios is discussed below.

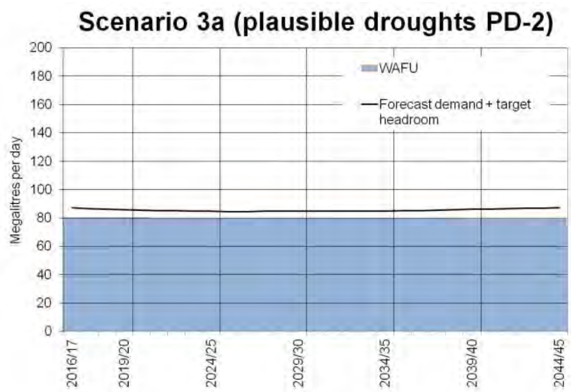
Table 7.9: Results of scenario analysis: Wimbleball WRZ

Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	green	green	green	green	green	green	green
2	Customer willingness to pay	green	green	green	green	green	green	green
3a	Plausible droughts (4 droughts)*	amber	amber	amber	amber	amber	amber	amber
3b	1 in 200 year drought	green	green	green	green	green	green	green
4a	Resource only plan	green	green	green	green	green	green	green
4b	Demand only plan	green	green	green	green	green	green	green
5a	Southern transfer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5b	Environmental needs (WINEP2)	green	green	green	green	green	green	amber
6a	Leakage consistency measures	green	green	green	green	green	green	green
6b	PR19 methodology (15% leakage reduction)	green	green	green	green	green	green	green
7a	High household demand	green	green	green	green	green	green	amber
7b	High non-household demand	green	green	green	green	green	green	green

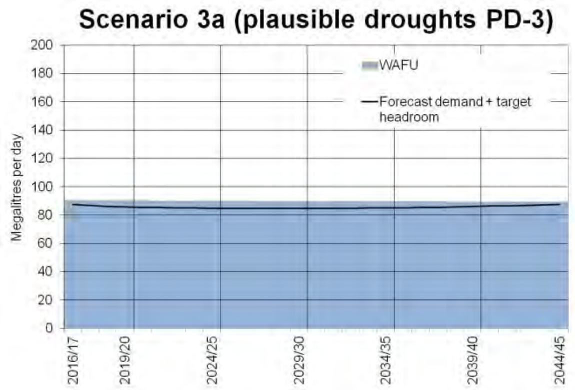
Note:
** Four different droughts were tested. Two showed deficit; two did not. For presentation purposes an average is included here, but full details are given below.*
green = no supply demand deficit; amber = small supply demand deficit (<3%); red = large supply demand deficit (>3%)

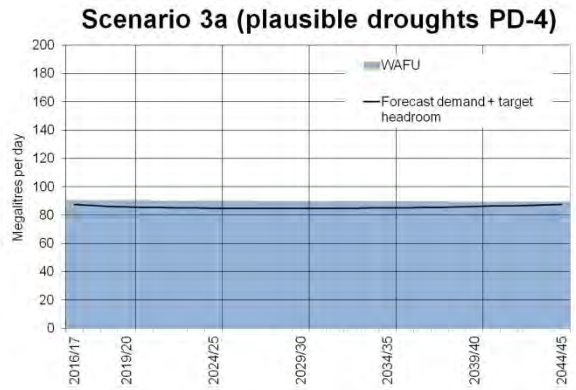
Figure 7.5: Results of scenario analysis: Wimbleball WRZ

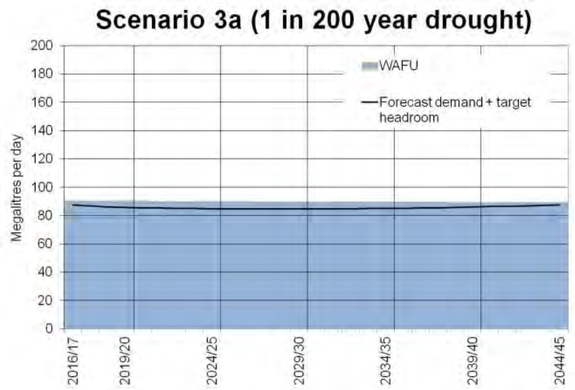


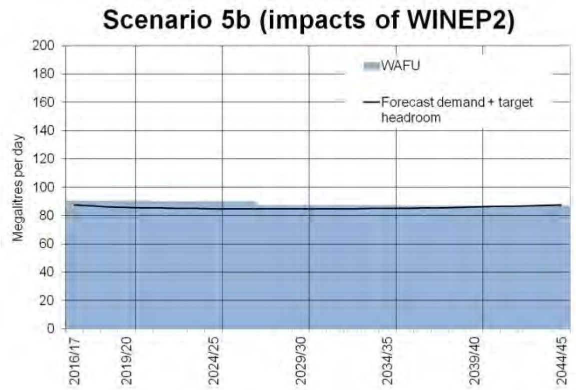


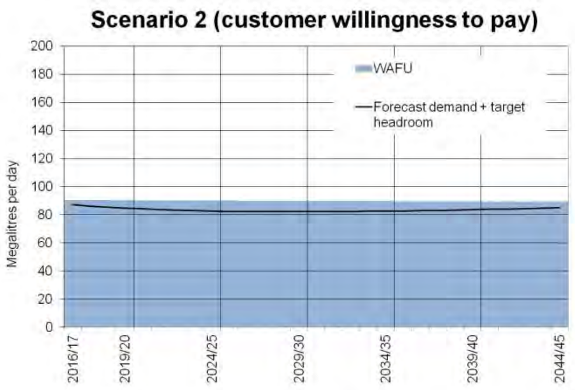
South West Water
Bournemouth Water


Scenario 3a (plausible droughts PD-3)
WAFU
Forecast demand + target headroom
Megalitres per day
200
180
160
140
120
100
80
60
40
20
0
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 3a (plausible droughts PD-4)
WAFU
Forecast demand + target headroom
Megalitres per day
200
180
160
140
120
100
80
60
40
20
0
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 3a (1 in 200 year drought)
WAFU
Forecast demand + target headroom
Megalitres per day
200
180
160
140
120
100
80
60
40
20
0
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 5b (impacts of WINEP2)
WAFU
Forecast demand + target headroom
Megalitres per day
200
180
160
140
120
100
80
60
40
20
0
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 2 (customer willingness to pay)
WAFU
Forecast demand + target headroom
Megalitres per day
200
180
160
140
120
100
80
60
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20
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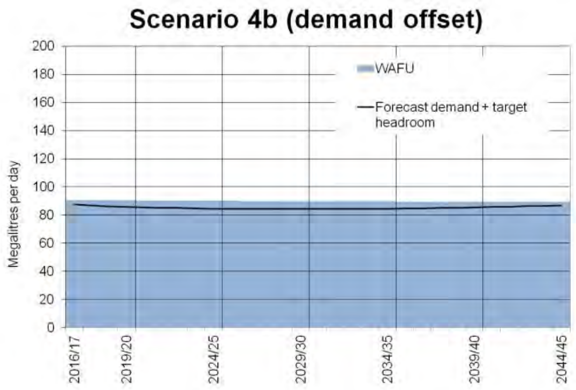
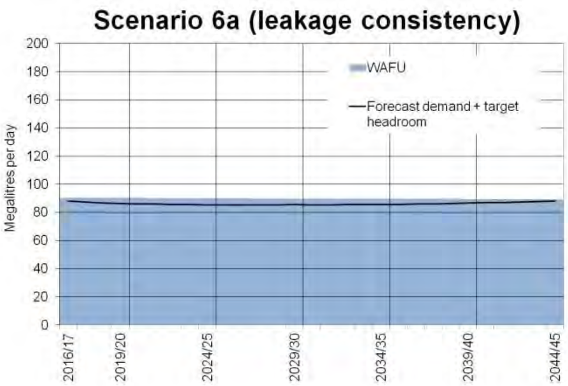
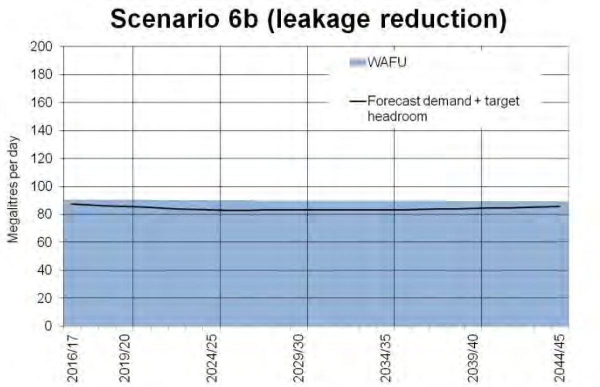
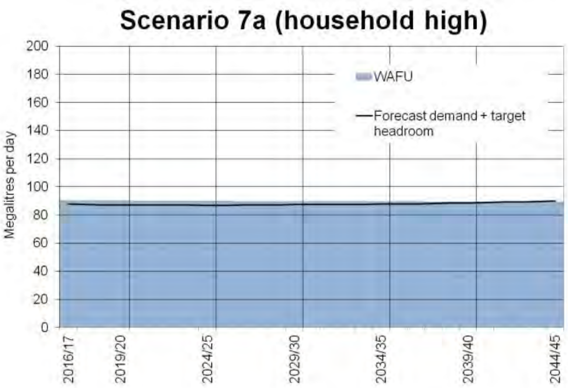
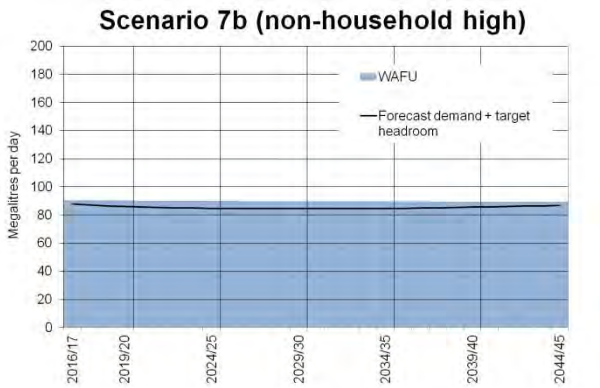
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 4b (demand offset)
WAFU
Forecast demand + target headroom
Megalitres per day
200
180
160
140
120
100
80
60
40
20
0
2016/17
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45









7.3.3.2 Scenario 2 – Customer preferences (customer willingness to pay)

This scenario used customer willingness to pay data (see Appendix 1) to calculate the cost-beneficial level of leakage reduction to customers.

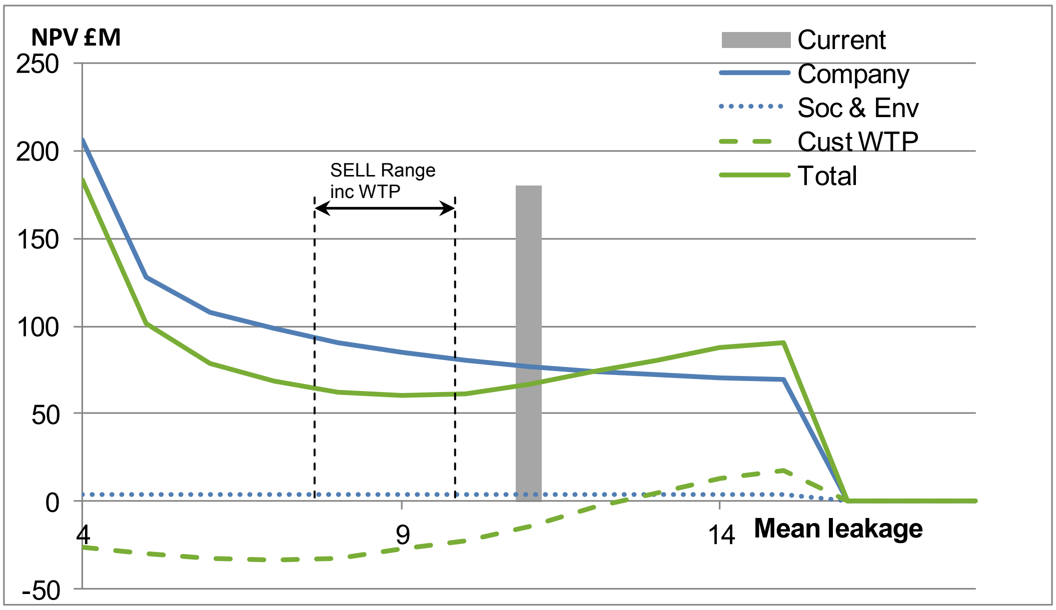
Figure 7.6 shows the NPV of operating at different leakage levels in the Wimbleball WRZ. The figure presents the private costs (i.e. the costs to the company) and the net cost taking into account the customer willingness to pay[7.20].

The results show that leakage reduction from current 11.4 Ml/d down to 8 – 10 Ml/d is cost-beneficial. This is because the willingness to pay based NPV reduces as leakage falls from its present day value. When leakage reduces below 8 Ml/d the NPV of the programme increases indicating the cost of further reductions in leakage is higher than customer willingness to pay.

The results of this analysis show that whilst there is no supply demand driver for leakage reduction, the value customers place upon these reductions means further reductions are cost-beneficial. Moving to a customer willingness to pay based

[7.20] The net cost is given by the company costs minus the customer willingness to pay (i.e. the benefit) leakage value would generate an additional supply demand surplus of around 1.5 to 3 Ml/d[7.21].

Figure 7.6: Wimbleball WRZ scenario analysis – Scenario 2 – programme costs



7.3.3.3 Scenario 3 – Resilience (plausible droughts and 1 in 200 year droughts)

This scenario tested the performance of the system against more extreme droughts. For each drought, the WAFU was recalculated to determine the level of demand that the WRZ could support whilst still meeting the levels of service. The supply demand balance was then recalculated to understand the sensitivity of the system to additional water resource stress.

Two drought scenarios were tested. The first (Scenario 3a) used plausible droughts. These are four synthetic drought sequences that are more extreme than seen historically. These are the same drought sequences as used in our Draft Drought Plan. These have return periods of between 1 in 525 and 1 in 2,500[7.22].

The second (Scenario 3b) was a 1 in 200 year drought sequence. Further details on these drought sequences are given in Appendix 7. The results (see Figure 7.5) show the WRZ does not go into deficit for a 1 in 200 year drought but can go into deficit for some of the more extreme droughts. Table 7.10 shows a summary of the impacts of the more extreme droughts. Of these droughts, only one (PD-2) gives rise to a material supply demand deficit and has a small likelihood over the whole planning period. If mitigated through leakage reduction, this risk would cost £70m over the 25 year planning period to mitigate.

[7.21] As leakage would reduce from 11.4 Ml/d down to 8 to 10 Ml/d.
[7.22] See Table 2 in Section A.7.2.2.

The additional resilience has a high customer benefit value although the precise benefit customers place on such extreme events is hard to quantify. The results should therefore be considered as indicative as to the importance of maintaining resilience to service. The performance of this plan taking wider factors into account is given in Section 7.5.

Table 7.10: Wimbleball WRZ scenario analysis – Scenario 3 results

Ref	Description	Return period (1 in X)	Likelihood within 25 year period[7.23]	Maximum supply demand deficit (Ml/d)	Cost of mitigation (£m)	Implied service benefit	Customer valuation [£m] [7.24]
3a	Plausible drought: PD-1	1,250 – 2,500	1% to 2%	5.9	48.9	1%	357
	Plausible drought: PD-2	525 - 675	3.6 to 4.7%	8.0	70.0	1%	357
	Plausible drought: PD-3	700 – 1,000	2.5 to 3.5%	0	0	0	0
	Plausible drought: PD-4	-	-	0	0	0	0

7.3.3.4 Scenario 4 – Long-term balance (resource only plan and demand only plan)

This scenario tested a policy decision to do a water resource only or a demand only plan (using leakage reduction) to offset a 10 year increase in demand. In doing so, this plan seeks to keep the supply risk to customers constant.

The results of the scenario are given in Table 7.11 and show:

- Compared to a baseline plan this policy decision would provide an additional 0.5 Ml/d of benefit to the supply demand balance by the end of the planning period
- A demand led plan using leakage reduction has a lower programme cost than a resource led plan.
- A water resource option led plan would give greater benefit to the supply-demand balance as the yield available for a given cost is higher than leakage reduction

7.23 Based on at least 1 event in 25 years.
7.24 Based on customer valuation for change in service levels of £88/property – see Appendix 1. Valuation is given by change in service level x 88 x property count (163k) x 25 years, where change in service level = 2% for PD-2, 3% for PD-3 and 4% for PD-1. The change in service level has been estimated based on the assumption that current service levels are 1 in 20 (5%) would be improved by at least 1% if planning for more extreme droughts

Table 7.11: Wimbleball WRZ scenario analysis – Scenario 4 results

Ref	Description	Estimated bill impact in 2025 [£/prop]	Additional benefit (Ml/d)	Additional cost over base line plan (£m NPV)
4a	Resource only plan	<0.5	4.5[7.25]	4.2
4b	Demand only plan	0.5-1	0.5	2.9

The overall performance of this plan, taking wider factors into account, is presented in Section 7.5.

7.3.3.5 Scenario 5 – Environment and markets (new environmental needs)

As for Colliford and Roadford WRZs, this scenario tested the performance of the system against future new environmental needs. Whilst this WRZ has no confirmed sustainability reductions, a number of investigations are planned in the 2020 to 2025 period as part of the National Environment Programme (WINEP2). For this scenario, in order to test the sensitivity of the supply demand balance, it was assumed that half of the total estimated loss of supply from all of these studies is realised. A loss of supply of 5.5 Ml/d in the 2025-2030 period was assumed.

The results show:

- The supply demand balance is sensitive to future sustainability reductions
- A reduction of 5.5 Ml/d would place the WRZ into deficit
- The deficit could be resolved by leakage reduction

If left unresolved, a reduction of this magnitude would give rise to a supply-demand deficit in the long term.

A worst case scenario was also examined that assumed all possible environmental needs would be implemented. This would lead to a material deficit in the 2025 to 2030 period of around 6 Ml/d which would increase to nearly 13 Ml/d (8%) by 2045 if not mitigated.

We have assessed this scenario as low likelihood, but we consider it is useful to understand the resilience of our system to large changes to the operation of our existing water resource supplies.

7.3.3.6 Scenario 6 – Data (leakage consistency and PR19 draft methodology)

This scenario examined the sensitivity of the baseline supply demand balance to two data changes:

[7.25] Brampford Speke boreholes

- Leakage consistency – the change in leakage reporting methodology to a single industry wide approach
- PR19 methodology – the impact of a 15% (1.7 Ml/d) reduction in leakage by 2025 in line with the proposed PR19 draft methodology

The results are presented in Figure 7.5 and Table 7.12. The results show:

- The supply demand balance is not sensitive to a change in the leakage methodology
- A reduction in leakage of 15% by 2025 would further increase the current surplus from 5.4 to 7.1 Ml/d in 2025
- This would increase costs to customers by £10.6m compared to the baseline case and have an estimated additional bill impact of £3-4/prop by 2025

A 15% leakage reduction by 2025 would provide further mitigation to long-term uncertainties due to the improvement in the supply-demand balance. A 15% reduction by 2025 would offset over 70%[7.26] of the total 25 year household growth in demand within the first five years of the programme.

It would offset over 30%[7.27] of the future risk on environmental needs. The benefit however would come at a larger increase in customer bills than would otherwise occur. The overall performance of this plan taking wider factors into account is presented in Section 7.5.

Table 7.12: Wimbleball WRZ scenario analysis – Scenario 6 results

Ref	Description	Estimated bill impact in 2025 (£/prop)	Leakage reduction (Ml/d)	Additional Cost (£m NPV)	Customer WTP (£m/Ml/d)	Customer WTP (£m NPV)
6a	Leakage consistency	0	0	0	0.54	0
6b	PR19 draft methodology	3-4	1.7	10.6	0.54	10.3

7.3.3.7 Scenario 7 – Demand uncertainty (higher household and higher non-household)

This scenario examined the sensitivity of the baseline forecasts to increases in household and non-household demand. To prevent double counting of uncertainty, this scenario recalculated the target headroom allowance reducing the demand uncertainty.

[7.26] Total growth in household demand over 25 years is 2.4 Ml/d.
[7.27] Environmental needs of 5.5 Mld.

The results show:

- The supply demand balance has some sensitivity to higher household demand
- Higher household demands could see the WRZ go into deficit in 2030 to 2035 if not mitigated with a long-term deficit at the end of the planning period of 4.9 Ml/d (3%)
- The supply demand balance is not sensitive to higher non-household demand

To close the supply-demand deficit the most appropriate solution is for additional leakage control as this is flexible to the timing of the deficit.

The leakage reduction to offset the higher household demand risk is within the range identified as cost-beneficial in the willingness to pay analysis (Scenario 2).

7.3.4 Bournemouth WRZ

The results of the scenario analysis are presented in Table 7.13 and Figure 7.7 respectively. Full details of all the scenarios are given in Appendix 7.

In contrast to the SWW Resource Zones we did not model a water resource option only plan. This is because this scenario overlaps with the work in the Bournemouth WRZ to Southern Water transfer.

7.3.4.1 Summary

The Bournemouth WRZ is robust against all but two of the scenarios tested.

The WRZ has a minor sensitivity at the end of the planning period if household demands are higher than forecast. Without intervention, this scenarios could give rise to a deficit of 1.7 Ml/d (<1%) at the very end of the planning period. This is not considered material in terms of scale and given the timing that it would occur.

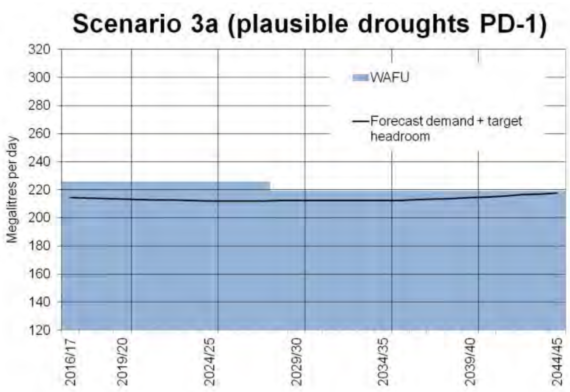
Only the Southern Water transfer showed a significant sensitivity in the plan. This scenario is presented in detail below. Further details on the other scenarios are given in Appendix 7.

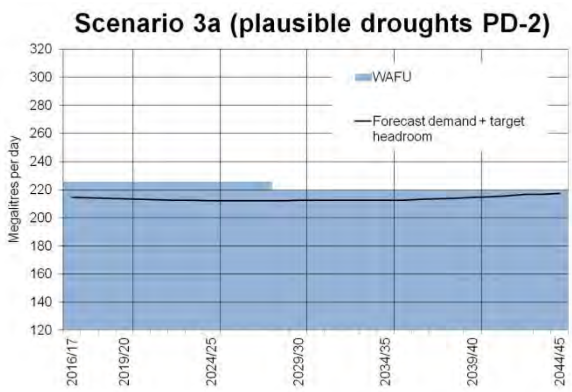
Table 7.13: Results of scenario analysis: Bournemouth WRZ

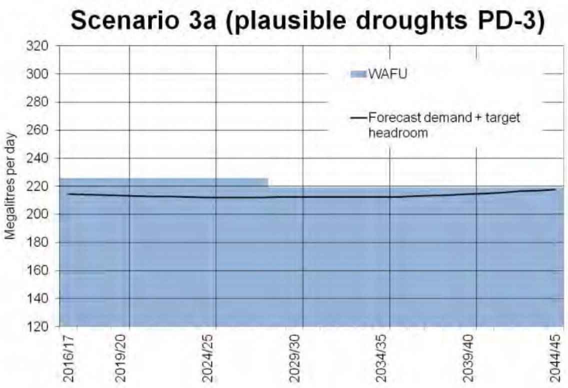
Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	green	green	green	green	green	green	green
2	Customer willingness to pay	green	green	green	green	green	green	green
3a	Plausible droughts (4 droughts)	green	green	green	green	green	green	green
3b	1 in 200 year drought	green	green	green	green	green	green	green
4a	Resource only plan							
4b	Demand only plan	green	green	green	green	green	green	green
5a	Southern transfer	blue	blue	blue	blue	blue	blue	blue
5b	Environmental needs (WINEP2)	green	green	green	green	green	green	green
6a	Leakage consistency measures	green	green	green	green	green	green	green
6b	PR19 draft methodology (15% leakage reduction)	green	green	green	green	green	green	green
7a	High household demand	green	green	green	green	green	green	amber
7b	High non-household demand	green	green	green	green	green	green	green

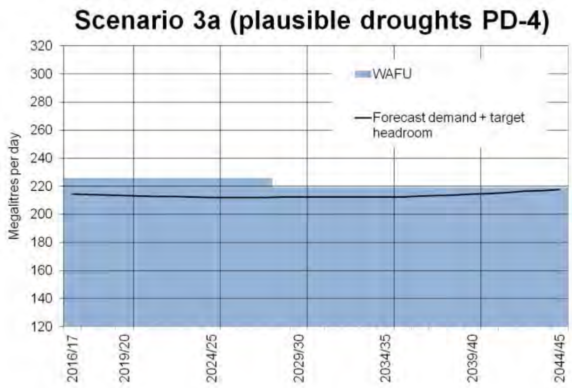
Note:
green = no supply demand deficit; amber = small supply demand deficit (<3%); red = large supply demand deficit (>3%); blue = can be met with infrastructure improvements

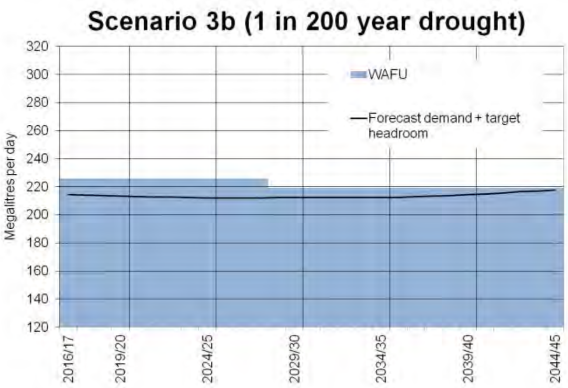
Figure 7.7: Results of scenario analysis: Bournemouth WRZ

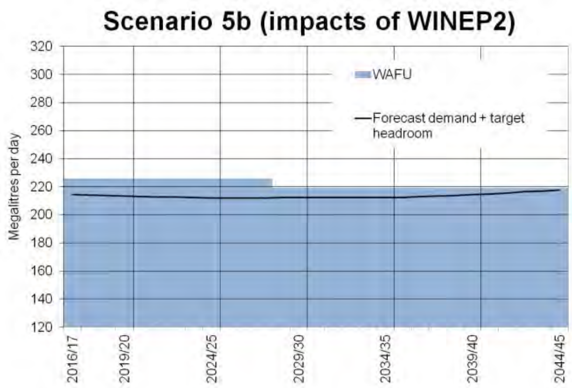


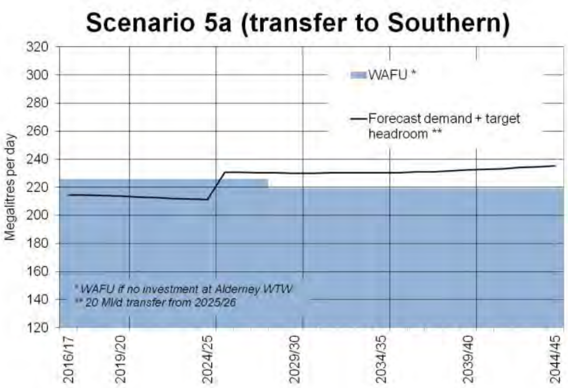


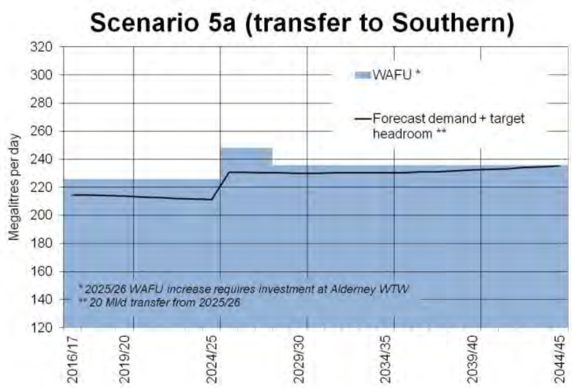

Scenario 3a (plausible droughts PD-3)
WAFU
Forecast demand + target headroom
Megalitres per day

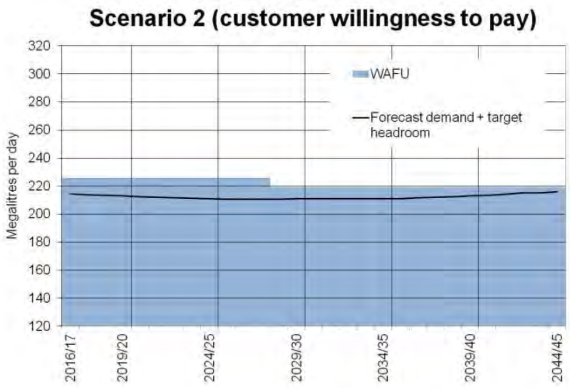

Scenario 3a (plausible droughts PD-4)
WAFU
Forecast demand + target headroom
Megalitres per day

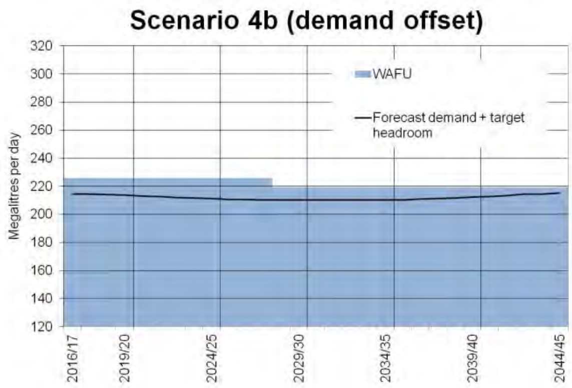

Scenario 3b (1 in 200 year drought)
WAFU
Forecast demand + target headroom
Megalitres per day

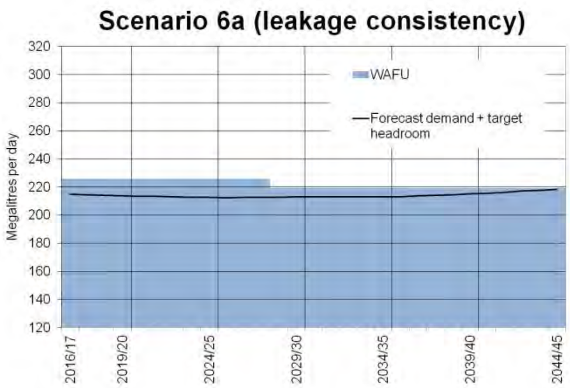

Scenario 5b (impacts of WINEP2)
WAFU
Forecast demand + target headroom
Megalitres per day

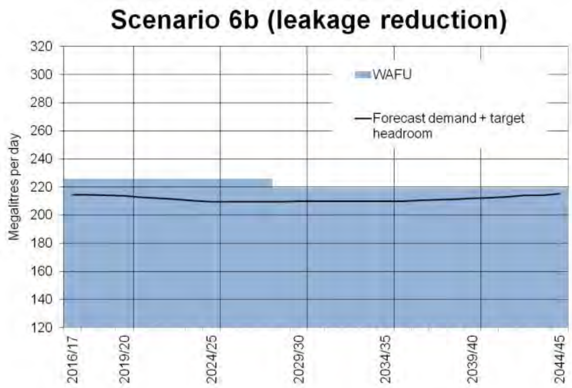

Scenario 5a (transfer to Southern)
WAFU *
Forecast demand + target headroom **
Megalitres per day
* WAFU if no investment at Alderney WTW
** 20 Ml/d transfer from 2025/26

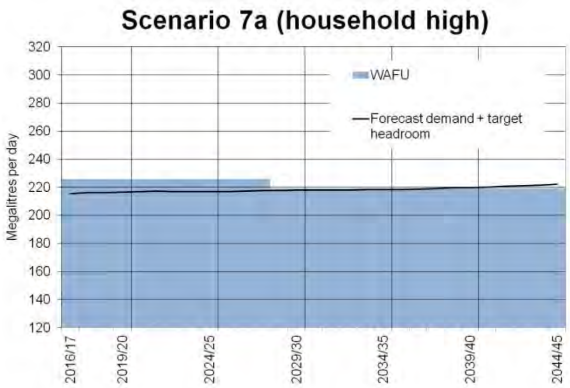

Scenario 5a (transfer to Southern)
WAFU *
Forecast demand + target headroom **
Megalitres per day
* 2025/26 WAFU increase requires investment at Alderney WTW
** 20 Ml/d transfer from 2025/26

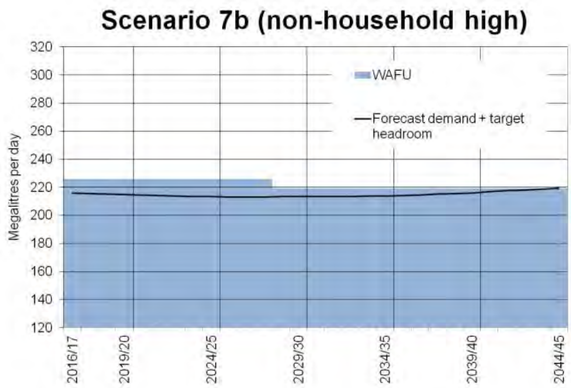












7.3.4.2 Scenario 5a – Environment and markets (transfer to Southern Water)

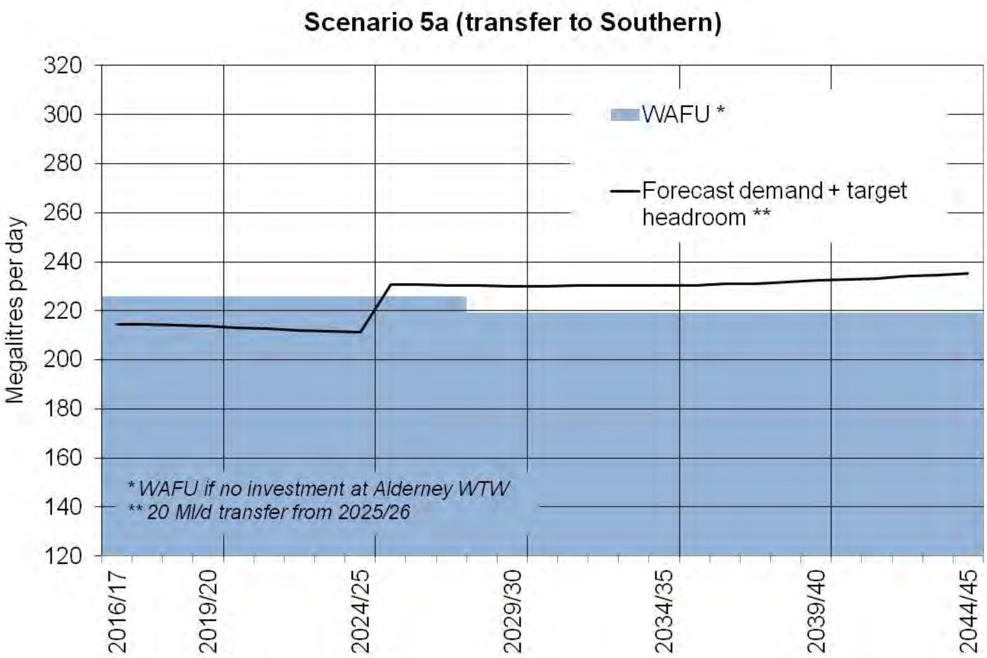
This scenario tested the sensitivity of the supply demand balance to a 20 Ml/d treated water transfer to Southern Water delivered in the 2025 to 2030 period. A minimum supply of 20 Ml/d was chosen as smaller rates of supply are highly unlikely to be viable on the grounds of disproportionate cost.

The timing was chosen as a practical view of when this could be delivered, although it is understood that Southern Water could be interested in a water transfer as early as possible. As the results show, an early timing of transfer does not affect the conclusions of the analysis.

The results show that at current water treatment works capacity a transfer of 20 Ml/d could not be sustained without placing the WRZ into deficit – see Figure 7.8.

The deficit would start at 3.6 Ml/d but increase to 14.7 Ml/d by the end of the period if no intervention was made. This is a deficit of 6% by the end of the period and would cause a material failure of current service levels.

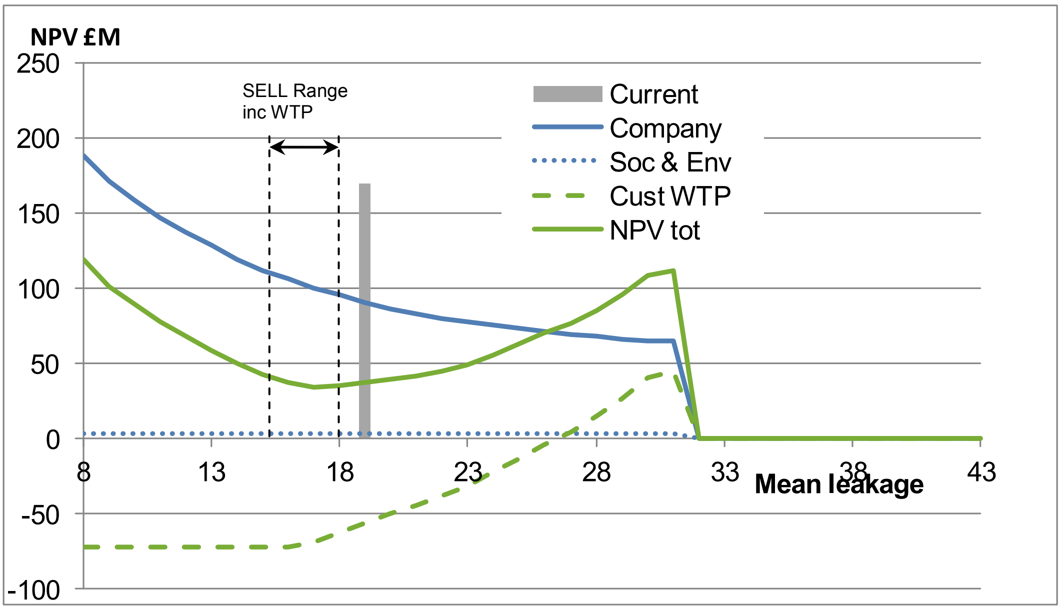
Figure 7.8: Scenario 5a – Transfer to Southern Water (no investment)



Leakage in this WRZ is currently at 19 Ml/d and analysis of customer willingness to pay and the costs of leakage reduction show the economic range of leakage is 16-18 Ml/d – see Figure 7.9.

To close the gap through leakage reduction would therefore be neither cost-beneficial nor could it be of sufficient scale to mitigate the longer-term deficit that would arise.

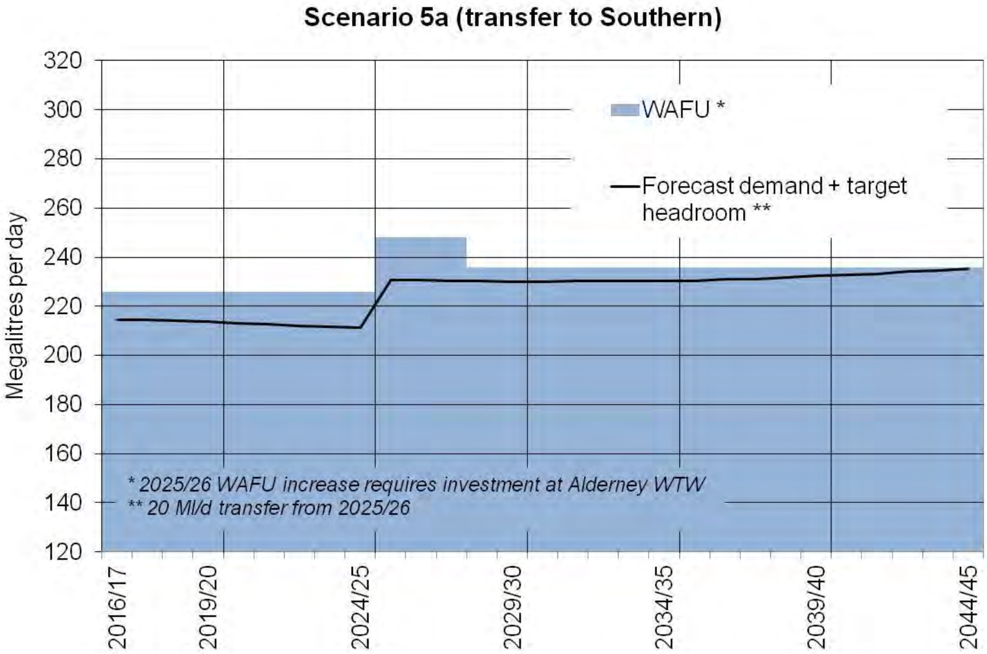
Figure 7.9: Scenario results – Willingness to pay



A further review of the system was undertaken to understand existing constraints and the implications of interventions to remove them. The Bournemouth WRZ is currently constrained by WTW capacity in order to meet statutory drinking water quality requirements during a drought. A scenario was therefore undertaken that which assumed a potential removal of this constraint.

The result is shown in Figure 7.10. This showed that with the constraint removed the transfer could be met without a detriment to service. This is because there is sufficient water available from the current sources and within the current licence constraints, but its availability is currently restricted by the infrastructure.

Figure 7.10: Scenario 5a – Transfer to Southern Water (with investment)



As part of our overall business planning process for the 2020 to 2025 period we are examining new investment in WTW capacity in the Bournemouth WRZ as part of regulatory requirements to improve water quality and mitigate water quality risks in this area.

Through combining this new investment together with the possibility of a water transfer we consider there may be synergies across water resource planning and water quality planning that can deliver outcomes for both Bournemouth WRZ customers and Southern Water, as well as the environment.

We shared our analysis and the pipeline cost[7.28] of a possible transfer with Southern Water in developing this Plan. The forecast supply demand deficit in the Southern Water plan results in a transfer from Bournemouth WRZ being selected as a viable option early in their programme.

We therefore concluded that this is a viable scheme to progress but a detailed feasibility study is needed in the 2020 to 2025 period to set out the detail of how it would operate and generate the synergies from new investment in water treatment capacity in this WRZ.

This study would also need to examine who has ultimate rights to the water, how it would be funded and financed, and how the options would operate in a drought.

[7.28] Water treatment works costs are linked to our existing investment needs. As such, the total cost of will be undertaken as part of a detailed feasibility review.

7.4 Multi-criteria decision making process

The scenarios described above for each Water Resource Zone resulted in different plans to maintain the supply demand deficit or deliver a particular policy objective. In order to test the overall performance of the different plans and policy decisions a multi-criteria assessment approach was adopted.

This assessed the scenarios against five key metrics:

- Financial
- Customer and affordability
- Reliability
- Resilience
- Markets and Innovation

For each metric, performance measures were identified – see Table 7.14.

A scoring method was developed for each measure. This was used to score the performance of all the scenarios for each Water Resource Zone. This gave a total score for each scenario for each of the five metrics set out above.

A multi-criteria analysis was chosen over and above other alternative assessments for the following reasons:

- It is transparent
- It is simple and commensurate with the nature of the complexity of the planning problem
- It allows comparison of the financial and non-financial performance characteristics of a programme
- It goes beyond the standard "lowest cost based plan" approach, and gives better information upon which to understand what the best value plan should be

Full details of the scoring method are given in Appendix 7. It should be noted that the scores for different metrics do not have the same maximum or minimum scores. For example, customer and affordability has a higher maximum score as there are more drivers in this area than in, for example, resilience.

This difference on scores was intentional to ensure there is transparency on the performance of different choices in the plan. In interpreting the results, however, it should be noted that whilst total scores can be compared, the underlying data also needs to be examined in order to understand what is driving the score in that scenario.

Table 7.14: Multi-criteria performance measures

Metric	Measure	Min Score	Max score	Total score range
Financial	Private costs	1	3	2 to 6
	Env & Social costs	1	3	
Customer and affordability	Bill impact	1	3	1 to 12
	Alignment to customer preferences	0	5	
	Alignment to govt objectives	0	4	
Deliverability	Cost certainty	1	3	2 to 9
	Yield certainty	1	3	
	Flexibility	1	3	
Resilience	Drought performance	1	3	2 to 6
	Single source dominance	1	3	
Markets and innovation	Promotes markets	1	3	2 to 6
	Direct procurement	1	3	
Total		9	39	9 to 39

7.5 Performance of different plans

The results of the multi-criteria analysis for each WRZ are presented in Table 7.15 and Figure 7.11 to 7.14. Full details of the scores are given in Appendix 7.

Key features of the results are:

- In general, plans with no intervention perform less well than those scenarios where intervention takes place
  - e.g. Baseline plan vs. resilience plan (plausible droughts)
- Plans that start early to mitigate uncertainties perform better than plans which delay intervention
  - e.g. long-term balance (water resource only or demand only plans); resilience (plausible droughts) vs. baseline plan
- Plans that seek to mitigate future demand and environmental need risks perform better than those with no intervention
  - e.g. demand uncertainty (high household demand) vs. baseline

- A plan based on customer willingness to pay performs well overall but poorly on affordability, due to the high actual cost in customer bills and poor reliability.
- A 15% reduction in leakage in line with the PR19 Draft methodology would increase our supply demand surplus in the short term but would also lead to higher bills than would otherwise be necessary

However, the underlying make-up of the performance of each scenario is important. A review of specific scenarios is discussed below.

7.5.1 Baseline scenario

This scenario performs well financially as there is no additional cost. It also performs well on deliverability as there is no intervention. However, it performs poorly in alignment to customer and affordability as it does not align to customer or government preferences. It also provides little benefit in terms of resilience and nor does it promote markets and innovation.

7.5.2 Customer preferences (Customer Willingness to Pay)

This scenario performs poorly financially, as the cost of delivering this level of reduction by 2025 would have a large increase in overall programme cost and in terms of bill impacts. Its wider performance is good. It scores highly with regard to meeting customers and government guidelines and provides additional resilience benefit. It is flexible and provides some benefit towards markets and innovation as the scale of the programme could, in theory, open up to direct procurement in the long term given the overall cost.

This scenario performs poorly, however, in terms of deliverability due to the uncertainty on cost and yield, as the levels of leakage in this plan and the timescales for delivery are beyond current knowledge.

7.5.3 Resilience (plausible drought and 1 in 200 year droughts)

The 1 in 200 year scenarios and the plausible droughts for Colliford and Bournemouth are identical to the baseline plan. These have no supply demand deficit, or in the case of Colliford a very minor deficit at the end of the planning period. As such, the lowest cost plan is to undertake no investment or very minor investment at the end of the period. These scenarios perform identically to the baseline scenario.

In contrast, Roadford and Wimbleball have some sensitivity to the more extreme droughts with high return periods. To resolve these deficits would require some investment. These scenarios perform better than the baseline scenario overall. This is because the additional leakage reduction has better alignment to customer preferences and government guidelines. They also deliver better performance in terms of resilience. Compared to the baseline scenario these performances on financial and deliverability are lower as the costs and levels of intervention are both higher.

7.5.4 Long-term balance (water resource only and demand only plan)

These scenarios look to offset 10 years growth in demand to mitigate risk. They perform well overall and better than the baseline scenario. These scenarios strike a balance between cost, customer preferences, deliverability and improvements in resilience. They can also offer some potential for direct procurement or new markets. For example, a water resource option plan could be opened up to wider competition.

The performances of the two scenarios are similar with small differences between Resource Zones. A demand led plan using leakage reduction generally performs better on cost as the total programme cost is lower than a water resource option led plan. Such a plan also has more flexibility and better alignment to customer preferences and Government guidelines. In contrast, new water resource options do provide more yield on a unit cost basis and in general perform better on cost certainty. They can also give better benefit in terms of resilience opportunities.

Our conclusion is, therefore, that there are arguments for and against each option type and that broader consideration is therefore important in deciding a wider overall strategy and plan between new water resource development and leakage reduction.

7.5.5 Environment and markets (Southern Water transfer and new environmental needs)

A programme that includes a transfer to Southern Water from Bournemouth WRZ performs well.

This scenario has particular benefits in terms of promoting better use of water through a regional transfer, has improved resilience (as new infrastructure is needed) and has the potential to promote competition through direct procurement.

The area it performs least well is on deliverability due to the cost and yield uncertainty. This is due to the need for a detailed feasibility study to understand the detail of both elements. Yield uncertainty is scored low as a reflection of the need to understand exactly how the transfer could operate and when Southern Water may need it; it is not a reflection of the yield itself, which we know is available from a hydrological perspective.

The environmental needs scenario performs better than the baseline scenario in all areas except Bournemouth where no intervention would be needed. This scenario uses leakage reduction to offset a loss in water resource capacity and in doing so has better alignment to customer preferences and government objectives. This is offset by slightly lower performance on deliverability and financial measures. As these actions take place in the future, they offer some possible benefit for markets and innovation as other options could be adopted or the leakage work packaged up for market testing.

7.5.6 Data (leakage consistency and PR19 draft methodology)

The change in leakage reporting methodology (leakage consistency) has a minor effect on all the Resource Zones due to the slight increase in distribution input that occurs. It drives some additional intervention around leakage reduction which in turn gives better performance in a number of areas.

The adoption of the PR19 draft methodology to reduce leakage by 15% by 2025 shows a clear trade-off. In all zones this scenario performs well in terms of improved resilience and alignment to customer preferences and Government objectives. The scale of the reduction means it also offers improved performance in terms of markets and innovation compared to the baseline ‘do nothing’ case.

However, it performs poorly from a financial perspective with a high cost in the early part of the programme. It results in an increase to our supply demand surplus in the short term but would lead to higher bills than would otherwise be necessary. The potential for a high bill impact is of particular concern in our operating area.

As with the willingness to pay scenario, the performance on deliverability is also low.

7.5.7 Demand uncertainty (household and non-household high demand forecast)

The non-household high demand forecast does not change the baseline programme. This therefore performs well on financial and deliverability measures but scores lower on resilience, alignment with customer preferences and promotion of markets and innovation.

In contrast, all SWW Resource Zones show some long-term sensitivity to higher household demand forecasts. The timing of the risk to the supply-demand balance means that mitigations could wait until AMP8 meaning these programmes perform well on cost grounds. The level of mitigation needed is also modest and these programmes also perform well on deliverability. We have used leakage reduction as the most appropriate response to this uncertainty and this performs well with regard to customer preferences and government guidelines.

Where this scenario performs less well is on resilience since it does not provide any additional security for future events until the middle of the programme. It also has low opportunity in the short term for markets and innovation.

Table 7.15: Results of multi-criteria assessment

Ref	Theme	Scenario title	Colliford	Roadford	Wimbleball	BW	Total
1a	Baseline	Baseline	24	24	24	24	96
2	Customer preferences	Customer willingness to pay	24	24	24	25	97
3a	Resilience	Plausible droughts	24	26	26	24	100
3b		1 in 200 year drought	24	24	24	24	96
4a	Long-term balance	Resource only plan	28	29	28	-	-
4b		Demand only plan	27	28	25	24	104
5a	Environment and markets	Southern Water transfer	-	-	-	28	-
5b		Environmental needs (WINEP2)	28	28	28	24	108
6a	Data	Leakage consistency measures	27	27	24	24	102
6b		PR19 methodology (15% leakage reduction)	25	24	26	25	100
7a	Demand uncertainty	High household demand	30	29	28	24	111
7b		High non-household demand	24	24	24	24	96

Note - for a given scenario, the scores may differ in each Resource Zone. This is because the impacts of the scenario can affect each WRZ differently.

Figure 7.11: Colliford: Results of multi-criteria assessment

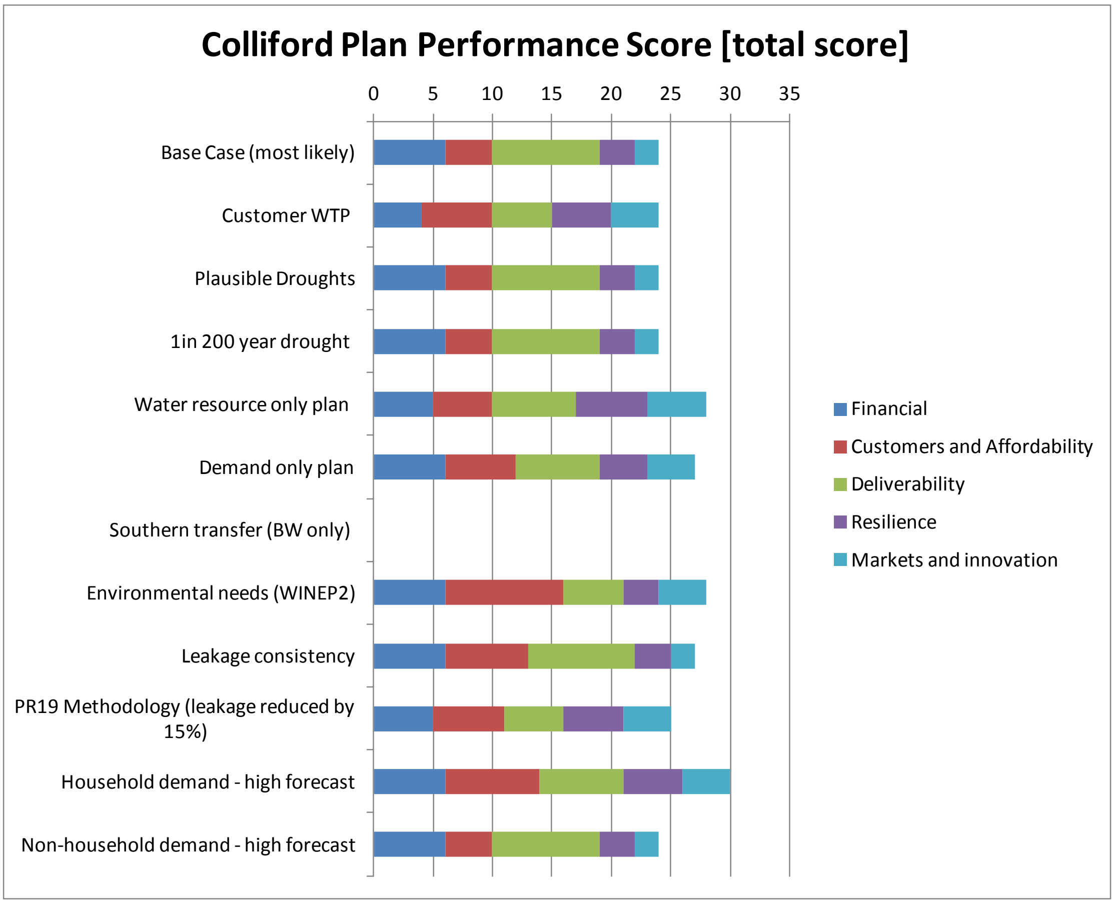


Figure 7.12: Roadford: Results of multi-criteria assessment

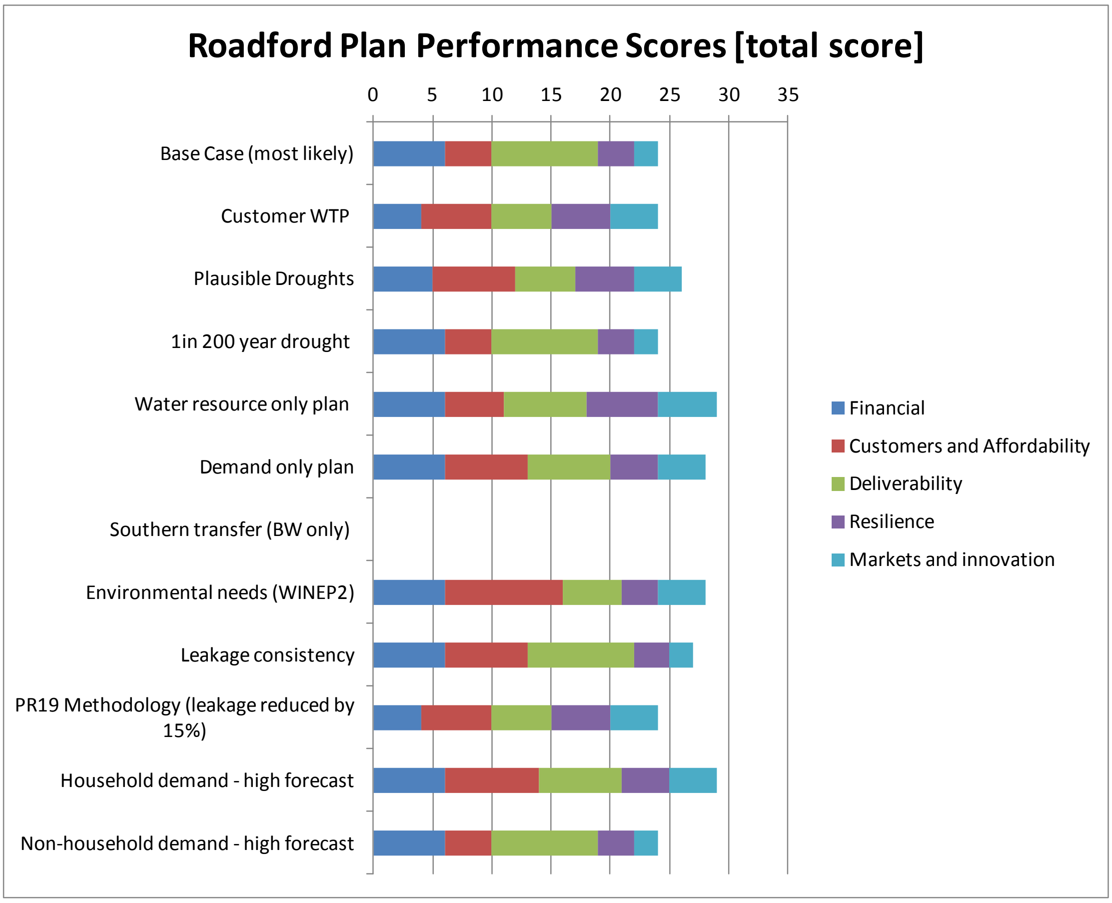


Figure 7.13: Wimbleball: Results of multi-criteria assessment

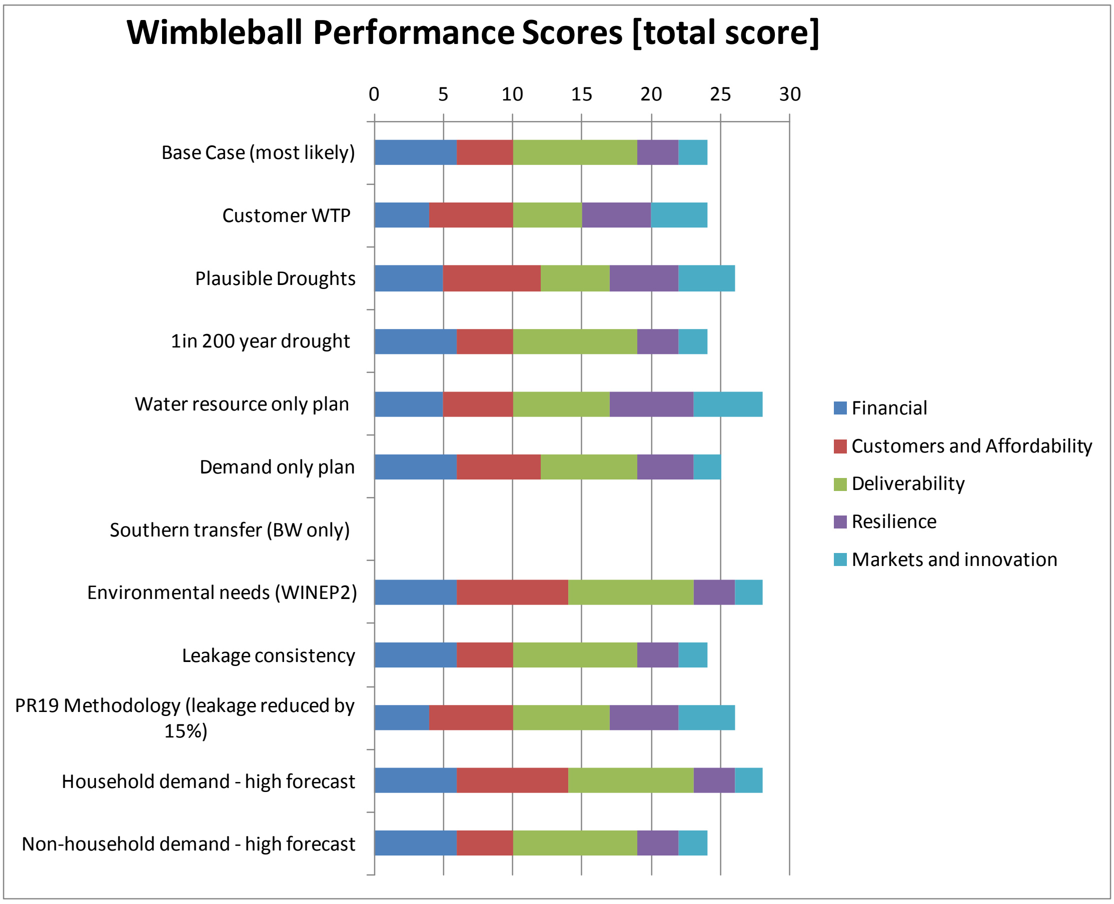
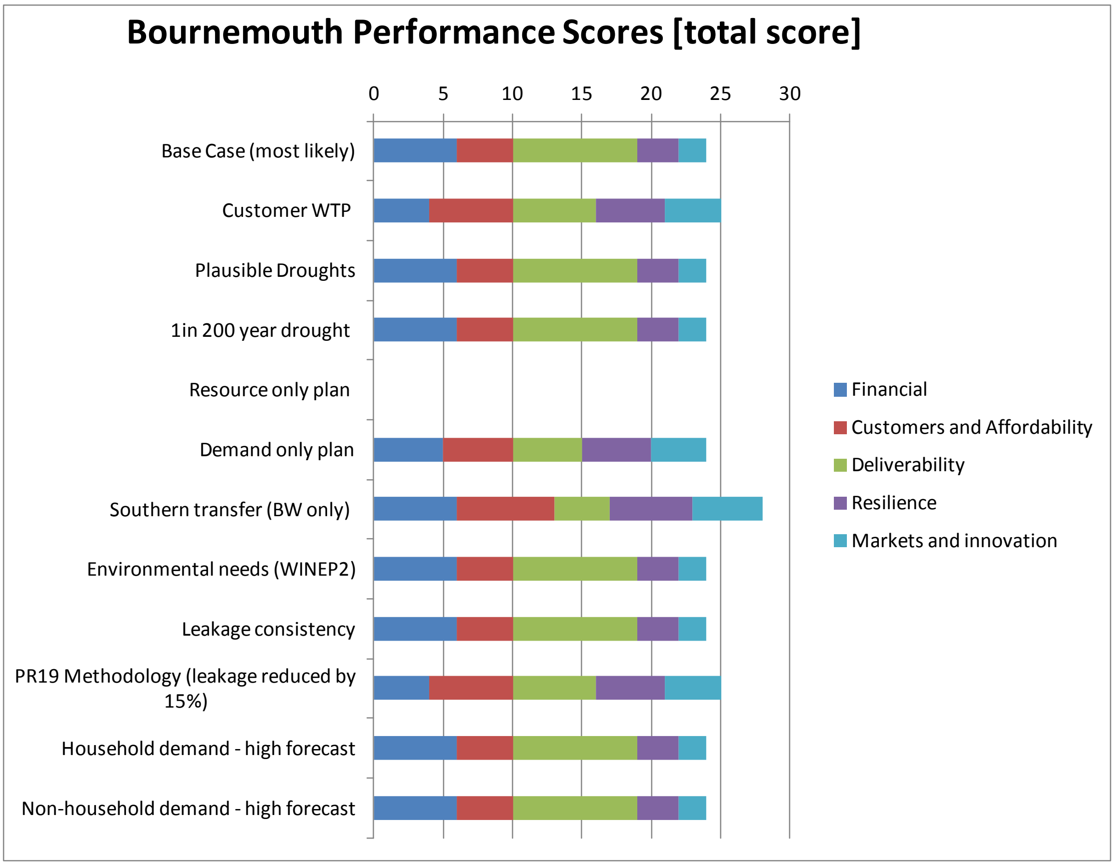


Figure 7.14: Bournemouth: Results of multi-criteria assessment



7.6 Conclusion

The scenario analysis was used to understand how robust the performances of the baseline forecasts are to future uncertainties.

Overall the WRZs show a robust supply demand balance. This is consistent with our problem characterisation which shows we are low risk. All the SWW WRZs however show some small sensitivity in the medium to long-term to one or more of the following:

- More extreme droughts (>1 in 200 year return period)
- New environmental needs
- Higher household demands

The assessed likelihood of these scenarios is low (hence the low risk categorisation), but were these uncertainties to occur, they would cause supply demand deficits to appear in the 2030 to 2045 period.

In contrast, Bournemouth WRZ is robust to the scenarios tested, but the results show that a transfer to Southern Water of the order of 20 Ml/d cannot be sustained in the medium to long-term without putting the WRZ into deficit.

The results of the multi-criteria analysis are helpful in understanding the tensions that lie within our long term planning to maintain the supply demand balance.

The results show that plans that include some intervention perform better than a baseline scenario with no action. Large interventions, such as meeting customer WTP levels of leakage reduction early in the programme can mitigate long term risks but with a considerable trade-off against affordability and deliverability.

In all WRZs a 15% leakage reduction by 2025 would mitigate many of the key uncertainties in the programme such as higher household demand, more environmental needs or more extreme droughts. This would, however, give rise to higher increases in bills than would otherwise occur. It would also deliver the mitigation by one option alone. This places additional uncertainty in future planning as all mitigation would be reliant on a single option.

The results show a clear tension between improving resilience now and affordability and deliverability.

The results of this assessment suggest that the best performing plan, taking all factors into account is one which would start early on some activities to mitigate risk, but needs to be flexible and adaptable should the future change. In doing so it should not try to mitigate all risks as this would be too risk averse and have significant cost impacts.

This means the decision on the activity in our Plan is more nuanced than a planning problem where there may be a well known forecast supply-demand deficit and the question is how to close that deficit. It requires consideration of a number of trade-offs around investment now vs. investment in the future. The timing of the uncertainties and their impact on the supply demand balance, suggest the decision making process in the next WRMP in 2024 could be important as we will have a better view of whether the uncertainties we are sensitive to have materialised.

The tensions in the choices available to us also suggest that in moving forward, our Plan needs to give due consideration to developing future tools and techniques should our planning problem move to one that is more complex than we have currently in readiness for our next Plan in 2024. This is discussed further in Section 8 as part of the explanation of our proposed strategy.

8. Water resource strategy

- Whilst the lowest cost plan would be for no interventions to maintain the supply demand balance, we do not think this gives the best value overall, nor does it meet the needs of our customers.
- Instead, our proposed strategy has three underlying pillars:
  - Reduce leakage and the future demand for water
  - Ensure availability of existing sources and their resilience to droughts
  - Develop our planning tools and understanding of future options
- By 2025 we will:
  - Set a stretching leakage target with industry Upper Quartile performance through a reduction of 8Ml/d (8%) from current levels, despite no supply demand deficit forecast
  - Set a stretching per capita consumption target with industry Upper Quartile performance delivered by increasing our water efficiency work through focusing in on behavioral and community based schemes
  - Reduce our own water use at five large operational sites
  - Undertake a number of studies to improve our understanding of future options and performance of existing assets in extreme droughts
  - Develop new demand and financial modeling tools to inform future plans
  - Continue to promote water transfer options, including a detailed study into a Bournemouth WRZ to Southern Water 20Ml/d transfer
- Post 2025 we will:
  - Further reduce leakage by 15Ml/d (c16%) by 2045
  - Continue to promote water efficiency with our customers and our own use
  - Continue to update our tools and processes for risk based supply demand planning
- The proposed plan has an overall multi-criteria performance score of 121 vs. a baseline 'do nothing' plan score of 96.
- The proposed plan is flexible, affordable and mitigates future risks without taking a worst case scenario. It sets stretching targets in important areas such as leakage and water efficiency.

8.1 Introduction

The previous sections have set out the results of the customer research for our water resource planning, our baseline supply demand balance, our review of possible options and the results of our scenario testing.

The baseline supply demand forecasts show there is no forecast supply demand deficit in any WRZs over the planning period with the exception of a minor deficit in Colliford forming in 2044/45. All WRZs are low risk even if no intervention is made.

However, the stress testing in Section 7 shows that all the WRZs in the SWW supply area have some medium to long-term sensitivity to one or more of the following:

- More extreme droughts (> 1 in 200 year droughts)
- New environmental needs
- Higher household demand

Any deficits that occur are relatively small and their future occurrence means there is sufficient time to mitigate their risk by adopting a flexible strategy. Bournemouth WRZ shows a robust supply demand balance and work on a possible transfer to Southern Water suggests this could be a viable option in the future.

Tables 8.1 and 8.2 show the overall proposed plan for the short-term and medium to long-term planning periods, respectively. Figure 8.1 shows the performance of the plan using the multi-criteria assessment used in the scenario analysis. This shows that the proposed plan performs better than alternative plans when all factors are taken into account. This is discussed further in Section 8.5.

In building this plan we pulled together the full range of information outlined in previous sections. There are both higher and lower cost plans, and plans that could contain more or less risk mitigation. The proposed plan is considered to give the best value overall and the best balance of activity taking into account the various tensions between different choices.

The following sections set out the detail of our proposed water resource strategy and plan.

Table 8.1: Summary of the overall plan – short-term (2020-2025)

Strategy	Why	Short-term (2020-2025)				
		Resources	Leakage	Demand management	Transfers	Other
Reduce leakage and the future demand for water	Low cost options to manage future risks Consistent with customer preferences Consistent with Government and regulatory policy	-	Reduce leakage by 8 Ml/d (8%) to 77 Ml/d in SWW and to 18 Ml/d in BW	Support customers to reduce overall average per capita consumption to 129 l/p/d on average through community based schemes and improved bill information Promote water efficiency for non-household tourist businesses Continue to promote optant metering and replace end of life meters with AMR technology Reduce our consumption of water at 5 large sewage treatment works	-	-
Optimise existing water resources and ensure they are resilient too future droughts	Consistent with ensuring that we can mitigate future more extreme droughts and make best use of existing supplies	Investigate the resilience of existing drought management options to more extreme droughts Update our understanding of future drought impacts	-	-		-
Develop our planning tools and understanding of future options	This is consistent with managing future risks and improving our forecasting tools. It will ensure we are in a good position for future plans particularly in the event demand savings are less than expected.	High level feasibility study on a Roadford pumped storage scheme* Undertake a feasibility study on a possible water transfer to Southern Water	-	Increase understanding of potential demand management savings in drought conditions	Explore options for transfers with neighbouring companies	Develop uncertainty based demand forecasts Produce new financial decision making tools Produce annual outage report

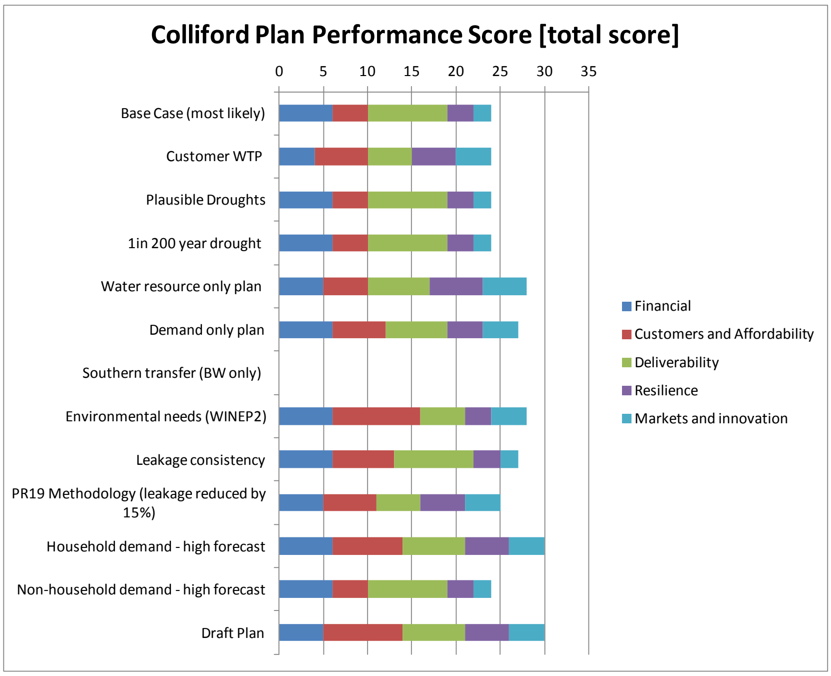
For the avoidance of doubt this is not a promotion of this scheme.

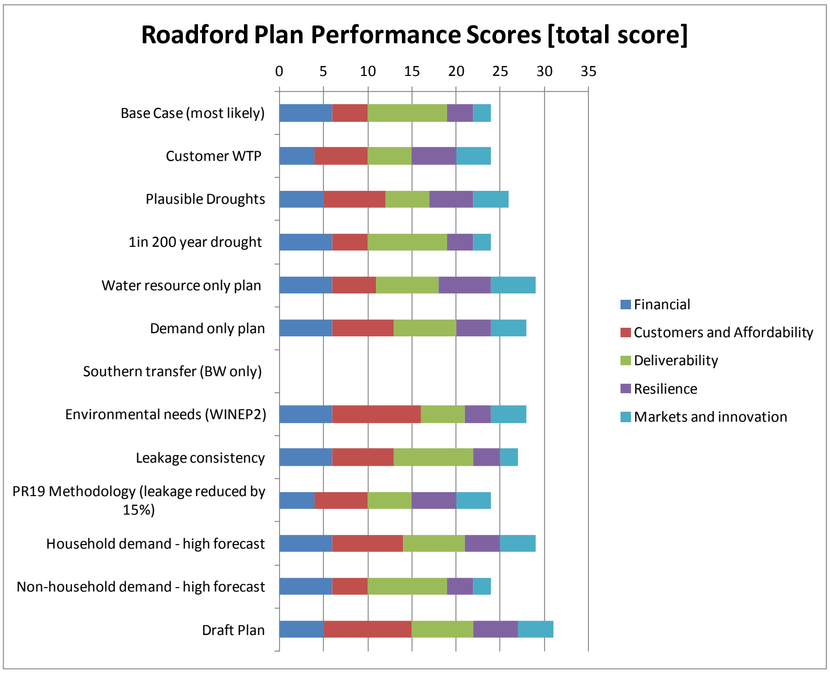
Table 8.2: Summary of the overall plan – medium to long-term (2025-2045)

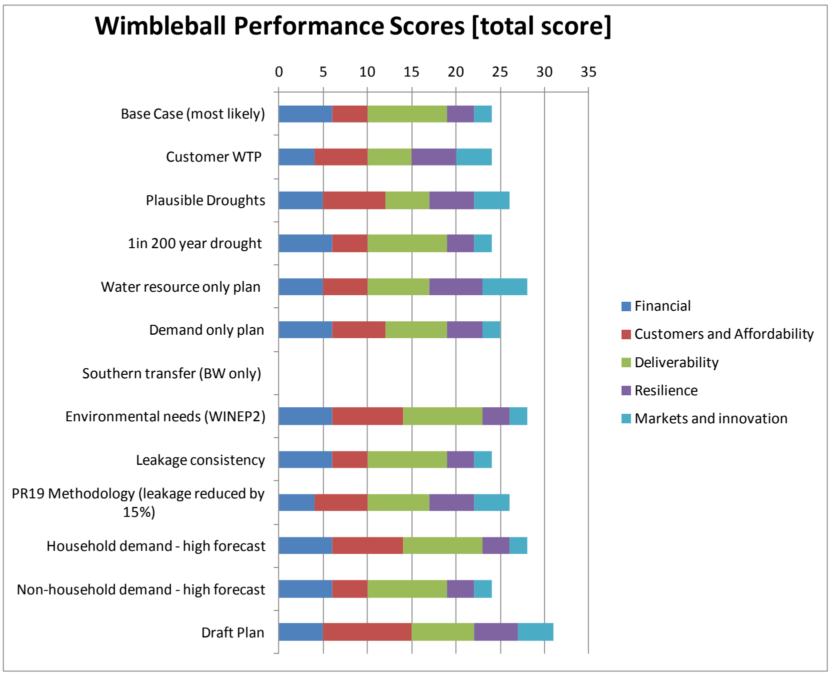
Strategy	Why	Medium to Long-term (2025-2045)				
		Resources	Leakage	Demand management	Transfers	Other
Reduce leakage and the future demand for water	Lowest cost options to manage future risks Consistent with customer preferences Consistent with Government and regulatory policy	-	Reduce leakage by a further 15 Ml/d (16%) to 64 Ml/d in SWW and to 16 Ml/d in BW	Continue to promote water efficiency and metering	-	-
Optimise existing water resources and ensure they are resilient too future droughts	Consistent with ensuring that we can mitigate future more extreme droughts and make best use of existing supplies.	Continue to ensure our assets perform as needed in a drought	-	-		-
Develop our planning tools and understanding of future options	This is consistent with managing future risks and improving our forecasting tools. It will ensure we are in a good position for future plans particularly in the event demand savings are less than expected.	As needed at next plan update in 2025	-	As needed at next plan update in 2025	Continue to seek opportunities for inter-company transfers including the possible delivery of a transfer to Southern Water in the 2025 to 2030 period	Continue to develop risk based approaches

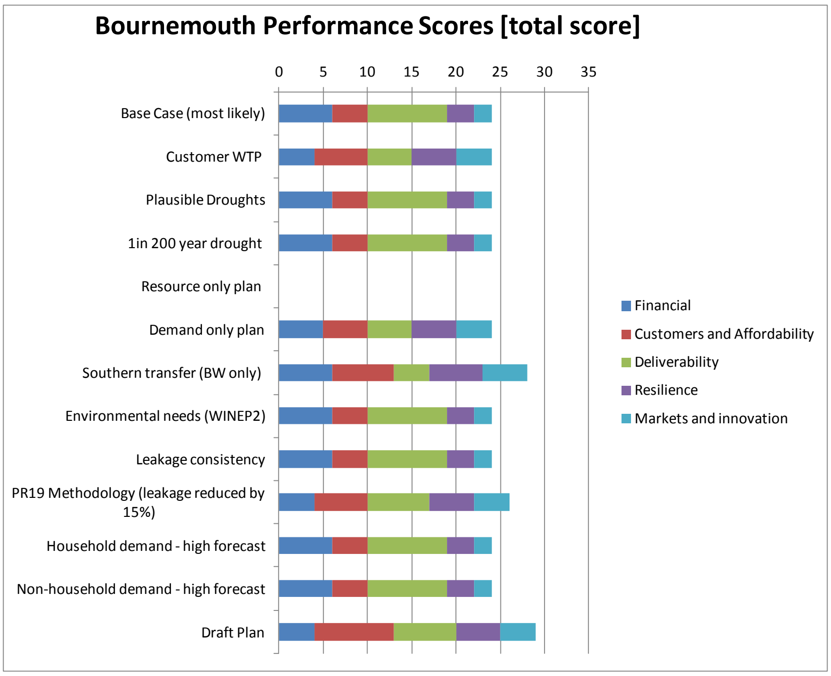
Figure 8.1: Performance of the proposed plan – multi-criteria scores

Ref	Theme	Scenario title	Colliford	Roadford	Wimbleball	Bournemouth	Total
1a	Baseline	Baseline	24	24	24	24	96
8	Draft Plan	Draft Plan	30	31	31	29	121






Wimbleball Performance Scores [total score]
0
5
10
15
20
25
30
35
Base Case (most likely)
Customer WTP
Plausible Droughts
1in 200 year drought
Water resource only plan
Demand only plan
Southern transfer (BW only)
Environmental needs (WINEP2)
Leakage consistency
PR19 Methodology (leakage reduced by 15%)
Household demand - high forecast
Non-household demand - high forecast
Draft Plan
Financial
Customers and Affordability
Deliverability
Resilience
Markets and innovation


Bournemouth Performance Scores [total score]
0
5
10
15
20
25
30
35
Base Case (most likely)
Customer WTP
Plausible Droughts
1in 200 year drought
Resource only plan
Demand only plan
Southern transfer (BW only)
Environmental needs (WINEP2)
Leakage consistency
PR19 Methodology (leakage reduced by 15%)
Household demand - high forecast
Non-household demand - high forecast
Draft Plan
Financial
Customers and Affordability
Deliverability
Resilience
Markets and innovation

8.2 Overall strategy

Our previous WRMP set out a strategy to 'do the right thing'. We still think this fundamental ethos holds true and we have continued to adopt this approach. However, in light of the results of the work in this report, this strategy needs to be focused on specific outcomes to manage future risks.

Based on the information in this report, our proposed water resource strategy is based on the following three pillars:

- Reduce leakage and the future demand for water
- Ensure availability of existing sources and their resilience to future droughts
- Develop planning tools and understanding of future options

This three pillar strategy balances future risks across different interventions and is flexible and adaptable to future changes.

The rationale behind each pillar is outlined below.

Reduce leakage and the future demand for water

All WRZs in the SWW supply area show some sensitivity to higher demands and increased demands will tighten the supply demand balance in Bournemouth WRZ. Increased environmental needs could also cause a potential supply demand deficit. A central strategic pillar to focus on reducing demand will help mitigate these risks.

Central to this is leakage reduction. The customer research and subsequent scenario analysis (see Section 7) show that customers' primary preference is leakage reduction above all other options. Whilst further reductions are still cost-beneficial, leakage reduction should therefore be a strategic theme in how we manage the supply demand balance.

However, leakage is only one component of the total demand for water. Therefore, we consider that at a strategic level we should look to reduce the overall demand for water, including our own use and supporting customers to reduce their use.

Ensure availability of existing sources and their resilience to future droughts

Customers show a strong preference for no deterioration in levels of service (see Section 1).

The results of the drought analysis show that the supply demand balance will be stressed with some rare drought events at return periods greater than 1 in 200 years. This is a risk that could cause supply demand deficits and a possible degradation in the level of service (see Section 7).

In addition, increased environmental needs would reduce the available water resources. In some WRZs, these cause a risk by placing the WRZ into a supply demand deficit (see Section 7).

In order for the supply demand balance to be maintained, we need to mitigate these two risks that affect our overall water resources availability. This could be addressed by the introduction of new water resources schemes, for example. However, customer preference for new resources schemes is low and there are limited opportunities for new water resources in our supply areas (Section 1 and 6 respectively).

It is therefore of a strategic importance that we ensure our supply capability of existing sources is maintained and we understand their operational resilience to more extreme future droughts. In doing so, we will make best use of existing water supplies without the need to build new sources.

Develop our planning tools and understanding of future options

The scenario analysis shows that we have three main risk areas that could place the future supply demand balance into deficit. Each of these is outside the direct control of the Company and requires decision making around risk mitigation in terms of both scale and timing. They are, however, events with low likelihood of occurrence.

Therefore, we consider it is of strategic importance to develop our planning tools and move to a fully risk based decision making process for future plans, where the planning problem may be more complex than the current one. The two pillars outlined above act as an 'insurance policy' to mitigate potential risks, but there is clearly a balance as to how far it is beneficial to make such interventions. We believe that this question of balance will be more important at future assessments and will require more complex analysis than is currently needed in this Plan.

In addition, whilst we believe a strategic focus on reducing leakage and the demand for water is vital, if these areas deliver less benefit than expected, we need to have alternative options in place to maintain the supply demand balance. Further, this will also compliment our Drought Plan, our understanding of the environmental impacts of our water resource options and will mitigate the risk around new environmental needs.

Table 8.3 shows how the three pillars map against government guidelines and customer preferences. It highlights which of the risks they seek to mitigate in the Plan.

The following section sets out in more detail our proposed planned activities against each of these areas and the supporting rationale. The section concludes with an overall assessment of risk and balance in the Plan.

Table 8.3: Mapping of the strategy to benefit areas

Strategy	Customers/ Government		Risk mitigation		
	Customer preferences	Government and regulator guidelines	More extreme droughts	New Environmental needs	Higher household demand
Reduce leakage and the future demand for water	✓	✓	✓	✓	✓
Ensure availability of existing source and resilience to future droughts	✓		✓		✓
Develop our planning tools and understanding of future options			✓	✓	✓

8.3 Reduce leakage and the overall demand for water

8.3.1 Leakage reduction

Our proposal is to further reduce leakage even though there is no supply demand driver. Our proposed leakage reduction targets are set out in Table 8.4 with rationale included below.

It is important to note that it is **not the leakage target** that is important in the Plan, but rather **the reduction in leakage** in Ml/d terms. It is this reduction in water losses that mitigates the future risks to the supply demand balance.

Table 8.4: Leakage reduction profile [Ml/d]

	2016/17	2024/25	2029/30	2034/35	2039/40	2044/45
SWW supply area						
Colliford WRZ	30.3	27.7	26.6	25.4	24.2	23.1
Roadford WRZ	42.3	38.8	37.2	35.5	33.9	32.3
Wimbleball WRZ	11.4	10.5	10.0	9.6	9.1	8.7
SWW WRZ Total	84.0	77.0	73.8	70.5	67.2	64.0
Bournemouth WRZ	19.0	18.0	17.5	17.0	16.5	16.0
Company Total	**103.0**	**95.0**	**91.3**	**87.5**	**83.7**	**80.0**

(note - figures appear not to add up in the 2044/45 column due to rounding)

8.3.1.1 Long-term plan (2025-2045)

Our proposed long-term plan is to reduce leakage to 64 Ml/d in the South West Water supply area and to 16 Ml/d in the Bournemouth Water supply area.

We have chosen this target for the following reasons:

- It aligns to the cost beneficial level supported by customers (see Section 7)
- The total saving of 20Ml/d in the SWW supply area mitigates over 30%[8.1] of the total risk over the planning period from extreme droughts, new environmental needs and higher household demand, thereby improving resilience
- It sets a stretching long-term target and thereby requires sustained improvement in our performance
- The target allows the rate of change to be adapted in each five year planning period to reflect forecast risks

The proposed reduction mitigates some of the risk in the plan, but not all risk. It thereby does not plan on the worst case scenario.

Whilst the lowest cost plan would be for no further leakage reduction, Section 7 shows this strategy performs poorly overall and was therefore rejected.

A significantly lower leakage target would not be supported, as shown in the customer research data.

The rate of leakage reduction and long-term target will be reviewed at each subsequent WRMP to ensure it adapts to the risks to maintaining the supply demand balance.

8.3.1.2 Short-term plan (2020-2025)

In the short-term we plan to reduce our overall leakage by 8Ml/d (or 8%) to 77Ml/d in the South West Water supply area, and to 18Ml/d in the Bournemouth WRZ. We have chosen these leakage targets for the following reasons:

- The scenario testing results show that leakage reduction early in the plan performs well overall (compared with demand only plans and environmental needs)
- The cost of reduction balances affordability vs. resilience with an estimated bill impact <£1/prop by 2025[8.2]
- The leakage saving sets a stretching target with industry Upper Quartile performance (5.5m^3/km vs industry UQ of 6.2m^3/km in 16/17). This

[8.1] Given by 20Mld / total risk in Table 8.1 = 20 / 51.5= 37%. 51.5Ml/d is 54Ml/d less the Bournemouth WRZ risk.
[8.2] As highlighted in Section 7, the bill impact is an estimate to compare the relative impact of different plans. The actual bill impact will depend on a range of factors within our overall PR19 plan

performance is maintained even if other companies improve by 10% from 16/17 performance

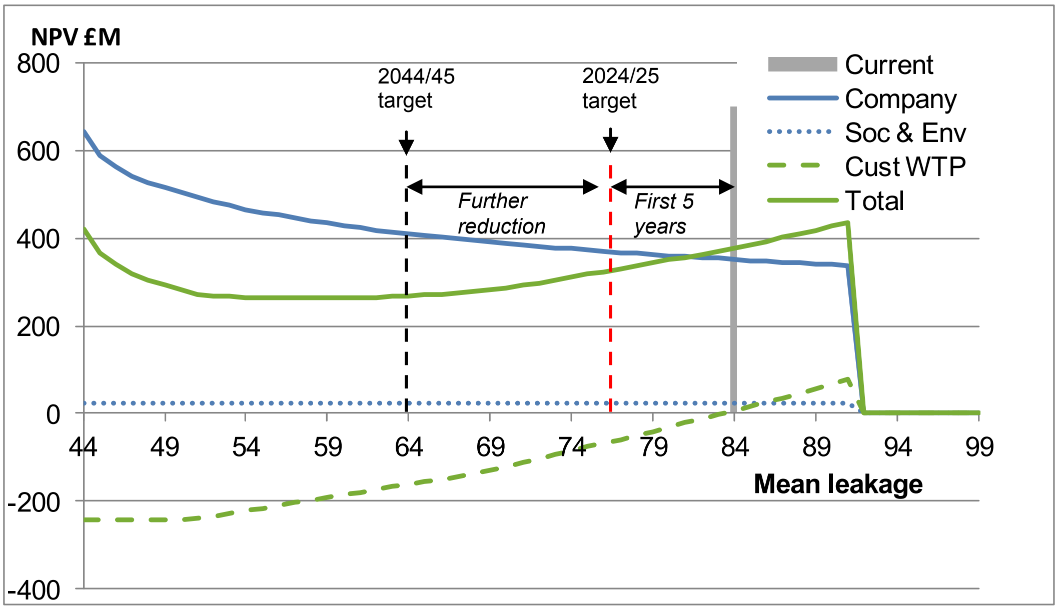
- The reduction sets a stretching target despite no strict supply demand driver to continually improve our performance

Our approach is consistent with the outcomes of our customer research, which shows preference to focus on starting early rather than late in mitigating future risks. It is also consistent with the preference for leakage reduction as the most favoured option for maintaining the supply demand balance.

The proposed reduction is twice the rate of reduction than the long-term leakage reduction target (distributed equally over each five year period through to the end of this plan in 2045). Figures 8.2 and 8.3 show how the proposed leakage targets map onto the cost of delivery in the short and long-term. This shows that in the first five years of the programme, we will deliver approximately 1/3 of the total leakage reduction over the whole planning period.

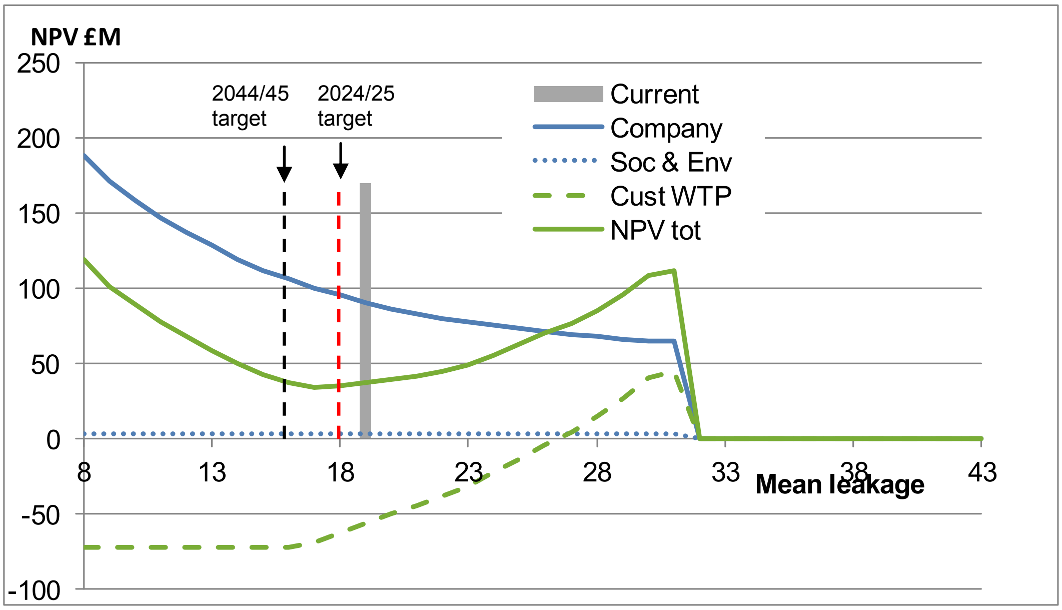
We will use the total company leakage for our target and review the detailed targets annually at a WRZ level, depending on local circumstances.

Figure 8.2: Leakage reduction targets – SWW supply area



Note:
This graph shows the Net Present Value (NPV) of leakage reduction. The blue line shows the direct cost to the company. As leakage reduction occurs, the costs of delivery increase. The green line show the net cost of leakage reduction taking into account customer willingness to pay. This cost reduces as leakage reduces to 50-70Mld. This suggests that a leakage target at this level should be our long term goal.

Figure 8.3: Leakage reduction targets – BW supply area



Note:
This graph shows the Net Present Value (NPV) of leakage reduction. The blue line shows the direct cost to the company. As leakage reduction occurs, the costs of delivery increase. The green line show the net cost of leakage reduction taking into account customer willingness to pay. This cost reduces as leakage reduces to 50-70Mld. This suggests that a leakage target at this level should be our long term goal.

The scenario analysis explored the impacts of higher and lower leakage and we also carried out additional costing work on the impacts in Asset Management Plan 7 (AMP7), as shown in Table 8.4.

Whilst a lower leakage reduction target could be justified on the grounds of minimising costs, such a plan performs poorly in other areas such as alignment to customer preferences, government policy and future risk mitigation, as shown in Section 7. This plan was therefore rejected.

Higher leakage reduction targets would deliver greater mitigation of future risks, but this would be at a significant cost in the short-term than would otherwise be necessary. As shown in Section 7, a 15% leakage reduction would:

- Create affordability issues as it would increase customer bills beyond £2/prop due to the high operating cost involved.
- Increase our water supply surplus by 15Ml/d[8.3] in total by 2025 although there is no supply demand deficit
- Have a high delivery risk

[8.3] 12.2 Ml/d in SWW supply area and 2.9 Ml/d in Bournemouth Water supply area

A leakage reduction of 15% is therefore not considered as a best value plan for customers. Further detail on this is given in Appendix 8.

8.3.2 Water efficiency

As shown in the results of the customer research, water efficiency is regarded as higher priority than new water resources options, but a lower priority than wider priorities in other areas of service. The scenario analysis also showed that our WRZs have some small sensitivity to higher demands in the medium to long-term.

Therefore, our proposed plan is to undertake targeted improvements in water efficiency to compliment the leakage reduction profile. However, our rationale for the programme of work is broader than just water resources planning and is described below.

8.3.2.1 Long-term plan (2025-45)

Our long-term plan is to continue to promote water efficiency improvements with our customers. We have chosen not to outline any specific schemes in this Plan for the period post 2025. This is in order to keep our approach flexible and adaptable to future uncertainties, which include future tariffs, for example.

To specifically define actions now would be to constrain our Plan and make decisions on future activities at the next WRMP review in 2024/25. However, with the long-term focus on leakage reduction, high meter penetration and with low water consumption per capita, this means our Plan is not sensitive to this approach.

Instead, we will use the information from the work in the short-term and future updates on our forecasts to inform future decisions.

8.3.2.2 Short-term plan (2020-25)

We have chosen a range of activities that are cost beneficial, set a stretching target and reduce per capita water consumption to 129 l/p/d by 2024/25.

This will place us in the water industry Upper Quartile performance in terms of water consumption (129l/per/d vs industry UQ of 134l/per/d in 2016/17), and save a forecast 2.1Ml/d[8.4] in total across all our WRZs by 2025.

We plan to undertake four key water efficiency programmes identified in our option analysis (Section 6), although there is no specific supply demand driver for their introduction. These are set out in Table 8.5.

These activities are a significant change in our current approach to water efficiency and set a stretching target in terms of delivery, but also in terms of cultural and behavioural change to how we approach water efficiency.

[8.4] Colliford = 0.53 Ml/d; Roadford = 0.71 Ml/d; Wimbleball = 0.40 Ml/d and Bournemouth = 0.53 Ml/d.

The proposed activities in this Plan are intended as a balanced response to improve water efficiency in our supply areas and reduce the risk of higher future demand. We have specifically chosen innovative and targeted measures, because due to our current supply demand surplus, our Plan can adapt should the savings be larger or smaller than predicted.

We chose the proposed activities for the following reasons:

- Community based initiatives and social norms feedback are cost beneficial and help connect our customers with the service they receive
- Social housing retrofit has wider benefits with regard to managing vulnerability and affordability challenges that our customers face
- Tourism is a key driver of demand in the summer and focused water efficiency support will help reduce the stress on the supply system during peak times

Whilst a plan with no water efficiency measures could be justified on the grounds of minimising overall cost, we rejected this option, because it does not mitigate future demand side risks, which are important to our WRZs. Further, it does not create a culture that values water.

We rejected additional water efficiency activity (over and above the proposed actions) on the grounds of poor overall value, specifically due to either poor cost benefit or little wider benefit to customers.

Table 8.6 shows that the water efficiency options we chose are similar to further leakage reduction in terms of marginal cost. Whilst, conversely, further leakage reduction could be chosen in place of water efficiency, this would result in a plan that we think is unbalanced in its approach to managing the risk of higher demand in our WRZs.

Table 8.5: Summary of water efficiency initiatives

	Water Saving [Ml/d]	Total Opex [£m]	Opex Saved [£m]	Total Capex [£m]	Total Customer WTP [£m][8.5]
Community water saving initiatives	0.56	0.25	<0.01	0.16	0.37
Social norms feedback	1.21	0.20	0.29	0.05	1.76
Social housing retro-fit	0.38	-	<0.01	0.62	0.36
Tourism water efficiency	0.11	-	<0.01	0.31	0.10
Total	2.26	0.45	0.30	1.14	2.59

Note: The presented costs are for the 2020-2025 period. For ease of comparison financing costs are excluded.

[8.5] Based on customer willingness to pay of £300k/Ml/d. See Appendix 1. AMP total takes into account profile of benefits. See WRMP Table 5.

Table 8.6: Cost of water efficiency initiatives vs equivalent leakage reduction

	Total Water Efficiency costs	Total equivalent additional leakage costs[8.6]
Opex	£0.45m	£1.75m
Capex	£1.14m	£0.38m
Totex	£1.59m	£2.13m

Note: Cost of saving 2 Ml/d over the period of 2020-2025. For ease of comparison financing costs are excluded.

8.3.3 Reduce our own demand for water

Our own water use affects the overall demand we have to supply. Therefore, our proposed plan is to undertake targeted water efficiency improvements at our operational sites.

We have chosen a commitment to reduce our own water use in order to keep overall demand down and to mitigate against the future risks in the scenario analysis.

8.3.3.1 Long-term (2025-2045)

Our plan includes a commitment to continue to reduce our own water use. We do not set out any specific schemes as there is no supply demand deficit forecast. Instead we will use the results from work in the short-term to inform future long-term plans.

However, we are examining possible improvements in our water treatment works capacity in Bournemouth WRZ. This could include an opportunity to reduce process water losses. This is being developed in more detail in our PR19 Business Plan, because the driver for such improvement does not lie with water resource planning alone.

8.3.3.2 Short-term plan (2020-25)

Our proposed plan is to undertake operational water re-use at five of our largest sewage treatment works (STWs)[8.7] to reduce their demand for water. Of these, four are based in Roadford WRZ, which contains more potential risk to maintaining the supply demand balance than our other WRZs (see Section 7).

With no supply demand deficit over the planning period, these options are not selected based on minimising total programme cost, but rather on their ability to:

[8.6] Costs based on further reduction of 2Ml/d in SWW based on costs in Roadford resource zones for reduction from 5 to 6Ml/d (see data in Table 5 of WRMP Tables).
[8.7] These include Brokenbury STW, Cambourne STW, Ernesettle STW, Plymouth Central STW and Radford STW.

- Mitigate higher future household demands
- Mitigate future more extreme droughts
- Reduce long-term costs to customers
- Compliment the water efficiency savings we ask of our customers

By 2025, the proposed schemes will save an estimated 2.8Ml/d in demand at a total cost of c£0.5m. This compares to a total customer benefit of over £4m[8.8].

The specific sites were selected from our option appraisal as they are the lowest cost options (<AIC of 4p/m3).

These activities are lower cost than equivalent reductions in leakage (Table 8.7). The remaining six sites that we identified were not selected, because they were associated with higher cost or had operational uncertainties limiting deliverability. We will, however, use information from this programme to inform further work in AMP7 and WRMP24.

Table 8.7: Cost of STW re-use schemes vs equivalent leakage reduction in AMP7

	STW own re-use costs	Equivalent additional leakage costs[8.9]
Opex	<£0.05m	£1.1m
Capex	£0.51m	£2.75m
Totex	£0.52m	£3.86m

Note: Total costs over 2020-2025. For ease of comparison, financing costs are excluded.

8.3.4 Overall impact of leakage and demand reduction on risk mitigation

The options described above have been selected as an overall package to manage the future risks identified in Section 7. The individual activities are informed by the findings from the scenario analysis as well as from the preferences of our customers, whilst taking into account planning guidelines from the government.

Table 8.8 shows the total expected benefit from these activities by 2025. Key features of the planned activities are:

- In total they mitigate 24 to 42% of the key risks causing supply demand deficits, which were identified in the scenario analysis
- The level of risk mitigation is similar across Colliford WRZ, Roadford WRZ and Bournemouth WRZ

[8.8] Based on customer willingness to pay for water efficiency and re-use.
[8.9] Costs based on further reduction of 3Ml/d in Roadford Resource Zone from 5-7Ml/d (See WRMP Table 5)

- Less risk is mitigated in Wimbleball WRZ since no cost effective options for reducing our own water use were identified

The activity therefore does not plan to mitigate all risks identified in Section 7, but does seek to mitigate some risks early. This is consistent with the findings from our research on customer preferences.

The risks to our supply demand balance do have relatively low likelihood. However, two of these risks are discrete events. They include plausible droughts and environmental needs. Given their discrete nature and the impact they could have on maintaining our level of service, we believe it is appropriate to mitigate some of the risk early in our programme[8.10].

The mix of activity is also set out to deliver against wider objectives (e.g. the promotion of water efficiency) and to increase the overall message on the value of water in our supply areas.

The mix of activity proposed performs better than a plan that only focuses on leakage reduction alone (such as the willingness to pay scenario) or a plan adopting a 15% leakage reduction by 2025.

A case could be made for more or less leakage reduction or more or less demand management savings. However, for the reasons outlined above, we believe the activities proposed to be adopted give a balanced plan to mitigate future risks, a plan that is flexible and adaptable. We believe it meets multiple objectives and has lower delivery risk than a plan which increases activity solely in any one of the areas identified.

[8.10] Note that in the main the activities chosen are cost beneficial (i.e. customer willingness to pay > cost of the option).

Table 8.8: Overall impact of leakage and demand reduction on risk mitigation

	Colliford WRZ	Roadford WRZ	Wimbleball WRZ	Bournemouth WRZ	Total
Activities by 2025 (in Ml/d)					
- Leakage reduction	2.52	3.53	0.95	1.00	8.0
- Water efficiency	0.53	0.71	0.40	0.53	2.2
- STW own re-use	0.34	2.44	-	-	2.8
- Total	3.39	6.68	1.35	1.53	13.0
Risks (over planning period)[8.11] (in Ml/d)					
- Plausible droughts	0	0 to 17	0 to 5.9	0	0 to 22.9
- Environmental needs	2.5	7	5.5	0	15.0
- High household demand	3.8	6.4	2.4	3.5	16.1
- Total	6.3	13.4 to 30.4	7.9 to 13.8	3.5	31 to 54
Risk covered by 2025 (%)[8.12]	54%	22% to 50%	10% to 17%	51%	24% to 42%

8.4 Ensure availability of existing sources and their resilience to future droughts

The scenario analysis in Section 7 shows that our WRZs have some sensitivity to extreme droughts. Although these are very rare events, to ensure our system remains resilient, our plan includes a number of activities to improve our understanding of this risk.

8.4.1 Short-term plan (2020-2025)

Our proposed plan is to undertake two key areas of work in each WRZ. These are:

- Investigate the resilience of existing drought management options to more extreme droughts
- Update our understanding of the impacts of future drought

We have not had an extreme drought in our region since the 1975/76 drought event and by their very nature, these events are rare. We therefore think that in the next period, we should undertake studies in each WRZ to understand in more detail how

[8.11] Risk is defined as the total Ml/d value for each activity. This does not include the effect of any surplus or deficit in a zone. This has been done to show explicitly how these actions mitigate the risk. We have chosen this presentation approach so as to show how the plan mitigates these risks as compared to the actual risk in the plan which depends on a range of factors, such as target headroom allowance and likelihoods of droughts over time. As highlighted in later sections, our plan includes additional activity for developing more risk based approaches for our future plans.
[8.12] For further technical discussion on risk mitigation see Appendix 8.

robust some of our existing drought options would be to these more extreme droughts. This would help inform our future Drought Plans and give better understanding of how extreme future drought events in our region would affect the day-to-day operation of our sources. Full details are given in Appendix 8.

We also plan to update our analysis of these more extreme droughts to get a better understanding of their characteristics including the risks around multi-season droughts. This work will give us better information for developing future plans and mitigation of this risk.

8.4.2 Long-term plan (2025-2045)

We will use the results from our work in the 2020 to 2025 period to inform our future plans.

With the proposed activities to reduce leakage and the future demand for water, we do not think we need to promote any specific schemes or actions in the long-term within this WRMP.

8.5 Develop our planning tools and understanding of future options

The scenario analysis in Section 7 shows that in the future, the decisions we may need to make could be more complex than they are today.

Our proposed plan is therefore to build our capability to improve our forecasting of future risks and develop new tools and approaches for use in future plans.

8.5.1 Long-term plan (2025-2045)

We will continue to move to a more risk based water resource planning approaches, which will include developing and using tools and data that allow greater analysis of the issues affecting the supply demand balance. We also plan to improve our data on our future options, especially on water resource options.

This will ensure we remain in a good position at future plans to quantify the risks we face in the short, medium and long-term and the options available to mitigate them.

To achieve this outcome, we plan to build our capability in the 2020 to 2025 period as set out below.

8.5.2 Short-term plan (2020-2025)

The summary Table 8.1 sets out the projects that we will undertake to improve our capability and reduce our planning risks.

The proposed plan contains the following:

- High level feasibility study on a Roadford pumped storage system

  Roadford Reservoir is our only strategic reservoir with no pumped storage scheme. Roadford WRZ is our largest WRZ and the results from Section 7 show that it is sensitive to very extreme droughts, new environmental needs and higher demands. Roadford WRZ also has the highest percentage loss in DO from climate change (see Section 2.2).

  Whilst there is no supply demand deficit now, given the strategic importance of Roadford Reservoir within our largest WRZ, we think it is prudent to undertake a study before 2025 to understand if a pumped storage scheme is feasible or promotable. The outcome of this study will be important for future decisions on what options are or are not available in Roadford WRZ, should risks materialize. It is important to highlight that this is a study to inform about the feasibility of the pumped storage scheme in order to aid future decision making. It is not a study to promote this scheme.

- Detailed feasibility study on a Bournemouth WRZ to Southern Water transfer

  As highlighted in Section 7, a water transfer to Southern Water has been identified as a possible future option.

  Whilst good progress has been made, we will undertake more work to understand how such a transfer could operate and how we can maximize the benefit from infrastructure improvements needed to facilitate the transfer. We propose to work with Southern Water to develop this option in more detail, with a view of potential delivery in the 2025 to 2030 period.

  We have agreed this plan jointly with Southern Water and consider this is a good example of cross-border cooperation of water companies, aiming to make best use of the water available.

  We will also keep an open dialogue with other water companies and stakeholders on possible water transfers, even though our area is more remote than other parts of the country.

- Develop our demand forecasting tool to take more account of future uncertainties

  Section 7 highlighted that higher demands are a key risk. We will develop our existing demand forecasting tools to give a better understanding of the likelihood of occurrence of different future demands. This will allow a more detailed assessment of the likelihood of a future supply demand deficit (or surplus) for future plans.

- Develop a new financial decision making tool

  The supply demand problem in our area is currently of low complexity.

  Whilst current tools are considered appropriate for our planning problem, we believe that we should transition to more enhanced methods for decision making for use in future plans. We want to do this to ensure we consistently maintain the supply demand balance at the lowest possible cost. This could include portfolio risk simulation or Infogap type analysis, for example.

  Whilst more complex decision making tools may not be required, we think we should explore these on a 'no regrets' basis as part of a continuous improvement of our planning process.

- Increased understanding of demand management savings in drought conditions

  We will undertake a study to update our understanding of possible demand management savings during drought conditions.

  With a long-term plan to reduce leakage and continue to improve water efficiency, it will be important to ensure for our future Water Resource Management Plans and accompanying Drought Plans that we have a better understanding of whether the actions we have taken in the 2020 to 2025 period to manage the long-term supply demand balance do not double count the benefits we assume in our Drought Plan.

  This is likely to be a broader industry issue. Although the risks of a severe drought are low, this study will ensure we are well placed for our future plans.

- Produce an annual outage report

  Section 7 shows that our supply demand balance is tighter than in previous forecasts. This means that the availability of our existing sources is even more important. We will therefore undertake an annual review to improve our understanding of our outages. We will use this to understand whether our asset availability is improving or deteriorating.

8.6 Levels of service across the planning period

Table 8.8 below gives information on our levels of service in our supply area. As can be seen, our Plan meets our minimum levels of service across the planning period.

Throughout the planning period, all of our WRZs are in surplus and therefore our levels of service will be higher than the minimum levels. The supply demand balance charts (Figures 8.4 – 8.8) show that the size of the surplus in each WRZ varies across the planning period. Therefore, the actual levels of service also vary across the planning period. However, this is difficult to quantity precisely given the nature of return period calculations but actual levels will lie within the ranges shown in Table 8.9.

Table 8.9: Company levels of service

Drought action	Company minimum service level for long-term planning	Company current service levels	
		SWW supply area	BW supply area
Publicity, appeals for restraint and water conservation measures	1 in 10 years (10%)*	> 1 in 10 years (< 10%)*	> 1 in 10 years (< 10%)*
Temporary Use Bans (TUBs)[8.13]	1 in 20 years (5%)*	> 1 in 40 years (< 2.5%)*	> 1 in 100 years (< 1%)*
Supply-side Drought Orders or Drought Permits[8.14]	1 in 20 years (5%)*	> 1 in 100 years (< 1%)*	> 1 in 100 years (< 1%)*
Demand-side Drought Orders[8.15]	1 in 40 years (2.5%)*	> 1 in 100 years (< 1%)*	> 1 in 100 years (< 1%)*
Emergency Drought Orders – partial supply, rota cuts or standpipes[8.16]	> 1 in 200 years (< 0.5%)*	> 1 in 200 years (< 0.5%)*	> 1 in 200 years (< 0.5%)*

**Annual percentage risk of occurrence*

8.7 Natural Capital assessment

It is important for the long term sustainability of our region and our water supplies that the environment is resilient to future challenges.

To complement our multi-criteria assessment we also undertook a high level assessment of the impact of our plan on natural capital. We are already playing a lead role in the Defra PIONEER projects and have worked with stakeholders in the development of a natural capital assessment for the North Devon area.

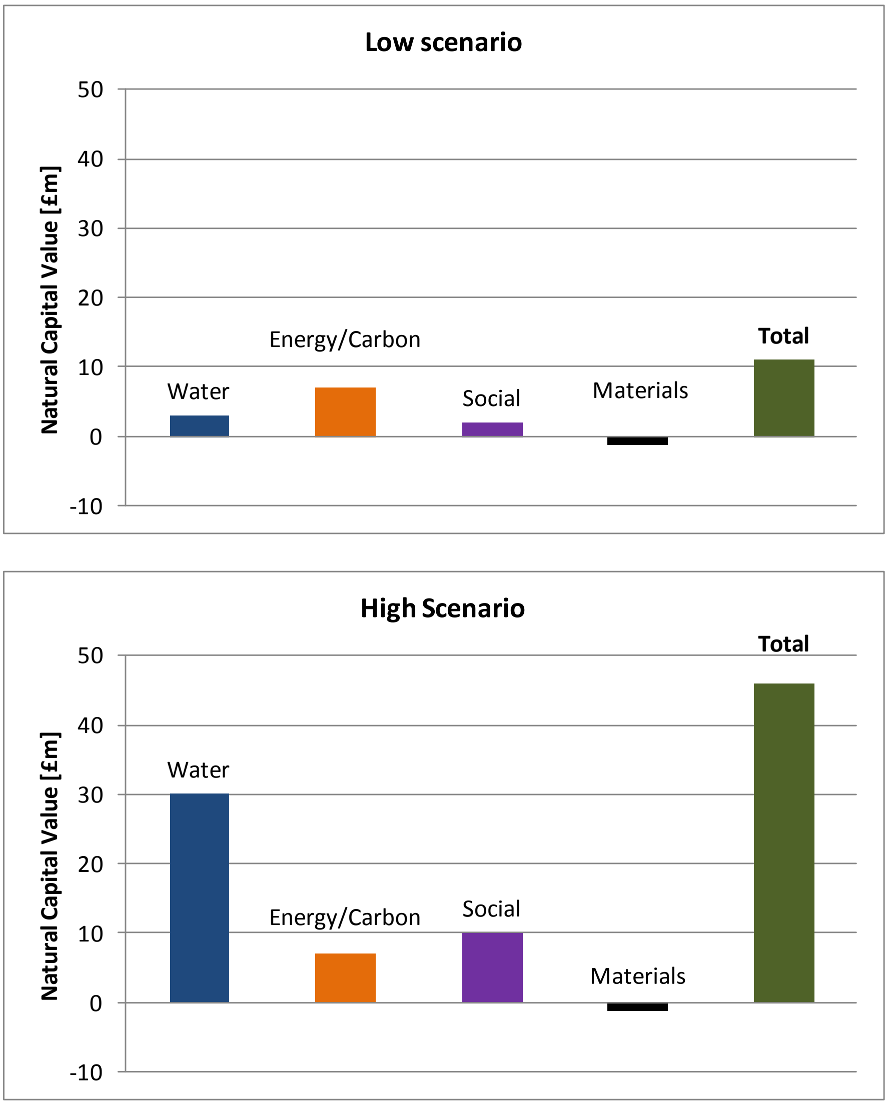
[8.13] Formerly termed hosepipe bans. Return period calculated based on historic droughts.
[8.14] The use of Drought Orders or Drought Permits of this nature is not envisaged in the lifetime of this plan as can be seen in our analysis of historic droughts.
[8.15] Formerly termed bans on non-essential use. All WRZs do not currently enter the Zone C of our drought triggers based on our worst historical drought of 1975/76. This has a return period of at least 1 in 100 years across all zones.
[8.16] Previously service level listed as unacceptable. Following further guidelines from the Environment Agency we have included an estimated return period for this service level based on our drought analysis. Drought return periods of this magnitude are inherently uncertain, but the events that would cause these interventions are rare.

The calculation of Natural Capital is new for our Water Resources Management Plan and an area we plan to develop in the future. The results of the analysis are given in detail in Appendix 8 but show:

- the Plan as an overall positive benefit to natural capital
- the Plan improves natural capital between £11m and £46m

We will continue to assess Natural Capital impacts of our activity as part of our PR19 Business Plan and continue to play a lead role in its application in the private sector.

Figure 8.4: Natural Capital Assessment



8.8 Overall performance and conclusion

It is our priority to ensure we operate a resilient water supply system for our customers. We achieve this by maintaining the balance between supply and demand over the next 25 years and beyond.

This Water Resources Management Plan lays out our approach to mitigating the uncertainties we face, such as population growth and climate change, whilst listening to our customers and addressing their preferences.

The overall performance of our proposed plan is shown in Figure 8.1 and shows strong performance across all performance metrics. Figures 8.5 to 8.9 show our final supply demand forecasts.

By selecting a range of leakage reduction, water efficiency, water re-use and by investigating water transfer options with Southern Water, this Plan performs better overall than a baseline plan with no intervention.

The proposed plan undertakes some action now to mitigate risks to our service for future generations, but balances this against affordability and ensures we don't plan on a worst case scenario unnecessarily.

Whilst there are lower or higher cost plans, and plans that could mitigate more or less risk, the proposed plan is considered to be the best overall balance of the preferences of our customers and the needs of the environment. It will ensure that we continue to deliver a safe and reliable water supply to customers for future generations.

The Plan is not built on minimising cost alone, but on looking at a range of factors that are important in the long-term planning. It performs considerably better when compared with a baseline plan, which would not include any intervention at all.

Our customers place a high priority on supply resilience and on leakage reduction. They also have an overall preference for starting managing risks early rather than late. With this in mind, we think that our Plan achieves the right mix of actions to maintain the supply demand balance in the future.

This Plan seeks to make the best use of water and has identified a possible water transfer to Southern Water. It also identified improvements in our own water use. We believe this enables us to reinforce the value of water and the need to use it wisely[8.17].

We will use the comments and feedback on this Plan to develop our Final Water Resources Management Plan in 2018.

[8.17] As our bills have been reducing over time, the cost to customers has been falling. There is therefore a risk that this undermines the value of water in our supply region.

That Plan will use demand forecasts that use the new industry leakage reporting approach. However, as shown in our sensitivity analysis, we do not expect this to have a material effect on our proposed plan.

The submission of our Periodic Review 2019 Business Plan to Ofwat will also occur in 2018. This will set out our overall plans for delivering all areas of our service to our customers for the 2020 to 2025 period and beyond.

As set out in Section 1, this has close links to our Water Resource Management Plan. The Business Plan will also set out any additional efficiencies we identify in areas such as the cost of leakage reduction to deliver the targets in this Plan.

In doing so, this Water Resource Management Plan is an integral part of our overall plans for the future. It gives a clear vision of how we will maintain our supply demand balance to ensure our service remains resilient in the future.

Figure 8.5: Final supply demand forecasts – Colliford WRZ (DYAA)

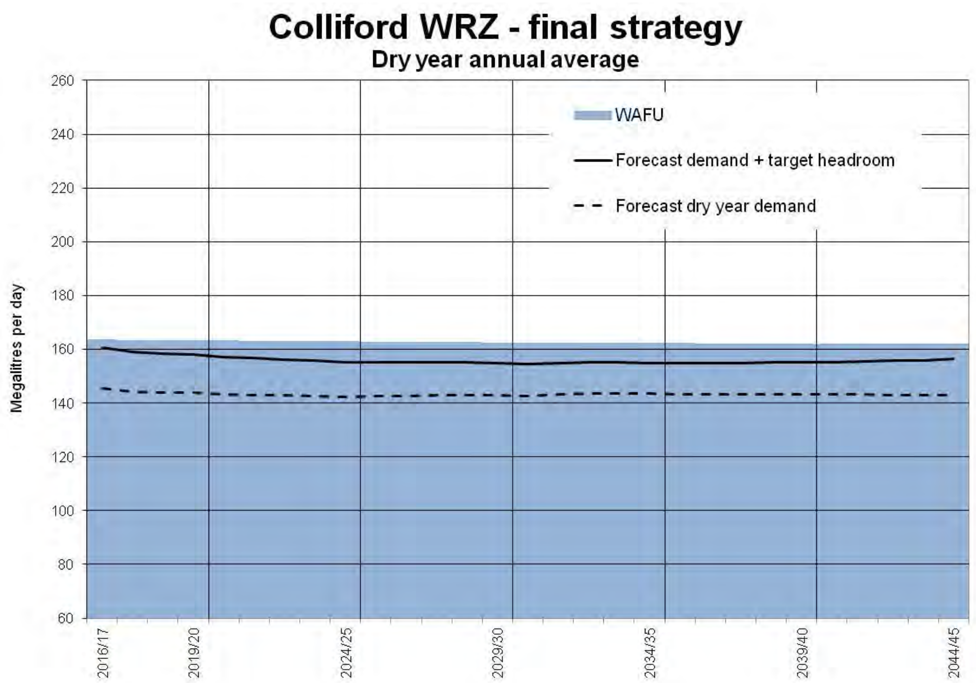


Figure 8.6: Final supply demand forecasts – Roadford WRZ (DYAA)

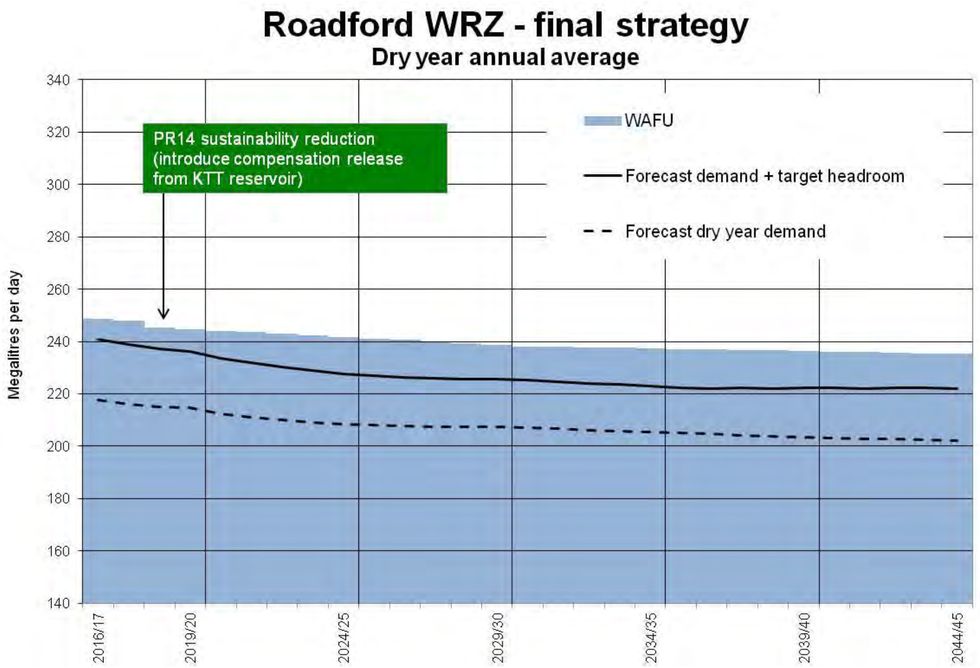


Figure 8.7: Final supply demand forecasts – Wimbleball WRZ (DYAA)

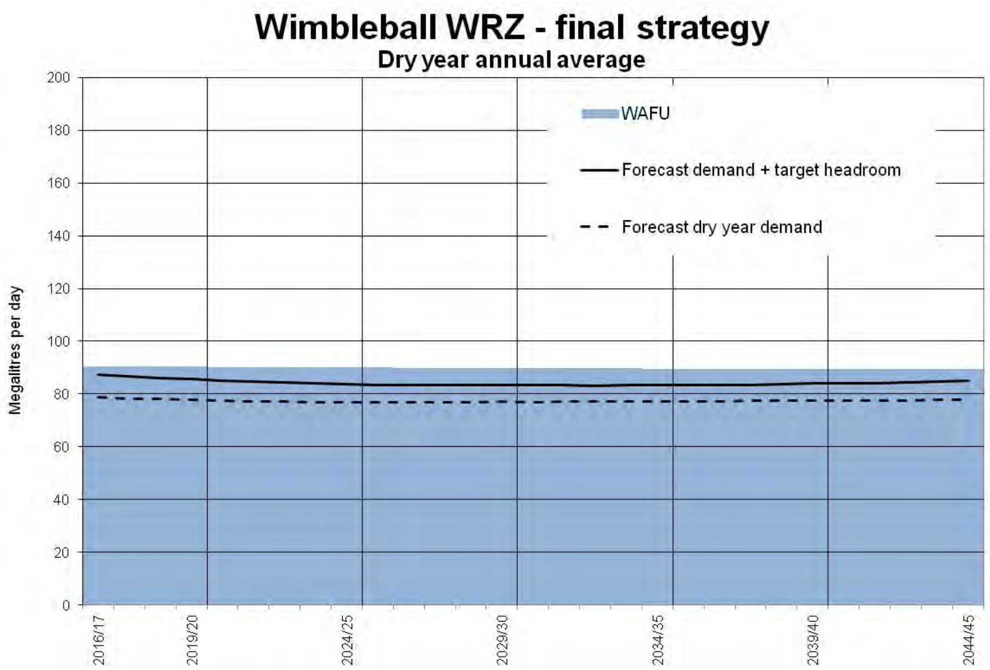


Figure 8.8: Final supply demand forecasts – Bournemouth WRZ (DYAA)

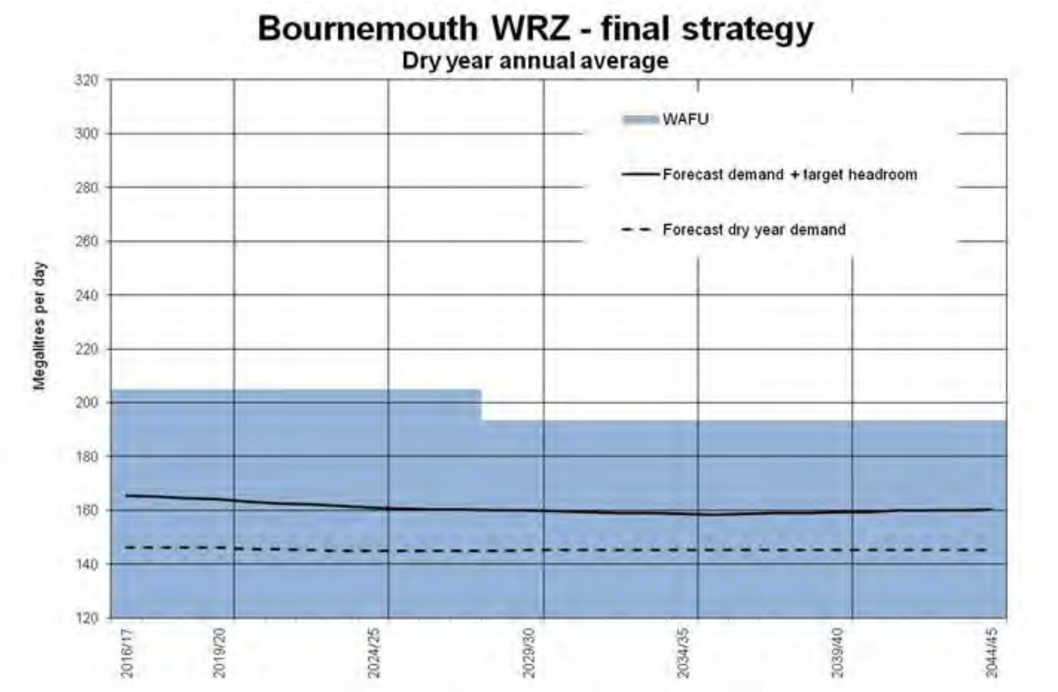
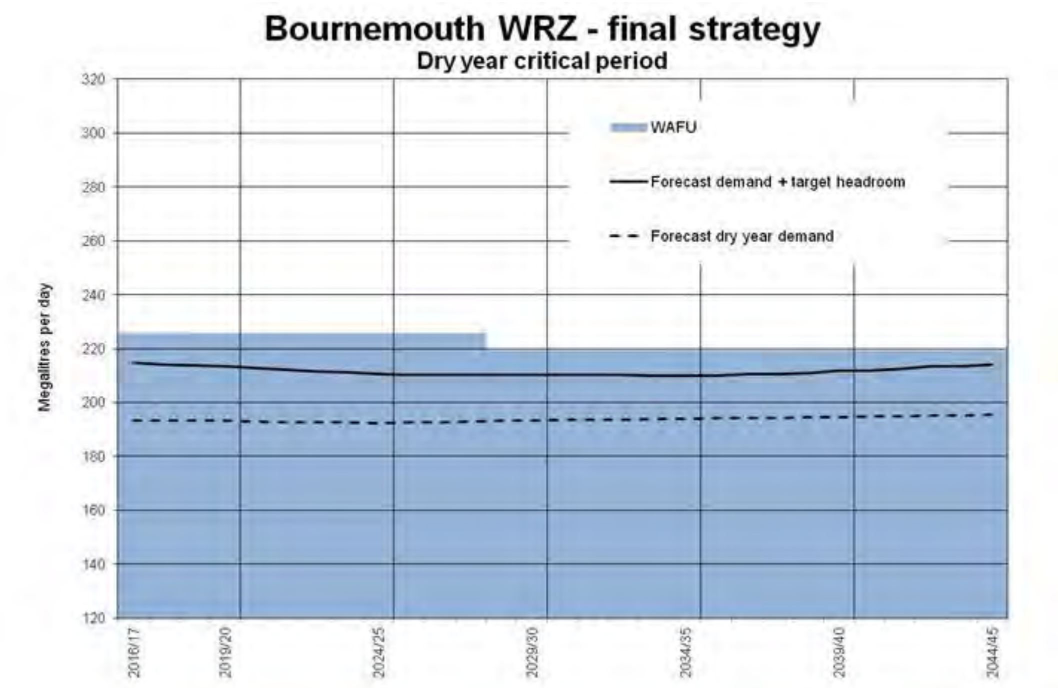


Figure 8.9: Final supply demand forecasts – Bournemouth WRZ (DYCP)



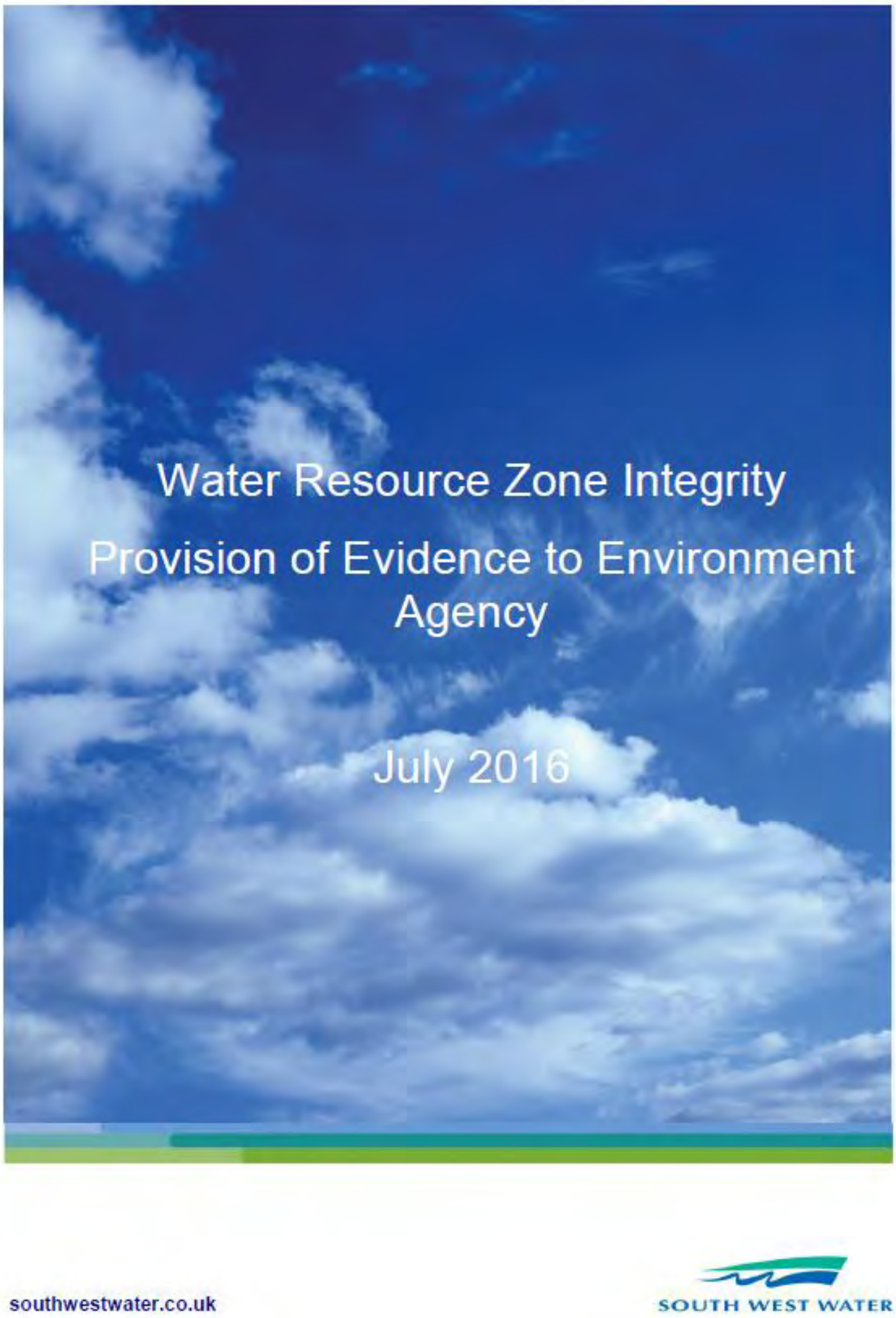
APPENDIX 1

General information on plan content and development

A.1.1 Water resource zone integrity

A.1.1.1 <u>South West Water supply area</u>

This section sets out our work on Water Resources Zone Integrity.



Water Resource Zone Integrity

Contents

Water Resource Zone Integrity

1. Purpose of report

In May 2016 the Environment Agency, OFWAT, Defra and the Welsh Government published the guideline for the production of statutory water resources management plans (WRMPs) to be produced by the Water Companies of England and Wales.[1] In July 2016 the Environment Agency produced a supporting document on Water Resource Zone (WRZ) integrity[2].

As described in the guideline, WRMPs are built up of assessments undertaken at the WRZ level. Further information on the definition of a WRZ, as described in the guideline and supporting document, is shown in the Appendix.

The purpose of this report is to provide information to the Agency to support our assessment that our WRZs are appropriate.

2. SWW Water Resource Zones

SWW identify three WRZs: Colliford, Roadford and Wimbleball. The WRZs are identified geographically in Figure 1. For completeness Figure 1 also shows the sub areas of our WRZs which we define as our Water Into Supply (WIS) Zones.

3. Evidence supporting our Water Resource Zones

3.1 Interconnectivity within each WRZ

Figures 2, 3 and 4 show the key components and connecting infrastructure within each WRZ.

As can be seen from the figures, there is a good degree of strategic interconnectivity within each WRZ.

3.2 Minimum connectivity between each WRZ

The connectivity between each WRZ is represented schematically in figures 2, 3 and 4 as the imports and exports. These links are used to provide a degree of resilience and flexibility rather than purely for water resources transfers during drier periods. The size of the water resources transfers during drier years are shown in the tables presented in our current WRMP[3]. As can be seen the imports and exports are relatively small compared to the deployable output in each WRZ.

[1] Environment Agency, Ofwat, Defra and the Welsh Government, "Final Water Resources Planning Guideline", May 2016
[2] Environment Agency, "Water resource zone integrity – supporting document for the Water Resources Management Plan Guidelines", July 2016
[3] South West Water, "Water Resources Management Plan 2015-2040", June 2014

No significant changes in these transfers have occurred in terms of water resources planning or are envisaged to occur since the production of our 2014 WRMP[4].

3.3 WRZs used in previous WRMPs and audited externally

Our WRZs defined above have been used within both our current and previous WRMPs and hence they were audited by the external auditor as part of the PR09 process. An extract of the auditor's report to OFWAT at that time which supports our WRZs is given in Figure 5.

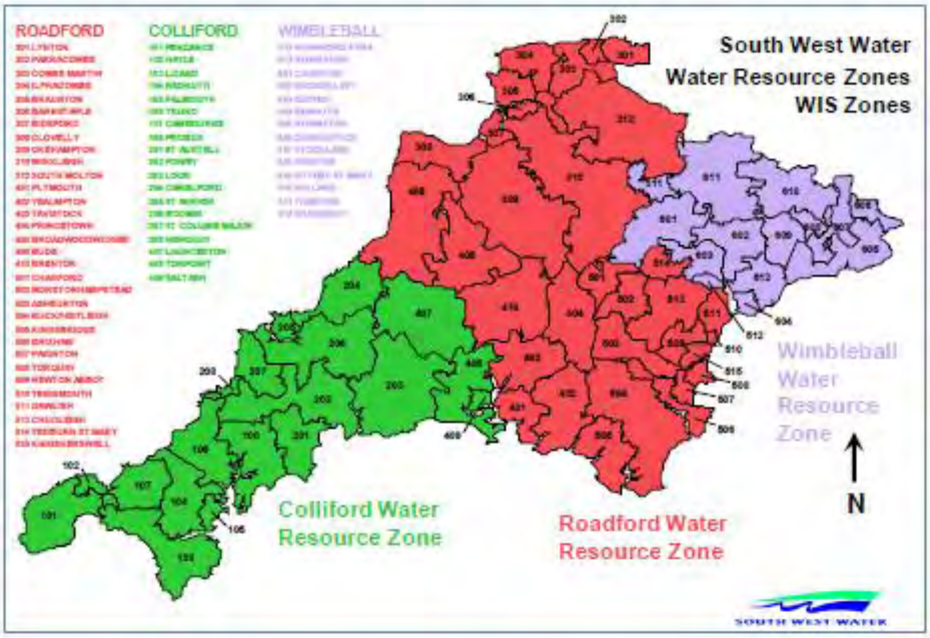
No significant changes in our WRZs have occurred or are envisaged to occur since this audit.

South West Water
22 July 2016

[4] *Ibid. 2*

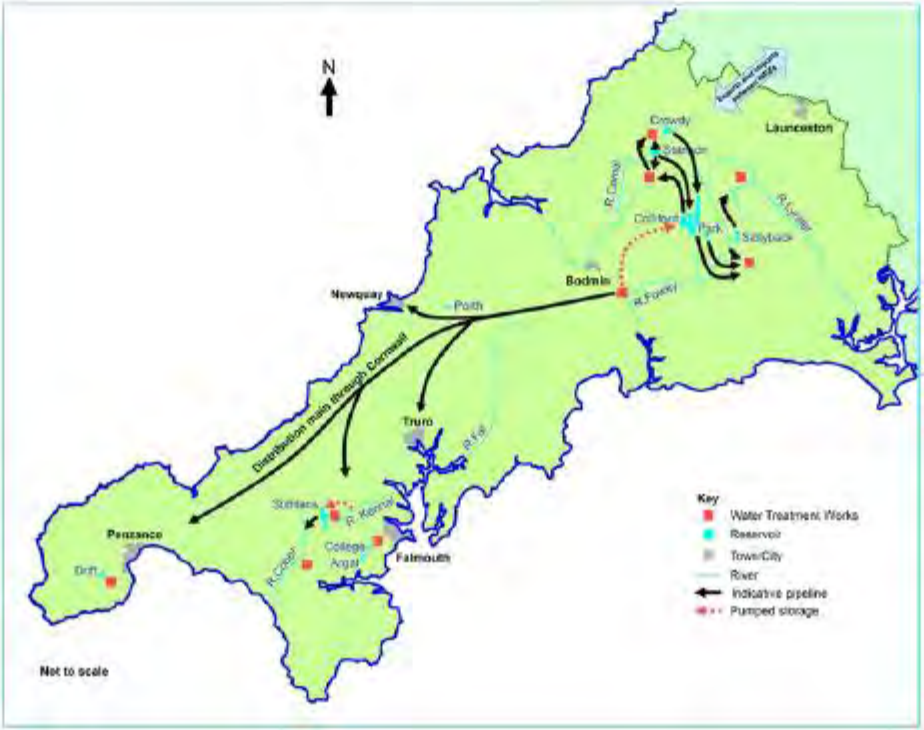
Water Resource Zone Integrity

Figure 1 SWW Water Resource Zones



Water Resource Zone Integrity

Figure 2 Key components of the Colliford Water Resource Zone



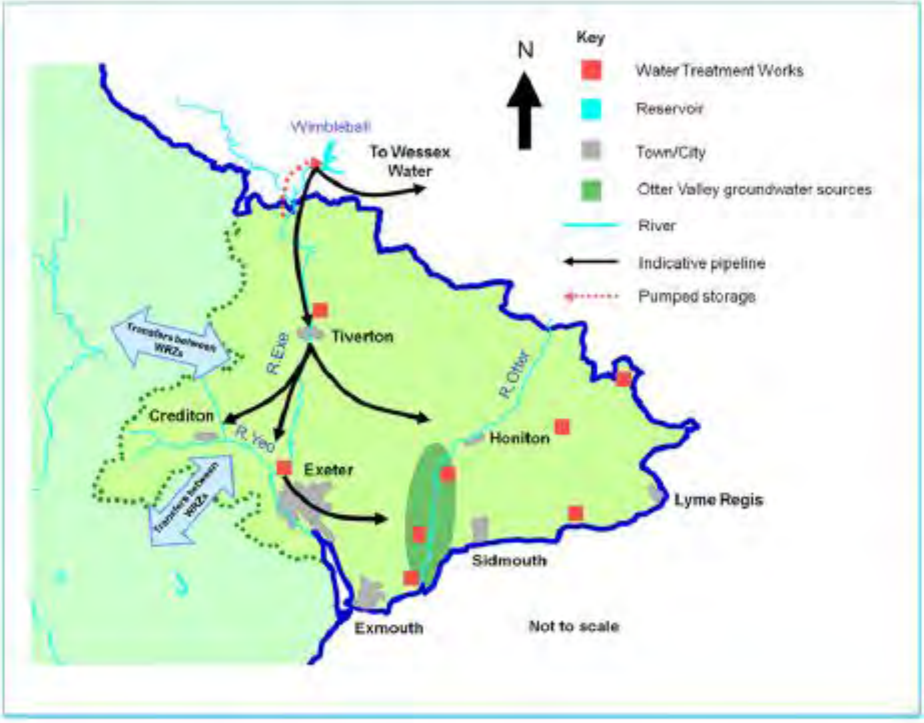
Water Resource Zone Integrity

Figure 3 Key components of the Roadford Water Resource Zone

** Before PR19 it is anticipated that Crownhill WTW will move to a new WTW north of Plymouth called Mayflower WTW (sources of supply will be the same as for Crownhill WTW).*

Water Resource Zone Integrity

Figure 4 Key components of the Wimbleball Water Resource Zone



Water Resource Zone Integrity

Figure 5 Extract from the auditor's report to OFWAT from SWW, March 2008

ATKINS
Business Analysis
South West Water
Report on the Company's Draft Water Resources Plan

Doc Ref: C-80375/MWH/SWT.PR51
Date: 31 March 2008
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Main Report

1. General Information

South West Water has produced the draft Water Resources Management Plan covering the period up until 2034/35. The data produced for 2006/07, the latest report year, has been used as the base year. Our report on this plan has been referenced to the same paragraph numbers as in the Company's plan wherever feasible.

1.1 Water Resource Zones

The Reporter should verify and confirm whether the Company has classified its water resource zones in line with the Environment Agency's definition. The Environment Agency defines a water resource zone as:

"The largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall."

The Company has identified three water resource zones – Colliford, Roadford and Wimbleball. These remain unchanged from the PR04 Business Plan.

We challenged the Company to substantiate that the number of water resource zones chosen for their planning purposes was in line with the Environment Agency's definition. The Company illustrated to us that the level of connectivity between areas is such that by splitting the Company into three zones the customers in each of the three areas are at the same level of risk of restrictions during a drought. However the connectivity is not sufficient to put all customers at the same risk. i.e. a drought in one zone would not necessarily lead to restrictions in the other two. From the illustration of this connectivity on the schematic diagram of the Company's water resources model and the output of the Company's modelling we were satisfied with the Company's justification.

Water Resource Zone Integrity

Appendix Extract from Final Water Resources Planning Guideline May 2016

3.2. Defining a water resource zone

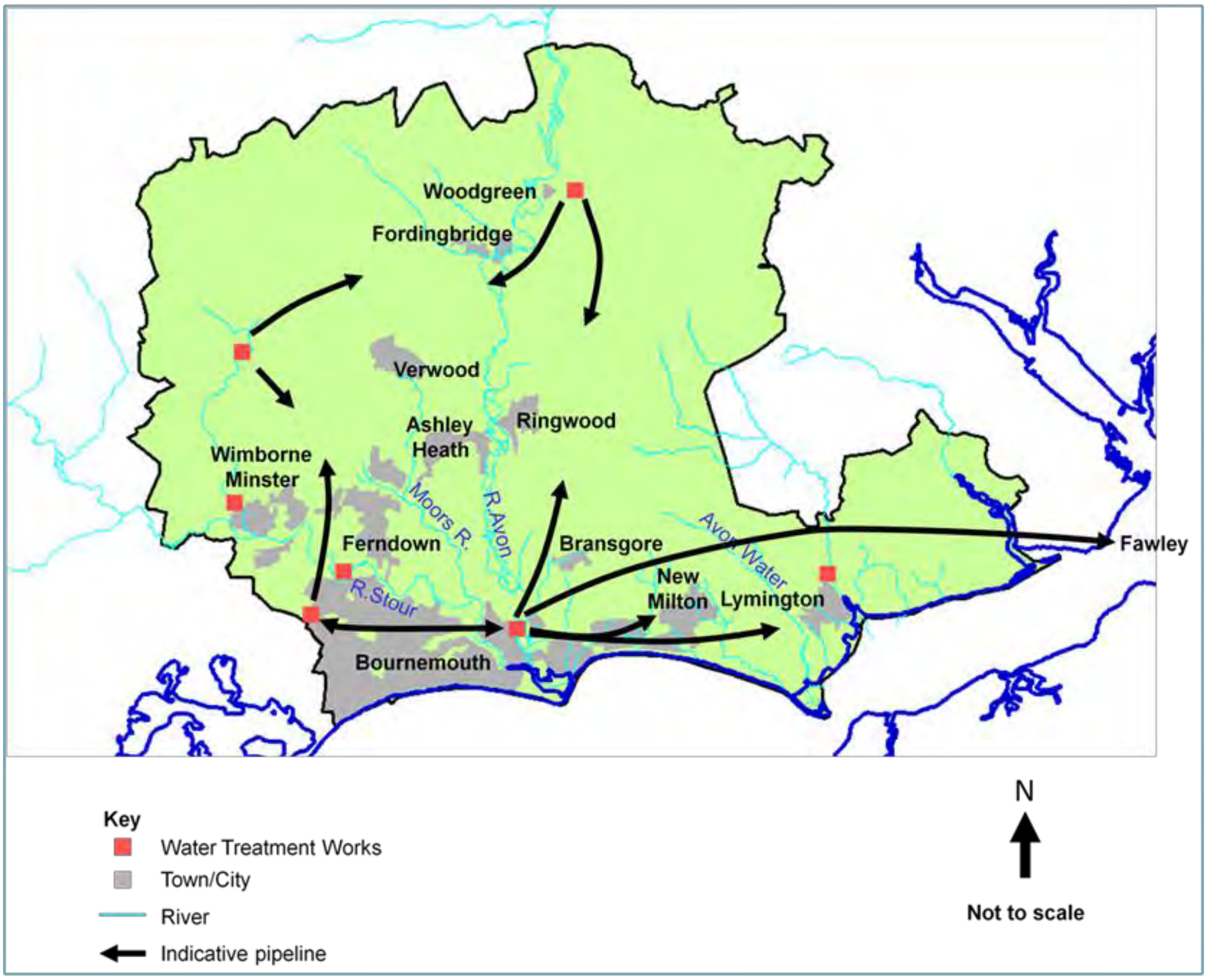
Your plan should be built up of assessments undertaken at a water resource zone (WRZ) level. The WRZ describes an area within which the abstraction and distribution of supply to meet demand is largely self-contained (with the exception of agreed bulk transfers). You may divide your supply area into one or more WRZs.

Within a WRZ all parts of the supply system and demand centres (where water is needed) should be connected so that all customers in the WRZ should experience the same risk of supply failure and the same level of service for demand restrictions. There will be limitations to achieving these due to the specific characteristics of a distribution network but significant numbers of customers should not experience different risks of supply failure within a single WRZ.

If you operate wholly or mainly in England, you should define your WRZs using the Environment Agency's WRZ assessment methods (Water Resource Zone Integrity, 2016). If you operate wholly or mainly in Wales, you should discuss requirements with Natural Resources Wales. You should provide your reasoning and confirm it in the pre-consultation phase to the Environment Agency or Natural Resources Wales.

A.1.1.2 Bournemouth supply area

Figure A.1 Bournemouth water resource zone



A.1.1.2.1 Summary of technical note (submitted in 2012)

The purpose of the Technical Note was to illustrate the integrity of a single Bournemouth WRZ for Bournemouth Water and to demonstrate that this single WRZ meets the WRZ definition and is fit for purpose.

A Stage 1 high level review was considered appropriate for SBW as the single Bournemouth WRZ is a fully integrated supply network with no difference in the risk of supply failure to customers throughout the company's supply area. Previous network connectivity issues between the previous Bournemouth and Hale WRZs were removed during AMP4 with the implementation of the Matchams booster scheme which allows the transfer of up to 15 Ml/d from River Avon (Hampshire) to the Woodgreen Reservoir.

A re-defined single Bournemouth WRZ is therefore justified as it consists of an integrated supply network capable of providing secure supplies to meet demand to all SBW customers for the defined 1 in 20 level of service.

A.1.2 Problem characterisation

This section sets out our assessment of the problem characterization.

It concludes the level of risk is low in all are WRZs.

This is confirmed in our scenario analysis in Section 7. This shows our WRZs have some small sensitivity to three areas of uncertainty, but not until the medium to long term. The likelihood of these events is also relatively low.

South West Water

Decision Making Process – Problem Characterisation and Selection of Appropriate Modelling Method

We shared our decision making process outlined in this report with the Environment Agency (EA) on 1st August 2016.

1. Summary and key points

1.1 Summary and proposed approach

- Our Water Resources Management Plan (WRMP19) is a single plan to cover the SWW and Bournemouth supply areas. These areas comprise four Water Resources Zones (WRZ).
- Initial analysis indicated that both SWW and Bournemouth supply areas could be in surplus for the majority of the WRMP19 planning period, or that if a deficit does occur it is likely to be relatively small.
- Each WRZ was considered separately in the Problem Characterisation process, which is specified in the UKWIR guideline[1].
- As summarised below, the results of the Problem Characterisation process indicate that the overall approach used in our previous WRMP14 is appropriate and fit for purpose. Therefore, there is no need to develop more complex methods.

1.2 Following the Guiding Principles from DEFRA and WRMP Guidelines from the EA

The proposed approach fits with the Guiding Principles from Defra[2] and WRPM Guidelines from the EA[3].

1.3 Implications and significance for supply demand balance, the environment and customer bills

The method chosen will have no material impact on the supply demand balance or the environment. Adopting a method appropriate to the circumstances also optimises the regulatory costs to the customer.

---

[1] UKWIR (2016). *WRMP 2019 Methods–Decision Making Process: Guidance.16/WR/02/10*
[2] Defra (2016). *Guiding principles for water resources planning. For water companies operating wholly or mainly in England.*
[3] Environment Agency (2017). *Water Resources Planning Guideline: Interim update. April 2017.*

2. Methods

In carrying out this analysis, we have followed the UKWIR guidance presented in the WRMP 2019 – Decision Making Process report[4].

2.1 Stage 1 - Collate and review planning information and supply demand balances

Supply Demand Components	Summary after consideration of factors in UKWIR report
WRZ boundaries	No changes from PR14 required
Justifiable changes to supply	Awaiting further information from EA regarding sustainability; risk of deterioration etc. Currently working on the assumption that there are no significant changes in supply(1)
Changes to Demand	Currently working on the assumption that there are no significant changes in demand (1)
Other changes affecting supply demand balance	Currently working on the assumption that no significant changes(1)
Changes to system performance	No known significant changes at present, other than those related to the issue of time limited licence or risk of deterioration etc as above. Currently working on the assumption that there are no significant changes
Uncertainty	Although there are uncertainties, working on the assumption that no significant changes to influence the methods used in the production of the WRMP
Planning Scenarios	No significant changes in the planning scenarios critical to the supply systems (1) Appropriate planning horizon is currently assumed to be the 25 years (2)

Table notes:

(1) *Assuming any information from the EA regarding time limited licences, risk of deterioration and sustainability has no significant impact*

(2) *During the WRMP process, if a small supply demand deficit in the latter part of the 25 year planning becomes apparent, then it is possible a longer planning horizon will be considered as options are considered and chosen*

[4] *Ibid 1*

Initial analysis indicated that both SWW and Bournemouth supply areas could be in surplus for the majority of the WRMP19 planning period, or that if a deficit does occur, it is likely to be small.

2.2 Stage 2 – Review List of Unconstrained Options

The previous WRMP14 for both Bournemouth and SWW supply areas showed a surplus in the supply demand balance. There were therefore no options at WRMP14.

As part of the WRMP19 process, a list of unconstrained options will be considered. This is documented elsewhere and will feed into stage 5 of the decision making framework.

2.3 Stage 3 - Problem characterisation – evaluate strategic needs and complexity

Problem characterisation has been carried out for each WRZ, following the methodology in the UKWIR report[5]. The tables shown in this document and the accompanying Appendix were derived following internal consultation in SWW and Bournemouth.

Decisions are based on information from WRMP14 along with that above.

Regarding demand side complexities (Table 4 in the Appendix), as previously shared with the EA, SWW currently consider the dry year uplift factor used to estimate dry year demand to be uncertain. This is because there has not been a significant dry year since 1995, with metering much higher and customer behaviour quite different compared to the past. A dry summer is required in order to improve the certainty in the dry year factor.

Using the templates in the UKWIR report[6], completed tables for each water resources zone are shown in the Appendix.

2.4 Stage 4 - Select appropriate modelling method

(i) Degree of modelling complexity using problem characterisation findings

Using the template Table 6 in the UKWIR report[7], the modelling complexity score for each WRZ is shown in the Tables 1.1 to 1.4 further below.

[5] *Ibid 1*
[6] *Ibid 1*
[7] *Ibid 1*

The tables show that each WRZ the complexity score was evaluated at **"Low level of concern".**

As per the guidelines[8], Low level of concern is described as:

"'Current' approaches (Economics of Balancing Supply and Demand, EBSD) should be adequate, and specific complexities can be examined through the steps recommended in the parallel UKWIR Risk Based Planning Methods project (to assist in derivation of DO, incorporation of uncertainty etc.)"

(ii) Selection of appropriate modelling method

For all our WRZs, we have decided that our decision making approaches that we used in WRMP14 and our previous WRMPs are appropriate for WRMP19.

This includes the use of our MISER water resources model and the current EBSD methods, as referenced in section 6.3.2 of the UKWIR report[9].

Water Resources Strategy team

South West Water

[8] *Ibid 1*
[9] *Ibid 1*

The Tables 1.1 to 1.4 below use the following colour coding (as per the UKWIR guidance[10]):

Low level of concern	Green
Moderate level of concern	Amber
High level of concern	Red

Table 1.1 Problem characterisation assessment to identify "modelling complexity" in Colliford WRZ

		Strategic Needs Score ("How big is the problem")			
		0-1 (None)	2-3 (Small)	4-5 (Medium)	6 (Large)
Complexity Factors Score ("How difficult is it to solve")	Low (<7)	✓ (green)	green	green	amber
	Medium (7-11)	green	green	amber	amber
	High (11+)	green	amber	red	red

Table 1.2 Problem characterisation assessment to identify "modelling complexity" in Roadford WRZ

		Strategic Needs Score ("How big is the problem")			
		0-1 (None)	2-3 (Small)	4-5 (Medium)	6 (Large)
Complexity Factors Score ("How difficult is it to solve")	Low (<7)	✓ (green)	green	green	amber
	Medium (7-11)	green	green	amber	amber
	High (11+)	green	amber	red	red

[10] *Ibid 1*

Bournemouth Water South West Water

Table 1.3 Problem characterisation assessment to identify "modelling complexity" in Wimbleball WRZ

		Strategic Needs Score ("How big is the problem")			
		0-1 (None)	2-3 (Small)	4-5 (Medium)	6 (Large)
Complexity Factors Score ("How difficult is it to solve")	Low (<7)	✓			
	Medium (7-11)				
	High (11+)				

Table 1.4 Problem characterisation assessment to identify "modelling complexity" in Bournemouth WRZ

		Strategic Needs Score ("How big is the problem")			
		0-1 (None)	2-3 (Small)	4-5 (Medium)	6 (Large)
Complexity Factors Score ("How difficult is it to solve")	Low (<7)	✓			
	Medium (7-11)				
	High (11+)				

South West Water Bournemouth Water

APPENDIX

Note that the tables below have been numbered in line with the relevant tables in the UKWIR guideline[11].

A1. Colliford Water Resources Zone

Table 2 Assessment of the strategic needs for WRMP purposes ("How big is the problem?")

Strategic WRMP risks	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
S. Level of concern that customer service could be significantly affected by current or future **supply side risks**, without investment	✓			
D. Level of concern that customer service could be significantly affected by current or future **demand side risks**, without investment	✓			
I. Level of concern over the acceptability of the cost of **the likely investment programme**, and/or that the likely investment programme contains **contentious options** (including environmental/planning risks)	✓			

Note: the term 'risk' here relates to either uncertainties in the current estimates of supply and/or demand (i.e. evaluation of supply capability or level of customer demand under drought conditions) that could present a problem to maintaining supply demand balance, or the potential size and impact of forecast changes (e.g. due to climate change, growth)[12].

[11] *Ibid 1*
[12] *Ibid 1*

Table 3 Assessment of supply side complexity of WRMP purpose

S	Supply side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
S(a)	Are there any concerns about **near term supply system performance**, either because of recent Level of Service failures or because of poor understanding of system reliability/resilience under different or more severe droughts that those contained in the historic record? Is this exacerbated by uncertainties about the **benefits of operational interventions contained in the Drought Plan?**	✓			
S(b)	Are there concerns about **future supply system performance**, primarily due to uncertain impacts of **climate change** on vulnerable supply systems, including associated source deterioration (water quality, catchments etc.), or poor understanding?	✓			
S(c)	Are there concerns about the potential for **'stepped' changes in supply** (e.g. sustainability reductions, bulk imports etc.) in the near or medium term **that are currently very uncertain?**		✓		
S(d)	Are there concerns that **the 'DO' metric might fail to reflect resilience** aspects that influence the choice of investment	✓			

S	Supply side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
	options (e.g. duration of failure), or are there **conjunctive dependencies between new options** (i.e. the amount of benefit from one option depends on the construction of another option). These can both be considered as ***non-linear problems***.				

Table 4 **Assessment of demand side complexity for WRMP purposes**

D	Demand side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
D(a)	Are there concerns about **changes in current or near term demand,** e.g. in terms of demand profile, total demand, or changes in economics/demographics or customer characteristics?		✓		
D(b)	**Does uncertainty associated with forecasts** of demographic / economic / behavioural changes over the planning period cause concerns over the level of investment that may be required?	✓			
D(c)	Are there concerns that a simple **'dry year/normal year' assessment of demand is not adequate,** e.g. because of high sensitivity of demand to drought (so demand under severe events needs to be understood), or because demand versus drought timing is critical.	✓			

Table 5 Assessment of the investment programme complexity for WRMP purposes

I	Investment programme complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
I(a)	Are there concerns that **capex uncertainty** (particularly in relation to new or untested technologies) could compromise the company's ability to select a 'best value' portfolio over the planning period?	✓			
I(b)	Does the nature of feasible options mean that **construction lead time or scheme promotability** are a major driver of the choice of investment portfolio?	✓			
I(c)	Are there concerns that **tradeoffs between costs and non-monetised 'best value' considerations** (social, environment) are so complex that they require quantified analysis (beyond SEA) to justify final investment decisions.	✓			
I(d)	Is the investment programme sensitive to assumptions about the utilisation of new resources, mainly because of large differences in variable opex between investment options?	✓			

Bournemouth Water South West Water

A2. Roadford Water Resources Zone

Table 2 Assessment of the strategic needs for WRMP purposes ("How big is the problem?")

Strategic WRMP risks	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
S. Level of concern that customer service could be significantly affected by current or future **supply side risks**, without investment	✓			
D. Level of concern that customer service could be significantly affected by current or future **demand side risks**, without investment	✓			
I. Level of concern over the acceptability of the cost of the likely **investment programme**, and/or that the likely investment programme contains **contentious options** (including environmental/planning risks)	✓			

Note: the term 'risk' here relates to either uncertainties in the current estimates of supply and/or demand (i.e. evaluation of supply capability or level of customer demand under drought conditions) that could present a problem to maintaining supply demand balance, or the potential size and impact of forecast changes (e.g. due to climate change, growth)[13].

[13] *Ibid 1*

Table 3 Assessment of supply side complexity of WRMP purpose

S	Supply side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
S(a)	Are there any concerns about near term supply system performance, either because of recent Level of Service failures or because of poor understanding of system reliability/resilience under different or more severe droughts that those contained in the historic record? Is this exacerbated by uncertainties about the benefits of operational interventions contained in the Drought Plan?	✓			
S(b)	Are there concerns about future supply system performance, primarily due to uncertain impacts of climate change on vulnerable supply systems, including associated source deterioration (water quality, catchments etc.), or poor understanding?	✓			
S(c)	Are there concerns about the potential for 'stepped' changes in supply (e.g. sustainability reductions, bulk imports etc.) in the near or medium term that are currently very uncertain?		✓		
S(d)	Are there concerns that the 'DO' metric might fail to reflect resilience aspects that influence the choice of investment options (e.g. duration of failure), or are there conjunctive dependencies between	✓			

S	Supply side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
	new options (i.e. the amount of benefit from one option depends on the construction of another option). These can both be considered as *non-linear problems*.				

Table 4 Assessment of demand side complexity for WRMP purposes

D	Demand side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
D(a)	Are there concerns about **changes in current or near term demand**, e.g. in terms of demand profile, total demand, or changes in economics/demographics or customer characteristics?		✓		
D(b)	**Does uncertainty associated with forecasts** of demographic / economic / behavioural changes over the planning period cause concerns over the level of investment that may be required?	✓			
D(c)	Are there concerns that a simple '**dry year/normal year' assessment of demand is not adequate**, e.g. because of high sensitivity of demand to drought (so demand under severe events needs to be understood), or because demand versus drought timing is critical.	✓			

Table 5 Assessment of the investment programme complexity for WRMP purposes

I	Investment programme complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
I(a)	Are there concerns that **capex uncertainty** (particularly in relation to new or untested technologies) could compromise the company's ability to select a 'best value' portfolio over the planning period?	✓			
I(b)	Does the nature of feasible options mean that **construction lead time or scheme promotability** are a major driver of the choice of investment portfolio?	✓			
I(c)	Are there concerns that **tradeoffs between costs and non-monetised 'best value' considerations** (social, environment) are so complex that they require quantified analysis (beyond SEA) to justify final investment decisions.	✓			
I(d)	Is the investment programme sensitive to assumptions about the utilisation of new resources, mainly because of large differences in variable opex between investment options?	✓			

A.3 Wimbleball Water Resources Zone

Table 2 Assessment of the strategic needs for WRMP purposes ("How big is the problem?")

Strategic WRMP risks	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
S. Level of concern that customer service could be significantly affected by current or future **supply side** risks, without investment		✓		
D. Level of concern that customer service could be significantly affected by current or future **demand side** risks, without investment				
I. Level of concern over the acceptability of the cost of the likely **investment programme**, and/or that the likely investment programme contains **contentious options** (including environmental/planning risks)				

Note: the term 'risk' here relates to either uncertainties in the current estimates of supply and/or demand (i.e. evaluation of supply capability or level of customer demand under drought conditions) that could present a problem to maintaining supply demand balance, or the potential size and impact of forecast changes (e.g. due to climate change, growth)[14].

[14] *Ibid 1*

Table 3 Assessment of supply side complexity of WRMP purpose

S	Supply side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
S(a)	Are there any concerns about **near term supply system performance**, either because of recent Level of Service failures or because of poor understanding of system reliability/resilience under different or more severe droughts that those contained in the historic record? Is this exacerbated by uncertainties about the **benefits of operational interventions contained in the Drought Plan?**	✓			
S(b)	Are there concerns about **future supply system performance**, primarily due to uncertain impacts **of climate change** on vulnerable supply systems, including associated source deterioration (water quality, catchments etc.), or poor understanding?	✓			
S(c)	Are there concerns about the potential for **'stepped' changes in supply** (e.g. sustainability reductions, bulk imports etc.) in the near or medium term **that are currently very uncertain?**		✓		
S(d)	Are there concerns that the **'DO' metric might fail to reflect resilience** aspects that influence the choice of investment options (e.g. duration of failure), or are there **conjunctive dependencies between**	✓			

S	Supply side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
	new options (i.e. the amount of benefit from one option depends on the construction of another option). These can both be considered as *non-linear problems*.				

Table 4 **Assessment of demand side complexity for WRMP purposes**

D	Demand side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
D(a)	Are there concerns about **changes in current or near term demand**, e.g. in terms of demand profile, total demand, or changes in economics/demographics or customer characteristics?		✓		
D(b)	**Does uncertainty associated with** forecasts of demographic / economic / behavioural changes over the planning period cause concerns over the level of investment that may be required?	✓			
D(c)	Are there concerns that a simple **'dry year/normal year' assessment of demand is not adequate**, e.g. because of high sensitivity of demand to drought (so demand under severe events needs to be understood), or because demand versus drought timing is critical.	✓			

Table 5 Assessment of the investment programme complexity for WRMP purposes

I	Investment programme complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
I(a)	Are there concerns that **capex uncertainty** (particularly in relation to new or untested technologies) could compromise the company's ability to select a 'best value' portfolio over the planning period?	✓			
I(b)	Does the nature of feasible options mean that **construction lead time or scheme promotability** are a major driver of the choice of investment portfolio?	✓			
I(c)	Are there concerns that **tradeoffs between costs and non-monetised 'best value' considerations** (social, environment) are so complex that they require quantified analysis (beyond SEA) to justify final investment decisions.	✓			
I(d)	Is the investment programme sensitive to assumptions about the utilisation of new resources, mainly because of large differences in variable opex between investment options?	✓			

A.4 Bournemouth Resources Zone

Table 2 Assessment of the strategic needs for WRMP purposes ("How big is the problem?")

Strategic WRMP risks	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
S. Level of concern that customer service could be significantly affected by current or future **supply side** risks, without investment	✓			
D. Level of concern that customer service could be significantly affected by current or future **demand side** risks, without investment	✓			
I. Level of concern over the acceptability of the cost of the likely **investment programme**, and/or that the likely investment programme contains **contentious options** (including environmental/planning risks)	✓			

Note: the term 'risk' here relates to either uncertainties in the current estimates of supply and/or demand (i.e. evaluation of supply capability or level of customer demand under drought conditions) that could present a problem to maintaining supply demand balance, or the potential size and impact of forecast changes (e.g. due to climate change, growth)[16].

[15] *Ibid 1*

Table 3 Assessment of supply side complexity of WRMP purpose

S	Supply side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
S(a)	Are there any concerns about **near term supply system performance**, either because of recent Level of Service failures or because of poor understanding of system reliability/resilience under different or more severe droughts that those contained in the historic record? Is this exacerbated by uncertainties about the **benefits of operational interventions contained in the Drought Plan?**	✓			
S(b)	Are there concerns about **future supply system performance**, primarily due to uncertain impacts of **climate change** on vulnerable supply systems, including associated source deterioration (water quality, catchments etc.), or poor understanding?	✓			
S(c)	Are there concerns about the potential for **'stepped' changes in supply** (e.g. sustainability reductions, bulk imports etc.) in the near or medium term **that are currently very uncertain?**	✓			
S(d)	Are there concerns that the **'DO' metric might fail to reflect resilience** aspects that influence the choice of investment options (e.g. duration of failure), or are there **conjunctive dependencies between**	✓			

S	Supply side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
	new options (i.e. the amount of benefit from one option depends on the construction of another option). These can both be considered as *non-linear problems*.				

Table 4 Assessment of demand side complexity for WRMP purposes

D	Demand side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
D(a)	Are there concerns about **changes in current or near term demand**, e.g. in terms of demand profile, total demand, or changes in economics/demographics or customer characteristics?	✓			
D(b)	**Does uncertainty associated with forecasts of demographic / economic / behavioural** changes over the planning period cause concerns over the level of investment that may be required?	✓			
D(c)	Are there concerns that a simple **'dry year/normal year' assessment of demand is not adequate**, e.g. because of high sensitivity of demand to drought (so demand under severe events needs to be understood), or because demand versus drought timing is critical.	✓			

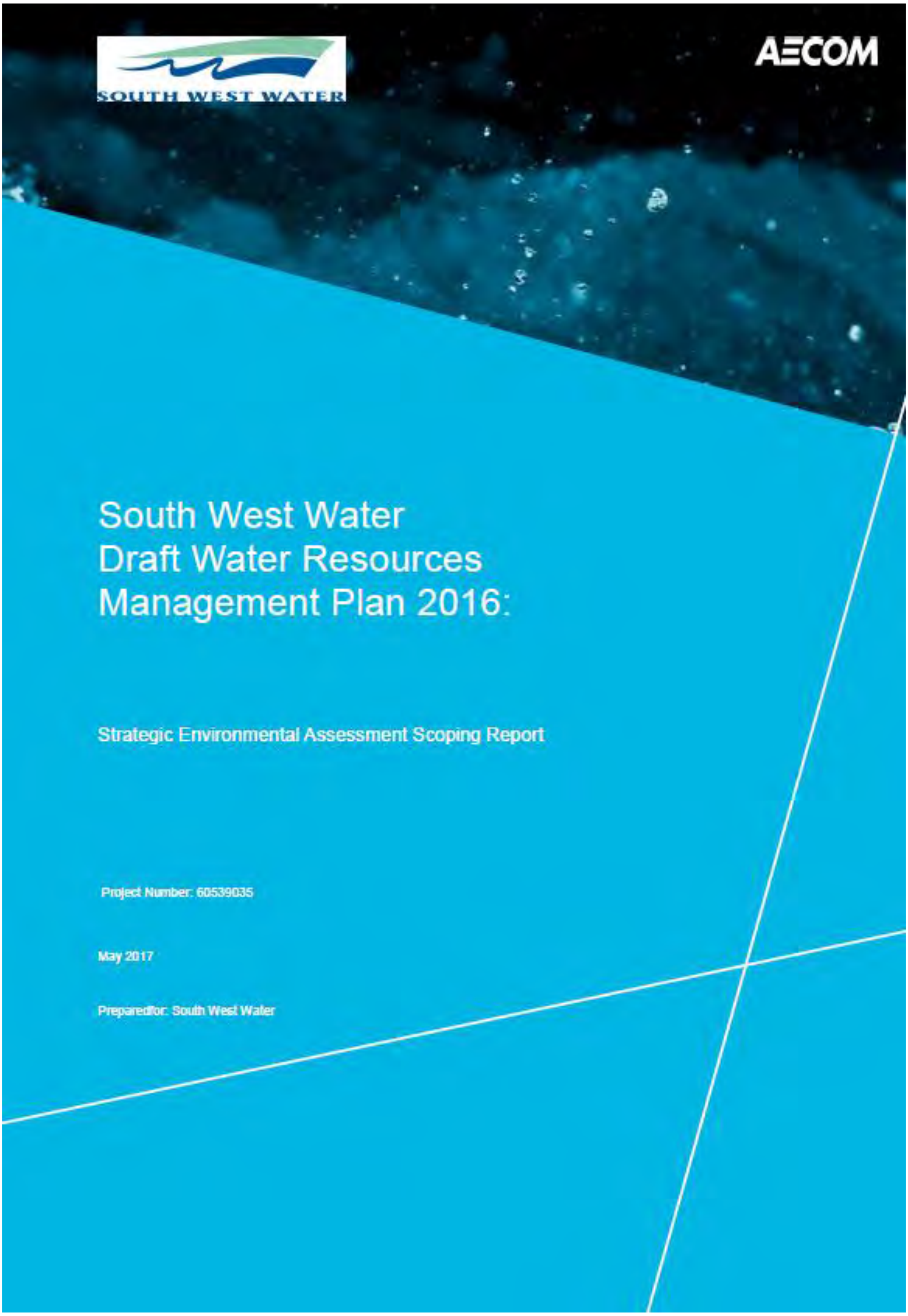
Table 5 Assessment of the investment programme complexity for WRMP purposes

I	Investment programme complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
I(a)	Are there concerns that **capex uncertainty** (particularly in relation to new or untested technologies) could compromise the company's ability to select a 'best value' portfolio over the planning period?	✓			
I(b)	Does the nature of feasible options mean that **construction lead time or scheme promotability** are a major driver of the choice of investment portfolio?	✓			
I(c)	Are there concerns that **tradeoffs between costs and non-monetised 'best value' considerations** (social, environment) are so complex that they require quantified analysis (beyond SEA) to justify final investment decisions.	✓			
I(d)	Is the investment programme sensitive to assumptions about the utilisation of new resources, mainly because of large differences in variable opex between investment options?	✓			

A.1.3 Strategic Environmental Assessment

A.1.3.1 A summary extract from the SEA scoping report by AECOM (May 2017)

As part of our proposed plan for the period 2020 to 2025 we will be undertaking an uplifted assessment of our available water resource options should they need to form part of our future plans. The SEA Scoping Report will underpin these new assessments ensuring environmental impact is fully considered as each option is re-appraised.


SOUTH WEST WATER

AECOM

South West Water
Draft Water Resources
Management Plan 2016:

Strategic Environmental Assessment Scoping Report

Project Number: 60539035

May 2017

Preparedfor: South West Water

Sutton and East Surrey Water Draft Water Resources Management Plan

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
1st draft	11/05/2017	Draft for client review			

AECOM

Sutton and East Surrey Water Draft Water Resources Management Plan

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Limitations

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AECOM

11. Summary of the SEA scope

Table 11-1 sets out a summary of the scope of the SEA. It illustrates the SEA topics, key issues identified and whether the topics/issues have been scoped in or out of the assessment.

Table 11-1 Scope of issues which will be a focus of the assessment

SEA topic (SEA Directive topics in brackets)	Key issues:	Scope
Population, Economy and Human Health	• The Study Area is largely rural with much of the population living in small communities. • The largest urban areas include Bournemouth; Plymouth, Exeter and Torbay. • The resident population of the SWW supply area was estimated to be 1.709 million in 2012 and this is forecast to grow to around 2.045 million by 2039. • The resident population of the BW area was estimated to be approximately 430,000 in 2012 and this is forecast to grow to around 468,700 by 2040. • It is predicted that there will be a move towards smaller household sizes (and therefore greater per capita resource consumption). • Key health issues and inequalities vary across the Study Area. • Due to the largely rural nature of the Study Area there are many economic challenges but also many opportunities. • The Study Area contains a range of important areas for recreation, which includes two National Parks, a number of AONBs and an extensive range of beaches and coastline.	Scoped in: Population and human health relating to water supply Recreation Scoped out: Population in terms of the effects on demographics
Material Assets	• The WRZs include a number of large urban areas such as Truro, Plymouth, Torbay, Exeter and Bournemouth. These urban areas are located mainly in coastal or estuarine settings in the lower lying parts of the various catchments. Linking these urban areas are important road/rail transport infrastructure. • The steep catchments in many SW areas, combined with climate change, may cause increased risk of flooding to these urban areas and transport infrastructure. • The Bournemouth WRZ is flatter and also has more permeable catchments in its northern parts. The permeable catchments mean that groundwater may influence river flows, and that flooding incidents due to higher groundwater levels may take longer to return to normal. Low-lying areas are also vulnerable to climate change as a result of sea level rise. • The history of quarrying and mining is extensive across the SW Region and has led to their being many sites for potential landfills, subject to the engineering of the landfill and the different hydrogeological settings. • Most councils across the SW region have sufficient landfill capacity for their own areas and relatively little inter-regional transfers takes place. There is no significant into the region movement of waste from outside the region.	Scoped in: Infrastructure Scoped out: Waste
Biodiversity, Flora and Fauna	• There are a large number of internationally and nationally designated sites, including SACs, SPAs, Ramsar sites, SSSIs and other designated areas within the Study Area. • There are a number of rare and protected habitats/ species found within the Study Area in terrestrial, riverine and aquatic environments. Many of these species/ habitats are sensitive to changes in hydrology and water quality. • Invasive non-native species have a major impact on biodiversity and are costly to eradicate. The number and location of invasive non-native species within the Study Area is not known at this stage.	Scoped in: Biodiversity, Flora and Fauna, in particular the effects on international and nationally designated sites.

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Landscape, Townscape and Visual Amenity	• Each WRZ is made up of a number of NCA's, these can be useful for determining the landscape character of each WRZ and the effect which particular options implemented through the WRMP may have on the landscape character of the area. • The Roadford WRZ contains the majority of the Dartmoor National Park and a small proportion of the Exmoor National Park in the north. The Wimbleball WRZ contains a very small proportion of the Dartmoor National Park in the south west. The Bournemouth WRZ contains the majority of the New Forest National Park . • There are AONBs located in all of the WRZs within the Study Area. AONBs are designated for conservation due to their significant landscape value and are offered protection from development similar to those of National Parks. Roadford WRZ contains the highest number of AONBs (four) while Bournemouth WRZ contains only one AONB.	Scoped in: Landscape character and quality, in particular the effects on designated sites.
Air and Climatic Factors	• AQMA's are found within Collliford, Roadford, and Wimbleball WRZ's. Roadford WRZ has 11 AQMAs which is the largest proportion of AQMAs in the Study Area. In contrast, Wimbleball has only four AQMA's. The AQMAs within the Study Area are primarily resulting from vehicle emissions and include those designated due to both Nitrogen Dioxide and Particulate Matter. • All WRZ's within the Study Area have shown an overall decrease in total CO2 emissions between 2005 and 2013. Bournemouth WRZ has shown the largest decrease in CO2 emissions (-33.1%), Roadford WRZ has shown the smallest decrease in CO2 emissions (-19.6%).	Scoped in: Climate change Scoped out: Air quality
Water	• The Study Area is surface water dominated. According to the CAMS surface water is available for licencing in most catchments of the South West Water WRZ with the exception of Tamar Catchment in Colliford and Roadford WRZ which is over-licensed or over-abstracted at low flows and thus water is only likely to be available at times of high flows. The predicted influences of climate change are likely to affect the future availability of water in this region. The only groundwater body identified in the South West WRZs is in East Devon and is not available for licencing. • In the Bournemouth area however, most surface water catchment and groundwater bodies are over-licensed or over-abstracted at low flows and thus water is only likely to be available at times of high flows and with Hands of Flow conditions. The predicted influences of climate change are likely to affect the future availability of water in these regions too. • The vulnerability of groundwater in the Study Area is monitored by the Environment Agency. In general, risk to groundwater quality results from polluting activities or the accidental release of pollutants. • The quality of surface waters in the Study Area is monitored by the Environment Agency. In general, risk to water quality in rivers and streams is caused by point and diffuse pollution, which is exacerbated by low flows. There may also be risk due to transfer of water from other sources. • Some parts of the South West Water and Bournemouth WRZs are within Flood Zone 3 where there is a significant risk of fluvial flooding.	Scoped in: Surface water quality, quantity and flood risk
Heritage assets and archaeology	• There are a significant number of heritage assets located within the Study Area. • The Colliford WRZ contains the Cornwall and West Devon Mining Landscape World Heritage Site, which is comprised of eleven separate sites. One of these sites partially falls within the Roadford WRZ which contains an eastern portion of the Tamar Valley Mining District site. The Wimbleball WRZ and Bournemouth WRZ do not contain any World Heritage Sites. • All WRZs contain a significant number of Listed Buildings and Scheduled Monuments, as well as Conservation Areas and Places of Worship. All WRZs within the Study Area also contain heritage assets defined as at risk by the Historic England Heritage at Risk Programme. Roadford WRZ contains the highest number of at risk	Scoped in: Historic environment, in particular the effect on designated heritage assets

South West Water Bournemouth Water

	assets (384) and Bournemouth WRZ contains the lowest number (54).	
Geology and soils	• A large proportion of land in the Study Area is agricultural land ranging from grade 1 (excellent quality agricultural land) to grade 5 (very poor quality agricultural land. This could place increased demand on water resources, especially in light of climate change impacts which could lead to increased erosion, new and emerging diseases and increases or decreases in local soil moisture content. • Some SSSIs within the Study Area have been designated for their geological significance. • There are number of active landfill sites and historic landfill sites (including closed mining waste sites) within the Study Area.	Scoped in: Soils, including agricultural land quality Scoped out: Geology

11.1 Temporal scope

It is proposed that it is split into 'planning horizons'; 0-25 years and then 25-80 years. Each planning horizon will have assumptions made to deal with the uncertainty of the timescales being assessed e.g. over 25 years there will be more uncertainty.

A.1.3.2 WRMP 2014 SEA Report - South West Water supply area

The new SEA Scoping Report builds on the full SEA covering our South West Water supply area WRZs which was carried out as part of our PR09 water resources planning.

Hyder

SOUTH WEST WATER

South West Water

Strategic Environmental Assessment of Water Resources Plan 2009

Summary Document

South West Water
Bournemouth Water

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South West Water

Strategic Environmental Assessment of Water Resources Plan 2009

Summary Document

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Report No	DV53405/NTS3	
Date	16/03/2009	

Hyder

Introduction

Hyder Consulting Ltd. was appointed by South West Water to carry out a Strategic Environmental Assessment (SEA) of its Water Resources Plan (WRP).

The water industry, through UK Water Industry Research Ltd (UKWIR), recognises that WRPs may be subject to SEA under the requirements of the European Directive 2001/42/EC 'on the assessment of effects of certain plans and programmes on the environment' (the SEA Directive). The SEA Directive has been transposed into UK legislation as Regulations. In England this is the Environmental Assessment of Plans and Programmes Regulations 2004 (Statutory Instrument 2004, No. 1633).

South West Water has chosen to undertake an SEA to ensure that environmental issues are considered throughout the development of the WRP.

An Environmental Report of the Draft WRP 2008, detailing the SEA process and outcomes, was prepared and then consulted upon in May 2008. Following the consultation, a Second Draft WRP and Environmental Report were produced before the WRP was finalised. This Summary Document provides a non-technical summary of the information provided in the Environmental Report of the Final WRP 2009.

The Purpose of SEA

The primary aim of the SEA process is to provide for a high-level of protection of the environment. By ensuring the integration of environmental issues into the preparation of plans and programmes, SEA encourages sustainable development.

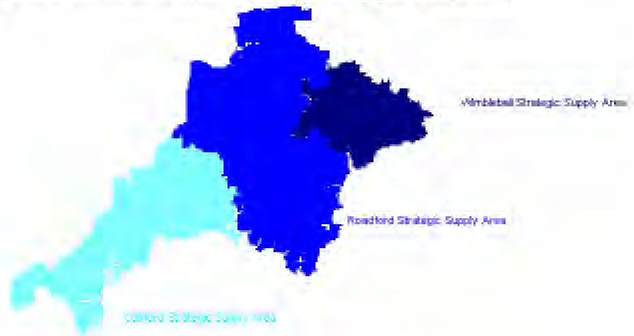
SEA is a decision-support tool, providing information on the environmental effects of the WRP. The output of the SEA process informs both the Plan makers and interested parties of possible significant environmental effects (both positive and negative) of the Plan and its reasonable alternatives. The findings of the SEA are presented in the Environmental Report[1].

The South West Water WRP

The Water Act 2003 introduced a legal requirement into the Water Industry Act 1991 for water companies to prepare, publish and maintain WRPs. These new provisions are contained in sections 37A to 37D of the Water Industry Act and came into force in April 2007.

The WRP outlines how South West Water proposes to meet the essential water supply needs of its customers through to the year 2035 in a sustainable manner. The WRP covers all of South West Water's water supply area, which covers Cornwall and Devon and small parts of Somerset and Dorset, shown in Figure 1 below.

Figure 1: South West Water Strategic Supply Areas (SSAs)



[1] South West Water (2009): *Strategic Environmental Assessment of Water Resources Plan – Environmental Report.* Report Number DV53405/ER3

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The water resources planning process requires a variety of studies to be carried out in order to establish the supply and demand balance in water supply within all the South West Water SSAs. Where deficits are identified, potential supply and demand management options to meet the shortfall are drawn up.

To arrive at the options detailed in the WRP, a range of demand and supply forecasting calculations were carried out. These calculations highlighted those SSAs that are in, or are predicted to fall into, deficit i.e. demand for water will be higher than available supply. A wide range of supply and demand management options were then considered to offset the determined deficit for each zone. These options are referred to as the **unconstrained options**. South West Water considered a range of unconstrained options for their WRP from the following four categories:

- Resource Schemes - Options which increase the available water output through the gaining of additional water supply (such as new boreholes abstractions or increased river abstraction).
- Customer Side - Measures which optimise customer water use efficiency through education, advice, metering and other means.
- Distribution Management - Measures which improve the efficiency and flexibility of the distribution network, such as leakage management and new pipelines.
- Production Management - Measures used at the production stage to improve capacity and efficiency such as blending, treatment, pumping regimes etc.

These unconstrained options were then narrowed down to a list of **feasible options** by South West Water using criteria which included environmental, social, economic and practical reasons. The feasible options consisted of generic options, for example, improved water efficiency measures that could be applied anywhere across the plan area and site-specific options that are only appropriate in certain locations.

Preferred options were chosen from the list of feasible options in consideration of the security of supply issues, economic factors and environmental impacts (including the findings of the SEA).

Consultation is a key component of the water resource planning process. South West Water invited comments on the WRP and Environmental Report at various stages in the plan development process.

Habitats Regulations Assessment Screening

European Union Directive 92/43/EEC (the 'Habitats Directive')[2] requires that any plan or programme likely to have a significant impact upon a Special Area of Conservation (SAC), candidate Special Area of Conservation (cSAC), Special Protection Area (SPA), potential Special Protection Area (pSPA) or Ramsar site, which is not directly concerned with the management of the site for nature conservation, must be subject to an Appropriate Assessment. All of these sites are of European/international importance.

A separate screening exercise was undertaken in parallel to the SEA process to determine if the WRP options were likely to result in significant effects on these valuable ecological sites. The Report concluded that the WRP is unlikely to have significant effects upon these sites but that further review of some of the options should be undertaken in the future when they are brought forward for implementation.

[2] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

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The SEA Process

The SEA for the WRP has been undertaken in a number of stages as shown below:

- **Stage A** – Setting the context and objectives, establishing the baseline and deciding on the scope;
- **Stage B** – Developing and refining alternatives and assessing effects;
- **Stage C** – Preparing the Environmental Report;
- **Stage D** – Consulting on the draft plan or programme and the Environmental Report; and
- **Stage E** – Monitoring the significant effects of implementing the plan or programme on the environment.

The Environmental Report is the key output of the SEA process. It details the SEA process for the WRP and presents information on the effects of the Plan.

Stage A: Policy Context, Environmental Baseline and Key Issues

A number of policies, plans and programmes have been identified and reviewed that set out a range of environmental themes (e.g. water, climate change, biodiversity, landscape, sustainable development, heritage, health and well-being). Environmental baseline data has also been collected in order to establish trends and the current state of the environment. This review highlighted key issues relevant to the WRP and these relate to the following:

- Predicted rise in population and seasonal fluctuations from tourism could have effects on water supply and demand;
- There is a need to protect and where possible enhance the condition of designated protected areas (e.g. Sites of Special Scientific Interest (SSSIs), SPAs and SACs);
- A number of rivers have poor water quality. There is a need to enhance this where possible;
- Climate change poses a long-term threat and there is a need to adapt to the risks it poses;
- Seasonal variations exist in both groundwater and surface water flows;
- There are high quality landscapes within the WRP plan area which includes two National Parks and six Areas of Outstanding Natural Beauty;
- There are wide-ranging recreational opportunities and Public Rights of Way; and,
- There is a need in the WRP plan area to reduce energy use and improve energy efficiency.

Stage B: Assessing the WRP

SEA Objectives

The SEA objectives were developed during Stage A. The SEA objectives provided a framework for assessing and improving the environmental performance of the WRP; ensuring maximum synergy with existing policies and plans. The SEA objectives are as follows (not in any order of priority):

1. Protection and enhancement of biodiversity, key habitats and species
2. Protection and enhancement of the cultural, historic and industrial heritage resource

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3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource
4. Ensuring the appropriate and efficient use of land
5. Limiting the causes, effects of, and adapting to climate change
6. Ensuring sustainable use of water resources
7. Protection and enhancement of landscape character
8. Protection and enhancement of human health

The above SEA objectives were used to test the WRP options.

Consideration of Alternatives

As mentioned previously, South West Water has considered a wide range of options (unconstrained options) for their WRP under four categories or 'strategic alternatives'

- Resource Scheme
- Customer Side
- Distribution Management
- Production Management

Due to the complex nature of WRPs, it is not possible to assess one strategic alternative against another, e.g. metering is not necessarily better or worse than repairing leaks. The WRP has considered options from each of these strategic alternatives.

Feasible Options

The feasible options were assessed against the SEA objectives. Feasible options included a combination of existing projects already initiated, and new schemes. Each feasible option was assessed for its potential impact on each of the SEA objectives in the short, medium and long term.

Preferred options were selected through consideration of the security of supply, economic factors and environmental impacts (including the findings of the SEA).

Preferred options

The primary objective of the WRP is to ensure that all South West Water's customers have a secure supply of water through to 2035, whilst having regard to economics and the environment.

Preferred options and their predicted effects are shown in Table 1.

SEA Scoring System

++	**Major positive**
+	**Positive**
?	**Uncertain**
O	**Neutral**
-	**Negative**
--	**Major negative**

It is possible for options to score a combination of these ratings, for example, there may be potential positive and negative aspects for the same objective.

In the table, S, M and L refers to short, medium and long term effects.

South West Water Bournemouth Water

Table 1 – Summary of Preferred Option Effects

Options	SEA Objectives																							
	Biodiversity			Cultural Heritage			Surface and Ground Water			Land Use			Climate Change			Sustainable use of water			Landscape			Human Health		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
Sophisticated Conjunctive Management	O	O	O	O	O	O	+	+	+	O	O	O	+	+	+	+	+	+	O	O	O	+	+	+
Compulsory metering	O	O	O	O	O	O	O	+	+	O	O	O	+	+	+	+	+	+	O	O	O	O	O	O
Changes to existing measured tariffs	O	O	O	O	O	O	O	O	+	O	O	O	+/O	+	+	+/O	+	+	O	O	O	O	O	O
Targeted water conservation information	O	O	O	O	O	O	O	O	+	O	O	O	O	+	+	O	+	+	O	O	O	O	O	O
Advice & information on direct abstraction & irrigation techniques	O	O	+	O	O	O	O	O	+	O	O	O	O	+	+	O	+	+	O	O	O	O	O	+
Advice & information on leakage detection & fixing techniques	O	O	O	O	O	O	+	+	+	O	O	O	+	+	+	+	+	+	O	O	O	O	O	O
Water saving devices	O	O	O	O	O	O	O	+	+	O	O	O	O	+	+	O	+	+	O	O	O	O	O	O
Recycling & reuse	O	O	O	O	O	O	O	O	O	O	O	O	+	+	+	+	+	+	O	O	O	O	O	O

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Options	SEA Objectives																							
	Biodiversity			Cultural Heritage			Surface and Ground Water			Land Use			Climate Change			Sustainable use of water			Landscape			Human Health		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
Other water efficiency initiatives	O	O	O	O	O	O	O	+	+	O	O	O	O	+	+	O	+	+	O	O	O	O	O	O
Customer supply pipe leakage reduction	-/?	O	O	-/?	O	O	-/?	O	O	-/?	O	O	+	+	+	+	+	+	-/?	O	O	-/?	O	O
Leak detection	O	O	O	O	O	O	O	O	+	O	O	O	+	+	+	+	+	+	O	O	O	O	O	O
Pressure reduction programme	O	O	O	O	O	O	O	O	O	O	O	O	+	+	+	+	+	+	O	O	O	O	O	O
Advanced replacement of infrastructure for leakage reasons	-/?	O	O	-/?	O	O	-/?	O	O	-	O	O	+	+	+	+	+	+	-/?	O	O	-/?	O	O
Distribution capacity expansion	-/?	O	O	-/?	O	O	O	O	O	O	O	O	O	O	O	O	O	+	-/?	O	O	-/?	O	O
Diagnostic studies	O	O	O	O	O	O	O	O	O	O	O	O	+	+	+	+	+	+	O	O	O	O	O	O
Improved leakage detection & reduction on raw water mains	-/?	O	O	-/?	O	O	-/?	O	O	O	O	O	+	+	+	+	+	+	-/?	O	O	-/?	O	O
Domestic water efficiency project	O	O	O	O	O	O	O	O	+	O	O	O	+	+	+	+	+	+	O	O	O	O	O	O

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Options	SEA Objectives																							
	Biodiversity			Cultural Heritage			Surface and Ground Water			Land Use			Climate Change			Sustainable use of water			Landscape			Human Health		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
Small and medium enterprises project	O	O	O	O	O	O	O	O	+	O	O	O	+	+	+	+	+	+	O	O	O	O	O	O
Waste water efficiency at WWTW	O	O	O	O	O	O	O	O	O	O	O	O	+	+	+	+	+	+	O	O	O	O	O	O
Porth catchment clean up and replacement for Rialton WTW	O	++	++	-/?	-/?	-/?	O	++	++	-	-/+	-/+	O	+	+	O	++	++	-/?	-/?	-/?	O	++	++
Reintroduce abstractions at Boswyn & Cargenwyn	-/?	-/?	O	-/?	O	O	-/?	O	O	O	O	O	O	O	O	O	O	O	-/?	O	O	-/+/ ?	+	+
Restormel licence variation	-/+/ ?	-/+/ ?	-/+/ ?	O	O	O	+	+	+	O	O	O	+	+	+	+	+	+	O	O	O	+	+	+
Northcombe WTW output increased capacity to 60 Ml/d	O	O	O	O	O	O	O	O	O	O	O	O	-/+	-/+	-/+	O	O	O	O	O	O	+	+	+
Roadford/Northcombe pumped storage from Gatherley	-	-	-	O	O	O	-	-	-	-	-	-	-/+	-/+	-/+	+	+	+	-	O	O	-/+/ ?	+	+

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Hyder

Environmental impacts have to be balanced against economic and security of supply issues to meet the needs of the region over the next 25 years. South West Water has sought to make the best use of the water that is already available rather than developing new resources wherever possible.

Many of the preferred options score as neutral against most of the SEA objectives and there are clearly many potential benefits as demonstrated by the number of pluses/green boxes, particularly in terms of 'Climate Change' and 'Sustainable Use of Water'. A particularly beneficial option is 'Porth catchment clean up'. It scores several major positives as the option involves the clean up of a polluted catchment which has beneficial effects on biodiversity, surface and groundwater, the sustainable use of water resources and human health and recreation.

Some of the options have the potential to have negative effects as indicated by the minuses/orange boxes. In many cases this is as a result of potential construction impacts that would be largely short-term and could be effectively mitigated through good working practices. Some of the preferred options would require new abstraction licences to enable abstraction from surface or groundwater sources. The potential effects on biodiversity resources including designated sites and Biodiversity Action Plan (BAP) Priority habitats and species were considered as part of the SEA. It is considered unlikely that there would be significant negative effects on biodiversity resources. Furthermore, all abstraction licences would have to be subject to a licence consent issued by the Environment Agency and during this process, the Environment Agency has to consider potential effects on environmental resources. Without licence consent South West Water would not be able to proceed with some of the site-specific options.

The implementation of the recommended mitigation measures by South West Water means that the options selected are not expected to have any significant adverse environmental impacts.

Mitigation Measures

South West Water is committed to environmental protection and enhancement and recognises the need to avoid and to mitigate adverse effects on environmental resources as far as possible. Prior to undertaking any works, South West Water will ensure that all appropriate projects are reviewed from an environmental perspective prior to any site works being initiated and that appropriate mitigation measures are implemented. The highest levels of environmental protection will be given to those environmental resources of international and national value, whilst also recognising the value of locally designated sites and interest features. Essentially, the environmental sensitivity of all projects will be considered on a case by case basis. In addition to more specific mitigation measures, a number of general mitigation measures are suggested that are summarised below:

- Ecological studies to be undertaken, particularly if works are to be carried out in an area with designated sites or BAP Priority habitats and site specific mitigation measures to be developed including good environmental codes of practice and appropriate protected species mitigation as necessary.
- Archaeological studies to be undertaken where works are to be carried out in an area of cultural heritage or historical value.
- Avoid impacting upon the setting or integrity of any scheduled monuments or World Heritage Sites when undertaking site works.
- Any fuel and oil storage on site for the purposes of operating machinery would comply with the Control of Pollution (Oil Storage) (England) Regulations 2001 (Oil Storage Regulations).
- Applications to be submitted for licence variations and new licences as appropriate.
- Replacement and/or repair of pipes should minimise disruption and must take into account any sensitive or designated sites, historic or cultural heritage resources, biodiversity and key habitats and species

Hyder

(as identified in the environmental baseline) and try to avoid affecting the public's opportunities for recreation where possible.

- Where new pumping stations/WTWs are to be built, investigate potential brownfield sites as an alternative to using greenfield sites.
- Consideration of energy efficiency and including increasing use of energy from renewable sources.

Stage C: Preparing the Environmental Report

The results of the SEA process have been presented in the Environmental Report and summarised in this Summary Document.

Stage D: Consultation Provisions

Consultation is a key component of both the WRP preparation process and the SEA process, ensuring that the views of key stakeholders are appropriately incorporated at an early stage and in an effective manner.

Consultation on the Draft WRP and Environmental Report took place between May and August 2008. Comments received during this time were incorporated into the Second Draft WRP 2009 and Environmental Report. The WRP and Environmental Report were finalised in March 2009.

Stage E: Monitoring

A requirement of the SEA process is to monitor potentially significant environmental effects predicted.

Monitoring is expected to draw upon existing monitoring programmes (or proposed monitoring programmes) undertaken centrally by the Government, and other organisations, rather than set out to collect a full set of plan specific data, for example, Natural England Condition Assessments of designated sites and Environment Agency river quality data. However, it is the responsibility of the plan-maker to ensure that the data collated is relevant to the significant effects identified through the SEA process and can be used to monitor the environmental effects of the plan. As part of the monitoring process, South West Water will monitor abstraction rates, rates of flow and groundwater levels for all options where there is an abstraction from a surface or groundwater source in order to ensure that it is within Environment Agency licence conditions. South West Water also monitors leakage, compliance with drinking water standards, carbon emissions and energy consumption (including percentage from renewables).

It will be necessary for the monitoring framework to be reviewed and updated on an ongoing basis, particularly in view of the long time span of the plan.

A.1.3.3 WRMP 2014 SEA Report - Bournemouth supply area

A detailed SEA was completed for PR14 for the Bournemouth supply area and has been used to inform the new SEA Scoping Report covering all our WRZs.

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Technical Note

Project:	Sembcorp Bournemouth Water WRMP14	**To:**	Greg Pienaar
Subject:	Strategic Environmental Assessment Position Paper	**From:**	Heather Coutts
Date:	30 August 2012 28 November 2012	**cc:**	Ben Piper; Norline Martin

Background from 2009 WRMP

The Strategic Environmental Assessment (SEA) Directive and associated Regulations require that when preparing certain plans and programmes, the need for SEA is considered. The Regulations require that an "authority" producing a plan or programme listed within the SEA Directive must consider whether it is likely to have a significant effect on the environment, and, if so, the authority must undertake a formal SEA. The application of SEA in the production of previous rounds of Water Resource Management Plans (WRMP) was analysed closely in the PR09 cycle, and it was concluded that WRMPs should be subject to the provisions of the SEA Directive, where they are likely to give rise to significant environmental effects.

Sembcorp Bournemouth Water (SBW) (formerly Bournemouth and West Hampshire Water - BWHW), as the authority producing the 2009 WRMP, was responsible for determining whether its WRMP fell within the scope of the SEA Regulations. In determining whether or not the plan required SEA, BWHW screened its plan for potentially significant environmental effects using the criteria in Schedule 1 of the Regulations. Representations from the consultation bodies listed in the Regulations (Natural England, Environment Agency and English Heritage) were also taken into consideration. A 'screening report' was produced in March 2008 to summarise the findings of work towards the determination. This was circulated to the consultation bodies and their views were sought on the findings. The conclusion of the Screening exercise was that the WRMP was unlikely to give rise to significant environmental effects, and did not require SEA. The statutory consultees concurred with this view, and a statement was produced to accompany the draft WRMP explaining the decision and the rationale behind it. Appendix J (Strategic Environmental Assessment (SEA) determination and statement of reasons) of the Final WRMP (November 2009) summarises the consultation responses and the reasons why BWHW "determined that none of the options was considered likely to have a significant effect on the environment, and that an SEA was not required".

Proposed revisions to WRMP for 2014

All water companies are required to revise their WRMPs on a five-yearly cycle, to ensure that any changes to predicted supply availability and anticipated demand since the production of the last WRMP are accounted for, and the plan is adjusted accordingly if required. SBW's WRMP is currently undergoing review, and the draft WRMP will be published for consultation in 2013.

The most notable change that has occurred since 2009 is that the inter-zone transfer scheme which links the Bournemouth Water Resource Zone (WRZ) and the Hale WRZ has now come into service. This means that the whole supply area can now be considered as a single WRZ for the purposes of water resource planning.

SBW is currently working on revisions to the supply-demand forecasts in preparation for the next iteration of the WRMP, due to be adopted in 2014. These investigations are showing that there is still expected to be a surplus of water available for supply above the predicted demand for the planning period 2014–2039.

Discussions with the Environment Agency to date on WRMP14 have indicated that there will be no sustainability reductions that could affect the SBW supply area. The possible locations and magnitude of sustainability reductions are investigated through the National Environment Programme (NEP), whose scope is developed by the Environment Agency and funding approved through Ofwat's price limits. They involve setting reductions in levels of permitted abstraction from surface or groundwater sources, where abstraction has been found to be adversely affecting Sites of Special Scientific Interest (SSSIs), sites designated under the Habitats and Birds Directives, and/or sites identified under the Water Framework Directive (WFD).

There are therefore no changes to the supply-demand forecast that require SBW to develop new water sources for the planning period 2014–2039. WRMP14 is therefore unlikely to identify any new measures

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either to reduce demand or to increase resources in order to maintain the company's supply demand balance; this position is unchanged from the last iteration of the WRMP in 2009.

Newly published guidance on SEA/HRA

In May 2012 a revision to existing guidance on SEA for Water Resource Plans and Drought Plans was published by UKWIR (Report reference 12/WR/02/7). This reviewed existing guidance published by UKWIR in 2007 (Report reference 07/W/02/5), and also added new guidance on undertaking Habitats Regulations Assessment for WRMPs and Drought Plans. It was therefore considered appropriate to review the WRMP and the previous screening decision for SEA against the recommended steps outlined in the revised UKWIR guidance and illustrated in Figure 1 (adapted from the UKWIR report). The next section of this Position Paper reviews the need for SEA with reference to the updated guidance.

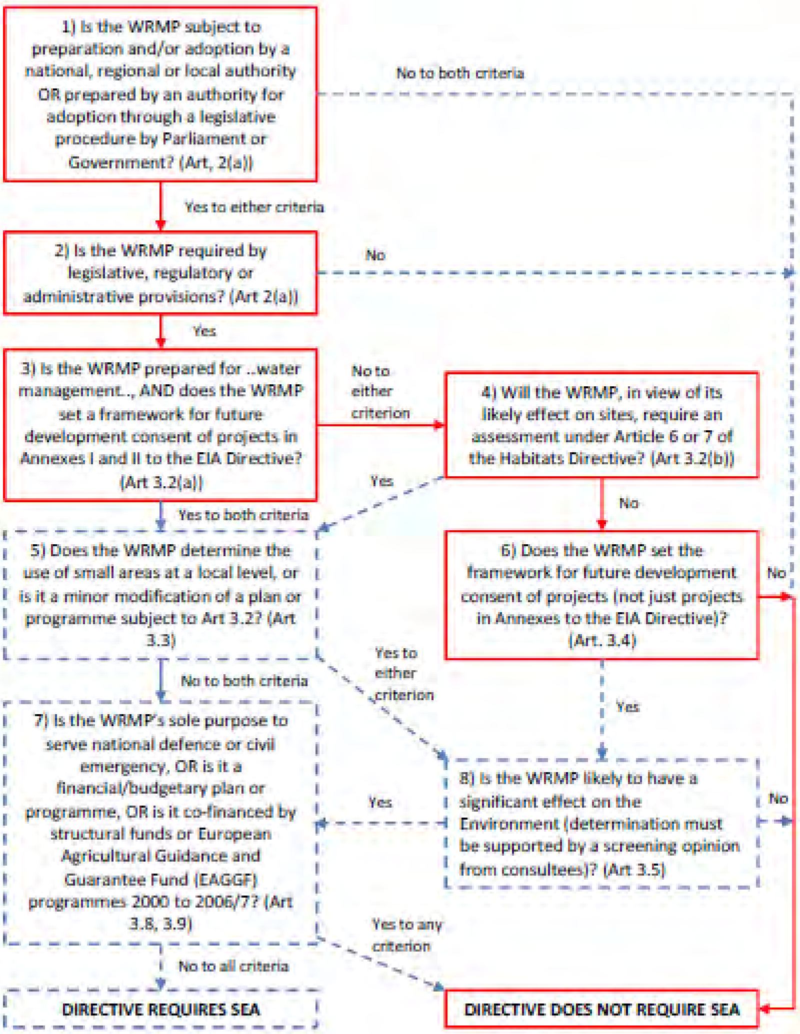

Figure 1 Flow diagram illustrating the decision-making process to apply the SEA Directive to WRMPs with the path relevant to SBW highlighted in red (adapted from UKWIR Guidance, 2012).

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Following the determination steps through

The UKWIR guidance (2012) recommends a series of eight possible steps that need to be considered to determine whether or not the SEA Directive should be applied to a WRMP. Figure 1 below (via the boxes and arrows with red solid outlines) shows the pathway through these steps to determine need for SEA of the revised SBW WRMP. A written explanation of the rationale behind the decision-making process is given below Figure 1.

Box 1

The UKWIR guidance (2012) confirms that Water Companies are considered to be an "authority" in the context of the SEA Regulations. With reference to the second criterion, WRMPs are not adopted via a legislative procedure in the UK, but regardless the positive response to criterion 1 in Box 1 moves the decision to the second stage.

Box 2

All Water Companies have a statutory duty to prepare and maintain WRMPs. The Water Act 2003 amended the Water Industry Act 1991 to confer this duty to the Water Companies, therefore creating a requirement for a WRMP by legislative provisions.

Box 3

WRMPs are clearly prepared for the purposes of water management, but in order for SEA to be applicable to the WRMP it must also set a framework for future development consent of projects listed under Annexes I and II of the EIA Directive. The UKWIR guidance (2012) broadly interprets this second criterion as being applicable if the WRMP includes any options that would result in projects to develop infrastructure for the sourcing, storage or transfer of water.

As there is currently a surplus of supply versus demand within the SBW supply area, the SBW WRMP does not contain any proposals for the development of new water resource options which would change SBW's water available for use (WAFU). It is therefore considered that the WRMP will not set a framework for future development consent of projects listed under Annexes I and II of the EIA Directive, and this Article does not apply. As discussed below, this position will need to be reviewed should the proposed transfer option to the east offered to the Water Resources in the South East (WRSE) project be developed further.

Box 4

This criterion deals with possible implications for sites designated under the Habitats and Birds Directives. Current operations within the WRMP on such sites have been assessed within Phase 1 of the NEP programme, and it has been concluded that sustainability reductions are not required in the supply area. As there are no new resource options proposed within the WRMP, there are no pathways for any adverse impact on these sites to occur. It is therefore concluded that this Article does not apply, and the next step is to consider the criteria in Box 6.

Box 6

These criteria seek to determine whether the WRMP will set a framework for future development consent of projects other than those listed in the Annexes to the EIA Directive, and whether those projects are likely to have significant environmental effects. As stated for Box 3, there are no new water resource development options proposed within the WRMP. Proposed demand-side infrastructure projects (related to metering) do no come under the remit of the SEA. The plan is therefore not considered to set a framework for future development consent of projects, and there is therefore no route for the WRMP to result in significant environmental effects.

At this point it is concluded that the WRMP is not subject to the requirements of the SEA Directive, and an SEA of the revised plan is not required.

Implications of the WRSE transfer option

As per the water resource planning guideline for PR14 (June 2012), a water company in surplus must be seen to investigate the feasibility of exporting surplus water from its resource zone. As part of the Water Resources in the South East (WRSE) project, SBW has put forward a transfer option which would require duplication of the Knapp Mill to Fawley main to supply up to 20 Ml/d to the area currently served by Southern Water (earliest start date of 2021). If the proposal is identified by the WRSE modelling as a feasible option to be included in SBW's WRMP, there could be a requirement for a SEA. It is however more likely for the option

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if selected, to be included in Southern Water's WRMP. SBW's transfer proposal has been included in Phase 2b of the WRSE project, the outcome of which should be available by mid December 2012; the third and final WRSE phase is timetabled for October/November 2013 by which time (if not before), SBW should have a clear steer as to whether or not the option has been accepted and should be included in the WRMP.

Review of Screening for Environmental Effects

A review of the Screening process undertaken in 2008 for the previous iteration of the WRMP has also been undertaken for completeness, although in line with the review process followed via the UKWIR guidance (2012) in Figure 1, this screening against the criteria in Schedule 1 of the SEA Regulations is not considered strictly necessary. The table is included as Appendix A to this SEA Position Statement for information only.

The only minor change to the screening assessment relates to the need to consider the Water Framework Directive (WFD) in this round of water resource planning (PR14), which was excluded in PR09. It is assumed that the EA will advise SBW of any sustainability changes that need to be considered for WRMP14 in order to meet WFD objectives. Criterion 1(e) of Schedule 1 to the SEA Directive requires consideration of the relevance of the WRMP for the implementation of other European Community legislation for the environment, and the WFD is clearly a relevant piece of environmental legislation. It is not anticipated that this is likely to be a significant issue as no new options are proposed, and all existing activities will already have been taken into account in producing the River Basin Management Plans and WFD objectives for the relevant waterbodies. However it is recommended that early discussions are held with the Environment Agency to agree whether any further clarifications relating to WFD issues are needed.

Initial conclusions

It is concluded from this review of the previous SEA Screening report and subsequent SEA Position Statement, taking into account the publication of new guidance by UKWIR in May 2012; that based on the proposed revisions to the WRMP for 2014 the SEA Directive will not apply to the revised WRMP. The rationale for this conclusion is primarily related to the lack of need for any new water resource developments for inclusion within the revised WRMP, as the SBW supply area shows a net surplus of supply versus demand. There are therefore no future projects to be considered, and no identified pathways for potentially significant environmental effects. The Company will also continue to manage demand and leakage to reduce the need for water, thus also seeking to reduce demands on the water environment. This position is however conditional pending the outcome of the proposed WRSE transfer option.

This position will be reviewed again when the supply-demand forecast is updated in the next water resource planning period. Should any changes occur to the forecast that require modifications to the WRMP, this position will be reviewed and revised, and an SEA undertaken if deemed necessary.

Proposed consultation and next steps

This is a draft Position Statement prepared for the purposes of providing the relevant statutory consultees with information about the WRMP and SBW's intentions regarding the preparation of an SEA. We will consult the following relevant statutory consultees on the draft conclusions of this Position Statement:

- The Environment Agency;
- Natural England; and
- English Heritage.

Following the results of this consultation, SBW will determine (in liaison with the statutory consultees) whether any further information is required with regard to the need for SEA, and/or if any further work is required.

The outcomes of the consultation and any additional information or revisions to this Position Statement will be summarised within the revised WRMP, and included as an appendix to the revised plan.

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Appendix A: Screening of the 2009 WRMP for potentially significant environmental effects against criteria in Schedule 1 of the SEA Regulations

Criteria for determining the likely significance of effects on the environment (as in Schedule 1 of the Environmental Assessment of Plans and Programmes Regulations 2004)	Likely to have significant environmental effects? YES/NO	Summary of significant environmental effects negative and positive	Comments
Characteristics of the plan			
1(a)The degree to which the plan or programme sets a framework for projects and other activities, either with regard to the location, nature, size and operating conditions or by allocating resources.	NO	*Not applicable*	The WRP will not be setting a framework for projects and other activities as no new resource development options are proposed.
1(b) The degree to which the plan or programme influences other plans or programmes including those in a hierarchy.	NO	*Not applicable*	To a large extent the WRP is influenced by other plans and programmes such Regional Spatial Strategies and Local Development Frameworks which determine levels of development, rather than influencing them.
1(c) The relevance of the plan or programme for the integration of environmental considerations in particular with a view to promoting sustainable development	YES	SBW programme of demand management incorporates some sustainability initiatives in order to lower water demand which reduce the need to develop new water resources. This is likely to have a positive effect on the water environment and associated ecosystems.	
1(d) Environmental problems relevant to the Plan or programme.	NO	*Not applicable*	The Environment Agency has advised that there are no sustainability reductions associated with any of the existing sources. This indicates that there are no environmental problems associated with SBW's current sources. No additional sources are being proposed.
1(e) The relevance of the Plan or Programme for the implementation of Community legislation on the environment (for example, Plans and Proposals linked to waste management or water protection).	NO	*Not applicable*	The legislative provisions of the Water Framework Directive are not allowed to be considered within this PR09 WRP.

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Characteristics of the effects and of the area likely to be affected			
2(a) The probability, duration, frequency and reversibility of the effects.	NO	*Not applicable*	SBW does not have a supply and demand deficit and therefore no new measures are required for this planning period. This will result in no environmental effects.
2(b)The cumulative nature of the effects	NO		SBW does not have a supply and demand deficit and therefore no new measures are required for this planning period. This will result in no environmental effects, including cumulative effects.
2(c)Trans-boundary nature of the effects (i.e. environmental effects on other EU Member States)	NO	*Not applicable*	SBW operates within England and no trans-boundary effects on other EU Member States result from its activities.
2(d) The risks to human health or the environment (for example, due to accidents).	NO	*Not applicable*	SBW does not have a supply and demand deficit and therefore no new measures are required for this planning period. Therefore there will be no risks to human health or the environment due to accidents.
2(e) The magnitude and spatial extent of the effects (geographical area and size of the population likely to be affected)	NO	*Not applicable*	SBW does not have a supply and demand deficit and therefore no new measures are required for this planning period. Therefore there will be no effects.
2(f) The value and vulnerability of the area likely to be affected due to: (i) special natural characteristics or cultural heritage; (ii) exceeded environmental quality standards or limit values; or (iii) intensive land-use.	NO	*Not applicable*	SBW does not have a supply and demand deficit and therefore no measures are required for this planning period. Therefore there will be no effects on the value and vulnerability of the area. The Environment Agency has advised that there are no sustainability reductions associated with existing sources at sites protected under the Habitats Directive and SSSI designation.
2(g) The effects on areas or landscapes which have a recognised National, Community or International protection status	NO	*Not applicable*	SBW does not have a supply and demand deficit and therefore no new measures are required for this planning period. Therefore there will be no effects on areas or landscapes which have a recognised National, Community or International protection status.

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A.1.4 Water Resources Management Plan Annual Review 2016/17

We review our WRMP annually and report the findings to the Environment Agency. Our Annual Review for 2016/7 focused on a review of our WRMP14.

We received feedback on our 2016/17 Annual Review which we have taken account of in our Draft WRMP19. For completeness a copy of our recent letter to the Environment Agency is given below.

South West Water
Peninsula House, Rydon Lane, Exeter, EX2 7HR
www.southwestwater.co.uk

27 October 2017

Jeremy Bailey
Account Manager – River Basin Management Services (RBMS)
National Operations
Environment Agency
Horizon House
Deanery Road
Bristol
BS1 5AH

By email: Jeremy.bailey@environment-agency.gov.uk

Dear Jeremy,

RE: WATER RESOURCE MANAGEMENT PLAN 2014: ANNUAL REVIEW 2017

Thank you for your letter of 26 September on the above. This was very helpful. In Annex 1 I've set out how we are, or propose to, address the points made. It would be helpful to discuss as part of the dWRMP19 process and wider PR19 discussions.

If you have any queries, please do not hesitate to contact me.

Yours sincerely

Rob Scarrott
Head of Environment and Upstream Markets

Annex 1 Annual Review Actions

ANNEX 1 ANNUAL REVIEW ACTIONS

A) South West Water

Part A – Significant Issues	**Recommended water company progress for the 2018 annual review**	**Proposed company actions**
Outage – data quality issue - The company has not presented clear and consistent information on actual outage experienced during 2016/17. This means we are unable to make an informed assessment of how the company is performing against its WRMP forecast.	Please explain to us how you estimate actual outage experienced. We will work with you to ensure you address outage data quality issues ahead of the next annual review.	In 2017 we have made live a new data collection process that gives detailed information on plant shut downs and general outages. In the dWRMP we are also proposing to produce a separate outage report each year using this data, with a first trial in 2018/19. This also links to the new PR19 outage metric.
Leakage - Although South West Water met its company level forecast, it did report above forecast leakage at a zonal level. This level of leakage did not affect headroom, however, it may suggest a lack of focus on leakage management in certain resource zones.	We expect South West Water to improve leakage management in all of its water resource zones.	Leakage remains a key ODI for the company. It is also a key customer priority. At a detail level, leakage will vary between zones and between years depending on a range of issues e.g. weather in one area vs. another, but the overall commitment and target remains true. Our dRWMP19 will include continued leakage reduction in AMP7, despite a supply-demand surplus. This will also include forecasts by Resource Zone.
Part B – Environment Agency recommended improvements	**Recommended water company progress for the 2018 annual review**	**Proposed company actions**
Actual distribution input (DI) in 2016/17 was higher than forecast Dry Year Annual Average DI from WRMP14. We also note that measured non-household consumption continues to increase steadily compared to a forecast fall.	You should review these recent trends in demand and consider any implications for your long term supply demand balance as part of your next WRMP.	We have completed this for the dWRMP19. Previous forecasts used a simple trend analysis which was a downward projection. We have since developed a forecast based on sector types (e.g. tourism) and using an econometric approach. This is a better approach in our opinion. In the dWRMP19 we have also stress tested the supply-demand balance to higher than expected non-household demand to see how sensitive it is to this forecast.
Both Raw Water and WTW Losses and Operational Use (RW&WTWLOU) are reported as being identical to your WRMP14 forecasts. Your commentary does not explain how you estimate these figures or the changes made since	Along with outage experienced, please explain to us how you estimate RW&WTWLOU. We will work with you to ensure you address RW&WTWLOU data quality issues ahead of the next annual review.	Noted. We will have a technical discussion with local area staff as part of the dWRMP processes. For info, we have reviewed our STW sites for water efficiency improvements for the dWRMP. We

the 2016 Annual Review.		have included proposed sites in our dWRMP as part of a plan to reduce our own use of water.

B) Bournemouth Water

Part A – Significant Issues	**Recommended water company progress for the 2018 annual review**	**Proposed company actions**
None		
Part B – Environment Agency recommended improvements	**Recommended water company progress for the 2018 annual review**	**Proposed company actions**
In comparison to previous year's submissions, this year's annual review is brief. It would be useful to see a more comprehensive commentary on the type of year and actual data differences against forecast. This would help us to better understand the context of the data reported in relation to the long-term forecasts in your WRMP.	You should provide a more detailed commentary on data derivation, particularly where components differ considerably compared to forecast values as part of subsequent annual reviews.	Noted. We have done considerable work on the data for the dWRMP which we can take you through. This work is linked to a possible transfer to Southern Water that could help alleviate water stress in the South West.
We have concerns about the data quality of some aspects of your supply-side data – outage experienced and both raw water and WTW losses and operational use.	You should explain how you estimate actual outage and losses/operational use experienced and make improvements for WRMP19.	Noted. We will have a technical discussion with local area staff as part of the dWRMP processes. The PR19 plan may have new investment at Bournemouth on the treatment works assets. This would be likely to reduce treatment works losses. We have shown the possible impact of this in our scenario analysis in the dWRMP.

South West Water   Bournemouth Water

A.1.5 Drinking Water Inspectorate (DWI) statement

dwi
guardians of drinking water quality

DRINKING WATER INSPECTORATE
Area 7E, 9 Millbank
c/o Nobel House
17 Smith Square
London SW1P 3JR

Enquiries: 030 0068 6400

E-mail: caroline.knight@defra.gsi.gov.uk
DWI Website: www.dwi.gov.uk

DWI Information Letter 03/2017

12 September 2017

Dear Sir/Madam

UPDATE TO GUIDANCE DOCUMENTS, INCLUDING GUIDANCE NOTE ON LONG TERM PLANNING FOR DRINKING WATER QUALITY

1. **Purpose**

1.1. The purpose of this Information Letter is to advise water companies and other stakeholders of recent updates to some of our guidance documents, and of the addition of a guidance note on long term planning for the quality of drinking water supplies that includes two specific requests for information.

2. Links to documents

2.1 The updates to guidance documents may be accessed here, and the guidance note here.

2.2 These updates to guidance documents arise from the consolidation of various advice and guidance previously provided in Information Letters.

2.3 The long term planning guidance note is not intended to be a comprehensive review of water supply practice, and there are no new policy initiatives set out therein, and no new legal obligations. The focus is on delivery of existing obligations including recent and imminent legislative changes, using current good practice, within a long term planning context.

2.4 The guidance note also provides advice on how the Inspectorate might assist companies in the periodic review process for setting of prices, led by Ofwat, including details of arrangements for information submissions to the Inspectorate; the Inspectorate's assessment processes; and a timeline for supporting current expectations of PR19 requirements. It takes account of current draft Ministerial guidance to Ofwat on strategic priorities and objectives from both the Welsh Government and the UK Government.

3. Requests for information

3.1 We would draw to your attention to two specific requests for information contained within the guidance note on long term planning for the quality of drinking water supplies:

a. A statement from the Board Level Contact for each company that the company's draft Water Resources Management Plan (WRMP) takes account of all statutory drinking water quality obligations, and plans to meet all drinking water quality legislation. This statement should be sent to the Inspectorate when the company's final draft WRMP is submitted to Ministers for approval, and it will inform any advice that the Inspectorate may subsequently provide to Ministers that is relevant to their decision (para 4.3.10); and

b. To provide assurance that risk assessments for drinking water quality include a long term view. Each company is requested to prepare and submit to the Inspectorate, a concise statement that sets out significant new future risk mitigation measures that a company considers it will need to provide for by the end of May 2018. New measures are those that are beyond routine provisions for current risk mitigation for all of a company's supplies from source to tap, insofar as they affect the quality of drinking water supplies (para 5.3.3).

4. Enquiries

4.1. Copies of this letter are being sent to Michael Roberts, Water UK; Catherine Harrold, Department for Environment, Food and Rural Affairs; Eifiona Williams, Welsh Government; Sue Petch, Drinking Water Quality Regulator for Scotland; Catriona Davis, Chief Inspector of Drinking Water for Northern Ireland; Tony Smith and Chairs of the Regional Committees, Consumer Council for Water; Carl Pheasey, Ofwat; Helen Wakeman, Environment Agency; Liz Stretton, Food Standards Agency; Frances Pollitt, Public Health England, Ceri Davies, Natural Resources Wales; and CCG Chairs.

4.2. This letter is being sent electronically to Board Level and day to day contacts. Please acknowledge receipt by email to dwi.enquiries@defra.gsi.gov.uk. Hard copies are not being sent but the letter may be freely copied. Any enquiries about the letter should be addressed directly to caroline.knight@defra.gsi.gov.uk.

Yours sincerely

Milo Purcell.

Milo Purcell
Deputy Chief Inspector of Drinking Water

Department for Environment, Food and Rural Affairs
Home Page: www.dwi.gov.uk
E mail: dwi.enquiries@defra.gsi.gov.uk
Llywodraeth Cymru
Welsh Government

A.1.6 Customer research

Before developing this plan we undertook a broad range of customer research to understand customer preferences and attitudes to water resource planning. Qualitative and quantitative research was undertaken as well as innovative new interactive video research.

The headline findings from the research are given in Section 1 of the main report. This appendix provides the detail of the work undertaken.

A.1.6.1 <u>Qualitative research</u>

A.1.6.1.1 Background

Qualitative research was undertaken in spring 2017. The research focussed on:

- Customer attitudes to existing performance measurement approach (output performance measures)
- Customer attitudes and preferences with regard to performance and future choices

The work for the WRMP was part of an overall study covering all areas of investment but had particular emphasis on the second of the focus areas.

The research was used to give insight into key areas that the WRMP should look to address in developing the proposed plan and strategy.

A.1.6.1.2 Results

The key findings from the survey were:

- Current performance metrics were fit for purpose
- Customers are familiar with hosepipe bans but not Drought Orders (non-essential use bans)
- Hosepipe bans beyond 3 months start to become too long ; 6 months considered a long time for these to be in place
- Customers want to see resilience investment – but this needs to be balanced against the bill impact
- SWW should plan for the long term – up to a generation (20-30 years)
- Agreeing leakage levels on Economic Level of Leakage (ELL) was sensible – not much appetite to go further if it impacts on customer bills
- Most popular options for water resource planning are water efficiency, metering, leakage and re-use; little support for new water resources
- Customers unsure if catchment management can deliver reliable outcomes

- Current meter penetration is high, so no need to force compulsory metering
- Support for smart meters **IF** they are to be genuinely helpful to customers

The customer research showed an overall trend to ensuring resilience but this needs to be balanced against the bill impacts. It also showed an overall preference from customers for solutions that reduce the future demand for water rather than building new resources.

We used this information together with that from the quantitative and EngageOne interactive video results to develop the multi-criteria scoring mechanism for assessing the different plan choices.

A.1.6.1.3 Detail on qualitative research

Key highlights from the research are given below. The full technical report is available on request.

Ability to move water around the network (and resilience in general)

- **OPMs** - None - indirect through drinking water restrictions and supply interruptions
- **Additional customer views**
  - Respondents thought customers on a single supply (unable to be supplied by another works or pipe if needed) was the best way to measure this
    - Expect to see gradual improvements in this measure
  - Customers want to see resilience investment - but this needs to be balanced against the bill.
    - Only invest in credible hazards/risks with reasonable chance of occurring
    - Should be more of a focus on day to day issues (e.g. Investing in pipes to prevent bursts and leaks) before ramping up resilience investment, which may not be needed
    - Some resilience just expected to be there - such as standby generation for power cuts and flood protection for works
  - SWW should be planning for long term - minimum of 5-10 years ahead, up to a generation (20-30 years, or as much as 50 years)
  - High levels of support for proposed response for customers on priority register when there are resilience issues
- **Proposed :**
  - New OPM to capture customers on single supplies (note valuation can be based on expected restrictions/interruptions)
  - New OPMs to capture other resilience investment

ICS

Leakage levels (Ml/day)
Time taken to fix significant leaks

- OPM framework

Mains leakage	Ml/d saved	Leakage

- Customer views
  - Leakage seen as quite high across the industry and as a whole there is more to do
    - But recognition that SWW/BW are doing well with good relative performance
  - Agreeing leakage levels on ELL is sensible
    - Recognise that different leaks have different water losses and costs to fix
    - No appetite to go much further than ELL if this impacts on bills
  - Time to fix leaks needs to be set at a reasonable level - several days is too long to leave big leaks
  - Respondents welcome reductions in leakage by lowering pressure at night and times of low demand
    - But could lead to concerns/contacts if not communicated to customers first
- Proposed :
  - Consider OPM to capture change in time to fix types of leaks - not valued as value driven by leakage

Security of Supply Index (1/2)

- OPM framework - leakage, metering, water conservation only

Water conservation	Ml/d saved	Water conserved
Metering	Number	Meter optants

- Customer views
  - Resource options are popular if they are:
    - Reliable (e.g. re-use, river or groundwater abstraction)
    - Reduce waste (metering, leakage reduction, water efficiency)
    - Reduce water abstracted from rivers and benefit environment
    - Encourage recycling (re-use)
  - Most popular options: water efficiency/conservation, metering, re-use, and leakage.
  - River abstraction is mixed: popular with some (as reliable) and unpopular with others (as damages environment)
  - Concerns over options that may not be reliable - transfer & catchment mgt
  - Expensive, unreliable options to be avoided
    - Unsure if catchment management can deliver

Security of Supply Index (2/2)

- Conservation
  - Customers support moves to help customers use water more wisely
    - Water butts and similar devices popular
    - More education should be provided to customers to help them use water more wisely
- Metering
  - Support for extending metering as seen as fair
    - But more limited support for compulsory metering given impact on some families
  - Support for smart meters IF they are able to give data that can genuinely help customers save money (but customers noted elect smart meters have not driven much saving and water bills are lower)
  - View is that current levels of metering are high, esp. as not water stressed areas, so no need to force compulsory metering

- Proposed :
  - WRMP team to consider wider range of options than currently in IM. Need to confirm if other options need to be added into IM

A.1.6.2 Quantitative research

A.1.6.2.1 Background

Quantitative research was undertaken during summer 2017. The research focussed on:

- Customer attitudes and valuations with regard to service levels
- Customer attitudes and valuations with regard to future interventions

This data was used in three ways:

- Firstly, it was used to determine if customers wanted a change in level of service and how they would value a change
- Secondly, it was used to identify the top 5 intervention types. These were then included in the multi-criteria assessment used to compare the different possible future programmes (see Section 7 of the main report)
- Thirdly, the willingness to pay data was used to calculate the net cost benefit of different programme choices. This was then used in the sensitivity analysis to understand what the 'cost-beneficial' plans driven by willingness to pay were and how they compare to programmes based on private costs only.

A.1.6.2.2 Results

The results showed that household and non-household customers have a strong preference not to see a decrease in current levels of service. The results showed a not statistically significant preference for increases in levels of service – i.e. current service levels are about right. In terms of valuing service levels:

- Household customers valued a 1% change in hosepipe bans at £39/property
- Household customers valued a 1% change in non-essential use bans and Drought Permits at £88/property.

This means that if current service levels for hosepipe bans at 1 in 20 years (i.e. 5%), customers value an improvement to 1 in 25 years (i.e. 4%) at £39/property. We used this data in assessing the final plan performance.

The results on the customer attitudes and valuations for future interventions is summarised in Table A.1.1 below.

The priorities were similar for both household and non-household customers.

The top 5 priorities were used in the multi-criteria analysis to assess how different choices aligned to customer needs.

The willingness to pay (WTP) data was used in two main calculations:

- Firstly, the leakage WTP data was used to calculate a customer valuation for a leakage reduction profile
- Secondly, it was used to assess the net cost benefit of water efficiency measures.

The results for the leakage assessment are presented in Section 7 of the main report and show reduction down to 50 to 70 Ml/d for SWW and between 16 to 19 Ml/d for BW are the most cost beneficial in the long run.

Table A.1.1: Customer preferences and willingness to pay[1]

Option	Preference	£/Ml/d
Leakage (reduce 20% to 16%)	1	540,000
(Dumb) meters	2	330,000
Smart meters	3	300,000
Helping Customers Save Water	4	300,000
Catchment management	5	180,000
Transfers*	6	180,000
Re-use	7	160,000
Groundwater schemes	8	150,000
River schemes	9	100,000

** Although Transfers have the same "willingness to pay" as catchment management, we did not include this. This is because it is included in the mutli-criteria score under innovation and markets for direct procurement. To include again here would double count the benefit.*

The option preferences need to be considered in relation to the overall priorities for customers in Business Planning[A.1.1]:

- Water supply resilience is ranked priority 6/18
- Leakage reduction is ranked priority 7/18
- Avoid water restrictions is ranked priority 10/18
- Smart metering is ranked priority 16/18
- Water efficiency is ranked priority 17/18

The results show that resilience (i.e. levels of service) and leakage are not only high priorities in the WRMP research but also in terms of overall customer priorities. Smart metering and water efficiency, whilst in the top 5 priorities in terms

[A.1.1] South West Water 2050 vision

of water resource planning, are lower priority relative to the rest of the activity undertaken by SWW.

A.1.6.2.3 Detail on qualitative research

Full details of the quantitative research are available separately on request, but highlights are presented below.

Background

Sample sizes and composition

- Respondents
  - 601 households (600 target)
  - 274 businesses (300 target)
- Split across SWW and BW regions
  - 100+ for both households and businesses in the BW region
- Quotas set
  - SEG, age, gender
  - SIC

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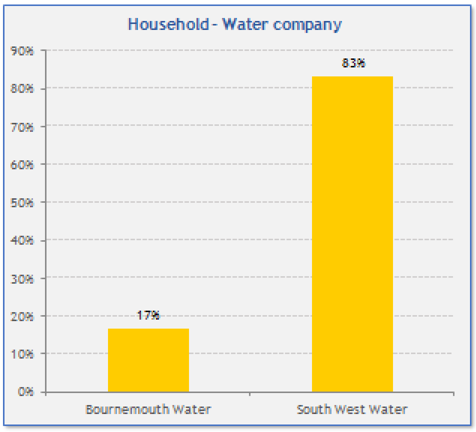
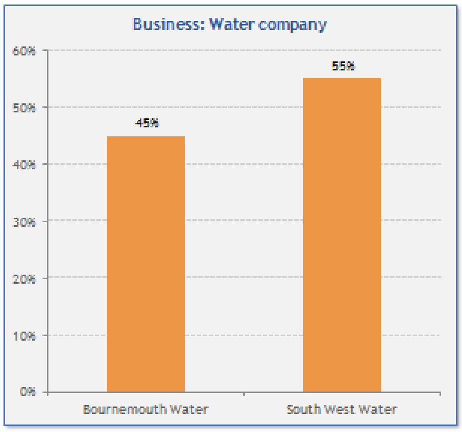
Both household and business samples cover the SWW and Bournemouth regions





So the results can be applied to both regions

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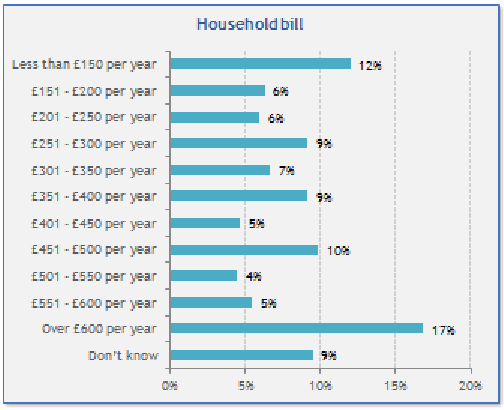
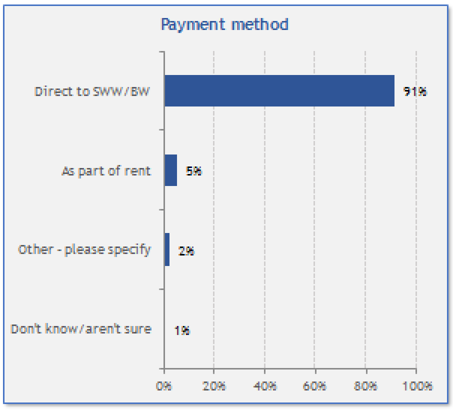
Household - Good range of bills covered in the research





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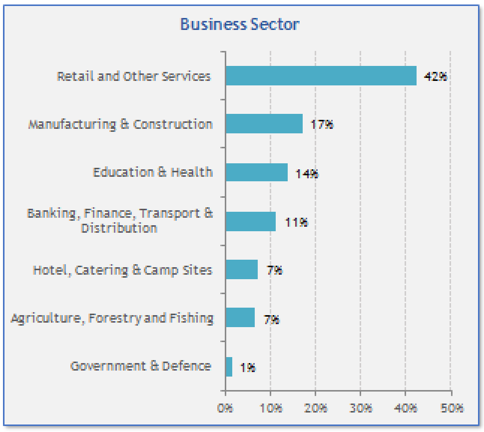
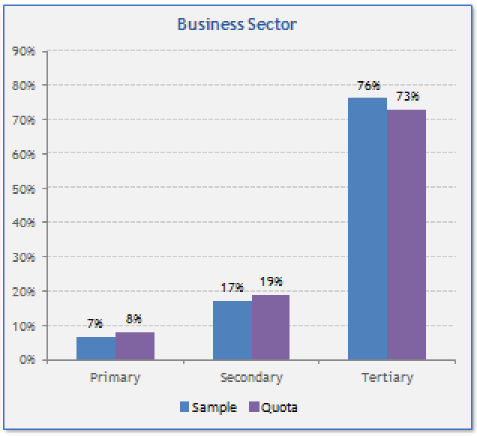
Businesses - sample is a good mix of businesses which aligns with the quotas set





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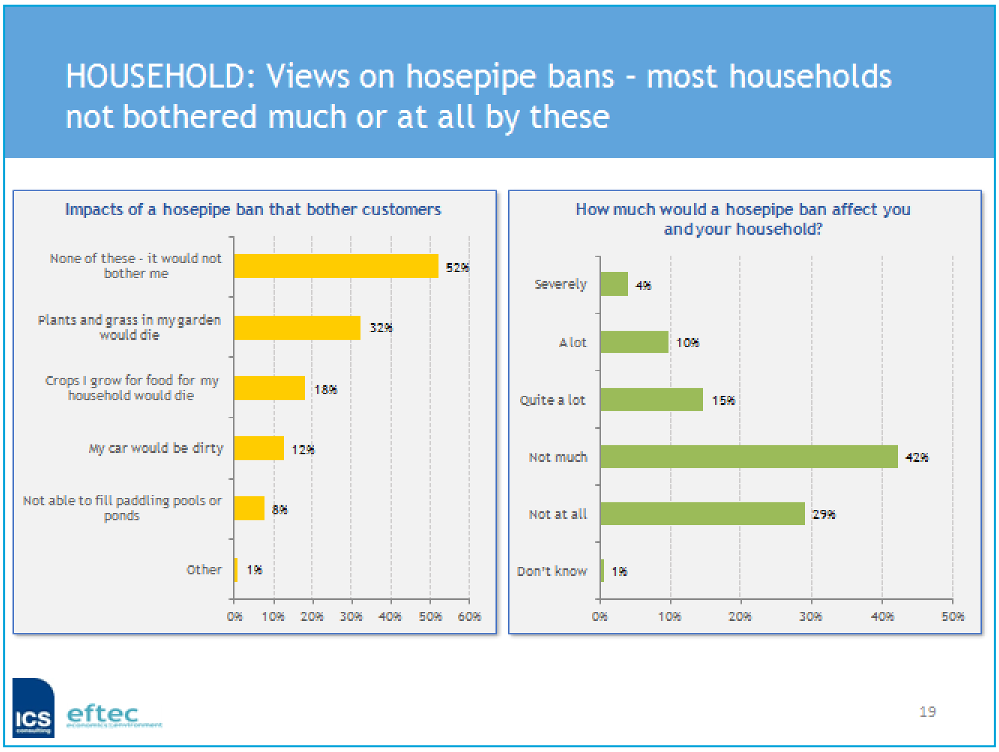
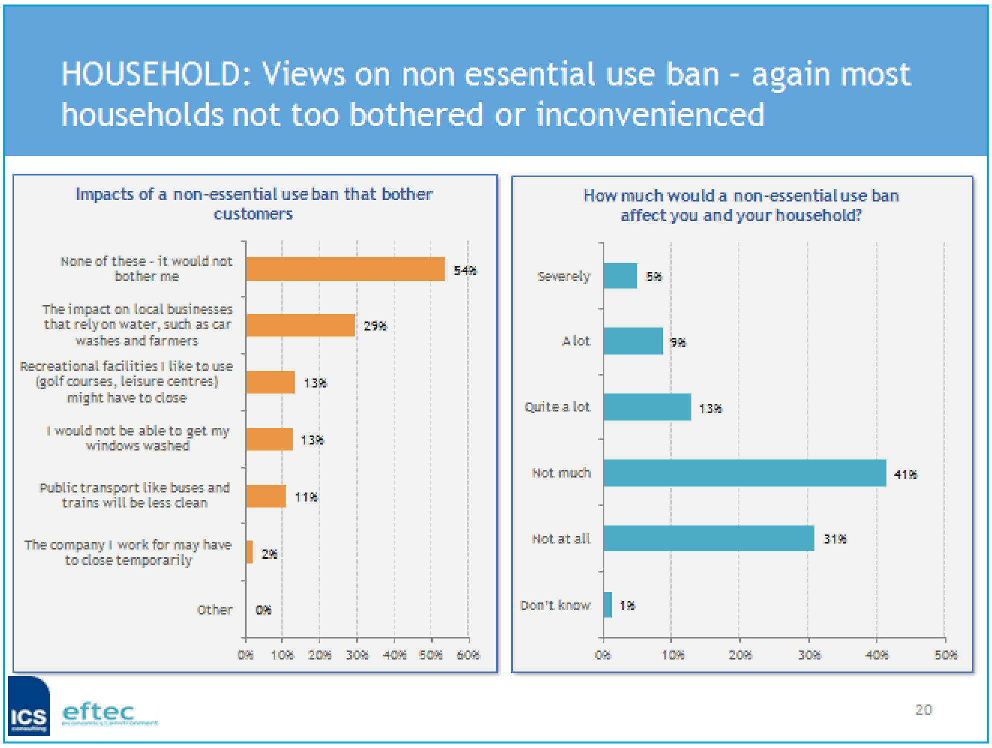
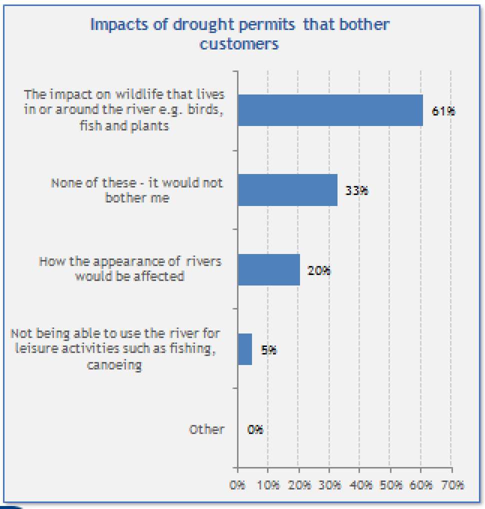
South West Water Bournemouth Water

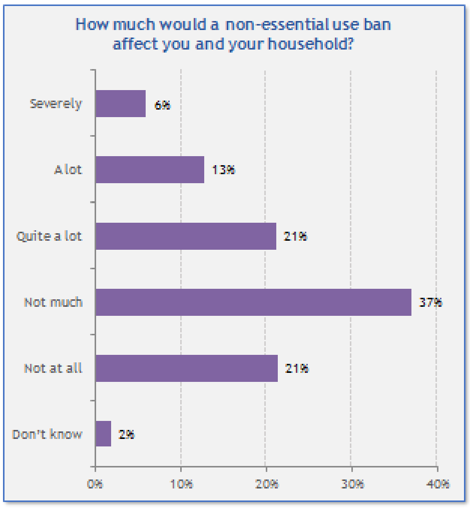
Attitudes towards restrictions





HOUSEHOLD: Views on drought permits - again this is not something that many households are bothered by





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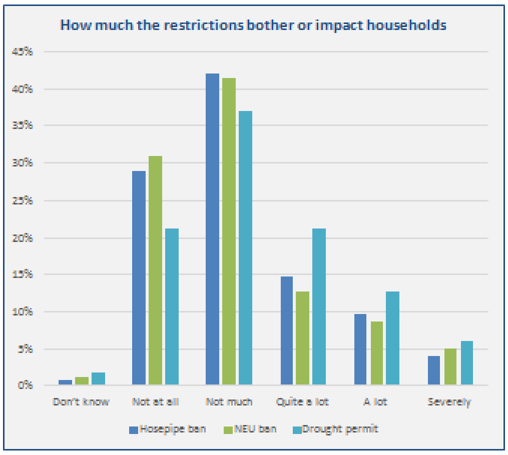
HOUSEHOLD: Comparing the results we can see that Drought Permits are the restriction of most concern



- Drought permits are the most concerning
  - This would be the impact on wildlife that lives in and around the rivers (61%)
  - Less concern about recreation (5%) or appearance of the river (20%)
  - One-third not bothered by this.

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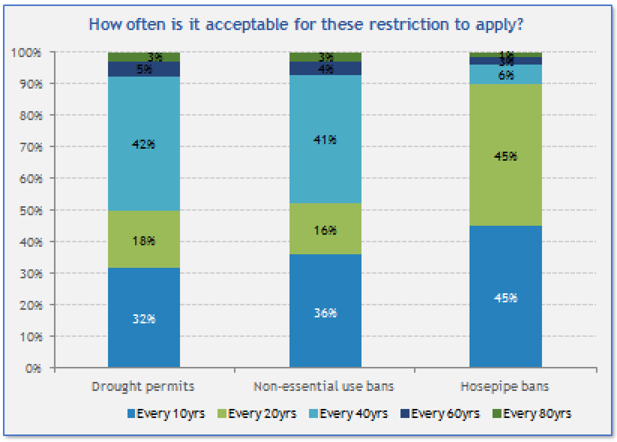
HOUSEHOLD: Acceptable levels of restriction



- The importance of drought permits emphasised again in the average frequency that is an acceptable minimum

Average: 28 years	Average: 33 years	Average: 18 years

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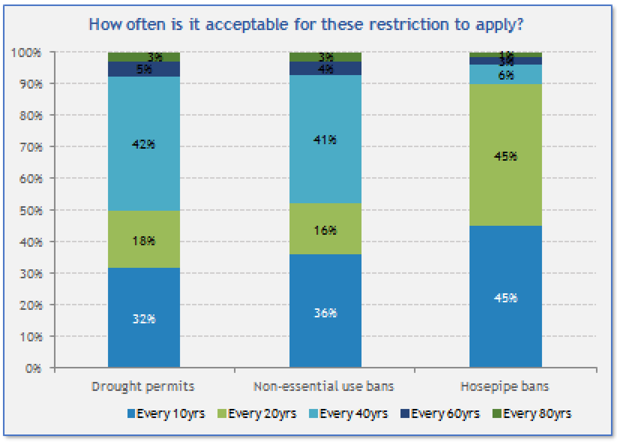
BUSINESS: Acceptable levels of restriction



- Similar results to households here
- NEU and Drought Permit should be less frequent than hosepipe bans

Average: 28 years	Average: 28 years	Average: 19 years

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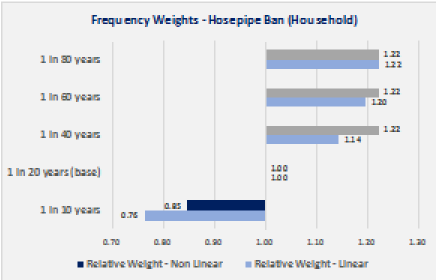
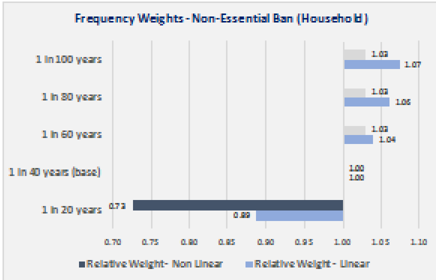
Restrictions

Estimated weights across frequencies by restriction types

Hosepipe bans



Non-essential bans



The graphics show how the strength of preference relative to a base frequency. Two types of model have been estimated. Linear assumes the weights change proportionately to the change in frequency. Non-linear relaxes this assumption, however the analysis shows each model gives similar estimates for the weights.

Base Weight = Current / Base Service Level. Weights < 1 are "worse" than base and weights > 1 are better than base. Grey bars indicates not significantly different to base weight = 1

Households are clearly averse to a level of service lower than the current (base) service. There is a preference (estimated weights > 1) for a lower frequency (better service) but this is not strong, i.e. not statistically different to the base levels of service.

ICS

Extending to hosepipe and non essential use

- 1% change in risk of HPB is £357,000
- 1% change in risk of NEUB is £355,000
- Convert to expected properties affected by dividing 1% change value by number of properties that would be affected by a 1% change (ie 0.01* relevant SWW properties)
  - HPB = households
  - NEUB = total properties

	Value £ per 1% reduction in risk	Value £ per expected property
Drought Permits	430,000	£43
Non-Essential Use Ban	355,000	£35
Hosepipe Ban	357,000	£39
Combined NEU + DP	785,000	£88

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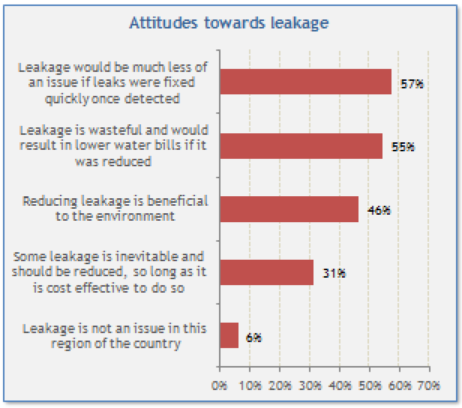
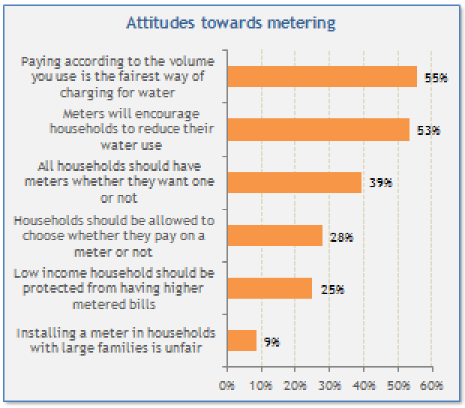
Attitudes towards options

HOUSEHOLD: Attitudes to demand side options…





- Strong views on leakage
- Some misunderstanding about the impact of leakage on bills
  - Confirms need to put into the choice tasks to isolate impact of bills
- Recognition that metering is fair and encourages water saving
- But less than half think further metering should be compulsory
- 25% support helping poorer families on meters

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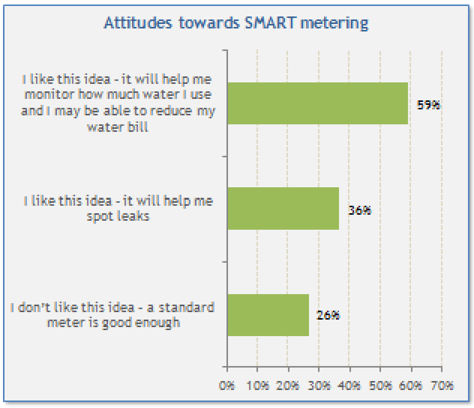
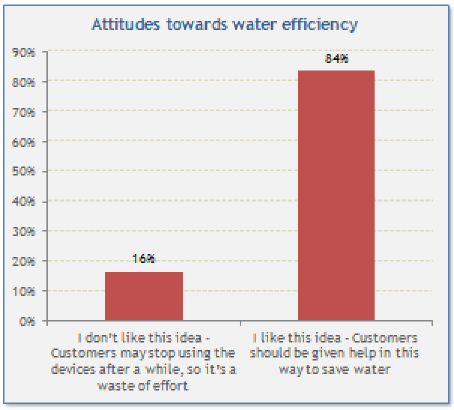
HOUSEHOLD: Attitudes to demand side options…





- Moving from dumb meters to smart meters supported by ¾ of respondents
- Need to explore differences between measured and unmeasured
- Well supported
- Few sceptical about benefits

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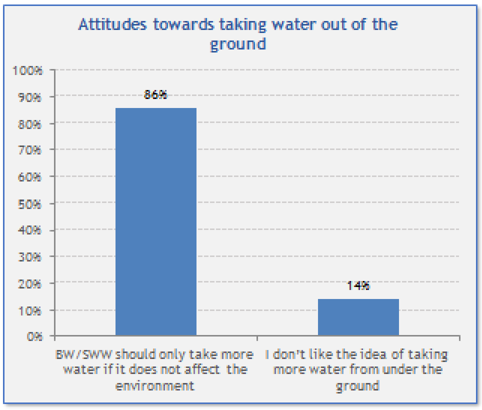
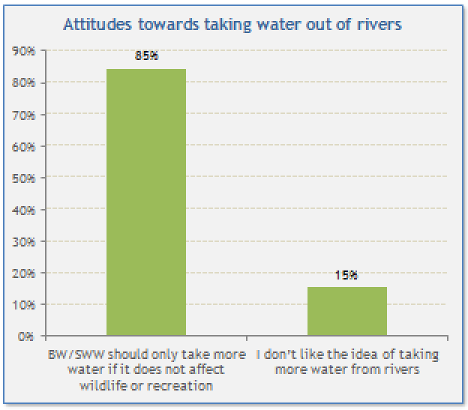
HOUSEHOLD: Attitudes to supply side options…





- Generally accept these as source if can do this without impacting on the environment
- Strong preference to avoid both of these suggests customers do not consider that to be possible ?

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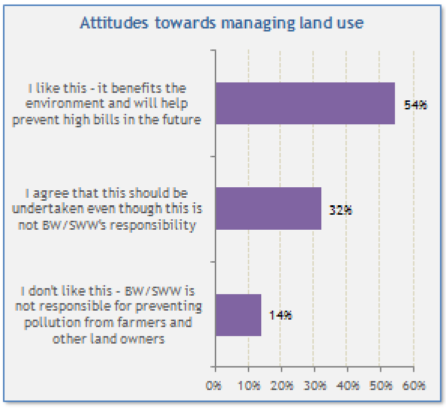
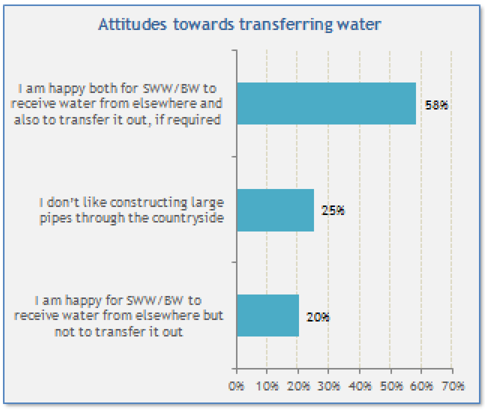
HOUSEHOLD: Attitudes to supply side options…





- Welcome initiative - although half consider this not to be SWW's responsibility
- Over half would be willing to see this as an option
- Including helping other water companies if needed

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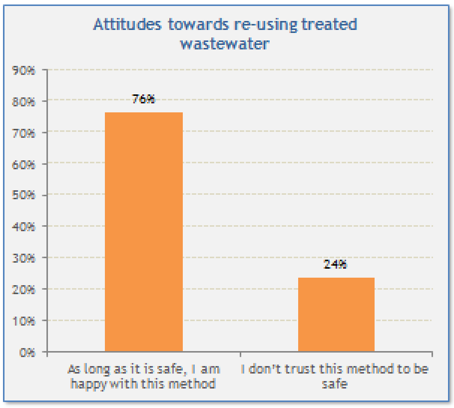
HOUSEHOLD: Attitudes to supply side options…



- Generally people okay with this as long as it is safe
- But still not as popular as demand options

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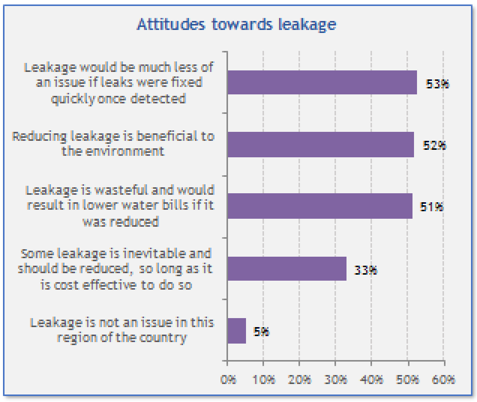
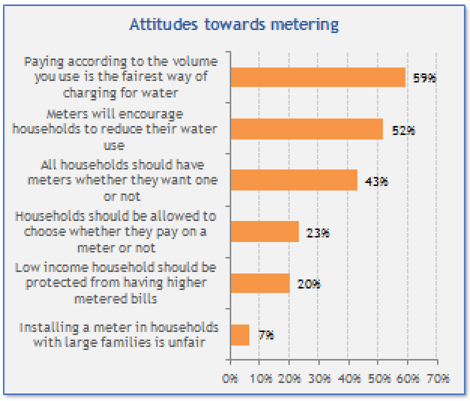
BUSINESS: Attitudes to demand side options…





- Strong views on leakage
- Some misunderstanding about the impact of leakage on bills
- Recognition that metering is fair and encourages water saving

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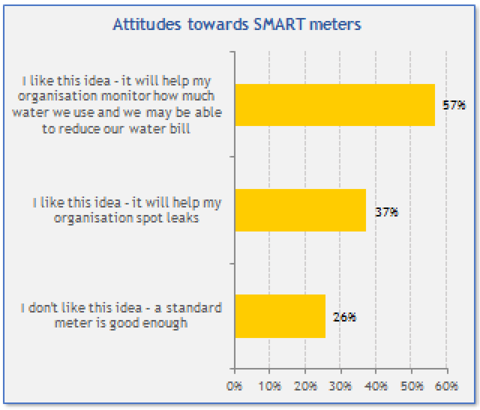
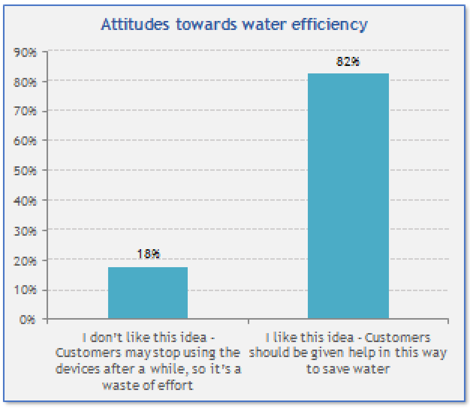
BUSINESS: Attitudes to demand side options…





- Businesses would welcome smart meters
- Well supported
- Few sceptical about benefits

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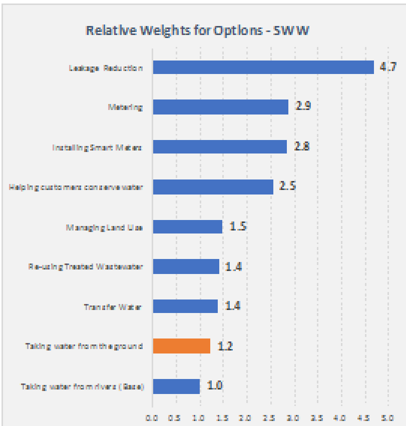
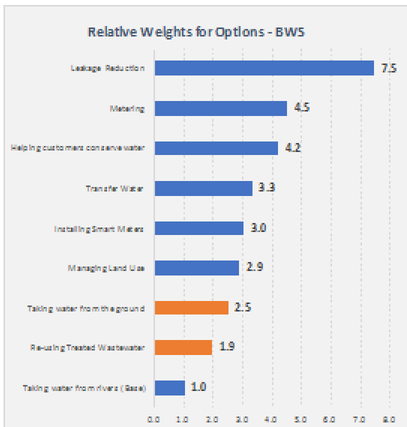
Water Resource Options
Findings - Household Samples

South West Water



Bournemouth



Note: orange denotes options with weights not significantly different to the base option

eftec

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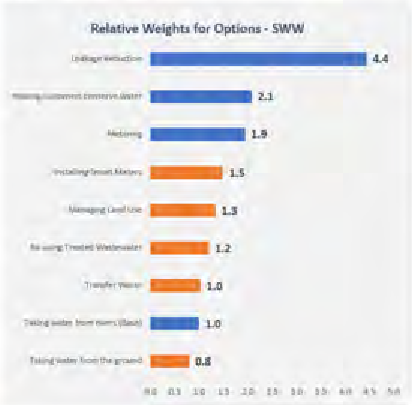
Water Resource Options - Findings - Business Samples
Note - small separate samples, so consider together

South West Water



Bournemouth

ICS eftec

Note: orange denotes options with weights not significantly different to the base option

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Using the results - Household Results

- First step is to monetise the results
- Main study Interim Results give value of reducing leakage by 1% which is converted into 1Ml/d = £540k Ml/d
- For further leakage (16%-12%) £540k is weighted by PR14 2nd Stage weight of 0.67 to give £360k
- Clear order of customer preference - leakage, metering/efficiency, other sources.
- Swapping ground or river water to leakage has big value to customers, whereas swapping to transfer and re-use does not

	Option	Ml/d
Stage 1	Leakage (20%-16%)	£540,000
Stage 2 weights	(Dumb) Metering	£330,000
	Smart Meters	£300,000
	Helping Customers Save Water	£300,000
	Catchment mgt (land use)	£180,000
	Transfer	£180,000
	Re-use	£160,000
	Take Groundwater	£150,000
	Take from Rivers	£100,000

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South West Water Bournemouth Water

A.1.6.3 EngageOne interactive video

A.1.6.3.1 Background

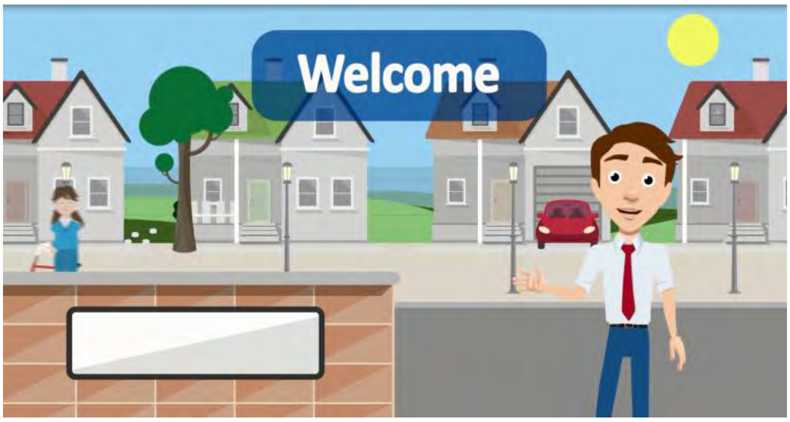
The need for additional customer research was identified early in the WRMP process. It was clear that the forecasts would continue to show a supply demand surplus over the planning period but would become more sensitive to long-term risks. This then raised the intergenerational questions as to whether to invest early or late, and whether to invest in resources (more certain and lower cost) or demand management (less certain and higher cost).

In addition to traditional customer research, we therefore also developed an interactive personal video that allowed all our customers to set out how they would like us to balance our plan. This was completed by over 2,500 customers and is the first of its type in the UK water sector.

This was well received by customers and the greater reach and data richness of this approach to normal surveys gave further insight into how customers would like us to develop our plans.

Figure A.2 shows screenshots of the interactive water resources video.

Figure A.2: Screenshots of interactive water resources video



A.1.6.3.2 Results

Key results are presented in Figure A.3. The results show:

- Plans that include reducing demand are preferred over accessing more water
- The preference was that plans are started now or within 5-10 years over waiting for service deterioration to occur
- There was some intergenerational differences in timing, with few young people/future bill payers seeking to wait to invest

We used this steer in developing our final strategy so that it focussed more on reducing demand and starting early and pro-actively rather than developing a plan geared around developing new water resources and acting 'just in time'.

In addition to the data, the feedback from the video was very positive. It also gave an additional unforeseen benefit with respect of improving our connection with customers on how the service they receive operates to help educate and inform decision making. The feedback is presented in Figure A.4.

Figure A.3: EngageOne video results

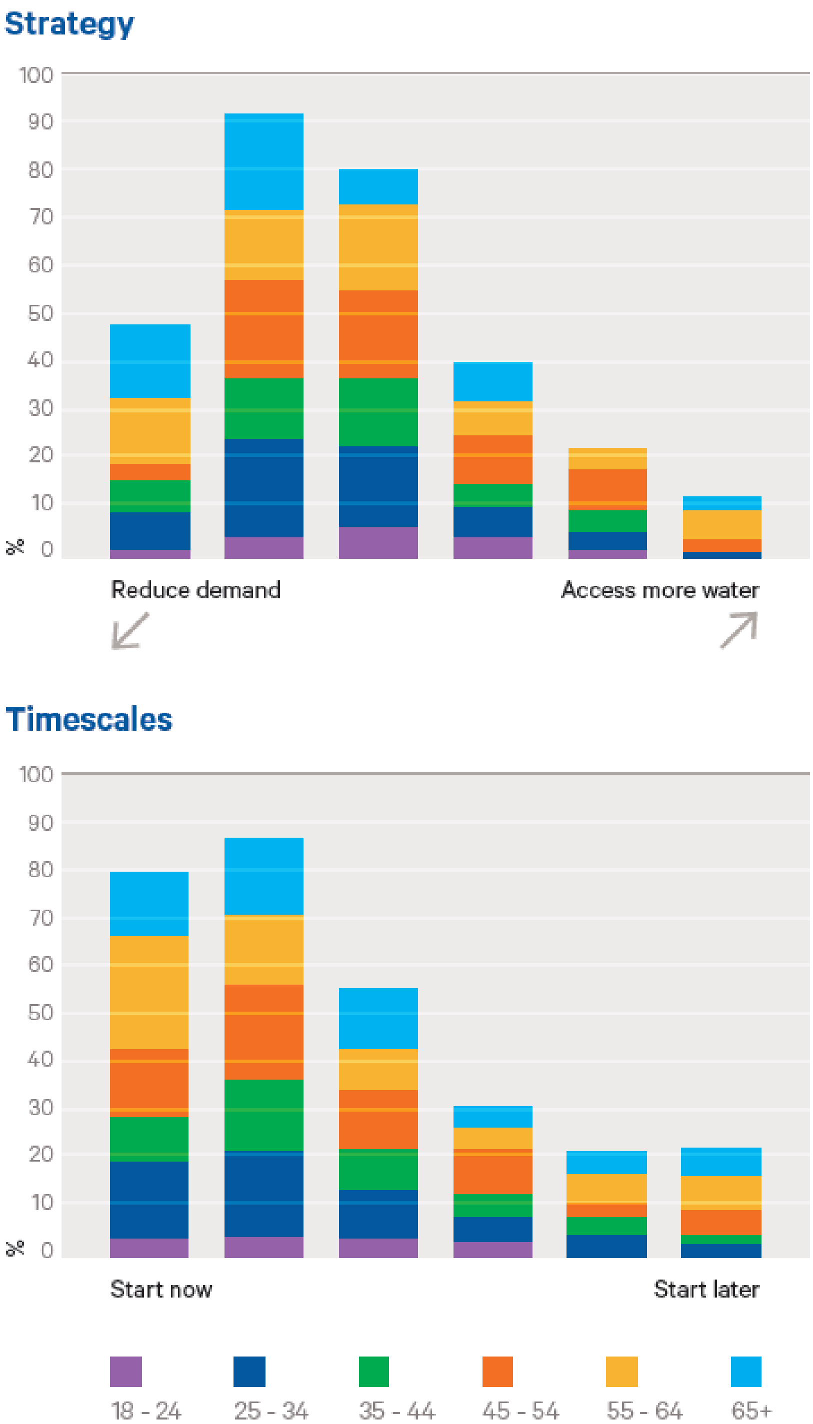


Figure A.4: EngageOne video feedback

- Very informative and very easy to understand.
- Very well done.
- Very good video. It being animated helped me to understand easier and not using complicated words helped to comprehend any future concerns people might be having about water.
- Was simple and easy to understand but informative too.
- Well produced.
- It was very informative to get a simple yet informative insight into how our water systems work.
- Found video very interesting in order to learn about the issues that South West Water are facing, and I will be interested to know exactly which strategy they will decide on eventually.
- Well put together and concise. More of these would help us understand the challenges we may face in our region.
- Very informative, very interesting.
- It made me thing about how I could better use water and ways to save water.
- Very informative. I watched it with my two sons aged 10 and 12. They have a different outlook now and the tap is never left running !!! What a result.
- I learnt something!
- I found it interesting.
- Really innovative way to engage customers in tackling company issues.
- I think the video is really informative, as someone who is in their early 20s I've never had a great deal of understanding about how a water meter works. I found the video really interesting as well as the facts and statistics helping me understand where water is sourced from, how the water is used and future decisions South West Water make. As a customer it is really important to be given information about future decisions which may impact us. Thank you.
- Great video. It is good to feel part of these very important decisions. Thank you.
  I think this was a very interesting method of including the consumer in your decision making process. I believe many people are very ignorant of where and how the water comes out of the tap every day.
- It made me think about exploring ways I could personally reduce my water consumption.

A.1.7 Stakeholder engagement

A.1.7.1 Environment Agency

We contacted the Environment Agency to invite them to comment on our plans to prepare a Water Resources Management Plan. We received a letter highlighting specific points concerning demand and supply. We have addressed these in our Plan. Table A.1.2 below provides references to where specifically these are discussed in the main report.

Table A.1.2: References to where points raised by Environment Agency are addressed in our Plan

Points raised by the Environment Agency	Our response and its consideration in the Plan
Extended flow scenarios	
We are pleased you worked with us to explore the use of extended flow sequences in relation to improving your assessment of deployable output and levels of service, and due to concerns over data quality, agree this work will not be used in WRMP19. We would, however, like you to consider moving to a stochastic approach to modelling river flow and/or rainfall as part of the WRMP24 planning process.	We will undertake a review of methods for modelling river flow and/or rainfall as part of our WRMP24 planning process and as part of this review we will consider a stochastic approach. If the review shows a stochastic approach to be an appropriate method for our area and circumstances then we will move towards this modelling method for future plans.
Drought scenarios	
As outlined in the Defra Guiding Principles, your WRMP should investigate your resilience to a range of plausible droughts of varying severity, duration, frequency, spatial extent, and very low rainfall, relative to expected conditions in your water resource zones. In our supplementary guidance, the Drought Plan links to Table 10.1 should be used to demonstrate the drought scenarios you have considered, and the benefits that drought permits offer. The table is divided into historic droughts and additional drought scenarios. It should include your design drought, your worst historic drought (if different to your design drought) and any other drought scenarios you have considered. The expectation is that your design drought is worse than or equal to the worst historic drought. As stated in the WRP Table Instructions, we are expecting one of the rows in Table 10.1 to be populated with	We have investigated our resilience to a range of plausible droughts – details are given in Section 7 and Appendix 7 of this WRMP. For all of our WRZs, the design drought is the worst historic drought in the period of record (1975/76). We have populated Table 10.1 with information that is identical to the scenario used to build the "base" plan, i.e. the design drought for each WRZ. We have included information on all of our plausible droughts in Table 10.1. A few of our plausible droughts show a DO loss which could result in a supply demand deficit. However, these droughts are all much more extreme than a 1 in 200 year drought. All of our WRZs are resilient to a 1 in 200 year and still meet our levels of service.

Points raised by the Environment Agency	Our response and its consideration in the Plan
information that is identical to the scenario used to build the "base" plan.	
Demand management We are pleased you are carrying out a detailed review of demand, and that you are engaging with customers on demand measures. In line with Defra Guiding Principles, we expect you to choose demand-side options as part of the preferred programme, and as such your WRMP should focus on options for managing demand, for example reducing leakage, helping customers reduce per capita consumption, and increasing customer metering.	Our Plan includes a further commitment to leakage reduction though there is no supply demand driver. We also include more work on water efficiency for our customers and our own use. Water efficiency savings can also benefit our customers with regard to affordability and we have included this dimension in setting out our Plan. See Section 8 for further information.
Leakage You should use the updated method for calculating leakage described in Consistency of Reporting Performance Measures (UKWIR 2017) to determine the leakage options in your WRMP. It is important that the potential impacts of changes to reported leakage are accounted for in your draft WRMP to avoid the risk of material change to plans in future. The expectation is that you will show how you have used the method and if necessary, use scenarios to assess the impacts on the water balance and the options in your plan. We also expect you to show how you will meet the requirements in the Defra Guiding Principles that the downward trend for leakage should continue and that total leakage does not rise at any point in the planning period.	While we have made initial assessments on the likely impact of these changes on our base year (2016/17) reported leakage, it is not possible to retrospectively calculate this reliably. We have therefore based this plan on our current leakage reporting methodology. We have included a scenario showing how the adoption of the new methodology is likely to impact our baseline position, and this is detailed in Section 7 of this report. When preparing the final version of our WRMP, we will be able to use a full year of data (2017/18) calculated in a way that is more aligned with the new guidance. The use of our existing methodology to calculate base year leakage does not affect our ability to meet government aspirations to reduce leakage over the planning period. The leakage reduction options that we have considered as part of this plan are not dependent on the calculation method. These options are described in Section 6 of this report.
Bulk supplies We expect you to fully explore resource sharing during WRMP19 and beyond, and we recognise you are a partner on WRSW/West Country WR Group. Any options to export water to another company	As part of the WRSW/West Country WR Group we are in discussion with neighbouring water utilities to explore options for transfers. Only transfers that do not pose

Points raised by the Environment Agency	Our response and its consideration in the Plan
must be done in a way that does not pose unacceptable risks to water supply. It must also be done in a way that ensures compliance with WFD objectives. Any raw water transfers should be assessed for their potential to spread Invasive Non-Native Species (INNS). Any identified risks and mitigation measures must be discussed with EA and Natural England for both new and existing transfers.	unacceptable risks to water supply will be considered. We have included a possible Bournemouth to Southern Water transfer in our Plan. We are in discussion with Southern Water regarding the scope, cost and timing of such a transfer – see Section 7 for details. In the future, any proposed transfers taken forward would require full investigations, both from an engineering and from an environmental perspective. Any environmental risks will be identified and mitigation measures discussed with Natural England and the EA.
Levels of Service and resilience	
Aside from any government Direction, we expect your plan to clearly demonstrate how you have considered and tested what the right level of service is for your customers and on what basis this decision is made, bearing in mind the long term needs of customers. The impact of restrictions on businesses and households when deciding on a planned level of service needs to be taken into account. We expect to see meaningful engagement with customers using descriptions and indicators that will help them understand the risks and reasons for the measures proposed. Informed by this engagement you should set out clearly in your plan how solutions are resilient for your customers over the long term, including the risks to delivery of those solutions, flexibility, and evidence that you have considered the full range of options for managing those risks. Your plan should set out a reference level of service that would mean resilience to a drought with at least an approximate 0.5% chance of annual occurrence (i.e. approximately a 1 in 200 year drought event). You should explain how you have selected and modelled this drought event. Resilience in this context would be avoiding emergency drought orders that allow restrictions, such as standpipes and rota cuts. This scenario should quantify any additional deployable output required, any preferred options, and the expected incremental costs of this scenario. You	All of our WRZs are resilient to a 1 in 200 year drought and hence we can meet the reference level of service without the need for any temporary use bans or non-essential use bans. For Roadford WRZ the historic design drought (1975/76) is a 1 in 200 year drought. For the other WRZs, the plausible drought analysis shows that these WRZs are resilient to a 1 in 200 year drought. See Sections 2, 7 and Appendix 7 (Sections A.7.3 and A.7.4) and Table 10 for details. Levels of service are discussed in Section 1.8. Customer engagement is discussed in Section 1.10.

South West Water Bournemouth Water

Points raised by the Environment Agency	Our response and its consideration in the Plan
should set out how you have calculated this, the evidence you have used, and the assumptions you have made. You should explain at what point in the planning period the reference level of service could be achieved, and if your solution leads to any changes in the level of service for temporary use bans and non-essential use bans.	
Wider issues to consider	
Government expects water companies to follow the water company water resources planning guideline when preparing their draft WRMP. It provides guidance and details on the technical methods of the water resources planning process. This revised guideline was released in April 2017 and has been jointly produced by the Environment Agency, Natural Resources Wales, the Welsh Government, Defra and Ofwat. To support our guideline, we have also produced a set of supplementary documents and templates that provide further information on specific topics. These include the supply-demand and water company level tables to be used for capturing and presenting water resources planning data at a resource zone level to support your WRMP. These are all available from Huddle or upon request from the Environment Agency. In May 2016, Defra released 'the guiding principles' which sets out advice for water companies in England. Government expects you to take account of the advice set out in this document when developing your WRMP. Your WRMP should clearly demonstrate your commitment to protect and improve the environment, and we expect you to consider the Water Industry National Environment Programme (WINEP) for PR19 for your company. We expect you to review the outputs of the Water UK project 'Water Resources Long Term Planning Framework' and consider what it means for your company and the range of resilience solutions you have considered.	We have followed the water company water resources planning guideline and supplementary guidance when preparing our Plan. See Appendix 9 (water company checklist) which lists where in the Plan we have considered each element of the guidelines. Throughout the Plan we refer to the relevant guidance that we have followed when producing that section of the Plan. See Section 2.3.2 for details of WINEP studies or improvements identified in our company area. We have reviewed the outputs from the Water UK Long Term Planning Framework and our Plan is structured along those lines. Specifically we have looked at: • Scenario analysis (Section 4.4 of the Water UK report) • Demand growth (Section 4.6 of Water UK report) • Drought risk (Section 6.1 of Water UK report) • Valuing household and wider effects (WTP and service level benefits) (Section 7.2 of Water UK report) • NPV comparisons (Section 8 of Water UK report)

Points raised by the Environment Agency	Our response and its consideration in the Plan
Customer and third party involvement	
We welcome your proposals outlined in your pre-consultation letter to consult with a range of statutory and non-statutory stakeholders, including your customers and neighbouring water companies.	We have consulted with a range of statutory and non-statutory stakeholders, including our customers and neighbouring water companies. See Sections 1.10 and 1.11 for details.

A.1.7.2 Devon County Council

We contacted the Devon County Council to invite them to comment on our plans to prepare a Water Resources Management Plan. We received a letter highlighting specific points concerning demand and supply. We have addressed these in our Plan. Table A.1.3 below provides references to where specifically these are discussed in the main report.

Table A.1.3: References to where points raised by Devon County Council are addressed in our Plan

Points raised by Devon County Council	Our response and its consideration in the Plan
We would like to use this response to highlight the significance for water demand of the Greater Exeter Strategic Plan, which is being prepared by the authorities of East Devon, Exeter, Mid Devon, Teignbridge and Devon County. Alongside local plans at district level across Devon, this formal, statutory document will provide the overall spatial strategy and level of housing and employment land to be provided up to 2040 for Greater Exeter. George Marshall, DCC's Principal Planning Officer, has assured me that SWW is engaged in the plan's development and we welcome continued engagement on this matter; a consultation on the draft plan is anticipated in early 2018.	We agree that meeting the demand for water is particularly important where future development is being focused within Devon and our approach to forecasting demand is detailed in Section 3 of the Plan. Although we are predicting maintenance of the supply demand balance throughout the planning period, we have examined the Plan's sensitivity to key risks, including variations to predicted demand, in Section 7. Our Plan includes the reduction of demand through leakage control and other measures which are key to mitigating the main risks to our Plan. We would be pleased to input into the local plans on both the water and wastewater sides of our service. For your information, we are also in the process of producing 25 year plans for wastewater to improve water quality. More details are given in Section 5.
On the topic of supply, the Plan should make a positive contribution to maintaining and enhancing Devon's outstanding environment, on which the county's economy and high quality of life depend.	We have carried out a Natural Capital assessment of our Plan, which is covered in Appendix 8. We are also involved in the North Devon

The "review of yield available from our water resources" should take a natural capital approach to include consideration of the opportunity for further environmental enhancements to store water, based on the 'catchment management' interventions deployed through SWW's 'Upstream Thinking' projects on Exmoor, Dartmoor and elsewhere.	Pioneer project and our water is being used to develop the Natural Capital valuation in that area. Whilst our Plan does not currently recommend more water storage, it does set out studies for this in the 2020-25 period.
With mounting evidence to support this approach, DCC would expect such catchment management measures to form an ever more prominent element of the strategy to be set out in the new Water Resource Management Plan. The more pressing question to address through the Plan is how such measures might be better integrated with future government policy and financial support mechanisms relating to agriculture and land management.	Catchment management is part of our overall Business Plan. See Section 6 for more details. Our overall approach is to integrate activity and we are planning more catchment management in the next five year overall Business Plan than we currently carry out.
Turning to the issue of demand, DCC would hope and expect there to be a further development in the approach to metering and other measures to assist customers in reducing their use of water, as well as a robust and ongoing commitment to leakage management.	Our Plan includes a further commitment to leakage reduction though there is no supply demand driver. We also include more work on water efficiency for our customers and our own use. Water efficiency savings can also benefit our customers with regard to affordability and we have included this dimension in setting out our Plan. See Section 8 for further information.
We would also urge South West Water to use the preparation of this new Plan as means of raising public consciousness of the value of water as a precious and finite resource and understanding the essential part that they play in ensuring its wise and sustainable use.	Customers value water and our Plan has been shaped around the demand for water. Noted in Section 1, we show some new interactive video tools we have developed to engage customers and raise awareness.

A.1.7.3 <u>West Country Water Resources Group</u>

The purpose of the above group and Terms of Reference are shown below.

West Country Water Resources Group

1. Purpose of Group

The West Country Water Resources Group has been set up to support a co-ordinated approach to water resources planning in the south west of England and neighbouring water company areas.

It is the intention that the group will initially support the development of 2019 Water Resources Management Plans (WRMPs) and additionally make steps towards collaboration for WRMPs in 2024. This collaboration will be implemented with due consideration to the research reported in the Water UK '*Water resources long-term planning framework*' (September 2016).

This includes developing a shared understanding of the following:

a. The current and future availability of water resources for each water company

b. Options available for resource development in each water company area including any related environmental issues (i.e. WFD no-deterioration and invasive non-native species)

c. Potential options available for future raw or treated water transfers/trades for water companies and others interested in multi-sector trades.

2. Terms of Reference

General elements

a. Membership is open to water companies, regulators and others by invitation who have WRMP related interests in the abstraction and use of water in or from the South West

b. Minutes of meetings and other records from the Group will be available on request and may be used or referenced in the preparation of WRMPs.

Technical elements

a. To achieve the objectives above, Group members agree to share reports and other information on the current and future availability of resources for export, as well as the related environmental issues. This includes feasible export options that are being considered for future development

b. To progress with the work, the Group will meet quarterly or more frequently if required. These Terms of Reference will be reviewed at least annually to ensure they remain fit for purpose.

T O R October 2017

APPENDIX 2

Developing our water supply forecast

A.2.1 Impacts of climate change on water supply

A.2.1.1 Climate change vulnerability assessment

A copy of our climate change vulnerability assessment report is included below.

Climate Change Vulnerability Assessment

April 2017

Climate Change Vulnerability Assessment

Contents

APPENDICES

1 INTRODUCTION

1.1 Purpose of report

Under the Water Act 2003, water companies in England and Wales are required to produce a water resources management plan (WRMP) every five years. The plan must set out how a water company intends to balance the supply and demand for water over a statutory minimum period of 25 years, taking into account the challenges and uncertainties of the future including the impact of climate change.

Defra[1] and the Environment Agency[2] published their guidelines for the production of the next WRMP, due in 2019. As described in these guidelines, a water company must assess the likely impact of climate change on its plan and report the likely implications for deployable output (DO).

Further Environment Agency guidelines[3&4], tailored specifically to assessing the impact of climate change, identify that the methods a water company uses to assess the effect of climate change on DO are to be proportionate to the risks presented by climate change to each water resource zone (WRZ). Therefore, before assessing the impact of climate change on DO, the guidelines recommend undertaking an initial assessment of the vulnerability of each WRZ to the effects of climate change.

The purpose of this report is to provide the appropriate evidence to support our assessment of the vulnerability of our sources to climate change. This, in turn, provides the evidence required to support our choice of the appropriate level of analysis undertaken to assess the effects of climate change on DO in each of the Company's WRZs, ie Colliford, Roadford, Wimbleball and Bournemouth. We have submitted a copy of this report to the Environment Agency as recommended in the published guidelines.

[1] Defra (2016) *Guiding principles for water resources planning*. For water companies operating wholly or mainly in England.
[2] Environment Agency and Natural Resources Wales (2017) *Final Water Resources Planning Guideline. Interim update.*
[3] Environment Agency (2017) *Estimating impacts of climate change on water supply*. Evidence.
[4] Environment Agency (2012) *Water resources planning guideline – The technical methods and instructions.*

2 VULNERABILITY ASSESSMENT

It is recognised within the Environment Agency guidelines[5] that the vulnerability assessment should be largely qualitative, based on a water company's current knowledge of system vulnerabilities and readily available information from previous drought and water resource management plans.

With this in mind, we have conducted a basic assessment of the extent to which each of our WRZs, ie Colliford, Roadford, Wimbleball and Bournemouth, is susceptible to the adverse effects of climate change. Specifically, we have followed the approach set out in the Environment Agency's (2017) 'estimating impacts of climate change on water supply', which in turn refers to section 3.3.3 of the Environment Agency (2012)[6] 'technical methods and instructions' and section 3.2 of the Environment Agency (2013) 'climate change approaches in water resources planning – overview of new methods'[7]. As specified in the guidance, our assessment has been based on the most up-to-date information available from the preparation of our previous water resources management and drought plans[8].

The vulnerability assessment involves the creation of two decision-making tools:

- A magnitude versus sensitivity plot; and,
- A tabular summary of the information used to determine the final vulnerability of each WRZ to climate change.

The magnitude versus sensitivity plot is used within the tabular summary to inform the qualitative determination of the final climate change vulnerability, alongside with other information and knowledge of the particular WRZ system. These decision-making tools are described further in Sections 2.1 and 2.2, respectively.

2.1 Magnitude versus sensitivity plot

Our magnitude versus sensitivity plot is presented in Figure 2.1. The plot shows the change in Water Available For Use (WAFU) by the year 2035 for the 'mid' climate change scenario, plotted against the uncertainty range (the percentage difference between the 'wet' and 'dry' scenarios). As in our previous plan, we have used WAFU as a surrogate for deployable output. This approach is allowed for within the Environment Agency (2013) guideline 'overview of methods' and has been previously approved by the Environment Agency.

The magnitude versus sensitivity plot uses the latest information available on the impact of climate change on WAFU, as generated for our 2014 WRMPs. The climate change scenarios are based on the UK Climate Projections 2009 (UKCP09). In Bournemouth WRZ, both surface and groundwater sources are limited by licence and infrastructure only and, therefore, DO/WAFU is not affected under any of the predicted climate change scenarios.

The vulnerability classification for each WRZ has been identified using the vulnerability scoring matrix in the Environment Agency's (2013)[7] 'climate change approaches in water resources planning -

[5] *Ibid 3 & 4*
[6] *Ibid 4*
[7] Environment Agency (2013) *Climate change approaches in water resources planning – Overview of new methods*. Report – SC090017/R3
[8] South West Water (2013) *Drought Plan*. https://www.southwestwater.co.uk/globalassets/document-repository/wholesale-documents/south_west_water_drought_plan_march_2013.pdf
South West Water (2014) *Water Resources Management Plan* https://www.southwestwater.co.uk/globalassets/documents/water_resources_management_plan_june_20141.pdf
Sembcorp Bournemouth Water (2012) *Drought Plan*. http://www.bournemouthwater.co.uk/company-information/economic-regulation/drought-plan.aspx
Sembcorp Bournemouth Water (2014) *Water Resources Management Plan* http://www.bournemouthwater.co.uk/company-information/economic-regulation/water-resources-plan.aspx

overview of new methods'. The magnitude versus sensitivity plot shows that Wimbleball and Bournemouth are at low climate vulnerability, whereas Colliford and Roadford fall within the medium tending to low category.

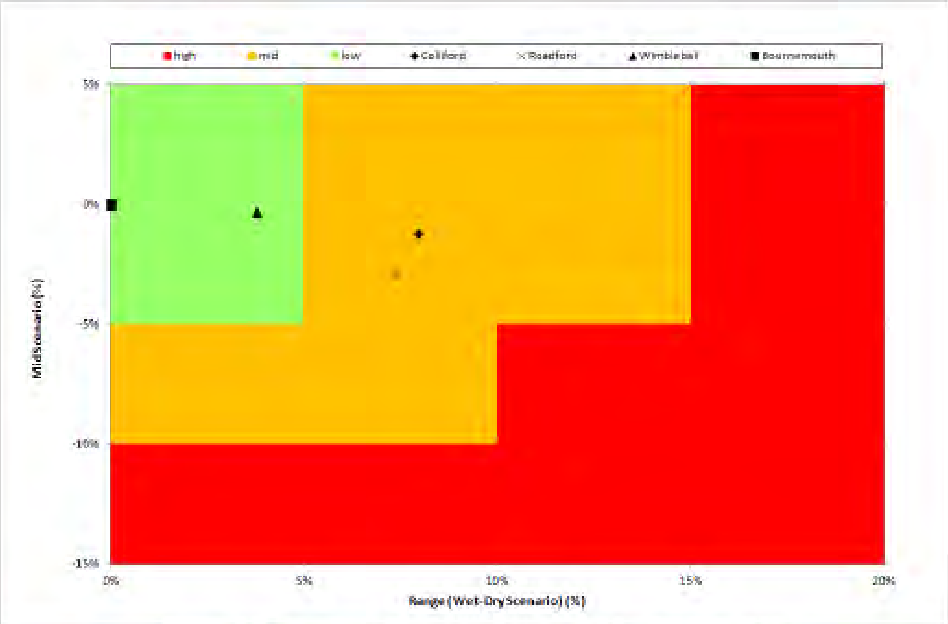


Figure 2.1. Magnitude versus sensitivity plot for the year 2035

2.2 Vulnerability assessment tables

Summaries of the information used to determine the final vulnerability of each of our WRZs to climate change are presented in Tables 2.1 – 2.4 below.

Table 2.1. Vulnerability assessment table – Colliford WRZ

As recommended in the Environment Agency guidelines[9], the information provided in the table is based on our current knowledge of system vulnerabilities and readily available information from the South West Water Drought Plan 2013 and WRMP 2014. Our WRMP 2019 includes observed data up to 31 December 2015.

Colliford WRZ			
Description	**Source**	**Data**	**Comments**
Critical drought years (top three)	Drought Plan 2013/WRMP 2014	1976, followed by a number of other dry periods such as 1984, 1995 and as shown in the Drought Plan 2013, Figure E.1.1. (page A.20)[10]	Colliford WRZ operates conjunctively, without significant groundwater sources other than Park and Stannon Lakes. (Note: The impact of climate change on our groundwater resources is being considered separately.)
Period used for Analysis (historic flow or gw level record)	Drought Plan 2013/WRMP 2014	1962-2011 (Note that our WRMP19 includes data until 2015.)	We currently believe the use of data post 1962 provides a good representation of historical droughts and that the use of long-term flow sequences of dubious quality could be very misleading. This view is supported by an analysis carried out in 2011/2012[11] and in 2013[12] conjunctively by the Environment Agency and SWW.
Types of Sources	WRMP 2014	Local sources supported by strategic reservoir; see Appendix A which shows maps included in the 2012 Water Resources Zones Integrity report[13]. Appendix B shows extracts from our WRMP giving further information about the types and number of sources.	No significant changes are envisaged for the WRMP19.
Supply-demand balance (base year)	WRMP 2014	In South West Water's WRMP14, Colliford WRZ is in surplus beyond 2035. Appendix B gives an extract from the WRMP14 showing the surplus.	It is envisaged that Colliford WRZ will continue to be in surplus, particularly in the early years of the WRMP19 planning period.
Security of water supply and/or water scarcity indicators	Company Annual Performance Report (CAPR) or equivalent	Security of Supply Index (SoSI) for 2014/15 is reported as 100.	SoSI is envisaged to remain at 100 throughout the WRMP19 planning period. The SWW area has been classified at Not Serious stress level by the Environment Agency[14].

[9] *Ibid* [384]
[10] South West Water (2013) *Drought Plan*. Appendix E
[11] South West Water (2013) *Drought Plan*. Chapter 2.6 Historic droughts
[12] South West Water (2013) *SWW Water Resources Modelling – Extended Flow Sequences*. Revised report September 2013.
[13] South West Water (2012) *Water Resources Zones Integrity, Provision of Evidence to Environment Agency*.
[14] Environment Agency & Natural Resources Wales (2013) *Water Stressed areas – final classification*. Cat code: LIT 3230

Colliford WRZ			
Description	**Source**	**Data**	**Comments**
Critical climate variables (e.g. summer rain, winter recharge)	Drought Plan 2013/ WRMP 2014 modelling work	Colliford Lake is a multi season reservoir. Under many climate change scenarios, higher rainfall in winter is predicted which will aid refill and minimise the impact of climate change in scenarios predicting lower flows in the summer. In Colliford WRZ, climate change has less of an impact on WAFU due to infrastructure and/or abstraction licence constraints e.g. Restormel WTW. Appendix B shows an extract from the WRMP14.	
Climate change DOs (Dry, Mid, Wet Scenarios from 2014 WRMP)	2014 WRMP modelling work	The WRMP14 climate change methodology used the UKCP09 flow factors approach. Colliford WRZ impact of climate change on WAFU in 2035 under mid, wet and dry scenarios: Dry = -6.52% Mid = -1.22% Wet = +1.42%	For further details of the methods used to identify the effects of climate change see the SWW WRMP14, Chapter 4-Climate Change.
Adaptive capacity (List of available sources and drought measures)	Drought Plan 2013	Some licensed sources are not currently included in WAFU calculations but are referenced in the Drought Plan 2013 (Drought Plan 2013 Table G.1.1, page A.35). Summary of supply-side drought management actions (for existing licences), along with the average daily take as a result of the annual licence constraint: • Boswyn Shaft (0.44 Ml/d), Boswyn Stream (1.87 Ml/d), Copper Hill Adit (1.43 Ml/d) • Cargenwyn Reservoir: (1.25 Ml/d) • Carwynen Stream (Botetoe) (1.64 Ml/d) • Porth Reservoir and Rialton Intake (6.30 Ml/d)	
Sensitivity from information in table above (low/medium/high)		Low	
Vulnerability classification from our magnitude versus sensitivity plot (Figure 2.1)		Medium tending to Low	
Identify overall vulnerability and proposed climate change assessment method		LOW	Proposed methodology for climate change assessment of surface water sources in the WRMP19 is: Tier 1 analysis – Future Flows hydrology monthly change factors.

Table 2.2. Vulnerability assessment table – Roadford WRZ

As recommended in the Environment Agency guidelines[15], the information provided in the table is based on our current knowledge of system vulnerabilities and readily available information from the South West Water Drought Plan 2013 and WRMP 2014. Our WRMP 2019 includes observed data up to 31 December 2015.

Roadford WRZ			
Description	**Source**	**Data**	**Comments**
Critical drought years (top three)	Drought Plan 2013/WRMP 2014	1976, and subsequent drawdowns of 1977 and 1978, followed by other periods such as 1995 as shown in the Drought Plan 2013, Figure E.1.4. (page A.22)[16]	Roadford WRZ operates conjunctively, without significant groundwater sources.
Period used for Analysis (historic flow or gw level record)	Drought Plan 2013/WRMP 2014	1957-2011 (Note that our WRMP19 includes data until 2015.)	We currently believe the use of data post 1957 provides a good representation of historical droughts and that the use of long-term flow sequences of dubious quality could be very misleading. This view is supported by an analysis carried out in 2011/2012[17] and in 2013[18] conjunctively by the Environment Agency and SWW.
Types of Sources	WRMP 2014	Local sources supported by strategic reservoir; see Appendix A which shows maps included in the 2012 Water Resources Zones Integrity report[19]. Appendix B shows extracts from our 2014 WRMP giving further information about the types and number of sources.	No significant changes are envisaged for the WRMP19.
Supply-demand balance (base year)	WRMP 2014	In South West Water's WRMP14, Roadford WRZ is in surplus beyond 2035. Appendix B gives an extract from the WRMP showing the surplus.	It is envisaged that Roadford will remain in surplus, particularly in the early years of the WRMP19 planning period.
Security of water supply and/or water scarcity indicators	Company Annual Performance Report (CAPR) or equivalent	Security of Supply Index (SoSI) for 2014/15 is reported as 100.	SoSI is envisaged to remain at 100 throughout the WRMP19 planning period. The SWW area has been classified at Not Serious stress level by the Environment Agency[20].
Critical climate variables (e.g. summer rain, winter recharge)	Drought Plan 2013/ WRMP 2014 modelling work	Roadford Reservoir is a multi season reservoir. Under many climate change scenarios, higher rainfall in winter is predicted which will aid refill and minimise	

[15] *Ibid* [384]
[16] South West Water (2013) *Drought Plan*. Appendix E
[17] South West Water (2013) *Drought Plan*. Chapter 2.6 Historic droughts
[18] South West Water (2013) *SWW Water Resources Modelling – Extended Flow Sequences*. Revised report September 2013.
[19] South West Water, Water Resources Zones Integrity, Provision of Evidence to Environment Agency, July 2012
[20] Environment Agency & Natural Resources Wales (2013) *Water Stressed areas – final classification*. Cat code: LIT 3230

Roadford WRZ			
Description	**Source**	**Data**	**Comments**
		the impact of climate change in scenarios predicting lower flows in the summer.	
Climate change DOs (Dry, Mid, Wet Scenarios from 2014 WRMP)	2014 WRMP modelling work	The WRMP14 climate change methodology used the UKCP09 flow factors. Roadford WRZ impact of climate change on WAFU in 2035 under mid, wet and dry scenarios: Dry = -7.39% Mid = -2.91% Wet = -0.03% In addition to the impact of climate change on WAFU, these figures account for sustainability reductions to WAFU proposed by the Environment Agency for the WRMP14. Appendix B shows an extract from the WRMP14 with further information.	For further details of the methods used to identify the effects of climate change see the SWW WRMP14, Chapter 4 – Climate Change.
Adaptive capacity (List of available sources and drought measures)	SWW records	Natural flows during a severe drought are usually lower than the reservoir compensation flows. Although reducing them during severe drought is not likely to form part of our current Drought Planning, historically Drought Orders have been granted at a number of sites across the Roadford WRZ in droughts such as 1976, 1984, 1989 and 1995. Drought Orders such as these have enabled a temporary increase in supplies.	Further information on historical drought orders or temporary changes in abstraction licences is available from both SWW records and other bodies within the water industry such as the Environment Agency and DEFRA.
Sensitivity from information in table above (low/medium/high)		Low	
Vulnerability classification from our magnitude versus sensitivity plot (Figure 2.1)		Medium tending to Low	
Identify overall vulnerability and proposed climate change assessment method		LOW	Proposed methodology for climate change assessment of surface water sources in the WRMP19 is: Tier 1 analysis – Future Flows hydrology monthly change factors.

Table 2.3. Vulnerability assessment table – Wimbleball WRZ

As recommended in the Environment Agency guidelines[21], the information provided in the table is based on our current knowledge of system vulnerabilities and readily available information from the South West Water Drought Plan 2013 and WRMP 2014. Our WRMP 2019 includes observed data up to 31 December 2015.

Wimbleball WRZ			
Description	**Source**	**Data**	**Comments**
Critical drought years (top three)	Drought Plan 2013/WRMP 2014	1976, closely followed by 1984, 1989, 1990 and 1995 as shown in the Drought Plan 2013, Figure E.1.7. (page A.24)[22].	The surface water sources in Wimbleball WRZ are operated in conjunction with the groundwater sources. For the majority of groundwater abstraction sites, the controlling constraint is either an abstraction licence limit or the abstraction capacity of the source. As a consequence, the impact on supply capability of a groundwater drought in our area is significantly less critical than that of a surface water drought. (Note: The impact of climate change on our groundwater resources is being considered separately.)
Period used for Analysis (historic flow or gw level record)	Drought Plan 2013/WRMP 2014	1957-2011 (Note that our WRMP19 includes data until 2015.)	We currently believe the use of data post 1957 provides a good representation of historical droughts and that the use of long-term flow sequences of dubious quality could be very misleading. This view is supported by an analysis carried out in 2011/2012[23] and in 2013[24] conjunctively by the Environment Agency and SWW.
Types of Sources	WRMP 2014	Local sources supported by strategic reservoir; see Appendix A which shows maps included in the 2012 Water Resources Zones Integrity report[25]. Appendix B shows extracts from our WRMP giving further information about the types of sources.	No significant changes are envisaged for the WRMP19.
Supply-demand balance (base year)	WRMP 2014	In South West Water's WRMP14, Wimbleball WRZ is in surplus beyond 2035. Appendix B gives an extract from the WRMP showing the surplus.	It is envisaged that Wimbleball WRZ will remain in surplus, particularly in the early years of the WRMP19 planning period.
Security of water	Company	Security of Supply Index (SoSI)	SoSI is envisaged to remain at

[21] *Ibid* [384]
[22] South West Water (2013) *Drought Plan*. Appendix E
[23] South West Water (2013) *Drought Plan*. Chapter 2.6 Historic droughts
[24] South West Water (2013) *SWW Water Resources Modelling – Extended Flow Sequences*. Revised report September 2013.
[25] South West Water, Water Resources Zones Integrity, Provision of Evidence to Environment Agency, July 2012

Wimbleball WRZ			
Description	**Source**	**Data**	**Comments**
supply and/or water scarcity indicators	Annual Performance Report (CAPR) or equivalent	for 2014/15 is reported as 100.	100 throughout the WRMP19 planning period. The SWW area has been classified at Not Serious stress level by the Environment Agency[25].
Critical climate variables (e.g. summer rain, winter recharge)	Drought Plan 2013/ WRMP 2014 modelling work	The majority of groundwater sources in the SWW area utilise the Triassic Otter Sandstone. Only a very small impact on groundwater levels is predicted which will have a negligible impact on source Deployable Output. Exceptions to this are a coastal borehole near the Otter Estuary which may be affected by a rise in sea level and small sources in the Axe catchment which utilise the Upper Greensand aquifer. However, critical climate variables in Wimbleball WRZ have less of an impact on WAFU due to infrastructure and/or licence constraints. Appendix B shows an extract from the WRMP.	
Climate change DOs (Dry, Mid, Wet Scenarios from 2009 WRMP)	WRMP 2014	The WRMP14 climate change methodology used the UKCP09 flow factors approach. Wimbleball WRZ impact of climate change on WAFU in 2035 under mid, wet and dry scenarios: Dry = -3.67% Mid = -0.34% Wet = +0.11%	For further details of the methods used to identify the effects of climate change see the SWW WRMP14, Chapter 4 – Climate Change.
Adaptive capacity (List of available sources and drought measures)	Drought Plan 2013	Some licensed sources are not currently included in WAFU calculations but are referenced in the Drought Plan 2013. SWW Drought Plan 2013, Table G.1.1 (page A.35), Summary of supply-side drought management actions (for existing licences), along with the average daily take as a result of the annual licence constraint: • Coleford (0.78 Ml/d) and Knowle Boreholes (0.39 Ml/d) • Stoke Canon (1.71 Ml/d) and Brampford Speke (3.55 Ml/d) • Uton Borehole (0.93 Ml/d)	
Sensitivity from		Low	

[25] Environment Agency & Natural Resources Wales (2013) *Water Stressed areas – final classification*. Cat code: LIT 3230

Climate Change Vulnerability Assessment

Wimbleball WRZ			
Description	**Source**	**Data**	**Comments**
information in table above (low/medium/high)			
Vulnerability classification from our magnitude versus sensitivity plot (Figure 2.1)		Low	
Identify overall vulnerability and proposed climate change assessment method		LOW	Proposed methodology for climate change assessment of surface water sources in the WRMP19 is: Tier 1 analysis – Future Flows hydrology monthly change factors.

Table 2.4. Vulnerability assessment table – Bournemouth WRZ

Note that the data in the table have been sourced from the Bournemouth Water WRMP 2014 and the 2015 update of the Bournemouth Climate Change Adaptation Plan[27].

Bournemouth WRZ			
Description	**Source**	**Data**	**Comments**
Critical drought years (top three)	Drought Plan 2012/WRMP 2014/CC Adaptation Plan 2015	1934, 1976, 1990 (from rainfall records)	1976 is the most severe event on record. (Note: The impact of climate change on our groundwater resources is being considered separately.)
Period used for Analysis (historic flow or gw level record)	Drought Plan 2012/WRMP 2014/CC Adaptation Plan 2015	1957-2012 and 1933-1934 for rainfall data 1973-2012 River Stour 1975-2012 River Avon (actual data) Modelled data were used to hind cast flow data for both of these surface water sources back to 1883. 1942-2012 chalk groundwater sources (Note that our WRMP19 includes data until 2015.)	
Types of Sources	WRMP 2014/CC Adaptation Plan 2015	We obtain up to 85% of our water from run-of-river abstractions on the Hampshire Avon and the Dorset Stour, and the remainder from boreholes. We demonstrated in the Bournemouth Water WRMP14 and the 2015 Climate Change Adaptation Report that both our surface water and groundwater sources are robust and yields are constrained by infrastructure and licensed quantity, not by water availability. Therefore, climate change does not affect the ability of the Company to supply our licensed volumes. Extracts from the 2015 Climate Change Adaptation Plan, illustrating the above, are included in Appendix C.	Our surface water sources have a large base flow component and, therefore, have a more stable flow regime that is not subject to large fluctuations such as those experienced in fully surface runoff fed rivers. This means that higher flows are maintained for longer during extended dry periods experienced in the summer. The predicted future conditions indicate that we are to expect drier summers. However, the higher predicted winter rainfall means that we should have greater winter groundwater recharge than in the past, which will in turn support base flow, thus mitigating the impacts of reduced summer rainfall.
Supply-demand balance (base year)	WRMP 2014	Positive	Our 2014 WRMP shows that Bournemouth WRZ is in surplus until at least 2040. A graph illustrating this is included in Appendix C (Figure C2).
Security of water	Company	100% security of supply	Our sources are all constrained by

[27] Bournemouth Water (2015) *Climate Change Adaptation Plan*. Update on progress.

Bournemouth WRZ			
Description	**Source**	**Data**	**Comments**
supply and/or water scarcity indicators	Annual Performance Report (CAPR) or equivalent		infrastructure and licence only and not by resource availability. We have never had to implement water supply restrictions. Bournemouth Water WRZ has been classified as Not Serious stress level by the Environment Agency[28].
Critical climate variables (e.g. summer rain, winter recharge)		Rainfall, temperature and sunshine hours	The key risk to the Company is demand exceeding our Water Available for Use (WAFU). Demands have a strong correlation to weather conditions particularly to sunshine hours and rainfall. This is particularly important when taking into account the impacts of climate change as the headline impacts for our regions show that the amount of summer rainfall is to decrease. This indicates that we would have less cloud cover and therefore potentially higher temperatures and daily sunshine hours. This could have an impact on demands in the future However, on average our demands are reducing year on year. We are also seeing lower peak demands which we believe are as a result of a shift in customer behaviour due to increased metering, water efficiency and improved technology.
Climate change DOs (Dry, Mid, Wet Scenarios from 2014 WRMP)	Drought Plan 2012/WRMP 2014/ CC Adaptation Plan 2015	It has been determined, using the Future Flows and Groundwater Levels (FFGWL) project, that the effects of climate change will not have an impact on the deployable output of Bournemouth WRZ sources. Our sources, therefore, remain limited by licence.	For both of our surface water sources, none of the projections give flows less than the minimum observed in 1976. On the Stour at Throop, the climate change projected flows are consistently higher than the hydrological yield, while on the Avon at Knapp Mill, the minimal of only 3 out of the 11 projections are marginally lower than the hydrological yield. A detailed description of the assessment can be found in Appendix 4 of the Bournemouth Water WRMP 2014.
Adaptive capacity (List of available sources and drought measures)	CC Adaptation Plan 2015 and Bournemouth Water records	Embedded in Company processes	Our Climate Change Adaptation Plan, first produced in 2011 and updated annually, takes into account all aspects of our business which potentially could be affected by climate change and provides a framework within which we can adapt to any changes. By continuously reviewing the risks and assumptions around climate change, we intend to identify risks before they become a problem.

[28] Environment Agency & Natural Resources Wales (2013) *Water Stressed areas – final classification.* Cat code: LIT 3230

Climate Change Vulnerability Assessment

Bournemouth WRZ			
Description	**Source**	**Data**	**Comments**
Sensitivity from information in table above (low/medium/high)		Low	Due to the nature of sources and long term planning
Vulnerability classification from our magnitude versus sensitivity plot (Figure 2.1)		Low	
Identify overall vulnerability and proposed climate change assessment method		LOW	Proposed methodology for climate change assessment of surface water sources in the 2019 WRMP is: Tier 1 analysis – Future Flows hydrology monthly change factors.

2.3 Vulnerability classification conclusion

We have used the information from the vulnerability assessment tables to form the view that all of our water resource zones are within the low vulnerability to climate change category. This is re-iterated in Table 2.4.

This view is also backed up by the fact that:

- Our WRZs all comprise conjunctive use sources;
- Two of our WRZs (Colliford and Roadford) contain multi-seasonal reservoirs and, therefore, the impact of climate change in one particular season can be offset by different changes in a different season;
- At some of our reservoirs, significant pump storage facilities are available which could also help to offset different changes in different seasons.
- In Bournemouth WRZ, current future predicted conditions will not affect our ability to discharge our duty to our customers. Our sources will remain limited by licence and infrastructure only. This is due in part to the nature of our sources as Bournemouth WRZ lies in an area of low water stress and the fact that customer demands are trending downwards in spite of population growth.

Table 2.4 Final vulnerability to climate change categorisation for the Company's WRZs

WRZ	Final vulnerability to climate change category
Colliford	Low
Roadford	Low
Wimbleball	Low
Bournemouth	Low

APPENDIX A

Water Resource Zones - Overview

A.1 Colliford Water Resource Zone

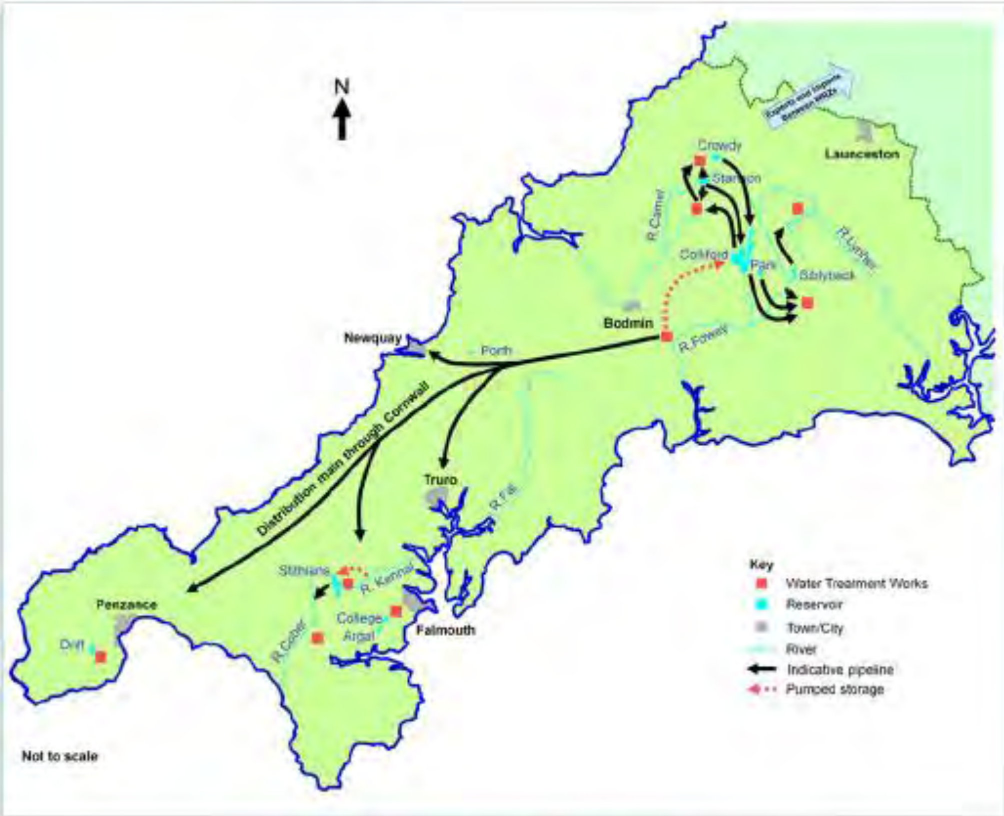


Figure A.1 Key components of the Colliford WRZ

A.2 Roadford Water Resource Zone

Figure A.2 Key components of the Roadford WRZ

A.3 Wimbleball Water Resource Zone

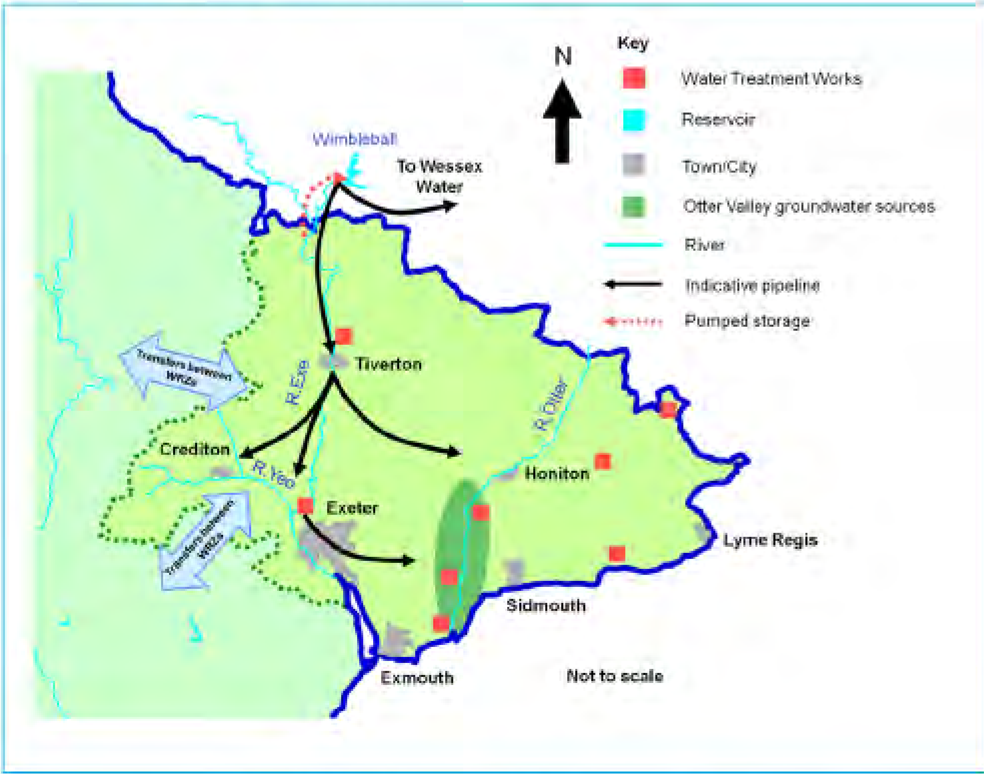


Figure A.3 Key components of the Wimbleball WRZ

A.4 Bournemouth Water Resource Zone

Figure A.4 Key components of the Bournemouth WRZ

APPENDIX B

Extracts from SWW Water Resources Management Plan 2014[29]

[29] South West Water (2014) *Water Resources Management Plan 2014*.
https://www.southwestwater.co.uk/media/pdf/o/o/Water_Resources_Management_Plan_June_20141.pdf

B.1 Colliford Water Resource Zone

Extract from section 1.2.2 (page 1.3) of the Water Resources Management Plan (2014):

> We use Colliford Reservoir conjunctively with local reservoirs, two disused former china clay pits and river intakes to form Colliford WRZ. These sources are supplemented by a bulk transfer from Roadford WRZ of up to the order of 3 Ml/d. The storage of Colliford Reservoir can also be supplemented by pumped transfers from Restormel.
>
> Colliford Reservoir is both a river regulation and a direct supply reservoir and supports supplies in three ways:
>
> - releases to the River Fowey for abstraction and treatment at Restormel Water Treatment Works (WTW)
> - pumping water direct to De Lank and Lowermoor WTWs
> - supplying water, via a gravity pipeline, direct to St Cleer WTW.

Extract from section 6.1.1 (page 6.1) of the Water Resources Management Plan (2014):

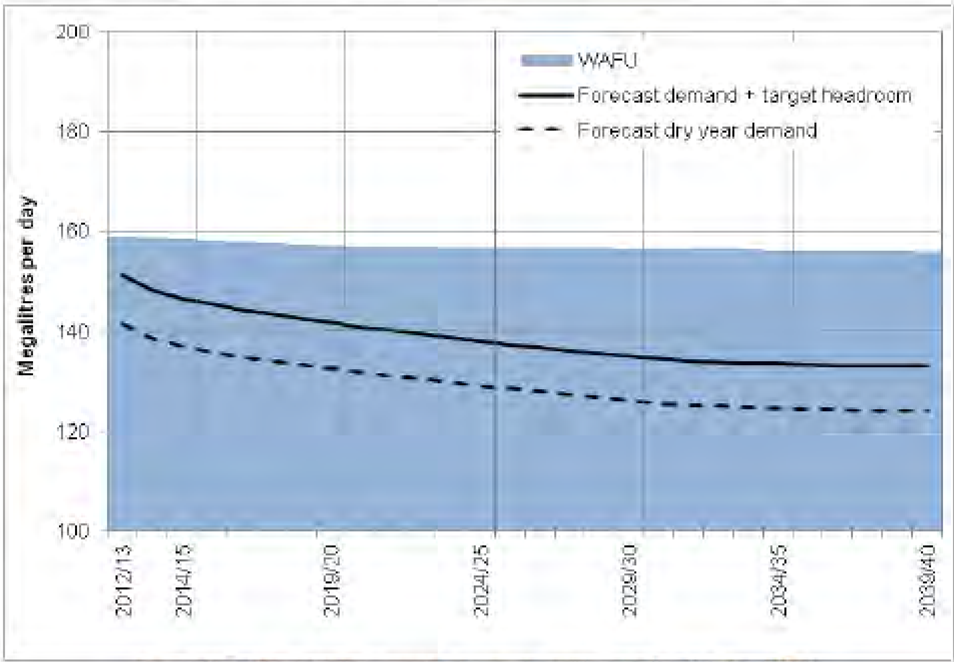


Figure B.1: The baseline supply demand position in the Colliford WRZ

B.2 Roadford Water Resource Zone

Extract from section 1.2.3 (page 1.5) of the Water Resources Management Plan (2014):

> The Roadford WRZ covers a large part of Devon, from Plymouth, the South Hams and Torbay in the south to Bideford and Barnstaple in the north. It also includes parts of north east Cornwall. The area is served primarily by Roadford Reservoir operating conjunctively with other impounding reservoirs, river intakes and other sources.
>
> The most important single source in the area is Roadford Reservoir on the River Wolf, a tributary of the River Tamar. We use Roadford to augment the River Tamar for abstraction downstream at Gunnislake and also for direct supply to parts of North Devon (via Northcombe WTW).

Extract from section 6.1.2 (page 6.2) of the Water Resources Management Plan (2014):

Note that the final Roadford WRZ WAFU includes the effect of sustainability reductions proposed by the Environment Agency in WRMP14.

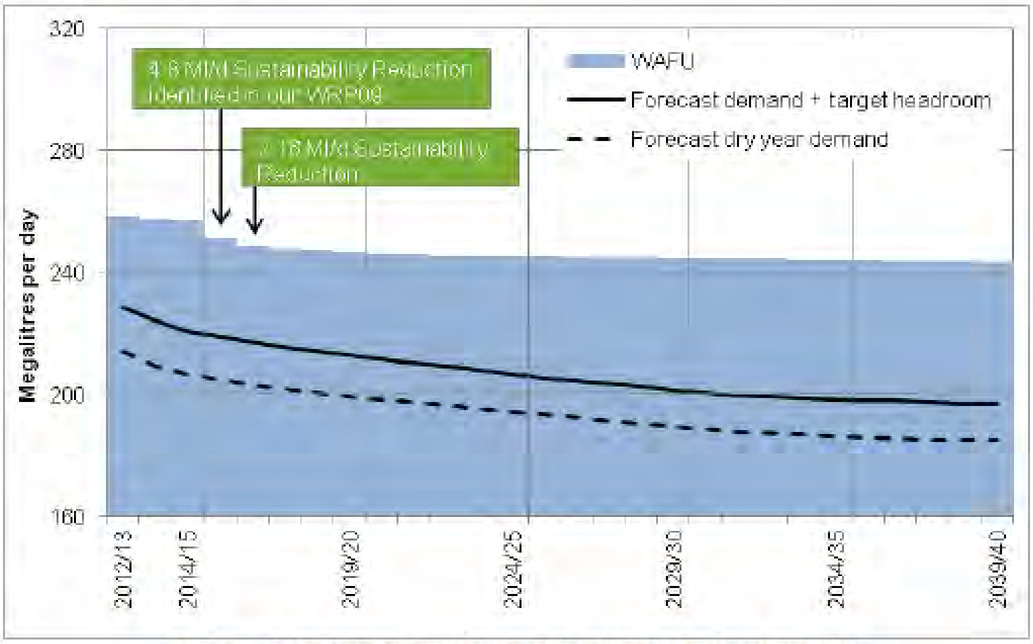


Figure B.2: The baseline supply demand position in the Roadford WRZ

B.3 Wimbleball Water Resource Zone

Extract from section 1.2.4 (page 1.7) of the Water Resources Management Plan (2014):

> Wimbleball Reservoir was constructed by South West Water Authority, the predecessor organisation of South West Water, with part of the financing costs being paid by Wessex Water Authority (WWA). We use the reservoir principally for making augmentation releases to the River Exe for subsequent abstraction near Tiverton and Exeter. These releases support abstractions from the natural flow of the River Exe. Wessex Water uses the reservoir for direct supply.
>
> The Wimbleball WRZ is also dependent on the significant groundwater resources of East Devon.

Extract from section 6.1.3 (page 6.3) of the Water Resources Management Plan (2014):

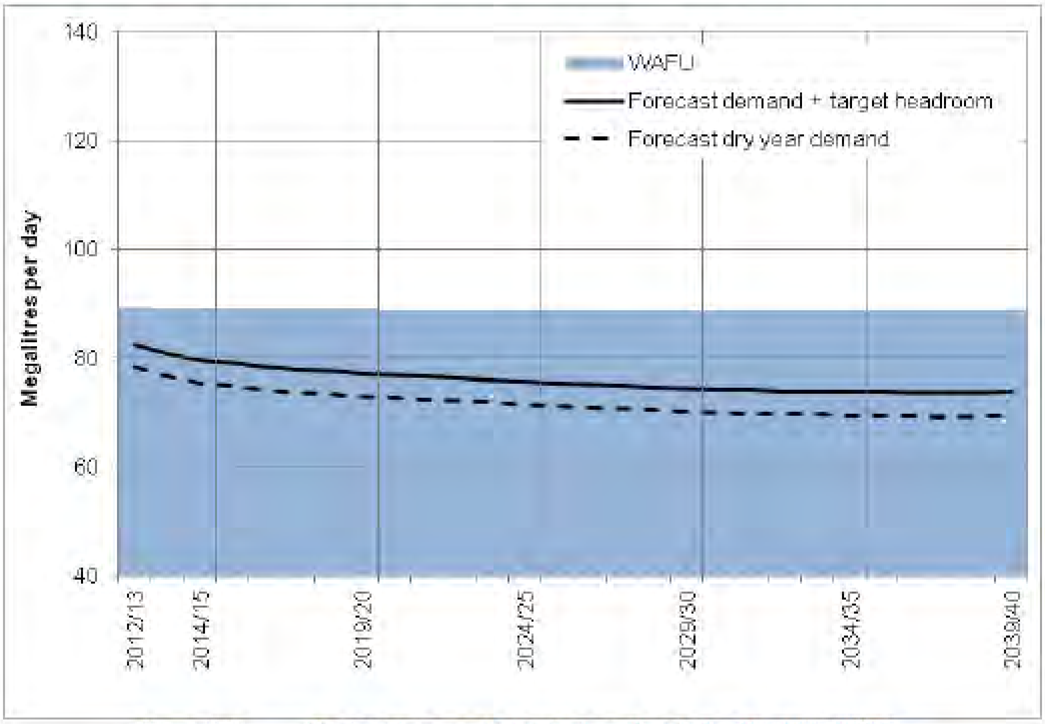


Figure B.3: The baseline supply demand position in the Wimbleball WRZ

APPENDIX C

Extracts from Bournemouth Water Resources Management Plan 2014[30] and Climate Change Adaptation Plan 2015 update[31]

[30] Sembcorp Bournemouth Water (2014) *Water Resources Management Plan* http://www.bournemouthwater.co.uk/company-information/economic-regulation/water-resources-plan.aspx
[31] Sembcorp Bournemouth Water (2015) *Climate Change Adaptation Plan* http://www.bournemouthwater.co.uk/company-information/economic-regulation/climate-change-adaption-report.aspx

Bournemouth Water Resource Zone

Extracts from our Water Resources Management Plan 2014 non-technical summary:

> (Section 1.1, p. 4) We obtain most of the water we supply from two rivers, the Avon in Hampshire and the Stour in Dorset. We also operate a number of boreholes.

Figure C1. The area we supply

Extracts from our Climate Change Adaptation Plan 2015 update:

(Section 3.4.1) The tables below provide the analysis of Company sources and the potential impacts of climate change on these. In all cases, climate change does not affect the ability of the Company to supply our licensed volumes therefore they are constrained by licence only.

Table C1. Surface water sources

Source	Q95 flow	Peak DO	Average DO	Effect of climate change mid scenario on DO
River Stour	179.3	44.3 (Excludes lakes)	44.3	None
River Avon	459.7	177.2	154.5	None

Table C2. Groundwater sources

Source	Estimated reduction in annual minimum groundwater levels	Effect of climate change mid scenario on DO
Ampress	0.1 m	None
Stanbridge	0.3 m	None
Wimborne	0.2 m	None
Woodgreen	0.2 m	None

Extract from our Water Resources Management Plan 2014 tables (dry year annual average):

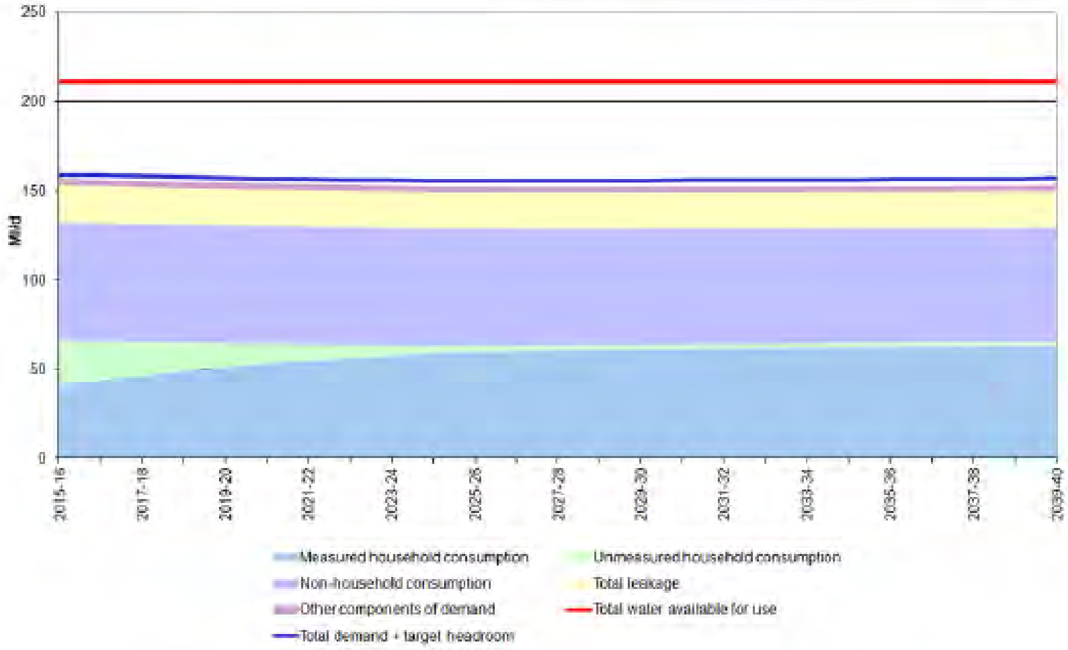


Figure C2. Final Planning Water Supply-Demand Balance for dry year annual average

A.2.1.2 Examples of monthly change flow factors for the 2080s

Examples of the monthly flow factors for selected flow sites in each WRZ are presented in Figures A.2.1 to A.2.4. They indicate that there is considerable variability within a given ensemble member, with no single member giving consistently high or low monthly flow factors across all our WRZs.

Figure A.2.1: Monthly change factors for Colliford Reservoir (Colliford WRZ)

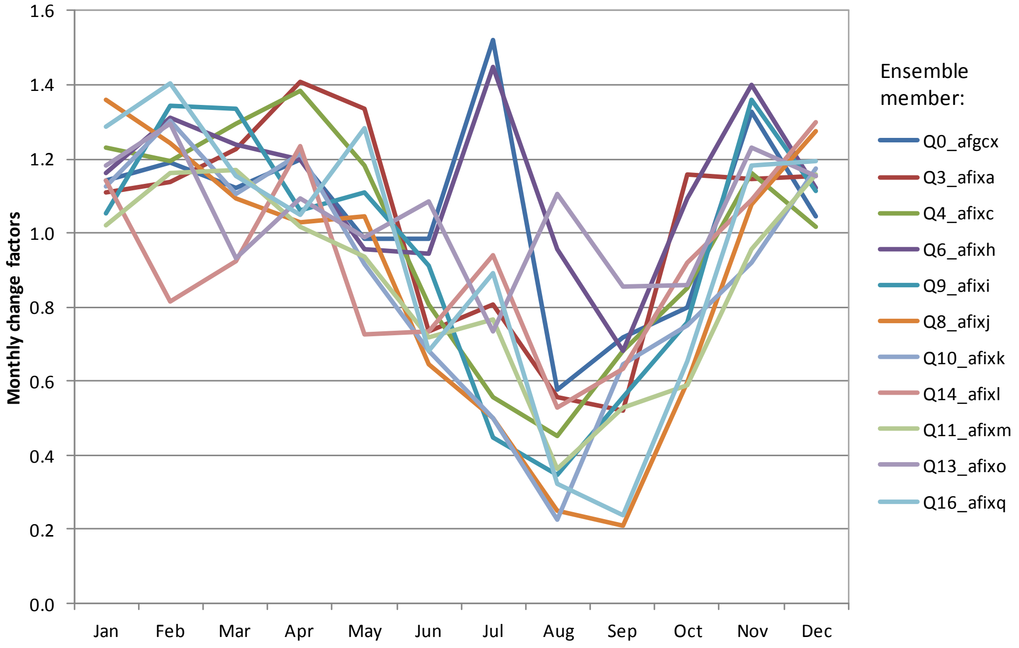


Figure A.2.2: Monthly change factors for Roadford Reservoir (Roadford WRZ)

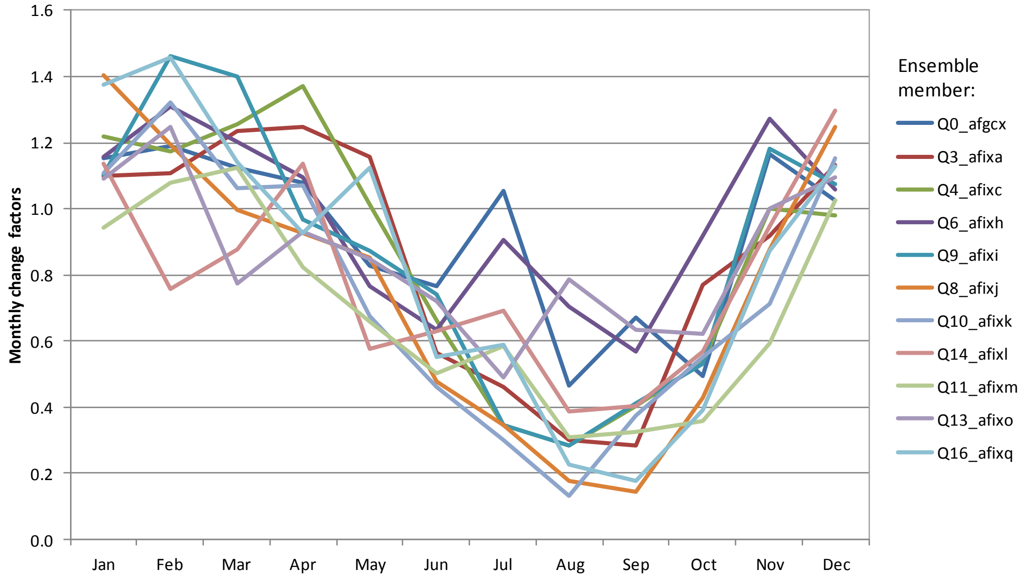


Figure A.2.3: Monthly change factors for Wimbleball Reservoir (Wimbleball WRZ)

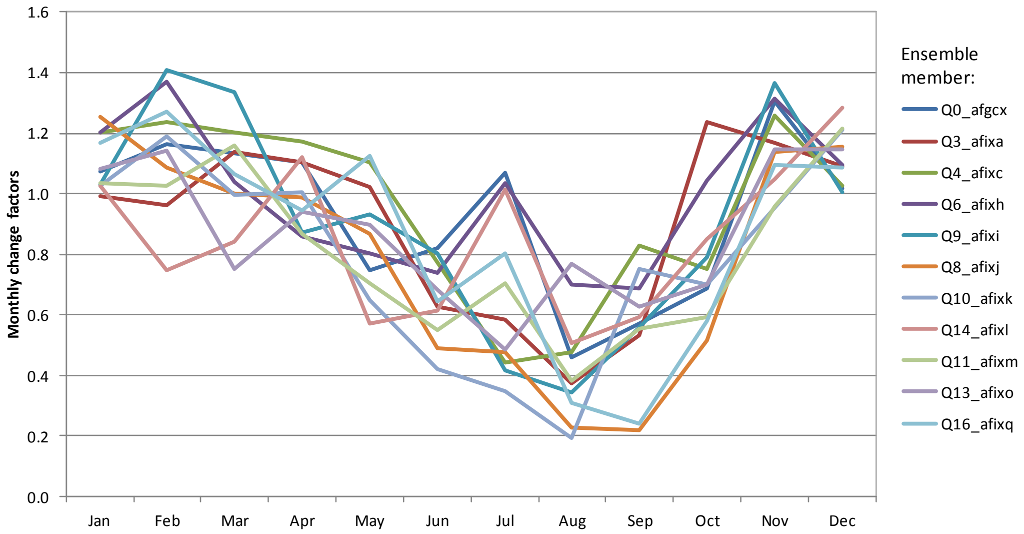
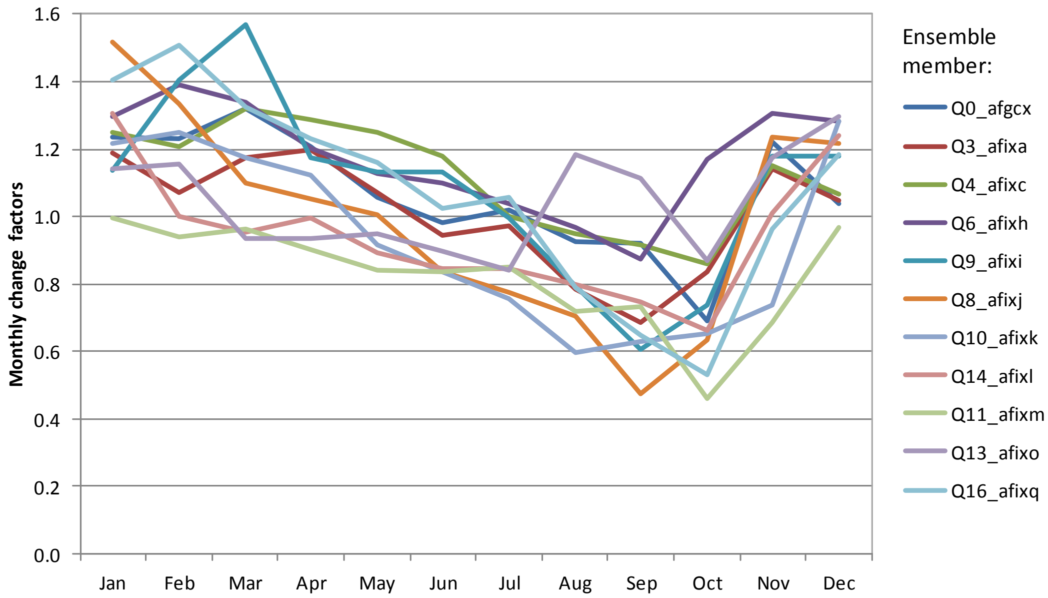


Figure A.2.4: Monthly change factors for Throop Mill (Bournemouth WRZ)



A.2.1.3 Climate change impacts on groundwater Deployable Output

Our groundwater sources are not the dominant source of supply in any of our Water Resource Zones (WRZs). As a consequence, analysis of climate change impact was tailored to provide a level of assessment appropriate to each source using the most suitable techniques and the data available. In carrying out our assessment, we followed the Environment Agency's (2017)[A.2.1] latest Water Resources Planning Guideline building on assessments carried out for WRMP14.

Previous Assessment

For our previous WRMP we commissioned AMEC Environment & Infrastructure UK Ltd (formerly ENTEC UK) to carry out the analysis following WRMP guidelines.

The assessment (REF) focussed on the Wimbleball WRZ where the majority of our groundwater sources abstract from either the Otter Sandstone or Upper Greenand aquifers. Two approaches were used:

- A lumped spreadsheet model
- The Otter Valley Groundwater Model

The lumped spreadsheet model was originally developed by AMEC during AMP4 and subsequently adopted into the methodology for climate change impact assessment as part of the PR14 WRMP planning process.

[A.2.1] Environment Agency and Natural Resources Wales (2017), *Water Resources Planning Guideline: Interim Update. April 2017*

The modelling demonstrated that the majority of our sources remain licence constrained due to high storage in the Otter Sandstone aquifer which limits the impact of climate change on groundwater levels.

Three sources were highlighted as being at risk from climate change:

- An East Devon coastal source
- Two East Devon spring sources

The coastal source is at risk of saline intrusion due to lowering groundwater levels and rising sea levels and its operation is controlled in such a way as to prevent saline intrusion. The assessment concluded that the sources might experience a reduction in DO of 0.9 Ml/d from 3.4 Ml/d to 2.5 Ml/d.

The spring sources were predicted to suffer from 0.3 Ml/d reductions resulting in both sites having DOs of 0.9 Ml/d.

No significant impact was predicted for our groundwater sources in the Roadford and Colliford WRZs.

The previous Bournemouth WRMP concluded that no groundwater sources were at risk from climate change at they are all constrained by licence.

For this WRMP we re-commissioned AMEC to review and update where necessary the climate change impact assessments[A.2.2] and to ensure they followed the latest WRMP guidelines.

The review utilised new data from the Otter Valley Model taken from a comprehensive 2014 investigation carried out by the Agency looking at the implications of climate change and associated rising sea level as part of an Agency project[A.2.3]. The modelling used the 11 UKCP09-based Future Flow climate sequences for 1950 to 2098 and the associated median estimate of rising sea level.

Results from the 11 scenarios for the East Devon coastal source and the two spring sources are given in Tables A.2.1 and A.2.2. They represent possible impacts which might be expected in the 2080s. For the Plan, the values have been averaged and scaled back to indicate potential impacts up to 2045.

[A.2.2] AMEC (2017), *Technical note: South West Water and Bournemouth Water WRMP groundwater deployable output and environmental flow resilience in relation to climate change and plausible severe droughts*
[A.2.3] Environment Agency (2014) *Combined report – Groundwater abs reform-FINAL*

Table A.2.1: East Devon coastal source DO impact from climate change

Impact from CC (m3/d)	734	298	326	278	291	654	672	616	887	483	532
	Flows1	Flows2	Flows3	Flows4	Flows5	Flows6	Flows7	Flows8	Flows9	Flows10	Flows11
	afixA	afixC	afGcx	afixH	afixI	afixJ	afixK	afixL	afixM	afixO	afixQ
Deployable Output (m3/d)	3400	3400	3400	3400	3400	3400	3400	3400	3400	3400	3400
CC impacted DO (m3/d)	2666	3102	3074	3122	3109	2746	2728	2784	2513	2917	2868

Table A.2.2: East Devon spring sources DO impact from climate change

% flow loss in drought	-9.5%	21.5%	-0.4%	13.4%	-8.8%	45.3%	3.2%	5.0%	-28.1%	-0.2%	-6.2%
	Flows1	Flows2	Flows3	Flows4	Flows5	Flows6	Flows7	Flows8	Flows9	Flows10	Flows11
	afixA	afixC	afGcx	afixH	afixI	afixJ	afixK	afixL	afixM	afixO	afixQ
Drought DO (m3/d)	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
CC impact (m3/d)	-105	236	-5	148	-97	498	36	55	-309	-2	-69
CC impacted DO (Ml/d)	1000.0	1300.0	1100.0	1200.0	1000.0	1600.0	1100.0	1200.0	800.0	1100.0	1000.0

Groundwater sources in the Bournemouth WRZ were assessed using historical data and the Wessex Basin Groundwater and River Flow Model. The groundwater level change factors provided by the FFGWL project have been used for the observation borehole (OBH) at West Woodyates Manor within the Hampshire Avon catchment. The analysis confirmed that all groundwater sources in the Bournemouth WRZ continue to be constrained by licence and that their DOs are not affected by climate change.

A.2.1.4 Climate change impacts on WRZ WAFU

For each of our WRZs, we have analysed the impact of climate change for each of the 11 Future Flows ensemble members.

There is no climate change impact on Bournemouth WRZ WAFU for any of the 11 climate change ensemble members, because all sources are licence constrained.

The impact of climate change on WAFU in the Colliford, Roadford and Wimbleball WRZs are given in Table A.2.3.

Table A.2.3: WAFU estimate for the 2080s

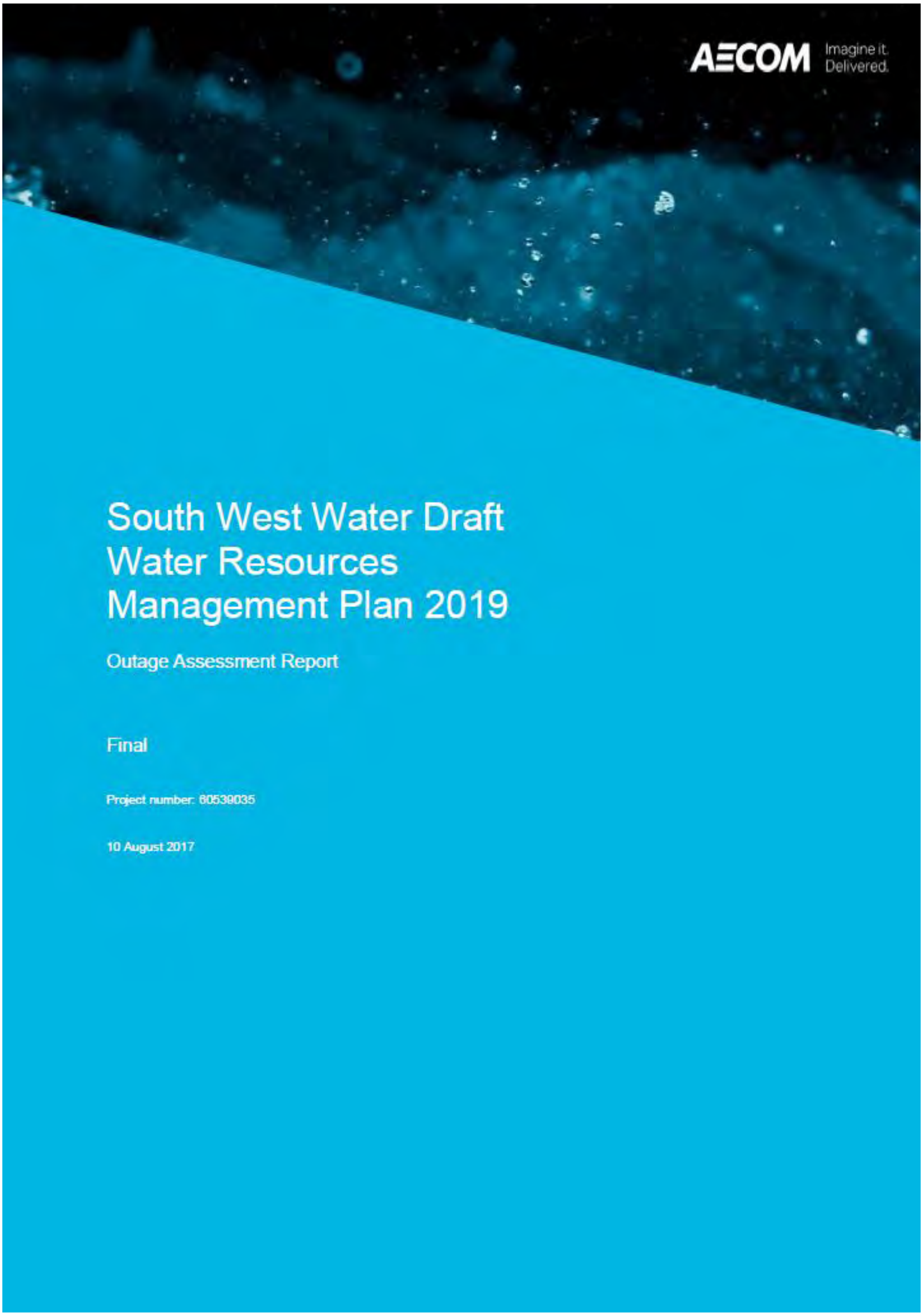
Climate change ensemble member	2080s WAFU (Ml/d)		
	Colliford WRZ	Roadford WRZ	Wimbleball WRZ
No climate change	*164.00*	*251.43*	*92.81*
Q0_afgcx	164.00	246.43	91.81
Q3_afixa	163.00	231.43	91.81
Q4_afixc	163.00	230.43	92.81
Q6_afixh	165.00	245.43	91.81
Q9_afixi	163.00	235.43	91.81
Q8_afixj	157.00	209.43	87.81
Q10_afixk	157.00	213.43	85.81

Climate change ensemble member	2080s WAFU (Ml/d)		
	Colliford WRZ	Roadford WRZ	Wimbleball WRZ
Q14_afixl	158.00	226.43	91.81
Q11_afixm	153.00	217.43	87.81
Q13_afixo	164.00	238.43	91.81
Q16_afixq	162.00	224.43	91.81

A.2.2 Outage

A.2.2.1 Outage assessment report

SWW commissioned Aecom to undertake the outage assessment for SWW and Bournemouth supply areas. The outage assessment report by Aecom is presented below.



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South West Water Draft Water Resources Management Plan 2019

Outage Assessment Report

Final

Project number: 60539035

10 August 2017

South West Water Draft Water Resources Management Plan 2019

Project number: 60539035

Quality information

Prepared by	Checked by	Approved by
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South West Water Draft Water Resources Management Plan 2019

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1. Introduction

1.1 Background

South West Water (SWW) is required to submit an Outage Allowance (OA) assessment to the Environment Agency (EA) and the Office of Water Services (OFWAT) every five years as part of its draft Water Resources Management Plan (dWRMP) 2019 submission. SWW now includes Bournemouth Water (BW) in its dWRMP2019 and this is the first Periodic Review in which BW has been included in SWW plans.

Outage is defined as 'short-term losses of supply and source vulnerability'. [1] The purpose of assessing a water company's outage is to calculate an allowance for inclusion within the supply/demand balance, to cover the amount of deployable output (DO) that may be unavailable for use at any given time, due to planned or unplanned outage events. Planned events include temporary shutdown of plant for routine maintenance, and unplanned events include less predictable shutdowns due to such factors as turbidity, power or system failure and source pollution.

Both South West Water and Bournemouth calculated a suitable outage allowance to incorporate within the supply/demand balance, for their Final Water Resources Management Plans (WRMP) 2014[2 3]. A summary of the results is given in Table 1-1, and is discussed further in Section 3.3

Table 1-1 WRMP14 Outage Allowance for SWW and BW

Water Resource Zone (WRZ)	Assumed Outage (Ml/d)
South West Water	
Colliford (Dry Year Annual average and Critical Period)	1.0
Roadford (Dry Year Annual average and Critical Period)	1.0
Wimbleball (Dry Year Annual average and Critical Period)	5.0
Bournemouth Water	
Bournemouth (Dry Year Annual Average)	5.58
Bournemouth (Dry Year Critical Period)	4.30

Note: Calculated outages in the SWW Colliford and Roadford Zones were very small therefore, as for WRMP09, *de minimus* values of 1 Ml/d were assumed.

The values for Wimbleball Water Resource Zone[4] (WRZ) and Bournemouth were derived from Monte Carlo simulations to combine probability distributions of outage duration with outage magnitude and frequency for each sourceworks (a combination of sources from which treated water is pumped into supply) and outage category. Outage allowance values were selected from the combined probability distributions at the 95th percentile (i.e. 95% of occurrences will be equal to or less than the assumed outage value). A *de minimis* of 1 Ml/d was applied to Colliford and Roadford WRZs as very few outage events were identified for these.

This analysis was completed in accordance with the Environment Agency's Water Resources Planning Guideline[5] (WRPG) and the supporting guidance in the UKWIR WR27 DO report (2012).

[1] Environment Agency and Natural Resources Wales (2017) – Interim WRPG update FINAL April 2017
[2] South West Water (2014) Final Water Resource Management Plan [online] available at: http://www.southwestwater.co.uk/index.cfm?articleid=1556
[3] Bournemouth Water. Water Resource Management Plan. Final Water Resources Management-2014 Technical Report. http://www.bournemouthwater.co.uk/company-information/economic-regulation/water-resources-plan.aspx
[4] A Water Resource Zone is the largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall
[5] Environment Agency (2012), Water Resources Planning Guideline (WRPG)

1.2 Current Report Objectives

AECOM has been commissioned to undertake the re-assessment of the OA for SWW's dWRMP2019 (and including BW OA for the first time).

The aim of the outage assessment is to calculate probability distributions of allowable outage for each outage category, sourceworks and planning scenario, and then to combine these into overall probability distributions of company allowable outage for each planning scenario. Outage allowance values can then be determined from the distribution for each period at an appropriate probability or level of risk.

The key objectives of this analysis can be summarised as follows:

- Review SWW and BW sourceworks output data and identify all events that may be classified as an outage;
- Categorise events according to cause, magnitude and duration of outage;
- Identify events which may be classified as legitimate outage events;
- Develop suitable probability distributions to represent allowable outage for each sourceworks based on event magnitudes, durations and frequencies observed in the data set; and
- Combine the individual probability distributions into single company distribution representing the range of outage allowances at alternative risk levels.

In the current report, Section 2 provides the methodology used to undertake the OA assessment and an analysis of the recorded outage data. Section 3 outlines the modelling assumptions and summarises the results of the assessment, and Section 4 provides conclusions and recommendations.

2. Outage assessment methodology

Both SWW and BW have adopted the standard method for the calculation of outage allowance, developed by UKWIR in 1995 and recommended by the Environment Agency (EA) in their WRMP19 methods paper.[6] The full methodology is outlined in 'Outage Allowances for Water Resource Planning: Operating Methodology'.[7]

In this approach, a probability distribution is assigned to each outage category, based on known data and other relevant information relating to event magnitude (deployable output loss in megalitres/day), event durations (number of days) and event frequencies (average number of occurrences per year). The probability distributions are then combined using the statistical technique of Monte Carlo simulation, which iteratively takes random samples from each distribution and sums them according to specified rules. The summed result of each iteration then forms a point on the curve of the combined distribution; by sampling the distributions over a large number of iterations it is then possible to build up a probability distribution to represent the combined company allowable outage for all sourceworks and categories.

The Monte Carlo simulation software @RISK was used for the analysis, which operates in conjunction with the Microsoft Excel spreadsheet package.

Due to the random nature of the Monte Carlo simulation technique, it is not possible to guarantee that identical results will be generated each time the same simulation is run. However, by selecting a suitably large number of iterations for the simulation, to give an acceptable mean standard error for the simulation results, it should be possible to obtain repeatable results to an acceptable level of accuracy. All Monte Carlo simulations undertaken for this outage assessment have been run for 10,000 iterations, which in practice gives fairly consistent results.

For the Final WRMP 2014, SWW based all its supply/demand balance analysis on three WRZ's. Whilst for BW, a single company-wide WRZ applied in their supply area. This approach is continued for the dWRMP2019, and for this assessment, and therefore the analysis of outage allowance will be carried out for these four WRZs.

Key outage categories (causes for a temporary or short-term losses of supply) were identified both from the recommended categories outlined in the UKWIR report and from data provided by the two companies. The outage categories adopted for this analysis are listed in Table 2-1.

Table 2-1 Outage Categories

Name	Description
Power failure	Temporary loss in power resulting in reduced output or complete works shutdown
Plant failure	Failure in the treatment process resulting in reduced output or complete works shutdown
Turbidity	Source water turbidity resulting in reduced output or complete works shutdown
Maintenance	Planned maintenance of assets resulting in reduced output or complete works shutdown
Low flows	Low flows in surface water sources resulting in lower abstraction rates hence reduced outputs
Flooding at Dotton[8]	Outage at Dotton boreholes 1 and 3 due to river flooding

[6] Environment Agency WRMP19 methods: Outage allowance (July 2016)
[7] UKWIR UK Water Industry Research (UKWIR) (1995), Outage Allowances for Water Resource Planning: Operating Methodology, 1995
[8] Dotton WTW – Dotton boreholes No.1 and No.3 suffer from contamination during times of river spate and are automatically shut down until the water quality is once again acceptable for supply.

2.1 Analysis of recorded data

The outage analysis has been completed using data from SWW and BW. A summary of the methodology and results is given here in the next section. The full listing of all data provided to AECOM is included in Appendix A.

The data provided has included a series of spreadsheets containing sourceworks output data and reservoir storage levels for a five year period 2012-2016 inclusive for SWW, and sourceworks output data for a 4 year period 2013-2016 inclusive for BW. Outage has been defined as *when output of a sourceworks falls to 30% below the 30 day running average AND the strategic reservoir in the WRZ is less than 90% full (see Appendix B)*. This approach is similar to the approach taken in WRMP14 as it takes into account daily variations or seasonal output fluctuations in output which are less than 30% and unlikely to be legitimate outages that reduce the DO.

The first step was therefore to use the data provided to calculate the 30 day running average output for each source. This data was then uploaded into a data visualisation software known as QlikSense[9]. This software was used to define the outage events by evaluating when each source fell below 30% of the 30 day running average, the period of time each event lasted and the loss in output from the source as a result. This data was then exported into Excel and each outage event was compared to the levels in the strategic reservoir i.e. Colliford Reservoir, Wimbleball Reservoir and Roadford Reservoir. Events that occurred when the reservoir was equal to or greater than 90% full were removed as these are not defined as an outage. It should be noted that Bournemouth WRZ does not have a strategic reservoir therefore all events identified were considered to be outages.

The final list of identified outage events were returned to SWW to enable categorisation of the outages as explained in Section 2. Once the categorisation was received, the final spreadsheet that included each outage events across the WRZ's, the duration of the event, the loss of output as a result of the event and the reason for the event (category of outage), was uploaded into QlikSense. This software was used to organise the data to enable efficient analyses to be undertaken, for example, determining which outage event was most prevalent (at the site level, WRZ level or company level), which time of the year most outages were experienced, and which site experienced the most outages etc. The frequency and duration of each event was also included in QlikSense at this stage in order to enhance the analysis as well as to allow quick extraction of the required data for the probabilistic modelling stage.

2.2 Determination of Legitimate Outage

SWW has discounted all outages when the strategic reservoir in the WRZ is above 90% full. This is because a drop in WTW output at times of high storage usually reflects operational decisions to optimise the use of sources within a WRZ and minimise the cost of production. This has meant that factors such as the impact of autumn leaf fall, which occurs when reservoirs are recovering, and affects the river quality and hence sourceworks output, have largely been discounted as the strategic reservoirs tend to be more than 90% full during this period. It should be noted that if the reservoir is less than 90% full, then the reduction in output has been counted as an outage and this would likely be the case during drought years.

There were several instances where an operational decision was made to switch off/reduce output from a sourceworks due to limited demand or to balance the network requirements. Although these were initially recorded within the outage database as a planned outage due to an "Operational decision", they were not considered as outage events within the outage assessment. This is because while they are planned events, they do not result from a requirement to maintain sourceworks asset serviceability, and do not represent an unavoidable loss of deployable output. Ultimately these operational decisions would not have been made if the water was needed, and so these were considered to be operational choices rather than outages.

Additional outage events were included at Dotton boreholes to account for the boreholes flooding on occasion (see Appendix B). The duration and frequency of these outages have been selected using 2012-2016 data. The frequency of this event between 2012 and 2016 was 3.2 and the duration was between 2 and 26 days.

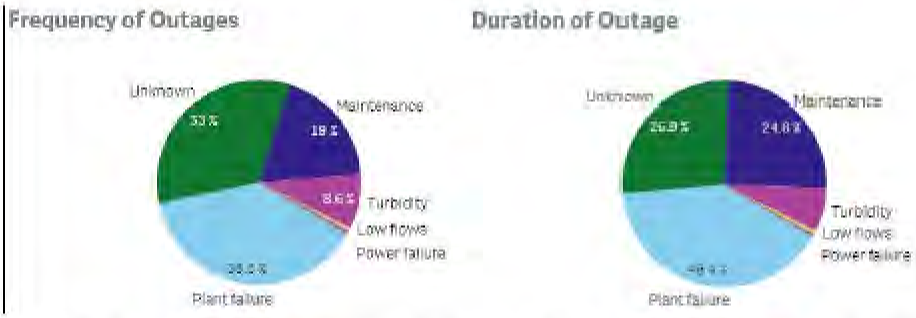
With respect to event magnitudes, all events have been assumed to have an outage magnitude of 100% of the DO. This is likely to be conservative, especially since only 180 out of 475 days of outage (37.9%) resulted in a 100% loss of DO, most of which (149 days) were in the Wimbleball WRZ. Where no outage events were identified at a source works in the 2012-2016 data, a minimum of 1 event lasting 1 day has been applied over a four year time period. The outage assessment is therefore conservative.

[9] www.qlik.com/us/products/qlik-sense

2.3 Summary of Legitimate Outage Events

Following the process described above, a total of 221 legitimate outage events were identified, which lasted a total of 475 days from the period January 2012 till the end of December 2016 in the SWW area, and March 2013 till the end of December 2016 in the Bournemouth WRZ (2012 output data was not available in the Bournemouth WRZ). Of these 221 legitimate outage events, 42 events (lasting 118 days) were planned events while 179 events lasting a total of 357 days were unplanned. Figure 2-1 below shows the distribution of various causes of outage in terms of their frequency and duration across all the WRZ's.

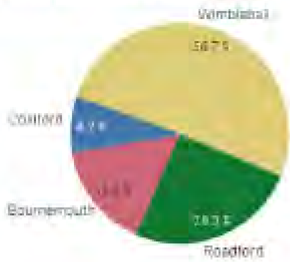
Figure 2-1: Overall frequency and duration of outages across all WRZ's for the period 2012-2016



The majority of known outages were a result of plant failure followed by planned maintenance. It should be noted that there were a large number of events (a total of 73 events lasting 128 days) where the reason for the outage could not be identified, and therefore the main reason for outages cannot be determined with any certainty.

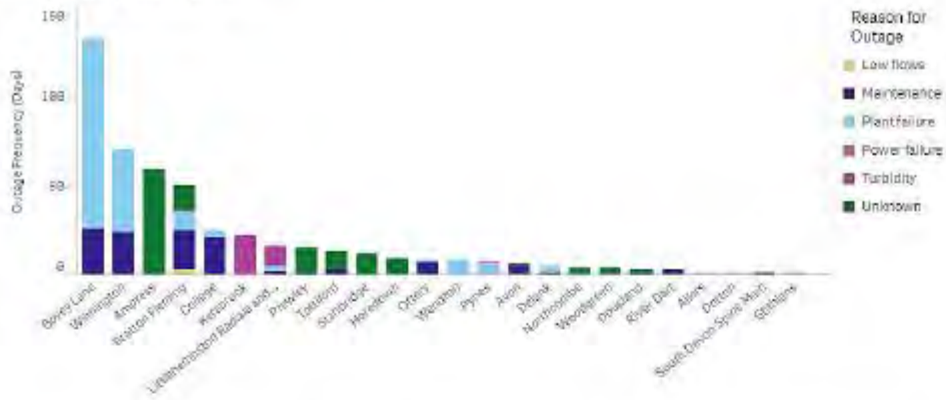
Despite the significant reduction in Wimbleball outage compared to WRMP14 (see Section 3.2), this WRZ still experienced the largest number of outages, which contributed to more than half the outages as shown in Figure 2-2 below. A key reason for this is that this WRZ has a large number of sources and treatment works therefore there is a higher potential for outages. For example Dotton is one treatment works which is supplied by fourteen boreholes, and each of these boreholes could experience an outage for a wide variety of reasons. This is compared to most works in the other WRZ which are fed by only a couple of sources.

Figure 2-2: Number of days of outage experienced by each WRZ



The analysis was further broken down to determine which site experienced the most outages and the most common reason for the outage. This is illustrated in Figure 2-3. Bovey Lane experienced the highest level of outage due to plant failure however this is atypical as most of the outage was caused by one event where the UV plant failed. The required maintenance was not carried out for an extended period of time as it was considered a low priority (as the water was not required).

Figure 2-3: Frequency of outages at sites across all WRZ's



The seasonal distribution of the outages is illustrated in Figure 2-4 below, which indicates that a greater proportion of outages occur from June to December than in January to May. This is the case even if planned maintenance is not considered, as shown in Figure 2-5 below. The reason for this seasonal distribution is not known however the new tool for collating daily water treatment works outages may provide insight into underlying causes and patterns of outages in the future.

Figure 2-4: Seasonal distribution of all legitimate outages across all WRZ's 2012-2016

Figure 2-5: Seasonal distribution of legitimate unplanned outages across all WRZ's 2012-2016

It should be noted that it was not possible to categorise all outage events due to time constraints and an incomplete data set during the period 2012-2016. Generic categories of planned and unplanned outages were therefore used for the probabilistic modelling. In 2017 a new system of recording outage events was implemented therefore a more detailed analysis will be possible in future assessments.

3. Probabilistic modelling assumptions and results

This section outlines the assumptions adopted in determining the sites deployable outputs (DO), and outage event durations and frequencies used to specify the probability distributions for each sourceworks. It also outlines the approach undertaken to complete the probabilistic modelling and provides the final outage results.

3.1 Modelling assumptions

The following assumptions were made in order to complete the analysis:

- Outage results in a 100% loss in DO i.e. all event magnitudes are assumed to be equal to the full DO value of the relevant sourceworks (this is likely to be conservative);
- DO has been calculated as the WAFU – AMP6 Outage, and then spread across the source works in proportion to the treatment works capacity as a percentage of the total WRZ treatment capacity;
- Where no outage events have been identified at a source works in the 2012-2016 data, a minimum of 1 event lasting 1 day has been applied over a four year time period (this is conservative);
- The average duration of an event is identified as the most likely to occur duration (50th percentile);
- AMP 6 Average DO's for Bournemouth have been used; and
- All outage events in the Bournemouth WRZ are categorised as unplanned. This is because limited records were available for this WRZ and therefore it was not possible to categorise events.

3.2 Assessment of results

The results of the probabilistic assessment is summarised in Table 3-1 below (The full results from @RISK spreadsheet is contained in Appendix C). A consistent approach was undertaken for the SWW and BW analysis by defining the outage allowance using the Dry Year Annual Average (DYAA) data.

Table 3-1 SWW Outage Allowance

Zone	Probability 50%	55%	60%	65%	70%	75%	80%	85%	90%	95%*
Colliford WRZ (Ml/d)	0.30	0.32	0.34	0.35	0.37	0.39	0.41	0.44	0.47	**0.51****
Roadford WRZ (Ml/d)	1.94	1.98	2.03	2.09	2.14	2.20	2.27	2.34	2.44	**2.57**
Wimbleball WRZ (Ml/d)	2.48	2.61	2.75	2.89	3.05	3.21	3.4	3.62	3.87	**4.19**
Bournemouth WRZ (Ml/d)	1.66	1.68	1.70	1.73	1.75	1.78	1.80	1.84	1.88	**1.93**
Total company outage allowance Ml/d	6.48	6.61	6.75	6.90	7.06	7.24	7.43	7.65	7.90	**8.77**
Total company outage allowance as % of DO	0.87%	0.89%	0.91%	0.93%	0.95%	0.97%	1.00%	1.03%	1.06%	**1.18%**

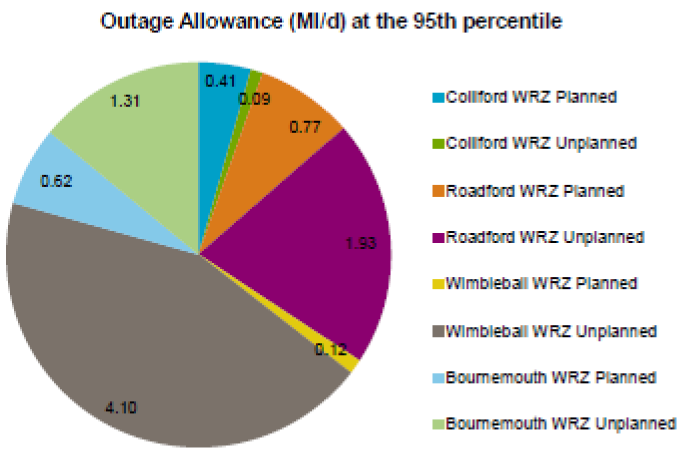
**Outage values to be used in the dWRMP 2019*

*** Calculated outage in the Colliford Zones is very small therefore, as for WRMP14, a de minimus value of 1 Ml/d is assumed.*

The outage values to be taken forward into South West Water's supply/demand balance analysis for dWRMP 2019 are based on the 95th percentile, i.e. the values with a 5% risk of exceedance. The outage allowance value adopted is therefore 8.77 Ml/d. It should be noted that the outage allowance values by WRZ in Table 3-1 do not sum to the company total outage allowance values. This is because the "Risk Output" function of @Risk was used to sum the outage at each site to produce a WRZ outage allowance. By using @Risk to sum the outage at each WRZ, the sums are done in each iteration (a total of 10,000 iterations are run) of the model, as the probabilistic nature of the Monte Carlo simulation allows for the fact that outage events in all WRZ's do not occur simultaneously in each step of the iteration. Simply summing the percentiles at the end would not allow for this and would therefore produce a higher outage allowance. By using @Risk to determine the WRZ outage allowance in this way, it is possible to produce probability distribution graphs which illustrate the range of values that are likely to occur (Appendix D).

The results by individual WRZs also provide an indication of their relative contributions to the combined company total values. Figure 3-1 below shows the main contributory factors to the company's outage allowance. As can be seen, Wimbleball WRZ unplanned events contribute to the most to the total outage allowance. This is in line with the data in Figure 2-2, which shows that Wimbleball had the largest number of outages. As already mentioned in Section 2.3, it is not possible to quantify the reasons for the outage as records detailing the reasons for the outages were not available. The second largest contributor to the total outage allowance is Roadford WRZ unplanned outages followed by Bournemouth WRZ unplanned events.

Figure 3-1: Relative contributions of outage categories to the total outage allowance



In order to understand how each sourceworks contributes to the outage allowance, a summary of the allowance for each sourceworks is shown in Table 3-2. These values have been selected from the allowable outage distribution for each individual sourceworks within the Monte Carlo simulation and the level of accuracy quoted (i.e. three decimal places) is an output from the probabilistic model. Table 3-2 shows only those values read off at the 95th percentile of each sourceworks distribution. Again, it should be noted that the outage values by sourceworks do not sum to the company total outage allowance due to the probabilistic or randomised nature of the Monte Carlo simulation.

Table 3-2: SWW outage allowance by sourceworks, 95% probability

Sourceworks	Outage allowance (Ml/d)
Colliford	
Bastreet	0.005
College	0.381
Delank	0.022
Drift	0.005
Lowermoor	0.004
Restormal	0.047
St Cleer	0.017
Stithians	0.019
Wendron	0.005
Roadford	
Avon	0.040
Bratton Fleming	0.797
Burrows	0.001
Crownhill	0.044
Dousland	0.040
Hore Down	0.033
Littlehempston	1.417
Northcombe	0.034
Prewley	0.265
Tamar Lakes	0.003
Tottiford	0.267
Venford	0.007
Wimbleball	
Allers	0.025
Bovey Lane	0.133
Dotton	3.686
Hook	0.001
Kersbrook	0.040
Ottery Intermediate	0.059
Pynes	0.269
Wilmington	0.123
Bournemouth	
Ampress	0.517
Stanbridge	0.344
Woodgreen	0.080
Alderney	0.591
Knapp Mill	0.498

It can be seen that certain sourceworks contribute the most to the outage allowance, namely College (Colliford WRZ), Littlehempston (Roadford WRZ), Dotton (Wimbleball WRZ) and Alderney (Bournemouth WRZ).

It should be noted that the relative contributions of each sourceworks to the overall outage values reflect mainly the occurrences at these sourceworks within the recorded outage data for 2012-2016 in SWW WRZs and 2013-2016 in the BW WRZ. The apportionment of the outage allowance between sourceworks will not necessarily represent the apportionment of actual recorded outage events in future; however the recent recorded data has been used to produce a representative value for the total company outage that may be expected in future.

3.3 Comparison with previous assessment

In WRMP14, separate outage assessments were carried out by BW and SWW, however this assessment combines the two regions to produce one outage assessment. The SWW outage assessment assumed the Dry Year Critical Peak (DYCP) analysis to be the same as the Dry Year Annual Average (DYAA), and this is consistent with the approach taken for this assessment (see section 3.2). The same approach has been undertaken to define an outage allowance for the Bournemouth WRZ (see Appendix B).

In WRMP14, a Monte Carlo analysis was completed only for Wimbleball and Bournemouth WRZ's as a *de minimis* of 1 Ml/d was assumed for Colliford and Roadford WRZ's. This assessment has run a Monte Carlo analysis for all WRZ's to determine the actual outage allowance, and then assigned a *de minimis* of 1 Ml/d to Colliford WRZ due to the low level of outage.

The dWRMP19 outage allowance is significantly lower than the WRMP09 allowance. Overall reduction in outage is mostly due to reduced outage in Bournemouth WRZ combined with a slight reduction in outage at Wimbleball WRZ (see Table 1-1 and Table 3-3). The main reason for the reduction in Bournemouth WRZ outage allowance is that only observed outage data from past events was used to calculate the outage allowance, unlike in WRMP14 which additionally included a prediction of outage events based on the experience of operational staff. This combined with a change in the methodology for estimating total outage (i.e. using @Risk to sum the individual sourceworks outage values and provide a WRZ outage value rather than rather than summing the sourceworks outage values in the end, which results in a much higher outage value (see Section 3.2)) has resulted in a lower outage allowance for this assessment. There is also a slight reduction in Wimbleball WRZ and this is because borehole pump failure and turbidity issues at Ottery St Mary which were included in WRMP14 were excluded this time round, as the issues with the pumps[10] and raw water turbidity[11] have since been resolved. Outage in the Colliford WRZ is very low therefore a de minimis of 1 Ml/d has been assumed as in the previous assessment. The Roadford WRZ is more than 2.5 times higher.

Table 3-3: South West Water outage allowance at the 95th percentile - comparison with previous results

Submission	South West Water	Bournemouth Water	Combined Outage allowance
	DYAA (Ml/d)	DYAA (Ml/d)	DYAA (Ml/d)
WRMP14	7	5.58	12.6
dWRMP19	6.84	1.93	8.77

[10] The last five years have revealed that the previous high pump failure rate was connected to a particular batch of pumps from a specific supplier. These pumps have now been replaced by pumps from a different supplier and the number of borehole pump failures is now very low. There is therefore no justification for continuing to make allowance for a high risk of borehole pump failure based on our experience over the last five years.

[11] Previously, significant outages in this wellfield were experienced linked to high turbidity on start-up. When boreholes were switched on it was necessary to flush for extended periods to bring down the turbidity to acceptable levels for public supply. Remedial work on the Greatwell boreholes since 2012 and the commissioning of a new borehole adding to the wellfield, has been successful in greatly reducing the flushing time on start-up and hence having a dramatic effect on the amount of borehole outage. There is therefore no justification for continuing to make allowance for extended periods of flushing on start-up based on our experience over the last five years.

4. Conclusions and recommendations

The outage allowance for SWW (including the Bournemouth WRZ), to be incorporated within SWW's supply/demand balance analysis and dWRMP2019 report due for submission in December 2017, is 8.77 Ml/d (or 1.18% of the company's DO). This outage value is for a probability of 95%, or exceedance probability of 5%. The outage allowance is based on two main categories of either planned outage or unplanned outage. Although these categories are considered sufficient to provide an outage allowance, this level of resolution is not considered to be appropriate in understanding the main contributors to outage. More detailed records with respect to the causes of the outage are required to provide this.

4.1 Recommendations

- Improvements in outage record keeping regarding outage events will ensure that for the next AMP cycle a more comprehensive data set is available. This will provide a wider benefit to the business as it will allow a more detailed evaluation of the causes of outage, which can be used to inform investment decisions on how to reduce outages.
- Use data from the new outage data collation tool to investigate the reason for the seasonal distribution in outage.
- Stakeholder comments that arise from the dWRMP19 report should be taken on board for the final WRMP19.

Appendix A – Raw data provided by SWW

Author	Prepared For	Title
SWW	AECOM	Sourceworks inc. WTW capacities
SWW	EA	Water Resources Management Plan_June 2014
Bournemouth Water	EA	Final_Water_Resources_Management_Plan_2014
SWW	AECOM	South West Devon Outputs and Res Storages
SWW	AECOM	Littlehempston Outputs (Roadford)
SWW	AECOM	Plymouth and North Devon Outputs (Roadford)
SWW	AECOM	Miser schematics of three SWW WRZs
Bournemouth Water	AECOM	Bournemouth Water maps
SWW	AECOM	Colliford Outputs and Res Storages
EA/NRW	SWW	Interim WRPG Update FINAL April 2017
SWW	AECOM	Wimbleball Outputs and Res Storages
SWW	AECOM	Bournemouth Outputs and Res Storages
SWW	AECOM	Roadford Outputs revised
SWW	AECOM	Dotton Outputs (2012-16)
SWW	AECOM	Draft WAFU and DO's

Appendix B – Outage Change Log

Date	Change Detail	WRZ/Site	Information provided by SWW	Completed by	Reviewed by
27/04/2017	Reduction in output when the strategic reservoir is more than 90% full removed from the outage log	Colliford, Roadford Wimbleball	27/04/2017 MA confirmed that levels in the reservoir should be used to screen out events where reservoirs were more than 90% full	MPN	
31/05/2017	First draft of model - outage statistics for duration and frequency obtained by AF, HC added 1 planned, and 1 unplanned outage over 4 years period for those sites with no outages and duration of 1 day	Colliford: Roadford: Wimbleball:		HC	
07/06/2017	Second draft - outage statistics for Littlehempston reviewed removing South Devon Spine Main outages as due to operational choices rather than true outage.	Roadford: Littlehempston	05/06/2017 MA confirmed would be operational decision	MPN	
07/06/2017	Need to remove River Dart outages from Littlehempston statistics as again these are operational choices not true outages. 13/06/17 - MPN has identified the 1 planned event and this is included, along with 1 event from the South Devon Spine Main that is not operational.	Roadford: Littlehempston	06/06/2017 MA: River Dart outages are due to operational choice not to use this source due to water quality. Where quality has deteriorated slightly the cost of treatment would increase and as such operationally there is a cut back on the intake and an increase in take from the South Devon Spine Main.	MPN/NM	HC
07/06/2017	All events identified as operational choices removed as these are not considered to be actual outages (operational choices rather than outage)	Roadford: Venford, Tamar, Avon, South Devon Spine main and River Dart		MPN	
06/06/2017	Need to include additional unplanned flooding events at Dotton site that were covered in the last assessment (6 Ml/d redn was reported last time, 6 events and up to 25 days loss of outage - see opp). Need to review this before inclusion. 13/06/17 HC reviewed data under Dotton Boreholes sheet and this is included as extra duration and 2 per year frequency.	Wimbleball: Dotton	06/06/2017 MA: Highlighted that additional events had been added to Dotton site to account for boreholes being flooded on occasion.	NM	
06/06/2017	The two other types of outage added to the Wimbleball last time - excluded this time round because issue with pumps solved with supplier. I think a new b/h was drilled at OSM - but need to check with MA if this is the reason for exclusion.	Wimbleball: Ottery St Mary & all boreholes	05/06/2017 MA: The two other types of outage added last time round are no longer applicable e.g. borehole pump failures and turbidity problems at Ottery St Mary	NM	

06/06/2017	All unplanned outages to be considered real and should be included	Roadford: Bratton Fleming	06/06/2017 MA: The Bratton Fleming outages should be included	NM	
07/06/2017	Stanbridge - Marcus to investigate reason for high level of outage - potentially planned outage	Bournemouth: Stanbridge	Standbridge data provided was instantaneous therefore incorrect - Marcus to send new daily data	MPN	
07/06/2017	Ampress - Marcus' view is that these outages (large nos but small outages should be included)	Bournemouth: Ampress	07/06/2017 MA: The Ampress outages should be included - Need to be checked against new data to confirm previous data is not instantaneous	NM/MPN	
08/06/2017	Duration and Frequency statistics updated to reflect changes to the data	ALL	Some new data for Bratton Flemming reasons for outages and operational decisions removed (Tamar Lakes and Venford affected)	MPN	HC
21/06/2017	Previous Bournemouth data was instantaneous data therefore incorrect outages identified.	Bournemouth	New Bournemouth daily data received - only from 2013-2016.	MPN	
23/06/2017	New draft of DYAA outages issued to Marcus including updated Bournemouth data	ALL		MPN	
22/06/2017	Some assumptions made in the new DYAA outage analysis need to be confirmed by Marcus	Bournemouth	23/06/2017 MA confirmed assumptions were valid	MPN	
28/06/2017	DYCP analysis not required	All	28/06/2017 MA confirmed that due to low level of outage across the company and poor data quality in the Bournemouth region, DYCP analysis is not required	MPN	
17/07/2017	Marcus suggested that Dotton failure frequency to be used should be based on 2012-2016 data only rather than averaging over the 54 years as this is representative of current conditions	Wimbleball	New outage using updated Dotton frequency calculated and sent to Marcus - confirmed that he would like to use this method	MPN	
23/08/2017	Dotton DO increased from 7.9 to 16.2 Ml/d	Dotton, Wimbleball	Email from Marcus on 22/08/17	MPN	

Appendix C – @RISK Spreadsheet Outputs

C.1 Sourceworks Outage Allowance (in Ml/d) by Probability - Colliford

	Bastreet	College	Delank	Drift	Lowermoor	Restormal	St Cleer	Stithians	Wendron	Colliford WRZ Total
50%	0.00	0.18	0.02	0.01	0.00	0.05	0.02	0.02	0.00	0.30
55%	0.00	0.19	0.02	0.01	0.00	0.05	0.02	0.02	0.00	0.32
60%	0.00	0.21	0.02	0.01	0.00	0.05	0.02	0.02	0.00	0.34
65%	0.00	0.23	0.02	0.01	0.00	0.05	0.02	0.02	0.00	0.35
70%	0.00	0.25	0.02	0.01	0.00	0.05	0.02	0.02	0.00	0.37
75%	0.00	0.27	0.02	0.01	0.00	0.05	0.02	0.02	0.00	0.39
80%	0.00	0.29	0.02	0.01	0.00	0.05	0.02	0.02	0.00	0.41
85%	0.00	0.31	0.02	0.01	0.00	0.05	0.02	0.02	0.00	0.44
90%	0.00	0.34	0.02	0.01	0.00	0.05	0.02	0.02	0.00	0.47
95%	0.00	0.38	0.02	0.01	0.00	0.05	0.02	0.02	0.00	0.51

C.2 Sourceworks Outage Allowance (in Ml/d) by Probability - Wimbleball

	Allers	Bovey Lane	Dotton	Hook	Kersbrook	Ottery Intermediate	Pynes	Wilmington	Wimbleball WRZ Total
50%	0.03	0.07	1.97	0.00	0.02	0.04	0.27	0.07	2.48
55%	0.03	0.07	2.10	0.00	0.03	0.04	0.27	0.08	2.61
60%	0.03	0.08	2.24	0.00	0.03	0.04	0.27	0.08	2.75
65%	0.03	0.08	2.38	0.00	0.03	0.04	0.27	0.09	2.89
70%	0.03	0.09	2.54	0.00	0.03	0.04	0.27	0.09	3.05
75%	0.03	0.10	2.71	0.00	0.03	0.05	0.27	0.09	3.21
80%	0.03	0.10	2.89	0.00	0.03	0.05	0.27	0.10	3.40
85%	0.03	0.11	3.11	0.00	0.03	0.05	0.27	0.11	3.62
90%	0.03	0.12	3.36	0.00	0.04	0.05	0.27	0.11	3.87
95%	0.03	0.13	3.69	0.00	0.04	0.06	0.27	0.12	4.19

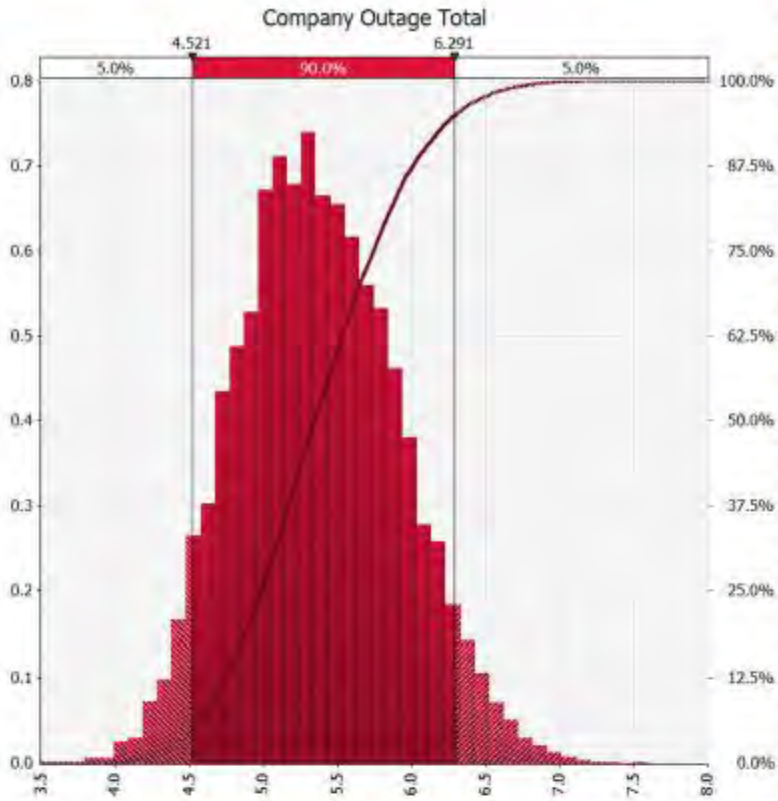
C.3 Sourceworks Outage Allowance (in Ml/d) by Probability – Bournemouth

	Ampress	Stanbridge	Woodgreen	Alderney	Knapp Mill	Bournemouth WRZ Total
50%	0.26	0.22	0.08	0.59	0.50	1.66
55%	0.28	0.23	0.08	0.59	0.50	1.68
60%	0.30	0.24	0.08	0.59	0.50	1.70
65%	0.32	0.25	0.08	0.59	0.50	1.73
70%	0.34	0.26	0.08	0.59	0.50	1.75
75%	0.37	0.27	0.08	0.59	0.50	1.78
80%	0.40	0.29	0.08	0.59	0.50	1.80
85%	0.43	0.30	0.08	0.59	0.50	1.84
90%	0.47	0.32	0.08	0.59	0.50	1.88
95%	0.52	0.34	0.08	0.59	0.50	1.93

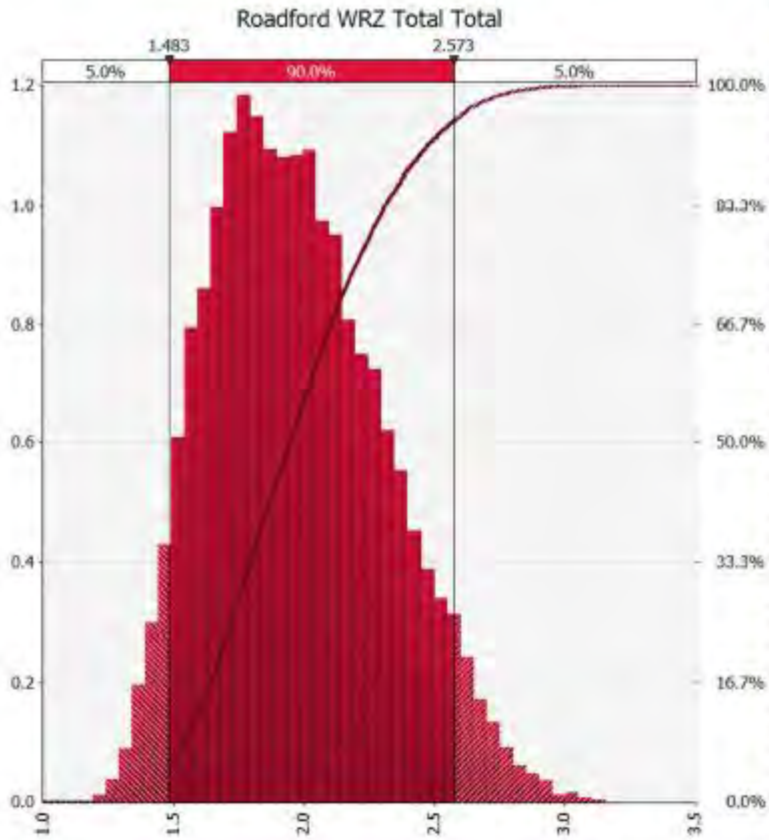
C.4 Sourceworks Outage Allowance (in Ml/d) by Probability – Roadford

	Avon	Bratton Fleming	Burrows	Crownhill	Dousland	Hore Down	Littlehempston	Northcombe	Prewley	Tamar Lakes	Tottiford	Venford	Roadford WRZ Total
50%	0.04	0.50	0.00	0.04	0.04	0.02	0.83	0.03	0.20	0.00	0.19	0.01	1.94
55%	0.04	0.52	0.00	0.04	0.04	0.02	0.87	0.03	0.20	0.00	0.19	0.01	1.98
60%	0.04	0.54	0.00	0.04	0.04	0.02	0.92	0.03	0.21	0.00	0.20	0.01	2.03
65%	0.04	0.57	0.00	0.04	0.04	0.02	0.96	0.03	0.21	0.00	0.21	0.01	2.09
70%	0.04	0.59	0.00	0.04	0.04	0.03	1.02	0.03	0.22	0.00	0.21	0.01	2.14
75%	0.04	0.62	0.00	0.04	0.04	0.03	1.08	0.03	0.23	0.00	0.22	0.01	2.20
80%	0.04	0.66	0.00	0.04	0.04	0.03	1.14	0.03	0.23	0.00	0.23	0.01	2.27
85%	0.04	0.69	0.00	0.04	0.04	0.03	1.21	0.03	0.24	0.00	0.24	0.01	2.34
90%	0.04	0.74	0.00	0.04	0.04	0.03	1.30	0.03	0.25	0.00	0.25	0.01	2.44
95%	0.04	0.80	0.00	0.04	0.04	0.03	1.42	0.03	0.27	0.00	0.27	0.01	2.57

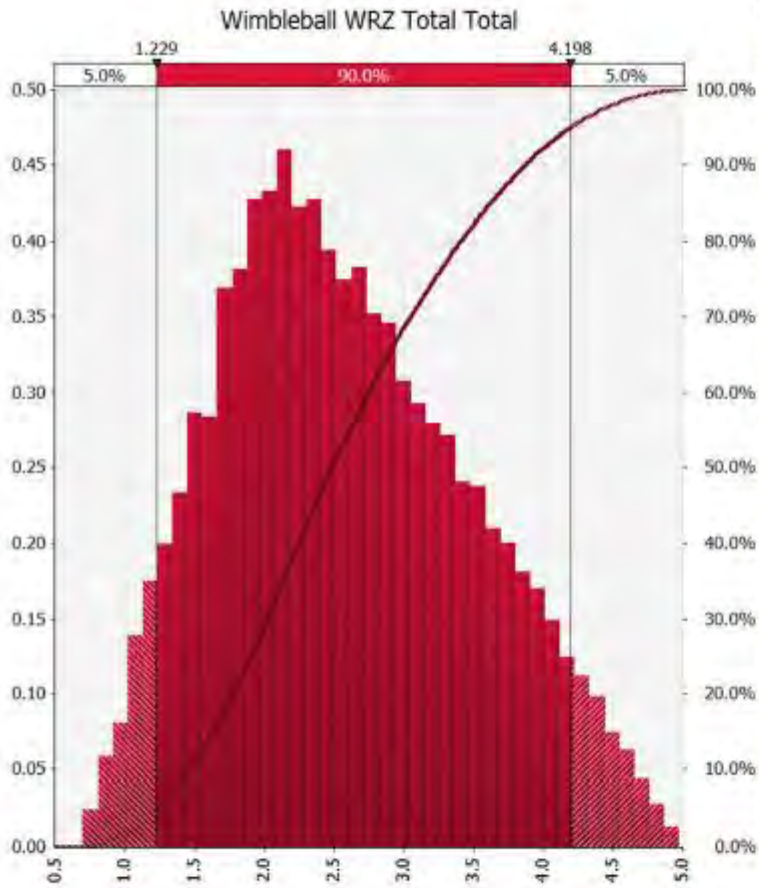
Appendix D - @Risk Graphical Outputs



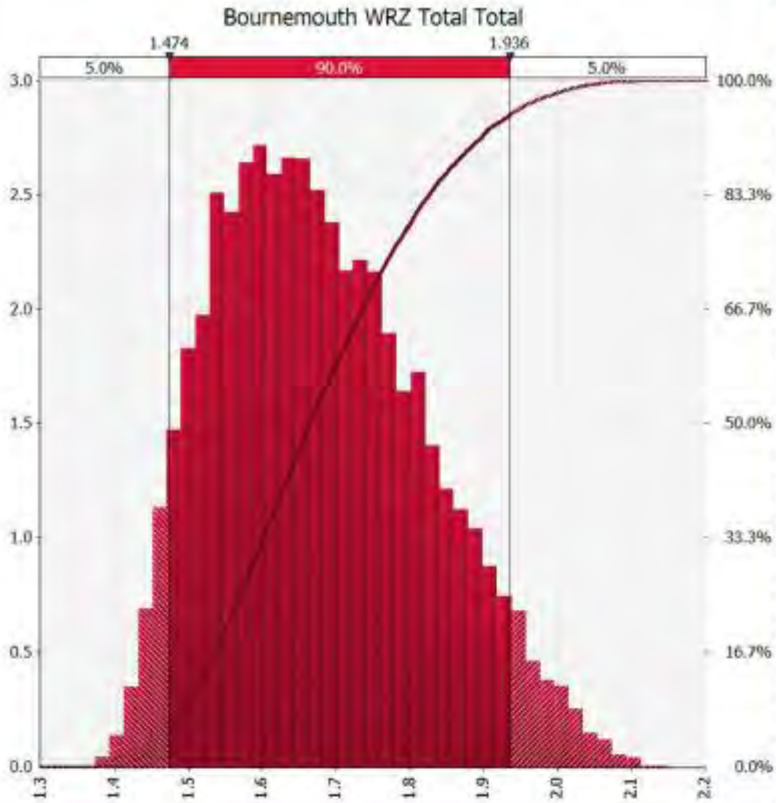
Statistics	Company Outa...
Cell	Simulation!F45
Minimum	3.6971
Maximum	7.6002
Mean	5.3697
Mode	5.2940
Median	5.3409
Std Dev	0.5398
Skewness	0.2045
Kurtosis	2.7823
Values	10000
Errors	0
Filtered	0
Left X	4.521
Left P	5.0%
Right X	6.291
Right P	95.0%
Dif. X	1.7704
Dif. P	90.0%
1%	4.2434
5%	4.5211
10%	4.6875
15%	4.7981
20%	4.8967
25%	4.9858
30%	5.0619
35%	5.1327
40%	5.2007
45%	5.2767
50%	5.3409
55%	5.4162
60%	5.4944
65%	5.5725
70%	5.6512
75%	5.7405
80%	5.8361
85%	5.9428
90%	6.0866
95%	6.2914



Statistics	Roadford WRZ ...
Cell	Simulation!F27
Minimum	1.1372
Maximum	3.1550
Mean	1.9722
Mode	1.7679
Median	1.9424
Std Dev	0.3328
Skewness	0.3991
Kurtosis	2.6836
Values	10000
Errors	0
Filtered	0
Left X	1.483
Left P	5.0%
Right X	2.573
Right P	95.0%
Dif. X	1.0896
Dif. P	90.0%
1%	1.3515
5%	1.4829
10%	1.5613
15%	1.6213
20%	1.6736
25%	1.7208
30%	1.7643
35%	1.8059
40%	1.8496
45%	1.8962
50%	1.9424
55%	1.9881
60%	2.0350
65%	2.0830
70%	2.1359
75%	2.1972
80%	2.2618
85%	2.3384
90%	2.4368
95%	2.5725



Statistics	Wimbleball WR...
Cell	Simulation!F36
Minimum	0.7003
Maximum	4.9783
Mean	2.5825
Mode	2.3032
Median	2.4821
Std Dev	0.8975
Skewness	0.3261
Kurtosis	2.4011
Values	10000
Errors	0
Filtered	0
Left X	1.229
Left P	5.0%
Right X	4.198
Right P	95.0%
Dif. X	2.9692
Dif. P	90.0%
1%	0.9275
5%	1.2287
10%	1.4571
15%	1.6321
20%	1.7759
25%	1.9055
30%	2.0214
35%	2.1318
40%	2.2470
45%	2.3618
50%	2.4821
55%	2.6157
60%	2.7479
65%	2.8925
70%	3.0484
75%	3.2194
80%	3.4054
85%	3.6181
90%	3.8723
95%	4.1979



Statistics	Bournemouth ...
Cell	Simulation!F43
Minimum	1.37359
Maximum	2.15181
Mean	1.67970
Mode	1.66631
Median	1.66456
Std Dev	0.14094
Skewness	0.4133
Kurtosis	2.5583
Values	10000
Errors	0
Filtered	0
Left X	1.474
Left P	5.0%
Right X	1.936
Right P	95.0%
Dif. X	0.46198
Dif. P	90.0%
1%	1.43190
5%	1.47397
10%	1.50429
15%	1.53001
20%	1.55007
25%	1.57041
30%	1.58923
35%	1.60755
40%	1.62690
45%	1.64567
50%	1.66456
55%	1.68426
60%	1.70545
65%	1.72821
70%	1.75089
75%	1.77591
80%	1.80482
85%	1.83685
90%	1.87909
95%	1.93595

Appendix E – DO of sourceworks

The table below summarises the calculated DO's for the sourceworks. DO has been calculated for the Colliford ,Roadford and Wimbleball surface water sources as the WAFU[12] – AMP6 Outage, and then spread across the source works in proportion to the treatment works capacity as a percentage of the total WRZ treatment capacity. DO's for the Wimbleball groundwater sources and Bournemouth WRZ were provided[13]

WRZ	Source name	Deployable Output (Ml/d)
Colliford	Bastreet	6.6
	College	6.9
	Delank	6.6
	Drift	8.0
	Lowermoor	6.6
	Restormal	69.2
	St Cleer	25.5
	Stithians	18.3
	Wendron	13.8
	Colliford WRZ Total	161.6
Roadford	Avon	8.3
	Bratton Fleming	7.2
	Burrows	2.2
	Crownhill	63.8
	Dousland	19.5
	Hore Down	2.7
	Littlehempston	56.3
	Northcombe	36.1
	Prewley	18.8
	Tamar Lakes	4.3
	Tottiford	20.2
	Venford	9.6
	Roadford WRZ Total	249.1
Wimbleball	Allers	24.5
	Bovey Lane	0.5
	Dotton	18.2
	Hook	1.1
	Kersbrook	1.4
	Ottery Intermediate	6.3
	Pynes	52.4
	Wilmington	1.1
	Wimbleball WRZ Total	105.5
Bournemouth	Ampress	2.4

[12] WAFUs for Colliford and Roadford provided on 28/06/2017
[13] Bournemouth Water WRMP14 DO values used for Bournemouth WRZ and draft DO values for Wimbleball provided on 28/04/2017.

	Stanbridge	12.5
	Woodgreen	12.5
	Alderney	107.9
	Knapp Mill	90.9
	Bournemouth WRZ Total	226.2
	Company Total	**731.7**

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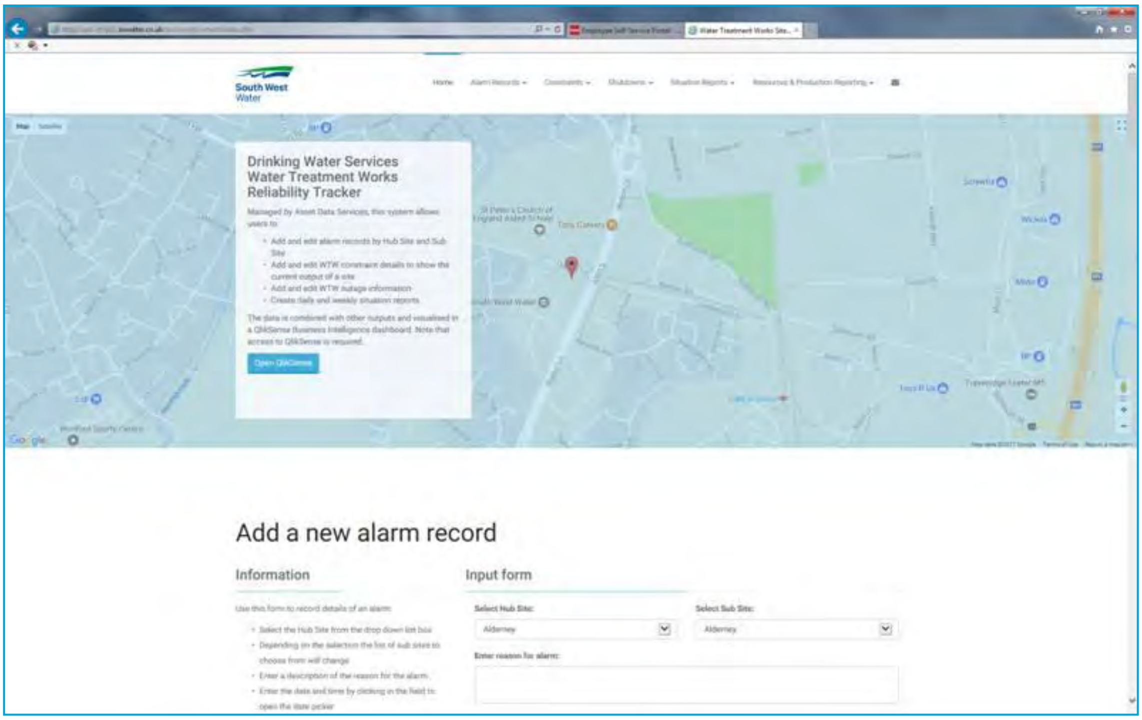
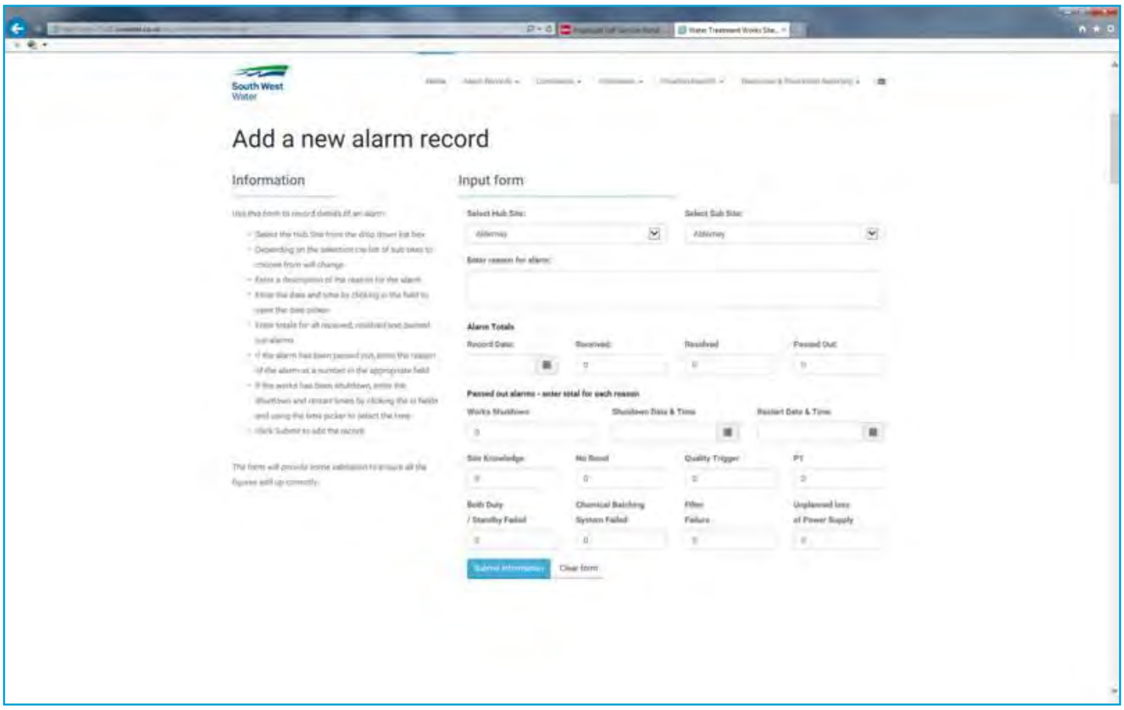
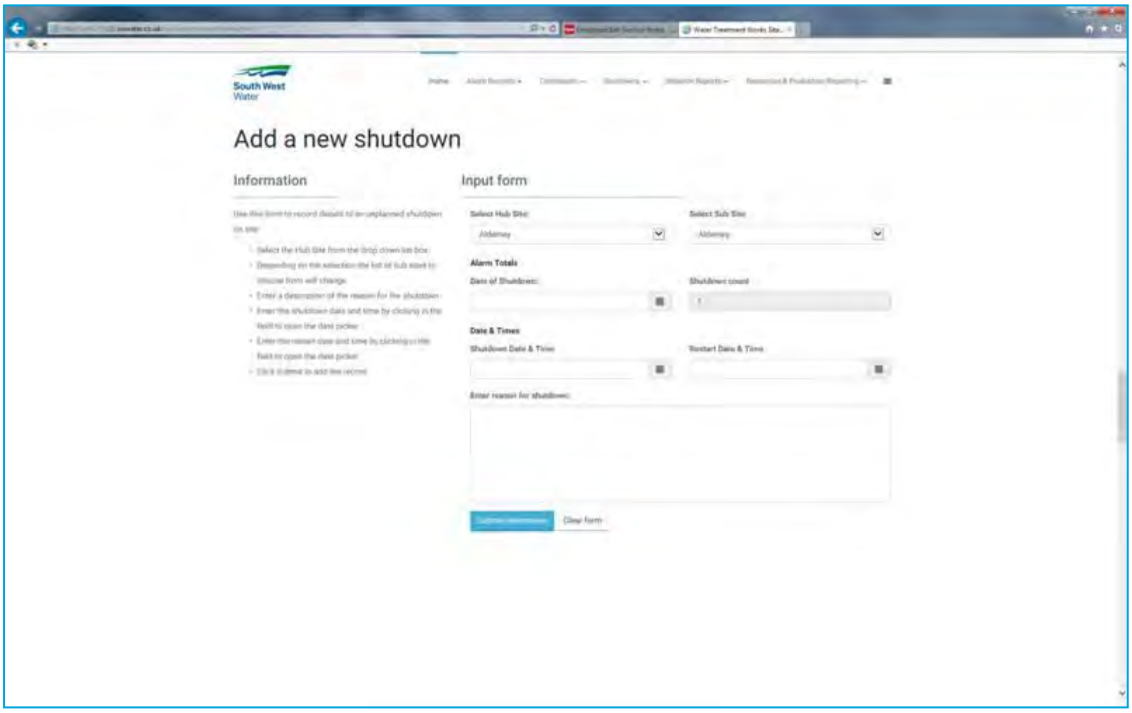
A.2.2.2 Water treatment works reliability tracker

Below are screenshots taken from our new outage information tool which is currently in development. Daily site asset availability information is recorded in the form of alarm records or shutdowns and an assessment is made of the impact on works potential output recorded as a works constraint.

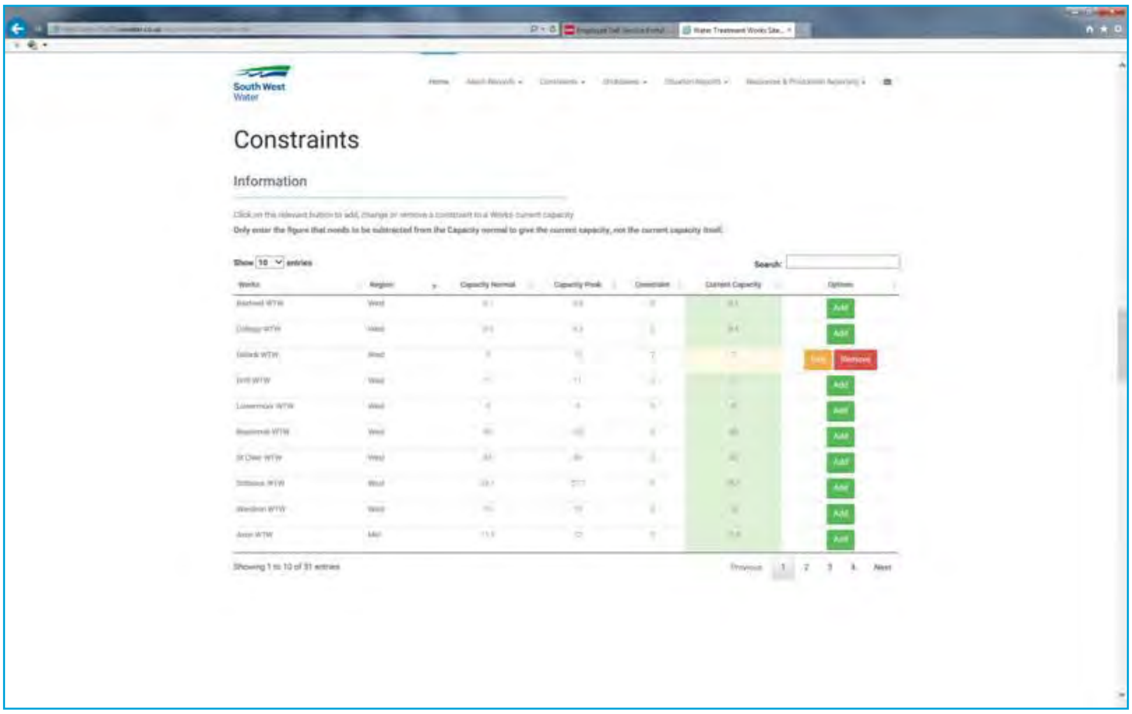
The tool will be extended to include the status of resource assets such as river intakes and boreholes to provide a long term data capture mechanism underpinning an annual outage report which will inform maintenance programmes and investment strategies. In particular, this tool will provide a robust record of the nature of asset interruptions and their consequences which we will integrate into our future WRMP annual reviews.







South West Water Bournemouth Water


South West Water
Constraints
Information

A.2.3 Drinking water quality

South West Water

Peninsula House, Rydon Lane, Exeter, EX2 7HR
www.southwestwater.co.uk

29 November 2017

Milo Purcell
Area 7E, 9 Millbank
c/o Nobel House
17 Smith Square
London SW1P 3JR

Dear Milo

Please accept this letter as confirmation that our draft Water Resources Management Plan (WRMP), for the South West Water and Bournemouth Water regions, has been developed in accordance with all statutory drinking water quality obligations. I can also confirm that our draft WRMP is consistent with our overall business plan in-order to meet our statutory drinking water obligations in full.

In addition to this statement, we will very shortly be sending the DWI a draft copy of our approach to "long-term planning for the quality of drinking water supplies", which is due for submission to the Inspectorate in May 2018. I hope this gives confidence and sufficient evidence to assure the DWI that we understand the future drinking water quality risks and their mitigation in relation to the planning period covered by the draft WRMP.

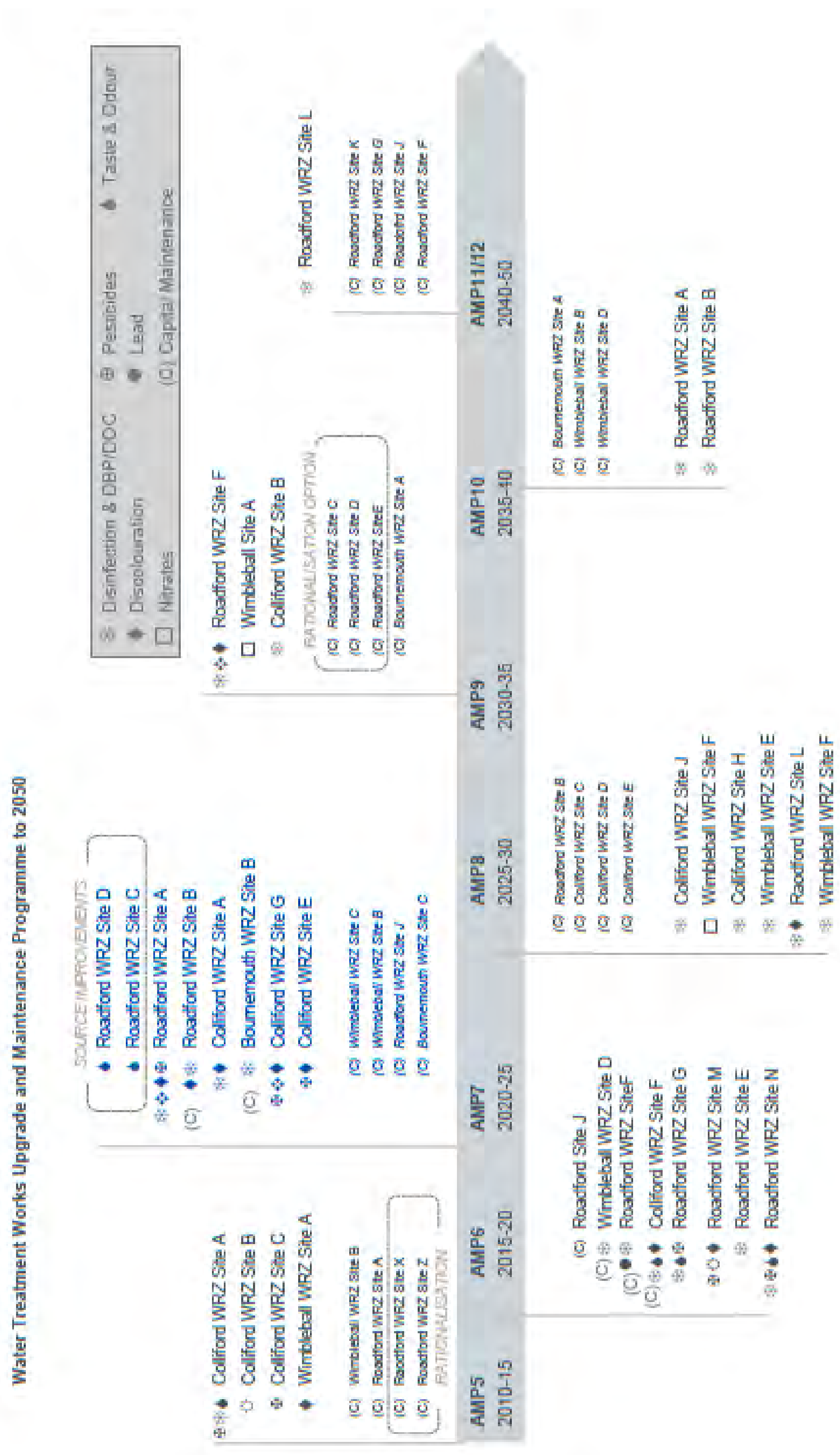
I hope you will appreciate that we are still in the process of developing our PR19 Business Plan, which includes technical assurance of water quality programme. Therefore, we envisage this document evolving as we proceed towards finalising our investment plan.

We would however welcome your comments and continued dialogue as we seek to finalise this document alongside our business plan in the coming months.

Yours sincerely

Bob Taylor
Operations Director - Drinking Water Services

South West Water Limited. Registered in England No 2366665
Registered Office: Peninsula House, Rydon Lane, Exeter EX2 7HR


Water Treatment Works Upgrade and Maintenance Programme to 2050
Disinfection & DBP/DOC
Discolouration
Nitrates
Pesticides
Lead
(C) Capital Maintenance
Taste & Odour
AMP5 2010-15
AMP6 2015-20
AMP7 2020-25
AMP8 2025-30
AMP9 2030-35
AMP10 2035-40
AMP11/12 2040-50
Colliford WRZ Site A
Colliford WRZ Site B
Colliford WRZ Site C
Wimbleball WRZ Site A
(C) Wimbleball WRZ Site B
(C) Roadford WRZ Site A
(C) Roadford WRZ Site X
(C) Roadford WRZ Site Z
RATIONALISATION
(C) Roadford Site J
(C) Wimbleball WRZ Site D
(C) Roadford WRZ SiteF
(C) Colliford WRZ Site F
Roadford WRZ Site G
Roadford WRZ Site M
Roadford WRZ Site E
Roadford WRZ Site N
SOURCE IMPROVEMENTS
Roadford WRZ Site D
Roadford WRZ Site C
Roadford WRZ Site A
(C) Roadford WRZ Site B
Colliford WRZ Site A
(C) Bournemouth WRZ Site B
Colliford WRZ Site G
Colliford WRZ Site E
(C) Wimbleball WRZ Site C
(C) Wimbleball WRZ Site B
(C) Roadford WRZ Site J
(C) Bournemouth WRZ Site C
(C) Roadford WRZ Site B
(C) Colliford WRZ Site C
(C) Colliford WRZ Site D
(C) Colliford WRZ Site E
Colliford WRZ Site J
Wimbleball WRZ Site F
Colliford WRZ Site H
Wimbleball WRZ Site E
Roadford WRZ Site L
Wimbleball WRZ Site F
Roadford WRZ Site F
Wimbleball Site A
Colliford WRZ Site B
RATIONALISATION OPTION
(C) Roadford WRZ Site C
(C) Roadford WRZ Site D
(C) Roadford WRZ SiteE
(C) Bournemouth WRZ Site A
(C) Bournemouth WRZ Site 4
(C) Wimbleball WRZ Site B
(C) Wimbleball WRZ Site D
Roadford WRZ Site A
Roadford WRZ Site B
Roadford WRZ Site L
(C) Roadford WRZ Site K
(C) Roadford WRZ Site G
(C) Roadford WRZ Site J
(C) Roadford WRZ Site F

A.2.4 Invasive Non-Native Species (INNS)

Since the last Price Review (PR14) we have carried out detailed investigations to assess the risk, potential impact of, and solutions for, a range of Invasive Non-Native Species (INNS) on SWW holdings and assets in our SWW supply area[A.2.4] and our Bournemouth Water supply area[A.25].

A.2.4.1 South West Water supply area

For our SWW supply area, the list of target species reviewed included ten INNS plant species and four INNS animal groups. The investigations on INNS had five aims:

- To collate data on current presence of INNS species
- To identify risk pathways for these species (in relation to Water Company assets and activities)
- To develop bio security processes
- To create a rapid response system and increase awareness
- To inform future NEP schemes

The SWW supply area comprises some 2,500 sites, covering 20,000 hectares.

Of these sites, we selected 58 sites for consideration as part of this project, totalling 3,212 ha and amounting to 16% of the company's landholdings. The site selection utilised three main criteria:

- Any site with recreational activities
- Size of site (including all clean water sites over 5 ha and waste water sites over 3 ha)
- Site designation as a Site of Special Scientific Interest (SSSI)

Following our surveys and desk top studies, eight of the target INNS species have been confirmed in our water supply assets (these are marked in red on the Table A.2.4) and four species are known to be in the region (highlighted in blue). INNS that were included in the PR14 National Environmental Programme (NEP) are listed in Table A.2.4. There are no known positive records in Cornwall and Devon for the remaining INNS.

Table A.2.4: Target INNS in the National Environmental Programme (NEP)

Fresh water plants	Terrestrial plants	Animals
Curly water thyme	Giant hogweed	Demon and Killer shrimps

[A.2.4] SWW (2017), *South West Water Investigation – Invasive plants and fish*
[A.2.5] SWW (2017), *Bournemouth Water Investigation – Invasive plants and fish*

Fresh water plants	Terrestrial plants	Animals
Floating pennywort	Himalayan balsam	Signal crayfish and other INNS crayfish
New Zealand pygmyweed (Crassula)	Japanese knotweed, Giant knotweed and hybrids	Topmouth gudgeon and other INNS fish
Parrots feather		Quagga and Zebra mussels
Water fern		
Water primrose		

Additionally to the target INNS, there are other INNS the presence of which we have investigated. This resulted in 32 INNS plant species (including the target INNS) identified within the surveyed sites (14 of these species are listed on schedule 9 of the Wildlife and Countryside Act 1981). The total area coverage of INNS that has been recorded is 41 ha, 33 ha of this being New Zealand pygmyweed at Roadford Reservoir. In addition to New Zealand pygmyweed, the most frequently occurring species are Japanese knotweed, rhododendron, montbretia, buddleja and winter heliotrope.

Control has historically focussed on Japanese knotweed, but no effective form of control currently exists for New Zealand pygmyweed. South West Water is the first water company to sponsor trials for innovative control measures on this INNS using a mite.

Control of two further plants is particularly important. These include Giant hogweed, which has health and safety implications, and American skunk cabbage, a European Union species of concern (occurring at Countess Wear Sewage Treatment Works and Drift Reservoir respectively).

Only two INNS animals, signal crayfish and ruffe, were confirmed on SWW assets. Signal crayfish were confirmed at two sites, Burrator and Roadford. It is important to carry out further surveys as these species are expected at Wimbleball and potentially other reservoirs. Monitoring programmes and awareness schemes are essential at the confirmed sites. Ruffes are considered INNS in the South West and these fish were found at three sites: Bussow, Colliford and Crowdy. Fish surveys identified three further sites considered of high risk of future colonisation, highlighting six sites in total. These include:

- Bussow Reservoir
- Colliford Reservoir
- Crowdy Reservoir
- Cargenwen Reservoir
- Lower Tamar Lakes
- Porth Reservoir

No target INNS fish, shrimp or mussel species have been identified to date, but, despite the lack of records, it is important not to be complacent and vigilant monitoring will be required.

While no Zebra mussels were found on water company assets, the presence of this highly invasive species on the Bude Canal is a concern, particularly for potential spreading by kayakers and fishermen to Roadford and Tamar Lakes.

A risk matrix has been developed in order to prioritise sites requiring action to control INNS. 30 sites have been identified at high risk of INNS colonisation/spread as listed in Table A.2.5. As reservoirs represent a major source and receptor risk, our Roadford WRZ, with a large number of reservoirs, is of primary concern.

Table A.2.5: Sites identified as high INNS risk

Site Name	Water Resources Zone
Siblyback Reservoir	Colliford
Colliford Reservoir	Colliford
Bussow Reservoir	Colliford
Argal Reservoir	Colliford
Crowdy Reservoir	Colliford
College Reservoirs (1-4)	Colliford
Drift Reservoir	Colliford
Porth Reservoir	Colliford
Stithians Reservoir	Colliford
Cargenwen Reservoirs (1-3)	Colliford
Trenchford Reservoir	Roadford
Fernworthy Reservoir	Roadford
Kennick Reservoir	Roadford
Roadford Reservoir	Roadford
Lower Tamar Lakes	Roadford
Upper Tamar Lakes	Roadford
Upper Slade Reservoir	Roadford
Lower Slade Reservoir	Roadford
Old Mill Reservoir	Roadford
Burrator Reservoir/ Burrator Quarry	Roadford
Tottiford Reservoir	Roadford
Lopwell River Intake	Roadford
Wistlandpound Reservoir	Roadford

Site Name	Water Resources Zone
Darracott Reservoir	Roadford
Jennetts Reservoir	Roadford
Gammaton Reservoir	Roadford
Melbury Reservoir	Roadford
Countess Wear Boathouse	Wimbleball
Wimbleball Reservoir	Wimbleball
Countess Wear STW	Wimbleball

These high risk sites include the sites with known signal crayfish populations (Burrator and Roadford), the highest risk sites for INNS fish introduction, and also the sites supporting the highest number of INNS plant species.

A.2.4.2 Bournemouth Water supply area

A similar investigation has been undertaken for our Bournemouth Water supply area. Surveys were carried out on 17 sites and they investigated the presence of INNS plant and animal species. This information was supplemented by desk studies that covered not only our assets and landholdings, but the entire area of water supply (ie Bournemouth WRZ) and both the Dorset Stour and Hampshire Avon catchments.

Desk studies have confirmed that both Hampshire Avon catchment and Dorset Stour have recorded twelve INNS species. As in our SWW supply area, Japanese Knotweed is the most recorded species in both catchments. There are no records of INNS fish, mussels or clams. A total of nine INNS species have been recorded on surveyed sites (Table A.2.6). No INNS were found on neighbouring land. As Bournemouth Water has no raw water reservoirs no INNS fish or mussel surveys have been performed although a shrimp trap was put into Longham Lake and regularly checked. No shrimp were found in the lakes.

Further surveys of INNS fish, mobile crayfish, clams and mussels surveys will be carried out before March 2020 at key sites at risk including the river Stour at Longham, Longham lakes and Ibsley lake at Blashford.

Table A.2.6: INNS priority species sites identified within Bournemouth WRZ (non priority identified shown in red)

Site Name	Species
Alderney WTW	Rhododendron
Ampress WTW	Himalayan Balsam, Japanese Knotweed
BW WTW	Canadian Pondweed
River Avon	Himalayan Balsam, Japanese

Site Name	Species
	Knotweed
Longham WTW	New Zealand Pigmyweed, Japanese Knotweed, Nuttall's Pondweed, Canada Goose, Pampas Grass
Woodgreen WTW	Rhododendron
Ibsley Lake	Canada Goose, Signal Crayfish, North American Mink, Ruddy Duck, New Zealand Pigmyweed, Waterweeds, Cherry Laural, Common Carp, Egyptian Goose, Wels catfish

The risk matrix was also used for Bournemouth Water sites in order to identify priority sites requiring action for bio security and to control INNS. The outcomes of the risk matrix are that, in general, the highest risk for all our sites represent wildfowl and other wildlife, followed by road vehicles (attached to tyres etc), staff site visits (attached to clothes and shoes) and specialist contractors entering site.

For both rivers the biggest risk represent moorings and boats, while for Christchurch harbour, high risk could be any kind of boat activities, canoes and fishing. Sites with the highest total risk score are all sites where recreational activities take place. These include River Avon, River Stour, Christchurch harbour and Longham water treatment works with Longham lakes. These sites are also those where most damage to the designated status would occur in case of presence or new introduction of INNS.

A.2.4.3 Next steps (PR19)

Bio security is paramount to prevent the introduction of new INNS and to reduce the spread of known INNS. We have produced an INNS bio security policy and a detailed management plan will be developed to deliver this. A rapid response system has been initiated, with a dedicated email address set up for South West Water staff to report records of INNS. South West Lakes Trust has a similar system in place and will also report to a dedicated staff at South West Water.

A process is in place by which any new records for 'alert' species will be dealt with immediately. INNS identification leaflets have been produced and will be provided to South West Water, South West Lakes Trust staff and volunteers.

Extensive awareness raising work has been undertaken both internally and externally, including national conferences, establishing a regional forum and holding workshops. Further awareness programmes are planned to be launched. Partnership working is essential and good local and national contacts have been established. We are supporting several liaison groups, catchment scale projects and national research on innovative control measures. Data is being shared with Local Record Centres and networks are being developed with other water companies.

In recognition of the increasing problems with INNS, alongside increased pressure from legislation and delivery of the Water Framework Directive, INNS are included in the Water Industry National Environmental Programme (WINEP) for PR19. There are two key elements: investigations into how INNS spread, particularly through water transfers; and action to prevent INNS spreading from our assets by implementing bio security measures.

A.2.5 Abstraction Incentive Mechanism (AIM) – South West Water PR19

A.2.5.1 <u>Background</u>

The Abstraction Incentive Mechanism (AIM) is a regulatory incentive mechanism, which complements the existing tools to reduce abstraction from sensitive sites. These include abstraction licence changes or licence conditions, which require abstractions to cease during periods of low flows.

Thirteen water companies operate abstractions subject to AIM, but no such schemes are required in any of the four South West Water WRZs at present.

We recognise that there is a desire to see further AIM schemes introduced across the country, including the South West, and we are assessing our resources and operations for suitable candidates. We are following Ofwat guidelines on AIM to identify where and how potential schemes might be developed. By way of an example we have investigated how a scheme could be established in the Otter Valley of East Devon.

The recent renewal of time limited licences for a series of groundwater sources in the Otter Valley has highlighted a possible AIM opportunity, which could be developed for PR19.

This example would establish an AIM scheme to help minimise abstraction impacts on the River Otter, which is currently assessed as Poor Ecological Status in the EA River Basin Management Plan covering the Otter catchment (under the Water Framework Directive (WFD) umbrella). Our approach to developing this possible option is discussed in detail below.

Whilst there is no formal requirement for an AIM scheme in our area, we think that if an appropriate scheme can be found we should trial it.

A.2.5.2 <u>Ofwat guidelines</u>

OFWAT guidelines[A.2.6] explain the approach water companies should take when developing AIM schemes. They define the steps companies should take as:

[A.6.6] Ofwat (2016), *Guidelines on the abstraction incentive mechanism.*

- Identify the abstractions sites to which the AIM applies;
- Identify the trigger points for each AIM site;
- Identify the abstraction baseline for each AIM site;
- Capture abstraction data at each AIM site; and
- Report the data through their annual performance report.

Details of how we could address each of the above steps are given below.

A.2.5.3 Identifying the abstractions sites to which the AIM applies

We followed this process for PR14 and at that time no sites were identified as being appropriate within the SWW area. However, the guidelines state that Ofwat would welcome companies including additional AIM sites.

In 2017, we renewed a number of time limited groundwater licences in the Otter Valley. This has indicated that a potential AIM scheme in East Devon could be considered to help balance the needs of the environment with the need to supply water.

An example of an AIM scheme in the Otter Valley – historical abstractions

Groundwater abstraction for public supply has been operating in the Otter Valley of East Devon for over 100 years. An increase in the level of abstraction in the last 40 years has taken place as more boreholes have been drilled, licensed and added to the supply system. SWW and Wessex Water both abstract water from this catchment.

At present, 21 boreholes are operated in the Otter Valley, which typically yield around 25 Ml/d in total. Of this, up to 9.5 Ml/d can be abstracted from four boreholes in the lower part of the catchment. Eight boreholes are covered by time-limited abstraction licences, whilst the remainder are operated under licences with no end date.

The abstractions have been subject to a series of environmental impact assessments since the 1990s to identify their sustainability. Particularly detailed investigations have been carried out in recent years linked to the development of a computer groundwater model, the Otter Valley Groundwater Model, which has provided an increased level of confidence in the assessment of impacts of the abstractions on flow in the River Otter and its tributaries. The renewal of time limited licences earlier in 2017 incorporated a wide-ranging re-assessment, included substantial groundwater modelling, of the impact from all the SWW abstractions in the Otter Valley on the environment.

In relation to the WFD as implemented through UK River Basin Management Plans, the Lower River Otter is categorised as Poor Ecological Status. This is in part due to failure of the hydrological test for surface waters supported by groundwater inflows. At the current levels of abstraction, this failure occurs due to predictions of impacted flows at times of low flow (Q95 conditions) being below the Environmental Flow Indicator (EFI) level.

To reduce impacts, changes to the abstraction licences in 2017 included a reduction in permitted annual volumes and a stream support scheme operating at times of low flow. Although this reduced the predicted deficit below the EFI by several Ml/d, a small deficit still exists.

As part of the renewal of abstraction licences, the EA has requested that SWW enter into discussions with the EA to identify options which will help bring the catchment into Good Ecological Status. One option, which could be considered, is the implementation of an AIM scheme to see if this could reduce the impact on the river.

A.2.5.4 Identifying the trigger points for each AIM site

Generally, an AIM will apply where a change in abstraction regime, initiated through a hydrological trigger, can lead to an environmental benefit. The trigger for the period when the AIM applies needs to be determined locally for each site, depending on environmental needs.

In the majority of AIM schemes, operation of the trigger would involve an immediate or rapid beneficial effect. In the case of the Otter Valley, the nature of the groundwater system is such that short-term abstractions have a small, delayed impact. Rather, it is the consequence of long-term abstractions over many years, which are considered to be reducing flows in the River Otter. Therefore, seasonal, localised changes in rainfall and recharge are not suitable triggers to benefit the river.

This AIM may therefore benefit from a longer term limitation of abstraction from key sites, which impact disproportionately on the environment.

The exact form of a suitable trigger in an Otter Valley AIM scheme would need to be discussed and agreed with the Environment Agency and would be followed by consultation with our CCG and other stakeholders. However, a potential trigger could be the relative groundwater condition experienced in springtime (not later in the year when low flow conditions have already developed) as an indicator of possible adverse effects on flows later in the year.

A.2.5.5 Identifying the abstraction baseline for each AIM site

The use of a longer term trigger affects the way that the abstraction baseline would be determined. The investigations which supported our applications for the recent licence renewals identified that the current levels of abstraction are sufficient to just cause flows in the River Otter to be below the Q95 EFI level at Assessment Point 1, immediately upstream of the estuary.

Although the environmental studies carried out over many years have not identified any significant ecological damage as a result of these levels of abstractions, the breaching of the EFI threshold results in the water body being classified as Poor Status. In order to support the Agency in its objective of gaining Good Status, the AIM for the Otter Valley would be a way of formalising the SWW commitment to limit those abstractions which have the greatest impact on river flows, whilst balancing this against the long-term needs for public water supply.

The Otter Valley Groundwater Model results, in terms of identifying river impacts, can be summarised as follows:

- Upstream of the local Environment Agency's Gauging Station, the impact of abstractions does not breach the EFI threshold
- Breaching of the EFI threshold only occurs in the very lower reaches of the River Otter where the cumulative impacts from all the abstractions in the catchment are felt
- Most benefit to the main river can be achieved by reducing the abstractions from the four boreholes in the lower part of the catchment.

One option for the baseline abstraction could therefore be the degree to which abstractions from the four boreholes in the lower part of the catchment can be minimised relative to the recently licensed annual average abstraction limit of 7.15 Ml/d. The exact form of this arrangement would be detailed following discussions with the EA taking into account operational needs.

To meet demands for water in East Devon, any reduction in abstraction from these four boreholes would need to be offset from supply elsewhere within East Devon groundwater sources. The supply demand balance for this area of East Devon was considered in depth as part of the licence renewal process. There is only limited headroom predicted to be available under design drought conditions and this already includes the maximised import of water locally from the River Exe supply system.

For an AIM scheme to be practical, an additional source of water will be required. Two options that could be considered are:

- Replacing Otter Valley-derived water with that from another catchment
- Giving preference to sources within the Otter Valley which have no, or a lower, impact on river flows

These two options are described in more detail below. As Wessex Water also abstracts from this catchment there may be a joint approach that could be implemented, but that is not covered here.

Replacing Otter Valley derived water with that from our catchments

Based on historical groundwater exploration records across the SWW supply area, there are likely to be very limited options for developing new resources outside the Otter Valley.

A number of specific areas of East Devon, West Somerset and Dorset have been investigated in the past, but the lack of operational sources beyond the Otter Valley is indicative of the unsuitable nature of the geology for producing groundwater abstractions of sufficient yield and/or acceptable water quality.

However, at this time, SWW is investigating the potential for a new source in the Sidford area, in the neighbouring River Sid catchment (Figure A.2.5). A trial borehole has been drilled and the viability of this location for a production borehole is being assessed. Should a resource be commissioned (nominally 1.5 to 2 Ml/d), then this could be used to help offset reduced abstractions from the Otter Valley boreholes into supply at times of low flow.

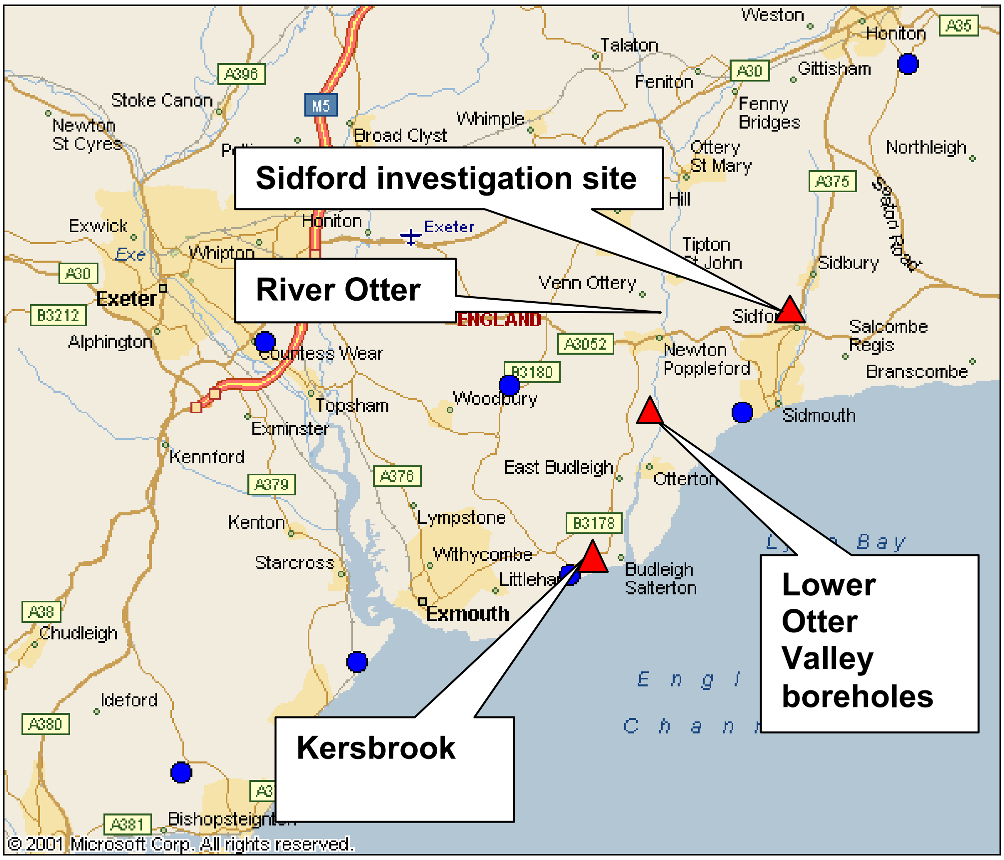
Giving preference to sources within the Otter Valley, which have no, or a lower, impact on river flows

Our water resources modelling assumes that the Otter Valley groundwater sources would be operating at their calculated Deployable Output rates. There is therefore no existing spare capacity, which could be taken up from those sources that impact on flows to a lesser degree. However, an AIM scheme could be viable if additional capacity were made available at one or more of these sites.

One potential site is in the Kersbrook area near Budleigh Salterton (Figure A.2.5). Our borehole in this area has a licence for 2.2 Ml/d, but borehole-related issues have restricted this to 1.2 Ml/d in recent years. Specific groundwater modelling is currently underway to assess the consequence of abstracting an additional 1.0 Ml/d from the Kersbrook area. Initial results indicate that impacts on the main River Otter may be minimal. If these results are confirmed, then the drilling and commissioning of a second borehole at this site, capable of supplying the additional 1 Ml/d, may provide an alternative supply to offset a reduction at the Otter Valley boreholes.

We are currently discussing with the Environment Agency how best to assess the impacts from any additional abstraction from the Kersbrook area, whilst also examining the practicality of drilling a new borehole and its integration into our existing operations.

Figure A.2.5: Key abstraction sites in the Otter Valley linked to a potential AIM scheme



A.2.5.6 <u>Capturing abstraction data at each AIM site</u>

The AIM guidelines indicate the following data would need to be collected to enable the performance of the company to be assessed:

- River level / flow data

  These data would indicate whether the water body impacted by abstraction from the AIM site is above, below or at the AIM trigger point for that site.

  These data might be weekly, daily or possibly more frequent.

- SWW abstraction volumes from the AIM site

  These data might be daily or possibly more frequent. In order to operate the AIM, the company abstraction volume data are only strictly needed at times when the AIM has been triggered.

- Aligning the level / flow and abstraction data

The hydrometric and abstraction data would need to be aligned to the same point in time in order to measure the volume of company abstraction at the site occurring when the impacted surface water body has a level / flow at or below the AIM trigger point.

For the potential Otter Valley AIM scheme to be practical, the data collection would be simplified as follows: the triggering of the scheme could be assessed annually just before the end of March, based on the prevailing hydrological conditions.

This is because the lower Otter Valley boreholes abstraction licence annual limit re-sets on 31st March each year. If the trigger condition is met, then the AIM could remain in place until the end of the licence year; at this time the AIM trigger could be re-assessed to determine whether the AIM should continue for a further year or cease until the scheme was triggered again.

Before a possible AIM scheme can be formalised, groundwater modelling will be required to identify the most appropriate location and flow to trigger the AIM.

A.2.5.7 Reporting the data through their annual performance report

SWW would become a fourteenth company operating an AIM scheme and we would report on its performance annually using the approach detailed in the AIM guidelines. Future discussions with the Environment Agency will determine whether a reputational or financial incentive should be associated with this AIM.

A.2.5.8 Next steps

We have outlined how we propose to approach consideration of potential AIM schemes and described in detail an example scheme in the Otter Valley. We will be undertaking further discussions with the Environment Agency to explore whether this, or other schemes, could be worthwhile and workable. In relation to the Otter Valley, we hope to develop more detailed plans whilst the viability of both the Sidford and Kersbrook resource options are being established.

APPENDIX 3

Developing our demand forecast

A.3.1 Household consumption forecasting report

We commissioned Artesia Consulting to produce our household consumption forecasting methodology. Their report, detailing the results and the methods that they used is included below.

Artesia Consulting

South West Water

WRMP19 Household consumption forecast: Baseline forecast

FINAL

AR1182

September 2017

Report title:	**WRMP19 Household consumption forecast: Baseline forecast**
Report number:	**AR1182**
Date:	**September 2017**
Client:	**South West Water**
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Executive Summary

The current Water Resources Planning Guideline identifies the need for water companies to use methods for supply and demand analysis that are appropriate to the level of planning concern in their water resources zones (WRZs).

The problem characterisation for the company's water resources zones has been confirmed as 'low'[1]. An assessment of suitable household consumption forecasting methods was carried out based on this characterisation. This indicated that micro-component forecasting would be the preferred forecasting approach for this level of concern. Regression modelling would be a suitable alternative, however, South West Water does not have sufficient data and information on individual household consumption and property characteristics to enable regression modelling. Therefore it has been decided to develop an updated micro-component forecast for WRMP19.

The micro-component model has been developed using best available data from local and national datasets. The model is segmented by property type using unmetered, new build metered and free optant metered households. The model is based on per household consumption (PHC), and includes linear modelling of key micro-components against occupancy to reflect the variation of PHC by occupancy within each household type. The model forecasts are developed from historic industry and UKWIR micro-component datasets and Market Transformation Programme predictions (these are explained in the report).

The results of the micro-component forecast give a 14.04 Ml/day increase in household consumption for Dry Year Annual Average (DYAA) consumption from the base year (2016/17) to the end of the forecast (2044/45), this is a 4.63% increase. This is driven by a 20% increase in the property forecast, and a 13% decrease in PHC. Average PHC and PCC decrease throughout the forecast period, this is partly due to decreases in component demand due to market transformation, but mostly due to the shift from unmeasured to measured properties. Average household PCC (mean of all household types) reduces from 145 to 131 l/person/day over the 25 year planning period for DYAA.

The model contains forecasts for Normal Year Annual Average (NYAA), Dry Year Annual Average and Critical Period with a breakdown of micro-components for each year of the forecast.

[1] To be confirmed by South West Water

Contents

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1 Context

South West Water used a micro-component forecast to predict household consumption in WRMP14. This predicted a change in PCC from the base year for unmeasured and measured properties; resulting in an average trend in PHC for all households from just over 150 l/head/day in the base year (dry year annual average scenario) to approximately 120 l/head/day in 2039/40. Since WRMP14 Bournemouth Water has been incorporated into South West Water, they also previously used a micro-component forecast which predicted a change from around 143 l/head/day in the base year to 118 l/head/day in the final year.

The problem characterisation for the company's water resources zones has been confirmed as 'low'[1]. An assessment of suitable household consumption forecasting methods was carried out based on this characterisation. This indicated that micro-component forecasting would be the preferred forecasting approach for this level of concern. Regression modelling would be a suitable alternative, however, South West Water does not have sufficient data and information on individual household consumption and property characteristics to enable regression modelling. Therefore it has been decided to develop an updated micro-component forecast for WRMP19.

Micro-component models have been used for water demand forecasting in England and Wales from the late 1990s. They quantify the water used for specific activities (e.g. showering, bathing, toilet flushing, dishwashing, garden watering, etc.) by combining values for ownership (O), volume per use (V) and frequency of use (F). This study makes use of a national micro-component survey of 62 properties, alongside additional micro-component data collected by South West Water. The additional sites cover mostly unmeasured household which is very helpful when allocating micro-components for the different household segments.

The micro-component model is combined with property, population and occupancy forecasts in a unique way in that the micro-components vary with occupancy. Certain components have a valid relationship with occupancy, and others don't. This method is used to calculate base year OVF PHC values, which are then calibrated to the zonal normal year PHC values.

Forecasts of the property, population and occupancy are established by household segment via a model to allow for various assumptions and mathematical calculations as the company tends towards 100% meter penetration. Each household segment has a different base year OVF table / calculation, these are based on both measured differences between measured and unmeasured households, as well as assumptions made about devices within new properties and optant properties.

Micro-components are then forecast using a combination of longitudinal micro-component data and future market transformation programme derived micro-component values. These trends are applied to the normal year micro-component values. An additional occupancy specific trend is also added, to ensure that the varying occupancy within each of the household segments is captured.

Data from national studies was used to update previous micro-component estimates (from surveys, the Market Transformation (MTP) scenarios and other, older sources), and to consider upper and lower consumption forecasts.

Relevant data, existing survey results, and consumption data from metered customer billing records were all analysed and investigated, along with data collected in the 2016 UKWIR behaviour integration study, to estimate base year micro-component estimates.

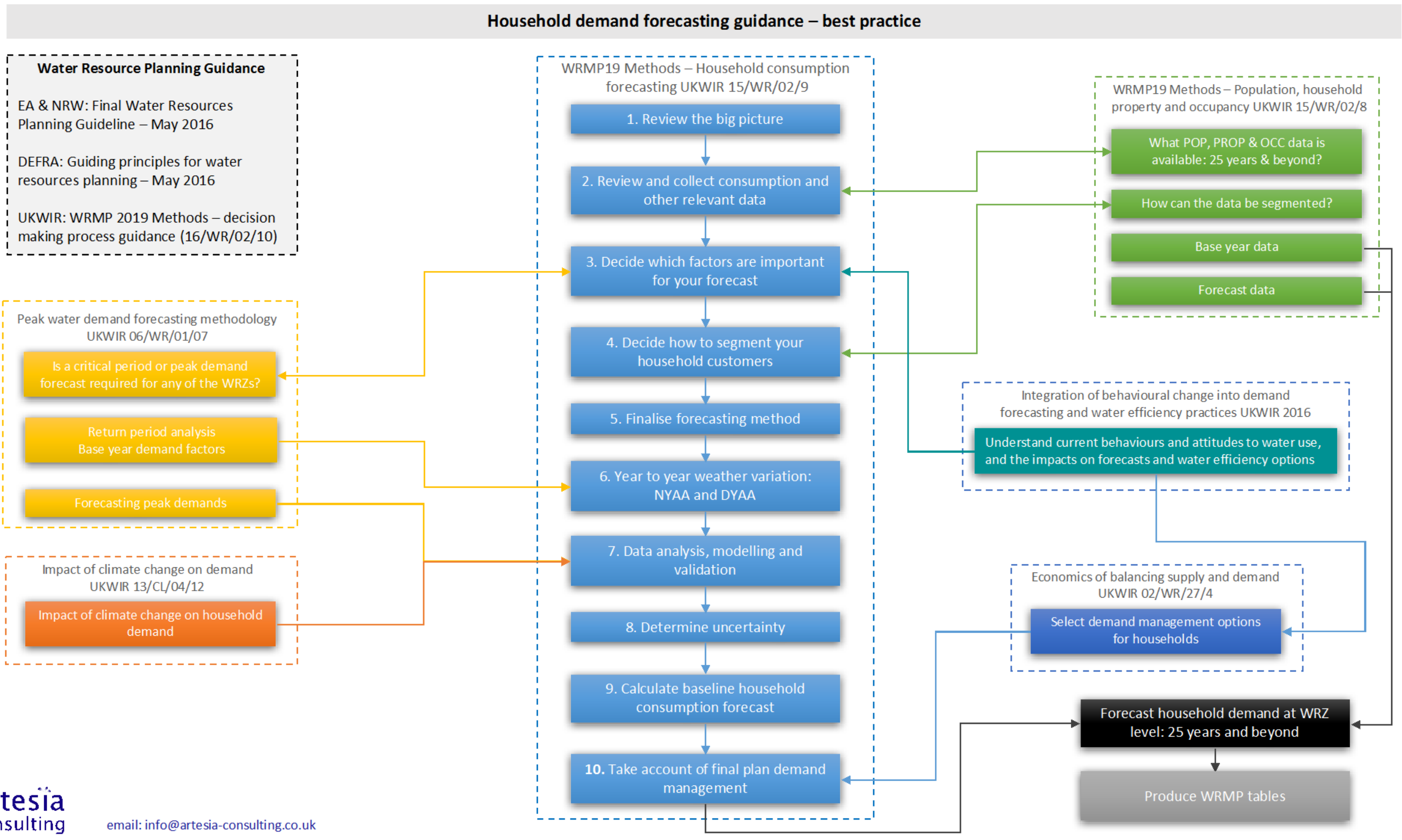
Household customers were segmented based on meter status (measured/unmeasured), with sub-divisions for meter type (existing metered, free meter optants, new property). Data was used to determine how to account for differences in consumption between segments and also the effect of meter switching.

Normal year and dry year adjustments were made to the base year consumption and the consumption forecast.

A scenario approach to modelling uncertainty was used, to reflect the various uncertainties in consumption forecasts.

Best practice guidelines (detailed in Figure 1) have been followed in deriving the baseline household demand forecast.

Figure 1 **Best practice guidelines for household demand forecasting**



2 Method selection

The current Water Resources Planning Guideline[2] identifies the need for water companies to use methods for supply and demand analysis that are appropriate to the level of planning concern in their water resources zones (WRZs).

The problem characterisation for the company's single water resources zone has been confirmed as 'low'. An assessment of suitable household consumption forecasting methods was carried out based on this characterisation. This indicated that micro-component forecasting would be the preferred forecasting approach for this level of concern. Regression modelling would be a suitable alternative, however, South West Water does not have sufficient data and information on individual household consumption and property characteristics to enable regression modelling.

Therefore it has been decided to develop an updated micro-component forecast for WRMP19.

2.1 Approach

Guidance on the selection of appropriate household consumption forecasting methods were developed by UKWIR (UKWIR, 2016), along with guidance on the application of these methods.

The UKWIR guidance identifies nine criteria and a weighting and scoring framework, set out in a 'RAG Matrix'[3]. The guidance recommends that practitioners adapt the weightings and scores in this matrix to reflect their own situation, in order to identify the most appropriate methods for forecasting household consumption. In particular, the matrix should be amended to reflect the level of planning concern in a particular WRZ.

South West Water has used the RAG matrix, with amendments to reflect the status of its WRZs to shortlist preferred methods for household consumption forecasting. The assessment that has been undertaken is presented in the following sections.

2.2 RAG matrix and comments

Figure 2 illustrates the results of the RAG matrix.

[2] Water Resources Planning Guideline: Interim Update April 2017
3 Red Amber Green Matrix, used to highlight which methods score best to worst

Figure 2 **South West Water RAG Matrix for household consumption forecast method selection**

Low concern zones	Weighting	Regression models	Micro-component models	Major consumption groups	Trend based models	Variable flow methods	Per capita methods	Use existing study data
Acceptance by stakeholders	10	7	8	8	6	6	4	2
Explicit treatment of uncertainty	5	8	6	6	5	5	2	2
Underpinned by valid data	7	6	7	7	6	6	2	2
Transparency and clarity	7	6	7	6	5	5	4	2
Appropriate to level of risk	7	6	8	7	6	6	3	2
Logical and theoretical approach	7	6	8	8	6	5	4	2
Empirical validation	5	6	7	7	6	5	2	2
Explicit treatment of factors that explain HH consumption	8	6	7	7	6	5	2	2
Flexibility to cope with new scenarios	5	6	7	6	5	5	3	2
Weighted score		**386**	**446**	**427**	**349**	**329**	**182**	**122**
Ranked		**3**	**1**	**2**	**4**	**5**	**6**	**7**

Table 4 provides comments on the justification for the scores presented in **Figure 2**.

Table 1 **Justification for RAG Matrix scoring**

Criteria	Comment
Acceptance by stakeholders	Use BY PCC/PHC with a trend developed from micro-comps or macro-comps.
Explicit treatment of uncertainty	Regression models do this best, so should score more highly.
Underpinned by valid data	SWW has some survey data (2012) on micro-components. Survey data insufficient for regression modelling so this is marked down. Low level of concern means national micro-comp estimates are suitable
Transparency and clarity	Using macro or micro-components underpinned by trends based on observed and forecast (MTP) trends will provide the appropriate level of transparency and clarity for this WRZ
Appropriate to level of risk	Low level of concern, so do not need to develop a completely new method. Micro-component model of demand should suffice with the data available.
Logical and theoretical approach	Given the level of concern and the data available, then the micro/macro approach does seem logical.
Empirical validation	Whilst the regression model should be better at this, the data won't allow it. The micro-component BY demand model can be calibrated against the BY reported PHC values.
Explicit treatment of factors that explain HH consumption	Same comment re data availability and the regression - so marked down. The micro and macro models pick up the main technological trends and personal bathing trends without the data requirements of the regression model.

Flexibility to cope with new scenarios	Micro-component modelling is sufficiently flexible for a zone with this level of concern.

The weightings used in the matrix are based on industry standards, amended where appropriate to reflect the South West Water position.

The scoring reflects the relevance of the methods to the South West Water situation – particularly with regard to the level of planning concern in the WRZ and the availability of company-specific data, particularly for regression modelling.

The micro-component forecast has therefore been selected as per the ranking set out in the RAG matrix. This will be based on recent national micro-component data to establish a base year model of consumption.

3 Review data availability

3.1 Base year data

The base year selected for the Draft model is 2016/17.

The base year figures have been extracted from Table 10 of the June returns. South West Water has four water resource zones (WRZ). The base year post MLE per capita consumption excluding supply pipe leakage (PCC) for measured and unmeasured properties are shown in Table 2.

Table 2 JR Table 10 2016/17 PCC figures

Water Resource Zone	Measured PCC (l/head/day)	Unmeasured PCC (l/head/day)
Colliford	124.02	194.63
Roadford	117.27	185.53
Wimbleball	115.53	171.94
Bournemouth Water	136.11	159.71

Measured and unmeasured property and population figures are also extracted from the June returns, these are shown in Table 3.

Table 3 Property, population, occupancy from June return 2016/17 and calculated PHC

Water Resource Zone	Properties	Population	Occupancy	Post MLE Measured PHC (l/prop/day)	Post MLE Unmeasured PHC (l/prop/day)
Colliford	232,839	508,706	2.18	249.76	540.36

Roadford	358,515	816,598	2.28	249.93	538.37
Wimbleball	146,093	337,046	2.31	247.03	519.40
Bournemouth Water	189,282	420,270	2.48	297.26	395.76

3.2 Other data

South West Water supplied Artesia with some other data sources which are either used in the forecast, or for validation of the model. This data includes:

- Forecasts from the WRMP14 forecast and the WRMP14 micro-component model
- Base year property and population numbers from company billing database
- Data from household consumption monitors
- Household billed volume data, including optant information
- Household and population forecasts

South West Water provided additional data to support this study, which included historic trends from the June Returns, WRMP14 forecast, historic weather data, historic distribution input (DI) data and survey data for micro-components from the SODWAC domestic consumption monitor (DCM).

In addition to the data provided by South West Water, several national datasets have been used to increase the understanding of historic, present and future micro-component consumption. Historic micro-components are extracted from the WRc CP187[4] report, current micro-components are extracted from UKWIR 16/WR/01/15 Integration of Behaviour Change[5] and future projections are extracted from the Market Transformation Programme (MTP).

3.3 Measured micro-component data

By 'measured' we mean micro-component data that has been collected by measuring the different micro-components used within the household (as opposed from survey questions and assumptions). This allows ownership (O), volume per use (V) and frequency of use (F), to be calculated for each micro-component. There are two main sources of national data for this:

- 2015-16 data collected using the Siloette system:

[4] Increasing the Value of Domestic Water use Data for Demand Management, WRc, March 2005
[5] Integration of behavioural change into demand forecasting and water efficiency practices, UKWIR 16/WR/01/15, 2016

- A sample of measured billed households, which has associated occupancies and demographic information on the households, collated during the UKWIR Study[5] (this contains 62 households from around England and Wales),

- A sample of South West Water unmeasured households, with partial occupancy information (occupancy not available for Blind survey), collated from a study specific to SWW in an ongoing study, this sample contains 39 household at present. Data collected via Ashridge loggers, but processed via Siloette software.

- A sample of RV billed households, which does not have associated demographics (collated from other anonymous Siloette studies carried out by Artesia from England and Wales).

- 2002 – 2004 O, V, and F data collected using the Identiflow system (a sample of RV (rateable value) billed households (also called unmeasured households), reporting in WRc Report CP187[5]).

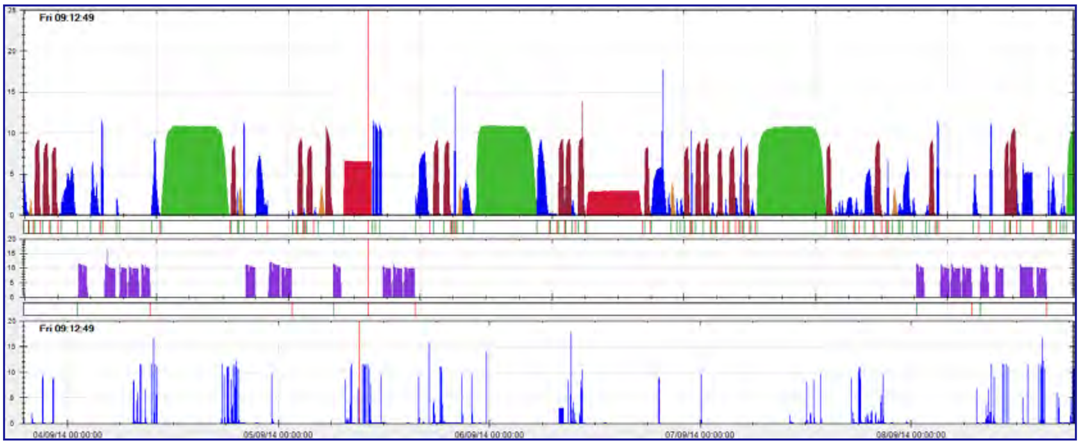
Both the Siloette and Identiflow systems measure the flow into a property and compute the individual micro-components through pattern recognition (although the detailed methodology of the two systems is different).

The Siloette system uses a Siloette logger that is connected to the pulsed output from a meter via a pulse unit, as illustrated in Figure 3.

Figure 3 Siloette logger installed in a boundary box

The logger records the flow through the meter at sub 1-second resolution. Once downloaded an algorithm is applied to the data to create a high-resolution flow trace of the flow into the property, as illustrated in Figure 4.

Figure 4 Illustration of Siloette logger output



Each water-using event in the house has a flow-rate profile characterised by the time, duration and volume of water per use. Siloette takes the data from the logger and uses pattern-recognition software to disaggregate and quantify the individual micro-component events and provide information on time of event, flow rates and volumes. In Figure 4 the bottom trace shows the time-series of the flow profile, and the top row shows the resulting events that have been characterised, with each event type shown in a different colour (for example, baths are coloured green in Figure 4.)

The four sources of data described above are shown in Table 4 to Table 7.

Table 4 Micro-component summary data from 2015/16 metered billed households

2015/16 UKWIR (metered bills)					
Micro-component	" Weighted Ownership"	Volume per use (l)	Frequency of use (#/day)	Mean per household use (l/prop/day)	Percentage of PHC
Toilet	1.00	7.26	8.96	65.02	27.36
Shower	0.92	62.36	0.98	56.14	23.63
Bath	0.43	104.60	0.27	12.36	5.20
Tap	1.00	5.66	13.29	75.19	31.64
Dish Washer	0.42	16.70	0.56	3.93	1.65
Washing Machine	0.95	54.19	0.63	32.77	13.79
Water Softener	0.02	52.06	0.97	0.98	0.41
External use	0.18	285.18	0.07	3.71	1.56
Plumbing Losses	0.22	37.20	1.70	14.07	5.92
Unknown	0.95	1.63	4.31	6.66	2.80

Table 5 SWW Micro-component summary data from 2016 unmetered billed households

2015/16 SWW (unmetered bills)					
Micro-component	" Weighted Ownership"	Volume per use (l)	Frequency of use (#/day)	Mean per household use (l/prop/day)	Percentage of PHC
Toilet	1.00	7.10	13.05	92.61	28.21
Shower	0.95	58.61	1.31	73.46	22.37
Bath	0.11	97.63	0.34	3.74	1.14
Tap	1.00	6.08	12.32	74.86	22.80
Dish W	0.65	9.76	0.58	3.69	1.12
Washing M	0.93	35.40	0.74	24.25	7.38
Water Soft	0.00	0.00	0.00	0.00	0.00
External use	0.14	300.91	0.24	10.09	3.07
Plumbing losses	1.00	8.87	5.15	45.63	13.90
Unknown	0.07	1.62	0.09	0.01	0.00

Table 6 Micro-component summary for 2015/16 RV billed households

2015/16 RV billed households					
Micro-component	" Weighted Ownership"	Volume per use (l)	Frequency of use (#/day)	Mean per household use (l/prop/day)	Percentage of PHC
Toilet	1.00	7.58	8.86	67.15	22.53
Shower	0.94	54.82	0.94	48.69	16.34
Bath	0.54	113.65	0.36	22.35	7.50
Tap	1.00	4.56	17.91	81.62	27.39
Dish Washer	0.37	19.68	0.28	2.02	0.68
Washing Machine	0.94	56.36	0.66	34.59	11.60
Water Softener	0.09	112.02	0.24	2.41	0.81
External use	0.51	183.03	0.19	17.58	5.90
Plumbing Losses	0.30	75.84	0.65	14.76	4.95
Unknown	0.93	1.56	4.75	6.85	2.30

Table 7 Micro-component summary for 2002/04 RV billed households

2002 (from WRc CP187)					
Micro-component	" Weighted Ownership"	Volume per use (l)	Frequency of use (#/day)	Mean per household use (l/prop/day)	Percentage of PHC
Toilet	1.00	9.40	11.52	108.29	29.19
Shower	0.85	25.70	1.46	31.97	8.62
Bath	0.88	73.30	0.95	61.35	16.54
Tap	1.00	2.30	37.90	87.17	23.50
Dish Washer	0.37	21.30	0.71	5.60	1.51
Washing Machine	0.94	61.00	0.81	46.30	12.48
Water Softener	0.02	182.50	0.39	1.14	0.31
External use	0.65	46.70	0.89	27.10	7.30
Plumbing Losses					0.00
Unknown	0.19	20.40	0.53	2.08	0.56

3.4 Market transformation data

Defra's Market Transformation Programme produced product summaries for various water using appliances in 2011[6]. These provide predictions of water use for appliances and devices in 2030 for three scenarios:

- Reference scenario (equivalent to baseline forecast)
- Policy scenario (assuming more effective implementation and accelerated take-up of more sustainable products)
- EBP or early best practice (which assumes a more positive impact than the policy scenario and an early take up of innovative water efficient products).

4 Property segmentation

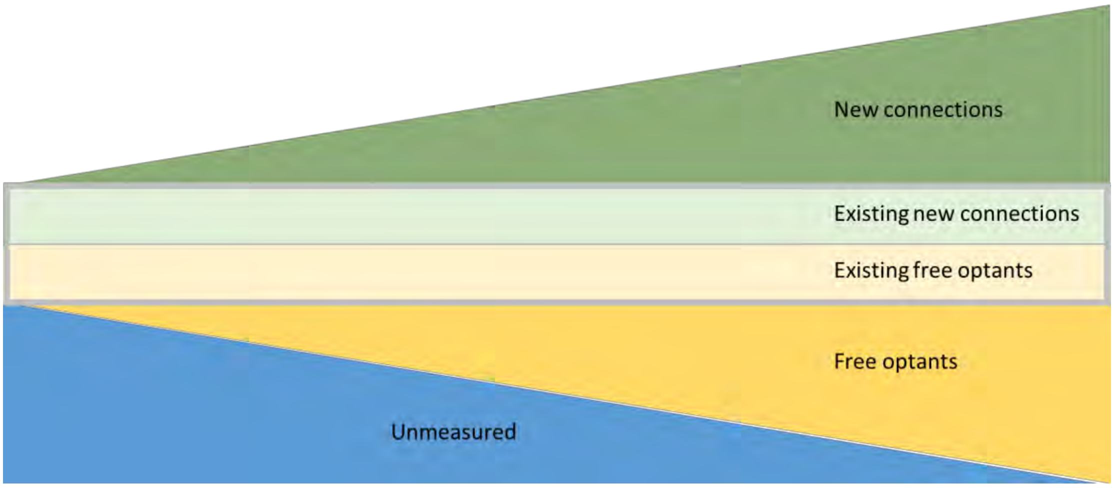
Most companies report consumption figures for measured and unmeasured properties. To fully explore the complexity of different household segments and the difference in their consumption, behaviour and future trends Artesia calculates the forecast with the measured households split into existing properties, new properties, free optants as well as Compulsory/ Selective/other metering programme. Existing metered are in fact a combination of these, but

[6] http://efficient-products.ghkint.eu/cms/product-strategies/subsector/domestic-water-using-products.html#viewlist

will be termed 'existing' and remain as a constant segment throughout the forecast from the base year value.

An illustration of the breakdown of the measured and unmeasured households is shown in Figure 5. From the base year the number of new properties increases based on property forecasts developed by South West Water, and the switch between unmeasured to optant depends on the forecast optant rate. The optant forecast rate is calculated using a combination of the WRMP14 forecast and the historic reported optant numbers. Property and optant forecasts are both inputs into the segmentation model.

Figure 5 Illustration of property breakdown within the company, forecast from base year to the point of 100% meter penetration

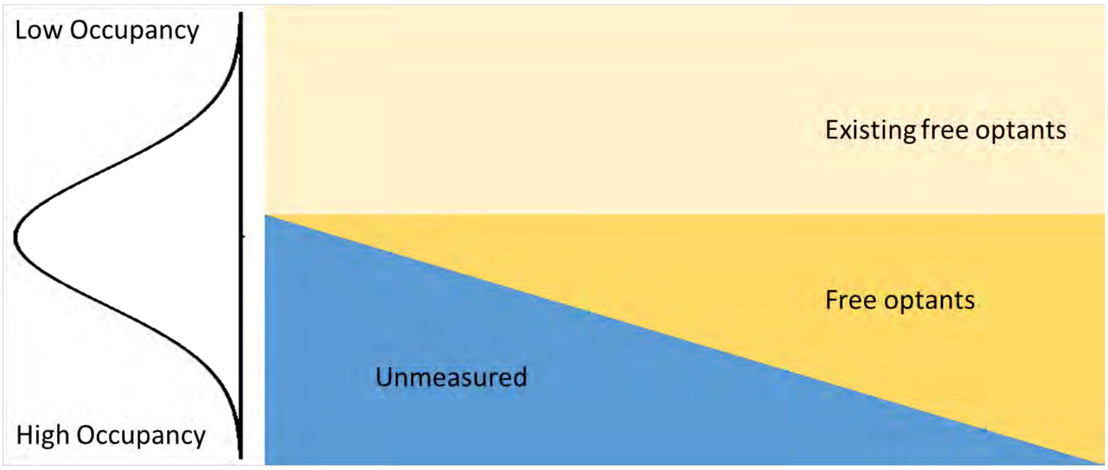


Some key assumptions made in the segmentation model:

- New households will always be metered.
- Free optants move directly out of the unmeasured property segment.
- Voids are forecast to remain constant throughout the forecast period, in that there are no further voids added beyond the base year. Voids have not been included in the baseline forecast due to their negligible consumption.
- The point at which 100% meter penetration occurs is based on the meter optant forecast.
- Despite 100% penetration being unlikely in practice, the year in which this point is reach is needed for the mathematical calculations in order to balance the population figures. In practice, this point is beyond the forecast period. The subtleties of final meter penetration rate may need further work in future forecasts.

Further to mapping properties into each of these segments, population must also be distributed.

Figure 6 Illustration of the change in occupancy as meter penetration tends towards 100%



In order to successfully distribute the population between the segments, certain assumptions and knowledge of the segments must be assessed. Occupancy is only reported for measured and unmeasured. Measured households generally have lower occupancy than unmeasured households. New properties are assumed to have company average occupancy (this assumes that occupants are moving into new properties from a range of existing properties, measured or unmeasured, either within or from outside the region, and hence have a company average occupancy). Occupancy of new properties and optant properties are inter-dependent, in that the sum of new and optant population within the existing measured households must equal the total for measured household population. Optants have a low occupancy, however this is highly dependent on meter penetration.

Figure 6 demonstrates that as meter penetration increases, the occupancy of the unmeasured and optants increase until 100% meter penetration. Throughout the forecast the sum population for the optants plus unmeasured remains the same (this assumes that each year optants come from the unmeasured pool). Meanwhile the average occupancy of all the segments must follow the change in occupancy from the property and population forecasts. These assumptions provide an estimate of the change in occupancy within the household segments over time; in reality there will be a complex movement of population within these segments, reflecting births, deaths, people moving into the region, people moving out of the region, and people moving within the region. Each year the segments are calibrated to take into account the company level occupancy changes throughout the forecast period. There is a slight decrease in company occupancy of the next 25 years, and this is attributed equally across all household segments.

To ensure the segmented households and populations sum to the company own forecast, various calibration steps and data validation checks are also included in the calculations.

5 Household consumption forecasts

5.1 Approach to micro-component forecasting

Micro-component models have been used for water demand forecasting in England and Wales from the late 1990s. They quantify the water used for specific activities (e.g. showering, bathing, toilet flushing, dishwashing, garden watering, etc.) by combining values for ownership (O), volume per use (V) and frequency of use (F). For example, per-capita (PCC) or per household consumption (PHC) can be modelled as:

$$\text{PCC or PHC} = \sum_i (O_i \times V_i \times F_i) + pcr$$

Where

'O' is the proportion of household occupants or households using the appliance or activity for micro-component 'i',

'V' is the volume per use for 'i',

'F' is the frequency per use by household occupants or households for 'i',

pcr is per capita residual demand.

By applying this together with the population or property data, a water demand model can be formed. By forecasting changes in each of the variables (O, V, F or daily water use for each micro-component) over time, a water demand forecast can be created. Hence the micro-component forecast model requires estimates of changes in these variables, to reflect future changes in technology, policy, regulation, and behaviour.

This report describes how the inputs have been generated for:

- Base year micro-components from a micro-component occupancy model.
- Final planning year micro-components from an occupancy model. This allows a rate of change of micro-component daily water use to be derived due to the change in occupancy over the planning period.
- Technology, policy and behaviour trend values for micro-components (based on historic analysis of trends and future predictions from the Market Transformation Programme).

5.2 Basic inputs required

To build the micro-component forecast model, we need the following inputs:

- Base year household consumption broken down into micro-components.

- Reported base year household consumption (from water company annual return data).

- Rates of change in micro-components across the planning period.

5.3 Selection of the basic unit of consumption

Two commonly used methods of consumption forecasts are based on Per Capita Consumption (PCC) and Per Household Consumption (PHC). Linear modelling can use either approach.

In the case of PHC modelling, occupancy needs to be included as an explanatory variable, and PHC is composed of a consumption allotted to the house on the basis of its characteristics, and an additional consumption assigned to each occupant.

PCC modelling assigns a different consumption value per person on the basis of the characteristics of the property they inhabit.

In the former case, the model is property driven, which aligns with the data collection based on household meter reads.

The latter case introduces all the error associated with the household occupancy figure into the model at the very first step. If the model is based on PCC, the PCC is calculated from estimated occupancy (for which there is an error), so there is no part of the consumption modelling that is independent of occupancy error; all the error in population forecasting is propagated through the zonal forecast if it is based on PCC.

Modelling by PHC makes occupancy-driven household consumption components implicit in the model whereas PCC-driven modelling would need to incorporate a correction for changing occupancy rates in PCC forecasting.

For these reasons PHC is used as the basis for aggregating up to a zonal consumption forecast.

The Environment Agency require that the micro-components are reported in the WRMP tables in units of occupancy, i.e. per capita consumption; and the model converts the PHC micro-component values at the zonal level to PCC by dividing through by occupancy.

5.4 Micro-component occupancy model

Whilst we carried out the forecast model at household level, there is an influence on a selection of the micro-components from occupancy. Therefore, in calculating the base year and final year PHC values, we use a set of linear models that relate either daily use or frequency of use to occupancy in each year. The model is also used to provide the base and final year values for different metered property types: existing metered, optant metered, new property metered and selective metered.

The UKWIR 2015/16[4] micro-component data for measured billed households was used for the modelling because this dataset had a complete set of occupancy data for each household over the logging period. The total number of households in the sample was 62. In addition to this the SWW properties from the SODWAC survey are added to the sample.

Figure 7 Each micro-component daily use plotted against occupancy

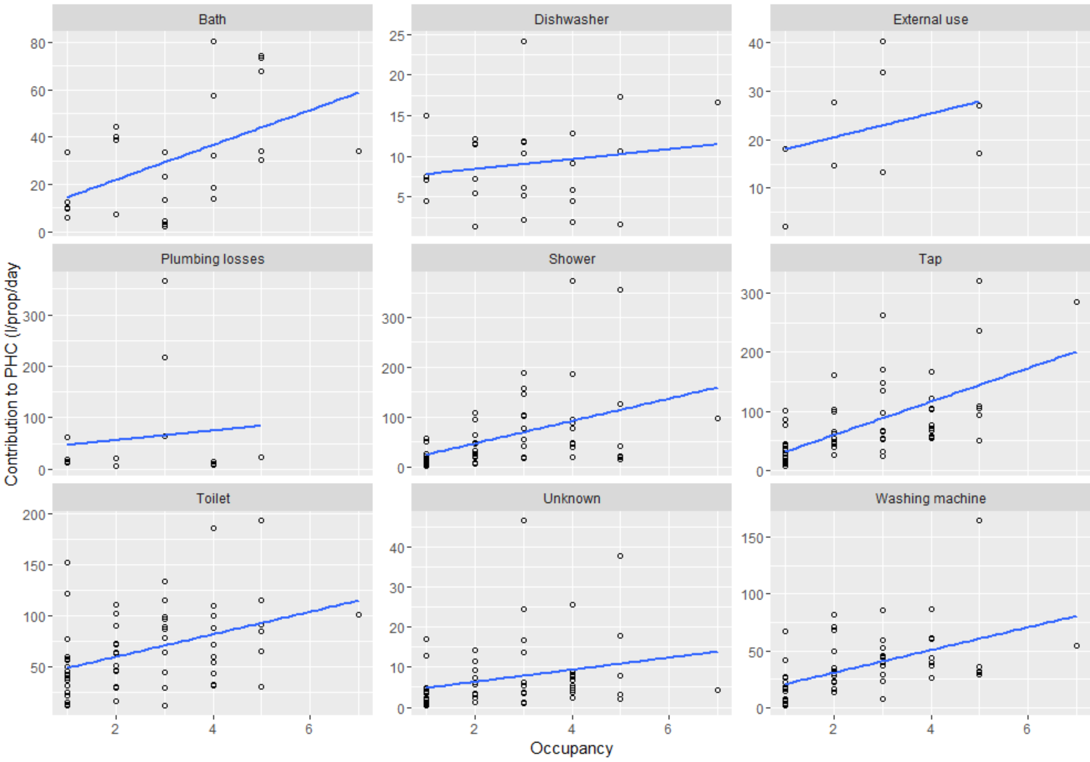


Figure 7 shows the average daily use (or contribution to per household consumption) for each of the following micro-components:

- WC flushing,
- Shower use,
- Bath use,
- Tap use,
- Dish washer use,
- Washing machine use,
- Water softener use,
- External use, and
- Miscellaneous use (including internal plumbing losses).

Each of the micro-components were investigated to determine whether the daily volume per use, frequency of use or ownership varied significantly with occupancy. The following micro-components showed relationships where occupancy was a significant factor:

- WC flushing,

- Shower use,
- Bath use,
- Tap use,
- Washing machine use.

For each of these micro-components (WC, Shower, Bath, WM and Taps) we developed a linear model using occupancy as the predictive factor.

Figure 8 shows the variation of WC flushing frequency per day with occupancy, with the mean frequency of use per day plotted against occupancy. The model is a log relationship of frequency of use against occupancy with the following equation:

*Frequency of use (uses/day) = 7.110 + 3.408 * ln(occupancy)* **Equation 1**

Figure 8 **Variation of WC flushing frequency (uses per day) with occupancy**

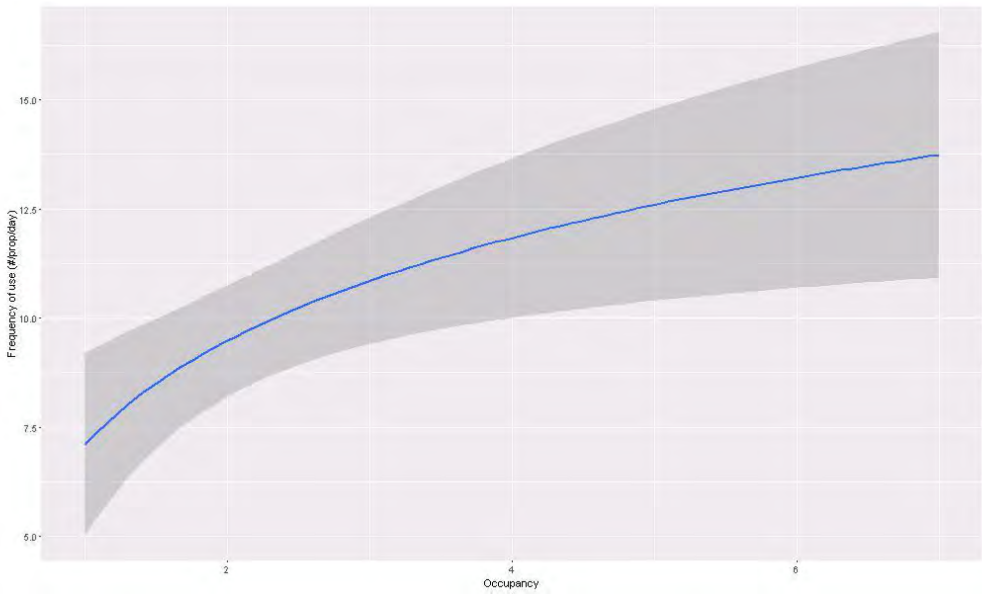


Figure 9 shows the variation of the water used for showering each day with occupancy, with the mean water use per day plotted against occupancy. Shower use was also explored in terms of frequency of use per day, but a more robust model could be built with volume used per day. This is probably because with increased occupancy there is increased variation in length of showering. The model is a log relationship of volume used per day against occupancy with the following equation:

*Shower volume used per day = 14.347 + 61.589 * ln(occupancy)* **Equation 2**

Figure 9 Variation of shower volume used per day with occupancy

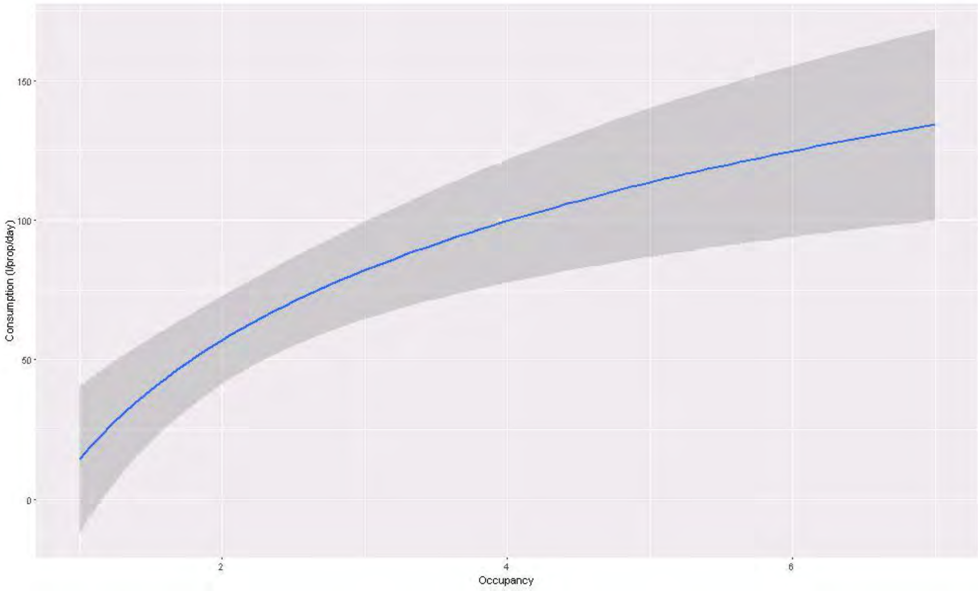


Figure 10 shows the variation of the water used for bath use each day with occupancy, with the mean water use per day plotted against occupancy. The model is a linear relationship of volume used per day against occupancy with the following equation:

*Bath volume used per day = 6.679 + 7.802 * occupancy* **Equation 3**

Figure 10 Variation of bath volume used per day with occupancy

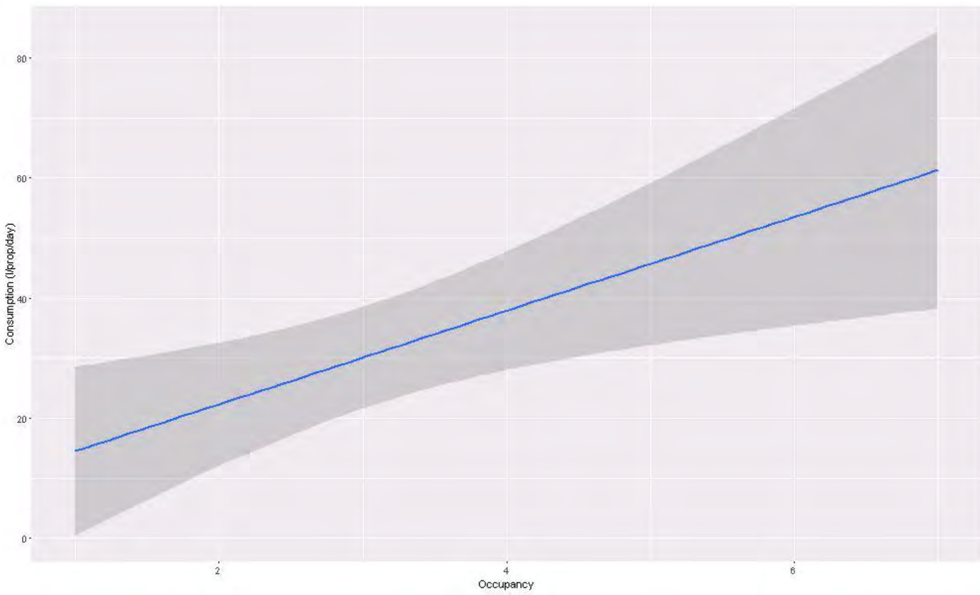


Figure 11 shows the variation of the water used for tap use each day with occupancy, with the mean water use per day plotted against occupancy. The model is a log relationship of volume used per day against occupancy with the following equation:

*Tap volume used per day = 31.374 + 59.506 * ln(occupancy)* **Equation 4**

Figure 11 Variation of tap volume used per day with occupancy

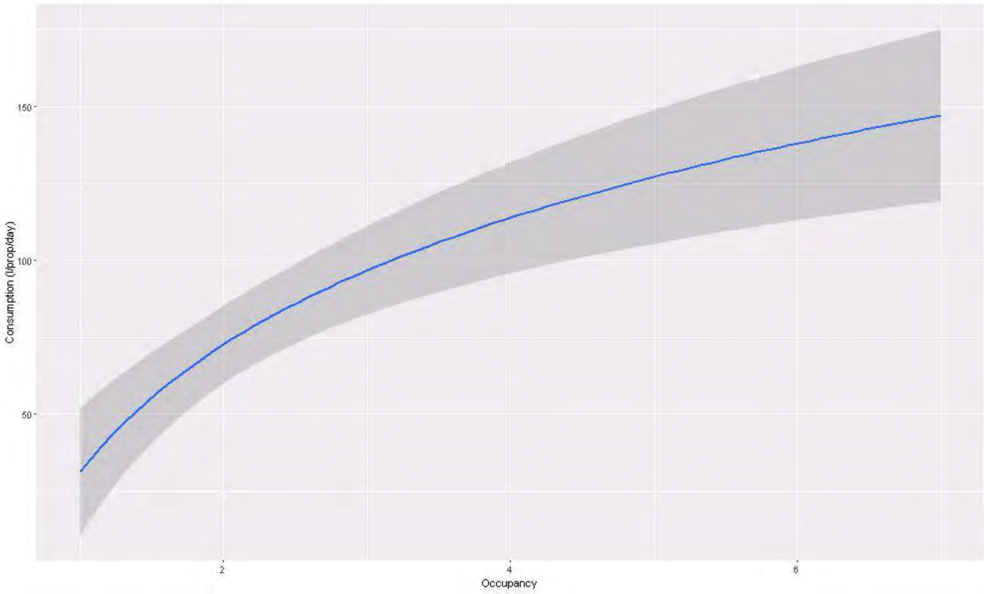
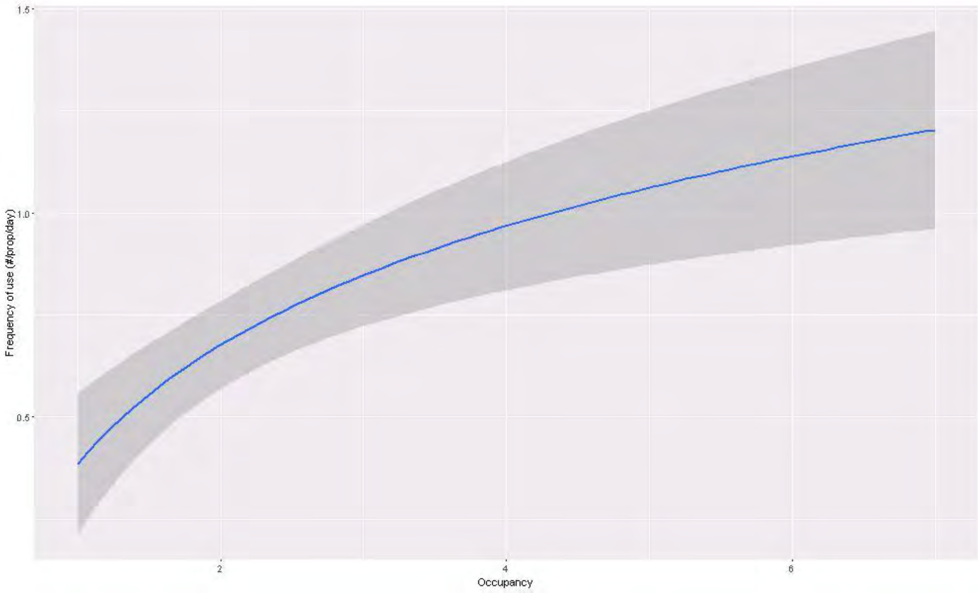


Figure 12 shows the variation of the water used for washing machine use each day with occupancy, with the mean frequency of use per day plotted against occupancy. The model is a log relationship of frequency of use per day against occupancy with the following equation:

*Frequency of use (uses/day) = 0.3852+ 0.4203 * ln(occupancy)* **Equation 5**

Figure 12 Variation of washing machine (frequency of use per day) with occupancy



For each property type the model variables shown in Table 8 are also changed depending on the meter status of the property.

Table 8 Micro-component variables that change with meter status

Property type	WC flush volume (mean l/flush)	Washing machine volume/use (mean l/use)	Dishwasher volume/use (mean l/use)	Wastage / plumbing losses (ownership)	External use (PHC = O*V*F)
Unmeasured household (HH)	7.58	54.19	16.7	0.71	16.56 = 0.46 * 189.22 * 0.19
Existing measured HH	7.26	54.19	16.7	0.22	3.34 = 0.18 * 285.18 * 0.07
Optant measured HH	6.0	54.19	16.7	0.11	3.34 = 0.18 * 285.18 * 0.07
New build measured HH	5.5	50.0	15.0	0.11	3.34 = 0.18 * 285.18 * 0.07
Selective metered HH	7.58	54.19	16.7	0.11	3.34 = 0.18 * 285.18 * 0.07

Combining all the relationships and variables, the micro-component occupancy model is defined in Table 9.

Table 9 Micro-component occupancy model parameters

Micro-component	Weighted Ownership 'O'	Volume per use 'V' (l/use)	Frequency of use 'F' (uses/day)	Daily use (l/prop/day)
WC flushing	1	See Table 8	See Equation 1	O*V*F
Shower use				See Equation 2
Bath use				See Equation 3
Tap use				See Equation 4
Dish washer	0.42	See Table 8	0.5	O*V*F
Washing machine	0.95	See Table 8	See Equation 5	O*V*F
Water softener	0.02	52.06	0.97	O*V*F
External use	See Table 8	See Table 8	See Table 8	O*V*F
Plumbing losses	See Table 8	37.2	1.55	O*V*F
Miscellaneous	0.95	1.63	3.74	O*V*F

The model can then be used to calculate the micro-component daily use (and hence the per household consumption 'PHC') for the following property types based on the occupancy assigned to each property type, in the base year and in the final year of the forecast:

- Unmeasured households
- Existing metered billed households
- Optant metered billed households
- New build metered households
- Selective (or compulsory) metered billed households.

Application of the occupancy model in the base year and final year are shown in Table 11 and mpany level occupancy forecast, which causes a slight decrease in the modelled PHC and modelled PCC.

Table 12 respectively. The base year in Table 11, which shows the occupancy, PHC derived from the micro-component occupancy model, and the calculated PCC. Also shown is the PHC and PCC calibrated to base year (normalised to NYAA).

As a calibration step consumption data for optants pre and post switching were analysed, and compared to the modelled PHC difference between unmeasured and optants. Using average occupancy of 2.26 we get an 18.07% decrease between the modelled PHCs. We assess the within household change from the historic optant data. This could incorporate a small amount of occupancy change but flags are used to exclude change of occupiers. Results for this analysis are shown in Table 10.

Table 10 Impact on PHC based on opting

Year	Pre switch PHC	Post switch PHC	Percentage reduction
2008	288.6297	235.4	18.44%
2009	281.83239	259.4	7.96%
2010	314.43996	262.8	16.43%
2011	303.92009	261.8	13.85%
2012	395.71818	261.0	34.06%
2013	372.75877	254.3	31.77%
2014	288.92183	267.2	7.52%
2015	365.23841	312.2	14.53%
2016	350.25046	273.1	22.03%
2017	346.40581	279.4	19.35%

The mean of the percentage reductions across all years equal 18.6%. The calculation of the percentage reduction in historic data is done completely independently of the modelling completed for the purpose of this report. We are content that the percentage reduction applied through modelling is a realistic reduction. When assessing Table 11, it is apparent that there is a considerably higher difference between unmeasured and optants. This is entirely driven by the diverging occupancies in the two segments.

Table 11 Micro-component occupancy model parameters – Base year (adjusted to NYAA)

Household types	WRZ	Occupancy	PHC (modelled) l/prop/day	PCC (modelled) l/head/day	Base year (NYAA) calibrated PHC l/prop/day	Base year calibrated PCC l/head/day
Unmeasured HH	Colliford	2.78	387.52	139.58	540.36	194.63
	Roadford	2.90	395.95	136.45	538.37	185.53
	Wimbleball	3.02	403.65	133.63	519.40	171.94
	Bournemouth	2.48	366.02	147.71	395.76	159.71
Existing metered billed HH	Colliford	2.01	296.56	147.27	250.49	124.39
	Roadford	2.13	307.10	144.00	250.66	117.53
	Wimbleball	2.14	307.60	143.85	247.71	115.84
	Bournemouth	2.18	307.60	143.85	247.71	115.84
New build metered HH	Colliford	2.10	277.62	132.31	224.79	107.13
	Roadford	1.64	234.77	143.06	183.01	111.52
	Wimbleball	2.10	277.79	132.27	214.59	102.18
	Bournemouth	2.10	277.76	132.27	254.96	121.41
Optant metered HH	Colliford	1.97	274.16	139.27	221.92	112.73
	Roadford	2.38	308.23	129.59	241.89	101.70
	Wimbleball	2.16	290.60	134.69	224.72	104.16

	Bournemouth	2.24	297.12	132.82	273.15	122.10

mpany level occupancy forecast, which causes a slight decrease in the modelled PHC and modelled PCC.

Table 12 shows the modelled PHC and PCC figures based on the final year occupancies. These figures are without the forecast trends applied so is to demonstrate the impact of the changing occupancy over time of each of the household segments. Unmeasured occupancy increases with a resulting increase in PHC and decrease in PCC. The measured segments all have a slight decrease in occupancy which follows the company level occupancy forecast, which causes a slight decrease in the modelled PHC and modelled PCC.

Table 12 Micro-component occupancy model parameters – Final year (NYAA)

Household types	WRZ	Occupancy	PHC (OVF calculated)	PCC (OVF calculated)
Unmeasured HH	Colliford	2.81	389.55	138.82
	Roadford	2.90	396.92	136.09
	Wimbleball	3.02	405.10	133.10
	Bournemouth	2.69	381.77	141.73
Existing metered billed HH	Colliford	2.07	291.39	140.57
	Roadford	2.18	300.26	137.71
	Wimbleball	2.11	294.59	139.55
	Bournemouth	2.05	289.81	141.08
New build metered HH	Colliford	2.17	273.02	125.55
	Roadford	1.58	219.70	138.86
	Wimbleball	1.96	255.60	130.41
	Bournemouth	1.81	242.46	133.79
Optant metered HH	Colliford	2.09	274.08	131.32
	Roadford	2.46	302.55	122.74
	Wimbleball	2.18	281.77	129.07
	Bournemouth	2.13	277.29	130.39

Using the base year and final year PHC values, a rate of change in PHC due to occupancy change can be calculated for each household metered status. This is in addition to the technology and behaviour trends described in the following section.

5.5 Micro-component trend model – baseline scenario

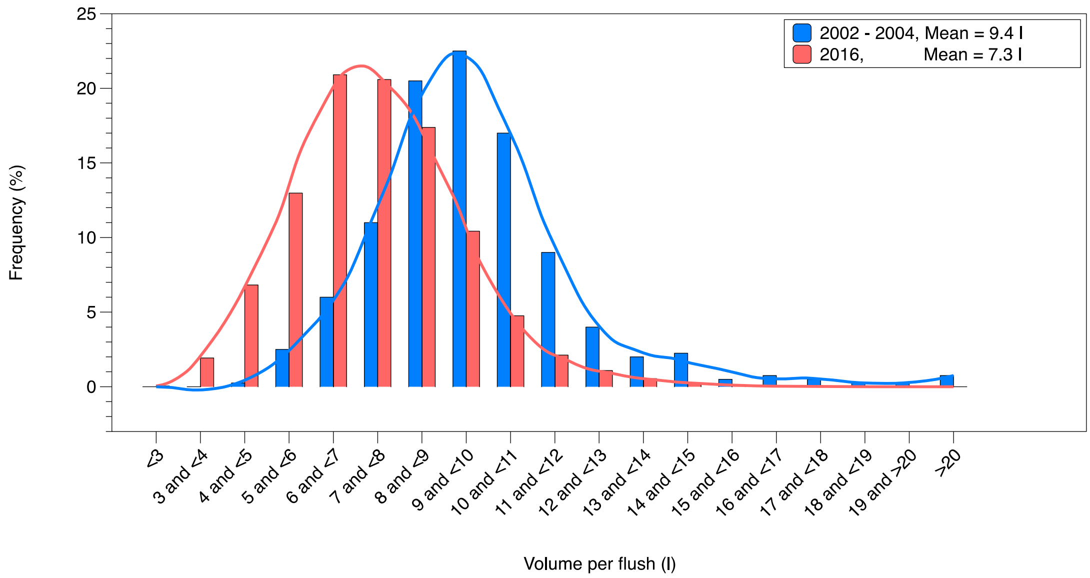
To investigate trends in individual micro-components due to technology change, policies and regulation, and behaviour change, we have used the data set from 2002/04 (Table 7) and the 2015/16 datasets (see back to Table 4 and Table 6). For future projections of trends we have generally used the forecast water use values from Defra's Market Transformation Programme.

5.5.1 *WC flushing*

For the trend we assume that ownership and frequency of use for WC flushing remains constant, with the volume per use changing due to market transformation.

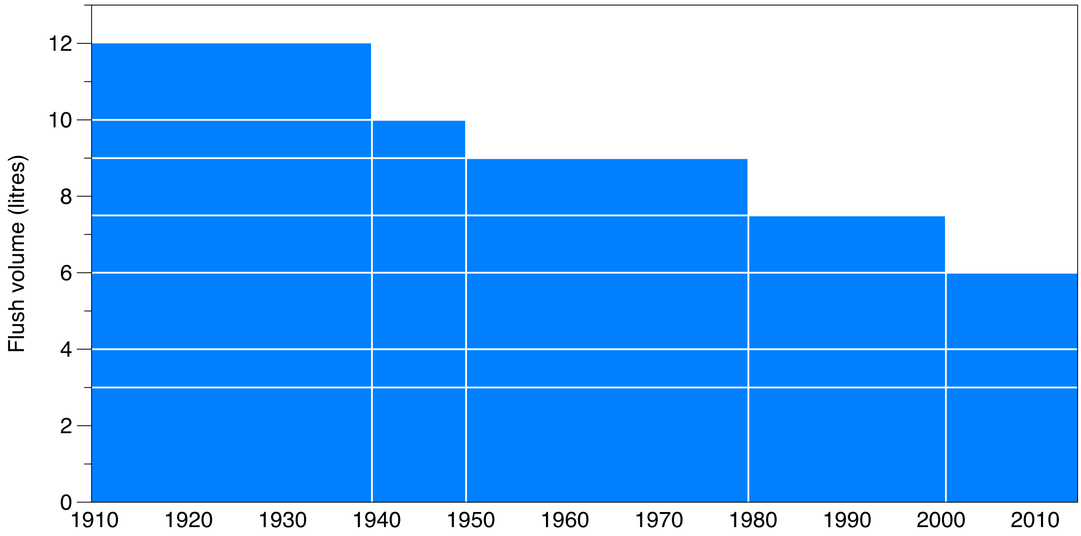
Using data from the WRc micro-component report CP187 and data from the UKWIR 2016 study, we can create a histogram of the volumes per flush from 2002/04 and 2015/16. These are shown in Figure 13. This shows that for 2002/04 the mean flush volume was 9.4 l/flush, with a range of flush volumes from 5 litres to > 15 litres. In 2015/16 the mean flush volume had reduced to around 7.3 litres with a range from 3 litres to about 13 litres per flush.

Figure 13 Histogram of WC flush volumes from 2002/04 and 2015/16



The reason for the reduction in flush volumes from 2002/04 to 2015/16 is due to the replacement of larger volume WC cisterns with smaller volume cisterns, due to market transformation based on regulatory policies. The schematic in Figure 14 shows the change in maximum flush volumes over time due to changes in regulation. From 12 litres in 1910 to 6 litre single flush or 6/4 or 6/3 litre dual flush in 2000 to date. The reason why we see larger flush volumes in the bar chart is due to incorrect setting up of the fill height or over filling during the flush period.

Figure 14 **Regulatory changes in flush volumes**

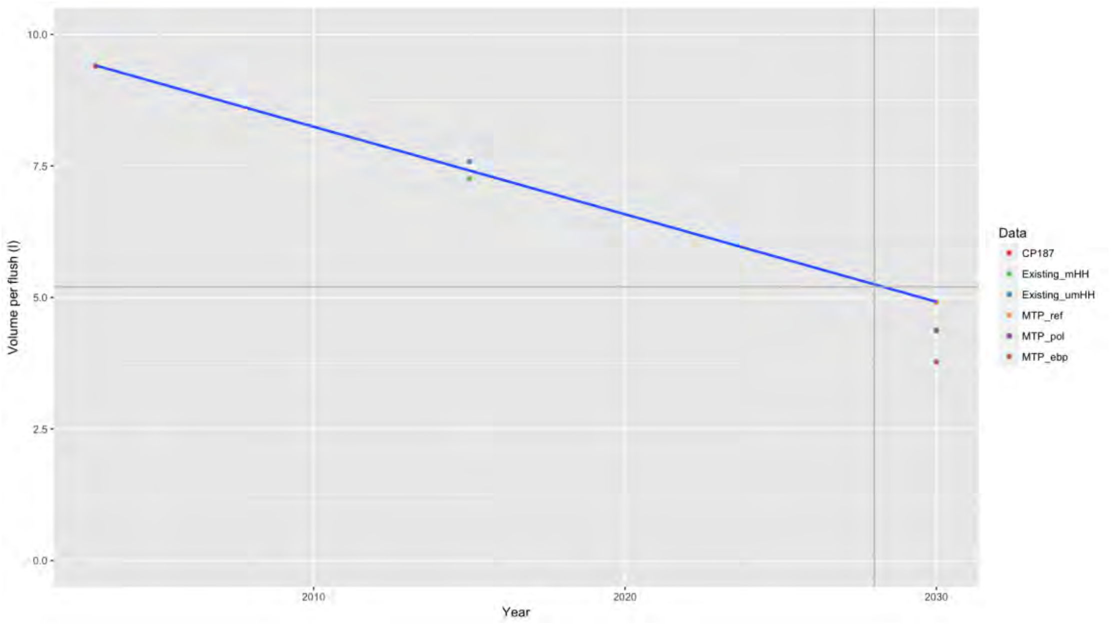


The latest MTP projections for WC flushing volumes[7] in 2030 for the reference scenario is 4.8 litres/flush. Figure 15 shows the mean 2002/04 (CP187), the 2015/16 flush volumes (Existing_mHH[8] and Existing_umHH[9]), and the flush volume from the MTP scenarios in 2030. The blue line shows the linear fit from the 2002/04, 2015/16 and MTP Reference scenarios.

If we assume that the market transformation continues at the current rate (a reasonable assumption for baseline forecasts, as there are no planned regulatory changes in WC flush volumes), then the flush volume in 2028 will be approximately 5.1 litres (shown by the intersect of the grey lines in Figure 15). This provides some confidence in the MTP Reference scenario for WC flush volumes.

[7] Source: http://efficient-products.ghkint.eu/spm/download/document/id/954.pdf
[8] mHH (measured household)
[9] umHH (unmeasured household)

Figure 15 Historic, current and future flush volumes

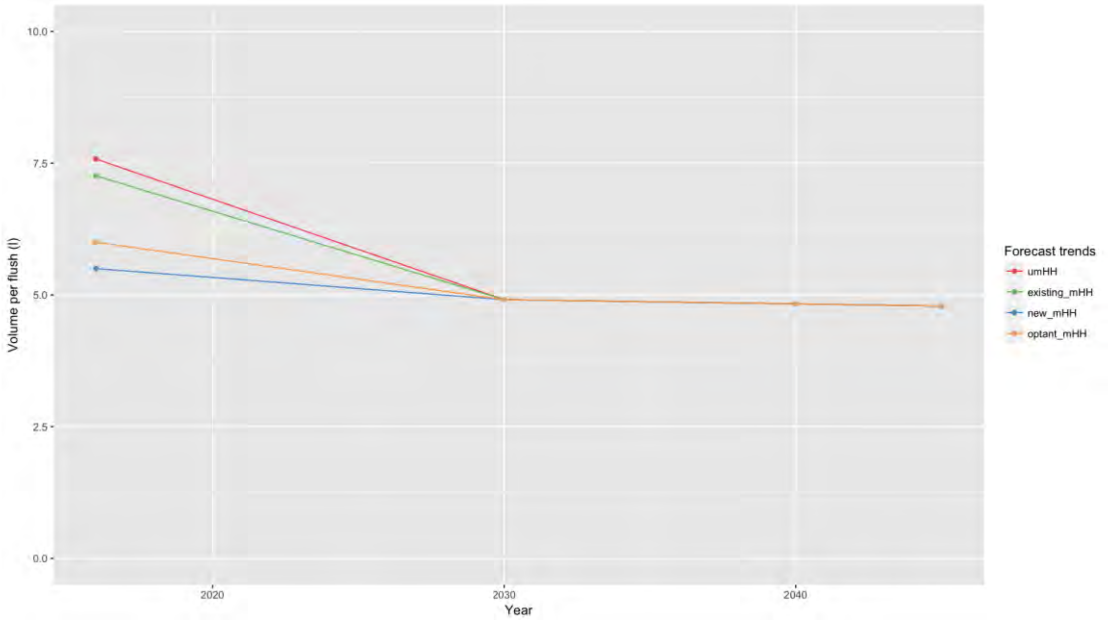


We have created future trends for WC volume per flush (see Figure 16) using:

- the base year volumes per flush in Table 8 for different property types,
- the 2030 projection for WC flush volume from the MTP reference scenario,
- an assumption that all property types will have achieved the MTP Reference scenario between the forecast base year and 2030 (for the baseline forecast assuming no change to current WC flush regulations)[10], and
- the assumption that the volume per use will then remain relatively constant until 2045.

[10] This is a reasonable assumption given the rate of change in actual data presented in Figure 14 and discussed elsewhere in this section.

Figure 16 Trends for WC flush volumes



From these trends, annual rates of change have been produced for each of the property types. The rates of change are then incorporated into the model.

5.5.2 Showering

To investigate showering trends, we have used the overall daily water use (per household) from shower data. This is because shower use is a complex mix of behaviour (showering time), technology (shower flows), as well as frequency of use and occupancy.

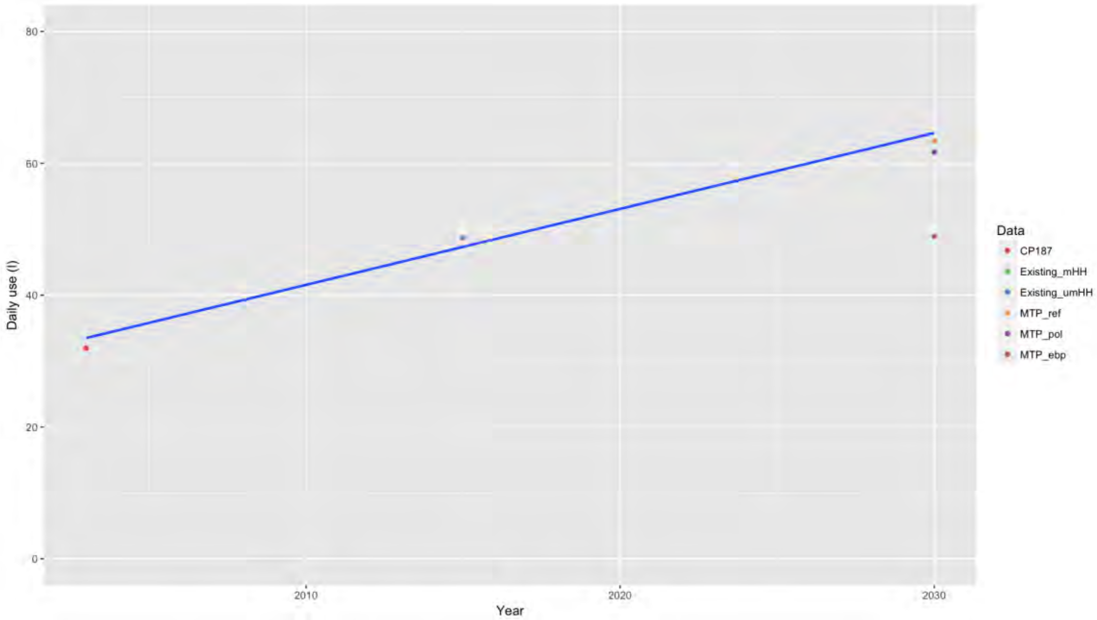
Figure 17 shows the following data points on daily shower volumes (l/day):

- 2003 from WRc CP187 report,
- 2016 from Table 4 (Existing_mHH) and Table 6 (Existing_umHH), both are approximately 49 l/day,
- 2030 from the MTP reference, policy and early best practice scenarios.

These data points assume an average occupancy for households in their specific years. The blue line shows a linear fit from the 2003, 2015/16 and MTP reference scenario. This shows a rising trend, which is consistent with the observations that shower use is increasing (in terms of ownership, frequency and flow rate).

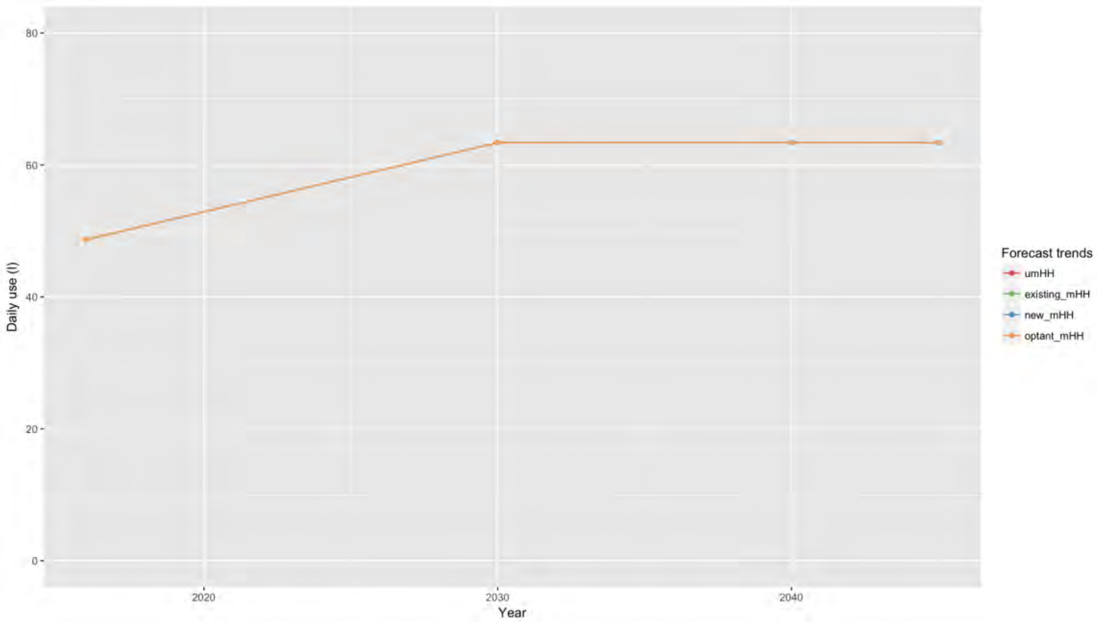
We have chosen not to fit trend line through the MTP Early Best Practice point as this assumes a very high proportion of water efficient showers being installed in new and existing households (which is not evident in current practice). This is used in the development of the lower PCC trend discussed in the alternative scenarios in Section 5.6

Figure 17 Trend of daily volume of water used for showering



Using the trend line from Figure 17 and assuming that shower volumes per day plateau at the MTP reference scenario in 2030 and remain flat over the rest of the planning period, we have produced a predicted trend for shower use as shown in Figure 18. There is no evidence for different house types having different trends, so the same trend is used for all house types.

Figure 18 Future trend for daily volume of water used for showering



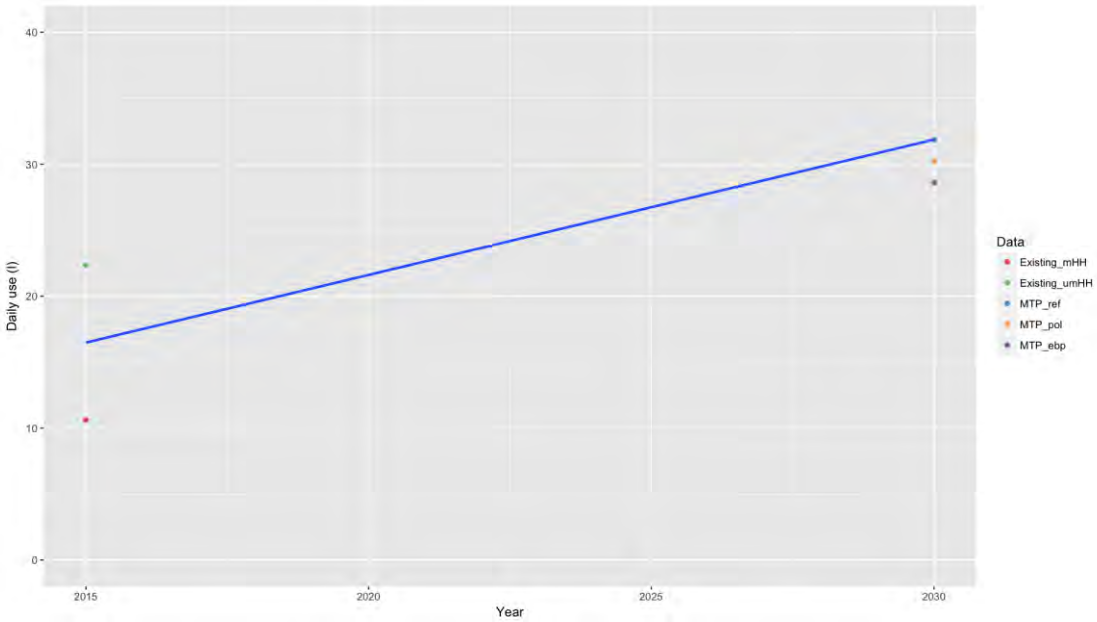
From this trend, annual rates of change have been produced. These are used for each of the property types. The rates of change are then incorporated in the model.

5.5.3 Bath use

For bath use trends, we have used the overall household daily water use from baths. Like showering, bath use is a mix of behaviour, frequency of use and volume per use. Figure 19 shows the evidence for daily volume of bath use from the following data points (l/day):

- 2016 from the bath use in Table 4 (Existing_mHH) and Table 6 (Existing_umHH),
- 2030 from the MTP reference, policy and early best practice scenarios.

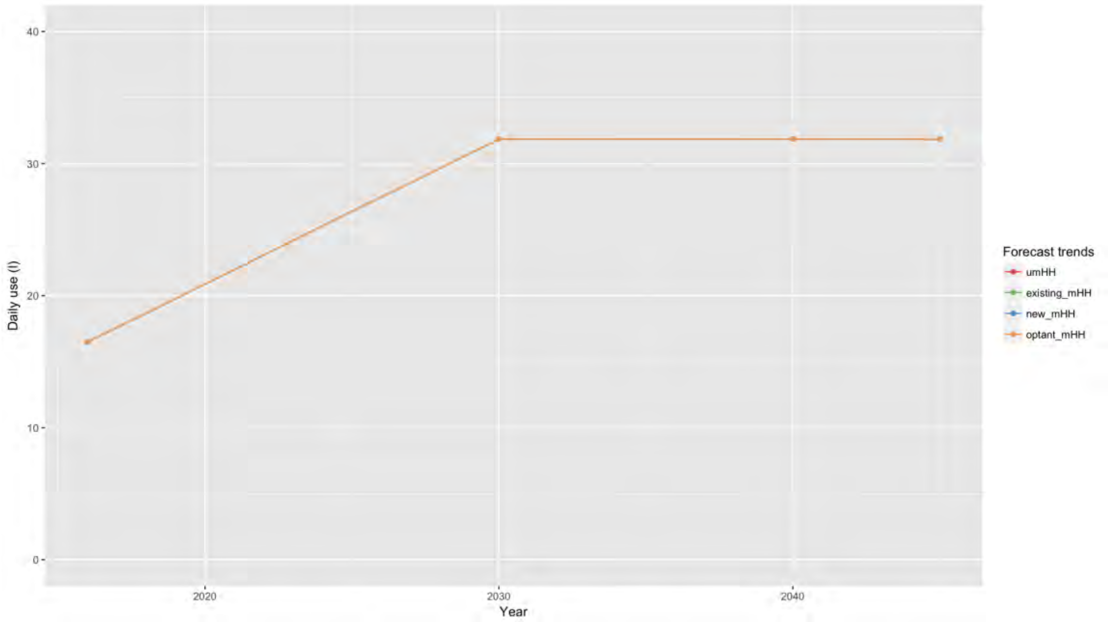
Figure 19 Trend of daily volume of water used for bath use



The blue line in Figure 19 is a linear fit of the 2016 and 2030 data. Using this trend, and assuming that bath use then levels off at 2030 to the end of the planning period, we have created the future trend shown in Figure 20. We have assumed that all household types show the same trend.

From this trend, annual rates of change have been produced. These are used for each of the property types. The rates of change are then incorporated in the model.

Figure 20 **Predicted trends of daily volume of water used for bath use**



5.5.4 Washing machine use

For washing machine use, the following evidence has been used to derive an historic trend in volume per use:

- Waterwise data on washing machine volume per use from 1999 and 2003,
- Washing machine volume per use in 2016 from Table 6.

This data was used to produce a linear trend over time shown in Figure 21 (blue line). The volume per use has a trend over time to reflect the improvement in technologies to reduce energy and water use.

For the future trend in washing machine volume per use, we have extrapolated this trend to the end of the planning period (assuming continuous developments in technology). This trend is applied to all household types except new properties. These are assumed to have a starting point of 50 l/use in 2016. The resulting future trends are shown in Figure 22. Rates of change are then computed from these trends and incorporated in the model.

Figure 21 Historic trend in washing machine volume per use

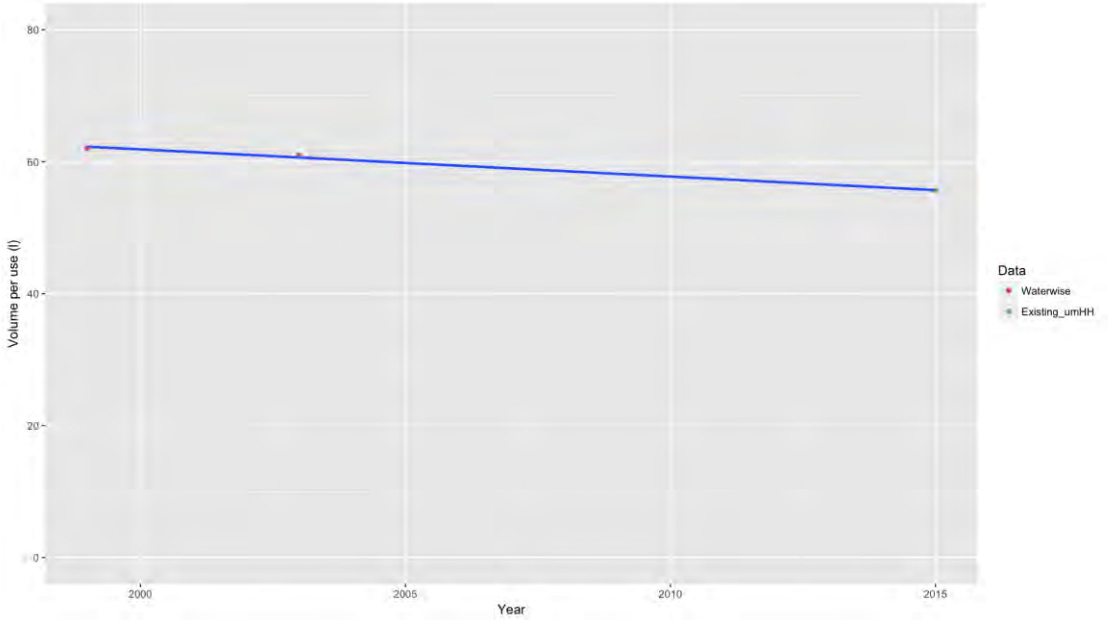
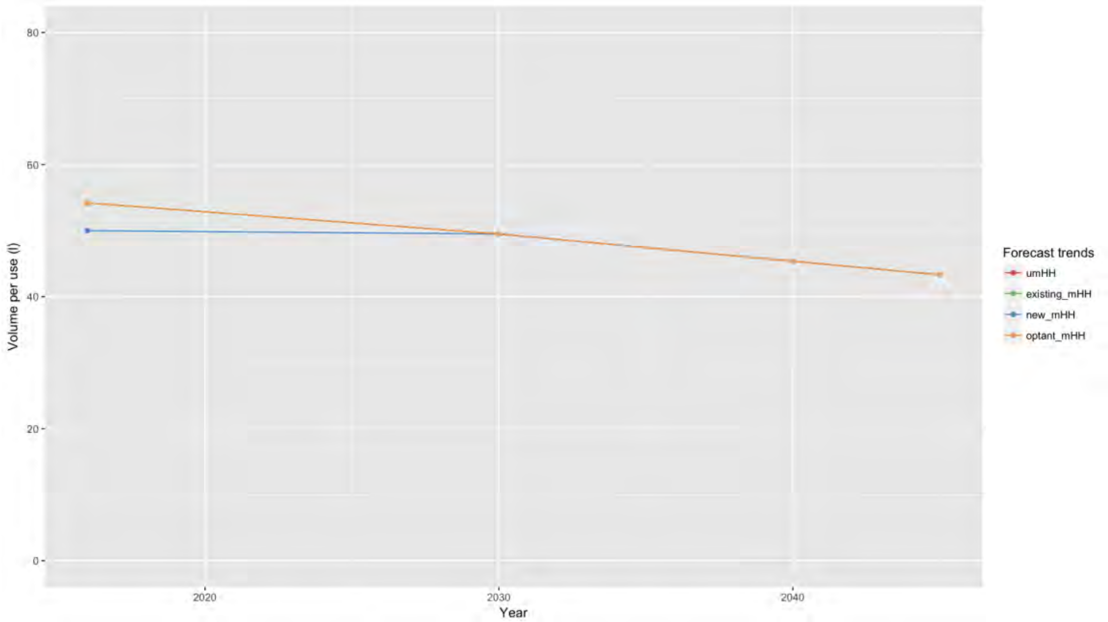


Figure 22 Future trend of washing machine volume per use



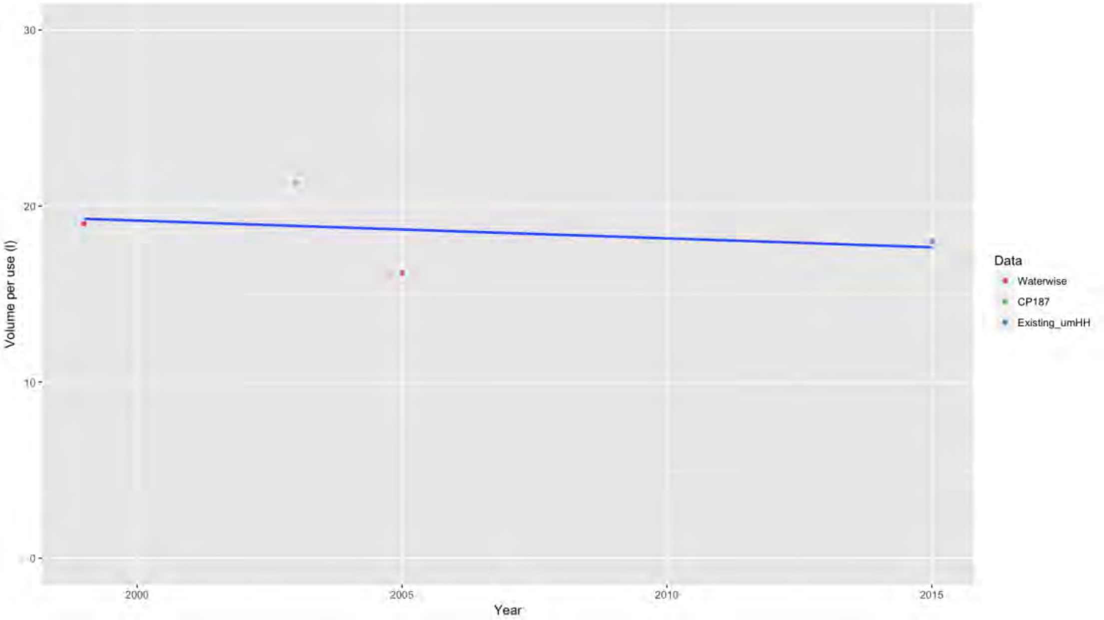
5.5.5 *Dish washer use*

For dishwasher use, the following evidence has been used to derive an historic trend in volume per use:

- Waterwise data on washing machine volume per use from 1999 and 2003,
- Washing machine volume per use in 2016 from Table 6.

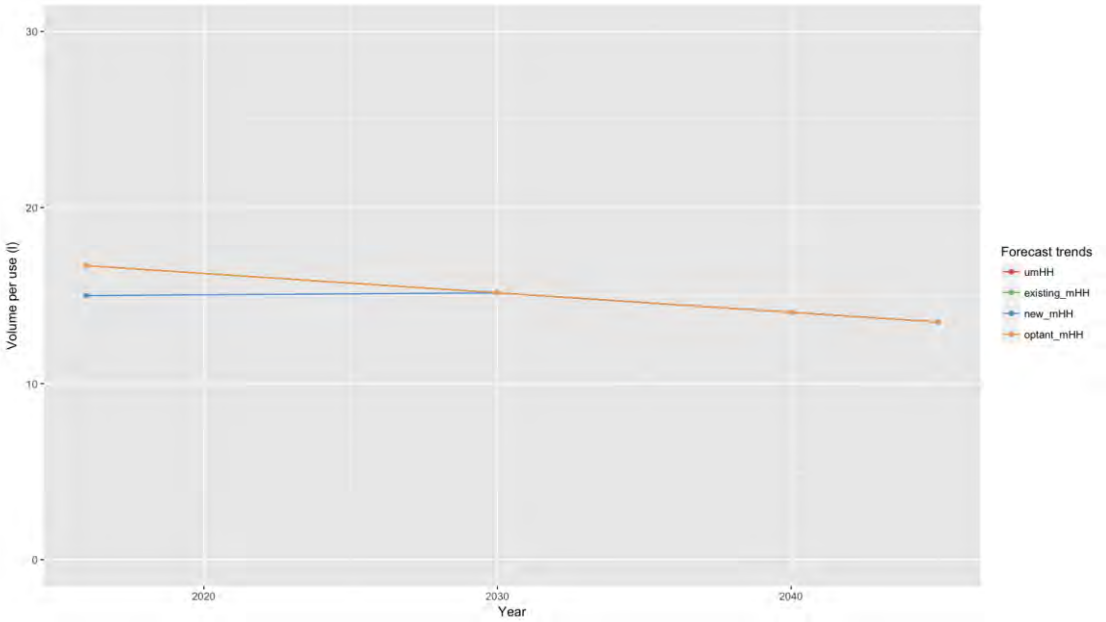
This data was used to produce a linear fit over time shown in Figure 23 (blue line). The volume per use has a trend over time to reflect the improvement in technologies to reduce energy and water use.

Figure 23 Historic trend in dish washer volume per use



For the future trend in dish washer machine volume per use, we have extrapolated this trend to the end of the planning period (assuming continuous developments in technology). This trend is applied to all household types except new properties. These are assumed to have a starting point of 15 l/use in 2016. The resulting future trends are shown in Figure 24. Rates of change are then computed from these trends and incorporated in the model.

Figure 24 Future trends of dish washer volume per use



5.6 Micro-component trend model – alternative scenarios

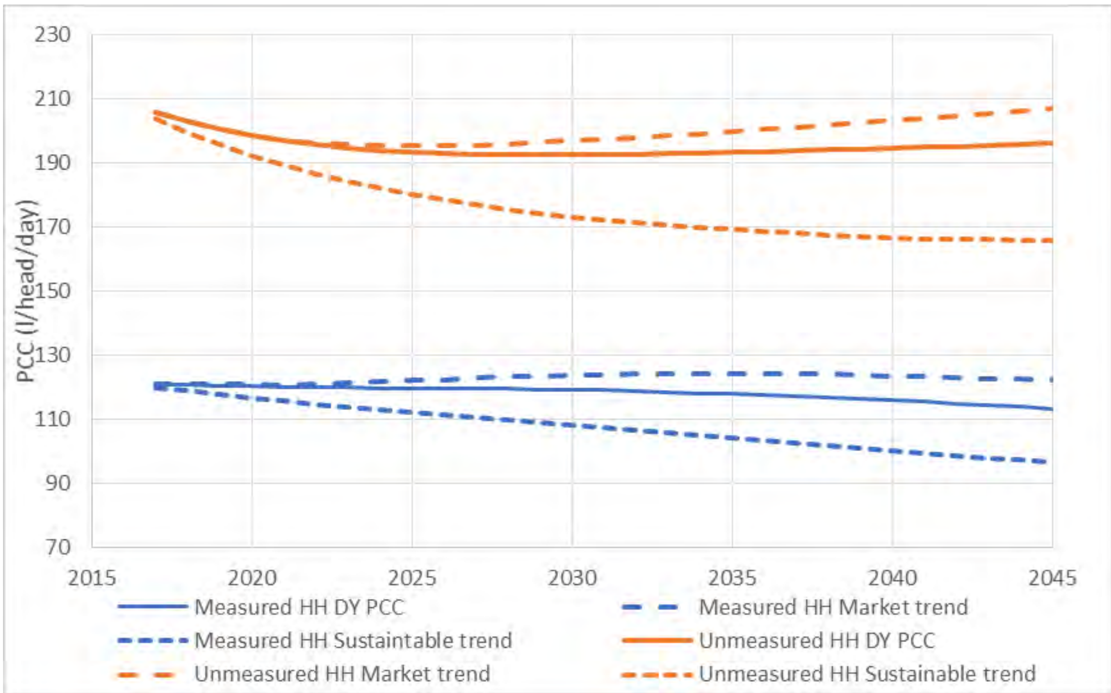
Two scenarios based on micro-component trends are added to account for variations within the future predicted rate of change in consumption.

Firstly, sustainable development, in this most extreme efficiency scenario, we have assumed that water saving is driven by both technological advancements and attitudinal changes. Sophisticated filtration technology would allow recirculation of shower water saving both energy and water. Waste water and washing functions are fulfilled by greywater recycling, aided by hydrophobic frictionless surfaces. Bathing is pretty much obsolete.

Secondly, market trend, this scenario assumes that the projected trend in micro-components does not continue beyond 2022. This would require a situation such where the UK building regulations might be decoupled from current standards (possibly within the context of the UK leaving the regulatory framework of the European Union and might set off a situation where the decline in flush volumes is curtailed. The observed upward trend in showering continues to increase.

The variation in the trends for measured and unmeasured household PCC are shown in Figure 25. These upper and lower scenarios may be used in the demand forecast uncertainty component of headroom.

Figure 25 Variation in base line (DY) PCC trends



5.7 Base Year Calibration

For each of the household segments, the OVF models are applied using the base year occupancy values. The OVF calculated PHC is then calibrated to the normal year annual average (NYAA) value. Further details of the normal year (NY) calculations are described in section 6. However, it is important to note that the NY factor is applied within the base year (BY) calibration to ensure that the rate of change over time for each component is not affected by annual variation that might by contained within the BY. The zonal reported measured and unmeasured BYAA are factored to NYAA.

The zonal PHC values for the non-reported figures; existing measured, new properties measured, optant measured and selective/compulsory measured are calculated proportionally based on the NYAA measured value using the OVF calculated PHC in each segment.

5.8 Climate change

Climate change impacts on consumption have been calculated in accordance to UKWIR 13/CL/04/12 Impact of Climate Change on water demand[11] Median percentage climate change impacts on household demand at 2040, relative to 2012 are published for each river basin within the UK. South West Water is comprised within the South West England River Basin. Therefore, the annual average forecasts have an average of 0.99% increase in

[11] UKWIR (2013) Impact of Climate Change on water demand. UKWIR report 13/CL/04/12

consumption over that period, which is the respective figure for the River Basin area. As the base year is now 2016/17 and the final forecast year is 2044/45 the percentage change is shifted along as there has been no further evidence since this report. However, as the forecast period with the base year set at 2016/17 is one year longer, the final percentage is slightly larger than the figure printed in the guidance. If the forecast were to be run under a critical period scenario, then the percentage affected by climate increases from 0.99% to 2.63%. When the critical period is selected the appropriate climate change factor is applied in a linear fashion across the forecast period.

The additional demand from climate change is added to the external use micro-component only. The volume attributed to climate change is displayed in a separate row in the top section of the outputs. The model includes functionality to output forecasts with and without climate change factors.

5.9 Trends, scenarios and uncertainty

Further work was carried out using a Monte Carlo approach, which has been applied at company (Ml/d) and at property level (PHC) split by measured and unmeasured to give an idea of the statistical variance and error calculations throughout the modelling procedure, these are shown in Figure 26 and Figure 27.

Population and property errors; for the population and properties we apply the UKWIR guideline[12] errors to a normal distribution (which we note is truncated at zero for the unmetered figures). The groups within the overall population and property figures are varied (where the figure is not fixed) and then normalised to sum to an overall population and property figure varied with the UKWIR errors. Note that the precise implementation requires a re-normalisation process at each time-step; as this process is somewhat complex we merely summarise the process here.

Modelling error has been derived from the standard statistical outputs from the micro-component linear modelling. It combines error within the predictor variables, modelling error and errors in the trends.

[12] UKWIR 15/WR/02/8 WRMP19 methods – population, household property and occupancy forecasting

Figure 26 **Company level measured HH consumption Monte Carlo error distribution**

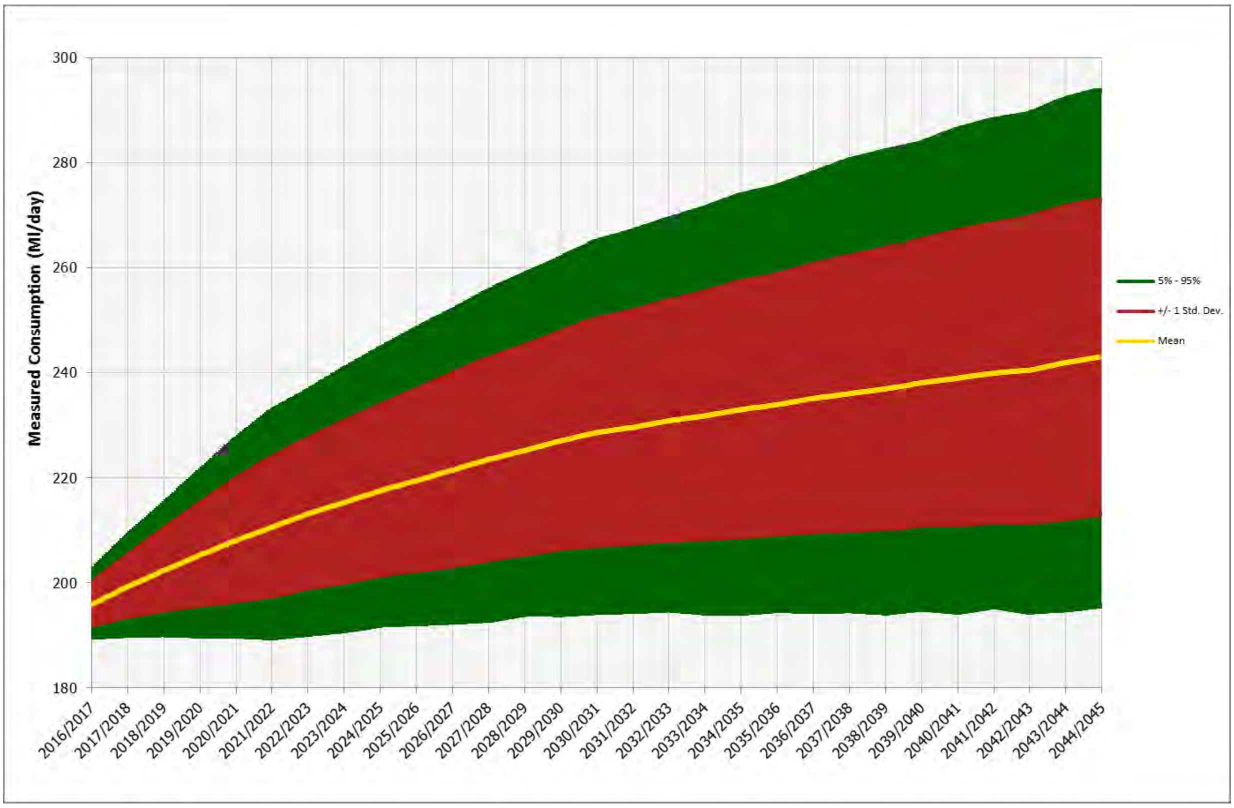
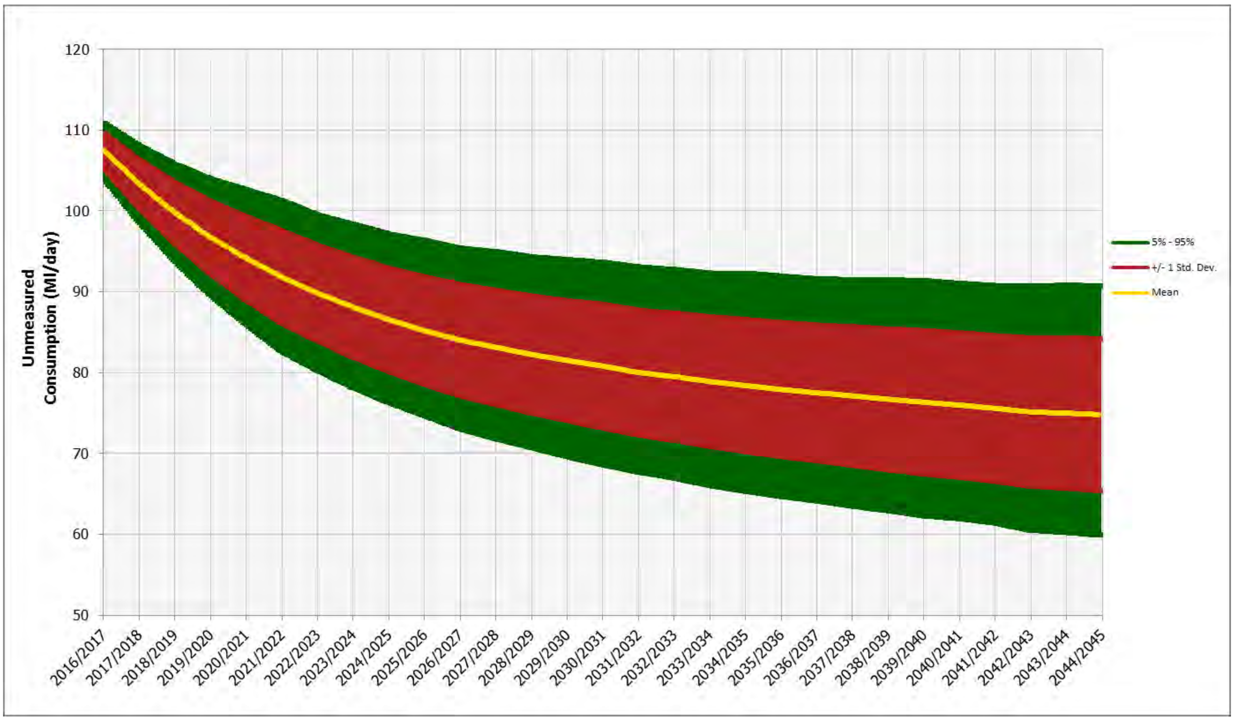


Figure 27 **Company level unmeasured HH consumption Monte Carlo error distribution**



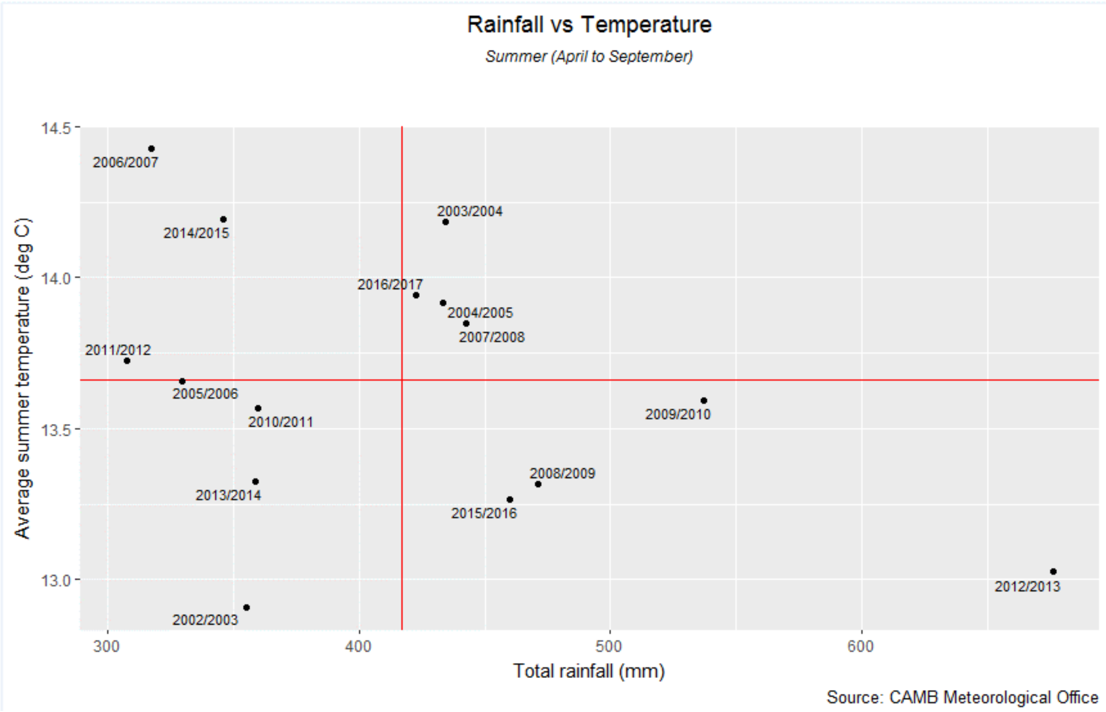
The results of this section are not used within the forecasting process, but are input into the headroom assessments. The graphs in Figure 26 and Figure 27 provide a graphical representation of the uncertainty surrounding the household consumption forecast.

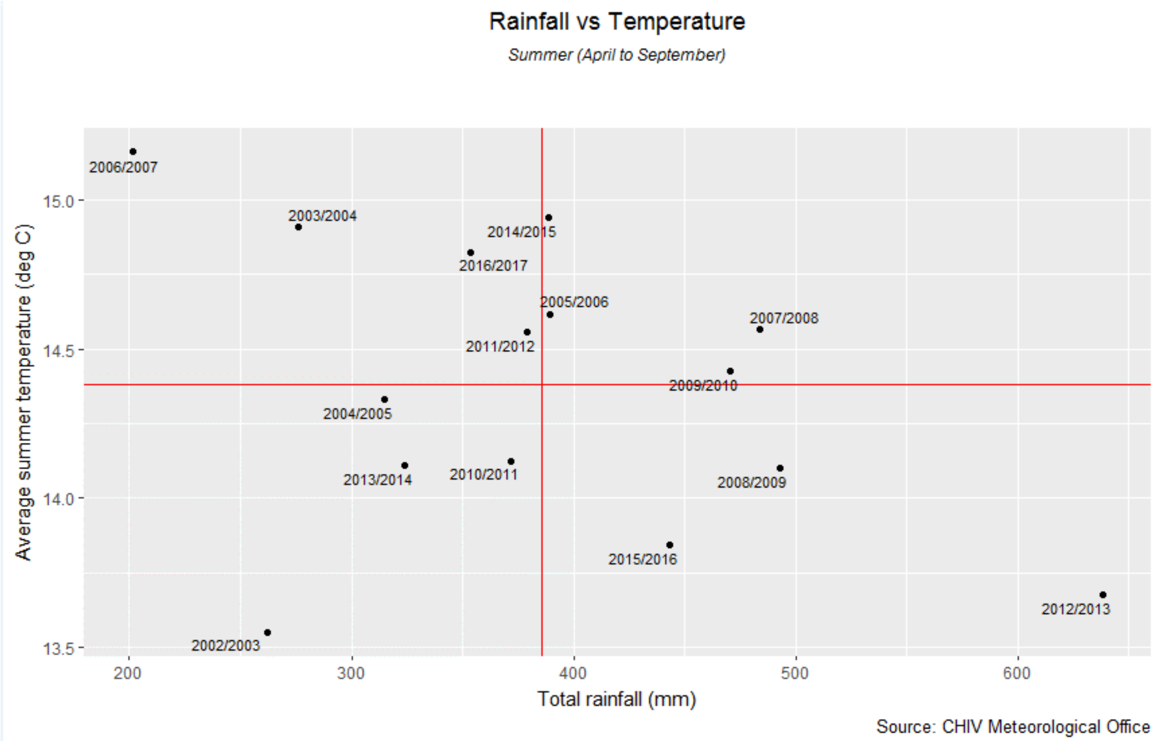
6 Consumption uplifts for normal, dry year and critical period

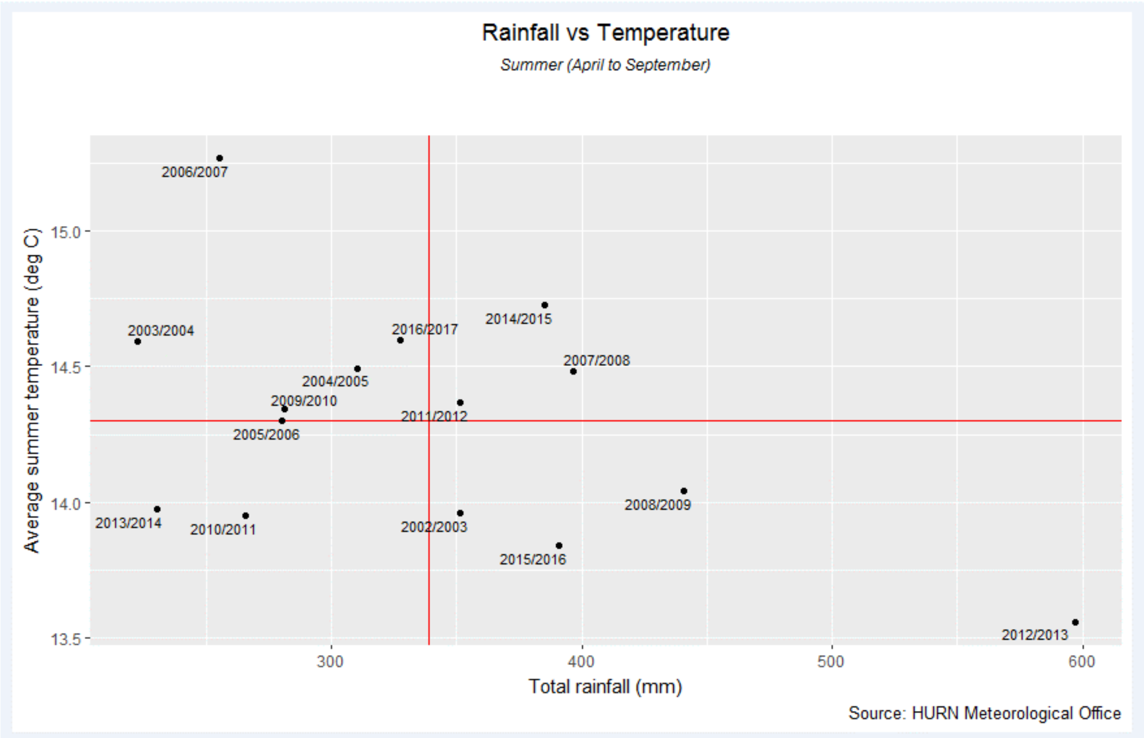
The application of NYAA was touched on in section 5.7. In this section the full methodology and application is explained. The methodology for the NYAA and DYAA factors comes from the UKWIR guidance report number 15/WR/02/9 – household consumption forecasting.

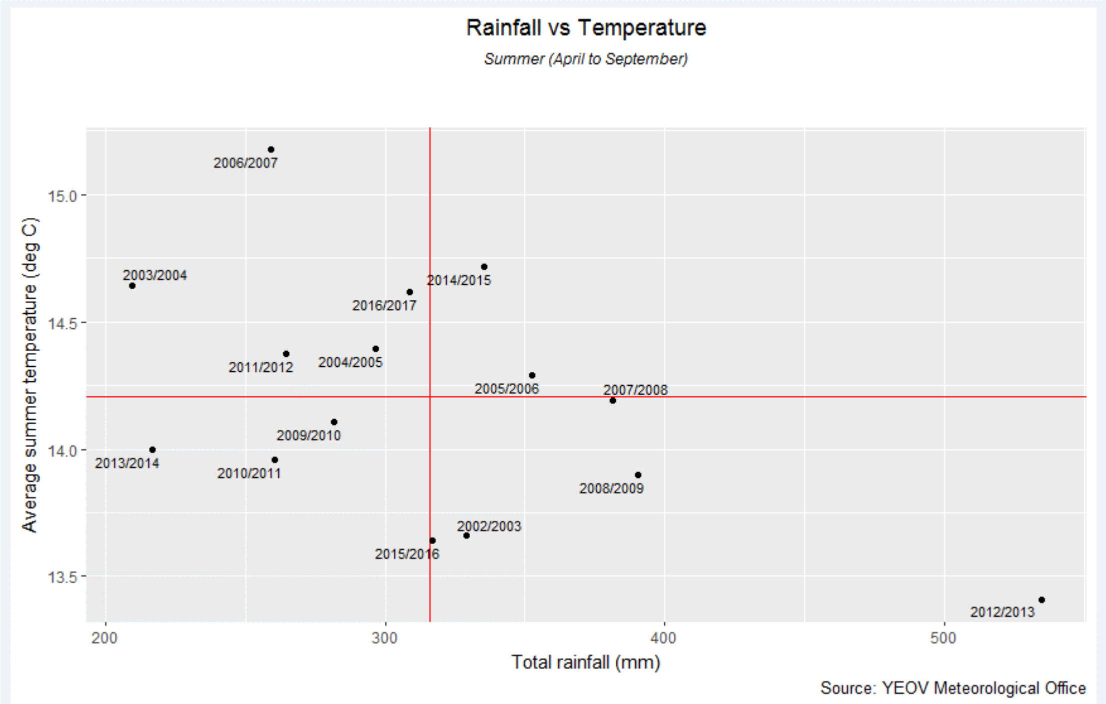
Stage one involved an assessment of the weather data, more specifically temperature and rainfall. Each factor is summarised for the summer months for each year. Total summer rainfall is plotted against mean summer temperature, with the mean of all years for the two factors plotted as red lines on the graph. Each of the four met office weather stations within the South West region are shown in in the graphs in Figure 28. A judgement is made as to which is the hottest and driest year; 2003/04 and 2006/07 are the strongest years in the top left quadrant which suggests a hot dry summer. There are several others that appear in the top left quadrant; 2004/05, 2009/10, 2011/12, 2014/15 and 2016/17, however these are not as prevalent either in terms of the position or the consistency between the four weather stations.

Figure 28 Quadrant plots for determining the dry year, met office weather stations Cambourne, Chivenor, Hurn and Yeovilton




Rainfall vs Temperature
Summer (April to September)
Average summer temperature (deg C)
Total rainfall (mm)
2006/2007
2003/2004
2014/2015
2016/2017
2005/2006
2007/2008
2011/2012
2009/2010
2004/2005
2013/2014
2010/2011
2008/2009
2015/2016
2012/2013
2002/2003
Source: CHIV Meteorological Office


Rainfall vs Temperature
Summer (April to September)
Average summer temperature (deg C)
Total rainfall (mm)
2006/2007
2003/2004
2016/2017
2014/2015
2007/2008
2004/2005
2009/2010
2011/2012
2005/2006
2013/2014
2010/2011
2002/2003
2008/2009
2015/2016
2012/2013
Source: HURN Meteorological Office



Stage two was to analyse the PCC trends for measured and unmeasured, these are done separately to account for the difference in trend and also the potential difference in impact of the dry year, as illustrated in Figure 29 and Figure 30 for measured and unmeasured properties respectively.

Figure 29 Reported PCC trend - measured properties (dry year indicated in red, base year indicated in yellow)

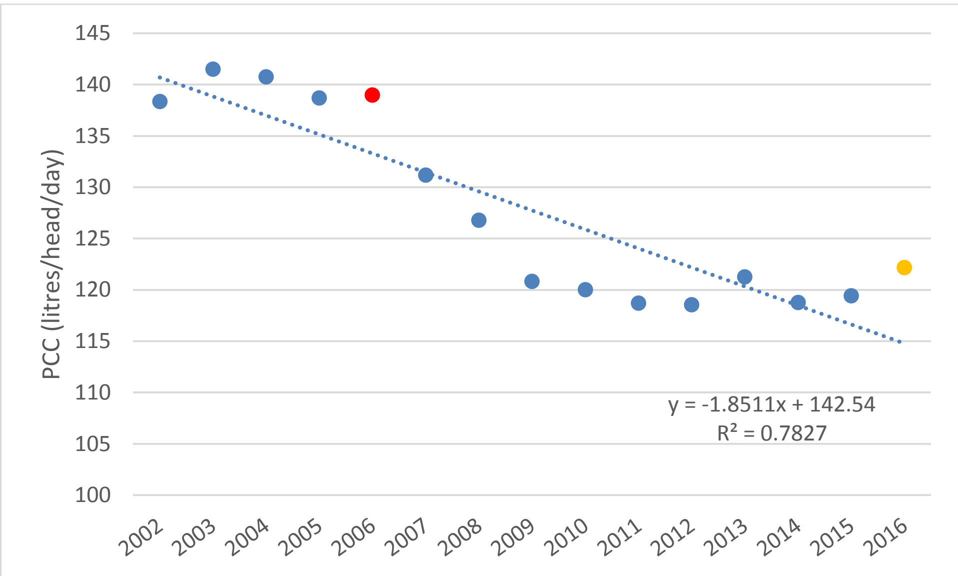
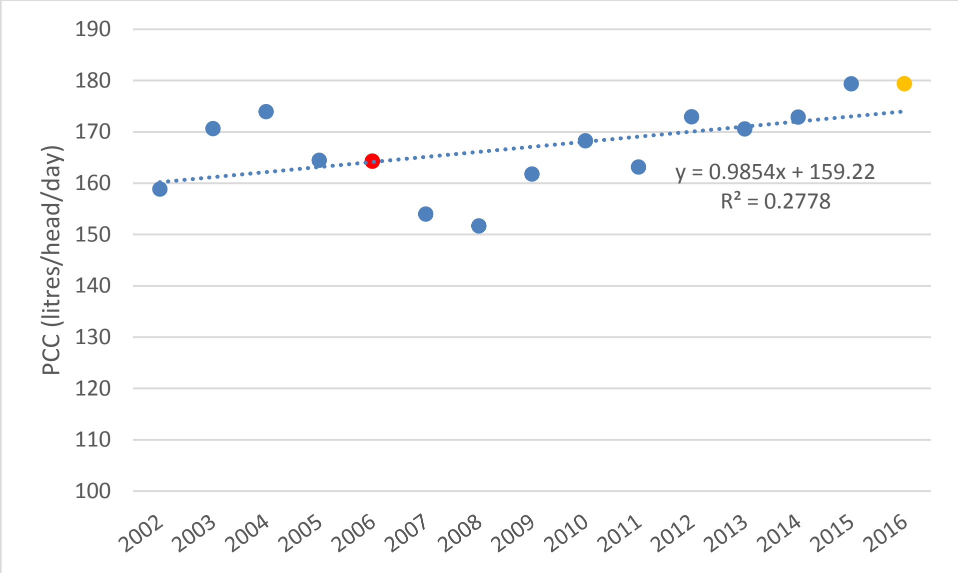


Figure 30 **Reported PCC trend - unmeasured properties (dry year in red, base year in yellow)**



The selection of the DY is done using the measured PCC values, shown in Figure 29. The reason for this is that measured values are deemed to be more accurate and less variable due to better quality data and less adjustments made with relation to supply pipe leakage. When assessing Figure 29, 2006/07 stands out as the year that responds the strongest out of the three possible dry year selections. In 2006/07 several companies enforced hosepipe bans especially in the South East of the UK. Whether or not South West Water enforced the ban, media coverage of the ban has been shown to decrease consumption across many of the water companies, however it remains as the largest dry year factor. The dry year factor is calculated by removing the dry year, then calculating a trend line through the remaining points. The dry year factor is the reported figure divided by the modelled figure.

Normal year factor calculations are calculated in a similar way, using the same trend line which excludes the dry year point. The normal year factor is the modelled figure divided by the reported figure (yellow dot in Figure 29 and Figure 30). As stated previously, this is done separately for measured and unmeasured.

The dry year factor is calculated to be 1.053 measured normal year factor is 0.943 and the unmeasured normal year factor is 0.976. The SWW WRMP14 forecast used a 1.061 dry year factor, which was using 95/96, a normal year adjustment factor was applied prior to the application of the dry year factor. Bournemouth water used a 1.075 dry year factor which was using 2003/04.

Critical period calculations are done in accordance to the methodology stated in UKWIR 06/WR/01/7. Distribution input (DI) is used due to the methodology requiring daily consumption figures. Despite DI including leakage it is the best source of data available. From the daily data a weekly rolling mean is calculated. For each (financial) year, the peak week and the annual average are calculated. A long term annual average is then calculated from all of the years in the time series, and the critical period peak week factor is the maximum peak week within one of the dry years (top left quadrant).

Critical period is only applied to Bournemouth Water WRZ, however DI data is only available for the original SWW WZRs. the peak week selected from 2006/07 has a result of 1.169, peak week from the full dataset going back to 1989 is 1.419, this occurred during 1994. WRMP14 used a 1.49 critical period adjustment. Based on the fact that we have not been able to calculate the factor on the Bournemouth Water DI, we suggest using the factor calculated in WRMP14. There has no evidence to suggest that this factor has been surpassed since this report.

Application of the NY factor is different to the DY factor. The base year to normal year is applied before the calibration of the OVF calculated PHC, the reported figures are adjusted prior to this step so that the forecast is run from the normal year. Once the normal year forecasts are calculated the DY factor is applied. The baseline forecast for South West is as a DYAA.

A summary of the NYAA and DYAA factors are summarised in Table 13.

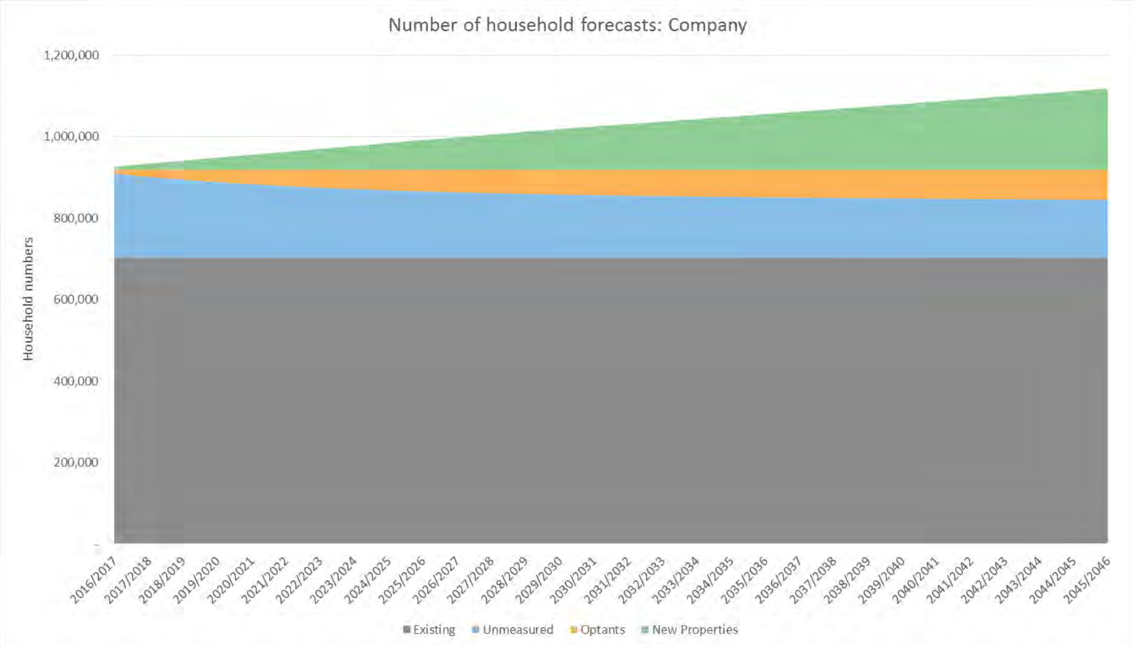
Table 13 Summary of factors applied in the household forecast

Factor	WRMP19	WRMP14 - SWW	WRMP - BW
Normal to Dry year factor (all households)	5.3%	6.1%	7.5%
Base to Normal year factor (measured households)	-5.7%	0.5%	0
Base to Normal year factor (unmeasured households)	-2.4%	-2.0%	0
Normal to Critical period factor (all households) – applied to Bournemouth only	16.9%	NA	49%

7 Household consumption outputs

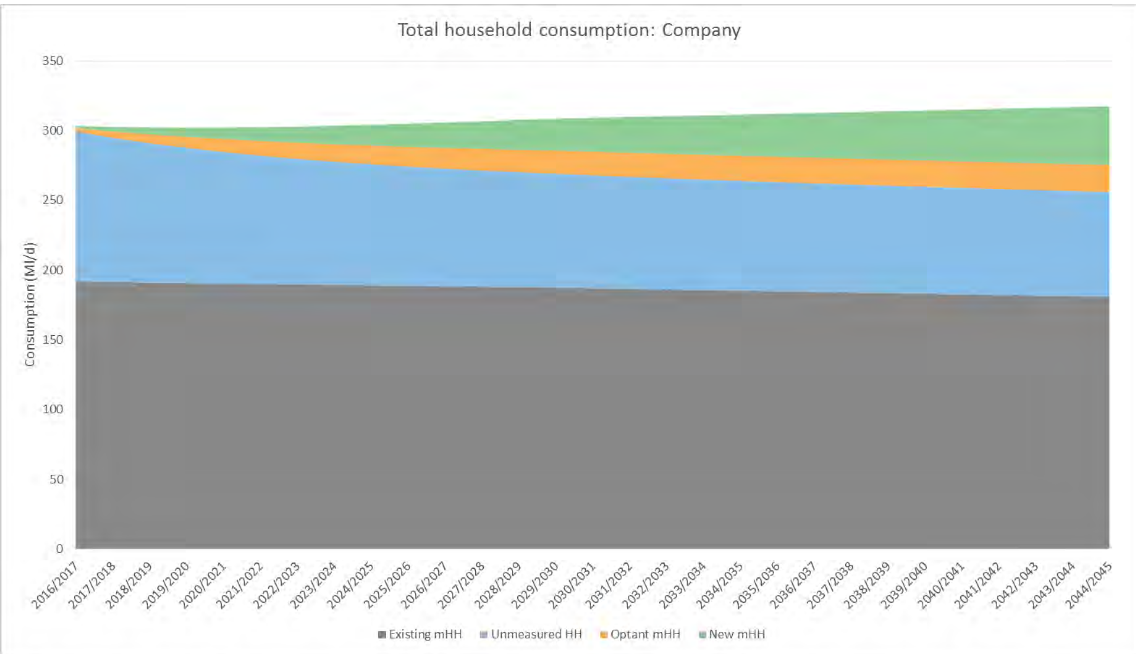
Graphical outputs for the central property forecast only are shown in Figure 31 and Figure 32, and in tabular form in Table 14.

Figure 31 Total number of households, split by household segment



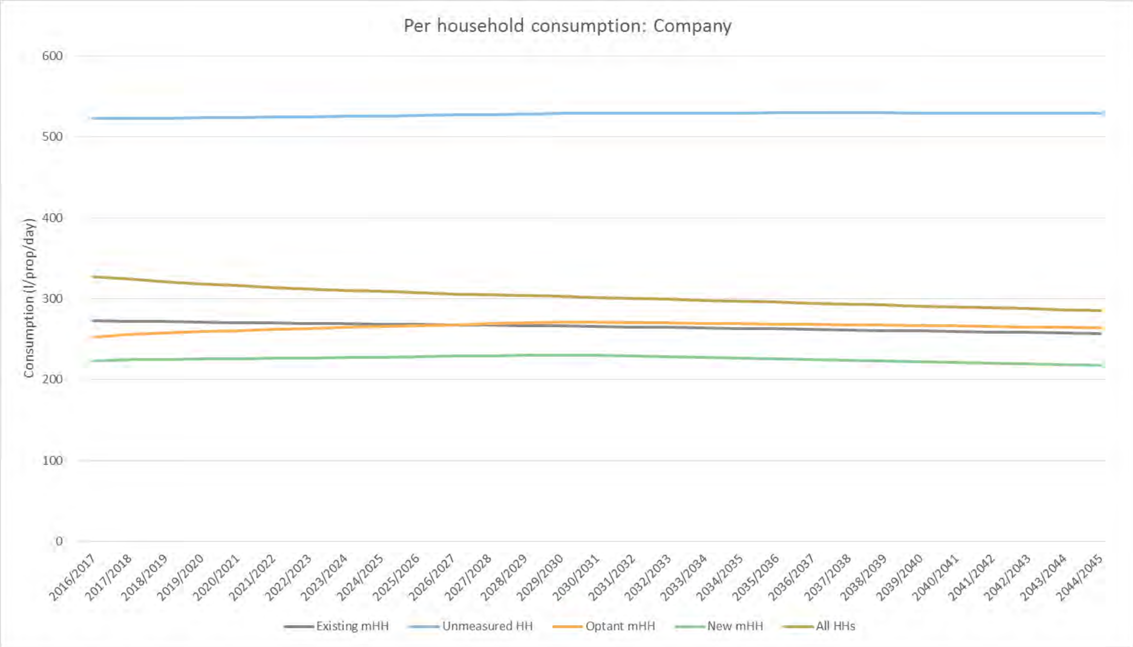
The total number of households, shown in Figure 31, increases from 926,729 to 1,112,455 so a 20% increase over the forecasting period.

Figure 32 Total household consumption (Ml/d), split by household segment



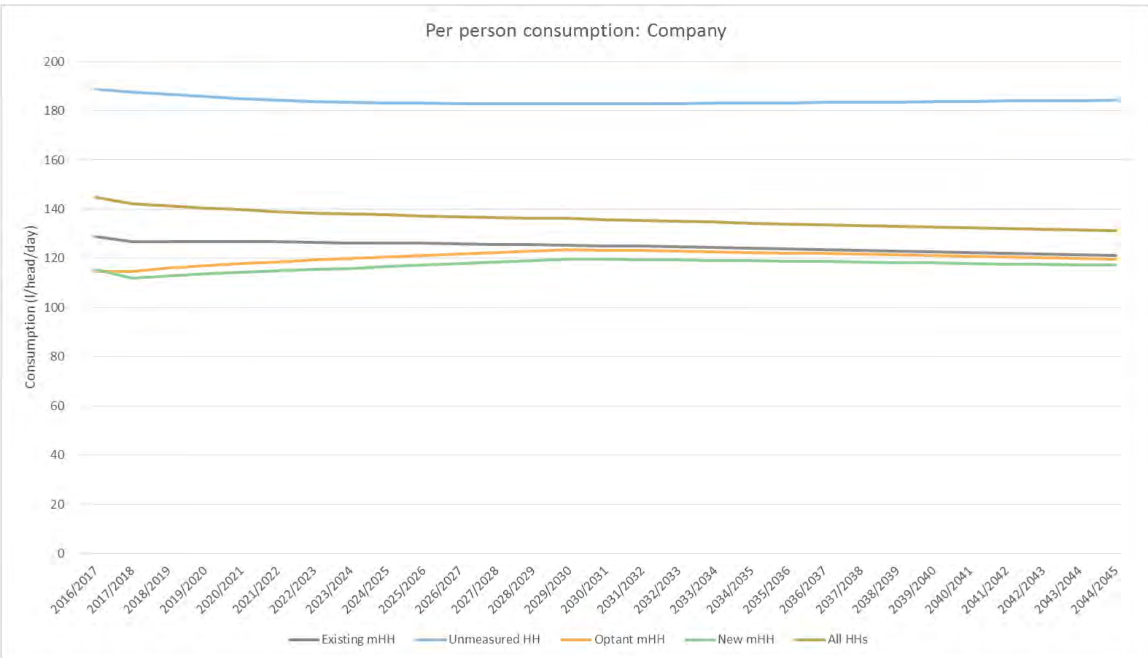
Total company household consumption for DYAA increase from 288.21 Ml/day to 301.54 Ml/day, which is a 4.6% increase in demand over the forecast period, shown in Figure 32.

Figure 33 Company level PHC, split by household segment



Therefore, the PHC must decrease over the forecasting period, this is shown in Figure 33. The total average PHC decreases from 311 l/property/day to 271 l/property/day. Each of the household segments have different trends, with the unmeasured households increasing from 497 l/prop/day to 502. Each of the measured segments remain quite stable, with a slight fall dependent on the rate of change developed from measured and MTP figures. The overall decrease in PHC is a function of the unmeasured households converting to optant properties with a lower PHC.

Figure 34 Company level PCC, split by household segment



Company level PCC has a similar trend to PHC, with a slight decrease from 138 to 125 (l/head/day). Unmeasured PCC shows a negative trend at the beginning of the planning period, which is different compared to the PHC trend; this is due to the increase in occupancy within this segment, shown in Figure 35. The lower occupancy properties convert to optants, while the higher occupancy properties remain in the unmeasured segment.

Figure 35 Company level occupancy, split by household segment

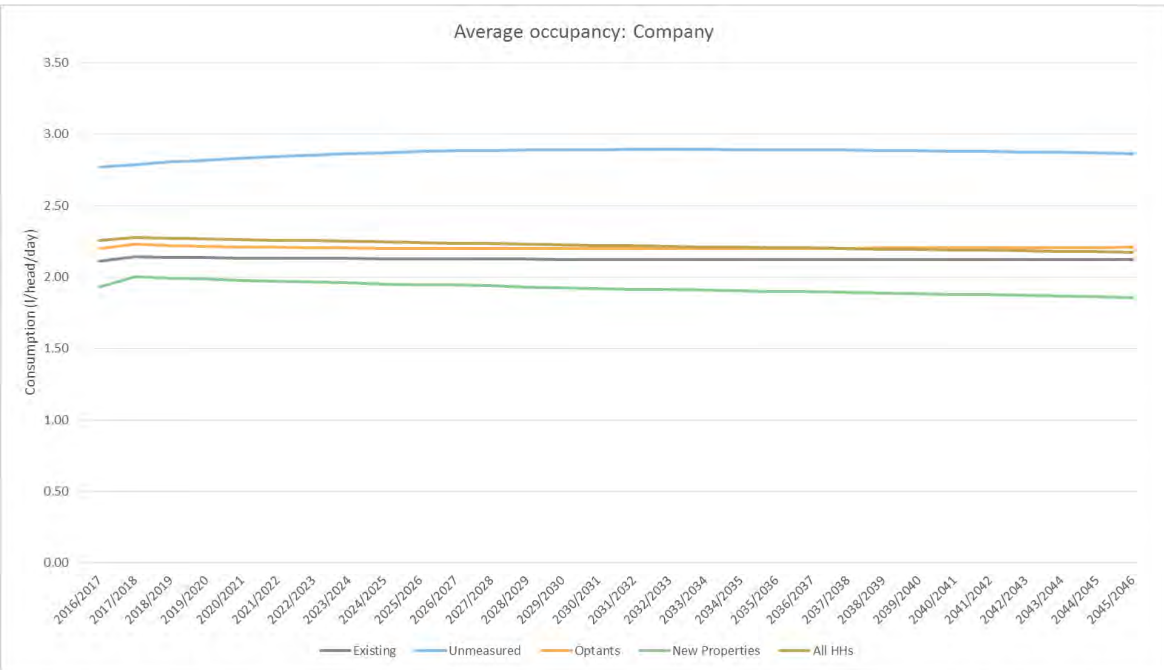


Figure 35 shows the trends in occupancy, the unmeasured initial rise is most notable and, as described before, this is the impact of optant properties coming from the lower end of the occupancy distribution within the unmeasured households.

Table 14 DYAA household consumption forecast

	AMP6				AMP7					AMP8	AMP9	AMP10	AMP11
Company Consumption (Ml/d)	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
Total company	288.21	287.53	287.17	287.03	287.07	287.32	287.69	288.27	288.96	293.18	295.88	298.67	301.54
Measured	186.07	189.31	192.30	195.04	197.58	200.03	202.29	204.50	206.60	215.63	221.15	225.85	230.25
Unmeasured	102.13	98.21	94.87	91.99	89.49	87.30	85.40	83.78	82.37	77.55	74.72	72.81	71.29
Company PHC (l/prop/day)	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
Company average	310.99	307.79	304.97	302.50	300.30	298.29	296.50	294.87	293.39	287.69	281.88	276.46	271.06
Measured	258.07	257.08	256.17	255.35	254.59	253.87	253.20	252.55	251.94	249.38	245.43	241.42	237.26
Unmeasured	496.50	496.60	496.83	497.15	497.53	497.97	498.45	498.96	499.50	502.16	502.88	502.83	502.09
Company PCC (l/head/day)	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
Company average	137.72	135.06	134.20	133.46	132.74	132.12	131.53	131.06	130.72	129.32	127.61	126.05	124.56
Measured	122.16	119.99	119.85	119.73	119.51	119.34	119.13	118.98	118.93	118.44	117.07	115.70	114.36
Unmeasured	179.38	178.19	177.19	176.35	175.64	175.06	174.59	174.24	173.99	173.72	173.92	174.43	175.01
Measured PCC (l/head/day)	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
WC (toilet) flushing	27.95	26.76	26.04	25.35	24.65	23.96	23.29	22.64	22.01	18.95	18.68	18.41	18.14
Personal washing	48.06	47.95	48.62	49.29	49.92	50.55	51.16	51.79	52.45	55.57	55.21	54.84	54.48
Clothes washing	14.97	14.63	14.54	14.44	14.34	14.23	14.13	14.03	13.94	13.46	12.83	12.21	11.61
Dishwashing	11.08	10.89	10.88	10.87	10.85	10.83	10.81	10.79	10.77	10.68	10.56	10.45	10.33
Miscellaneous (internal) use	13.46	13.20	13.16	13.12	13.07	13.03	12.98	12.94	12.92	12.76	12.60	12.46	12.32
External use	6.63	6.57	6.61	6.66	6.70	6.73	6.77	6.81	6.85	7.03	7.18	7.33	7.47
SUM	122.16	119.99	119.85	119.73	119.51	119.34	119.13	118.98	118.93	118.44	117.07	115.70	114.36
Unmeasured PCC (l/head/day)	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
WC (toilet) flushing	37.14	35.96	34.83	33.74	32.68	31.65	30.64	29.66	28.70	24.06	24.01	24.02	24.03
Personal washing	69.33	69.90	70.54	71.24	71.98	72.77	73.60	74.48	75.40	80.44	81.07	81.84	82.64
Clothes washing	20.17	19.93	19.70	19.50	19.31	19.14	18.97	18.83	18.69	18.11	17.54	17.00	16.45
Dishwashing	15.19	15.09	15.00	14.93	14.87	14.82	14.78	14.75	14.72	14.69	14.75	14.83	14.92
Miscellaneous (internal) use	29.89	29.65	29.45	29.27	29.11	28.98	28.86	28.76	28.67	28.41	28.30	28.23	28.18
External use	7.66	7.66	7.66	7.68	7.69	7.71	7.74	7.77	7.80	8.01	8.26	8.52	8.79
SUM	179.38	178.19	177.19	176.35	175.64	175.06	174.59	174.24	173.99	173.72	173.92	174.43	175.01

The increase in company level household demand is largely due to the 20% increase in properties. The decline in PHC and PCC is due to water savings that are expected and also the conversion of the unmeasured to measured households. The households that remain in the unmeasured section are a subset of the household that have resisted going on to a meter despite heavy financial incentives to switch, therefore, these properties are likely to have very high consumption and high occupancy, where the saving from switching will have less impact on their bill. The PCC in the final year of this forecast is 125 l/head/day, with a total company household consumption of 301.54 Ml/day.

8 Conclusions & Recommendations

A baseline household consumption forecast has been produced for the South West Water Resource Zone using micro-component modelling and forecasting, which is suitable for a zone with a low level of water resource planning concern.

The micro-component model has been developed using best available data from local and national datasets. The model is segmented by property type using unmetered, new build metered and free optant metered households. The model is based on per household consumption (PHC), and includes linear modelling of key micro-components against occupancy to reflect the variation of PHC by occupancy within each household type. The model forecasts are developed from historic micro-component datasets and Market Transformation Programme predictions.

The results of the micro-component forecast give a 13.34 Ml/day increase in household consumption for Dry Year Annual Average (DYAA) consumption from the base year (2016/17) to the end of the forecast (2044/45), this is a 4.6 % increase. This is driven by a 20% increase in the property forecast, and a 13% decrease in PHC. Average PHC and PCC decrease throughout the forecast period, this is partly due to decreases in component demand due to market transformation, but mostly due to the shift from unmeasured to measured properties. Average household PCC (mean of all household types) reduces from 138 to 125 l/person/day over the 25 year planning period for DYAA.

The model contains forecasts for Normal Year Annual Average, Dry Year Annual Average and Critical period; with a breakdown of micro-components for each year of the forecast.

A.3.2 Non-household consumption forecasting report

We commissioned Servelec Technologies to produce our non-household consumption forecasting methodology. Their report, detailing the results and the methods that they used is included below.

South West Water

Non-Household Demand Forecasting

Reference: J1713\GD\004\03
Date: 20 November 2017

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CONTENTS

1 INTRODUCTION

South West Water (SWW) is required to develop forecasts for non-household water demand as part of its long-term strategy for water resources management. The next Water Resources Management Plan (WRMP) will require forecasts for the period to 2045.

SWW has asked Servelec Technologies[1] to develop a detailed non-household water demand forecast that takes into account geographical and sector specific trends.

This document provides details of the modelling analysis and forecast results. The intended audience for this document is Paul Merchant and colleagues at SWW.

2 PROJECT OVERVIEW

2.1 Aim

The aim of this project is to develop models of non-household demand across the SWW regions for the period to 2045, under the following planning scenarios:

- Normal Year Annual Average (NYAA)
- Dry Year Annual Average (DYAA)
- Dry Year Critical Period (DYCP) for the Bournemouth region only

2.2 Scope

Non-household demand in all 4 of the Resource Zones (RZs) in the SWW area has been considered: Bournemouth, Colliford, Roadford and Wimbleball.

The areas Colliford, Roadford and Wimbleball are collectively referred to as the Devon and Cornwall region.

2.3 Approach

The analysis divided the non-household customers by geographical area and industry sector. Separate regression models have been produced at RZ levels, and the company average obtained by aggregating the outputs from these models.

The calibration of each model is based on appropriate selection of explanatory variables, such as numbers in employment or the level of economic activity, which best account for historical trends and variations in demand.

2.4 Data Used

The following data were received from SWW in support of the project:

- Historical annual return data for each of the resource zones in the SWW region
- Extract of SWW billing data for non-household properties covering the periods between 2007 and 2017
- Forecast data for resident population in the SWW region
- Forecast data for the economic variables in the SWW region
- Charge history for non-household properties

[1] Tynemarch Systems Ltd trading as Servelec Technologies

- Daily distribution input time-series for the Bournemouth region
- Logged non-household consumption data

The following datasets were sourced from the public domain:

- Historical and forecast of weather data in the South West of England
- Forecast data for the economic variables in the South West of England
- Public domain evidence for prospective new SWW major customers

3 DATA RECONCILIATION

The annual non-household consumptions calculated from the billing extract are lower than those reported by SWW. The discrepancies are assumed to be due to a number of factors:

- The Devon and Cornwall region dataset excluded Meter Under-Registration (MUR) allowances for which an average value of 5% was assumed
- The Bournemouth region dataset excluded MUR allowances, for which an average value of 3.05% was added between 2011 and 2017.
- Maximum Likelihood Estimation (MLE) adjustments applied to the reported numbers
- Exclusion of consumptions from properties with erroneous or invalid reading data
- Discrepancies in the allocation of property types that classify household and non-household properties
- Consumption data for 2016-17 in the Bournemouth region were significantly reduced due to the reassignment of some properties to households.

A figure of 3% in the Devon and Cornwall region and 5% in the Bournemouth region has been assumed for the factors other than MUR. With this uplift, the totals of consumption are generally closely aligned with the reported numbers.

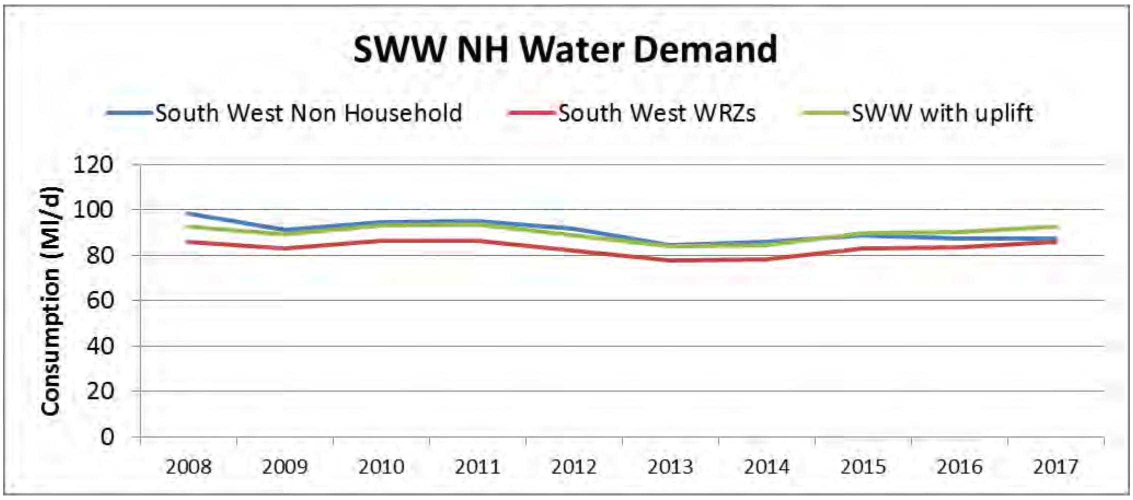


Figure 1: Historical Non-Household Demand in the Devon and Cornwall region

4 PROPERTY COUNT FORECASTING

The historical numbers of properties in the South West regions were reviewed to determine whether relationships exist with the non-household consumption observed. It was considered appropriate to model the measured non-household property counts in the Bournemouth area and the Devon and Cornwall regions as proportional trends based upon the periods where data are relatively consistent.

In the Bournemouth region, although there is some evidence of correlation between the property counts and demand, a strong relationship is not apparent. In particular, the increase of demand from 2014 onwards compared to the 2013 level is not reflected by the decrease in the numbers of properties.

Given the recent decreases in the number of properties representing a step change for the measured properties, the period between 2008 and 2015, as shown in Figure 2, was considered consistent during which the property count in the Bournemouth area is decreasing at an average rate of 0.2% per annum. This rate is then used to forecast the number of measured non-household properties with the 2016/17 figure as the base year.

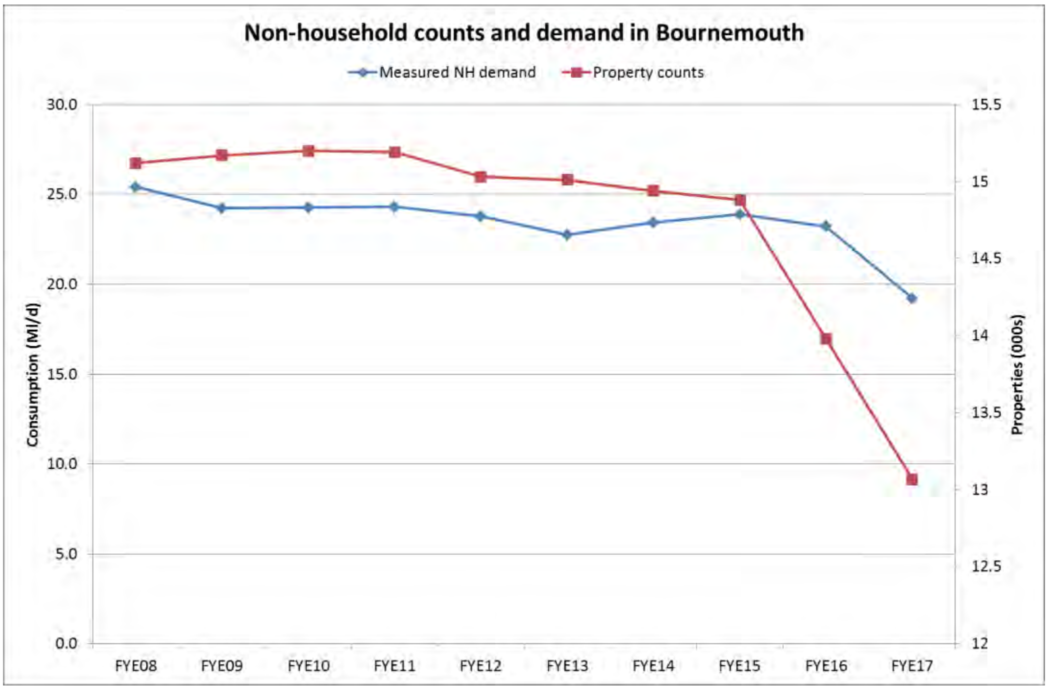


Figure 2: Measured non-household counts and demand in BRM

For the unmeasured properties in Bournemouth, the property count has increased in the last few years in contrast to a decreasing trend in the previous years. Considering the most consistent period from 2008 to 2015, shown in Figure 3, the number of unmeasured properties decreased with an average of 0.8% per annum. This modelling is considered more appropriate than the increasing trend if the 2016 data was included, as the number of unmeasured properties should in principle be decreasing with all new properties being metered.

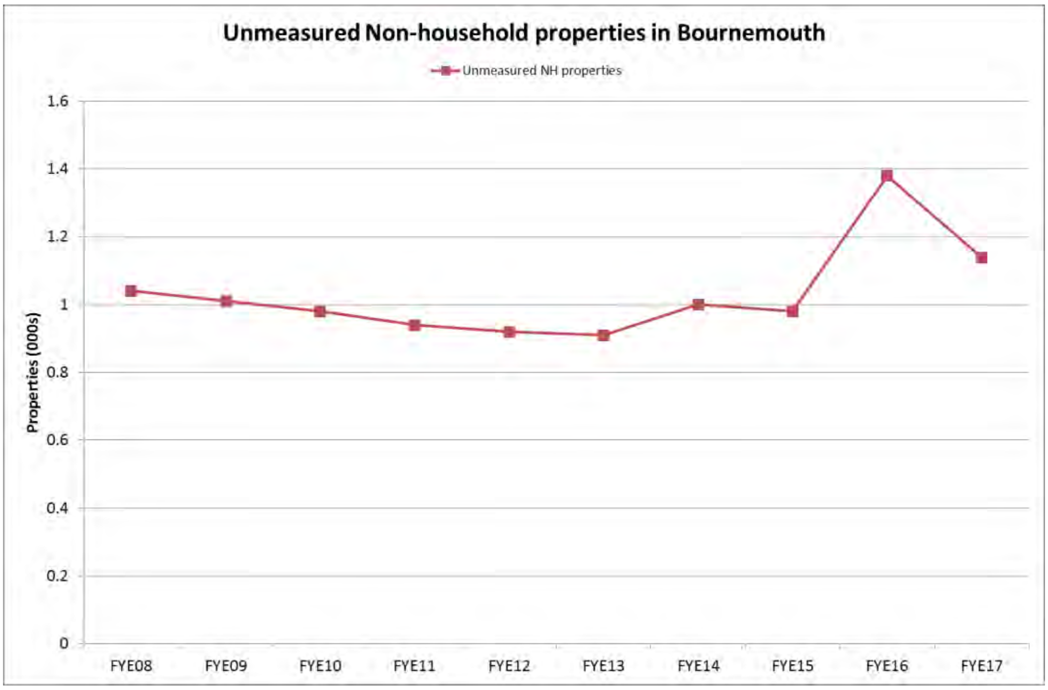


Figure 3: Unmeasured NH counts in BRM

In the Devon and Cornwall region, there is some evidence of relationships between property counts and demand. Notable step changes in the property counts are between 2009 and 2010 and between 2015 and 2016, as shown in Figure 4.

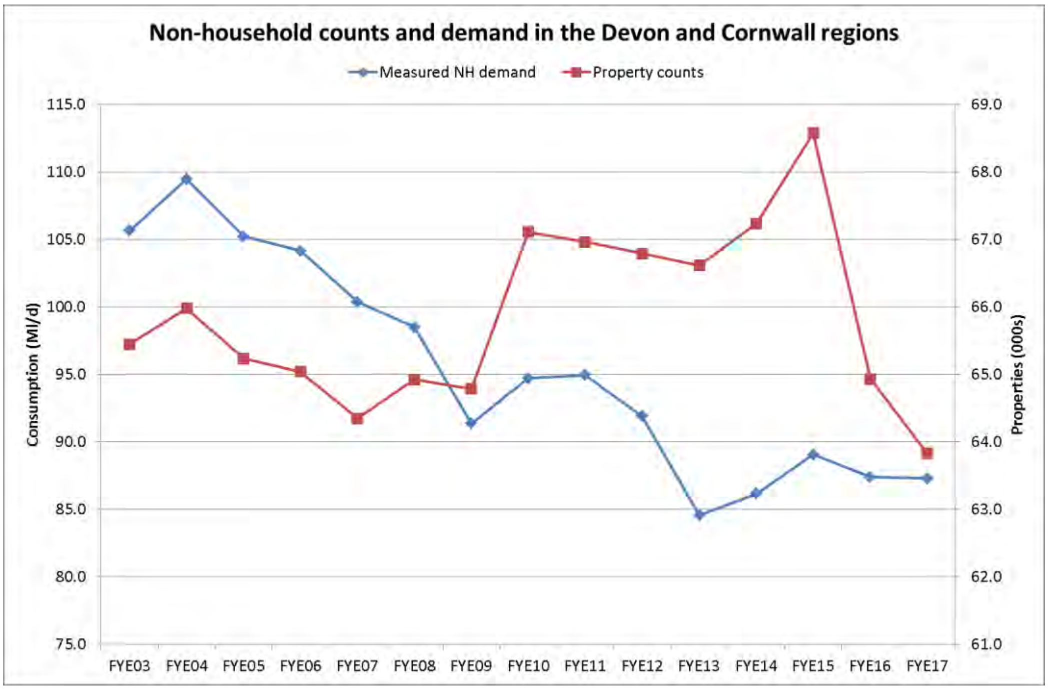


Figure 4: Measured non-household counts and demand in the Devon and Cornwall regions

Prior to 2009, property counts decreased with an average rate of 0.2%. Between 2010 and 2015, an average increase of 0.1% is observed but this is not reflected by the sharp falls in 2016 and 2017. Therefore, it was considered appropriate to consider the period prior to 2009 to be the most consistent and model the measured non-household properties as a proportional trend based on a decreasing average of 0.2% per annum from the 2017 level.

This decreasing average is arguably reflected by the numbers of properties which contributed to the modelling of non-household demand in the Devon and Cornwall area. Over the period between 2008 and 2017, an average reduction of 0.1% per annum in the numbers of properties with valid datasets is observed. (Note that this reduction is not the same in each of the enclosed resource zones, as in Colliford the numbers of contributing properties are slightly decreasing, in Roadford they are relatively constant, and in Wimbleball they are slightly increasing.)

The numbers of unmeasured non-household properties followed a steady downward trend since 2002, as shown in Figure 5 below, with the notable step changes in 2004-05 and in 2016. Based on the period between 2006 and 2015 which was considered most consistent, the unmeasured property counts are forecast to decrease at an average rate of 4.8% per annum.

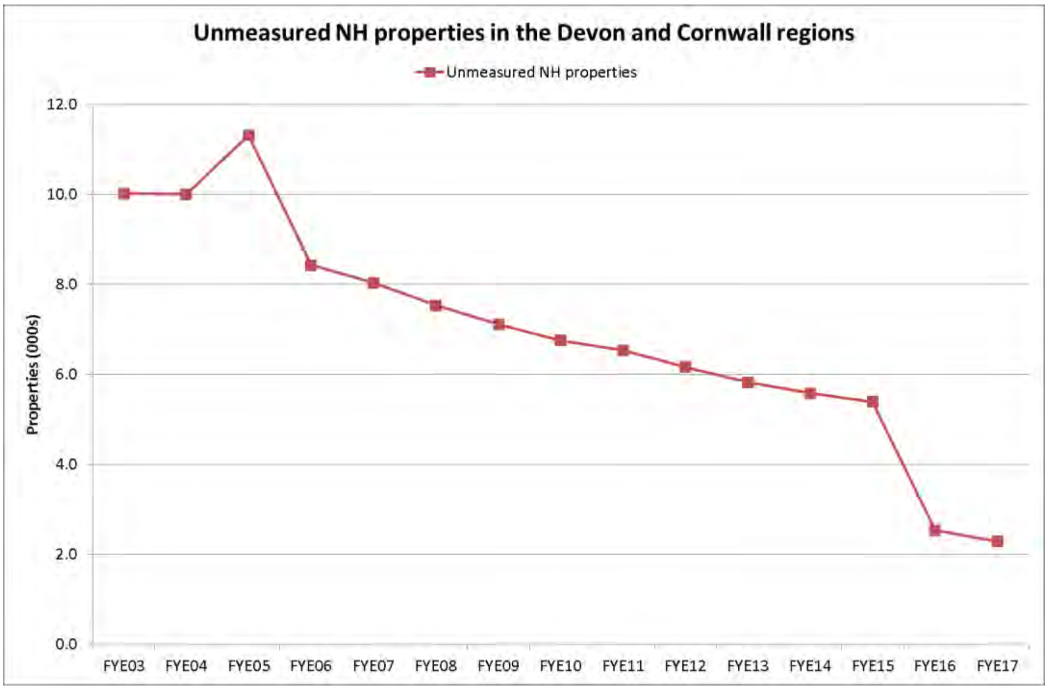


Figure 5: Unmeasured NH counts in the Devon and Cornwall regions

5 UNMEASURED NON-HOUSEHOLD DEMAND

Limited information is available regarding unmeasured non-household demand. Recently, many properties were reclassified as households and demand is currently estimated at about 2 Ml/d. In the absence of any evidence to the contrary, it is reasonable to assume that unmeasured non-household demand per property will remain constant. SWW should therefore apply the current unmeasured non-household demand assumptions to their forecast unmeasured non-household property counts.

Open Water may represent a driver for switching unmeasured non-households to measured billing. If this is the case, the measured non-household demand should in principle be adjusted to compensate for the corresponding reduction in unmeasured non-household demand, although the amount of the adjustment would be negligible in the context of the uncertainty of the overall demand forecast.

6 MODELLING SETUP

6.1 Industrial sector breakdowns

Each of the resource zones in the SWW region were modelled as individual areas. Each of the models aggregates the industry sectors into seven sector groups:

- Serv1: Including sectors in accommodation and food, wholesale and retail trade, distribution, transport and storage, which are focused on both public and private sectors
- Serv2: Including sectors in professional and business service activities, real estate, financial and insurance activities, information and communication, which tend to be more focused on providing professional services
- Serv3: Including sectors in education, health and public administration, which are public sectors and tend to be more related to household population
- Serv4: Including sectors in arts and entertainment, other services and household activities, which are more private sector focused and tend to be related to household population
- NServ1: Including sectors in agriculture and production other than manufacturing
- NServ2: Including sectors in construction, engineering and remaining sectors in manufacturing
- Unknown: Industries without a known sector.

The South West of England usually attracts more visitors and tourists during summer periods. Peaking demand trends, particularly in summers, are observed in the tourism sector (Serv4) as discussed in Section 8.2.

6.2 Impact of major customers

A separate model was developed for a major customer in the Bournemouth region. This is an exceptionally high user whose demand represented more than a third of the total non-household demand in Bournemouth.

The consumption trends from the remaining high consumption customers have been reviewed. Not enough evidence was found to justify a separate model for these properties as they only have limited impact on the modelling at sector group level.

In the Bournemouth area, major customers are mostly in service industries which tend to be public sector focused. In the other zones, most major customers are found in industries that are grouped into Serv3 (education, health and public administration) and NServ2 (manufacturing and engineering).

Bournemouth: The Bournemouth region contains an exceptionally high consumption customer. The meter readings and consumption data for this property were excluded from the datasets received. A steady decreasing consumption is forecast for this property over the forecast period. A brief review of information in the public domain did not provide any evidence of a substantial change in the expected future consumption at this site.

High consumption customers are generally in the service sectors including transport, accommodation and food (Serv1), education and health (Serv3), and arts and entertainment (Serv4).

The consumption trend of high users in Serv1 is increasing, whereas the average trend of the remaining properties is decreasing and this is driving the downward demand forecast of this group.

The consumption trend of high users in Serv3 is increasing, and this similar to the average trend of the remaining properties in this group.

Various consumption trends are observed for the high consumption customers in Serv4, with a consumption trend slightly increasing. However, the trend of the remaining properties is decreasing. Demand for this group is forecast to marginally increase.

The total demand from the top ten highest consumption customers, excluding the high consuming major customer, amount to 1.7 Ml/d in 2016 and 1.2 Ml/d in 2017. These are about 7.6 and 7.1 % of the total demand in Bournemouth. The average proportion 7.4% was maintained in recent years. Note that the consumption trend of these properties is increasing, whereas the trend of the total demand in Bournemouth is decreasing.

Colliford: Most high consumption customers in the service sectors have the property types 48 (Uni & Uni Colleges), 49 (Crown occupation), and 50 (Non NHS Hospitals/Clinics etc.) which are included in Serv3. These properties are typically in Lizard (Wis 103), Redruth (Wis 104), Truro (Wis 106) and Newquay (Wis 408).

The consumption trend of the high users in Serv3 is increasing, whereas the trend of the remaining properties is decreasing. Although some other properties have increasing demand in Serv3, the high consumption customers have most influence on the overall trend for this group. However, they have limited impact on the overall forecast at zonal level given that forecast trends of other sector groups are also increasing.

In the non-service sectors, high users generally have the property type 29 (Factories, Mills etc.) which is included in NServ2. Various consumption trends are observed for each of the individual customers, but overall do not impact the marginally increasing consumption trend of the group as a whole.

The total demand from the top ten highest consumption customers currently amounts to about 3.9 Ml/d which is about 14.2% of the total demand in Colliford. This is a notable increase of the proportion 9.4% in 2008. Note also that the general consumption trend of the remaining properties in this region is also increasing.

Roadford: Most high consumption customers in the service sectors have the property types 49 (Crown occupation), and 50 (Non NHS Hospitals/Clinics etc.) which are included in Serv3. They are generally in Plymouth (Wis 401), Ashburton (Wis 503) and Torquay (Wis 508).

In the non-service sectors, high users have the property types 29 (Factories, Mills etc.) and 31 (Gas) which are in NServ2 and NServ1 respectively. They are in Ilfracombe (Wis 304), Yealmpton (Wis 402), Tavistock (Wis 403) and Brentor (Wis 410).

In each of the groups Serv3, NServ1 and NServ2, the consumption trend of the high consumption customers is decreasing, similar to the trend of the remaining properties.

The total demand from the top ten highest consumption customers currently amounts to about 3.5 Ml/d which is about 9% of the total demand in Roadford. This is a decrease of the proportion 13.3% in 2008. The general consumption trend of the remaining properties in this region is also decreasing.

Wimbleball: Most high consumption customers in the service sectors have either the property type 23 (Holiday Camps/C'van Fields) which is included in Serv4, or any of the types 48 (Uni & Uni Colleges), 49 (Crown Occupation) and 50 (Non NHS Hosp/Clinics etc.) which are included in Serv3. They are mostly in Exeter (Wis 603) and Exmouth (Wis 604).

In the non-service sectors, high users have the property types 29 (Factories, Mills etc.) which is included in NServ2. They are in Crediton (Wis 601), Exeter (Wis 603) and Tiverton (Wis 611).

In the group Serv4, the consumption trend of the high consumption customers is increasing, similar to the trend of the remaining properties.

In each of the groups Serv3 and NServ2, the consumption trend of the high consumption customers is increasing. However, the trend of the remaining properties is decreasing and this is driving the downward forecast of the group.

The total demand from the top ten highest consumption customers currently amounts to about 2.2 Ml/d which is about 13.5% of the total demand in Wimbleball. This is a slight increase of the proportion 12.2% in 2008, but a decrease of the proportion 16.2% in 2013. The general consumption trend for these properties is increasing, but this does not appear to impact the relatively constant trend of the remaining properties in this region.

6.3 Treatment of the Unknown sector

The demand from properties without a known sector was individually forecast in each of the resource zone. This approach was preferred to a pro-rata assignment as there may be specific types of non-household that are more likely to be unassigned in the dataset. This sector represents about 4.0 % of the total demand in 2016-17, although it is forecast that this element of demand will follow a steady decreasing trend over the period to 2045.

6.4 Forecast assumptions

The model implicitly assumes that historical trends in factors such as the impact of water efficiency programmes are assumed to continue. Additional demand management initiatives that may potentially be introduced as part of the WRMP would require an adjustment to the forecasts.

The model inputs regarding population represent the resident population in the SWW region, rather than the population of the non-household customer base (noting that the health and education industries serve the whole local population).

The effect of new or demolished properties is already included within the historical dataset by the associated increase or reduction of demand, hence already assumed reflected in the forecast.

7 MODELLING RESULTS

The general model used for each sector group in each resource zone has the following form:

$$\ln(Consumption_i) = C + \alpha_1 Empl_i + \alpha_2 \ln(GVA_i) + \alpha_3 Pop_i + \alpha_4 Year_i + \alpha_5 \ln(Rainfall_i)$$

Where:

- $Consumption_i$ - the consumption in year *i* for the particular sector group in the particular area
- $Empl_i$ – the number of employees in the sectors modelled in year *i*
- GVA_i - the GVA in £million for the relevant groups in the relevant area in year *i*. (Note that all the GVA figures were in 2009 prices, hence no rebasing was used)
- Pop_i - the population resident in the relevant area in year *i*
- $Year_i$ - the year, which is used to give an absolute trend to the model
- $Rainfall_i$ - the total rainfall in year *i*

- α_{1-5} are the coefficients determined through linear regression. A coefficient of zero means that the explanatory factor is not used
- *C* – a constant term determined by the regression analysis.

This form was preferred over other forms, such as those without the logarithm being taken of the consumption or GVA terms, since it gave an improved fit to the historical data.

α_{1-5} and *C* were found using a standard multiple linear regression technique applied to the data for the period FYE08[2] to FYE17.

The models for each industry sector within an area are summed to obtain the forecast for the area, and then the areas summed to give the forecast for SWW as a whole.

The choices of the explanatory variables in a model are based on the assessment of best fittings and predictions while taking account of the statistical outputs (r2, p-values and residuals) of the analyses. Priorities were given to the factors that are closely related to the considered sector groups, although other factors may be chosen where the statistical analysis indicates this is more appropriate. For instance, the total rainfall in the year was preferred to over period since it provided the best fit in the modelling at company level.

The forecast results for each of the resource zones are shown in Figure 6.

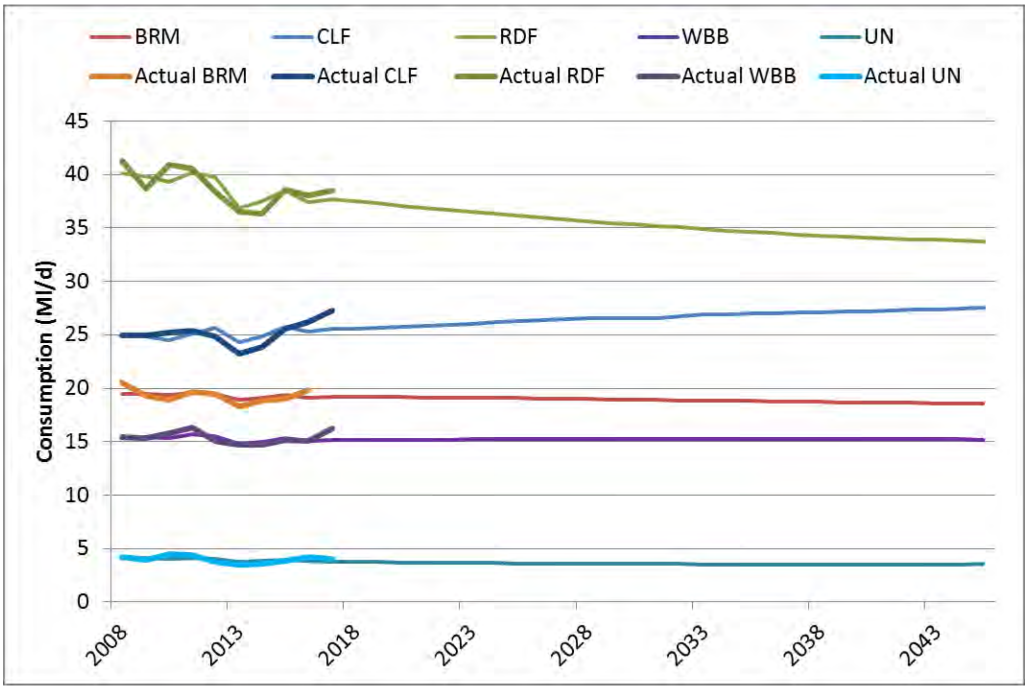


Figure 6: Non-household demand forecast at zonal level

Note that, although the projected trends in some individual models can be argued to be influenced by issues with historical assignment (particularly in the case of the unknown model), and by over-fitting of the explanatory factors due to fluctuations in demand, the combined outputs at zonal levels have been reviewed and are considered to forecast the most probable trends.

More details on the forecast results at zonal level can be found in the Appendix.

2 The notation FYE08 is used to denote the Financial Year Ending 2008 (i.e. April 2007-March 2008)

7.1 Bournemouth - BRM

Demand for the high consumption customer is forecast to decrease over time. The overall demand of the remaining non-household properties in Bournemouth is forecast to follow a steady downward trend.

The model fitting for the Bournemouth RZ was based on the consumption data from 2008 to 2016 to limit the bias caused by property reassignments (Open Water) in 2017. The reassignments reduces consumption thus the 2017 consumption data has been excluded in the model fitting since the reduction in demand is not based on customers using less water.

To maintain consistency with the 2017 figure, the ratio between the previous forecast and actual consumption for 2017, calculated as 10.4%, has been used as a rebasing factor in the current model.

The following trends are observed for the different sectors:

- Service sector (approximately 85% of demand in 2016, excluding the high consumption customer): The average demand from all service sectors is forecast to decrease. Only demand from the sectors including education, health, and recreational activities are estimated to follow increasing trends. Demand from the remaining service sectors will see a steady downward trend
- Non-service sector: Demand from the non-service sector is estimated to remain relatively constant over the forecast period.

An alternative model at resource zone level was used to compare against the detailed model. The two models are closely matched when the explanatory variables used in the alternative model are employment and rainfall. It is noted that the alternative model should only be used for comparison of the results.

7.2 Colliford - CLF

The overall demand in Colliford is forecast to be increasing. The following trends are observed:

- Service sector (approximately 68% of demand in 2017): The average demand from all service sectors is increasing. Only demand from professional and business services (Serv2) is forecast to reduce.
- Non-service sector: Demand from sectors including agriculture and production are decreasing, whereas the remaining non-service sectors will remain relatively constant
- Demand from the unknown sector is forecast to be relatively constant.

An alternative model at resource zone level was also used for comparison. The two models show close agreements when the explanatory variables used in the alternative model are employment and rainfall.

7.3 Roadford - RDF

The overall demand in Roadford is forecast to steadily decrease. The following trends are observed:

- Service sector (approximately 71% of demand in 2017): The average demand from all service sectors is relatively constant. Demand from sectors involving professional services will remain relatively constant, demand from sectors education, health will decrease, and demand from the remaining sectors will increase
- Non-service sector: Demands from the non-service sectors are forecast to decrease

- Demand from the unknown sector is forecast to decrease.

An alternative model at resource zone level was used for comparison. The alternative model generally suggests a faster reduction than the current model, in particular when the explanatory variables used in the alternative model are employment and year.

7.4 Wimbleball - WBB

The overall demand in Wimbleball is forecast to remain relatively constant. The following trends are observed:

- Service sector (approximately 67% of demand in 2017): The average demand from all service sectors is increasing. Only demand from the sectors education and health are decreasing. Demand from the remaining service sectors are generally increasing.
- Non-service sector: Demand from the non-service sectors are forecast to decrease
- Demand from the unknown sector is forecast to remain approximately constant.

An alternative model at resource zone level was used for comparison. The two models show close agreements when the explanatory variables used in the alternative model are employment and rainfall.

7.5 Overall model fit

The overall measured non-household demand at company level is the aggregated demand outputs from each of the zonal models. Demand in SWW is forecast to decrease over the forecast period, and as can be seen from Figure 6, this is predominantly driven by the forecast demand in the Roadford area.

At company level, it is forecast that demand from service industries will increase, but this is offset by demand from non-service industries which is forecast to decrease. Demand in the unknown sector is forecast to remain relatively constant.

The overall forecast for non-household demand by high-level sectors is shown in Figure 7. Details of forecasts at zonal level can be found in the Appendix.

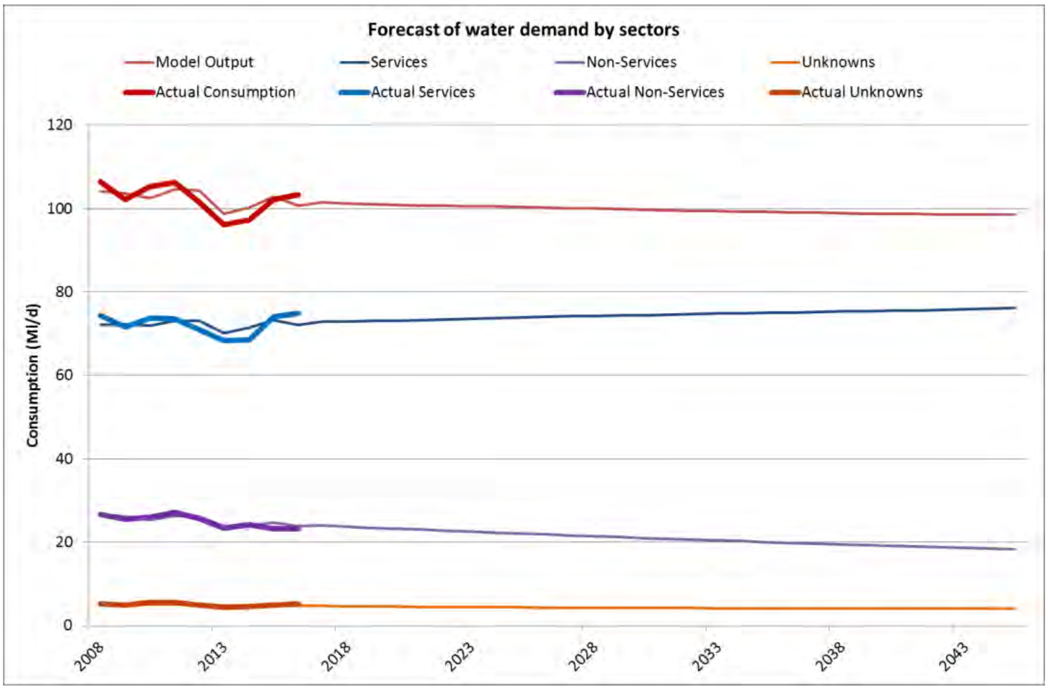


Figure 7: Model forecast for known and unknown sectors (excluding high consuming customer)

The model forecast was compared with the output of an alternative company model based upon the high-level data directly. The alternative model generally provides a lower forecast, except when rainfall only is the independent variable used. As previously noted, the alternative model does not give any indication of the different trends across the resource zones, and thus was only used for assessing the robustness of the detailed model.

8 WRMP PLANNING SCENARIO

8.1 Dry Year Annual Average

The Dry Year Annual Average (DYAA) is built upon a minimum level of rainfall across the SWW regions, which potentially increase consumption in some industries. The lowest figures seen since 1980 were in 1992 with total rainfall 968.9mm, and in 1996 with total rainfall 984.9mm.

Dry weather generally is seen to have a greater impact on household rather than non-household demand. However, in addition to agriculture, there are industries and properties that may increase consumption due to a lack of rainfall on hot days, including hotels and leisure centres.

The DYAA peak factor is obtained by applying the 1992 rainfall amount in the models developed and comparing to the average rainfall is 2.07% in 2017, with an average factor over the forecast period of 1.93%. Note that this scenario assumes that the estimates and forecasts of the other explanatory variables remain the same as in the NYAA planning scenario.

The result of this scenario is shown in Figure 8.

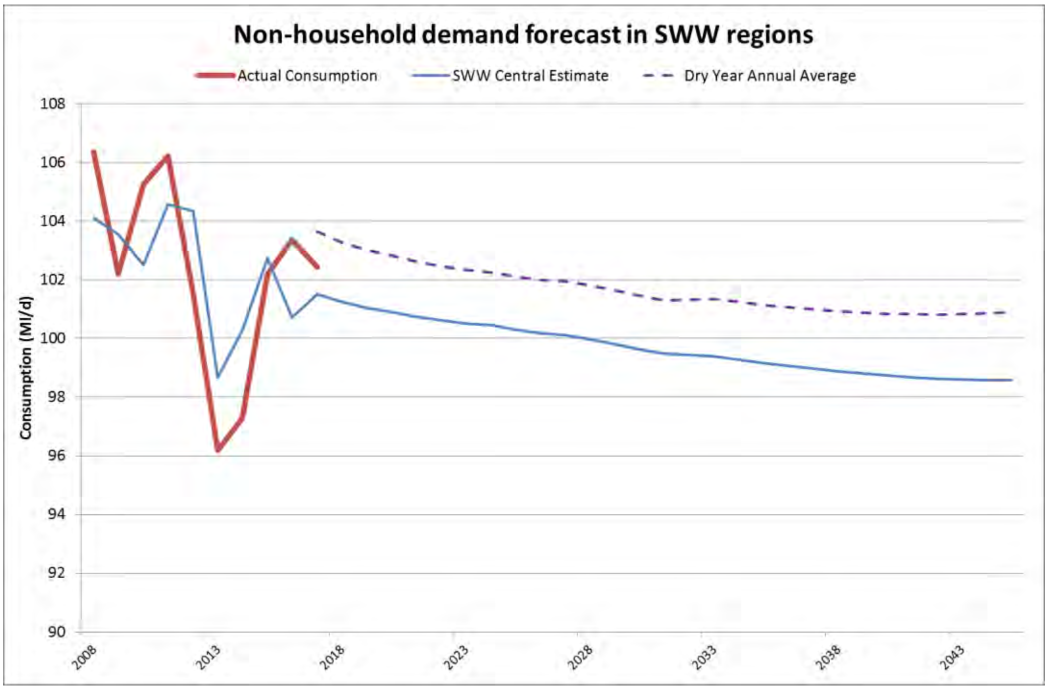


Figure 8: Normal Year and Dry Year Annual Average forecast in the SWW regions

8.2 Dry Year Critical Period

A critical period is only required for the Bournemouth RZ since none of the other three RZs have a peak supply-demand constraint. A study of critical periods requires higher resolution consumption data and therefore daily logger data has been used. There are insufficient logged non-household properties in the Bournemouth RZ so data has been used from properties across the RZs.

Overall the logged properties did not show peaking consistently at the same time of the year. However when the industry types were separated out into the groups defined in Section 6.1 then the Serv4 sector showed clear summer peaking, while other sectors remained broadly constant over the year. Figure 9 shows the consumptions for the sectors with significant volumes of data for a single year. Serv1 and NServ2 show lower consumption every weekend, whereas Serv4 shows a consistent weekly use with peaking during the Easter, summer and the school half term holiday periods.

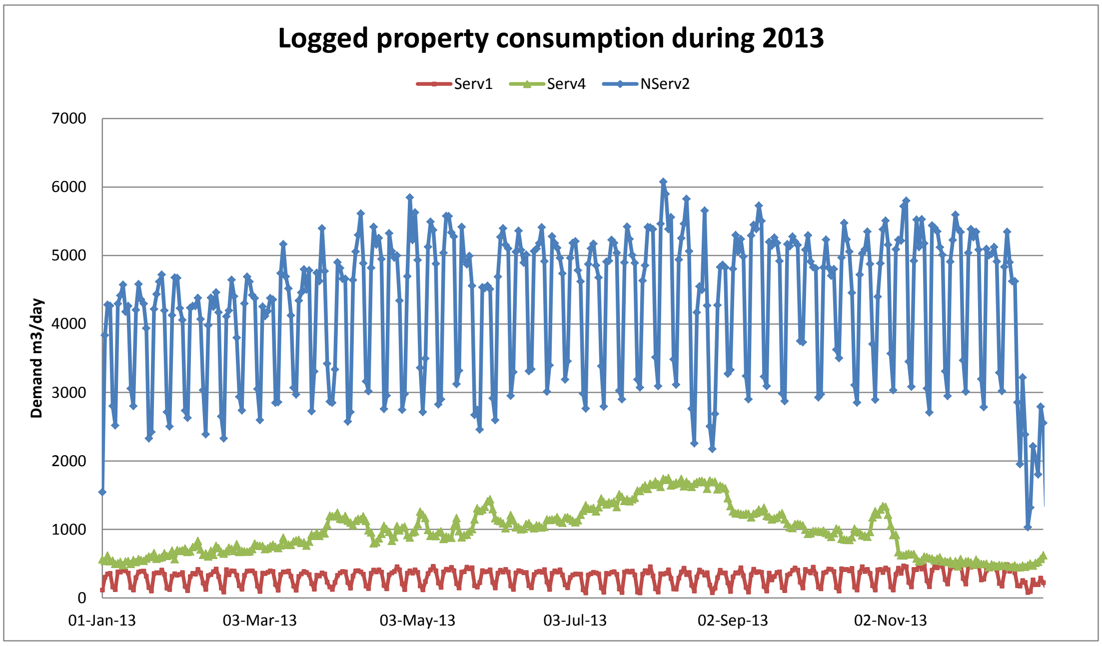


Figure 9: Logged property consumption split by industry sector

The Serv4 group consists of entertainment and arts related properties, and therefore the peaking observed can be linked to the summer increase in tourism, which is prevalent in the Bournemouth RZ.

The peak week to annual average factor for the Serv4 group was compared to various weather parameters for the period 2004-2016. However the peaking factor has shown a steady decline over the period observed, and no strong relationship was found with any weather variable. This corresponds with the trend in the peaking factors seen in the Bournemouth RZ distribution input.

The peak factor of 2.5, seen in August 2004 is taken to be a reasonable upper bound on the DYCP peaking factor for the Serv4 group, with the consumption of the other groups during the peak period assumed to be equal to average consumption given the lack of evidence of peaking in the logged customer data.

When the peak factor is applied to the Serv4 group DYAA forecast for the Bournemouth RZ this represents a rise in demand of approximately 12.8Ml/d, as shown in Figure 10. Compared to the peaking in distribution input observed in the Bournemouth RZ, where the peak demands 30-40 Ml/d above the annual average are seen, this scale of increase is plausible, given that Bournemouth's population is small in comparison to the number of visitors and hence the non-households will comprise a significant proportion of the peaking observed.

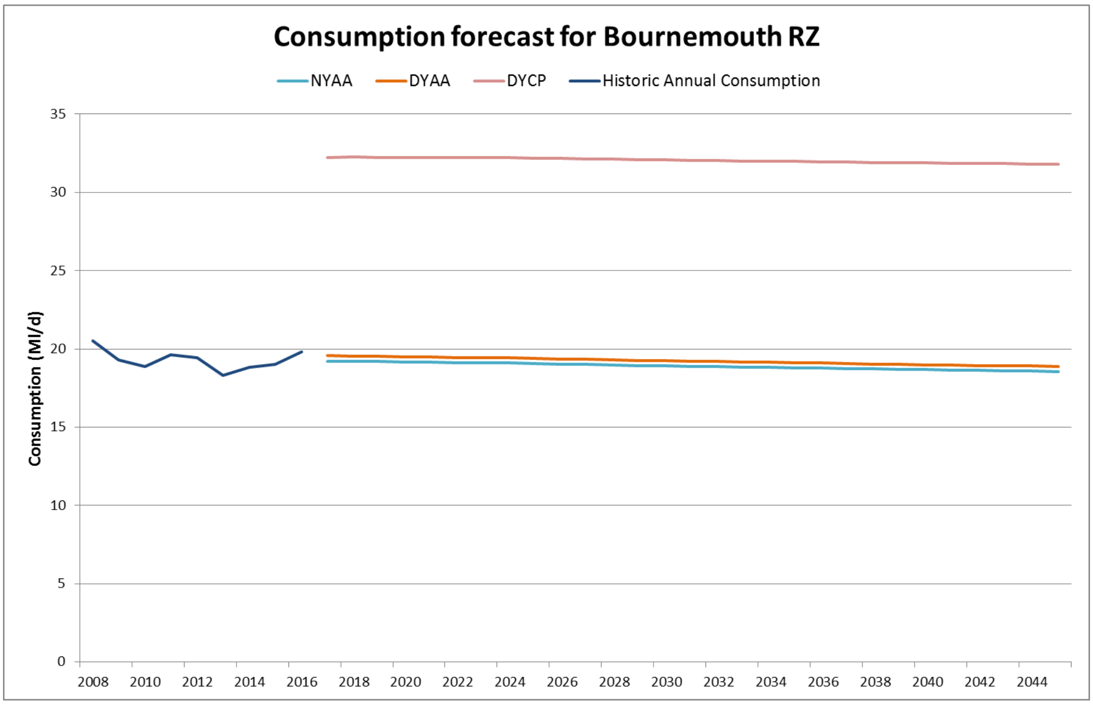


Figure 10: Consumption forecasts for Bournemouth RZ

9 SCENARIO ANALYSIS

The central scenario assumes a continuation of current trends involving, for example, pressures from the Environment Agency to reduce demand, metering and water efficiency programmes and use of effective appliances to reduce water consumption.

9.1 Impact of Open Water retail separation

Since April 2017 non-household customers in England were able to choose who supplies their water and wastewater retail services. Two of the proposed benefits of this will be the introduction of more tailored prices and increased incentives for offering water efficiency advice[3].

The overall impact this might have on consumption is uncertain, since more tailored prices could include a reduction in the marginal cost of water to a business leading to a reduced incentive to reduce consumption. Conversely, the increased incentives for water efficiency could result in consumption reductions.

Retail water competition was introduced in Scotland in 2008. Business Stream, the retail subsidiary of Scottish Water stated in 2014 that it had saved customers £43m through water efficiency measures, or 20 billion litres of water[4].

If non-household consumption in Scotland prior to retail separation was 470Ml/d[5], (non-household consumption being 20.7% of total distribution input of 2,271Ml/d), then this represents an average reduction over the period of approximately 9 Ml/d (2%) compared to pre-competition levels. However it is not clear how the savings are calculated, and whether they might have come about as part of the general declining trend seen in UK non-household consumption.

[3] http://www.open-water.org.uk/customers/
[4] http://www.business-stream.co.uk/scottish-businesses-save-%C2%A3100m-their-water-bills
[5] https://www.scottishwater.co.uk/assets/about%20us/files/key%20publications/adoptedwrp09summarydoc.pdf

The December 2010 report by Grant Thornton for the Water Industry Commission for Scotland[6], examining competition for business customers in Scotland since April 2008, assumed a 20% reduction in water consumed by businesses in Scotland by 2020 is possible, representing an annual volume reduction target of 1.84%. This appears to be based on basic assumptions that the European Union targets for reductions in primary energy usage and greenhouse gas emissions can also be applied to water consumption, and ignores the use of 1990 usage levels as a base for energy consumption. This probably represents an upper bound on the water efficiencies that might be achieved.

9.2 High consumption scenario

The high consumption scenario is built upon a faster economic and demographic growth across the SWW regions, increasing activities in the service and non-service sectors. The high scenario assumes, in terms of growth rates,

- Employment growth rate 0.6% per annum
- GVA growth rate 2.5% per annum
- Population growth rate 0.8% per annum in each of the resource zones
- Minimum level of rainfall similar to the dry year annual average scenario.

The result of this scenario is shown in Figure 11.

9.3 Low consumption scenario

The low consumption scenario is built upon a slower economic and demographic growth, reducing activities in the service and non-service sectors. The low scenario assumes, in terms of growth rates,

- Employment growth rate 0.25% per annum
- GVA growth rate 1% per annum
- Population growth rate by 0%, i.e. constant
- Increase of rainfall by 5% than in the central estimate.

The result of this scenario is shown in Figure 11.

6 http://www.watercommission.co.uk/UserFiles/Documents/Grant%20Thornton%20CBA%20report%20December%202010.pdf

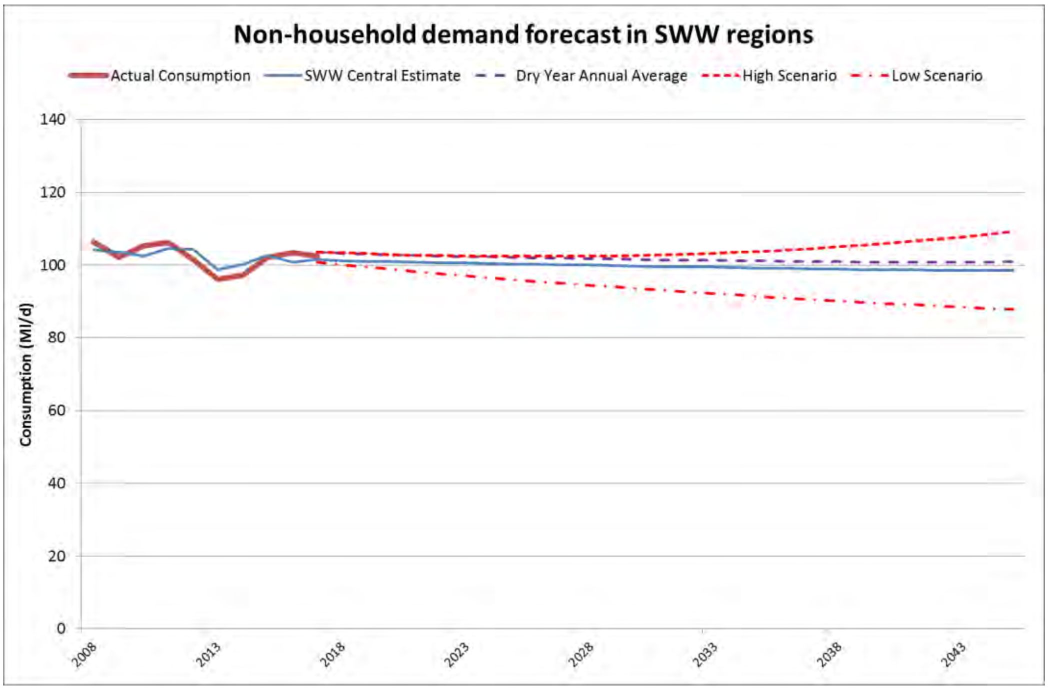


Figure 11: SWW Measured Non-household under high and low scenarios

10 SPREADSHEET IMPLEMENTATION OF THE MODEL

The models have been implemented within the spreadsheet provided[7]. This contains worksheets for:

- Input of detailed consumption data
- Input of explanatory factor data and forecasts
- Overall model output for the company as a whole
- Detailed modelling sheets for each resource zone
- Overall view of each resource zone, including the aggregate of the industry sector models at the resource zone levels.

Each detailed modelling sheet contains:

- The explanatory variables used in the model and the resulting coefficients
- The sector groups modelled
- The historic values for consumption in the area
- The modelled values based on the selected explanatory variables and fitted coefficients, and the forecast values
- Graphs showing the model fit against the historical data, and the forecast of future consumption.

A full index of the worksheets at the front describes each sheet in more detail.

[7] Spreadsheet reference J1713_GD003_02, dated 15 September 2017

The aim of the spreadsheet is that it will allow further exploration of scenarios. By altering the future assumptions in the explanatory values, the impacts on each resource zone can be observed.

11 CONCLUSION

The modelling of measured non-household demand provided detailed models of the resource zones within the SWW regions. Different model patterns and variations were observed, and the validations of the forecasts were based upon the selection of explanatory variables and the assessment of the fittings to yield the most probable output. It is recommended to review the output of the model following any update related to the forecasts of these variables.

Demand in the service sector is forecast to increase, but this is offset by demand from the non-service sector which is forecast to decrease. Demand in the Unknown sector is forecast to remain constant over the forecast period.

The modelling at company level is based on the aggregation of the zonal models. The resulting output shows that the overall non-household demand in SWW regions will steadily decrease over the forecast period.

APPENDIX A. MODELLING RESULTS BY RESOURCE ZONE

The graphs below show the forecasts and historical consumption for all known service and non-service sectors for each of the resource zones in SWW. The results for Bournemouth do not include the high consumption customer.

A.1. Bournemouth

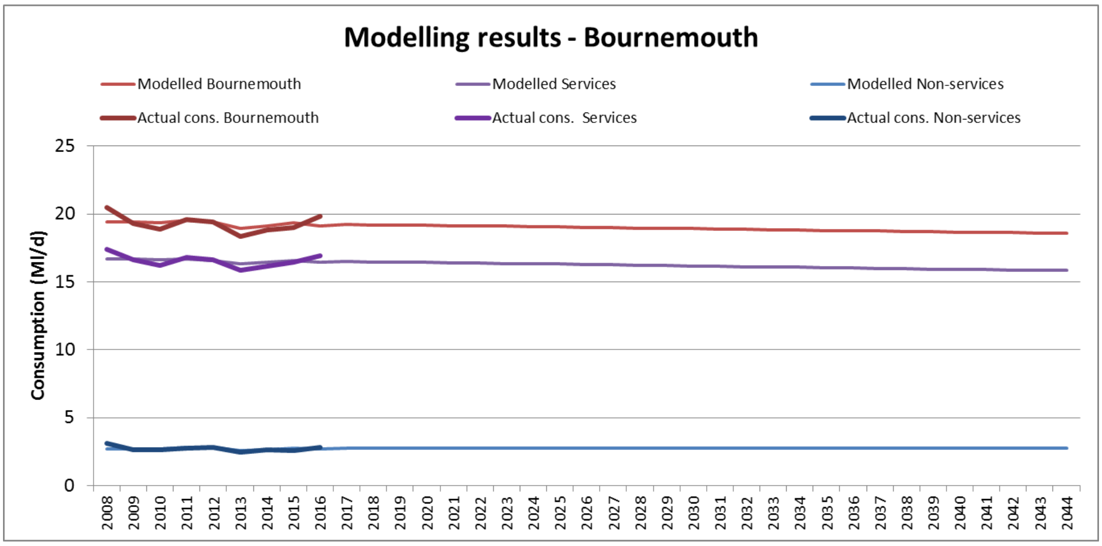


Figure 12: Forecasts of demand by sectors in Bournemouth

A.2. Colliford

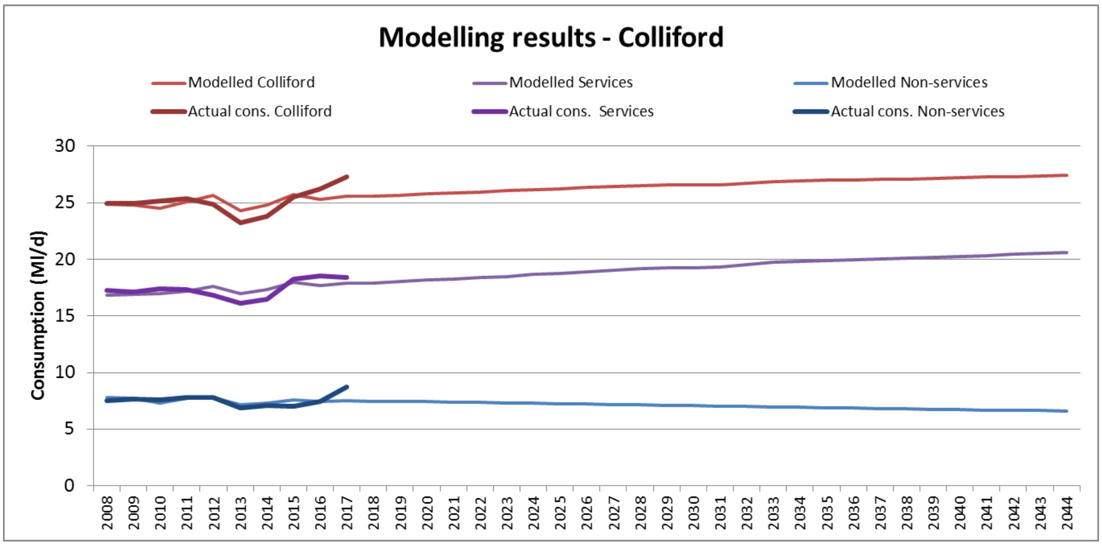


Figure 13: Forecasts of demand by sectors in Colliford

A.3. Roadford

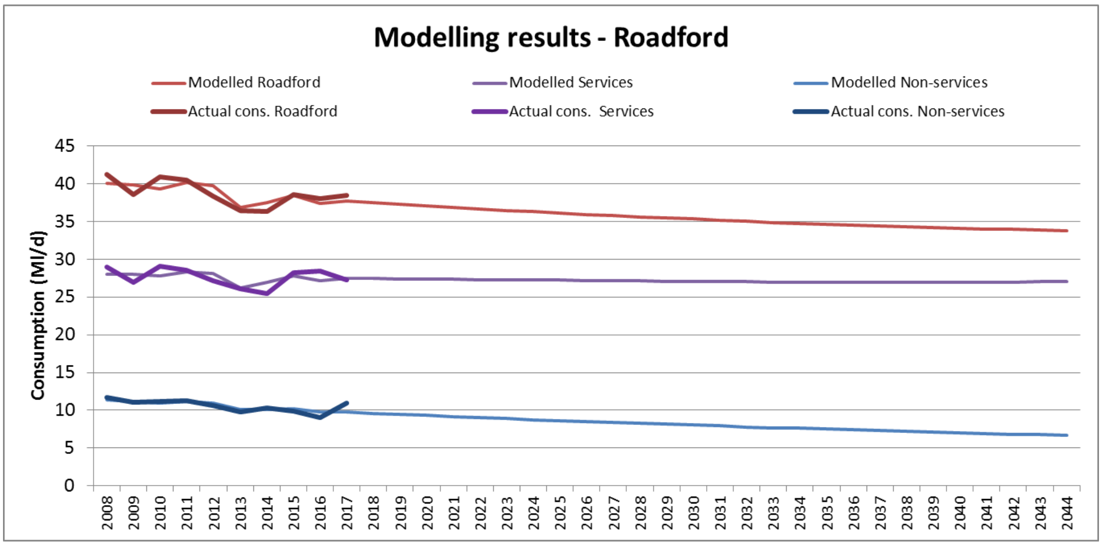


Figure 14: Forecasts of demand by sectors in Roadford

A.4. Wimbleball

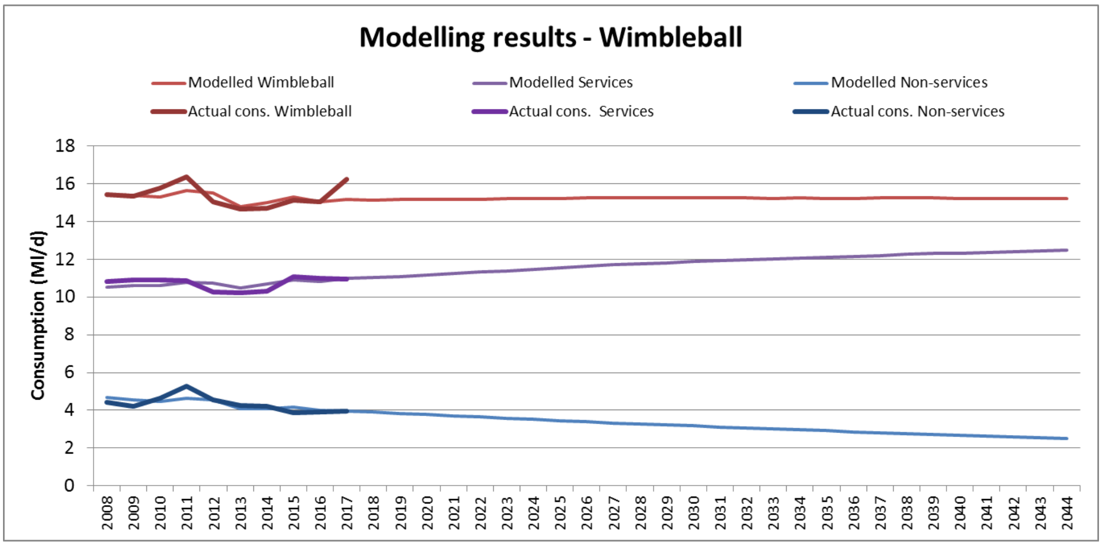


Figure 15: Forecasts of demand by sectors in Wimbleball

A.3.3 Plan for compliance with leakage consistency reporting

Currently all water companies in England and Wales are working towards reporting leakage in a consistent way, as described in the *Consistency of reporting performance measures*[A.3.1] report. Complying with this new guidance requires significant investment in flow monitoring, and different management procedures.

In line with Ofwat reporting requirements, we have completed a RAG assessment of our current ability to report against the consistency measures. Since our merger with Bournemouth Water there has been insufficient time to harmonise our leakage reporting methodologies. Therefore South West Water area and Bournemouth WRZ leakage reporting currently differs, and separate RAG assessments have been completed for each. These RAG assessments, along with out plans to move to a consistent position are shown in the tables below.

Table A.3.3.1: South West Water area leakage reporting consistency RAG analysis

Component		RAG status	Target compliance date	Reason for any non-compliance and planned actions to resolve
1	Coverage	G	-	Coverage is 97% vs. the consistency target of 95%
2	Availability	R	2019/20	South West Water current operability is 84% which is below the 90% target. Similarly, our average DMA inoperability of 14 months is greater than the three month limit. Improvements to DMA operability will be prioritised based on contribution to leakage and ease of rezoning. We foresee our % operability improving towards near compliance levels over this AMP. In the event of >3 month inoperability our systems allow us to apply the WIS average in accordance with consistency measures.
3	Properties	A	2019/20	Inconsistencies in property geolocation for DMAs.
4	Night flow period and analysis	R	2019/20	A minimum one hour rolling window between 00:00 and 06:00 is currently used. During the next 2 years we will review each DMA to determine the appropriateness of applying the restricted fixed window. However,

A.3.1 UKWIR, *Consistency of reporting performance measures*, 2017

South West Water Bournemouth Water

Component		RAG status	Target compliance date	Reason for any non-compliance and planned actions to resolve
				due to the characteristics of the water use patterns by our customers in some of our DMAs we foresee the need to retain a different night flow analysis period in accordance with the Consistency measures. Data gathering and further analysis will therefore be required to support our assumptions. South West Water uses the monthly 27th percentile as opposed to the weekly average. Moving to weekly average is possible within the system however we deem it unreasonable to move some DMAs to this measure due to the high volatility of pressures arising from our challenging landscape. A weekly percentile would therefore not be representative of leakage for these DMA's and it will be reviewed as per above.
5	Household night use	A	2019/20	Our adjustments for variable consumer night use patterns are not statistically robust. We have recognised our shortfall in coverage and we have initiated a programme of logger installations to meet the statistically representative sample size in this AMP. In addition, we have recognised the resource implications for the more frequent night use analysis for which we will deploy additional analysts.
6	Non-household night use	A	2019/20	We have recognised our insufficient logged sample of NHH customers (347) against target of logging all NHH customers with consumption of greater than 12m^3/day (c. 2,000). As per Item 5, we initiated a programme of logger installations to close the gap and we recognise that this needs to be accelerated in-order to meet the consistency requirements.
7	Hour to day conversion	A	2019/20	Our Hour to Day conversion is currently calculated every 4 years. We are revising our policy to ensure this measure is calculated annually.

Component		RAG status	Target compliance date	Reason for any non-compliance and planned actions to resolve
8	Annual distribution leakage and MLE	A	2019/20	Annual leakage is currently derived from monthly values. Our systems allow weekly derivations and we plan to deploy additional resources to undertake this analysis.
9	Trunk main leakage	A	2019/20	Static BABE values are already used. More field inspections and flow reviews are required to reduce trunk mains leakage under 5% target (currently 11%). Work is under-way to help address this issue.
10	Service reservoir losses	G	-	95% of our service reservoirs are metered allowing the required volumetric balances to be calculated.
11	Distribution input	G	-	We have full metering and the necessary weekly checks are undertaken, documented and reviewed.
12	Water delivered measured	G	-	Our meter penetration rate is among the highest in the industry. This data is used to reconcile our measured water delivered figures. Supply pipe losses (internally metered customers) and meter under-registration assumptions are derived from our own datasets.
13	Water delivered unmeasured	A	2019/20	Our customer logger penetration is not yet at sufficient levels for statistical robustness. We have recognised our shortfall in coverage and we have initiated a programme of logger installations to meet the statistically representative sample size in this AMP. SAMs and internal weekly DNU/PCC analysis will be established this AMP under an existing commitment.
14	Company own water use	A	2018/19	We have recognised our own shortfall in accurately capturing our own water use across assets and operational use. A study is underway to provide additional company specific water use datasets.
15	Other water	G	-	An initiative has been underway since 2005 to

Component		RAG status	Target compliance date	Reason for any non-compliance and planned actions to resolve
	use			better understand our legally unbilled water use. We have determined, through metering and logging, that 95% of our water taken legally unbilled is consumption at our Waste Water Treatment Works.
16	Water balance	G	-	Our water balance is calculated in accordance with the consistency guidelines. Through adoption of other consistency measure components, we foresee our water balance calculation meeting “good practice”.

Table A.3.3.2: Bournemouth WRZ leakage reporting consistency RAG analysis

Component		RAG status	Target compliance date	Reason for any non-compliance and planned actions to resolve
1	Coverage	G	-	Coverage is 97% vs. the consistency target of 95%
2	Availability	A	2019/20	Current operability is 85% which is below the 90% target. Similarly, average DMA inoperability is greater than the three month limit.
3	Properties	A	2019/20	Review of geolocation process required to ensure compliance.
4	Night flow period and analysis	R	2019/20	A minimum one hour rolling window between 00:00 and 06:00 is currently used. For night flow analysis BW use the weekly 20th percentile as opposed to the weekly average. During the next 2 years we will review each DMA to determine the appropriateness of applying the restricted fixed window and weekly average based on the influence of factors such as tourism. Data gathering and further analysis will therefore be required to support our assumptions.

Component		RAG status	Target compliance date	Reason for any non-compliance and planned actions to resolve
5	Household night use	A	2019/20	Adjustments for variable consumer night use patterns do not meet future standards. Compliance will depend on expanding the current South West Water IHM and SAM initiatives to update and expand the Bournemouth WRZ dataset. In addition, we have recognised the resource implications for the more frequent night use analysis for which we will deploy additional analysts.
6	Non-household night use	A	2019/20	Insufficient logged sample of NHH customers with consumption of greater than 12m^3/day. As per Item 5, dependent on expanding programme of logger installations.
7	Hour to day conversion	G	-	Level of pressure logging across the Bournemouth area allows annual updating.
8	Annual distribution leakage and MLE	A	2019/20	Annual leakage is currently derived from monthly values. Our systems allow weekly derivations and we plan to deploy additional resources to undertake this analysis.
9	Trunk main leakage	A	2019/20	Static values based on default values are used. More field inspections and flow reviews are required to reduce trunk mains leakage under 5% target and implement company-specific values.
10	Service reservoir losses	A	2019/20	Review of metering and analysis required to allow calculation of volumetric balances and company-specific data and ensure compliance.
11	Distribution input	A	2019/20	Review of metering and analysis frequency and robustness required.
12	Water delivered measured	A	2019/20	Customer billing data is used to reconcile measured water delivered figures. Supply pipe losses (internally metered customers) and meter under-registration assumptions require further logging and analysis for compliance.

Component		RAG status	Target compliance date	Reason for any non-compliance and planned actions to resolve
13	Water delivered unmeasured	A	2019/20	Based on SAMs. IHM programme will be required to provide statistically robust sample size. Weekly DNU/PCC analysis will be initiated this AMP once sample set established.
14	Company own water use	A	2019/20	Review of metering coverage and analysis required to allow calculation of company-specific data and ensure compliance.
15	Other water use	A	2019/20	Review of minor component analysis required. Consultant studies required to improve data quality and sample size.
16	Water balance	G	-	Our water balance is calculated in accordance with the consistency guidelines. Through adoption of other consistency measure components, we foresee our water balance calculation meeting “good practice”.

A.3.4 Weekly demand profiles for Colliford, Roadford and Wimbleball WRZs

The following tables set out the weekly demand profiles used in our MISER model to assess our deployable output.

Table A.3.4.1: Colliford WRZ demand profiles

Week Number	WIS zones		
	101, 103-107, 201, 206, 407-409	102, 108, 202-204, 208	205, 207
1 - 13	0.914	0.832	0.672
14	1.040	1.090	1.200
15	1.040	1.090	1.200
16	1.020	1.040	1.100
17	1.020	1.040	1.100
18	1.050	1.060	1.140
19	1.020	1.040	1.100
20	1.020	1.040	1.100
21	1.100	1.110	1.200
22	1.100	1.200	1.300
23	1.070	1.150	1.260
24	1.070	1.150	1.260
25	1.100	1.150	1.350
26	1.100	1.220	1.350
27	1.120	1.250	1.500
28	1.160	1.270	1.520
29	1.200	1.310	1.550
30	1.200	1.320	1.600
31	1.170	1.340	1.600
32	1.160	1.340	1.726
33	1.160	1.320	1.685
34	1.130	1.310	1.600
35	1.100	1.220	1.450
36	1.070	1.150	1.300
37	1.040	1.100	1.200
38	1.000	1.050	1.095
39	0.950	1.000	1.024
40 - 52	0.914	0.832	0.672

Table A.3.4.2: WIS zones in Colliford WRZ

WIS Zone Ref	WIS Zone Name
101	Penzance
102	Hayle
103	Lizard
104	Redruth
105	Falmouth
106	Truro
107	Camborne
108	Probus
201	St Austell
202	Fowey
203	Looe
204	Camelford
205	St Minver
206	Bodmin
207	St Columb Major
208	Newquay
407	Launceston
408	Torpoint
409	Saltash

Table A.3.4.3: Roadford WRZ demand profiles

Week Number	WIS zones		
	301-310, 312, 405-406, 410, 501, 514	401-404	502-511, 513, 515
1 - 13	0.908	0.940	0.902
14	1.020	1.020	1.060
15	1.020	1.020	1.060
16	1.000	1.000	0.980
17	1.000	1.000	0.980
18	1.030	1.050	1.040
19	1.000	1.040	1.000
20	1.000	1.040	1.000
21	1.000	1.040	1.000
22	1.090	1.090	1.130
23	1.080	1.050	1.100
24	1.100	1.050	1.100
25	1.130	1.050	1.150
26	1.150	1.090	1.150
27	1.170	1.090	1.180
28	1.230	1.140	1.260
29	1.230	1.140	1.260
30	1.200	1.120	1.230
31	1.200	1.120	1.230
32	1.200	1.120	1.200
33	1.200	1.120	1.200
34	1.140	1.040	1.140
35	1.120	1.040	1.100
36	1.050	1.040	1.050
37	1.030	1.040	1.020
38	1.020	1.010	1.000
39	0.970	0.980	0.950
40 - 52	0.908	0.940	0.902

Table A.3.4.4: WIS Zones in Roadford WRZ

WIS Zone Ref	WIS Zone Name
301	Lynton
302	Parracombe
303	Combe Martin
304	Ilfracombe
305	Braunton
306	Barnstaple
307	Bideford
308	Clovelly
309	Okehampton
310	Winkleigh
312	South Molton
401	Plymouth
402	Yealmpton
403	Tavistock
404	Princetown
405	Broadwoodwidger
406	Bude
410	Brentor
501	Chagford
502	Moretonhampstead
503	Ashburton
504	Buckfastleigh
505	Kingsbridge
506	Brixham
507	Paignton
508	Torquay
509	Newton Abbot
510	Teignmouth
511	Dawlish
513	Chudleigh
514	Tedburn St Mary
515	Kingskerswell

Table A.3.4.5: Wimbleball WRZ demand profiles

Week Number	WIS zones	
	604, 605, 612	311, 512, 601-603, 606-611
1 - 13	0.874	0.916
14	1.110	1.050
15	1.080	1.050
16	1.040	1.030
17	1.040	1.030
18	1.060	1.070
19	1.040	1.060
20	1.040	1.060
21	1.040	1.060
22	1.150	1.090
23	1.100	1.070
24	1.100	1.070
25	1.130	1.120
26	1.130	1.140
27	1.150	1.150
28	1.170	1.170
29	1.250	1.170
30	1.260	1.170
31	1.260	1.160
32	1.320	1.150
33	1.270	1.120
34	1.220	1.060
35	1.150	1.040
36	1.090	1.040
37	1.050	1.040
38	1.030	1.020
39	1.000	1.000
40 - 52	0.874	0.916

Table A.3.4.6: WIS Zones in Wimbleball WRZ

WIS Zone Ref	WIS Zone Name
311	Washford Pyne
512	Exminster
601	Crediton
602	Broadclyst
603	Exeter
604	Exmouth
605	Axminster
606	Chardstock
607	Stockland
608	Honiton
609	Ottery St Mary
610	Willand
611	Tiverton
612	Woodbury

A.3.5 Leakage levels and costs for supply demand scenarios

The charts in this section are outputs from the testing supply and demand scenarios in Section 7 using the SELL model. The x axis is the mean leakage level over the 25 years of the plan for that scenario; the y axis being the net present value (NPV) of the respective components for the whole period (in £M). The baseline set of charts illustrates the relationship for our baseline forecast.

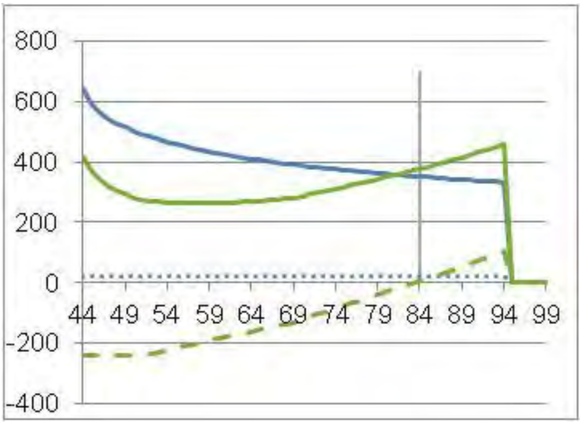
In each chart the maximum leakage level is constrained by the balance of supply and demand. Leakage is not allowed to rise beyond this balance, and so the NPV drops to zero – visible as ‘tails’ on each series.

Other scenarios, such as the cost analyses for willingness to pay, are not necessarily constrained by the supply demand balance. For these scenarios the ‘base dry’ model results are used by setting leakage to the respective WRZ leakage level. The resultant costs are then derived for the whole 25 year profile (inclusive of transitional costs when moving from one leakage level to another).

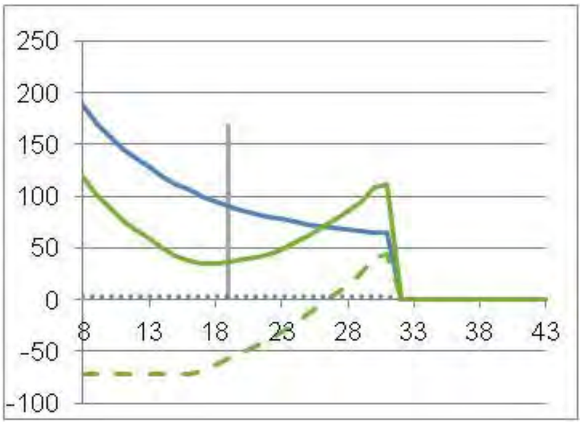
The purpose of this analysis is that it allows the cost of different uncertainties or policy decisions to be assessed. We then used this as part of the data in the multi-criteria assessment to understand what the best value programme is overall.

Figure 3.5.1 1a (baseline)

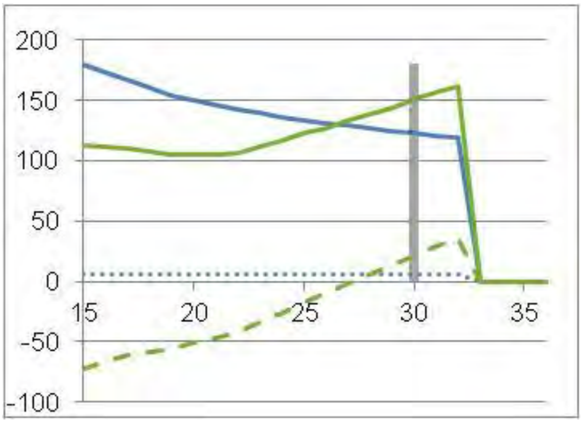
SWW



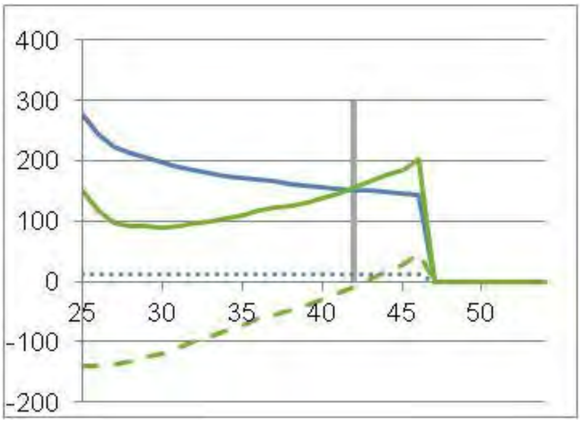
Colliford



Roadford



Wimbleball



Bournemouth

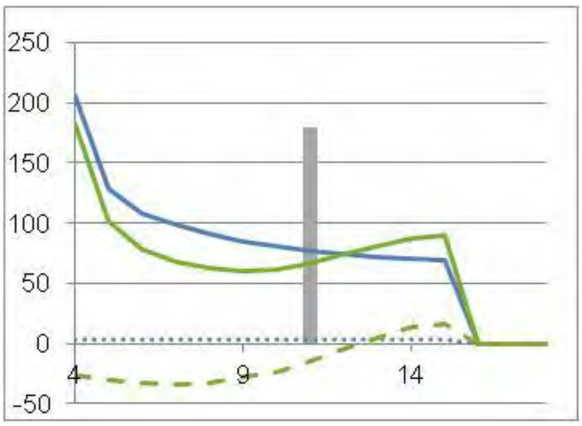
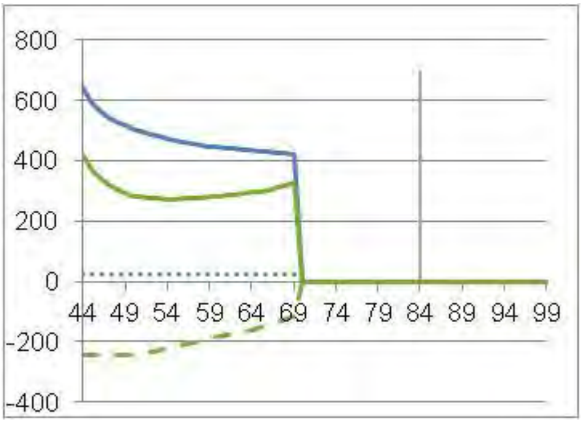


Figure 3.5.2 3a (plausible droughts PD-1)

SWW



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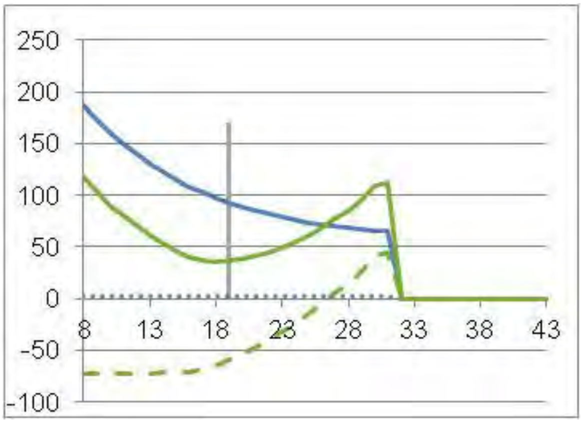

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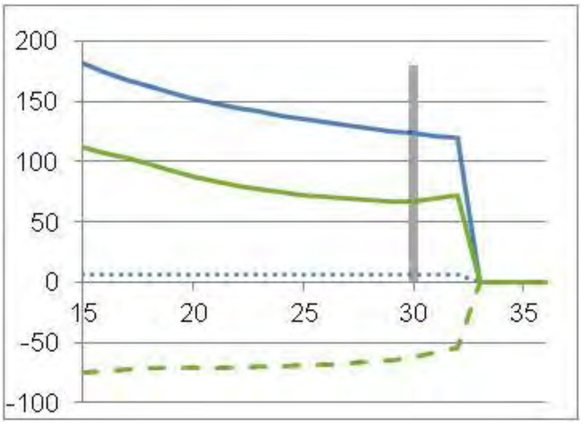

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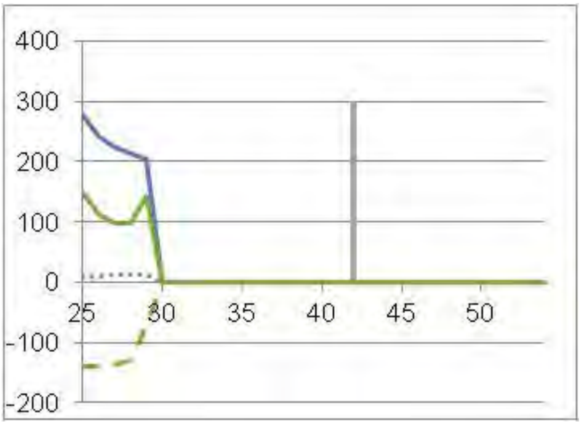
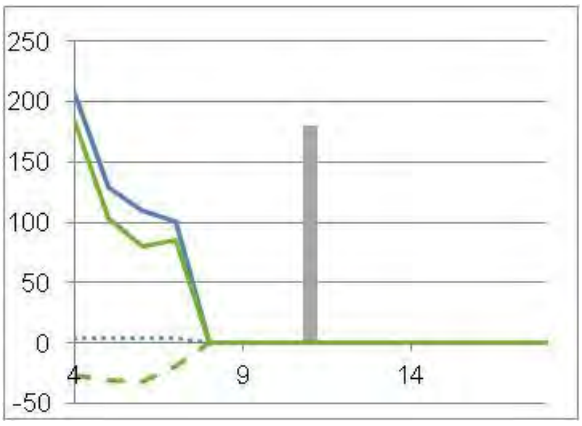


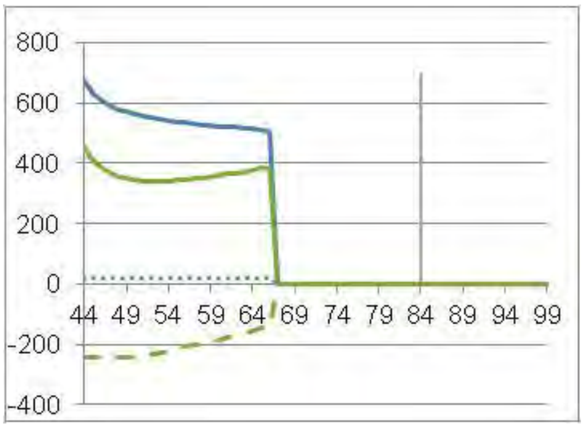
Bournemouth



South West Water Bournemouth Water

Figure 3.5.3 3a (plausible droughts PD-2)

SWW



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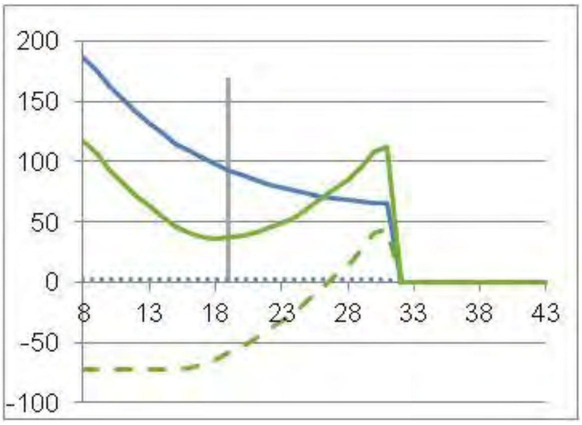

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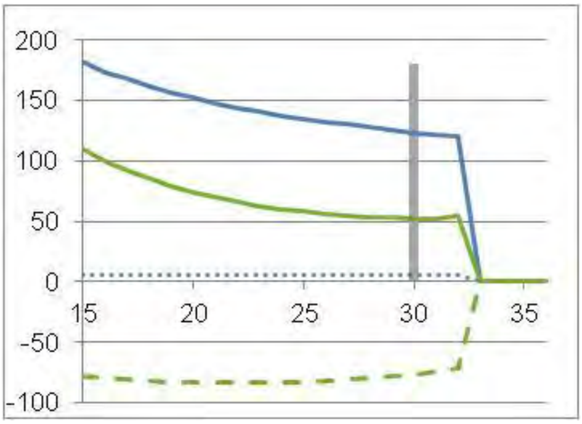

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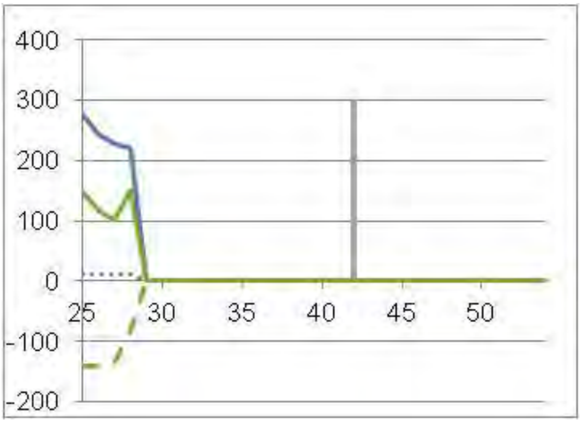

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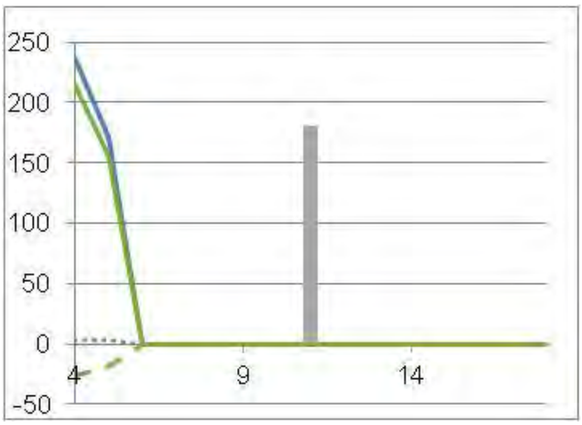
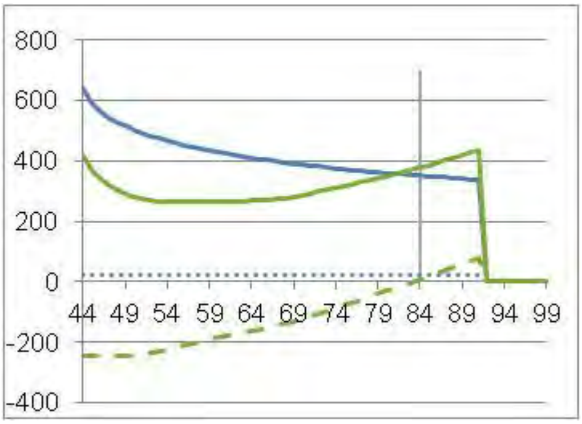


Figure 3.5.4 3a (plausible droughts PD-3)

SWW



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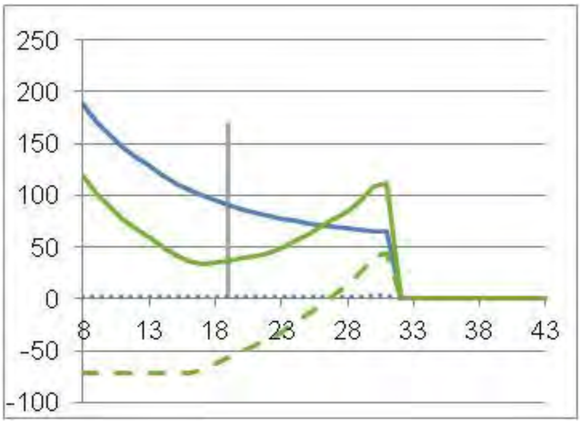

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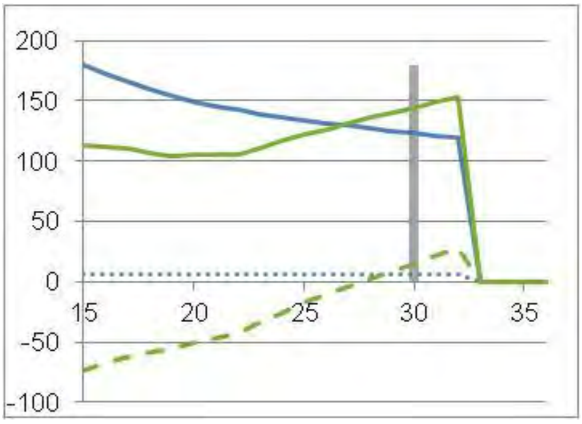

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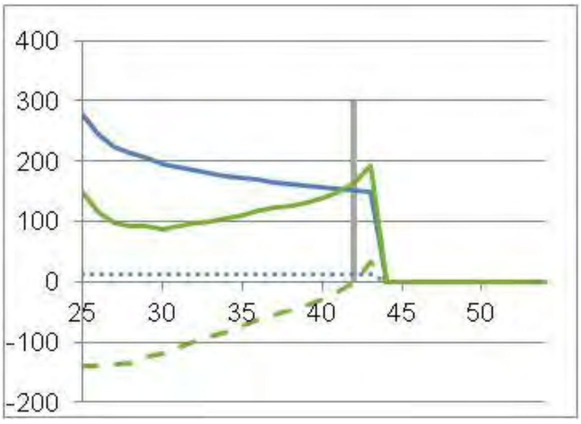

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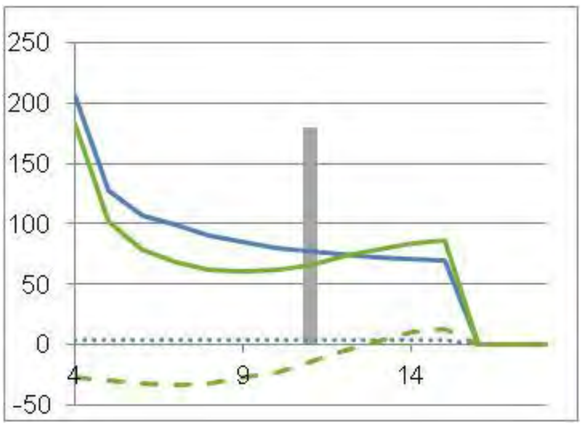
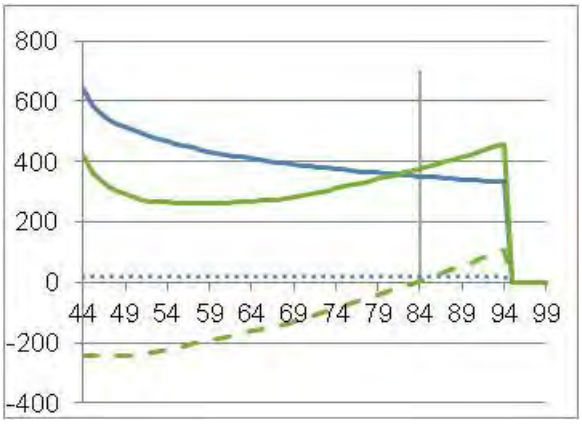


South West Water Bournemouth Water

Figure 3.5.5 3a (plausible droughts PD-4)

SWW



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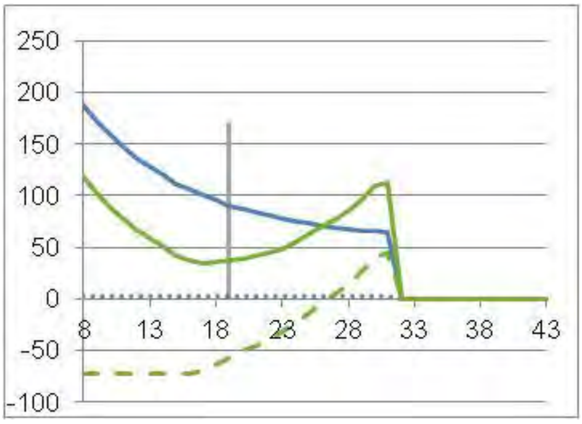

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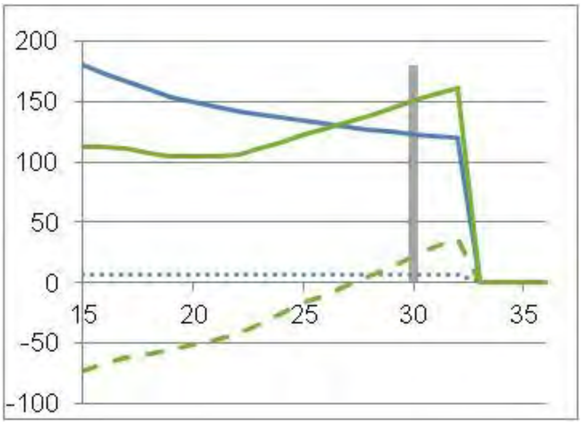

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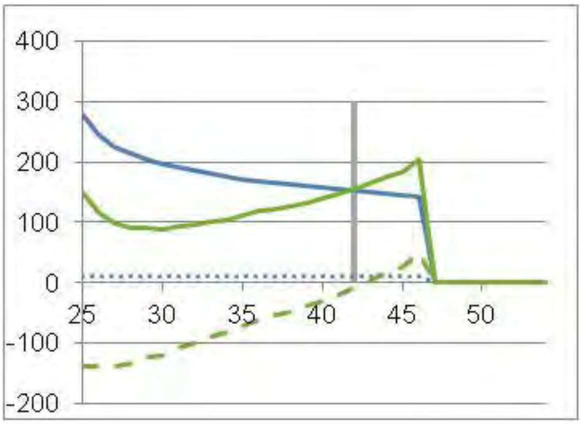

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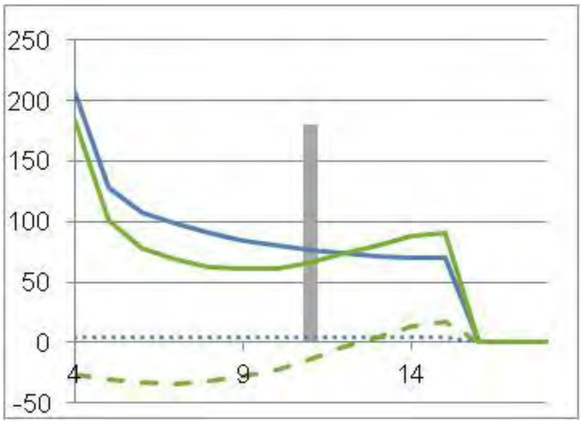
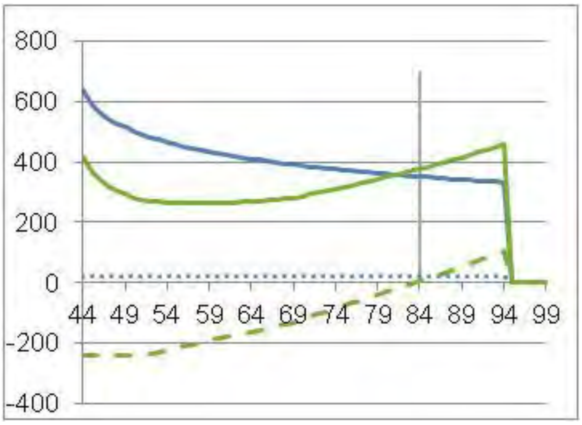


Figure 3.5.6 3b (1 in 200 year drought)

SWW



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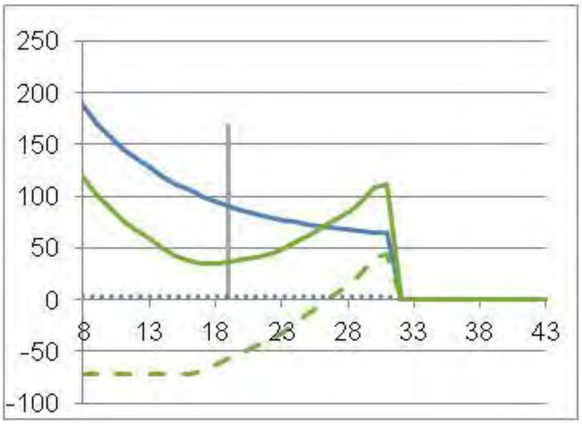

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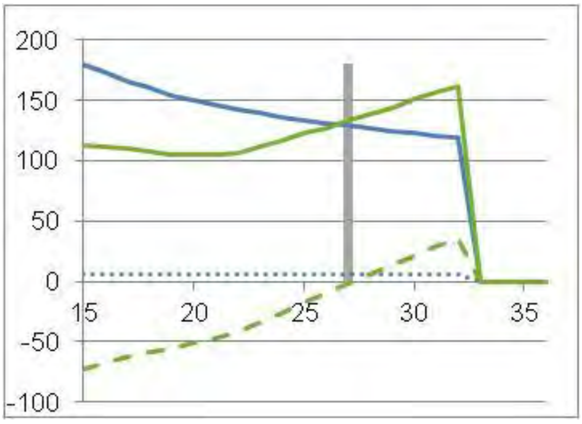

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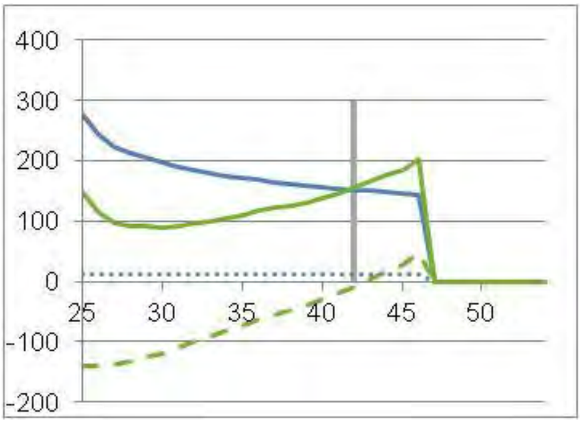

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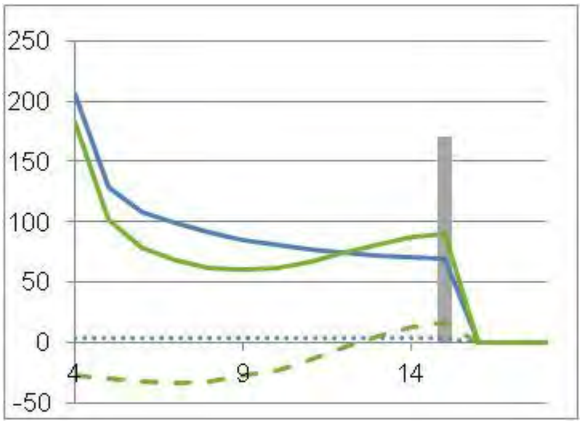
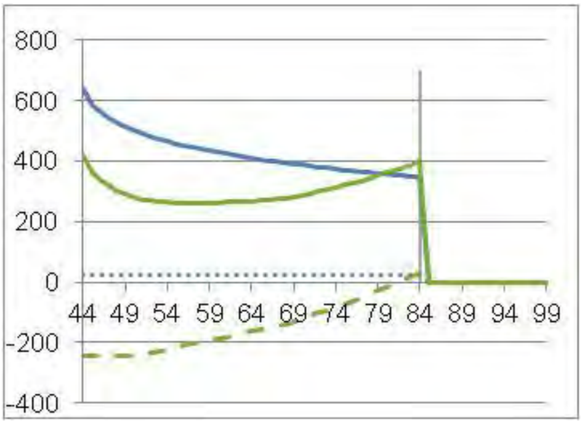


Figure 3.5.7 5b (impacts of WINEP2)

SWW



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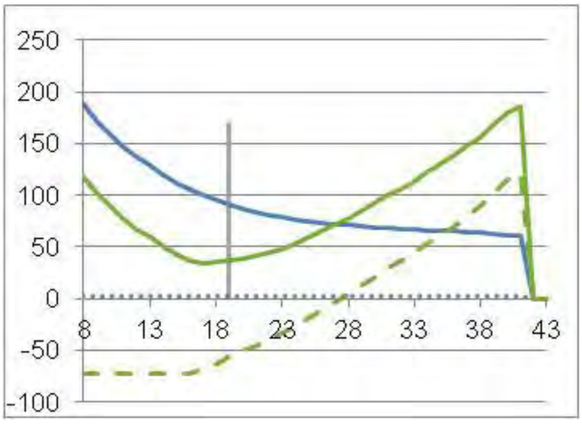

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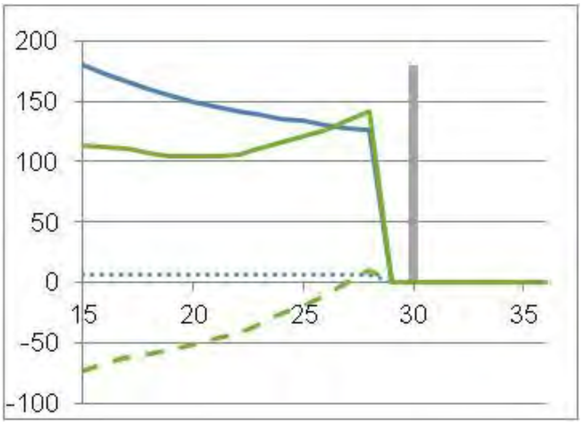

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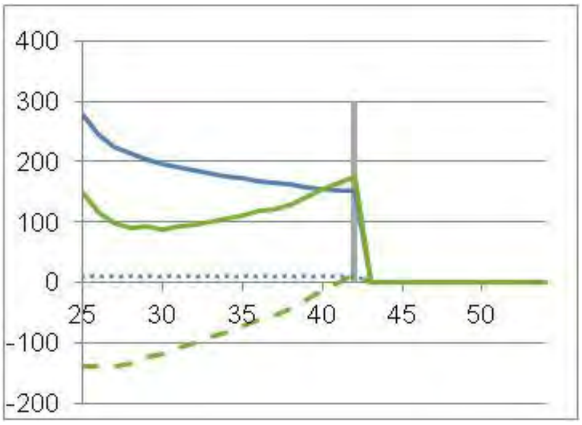

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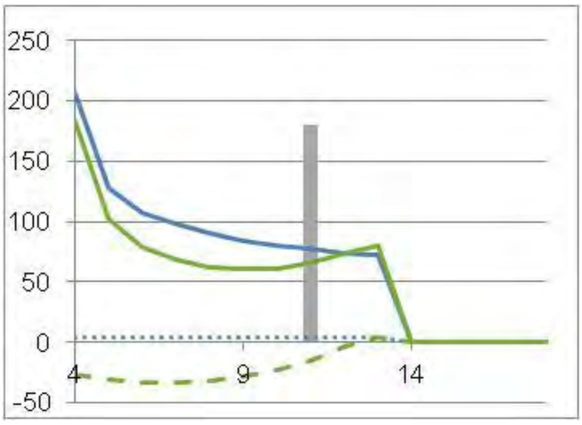
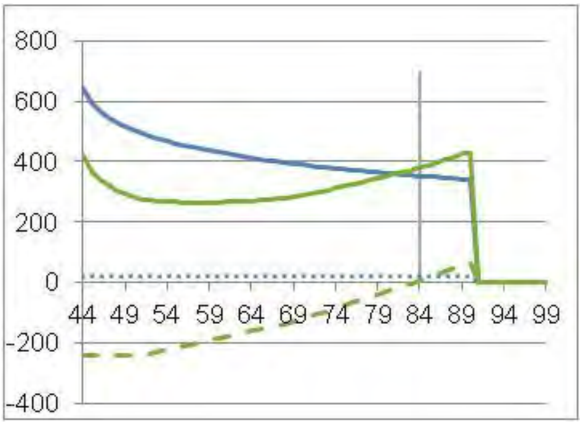


Figure 3.5.8 6a (leakage consistency)

SWW



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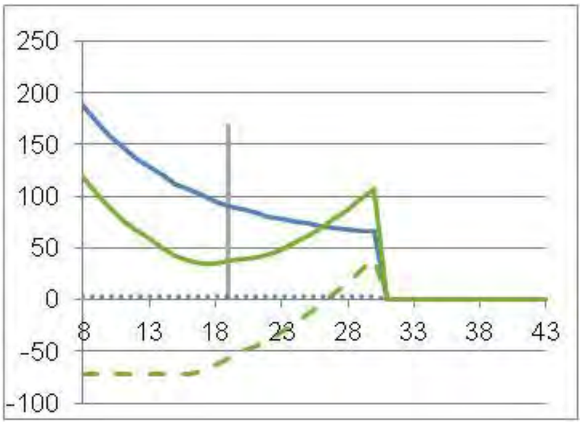

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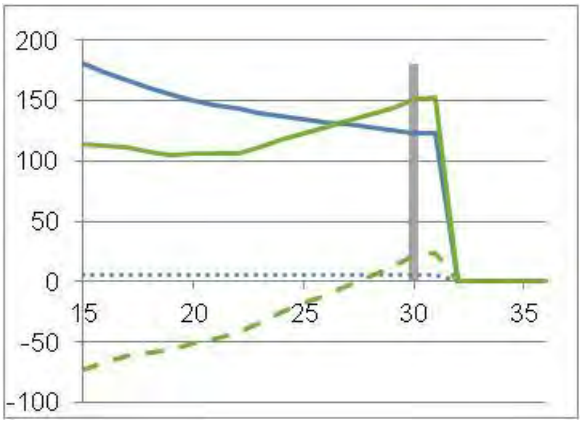

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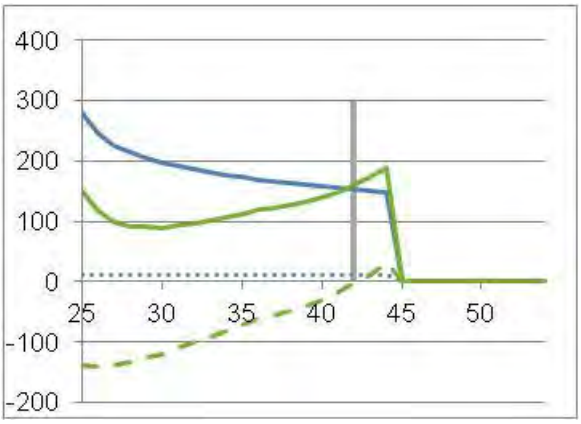

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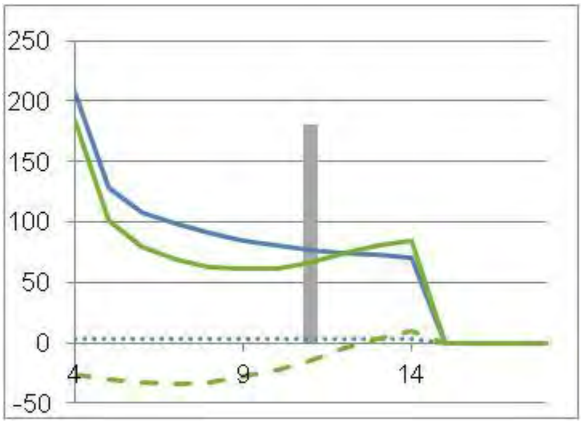
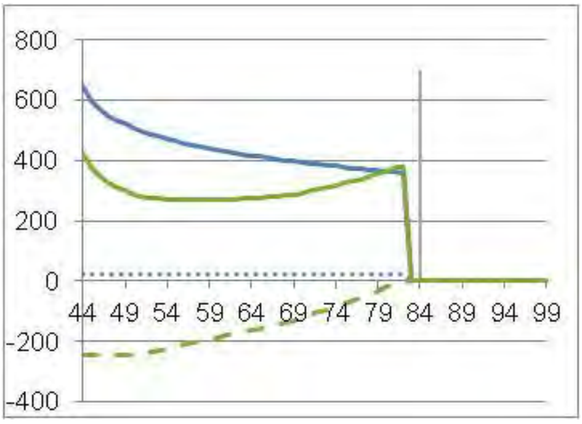


South West Water Bournemouth Water

Figure 3.5.9 7a (household high)

SWW



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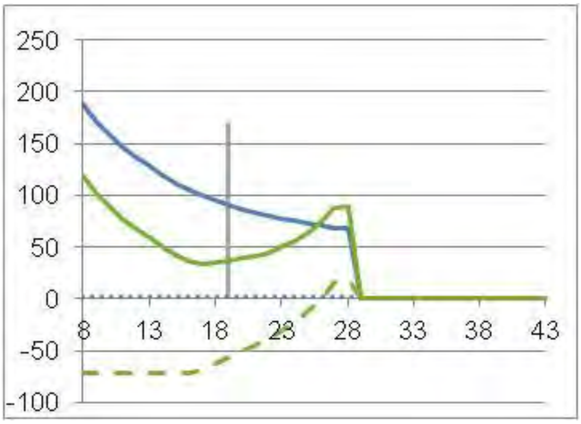

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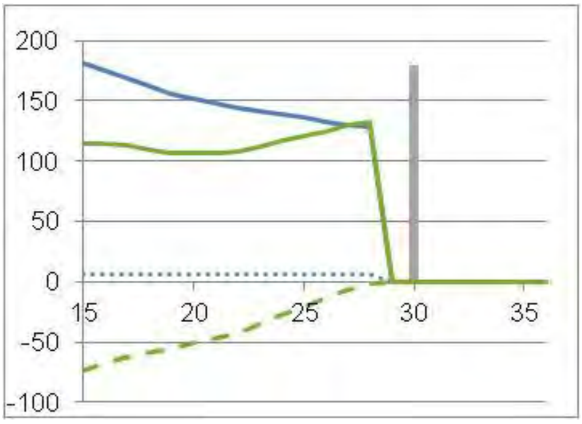

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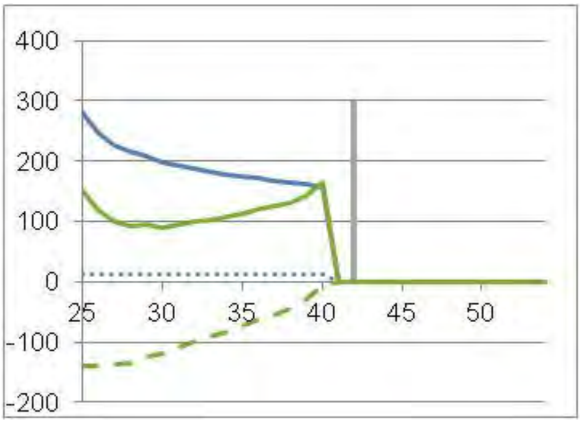

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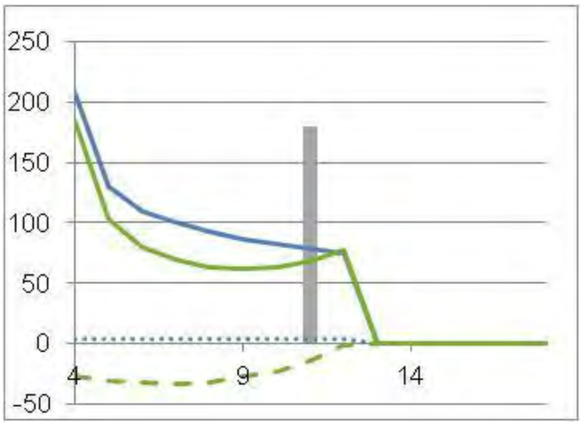
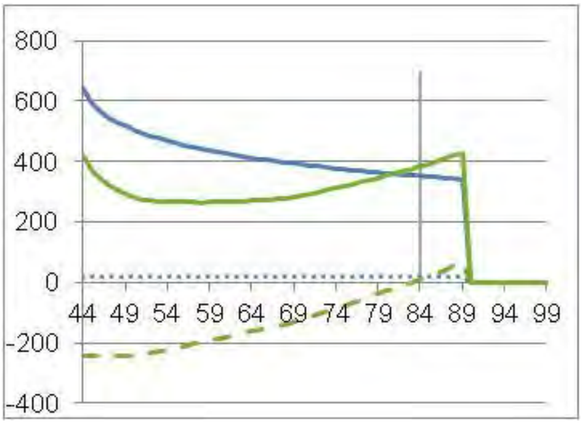


Figure 3.5.10 7b (non-household high)

SWW



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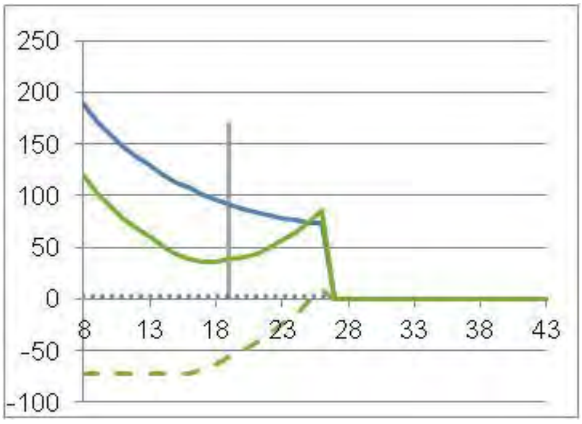

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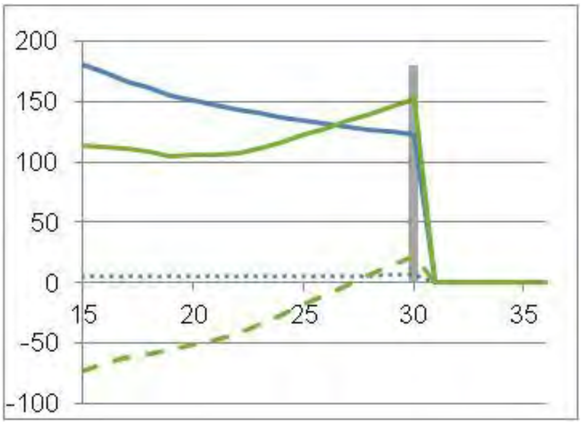

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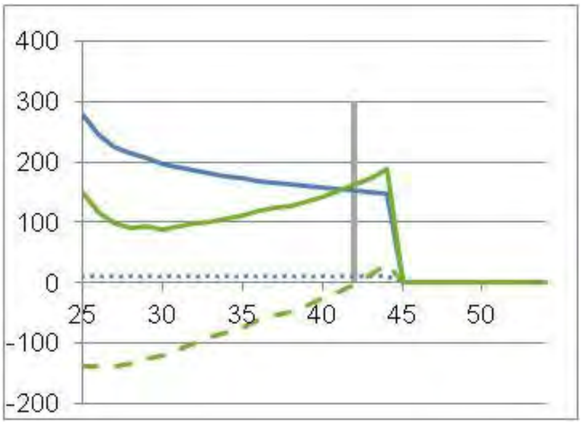

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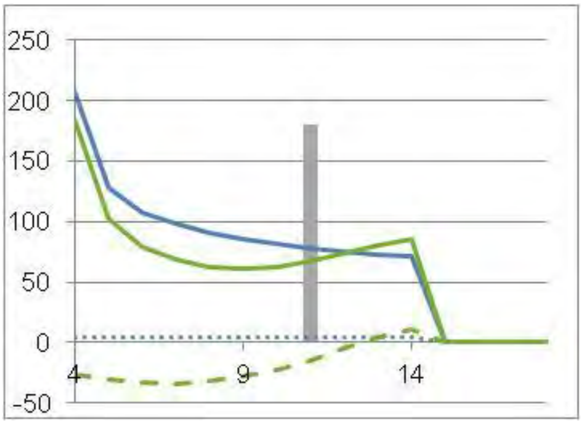
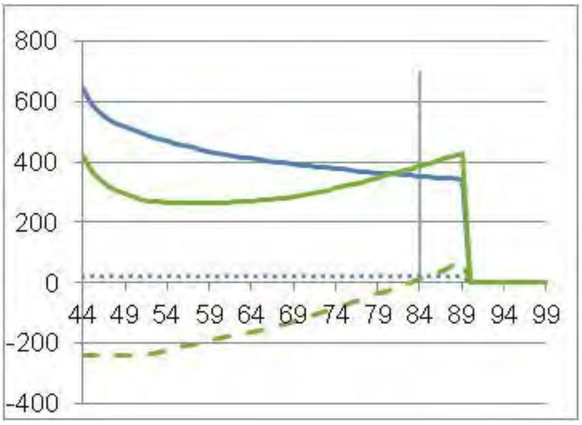


Figure 3.5.11 7b alternative (non-household high)

SWW



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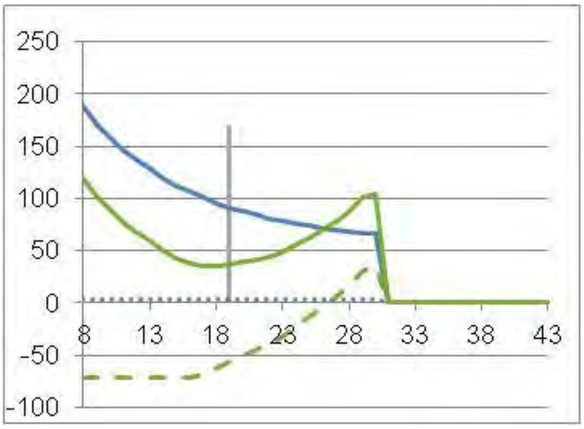

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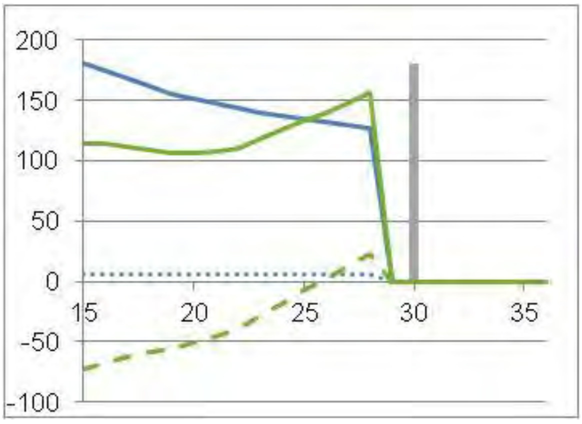

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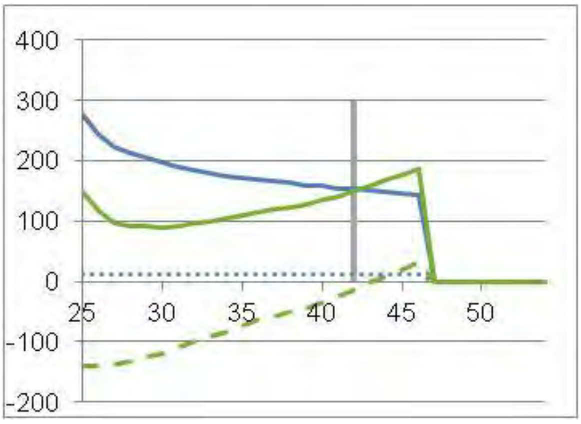

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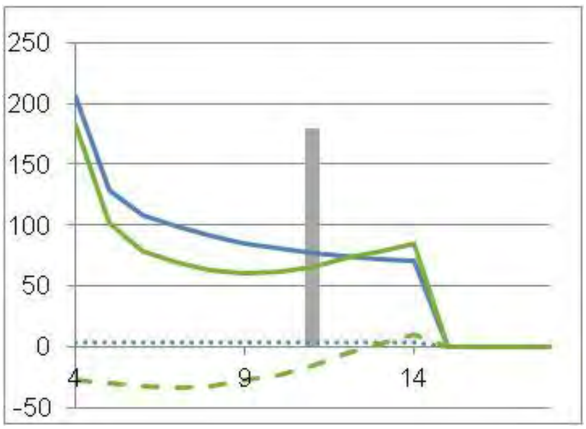


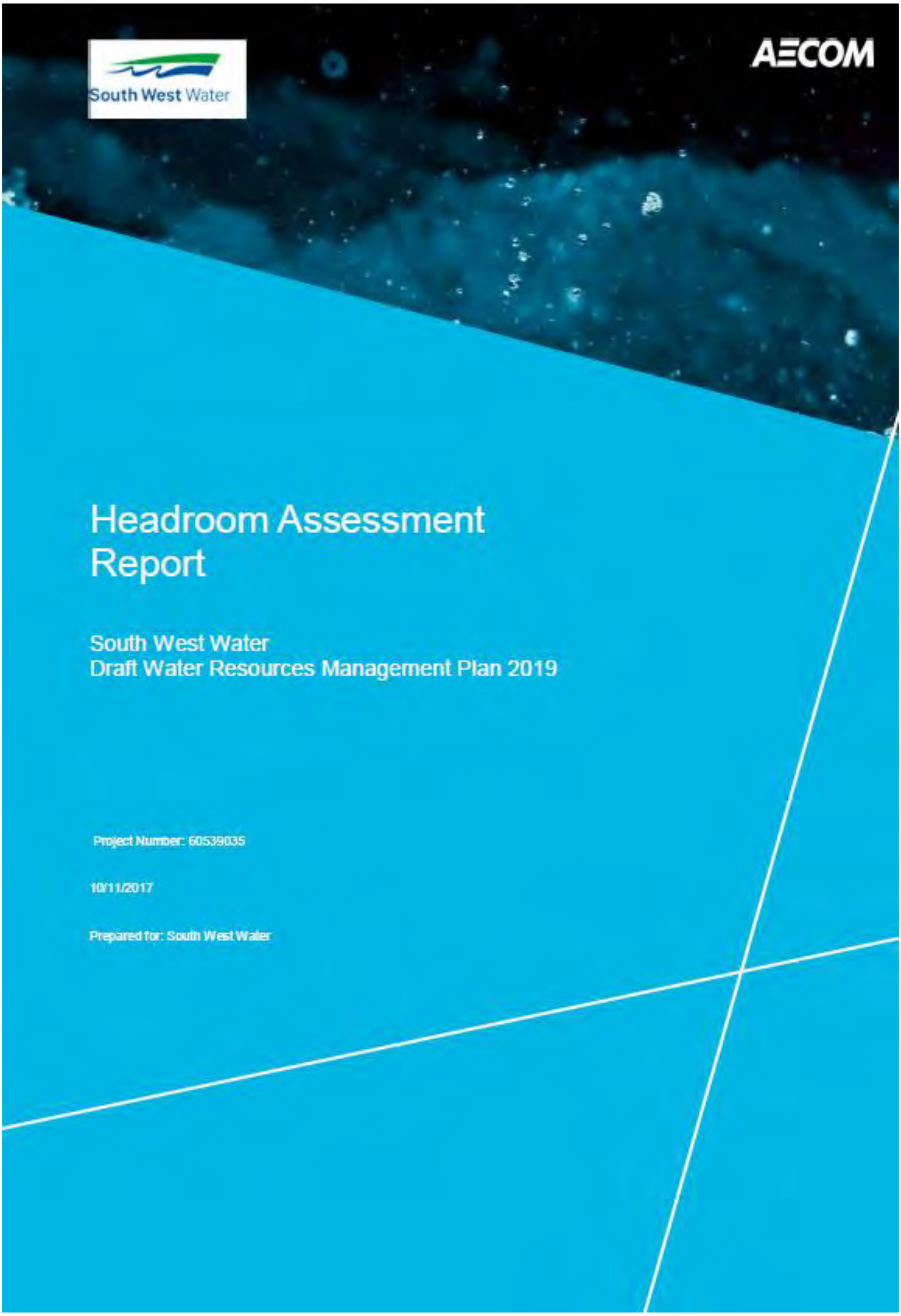
South West Water Bournemouth Water

APPENDIX 4

Target headroom

A.4.1 Target headroom methodology and results

SWW commissioned AECOM to undertake the headroom assessment for SWW and Bournemouth supply areas. This appendix presents the final Headroom Assessment Report by Aecom.



South West Water

AECOM

Headroom Assessment Report

South West Water
Draft Water Resources Management Plan 2019

Project Number: 60539035

10/11/2017

Prepared for: South West Water

South West Water

Bournemouth Water

Quality information

Prepared by	Checked by	Approved by
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Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	Aug 2017	Draft for client review			
2	October 2017	Second Draft			
3	November 2017	Final			

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1. Introduction

1.1 Background

South West Water (SWW) is required to submit an assessment of its target headroom allowance every five years as part of its Water Resources Management Plan (WRMP) submission. The purpose of including a headroom allowance within the supply/demand balance is to include a margin between supply and demand to allow for the risk of variations in the forecast supply/demand balance due to uncertainty in the various components.

SWW carried out an assessment of supply/demand uncertainties and calculated a suitable headroom allowance for each Water Resource Zone (WRZ), in order to incorporate within the supply/demand balance for their Final WRMP submission of 2014 (excluding Bournemouth Water (BW) which was submitted independently for WRMP14). A summary of the results is given in Table 1-1.

Table 1-1: South West Water (including Bournemouth WRZ) WRMP14 Headroom Allowance (Ml/d)

Year	Colliford DYAA	Roadford DYAA	Wimbleball DYAA	Bournemouth DYAA*	Bournemouth DYCP*
2012/13	9.79	14.83	4.23	2.4	2.8
2015/16	10.33	15.18	4.54	2.3	2.8
2020/21	9.78	13.82	4.55	2.5	3.0
2025/26	8.78	12.10	4.17	2.7	3.4
2030/31	9.45	12.69	4.60	3.0	4.1
2035/36	8.30	11.20	4.32	3.4	4.7
2039/40	8.92	12.02	4.49	3.9	5.5

** Separate return to OFWAT*

The figures in Table 1-1 were based on Monte Carlo simulations to combine probability distributions for a number of key uncertainty factors, including accuracy of supply and demand data, demand forecast variation and impact of climate change on Water Available For Use (WAFU). SWW's headroom allowance values were selected from each distribution at a reducing profile of risk across the 25-year planning horizon. The most appropriate level of headroom uncertainty was considered to be the 85th percentile for the beginning of the planning period, declining to the 70th percentile by 2039/2040.

The methodology applied was the UKWIR's *An Improved Method for Assessing Headroom* (2002) which allows for a detailed, analytical approach to the determination of uncertainty through probabilistic simulation.

1.2 Objectives

AECOM has been commissioned to undertake the re-assessment of the headroom allowance for SWW's dWRMP19 (and including BW's headroom for the first time, following the purchase of this Company by Pennon who now own both companies). The aim of the headroom assessment is to determine probability distributions to represent the range of uncertainty within the supply/demand balance for each relevant factor. These are then combined into overall probability distributions for each WRZ, to provide the target headroom for the relevant planning scenario and for each year across the 25 year planning horizon from 2020 to 2045. A time-varying profile of headroom can then be determined from the distribution for each period at an appropriate level of risk.

The key objectives of this analysis can be summarised as follows:

- Assess the risks and uncertainties which apply to the components of SWW's supply/demand balance, through consideration of operational data and other relevant information;
- Develop suitable probability distributions to represent each relevant uncertainty factor;
- Combine the individual probability distributions into a single distribution representing the WRZ's headroom uncertainty for each year in the planning horizon; and

- Determine headroom allowance profiles, by selecting values from the combined headroom uncertainty distributions at appropriate levels of risk across the planning horizon.

In the current report, Section 2 provides an overview of the methodology used to undertake the headroom assessment. Section 3 presents a review of the relevant uncertainty factors in SWW's supply/demand balance and the assumptions adopted for each of the individual probability distributions, whilst Section 4 summarises the results of the assessment. Section 5 provides the conclusions.

2. Headroom assessment methodology

2.1 Overview

SWW has adopted the industry standard method for the calculation of target headroom allowance; the method is outlined in *An Improved Methodology for Assessing Headroom* (UKWIR, 2002) and referred to by the Environment Agency in their most recent update to the *Water Resources Planning Guideline* (April, 2017).

In this approach, a probability distribution is assigned to each individual risk or uncertainty factor within the supply/demand balance, based on known data and other relevant information. These probability distributions are then combined using the statistical technique of Monte Carlo simulation, which iteratively takes random samples from each distribution and sums them according to specified rules. The summed result of each iteration then forms a point on the curve of the combined distribution; by sampling the distributions over a large number of iterations it is then possible to build up a probability distribution to represent the overall risk or uncertainty of all factors taken together.

The Monte Carlo simulation software @RISK was used for the analysis, which operates in conjunction with the Microsoft Excel spreadsheet package. Due to the random nature of the Monte Carlo simulation technique, it is not possible to guarantee that identical results will be generated each time the same simulation is run. However, by selecting a suitably large number of iterations for the simulation, to give an acceptable mean standard error for the simulation results, it should be possible to obtain repeatable results to an acceptable level of accuracy. This study found that consistent results were obtained using 10,000 iterations.

2.2 Planning scenarios

For the WRMP14, SWW evaluated the supply/demand balance analysis separately in each Water Resource Zone (WRZ). This approach has been continued for the dWRMP19, and therefore the analysis of headroom allowance has also been carried out at the WRZ level. Two planning scenarios have been considered in this headroom assessment:

- Dry Year Annual Average (DYAA) – based on Average Demand DO (ADO). The assessment of ADO is linked to the DYAA planning scenario. The UKWIR WR27 DO report (2012) defines the ADO as *'the deployable output of a source for the average annual period'* and goes on to state that *'the average demand is literally the average over the year computed as average over a normal year or average over a dry year'*; and
- Dry Year Peak Week (DYCP) – based on dry year Average Demand in the Peak Week (ADPW) and Peak DO (PDO). Water companies *"may also choose to explain how you will deal with a period of peak strain known as the critical period"* (Environment Agency, April 2017). The assessment of PDO is associated with the 'dry year critical period' (DYCP) planning scenario, where the resource zone supply-demand balance is sensitive to peak demand. PDO is the "*deployable output for the period in which there is highest demand*" (UKWIR, 2014).

The DYCP is only assessed for Bournemouth WRZ. This is because the nature of WAFU constraints in the other WRZ's means that a DYCP analysis is not required. This is consistent with WRMP14.

2.3 Uncertainty factors

Key areas of future risk and uncertainty relevant to SWW future supply/demand balance were identified through discussion and correspondence with SWW. A review of relevant data, including DO assessments/Water Available For Use (WAFU), demand forecasts, water quality data and other relevant information, was also carried out. The key areas of future risk and uncertainty were categorised with reference to the uncertainty factors specified in the 2002 UKWIR methodology, and are shown in Table 2-1. These uncertainties, along with the assumptions adopted for SWW headroom calculations, are discussed further in Section 3.

Table 2-1: Headroom Uncertainty Factors

Factor	Name	Description
S1	Vulnerable Surface water licences	Risk of future loss of supply due to sustainability changes to surface water abstraction licences for environmental reasons
S2	Vulnerable Groundwater licences	Risk of future loss of supply due to sustainability changes to groundwater abstraction licences for environmental reasons
S3	Time Limited Licences	Risk of future loss of supply due to non-renewal of time limited abstraction licences
S4	Bulk Imports	Risk of future loss of supply due to changes in bulk supply agreements (imports only)
S5	Gradual Pollution	Risk of future loss of supply due to pollution and/or water quality issues which cannot be mitigated or recovered
S6	Accuracy of Supply-Side Data	Uncertainty surrounding the accuracy of supply side data e.g. percentage accuracy of abstraction meters
S8	Impact of Climate Change on Deployable Output	Uncertainty surrounding the future impact of climate change on supply (varying estimates of loss depending on scenario)
S9	New Sources	Uncertainty surrounding the available yield of major new resource developments included in the final planning supply-demand balance
D1	Accuracy of Sub-component Demand Data	Uncertainty surrounding the accuracy of demand side data i.e. percentage accuracy of distribution input meters (generally located at service reservoirs)
D2	Demand Forecast Variation	Uncertainty surrounding future demand forecasts which may be higher or lower than assumed in the baseline supply-demand balance
D3	Impact of Climate Change on Demand	Risk of future increases in demand due to climate change impacts (varying estimates of demand effects depending on scenario)
D4	Demand Management Measures	Uncertainty surrounding the impact on future demand of demand management measures including leakage reduction, metering strategy and water efficiency activities.

3. Headroom assumptions

3.1 Overview of headroom assumptions

The key assumptions and relevant probability distributions used to inform this headroom analysis along with assumptions made for the WRMP14 headroom analysis are summarised in Table 3-1 and are discussed further in the following sections.

Table 3-1: Summary of assumptions informing the headroom analysis – WRMP14 and dWRMP19

Factor	WRMP14	dWRMP19
	Supply related	
S1 - Vulnerable surface water licences	No vulnerable surface water licences identified.	No change.
S2 - Vulnerable groundwater licences	No vulnerable groundwater licences identified.	No change.
S3 - Time limited licences	Environment Agency guidelines preclude these from the headroom analysis.	No change.
S4 - Bulk imports	No bulk imports into any WRZ's.	No change.
S5 - Gradual pollution causing a reduction in abstraction	No sources at risk in any WRZ.	No change.
S6 - Accuracy of supply-side data		
S6/1 - Uncertainty for yields constrained by pump capacity	No allowance included: groundwater DO assessments use actual pumping rates rather than nominal pumping capacities or groundwater sources are constrained by licence. BW main GW sources constrained by licence therefore this component does not apply	No change.
S6/2 - Meter uncertainty for licence critical sources	95% probability that the reading is within ±5%. Error is distributed normally around a mean of 0Ml/d. Standard deviation of ±2% of the total WAFU, distributed normally around a mean of 0Ml/d used in BW.	No change for SWW. Bournemouth WRZ uncertainty increased to +/- 5%.
S6/3 - Uncertainty for aquifer constrained groundwater sources	No allowance included: Wimbleball has some aquifer constrained sources however a high confidence in the ability of the drought curve to estimate the source performance meant it was not included. BW main groundwater sources constrained by licence therefore this component does not apply.	No change.
S6/4 - Uncertainty for climate and catchment characteristics affecting surface waters	95% probability that the value is within ±10%. Error is distributed normally around a mean of 0Ml/d. Not included in BW.	No change for SWW. Same uncertainty applied to Bournemouth WRZ.
S8 - Uncertainty of impact of climate change on source yield	Triangular distribution with upper and lower bounds of the impact of climate on supply, and the best estimate is the difference between the two.	No change; however new methodology to determine the upper and lower bounds used.
S9 - Uncertain output from new resource developments S9	No allowance included.	No change.
	Demand related	
D1 - Accuracy of sub-component data	95% probability that the recording is within ±2.5%. Error is distributed normally around a mean of 0Ml/d. Standard deviation of ±2% distributed normally around a mean of 0Ml/d used in BW.	No change for SWW. Bournemouth WRZ uncertainty increased to ±2.5%.

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Factor	WRMP14	dWRMP19
D2 - Demand forecast variation	Triangular distribution starting with 0 variation in first year, leading linearly to ±15% at the end of the planning period. Uncertainty from the baseline demand forecast used in BW.	No change for SWW. WRMP14 SWW uncertainty applied to Bournemouth WRZ.
D3 - Uncertainty of impact of climate change on demand	Increase in consumption by 1% at the end of the planning period, ±20% for headroom – triangular distribution. Not considered by BW as was assumed to be included in the baseline demand forecast.	Increase in consumption by 0.71% in Colliford, 0.74% in Roadford, 0.72% in Wimbleball and 0.54% in Bournemouth.
D4 - Uncertain outcome from demand management measures	Assumed saving of 0.75Ml/d every year thought the planning period. Estimated pro rata on the basis of forecast DI between the three WRZs. Triangular distribution with 0 as most likely, ±10% Not included in BW.	Same saving and uncertainty applied; however saving is estimated pro rata on the basis of forecast distribution input between the four WRZs, to include Bournemouth WRZ.

In summary, the changes from WRMP14 are small and unlikely to affect the target headroom allowance calculations significantly for the SWW WRZ's. More significant changes have been made for the Bournemouth WRZ. Further detail on how the assumptions were determined for each of the specified uncertainty factors is given in the sections below.

3.2 S1 Vulnerable surface water licences

No vulnerable surface water licences have been identified; therefore risk/uncertainty allowance for this factor was excluded from this assessment.

3.3 S2 Vulnerable groundwater licences

No vulnerable groundwater licences have been identified; therefore risk/uncertainty allowance for this factor was excluded from this assessment.

3.4 S3 Time limited Licences

The Environment Agency's *Water Resources Planning Guideline* (April 2017) states that companies may include an uncertainty allowance for the non-replacement of time-limited licences based on an assessment of environmental risks. Any allowance for uncertainty related to sustainability changes to permanent licences should not be included, "as the Environment Agency or Natural Resources Wales will work with the company to ensure that these do not impact security of supply". This factor was therefore excluded from the headroom analysis.

3.5 S4 Bulk imports

SWW (including Bournemouth) do not currently have any bulk imports, and therefore risk/uncertainty allowance for this factor was not included in this assessment.

3.6 S5 Gradual pollution

None of the sources are considered to be at risk from gradual pollution; therefore risk/uncertainty allowance for this factor was not included in this assessment.

3.7 S6 Accuracy of supply side data

3.7.1 S6/1: Uncertainty for yields constrained by pump capacity

There are no traditional groundwater sources in the Colliford WRZ, while Roadford and Wimbleball WRZ's groundwater DO assessments use actual pumping rates rather than nominal pumping capacities. Therefore this component does not apply. In the case of Bournemouth WRZ, the main groundwater sources are constrained by licence and therefore are not included.

3.7.2 S6/2 Meter uncertainty for licence critical sources

It is assumed that all sources are subject to meter uncertainty. A ± 5% uncertainty allowance has therefore been included in this analysis with a 95% probability that the value is within this range. A normal probability distribution has been adopted to represent the range of uncertainty, around a mean of 0 Ml/d as shown in Table 3-2. It should be noted that the mean impact of climate change has been incorporated in the WAFU forecasts used, and only the uncertainty in this estimate has been included in the S8 headroom component (i.e. with "best estimate" of the mean impact on WAFU = 0). This method was chosen to keep the assessment consistent with previous WRMP headroom assessments.

Table 3-2: S6/2 meter uncertainty probability distribution summary data for all WRZ's

	Colliford			Roadford			Wimbleball			Bournemouth DYAA			Bournemouth DYCP		
Year	WAFU (Ml/d)	5% WAFU	SD	WAFU (Ml/d)	5% WAFU	SD	WAFU (Ml/d)	5% WAFU	SD	WAFU (Ml/d)	5% WAFU	SD	WAFU (Ml/d)	5% WAFU	SD
2015/16	163.7	8.2	4.2	249.1	12.5	6.4	92.6	4.6	2.4	204.8	10.2	5.3	225.8	11.3	5.8
2016/17	163.6	8.2	4.2	248.5	12.4	6.3	90.5	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2017/18	163.5	8.2	4.2	247.9	12.4	6.3	90.5	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2018/19	163.4	8.2	4.2	245.3	12.3	6.3	90.4	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2019/20	163.3	8.2	4.2	244.7	12.2	6.2	90.4	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2020/21	163.3	8.2	4.2	244.1	12.2	6.2	90.3	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2021/22	163.2	8.2	4.2	243.5	12.2	6.2	90.2	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2022/23	163.1	8.2	4.2	242.9	12.1	6.2	90.2	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2023/24	163.0	8.2	4.2	242.3	12.1	6.2	90.1	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2024/25	162.9	8.1	4.2	241.8	12.1	6.2	90.1	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2025/26	162.8	8.1	4.2	241.2	12.1	6.2	90.0	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2026/27	162.7	8.1	4.2	240.6	12.0	6.1	90.0	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2027/28	162.7	8.1	4.1	240.0	12.0	6.1	89.9	4.5	2.3	204.8	10.2	5.3	225.8	11.3	5.8
2028/29	162.6	8.1	4.1	239.4	12.0	6.1	89.8	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2029/30	162.5	8.1	4.1	238.8	11.9	6.1	89.8	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2030/31	162.4	8.1	4.1	238.2	11.9	6.1	89.7	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2031/32	162.4	8.1	4.1	238.0	11.9	6.1	89.7	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2032/33	162.4	8.1	4.1	237.8	11.9	6.1	89.7	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2033/34	162.3	8.1	4.1	237.6	11.9	6.1	89.7	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2034/35	162.3	8.1	4.1	237.4	11.9	6.1	89.6	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2035/36	162.3	8.1	4.1	237.2	11.9	6.1	89.6	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2036/37	162.2	8.1	4.1	237.0	11.8	6.0	89.6	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2037/38	162.2	8.1	4.1	236.8	11.8	6.0	89.6	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2038/39	162.2	8.1	4.1	236.6	11.8	6.0	89.6	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2039/40	162.2	8.1	4.1	236.4	11.8	6.0	89.5	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2040/41	162.1	8.1	4.1	236.2	11.8	6.0	89.5	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2041/42	162.1	8.1	4.1	236.0	11.8	6.0	89.5	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2042/43	162.1	8.1	4.1	235.8	11.8	6.0	89.5	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2043/44	162.0	8.1	4.1	235.6	11.8	6.0	89.5	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6
2044/45	162.0	8.1	4.1	235.3	11.8	6.0	89.4	4.5	2.3	193.3	9.7	5.0	219.4	11.0	5.6

3.7.3 S6/3 Uncertainty for aquifer constrained groundwater sources

Colliford, Roadford and Bournemouth WRZ's do not have any aquifer constrained sources. An allowance for aquifer constrained sources in Wimbleball WRZ was excluded as SWW have a high confidence in the ability of the drought curve to estimate the source performance.

3.7.4 S6/4 Uncertainty for climate and catchment characteristics affecting surface waters

Uncertainty around the accuracy of river flow measurements has been included in this assessment. The 2002 UKWIR methodology suggests that an accuracy of ± 10% should be assumed for catchments/sources with long records and/or where the catchments are large. A ± 10% uncertainty allowance has therefore been chosen, with a 95% probability that the value is within this range. A normal probability distribution has been adopted to represent the range of uncertainty, around a mean of 0 Ml/d. This is shown in Table 3-3. It should be noted that the mean impact of climate change has been incorporated in the WAFU forecasts used as explained in Section 3.7.2.

Table 3-3: S6/4 climate and catchment uncertainty probability distribution summary data for all WRZ's

	Colliford			Roadford			Wimbleball			Bournemouth DYAA			Bournemouth DYCP		
Year	WAFU (Ml/d)	10% WAFU	SD	WAFU (Ml/d)	10% WAFU	SD	WAFU (Ml/d)	10% WAFU	SD	WAFU (Ml/d)	10% WAFU	SD	WAFU (Ml/d)	10% WAFU	SD
2015/16	163.7	16.4	8.4	249.1	24.9	12.7	92.6	9.3	4.7	204.8	20.5	10.5	225.8	22.6	11.6
2016/17	163.6	16.4	8.3	248.5	24.8	12.7	90.5	9.1	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2017/18	163.5	16.4	8.3	247.9	24.8	12.6	90.5	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2018/19	163.4	16.3	8.3	245.3	24.5	12.5	90.4	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2019/20	163.3	16.3	8.3	244.7	24.5	12.5	90.4	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2020/21	163.3	16.3	8.3	244.1	24.4	12.5	90.3	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2021/22	163.2	16.3	8.3	243.5	24.4	12.4	90.2	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2022/23	163.1	16.3	8.3	242.9	24.3	12.4	90.2	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2023/24	163.0	16.3	8.3	242.3	24.2	12.4	90.1	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2024/25	162.9	16.3	8.3	241.8	24.2	12.3	90.1	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2025/26	162.8	16.3	8.3	241.2	24.1	12.3	90.0	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2026/27	162.7	16.3	8.3	240.6	24.1	12.3	90.0	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2027/28	162.7	16.3	8.3	240.0	24.0	12.2	89.9	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.6
2028/29	162.6	16.3	8.3	239.4	23.9	12.2	89.8	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2029/30	162.5	16.2	8.3	238.8	23.9	12.2	89.8	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2030/31	162.4	16.2	8.3	238.2	23.8	12.2	89.7	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2031/32	162.4	16.2	8.3	238.0	23.8	12.1	89.7	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2032/33	162.4	16.2	8.3	237.8	23.8	12.1	89.7	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2033/34	162.3	16.2	8.3	237.6	23.8	12.1	89.7	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2034/35	162.3	16.2	8.3	237.4	23.7	12.1	89.6	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2035/36	162.3	16.2	8.3	237.2	23.7	12.1	89.6	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2036/37	162.2	16.2	8.3	237.0	23.7	12.1	89.6	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2037/38	162.2	16.2	8.3	236.8	23.7	12.1	89.6	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2038/39	162.2	16.2	8.3	236.6	23.7	12.1	89.6	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2039/40	162.2	16.2	8.3	236.4	23.6	12.1	89.5	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2040/41	162.1	16.2	8.3	236.2	23.6	12.0	89.5	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2041/42	162.1	16.2	8.3	236.0	23.6	12.0	89.5	9.0	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2042/43	162.1	16.2	8.3	235.8	23.6	12.0	89.5	8.9	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2043/44	162.0	16.2	8.3	235.6	23.6	12.0	89.5	8.9	4.6	193.3	19.3	9.9	219.4	21.9	11.3
2044/45	162.0	16.2	8.3	235.3	23.5	12.0	89.4	8.9	4.6	193.3	19.3	9.9	219.4	21.9	11.3

3.8 S8 Impact of climate change on WAFU

The minimum, mean and maximum climate change impacts on WAFU were calculated from eleven Future Flows hydrology monthly change factors. This dataset consists of 11 equally likely scenarios of climate to 2085/2086. These values were then used in this assessment to determine the uncertainties using a triangular distribution to represent the potential variation from the most likely impacts if either the low or high impacts were to apply. The parameters of each triangular distribution were therefore calculated as follows:

Minimum = Low – most likely in Ml/d (a negative value)

Most Likely = 0 (i.e. zero uncertainty)

Maximum = High – most likely forecast in Ml/d (a positive value)

It was determined that there was no impact of climate change on WAFU for Bournemouth WRZ, therefore the two Bournemouth scenarios have not been shown in the Table 3-4. This approach is consistent with WRMP14. The minimum and maximum values for all other WRZ's are shown in Table 3-4; however the most likely is not shown as it is zero for all WRZ's across all the years.

Table 3-4: S8 impact of climate change uncertainty probability distribution summary data for all WRZ's

	Colliford			Roadford			Wimbleball		
Year	WAFU (Ml/d)	Min	Max	WAFU (Ml/d)	Min	Max	WAFU (Ml/d)	Min	Max
2015/16	163.7	-0.8	0.4	249.1	-2.1	1.8	92.6	-0.5	0.2
2016/17	163.6	-1.0	0.6	248.5	-2.6	2.3	90.5	-0.6	0.3
2017/18	163.5	-1.2	0.7	247.9	-3.1	2.8	90.5	-0.8	0.3
2018/19	163.4	-1.4	0.8	245.3	-3.6	3.2	90.4	-0.9	0.4
2019/20	163.3	-1.6	0.9	244.7	-4.1	3.7	90.4	-1.0	0.5
2020/21	163.3	-1.9	1.0	244.1	-4.6	4.1	90.3	-1.1	0.5
2021/22	163.2	-2.1	1.1	243.5	-5.1	4.6	90.2	-1.3	0.6
2022/23	163.1	-2.3	1.2	242.9	-5.7	5.1	90.2	-1.4	0.6
2023/24	163.0	-2.5	1.3	242.3	-6.2	5.5	90.1	-1.5	0.7
2024/25	162.9	-2.7	1.4	241.8	-6.7	6.0	90.1	-1.6	0.8
2025/26	162.8	-2.9	1.5	241.2	-7.2	6.4	90.0	-1.8	0.8
2026/27	162.7	-3.1	1.7	240.6	-7.7	6.9	90.0	-1.9	0.9
2027/28	162.7	-3.3	1.8	240.0	-8.2	7.3	89.9	-2.0	0.9
2028/29	162.6	-3.5	1.9	239.4	-8.7	7.8	89.8	-2.2	1.0
2029/30	162.5	-3.7	2.0	238.8	-9.3	8.3	89.8	-2.3	1.0
2030/31	162.4	-3.9	2.1	238.2	-9.8	8.7	89.7	-2.4	1.1
2031/32	162.4	-4.0	2.1	238.0	-10.0	8.9	89.7	-2.5	1.1
2032/33	162.4	-4.1	2.2	237.8	-10.1	9.1	89.7	-2.5	1.1
2033/34	162.3	-4.1	2.2	237.6	-10.3	9.2	89.7	-2.5	1.2
2034/35	162.3	-4.2	2.2	237.4	-10.5	9.4	89.6	-2.6	1.2
2035/36	162.3	-4.3	2.3	237.2	-10.7	9.5	89.6	-2.6	1.2
2036/37	162.2	-4.3	2.3	237.0	-10.8	9.7	89.6	-2.7	1.2
2037/38	162.2	-4.4	2.4	236.8	-11.0	9.8	89.6	-2.7	1.2
2038/39	162.2	-4.5	2.4	236.6	-11.2	10.0	89.6	-2.8	1.3
2039/40	162.2	-4.5	2.4	236.4	-11.4	10.2	89.5	-2.8	1.3
2040/41	162.1	-4.6	2.5	236.2	-11.6	10.3	89.5	-2.9	1.3
2041/42	162.1	-4.7	2.5	236.0	-11.7	10.5	89.5	-2.9	1.3
2042/43	162.1	-4.8	2.5	235.8	-11.9	10.6	89.5	-2.9	1.3
2043/44	162.0	-4.8	2.6	235.6	-12.1	10.8	89.5	-3.0	1.4
2044/45	162.0	-4.9	2.6	235.3	-12.3	11.0	89.4	-3.0	1.4

3.9 S9 New sources

There are no new sources proposed in dWRMP19; therefore this component is not included in this headroom analysis.

3.10 D1 Accuracy of sub-component demand data

A small allowance of ± 2.5% has been included to represent the uncertainty in the accuracy of distribution input (DI) meters, with a 95% probability that the value is within this range. A normal probability distribution has been adopted to represent the range of uncertainty, around a mean of 0 Ml/d. It should be noted that these meters are typically located at the point of distribution and are not the same as those used to measure abstraction, so this avoids double-counting with factor S6/2 (see Section 3.7.2). The parameters of the normal distribution, for each year in the planning horizon and for each planning scenario, are defined as follows:

Mean = 0

Standard Deviation (σ) = 2.5% of Company Distribution Input / 4

This ensures that the probability of the variation from DI due to meter error lying within the range ± 2.5% of DI is 99.99%. The variation lies almost entirely between a minimum value of -2.5% of DI and a maximum value of +2.5% of DI, as shown in Table 3-5.

Table 3-5: D1 demand uncertainty probability distribution summary data for all WRZ's

	Colliford			Roadford			Wimbleball			Bournemouth DYAA			Bournemouth DYCP		
Year	DI (Ml/d)	2.5% DI	SD	DI (Ml/d)	2.5% DI	SD	DI (Ml/d)	2.5% DI	SD	DI (Ml/d)	2.5% DI	SD	DI (Ml/d)	2.5% DI	SD
2015/16	143.9	3.6	1.8	215.2	5.4	2.7	76.9	1.9	1.0	145.5	3.6	1.9	195.0	4.9	2.5
2016/17	145.4	3.6	1.9	217.8	5.4	2.8	78.8	2.0	1.0	146.3	3.7	1.9	193.2	4.8	2.5
2017/18	144.2	3.6	1.8	216	5.4	2.8	78.3	2.0	1.0	146.2	3.7	1.9	193.2	4.8	2.5
2018/19	143.8	3.6	1.8	215	5.4	2.7	78	2.0	1.0	146.2	3.7	1.9	193.2	4.8	2.5
2019/20	143.7	3.6	1.8	214.6	5.4	2.7	77.9	1.9	1.0	146.1	3.7	1.9	193.3	4.8	2.5
2020/21	143.8	3.6	1.8	214.2	5.4	2.7	77.8	1.9	1.0	146.1	3.7	1.9	193.4	4.8	2.5
2021/22	143.9	3.6	1.8	214	5.4	2.7	77.7	1.9	1.0	146.2	3.7	1.9	193.5	4.8	2.5
2022/23	144.1	3.6	1.8	213.8	5.3	2.7	77.7	1.9	1.0	146.2	3.7	1.9	193.6	4.8	2.5
2023/24	144.4	3.6	1.8	213.7	5.3	2.7	77.7	1.9	1.0	146.3	3.7	1.9	193.8	4.9	2.5
2024/25	144.6	3.6	1.8	213.6	5.3	2.7	77.8	1.9	1.0	146.4	3.7	1.9	194.0	4.9	2.5
2025/26	145	3.6	1.8	213.6	5.3	2.7	77.8	1.9	1.0	146.5	3.7	1.9	194.2	4.9	2.5
2026/27	145.4	3.6	1.9	213.7	5.3	2.7	77.9	1.9	1.0	146.6	3.7	1.9	194.5	4.9	2.5
2027/28	145.8	3.6	1.9	213.7	5.3	2.7	78.1	2.0	1.0	146.7	3.7	1.9	194.7	4.9	2.5
2028/29	146.1	3.7	1.9	213.9	5.3	2.7	78.2	2.0	1.0	146.9	3.7	1.9	195.0	4.9	2.5
2029/30	146.2	3.7	1.9	214.2	5.4	2.7	78.3	2.0	1.0	147.1	3.7	1.9	195.4	4.9	2.5
2030/31	146.4	3.7	1.9	214.3	5.4	2.7	78.4	2.0	1.0	147.2	3.7	1.9	195.6	4.9	2.5
2031/32	147	3.7	1.9	214.2	5.4	2.7	78.5	2.0	1.0	147.3	3.7	1.9	195.8	4.9	2.5
2032/33	147.6	3.7	1.9	214	5.4	2.7	78.6	2.0	1.0	147.4	3.7	1.9	196.0	4.9	2.5
2033/34	147.8	3.7	1.9	214	5.4	2.7	78.7	2.0	1.0	147.5	3.7	1.9	196.2	4.9	2.5
2034/35	148	3.7	1.9	213.9	5.3	2.7	78.9	2.0	1.0	147.6	3.7	1.9	196.5	4.9	2.5
2035/36	148.2	3.7	1.9	213.9	5.3	2.7	79	2.0	1.0	147.7	3.7	1.9	196.7	4.9	2.5
2036/37	148.3	3.7	1.9	213.8	5.3	2.7	79.2	2.0	1.0	147.8	3.7	1.9	196.9	4.9	2.5
2037/38	148.5	3.7	1.9	213.8	5.3	2.7	79.3	2.0	1.0	147.9	3.7	1.9	197.1	4.9	2.5
2038/39	148.7	3.7	1.9	213.8	5.3	2.7	79.5	2.0	1.0	148.0	3.7	1.9	197.3	4.9	2.5
2039/40	148.8	3.7	1.9	213.8	5.3	2.7	79.6	2.0	1.0	148.1	3.7	1.9	197.6	4.9	2.5
2040/41	149	3.7	1.9	213.8	5.3	2.7	79.7	2.0	1.0	148.2	3.7	1.9	197.8	5.0	2.5
2041/42	149.2	3.7	1.9	213.8	5.3	2.7	79.9	2.0	1.0	148.4	3.7	1.9	198.1	5.0	2.5
2042/43	149.4	3.7	1.9	213.8	5.3	2.7	80	2.0	1.0	148.5	3.7	1.9	198.3	5.0	2.5
2043/44	149.6	3.7	1.9	213.8	5.3	2.7	80.1	2.0	1.0	148.6	3.7	1.9	198.6	5.0	2.5
2044/45	149.8	3.7	1.9	213.9	5.3	2.7	80.2	2.0	1.0	148.8	3.7	1.9	198.8	5.0	2.5

3.11 D2 Demand forecast variation

A triangular distribution has been used to express the probability distribution, starting with zero forecast variation in 2015/16 and leading linearly to an assumed error of ±15% at the end of the planning period. The Min and Max values are shown in

Table 3-6 however the most likely is not shown as it is zero for all WRZ's across all the years. This approach is consistent with WRMP14.

Table 3-6: D2 headroom uncertainty probability distribution summary data for all WRZ's

	Colliford			Roadford			Wimbleball			Bournemouth DYAA			Bournemouth DYCP		
Year	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max
2015/16	143.9	0.0	0.0	215.2	0.0	0.0	76.9	0.0	0.0	145.5	0.0	0.0	195.0	0.0	0.0
2016/17	145.4	-0.8	0.8	217.8	-1.1	1.1	78.8	-0.4	0.4	146.3	-0.8	0.8	193.2	-1.0	1.0
2017/18	144.2	-1.5	1.5	216	-2.2	2.2	78.3	-0.8	0.8	146.2	-1.5	1.5	193.2	-2.1	2.1
2018/19	143.8	-2.3	2.3	215	-3.3	3.3	78	-1.2	1.2	146.2	-2.3	2.3	193.2	-3.1	3.1
2019/20	143.7	-3.1	3.1	214.6	-4.4	4.4	77.9	-1.7	1.7	146.1	-3.1	3.1	193.3	-4.1	4.1
2020/21	143.8	-3.9	3.9	214.2	-5.5	5.5	77.8	-2.1	2.1	146.1	-3.8	3.8	193.4	-5.2	5.2
2021/22	143.9	-4.6	4.6	214	-6.6	6.6	77.7	-2.5	2.5	146.2	-4.6	4.6	193.5	-6.2	6.2
2022/23	144.1	-5.4	5.4	213.8	-7.7	7.7	77.7	-2.9	2.9	146.2	-5.4	5.4	193.6	-7.2	7.2
2023/24	144.4	-6.2	6.2	213.7	-8.9	8.9	77.7	-3.3	3.3	146.3	-6.2	6.2	193.8	-8.2	8.2
2024/25	144.6	-7.0	7.0	213.6	-10.0	10.0	77.8	-3.7	3.7	146.4	-6.9	6.9	194.0	-9.3	9.3
2025/26	145	-7.7	7.7	213.6	-11.1	11.1	77.8	-4.1	4.1	146.5	-7.7	7.7	194.2	-10.3	10.3
2026/27	145.4	-8.5	8.5	213.7	-12.2	12.2	77.9	-4.6	4.6	146.6	-8.5	8.5	194.5	-11.3	11.3
2027/28	145.8	-9.3	9.3	213.7	-13.3	13.3	78.1	-5.0	5.0	146.7	-9.2	9.2	194.7	-12.4	12.4
2028/29	146.1	-10.1	10.1	213.9	-14.4	14.4	78.2	-5.4	5.4	146.9	-10.0	10.0	195.0	-13.4	13.4
2029/30	146.2	-10.8	10.8	214.2	-15.5	15.5	78.3	-5.8	5.8	147.1	-10.8	10.8	195.4	-14.4	14.4
2030/31	146.4	-11.6	11.6	214.3	-16.6	16.6	78.4	-6.2	6.2	147.2	-11.5	11.5	195.6	-15.5	15.5
2031/32	147	-12.4	12.4	214.2	-17.7	17.7	78.5	-6.6	6.6	147.3	-12.3	12.3	195.8	-16.5	16.5
2032/33	147.6	-13.2	13.2	214	-18.8	18.8	78.6	-7.1	7.1	147.4	-13.1	13.1	196.0	-17.5	17.5
2033/34	147.8	-13.9	13.9	214	-19.9	19.9	78.7	-7.5	7.5	147.5	-13.9	13.9	196.2	-18.5	18.5
2034/35	148	-14.7	14.7	213.9	-21.0	21.0	78.9	-7.9	7.9	147.6	-14.6	14.6	196.5	-19.6	19.6
2035/36	148.2	-15.5	15.5	213.9	-22.1	22.1	79	-8.3	8.3	147.7	-15.4	15.4	196.7	-20.6	20.6
2036/37	148.3	-16.3	16.3	213.8	-23.2	23.2	79.2	-8.7	8.7	147.8	-16.2	16.2	196.9	-21.6	21.6
2037/38	148.5	-17.0	17.0	213.8	-24.3	24.3	79.3	-9.1	9.1	147.9	-16.9	16.9	197.1	-22.7	22.7
2038/39	148.7	-17.8	17.8	213.8	-25.4	25.4	79.5	-9.5	9.5	148	-17.7	17.7	197.3	-23.7	23.7
2039/40	148.8	-18.6	18.6	213.8	-26.6	26.6	79.6	-10.0	10.0	148.1	-18.5	18.5	197.6	-24.7	24.7
2040/41	149	-19.4	19.4	213.8	-27.7	27.7	79.7	-10.4	10.4	148.2	-19.2	19.2	197.8	-25.8	25.8
2041/42	149.2	-20.1	20.1	213.8	-28.8	28.8	79.9	-10.8	10.8	148.4	-20.0	20.0	198.1	-26.8	26.8
2042/43	149.4	-20.9	20.9	213.8	-29.9	29.9	80	-11.2	11.2	148.5	-20.8	20.8	198.3	-27.8	27.8
2043/44	149.6	-21.7	21.7	213.8	-31.0	31.0	80.1	-11.6	11.6	148.6	-21.6	21.6	198.6	-28.8	28.8
2044/45	149.8	-22.5	22.5	213.9	-32.1	32.1	80.2	-12.0	12.0	148.8	-22.3	22.3	198.8	-29.9	29.9

3.12 D3 Impact of climate change on demand

Demand forecasts conducted by SWW suggest an increase in consumption of due to climate change of 0.71% in Colliford, 0.74% in Roadford, 0.72% in Wimbleball and 0.54% in Bournemouth by 2044/45. A potential variation of ±20% has been assumed and a triangular distribution was used to represent the uncertainty. This differs from WRMP14 which assumed a 1% increase in consumption due to climate change by the end of the planning period.

Table 3-7: D3 headroom uncertainty probability distribution summary data for all WRZ's

	Colliford			Roadford			Wimbleball			Bournemouth DYAA			Bournemouth DYCP		
Year	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max
2015/16	143.9	0.0	0.0	215.2	0.0	0.0	76.9	0.0	0.0	145.5	0.0	0.0	195.0	0.0	0.0
2016/17	145.4	0.0	0.0	217.8	0.0	0.0	78.8	0.0	0.0	146.3	0.0	0.0	193.2	0.0	0.0
2017/18	144.2	0.0	0.0	216.0	0.0	0.0	78.3	0.0	0.0	146.2	0.0	0.0	193.2	0.0	0.0
2018/19	143.8	0.0	0.0	215.0	0.0	0.0	78.0	0.0	0.0	146.2	0.0	0.0	193.2	0.0	0.0
2019/20	143.7	0.0	0.0	214.6	0.0	0.0	77.9	0.0	0.0	146.1	0.0	0.0	193.3	0.0	0.0
2020/21	143.8	0.0	0.0	214.2	-0.1	0.1	77.8	0.0	0.0	146.1	0.0	0.0	193.4	0.0	0.0
2021/22	143.9	0.0	0.0	214.0	-0.1	0.1	77.7	0.0	0.0	146.2	0.0	0.0	193.5	0.0	0.0
2022/23	144.1	-0.1	0.1	213.8	-0.1	0.1	77.7	0.0	0.0	146.2	0.0	0.0	193.6	-0.1	0.1
2023/24	144.4	-0.1	0.1	213.7	-0.1	0.1	77.7	0.0	0.0	146.3	0.0	0.0	193.8	-0.1	0.1
2024/25	144.6	-0.1	0.1	213.6	-0.1	0.1	77.8	0.0	0.0	146.4	-0.1	0.1	194.0	-0.1	0.1
2025/26	145.0	-0.1	0.1	213.6	-0.1	0.1	77.8	0.0	0.0	146.5	-0.1	0.1	194.2	-0.1	0.1
2026/27	145.4	-0.1	0.1	213.7	-0.1	0.1	77.9	0.0	0.0	146.6	-0.1	0.1	194.5	-0.1	0.1
2027/28	145.8	-0.1	0.1	213.7	-0.1	0.1	78.1	-0.1	0.1	146.7	-0.1	0.1	194.7	-0.1	0.1
2028/29	146.1	-0.1	0.1	213.9	-0.1	0.1	78.2	-0.1	0.1	146.9	-0.1	0.1	195.0	-0.1	0.1
2029/30	146.2	-0.1	0.1	214.2	-0.2	0.2	78.3	-0.1	0.1	147.1	-0.1	0.1	195.4	-0.1	0.1
2030/31	146.4	-0.1	0.1	214.3	-0.2	0.2	78.4	-0.1	0.1	147.2	-0.1	0.1	195.6	-0.1	0.1
2031/32	147.0	-0.1	0.1	214.2	-0.2	0.2	78.5	-0.1	0.1	147.3	-0.1	0.1	195.8	-0.1	0.1
2032/33	147.6	-0.1	0.1	214.0	-0.2	0.2	78.6	-0.1	0.1	147.4	-0.1	0.1	196.0	-0.1	0.1
2033/34	147.8	-0.1	0.1	214.0	-0.2	0.2	78.7	-0.1	0.1	147.5	-0.1	0.1	196.2	-0.1	0.1
2034/35	148.0	-0.1	0.1	213.9	-0.2	0.2	78.9	-0.1	0.1	147.6	-0.1	0.1	196.5	-0.1	0.1
2035/36	148.2	-0.2	0.2	213.9	-0.2	0.2	79.0	-0.1	0.1	147.7	-0.1	0.1	196.7	-0.1	0.1
2036/37	148.3	-0.2	0.2	213.8	-0.2	0.2	79.2	-0.1	0.1	147.8	-0.1	0.1	196.9	-0.2	0.2
2037/38	148.5	-0.2	0.2	213.8	-0.2	0.2	79.3	-0.1	0.1	147.9	-0.1	0.1	197.1	-0.2	0.2
2038/39	148.7	-0.2	0.2	213.8	-0.3	0.3	79.5	-0.1	0.1	148.0	-0.1	0.1	197.3	-0.2	0.2
2039/40	148.8	-0.2	0.2	213.8	-0.3	0.3	79.6	-0.1	0.1	148.1	-0.1	0.1	197.6	-0.2	0.2
2040/41	149.0	-0.2	0.2	213.8	-0.3	0.3	79.7	-0.1	0.1	148.2	-0.1	0.1	197.8	-0.2	0.2
2041/42	149.2	-0.2	0.2	213.8	-0.3	0.3	79.9	-0.1	0.1	148.4	-0.1	0.1	198.1	-0.2	0.2
2042/43	149.4	-0.2	0.2	213.8	-0.3	0.3	80.0	-0.1	0.1	148.5	-0.2	0.2	198.3	-0.2	0.2
2043/44	149.6	-0.2	0.2	213.8	-0.3	0.3	80.1	-0.1	0.1	148.6	-0.2	0.2	198.6	-0.2	0.2
2044/45	149.8	-0.2	0.2	213.9	-0.3	0.3	80.2	-0.1	0.1	148.8	-0.2	0.2	198.8	-0.2	0.2

3.13 D4 Demand management measures

An assumption has been made by SWW that demand management measures will save 0.75 Ml/d every year throughout the planning period. The savings have been estimated on a pro rata basis of forecast DI between the four WRZs (Table 3-8), by adopting a triangular distribution with the most likely outcome that the savings will be made (i.e. an uncertainty of 0) and an allowance of ±10%. The minimum and maximum values are shown in Table 3-9 however the most likely is not shown as it is zero for all WRZ's across all the years. This approach is consistent with WRMP14.

Table 3-8: Distribution of demand management savings across the WRZ's

WRZ	2015/2016 DI (Ml/d)	Ratio	Demand management savings Ml/d per year
Colliford	143.9	0.25	0.19
Roadford	215.2	0.37	0.28
Wimbleball	76.9	0.13	0.10
Bournemouth	145.5	0.25	0.19
Total	**581.5**	**1.00**	**0.75**

Table 3-9: D4 headroom uncertainty probability distribution summary data for all WRZ's

	Colliford			Roadford			Wimbleball			Bournemouth DYAA			Bournemouth DYCP		
Year	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max	DI (Ml/d)	Min	Max
2015/16	143.9	0.0	0.0	215.2	0.0	0.0	76.9	0.0	0.0	145.5	0.0	0.0	195.0	0.0	0.0
2016/17	145.4	0.0	0.0	217.8	0.0	0.0	78.8	0.0	0.0	146.3	0.0	0.0	193.2	0.0	0.0
2017/18	144.2	0.0	0.0	216.0	-0.1	0.1	78.3	0.0	0.0	146.2	0.0	0.0	193.2	0.0	0.0
2018/19	143.8	-0.1	0.1	215.0	-0.1	0.1	78.0	0.0	0.0	146.2	-0.1	0.1	193.2	-0.1	0.1
2019/20	143.7	-0.1	0.1	214.6	-0.1	0.1	77.9	0.0	0.0	146.1	-0.1	0.1	193.3	-0.1	0.1
2020/21	143.8	-0.1	0.1	214.2	-0.1	0.1	77.8	-0.1	0.1	146.1	-0.1	0.1	193.4	-0.1	0.1
2021/22	143.9	-0.1	0.1	214.0	-0.2	0.2	77.7	-0.1	0.1	146.2	-0.1	0.1	193.5	-0.1	0.1
2022/23	144.1	-0.1	0.1	213.8	-0.2	0.2	77.7	-0.1	0.1	146.2	-0.1	0.1	193.6	-0.1	0.1
2023/24	144.4	-0.2	0.2	213.7	-0.2	0.2	77.7	-0.1	0.1	146.3	-0.2	0.2	193.8	-0.2	0.2
2024/25	144.6	-0.2	0.2	213.6	-0.3	0.3	77.8	-0.1	0.1	146.4	-0.2	0.2	194.0	-0.2	0.2
2025/26	145.0	-0.2	0.2	213.6	-0.3	0.3	77.8	-0.1	0.1	146.5	-0.2	0.2	194.2	-0.2	0.2
2026/27	145.4	-0.2	0.2	213.7	-0.3	0.3	77.9	-0.1	0.1	146.6	-0.2	0.2	194.5	-0.2	0.2
2027/28	145.8	-0.2	0.2	213.7	-0.3	0.3	78.1	-0.1	0.1	146.7	-0.2	0.2	194.7	-0.2	0.2
2028/29	146.1	-0.2	0.2	213.9	-0.4	0.4	78.2	-0.1	0.1	146.9	-0.2	0.2	195.0	-0.2	0.2
2029/30	146.2	-0.3	0.3	214.2	-0.4	0.4	78.3	-0.1	0.1	147.1	-0.3	0.3	195.4	-0.3	0.3
2030/31	146.4	-0.3	0.3	214.3	-0.4	0.4	78.4	-0.2	0.2	147.2	-0.3	0.3	195.6	-0.3	0.3
2031/32	147.0	-0.3	0.3	214.2	-0.4	0.4	78.5	-0.2	0.2	147.3	-0.3	0.3	195.8	-0.3	0.3
2032/33	147.6	-0.3	0.3	214.0	-0.5	0.5	78.6	-0.2	0.2	147.4	-0.3	0.3	196.0	-0.3	0.3
2033/34	147.8	-0.3	0.3	214.0	-0.5	0.5	78.7	-0.2	0.2	147.5	-0.3	0.3	196.2	-0.3	0.3
2034/35	148.0	-0.4	0.4	213.9	-0.5	0.5	78.9	-0.2	0.2	147.6	-0.4	0.4	196.5	-0.4	0.4
2035/36	148.2	-0.4	0.4	213.9	-0.6	0.6	79.0	-0.2	0.2	147.7	-0.4	0.4	196.7	-0.4	0.4
2036/37	148.3	-0.4	0.4	213.8	-0.6	0.6	79.2	-0.2	0.2	147.8	-0.4	0.4	196.9	-0.4	0.4
2037/38	148.5	-0.4	0.4	213.8	-0.6	0.6	79.3	-0.2	0.2	147.9	-0.4	0.4	197.1	-0.4	0.4
2038/39	148.7	-0.4	0.4	213.8	-0.6	0.6	79.5	-0.2	0.2	148.0	-0.4	0.4	197.3	-0.4	0.4
2039/40	148.8	-0.5	0.5	213.8	-0.7	0.7	79.6	-0.2	0.2	148.1	-0.5	0.5	197.6	-0.5	0.5
2040/41	149.0	-0.5	0.5	213.8	-0.7	0.7	79.7	-0.3	0.3	148.2	-0.5	0.5	197.8	-0.5	0.5
2041/42	149.2	-0.5	0.5	213.8	-0.7	0.7	79.9	-0.3	0.3	148.4	-0.5	0.5	198.1	-0.5	0.5
2042/43	149.4	-0.5	0.5	213.8	-0.8	0.8	80.0	-0.3	0.3	148.5	-0.5	0.5	198.3	-0.5	0.5
2043/44	149.6	-0.5	0.5	213.8	-0.8	0.8	80.1	-0.3	0.3	148.6	-0.5	0.5	198.6	-0.5	0.5
2044/45	149.8	-0.5	0.5	213.9	-0.8	0.8	80.2	-0.3	0.3	148.8	-0.5	0.5	198.8	-0.5	0.5

3.14 Relationship between headroom components

Interdependencies between uncertainty factors have been incorporated within the Monte Carlo analysis. Interdependency is where the sampled value of one probability distribution is not completely independent of the value of another, i.e. there is some relationship between the two variables. The only interdependency identified in this assessment is between the impact of climate change on WAFU and on demand, i.e. the greater the increase in demand due to climate change, the greater the reduction in WAFU (both of which impacts have a positive effect on the calculated headroom allowance). This has been modelled by setting a positive correlation between the probability distribution functions for factor S8 and factor D3 respectively, in each year across the planning horizon.

3.15 Summary of key changes in assumptions from WRMP14

This assessment is consistent with WRMP14 in all categories except for the impact of climate change on WAFU (S8). There has been a change in the methodology for estimating the impact of climate change on WAFU (including uncertainty) since WRMP14. Previously, UKCP09 monthly flow factors were used to obtain "dry" and "wet" predictions, which were used to give an estimate of uncertainty to include in the headroom. The Environment Agency's *Estimating impacts of climate change on water supply* (June 2017) specifies that where a WRZ is classified as Low Vulnerability and rainfall-runoff models are available, a "Tier 2" analysis should be undertaken as a minimum. Although some rainfall runoff models are available for groundwater modelling, there are none available for surface water modelling, and since 90% of SWW resources are surface water, a Tier 1 analysis has been adopted. This assessment therefore used a dataset consisting of 11 equally likely scenarios of climate to 2085/2086 (Future Flows hydrology monthly change factors), to determine the minimum, mean and maximum climate change impacts on WAFU.

For WRMP14, separate headroom assessments were carried out by BW and SWW; however this assessment combines the two regions to produce one headroom allowance assessment. Bournemouth has been included as a WRZ in this assessment, and the headroom assessment methodology and assumptions have been aligned with the SWW approach as demonstrated in Table 3-1.

4. Results

4.1 Target headroom allowance

The results of the probabilistic assessment is summarised in Table 4-1 below (the full results from @RISK spreadsheet is contained in Appendix A), which shows the target headroom for the WRZ's at the end of the planning period. The DYCP is only assessed for Bournemouth WRZ. This is because the nature of WAFU constraints in the other WRZ's means that a DYCP analysis is not required.

Table 4-1: Target headroom (Ml/d) at the end of the planning period (2044/45)

WRZ	Probability								
	55%	60%	65%	70%	75%	80%	85%*	90%	95%*
Colliford WRZ (Ml/d)	0.79	2.59	4.44	6.49	8.45	10.74	**13.31**	16.62	21.07
Roadford WRZ (Ml/d)	2.13	4.58	7.23	9.99	12.78	16.16	**19.90**	24.68	31.73
Wimbleball WRZ (Ml/d)	0.49	1.41	2.30	3.33	4.42	5.73	**7.15**	9.04	11.65
Bournemouth WRZ DYAA (Ml/d)	1.76	3.58	5.55	7.63	9.90	12.12	**14.89**	18.53	23.39
Bournemouth WRZ DYCP (Ml/d)	2.27	4.69	7.10	9.78	12.44	15.30	**18.71**	22.67	29.10

** Risk Percentile to be used at the end of the planning period*

4.2 Risk profile

The company headroom values presented in Table 4-2 below vary according to the selected probability point on each combined headroom distribution from which these values are taken. In order to determine a single profile of target headroom allowance across the 25-year planning period, for each planning scenario, it is necessary to select the appropriate level of risk on which to base the target headroom allowance for each year. SWW can then incorporate the corresponding headroom value into its supply-demand balance across the planning period.

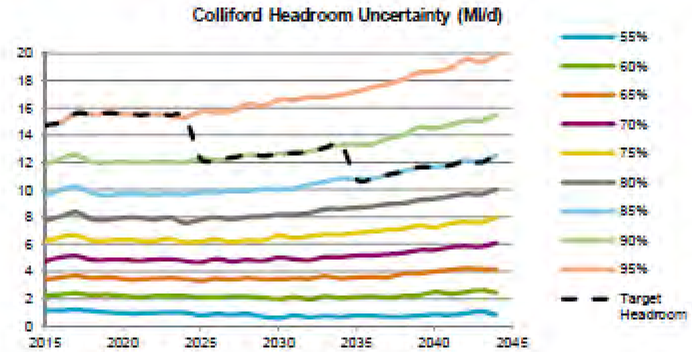
For WRMP14 the risk profile chosen was the 85th percentile at the start of the planning period, falling to the 70th by the end of the planning period. In its 2020 Direction, OFWAT has instructed companies to use 95% uncertainty (or equivalent for complex methods) for the first five years of the planning period forecasts. The level of acceptable risk was therefore determined to be 95% in the beginning of the planning period, falling to 85% at the end of the planning period. This was considered to be most appropriate in order to ensure the headroom is not so large that it drives unnecessary expenditure, and not too small that it leaves the possibility that the planned level of service cannot be met. A higher level of risk is more acceptable in the future than in the early years (first 5 years) because as time progresses, the uncertainties for which headroom allows reduce and there is more time to adapt to any changes. This is in line with the Environment Agency's WRPG (April 2017), which promotes the use of a glide path approach.

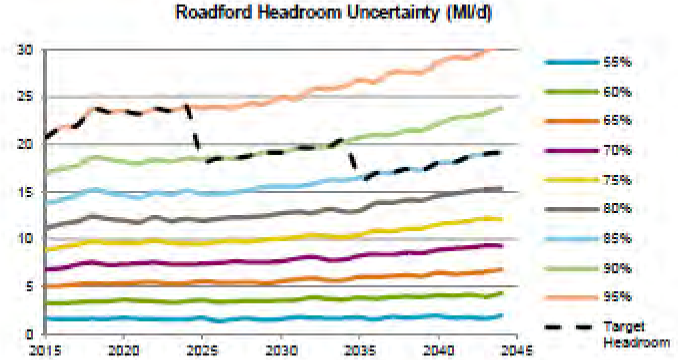
Table 4-2 dWRMP19 Target headroom risk profile

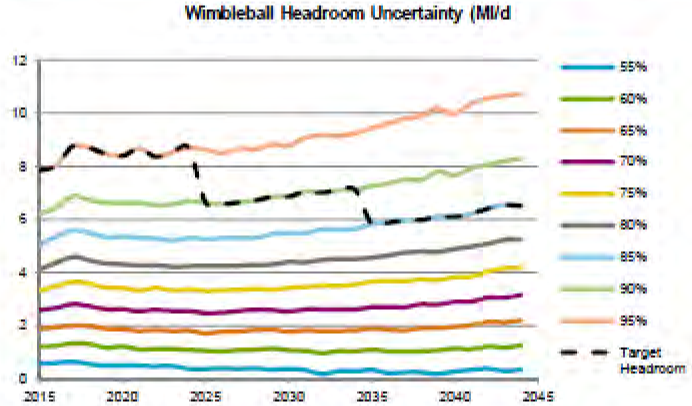
Component	2020/21 - 2024/25	2025/26 - 2029/30	2030/31 - 2034/35	2035/36 - 2039/40	2040/41 – 2044/45
Risk of variation (reduced surplus/ increased deficit) in the supply-demand balance	5%	10%	10%	15%	15%
Headroom distribution probability	95%	90%	90%	85%	85%

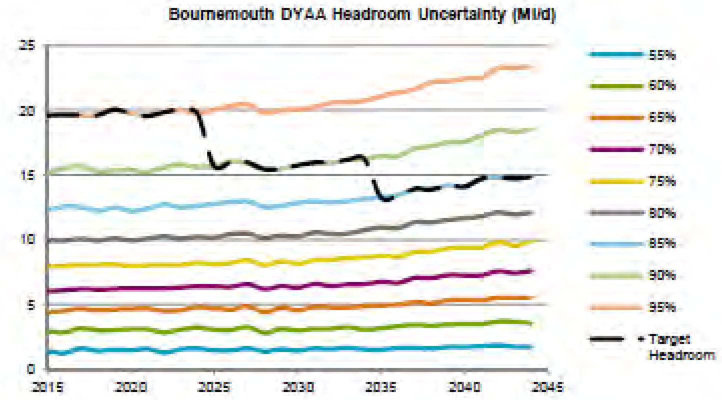
Figure 4-1 below summarises how the headroom uncertainty varies over time in each WRZ as well as the target headroom based on the acceptable level of risk over the planning period. It can be seen that generally the uncertainty increases with time; however the glide path approach means that the headroom allowance is actually lower at the end of the planning period than it is at the start. This is because a lower level of risk is acceptable in the early years (hence using the 95th percentile value) as there is little time to react and implement mitigation measures, while in the longer term there is more time to implement appropriate measures and so a higher level of risk is acceptable (85th percentile).

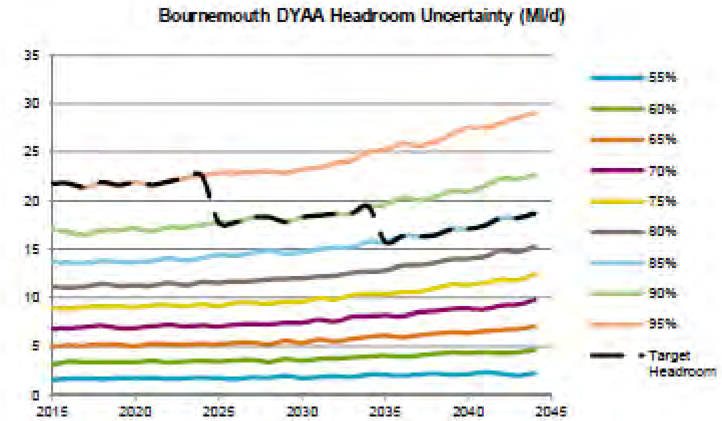
Figure 4-1: Target headroom risk profile







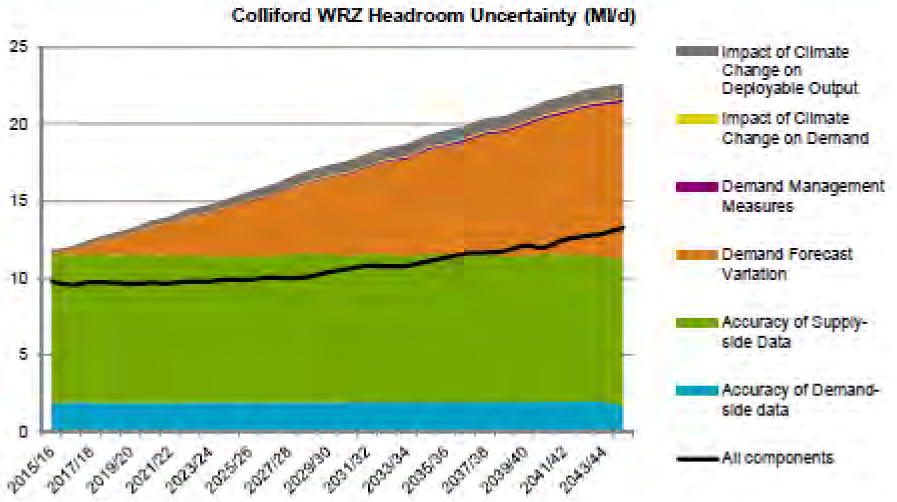


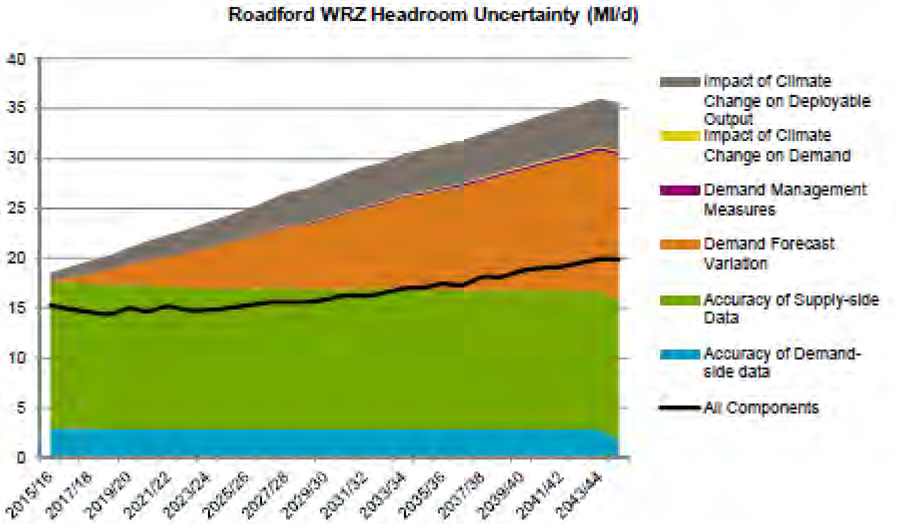


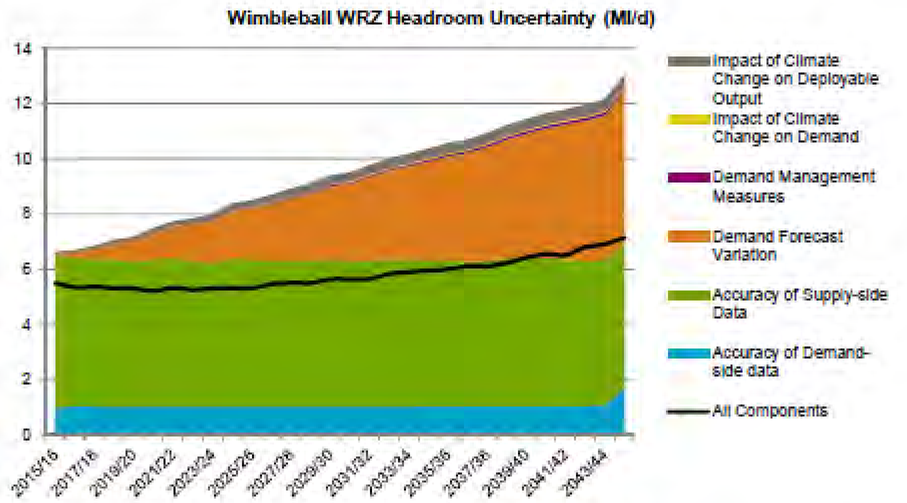
4.3 Headroom by uncertainty factor

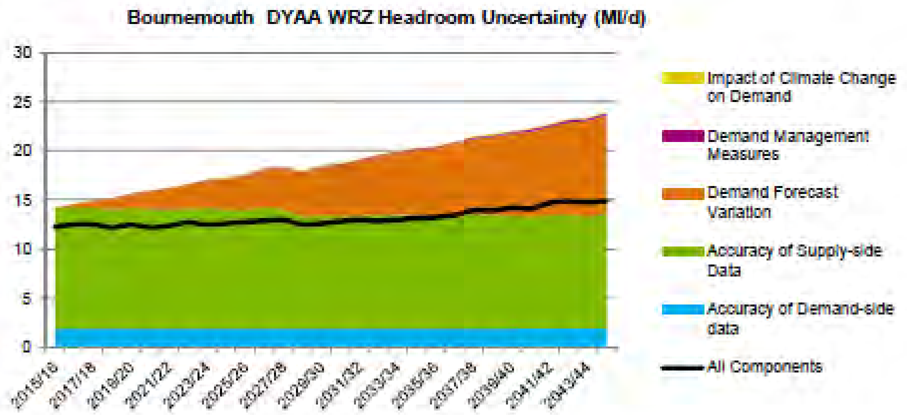
The relative contribution of the different components of the target headroom assessment is shown in Figure 4-2 below. It should be noted that the sum of the different categories do not match the target headroom. This is because the sum of the individual categories does not provide a statistically correct percentile impact for the overall target headroom. The sum of all these components' results is greater than the overall target headroom result, because statistically, the probability of all components experiencing the same percentile impact simultaneously is much smaller than a single headroom component experiencing a particular percentile impact. By using @Risk to sum all the categories within the model runs, the sums are done during each iteration of the model and therefore the target headroom allowance is lower than the sum of the individual categories.

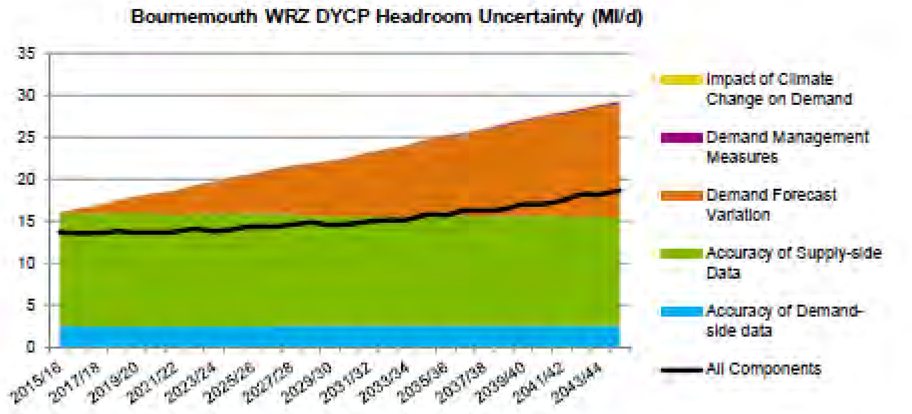
Figure 4-2: Relative contribution of the different categories to the target headroom at the 85th percentile






Wimbleball WRZ Headroom Uncertainty (Ml/d)
Impact of Climate Change on Deployable Output
Impact of Climate Change on Demand
Demand Management Measures
Demand Forecast Variation
Accuracy of Supply-side Data
Accuracy of Demand-side data
All Components

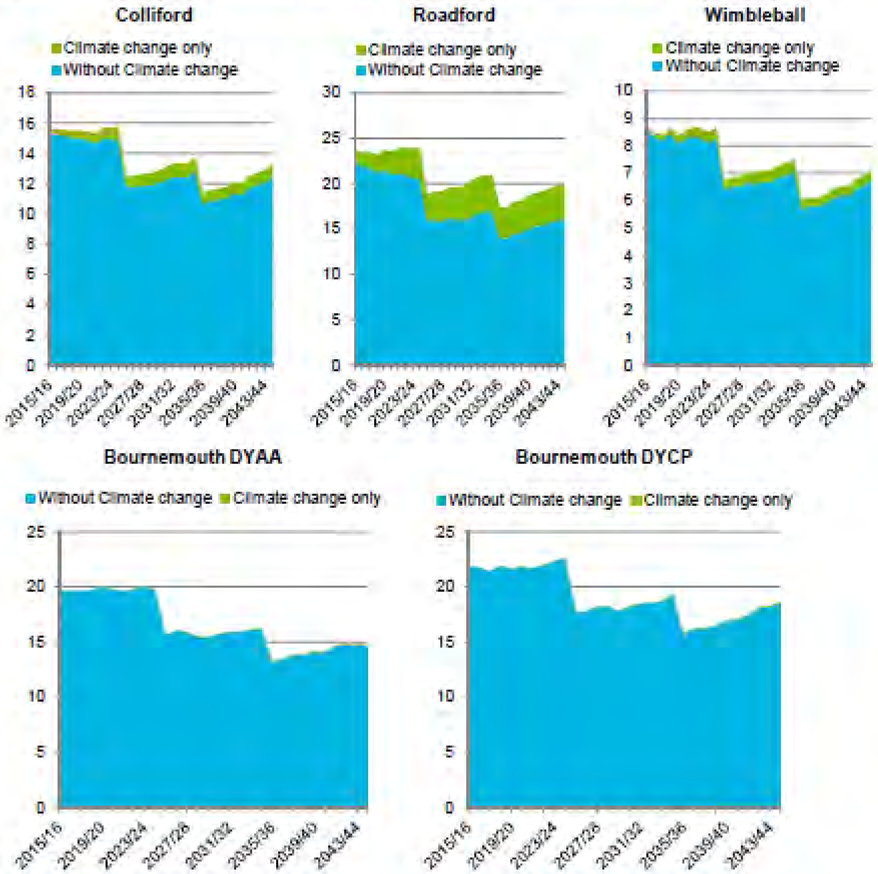

Bournemouth DYAA WRZ Headroom Uncertainty (Ml/d)
Impact of Climate Change on Demand
Demand Management Measures
Demand Forecast Variation
Accuracy of Supply-side Data
Accuracy of Demand-side data
All Components


Bournemouth WRZ DYCP Headroom Uncertainty (Ml/d)
Impact of Climate Change on Demand
Demand Management Measures
Demand Forecast Variation
Accuracy of Supply-side Data
Accuracy of Demand-side data
All Components

4.4 Impact of climate change on the target headroom

The impact of climate change on the target headroom allowance has been assessed separately in accordance with the Environment Agency's WRPG (April 2017). The full results can be found in Appendix B and a summary of the results is shown in Figure 4-3. The impact of climate change on the headroom allowance is largest in Roadford WRZ; however as shown in Figure 4-2, the overall contribution of the climate change components is relatively small when compared to the other components in all WRZ's. It can also be seen that the impact of climate change on WAFU has a larger contribution to the headroom allowance than the impact of climate change on demand in Colliford, Roadford and Wimbleball WRZ's. The impact of climate change in Bournemouth WRZ is very limited since there is no impact on the WAFU, only an impact of climate change on demand.

Figure 4-3: Estimated contribution (Ml/day) of climate change (green) to total headroom



4.5 Overall assessment of results

Details on how the different factors contribute to uncertainty and hence the headroom allowance can be found in Appendix C. The uncertainty associated with the impact of climate and catchment characteristics on surface waters (S6/4) has the largest contribution to the headroom allowance across the whole planning period. As the forecast moves further into the future, uncertainties associated with the demand forecast variation and the impact of climate change on WAFU also increase. Uncertainties associated with demand management measures and impact of climate change on demand also start to contribute to the headroom allowance towards the end of the planning period, however the contribution of these components is small.

4.6 Comparison with WRMP14

The results of the dWRMP19 assessment are compared with WMP14 in Table 4-3 below. It should be noted that in WRMP14 the risk profile chosen was the 85th percentile at the start of the planning period, falling to the 70th by the end of the planning period. The chosen risk profile for this assessment is therefore uncertainties at the 95th percentile at the start of the planning period, falling to the 85th percentile by the end of the planning period. The WRMP14 results presented in Table 4-3 are therefore not the headroom allowance in WRMP14 (which used different percentiles), but the values for the 95th and 85th percentiles, in order to provide a like for like comparison.

It can be seen that the headroom allowance for Bournemouth WRZ is significantly higher than in WRMP14. This is mainly because the WRMP14 assessment for Bournemouth did not take into account S6/4 as all their sources are licence constrained and therefore they assumed that they did not need to include this component. Following discussions with SWW, it was decided that this approach was not appropriate in this assessment, as the purpose of the S6/4 component is to estimate uncertainty in river flow measurement, regardless of whether the supply is considered to be sufficient. This combined with an increase in the uncertainty factors for S6/2 and D2 have resulted in a higher headroom allowance, since these three components have the largest impact on the headroom allowance as shown in Appendix C.

Table 4-3: SWW headroom allowance summary and comparison with previous results

WRZ	Headroom allowance (Ml/d) in WRMP14		Headroom allowance (Ml/d) in dWRMP19	
	Start of planning period (95th Perc)	End of planning period (85th Perc)	Start of planning period (95th Perc)	End of planning period (85th Perc)
Colliford	15.53	15.50	15.53	13.31
Roadford	23.72	21.52	23.72	19.90
Wimbleball	6.66	7.50	8.71	7.15
Bournemouth (DYAA)*	2.4	3.9	19.61	14.89
Bournemouth (DYCP)*	2.8	5.5	21.8	18.71

**Only results from the 90th Perc were available for Bournemouth WRZ headroom allowance*

Overall the headroom allowance at the start of the planning period is identical to the WRMP14 allowance for Colliford and Roadford, and is similar for Wimbleball. The allowance at the end of the planning period however is lower than WRMP14 for these WRZ's. This is because the impact of climate change on the headroom allowance is much lower in this assessment than in WRMP14, as shown in Table 4-4. This is likely due to the change in the methodology for estimating the impact of climate change on WAFU (including uncertainty) since WRMP14.

Table 4-4: Comparison of the impact of climate change on the headroom allowance between WRMP14 and dWRMP19

WRZ	Estimated impact of climate change on headroom (%)		Estimated impact of climate change on headroom (%)	
	Start of planning period WRMP14	End of planning period WRMP14	Start of planning period dWRMP19	End of planning period dWRMP19
Colliford	4.6	33.1	1.7	6.1
Roadford	3.9	28.7	4.9	19.7
Wimbleball	4.2	31.5	1.5	5.2
Bournemouth (DYAA)	N/a	N/a	0	0.5
Bournemouth (DYCP)	N/a	N/a	0	0.5

5. Conclusions and recommendations

A target headroom allowance assessment for SWW and BW's combined dWRMP19 submission has been prepared. The assessment runs through to 2044/45, and has adopted the latest guidance given by the Environment Agency.

In general, the assumptions made for WRMP14 have been followed through with this assessment. A slight change has taken place for category S8 (the impact of climate change on WAFU) and D3 (the impact of climate change on demand) due to the new methodology for assessing the impact of climate change.

A glide path approach has been adopted, whereby the level of acceptable risk is maintained at 95% for the next AMP period, reducing to 85% at the end of the planning period. This is in line with the latest Environment Agency guidance.

5.1 Recommendations

- The dWRMP19 headroom assessment will need to be updated once the final supply and demand options are agreed.
- Stakeholder comments that arise from the dWRMP19 report should be taken on board for the final WRMP19.
- A final headroom assessment should be completed if EBSD (Economics of Balancing Supply and Demand) modelling indicates the need for new supply options

Appendix A - @Risk Spreadsheet Outputs

A.1 Colliford Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.18	1.13	2.28	3.55	4.87	6.29	7.83	9.79	12.04	15.53
2016/17	-0.07	1.03	2.32	3.59	4.87	6.29	7.81	9.59	12.01	15.64
2017/18	-0.21	0.99	2.24	3.49	4.89	6.34	7.93	9.74	12.06	15.58
2018/19	-0.20	0.96	2.14	3.44	4.80	6.29	7.98	9.74	12.00	15.51
2019/20	-0.24	1.01	2.20	3.50	4.87	6.27	7.81	9.65	12.05	15.54
2020/21	-0.25	1.03	2.24	3.54	4.93	6.40	7.98	9.71	12.05	15.48
2021/22	-0.22	1.01	2.20	3.49	4.79	6.15	7.59	9.69	12.02	15.32
2022/23	-0.38	0.82	2.13	3.34	4.68	6.22	7.82	9.81	12.29	15.73
2023/24	-0.31	0.92	2.14	3.50	4.95	6.36	7.98	9.82	12.20	15.72
2024/25	-0.39	0.86	2.17	3.44	4.75	6.18	7.83	9.93	12.37	15.76
2025/26	-0.36	0.92	2.17	3.54	4.86	6.30	8.02	9.94	12.55	16.29
2026/27	-0.51	0.71	2.12	3.46	4.80	6.30	8.05	10.06	12.49	16.17
2027/28	-0.66	0.62	2.01	3.46	5.05	6.66	8.20	10.04	12.64	16.61
2028/29	-0.45	0.79	2.14	3.51	4.91	6.46	8.20	10.11	12.70	16.57
2029/30	-0.59	0.68	1.99	3.50	4.86	6.61	8.32	10.41	12.80	16.81
2030/31	-0.60	0.75	2.21	3.68	5.10	6.75	8.60	10.61	13.10	16.79
2031/32	-0.66	0.71	2.08	3.51	5.09	6.74	8.61	10.82	13.32	16.97
2032/33	-0.68	0.78	2.15	3.60	5.19	6.85	8.71	10.78	13.35	17.20
2033/34	-0.56	0.77	2.19	3.61	5.20	6.96	8.79	10.82	13.35	17.51
2034/35	-0.63	0.72	2.12	3.60	5.29	7.08	8.96	11.10	13.77	17.75
2035/36	-0.69	0.72	2.21	3.85	5.39	7.15	9.01	11.35	14.01	18.10
2036/37	-0.72	0.78	2.26	3.89	5.58	7.39	9.26	11.65	14.58	18.60
2037/38	-0.62	0.87	2.52	4.03	5.60	7.24	9.35	11.68	14.53	18.66
2038/39	-0.57	0.86	2.40	4.12	5.80	7.55	9.52	11.79	14.75	18.88
2039/40	-0.67	0.94	2.51	4.25	5.87	7.64	9.70	12.14	15.06	19.59
2040/41	-0.50	1.12	2.66	4.19	5.85	7.63	9.68	12.01	15.05	19.35
2041/42	-0.79	0.83	2.45	4.16	6.12	7.98	10.06	12.53	15.51	19.83
2042/43	-0.81	0.82	2.54	4.34	6.14	7.94	10.18	12.74	15.82	20.19
2043/44	-0.72	0.88	2.61	4.30	6.25	8.25	10.36	12.92	16.16	20.79
2044/45	-0.95	0.79	2.59	4.44	6.49	8.45	10.74	13.31	16.62	21.07

A.2 Roadford Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.17	1.66	3.50	5.39	7.57	9.77	12.41	15.30	18.63	23.72
2016/17	-0.20	1.64	3.49	5.32	7.33	9.62	12.14	14.90	18.43	23.44
2017/18	-0.02	1.75	3.65	5.39	7.41	9.61	12.00	14.66	18.21	23.53
2018/19	-0.19	1.63	3.55	5.48	7.47	9.64	11.80	14.38	18.03	23.25
2019/20	-0.23	1.63	3.52	5.52	7.59	9.90	12.34	14.96	18.42	23.78
2020/21	-0.13	1.56	3.36	5.30	7.37	9.61	11.96	14.69	18.23	23.55
2021/22	-0.28	1.56	3.49	5.43	7.40	9.56	12.17	15.17	18.52	24.00
2022/23	-0.03	1.75	3.62	5.61	7.46	9.55	12.00	14.81	18.50	23.92
2023/24	-0.42	1.40	3.42	5.48	7.53	9.75	12.19	14.79	18.58	23.96
2024/25	-0.15	1.63	3.52	5.51	7.68	9.83	12.33	14.98	18.54	23.91
2025/26	-0.27	1.67	3.53	5.52	7.62	9.78	12.36	15.24	18.84	24.36
2026/27	-0.31	1.50	3.55	5.40	7.60	9.97	12.48	15.56	19.17	24.30
2027/28	-0.38	1.62	3.57	5.61	7.71	10.10	12.77	15.58	19.18	25.01
2028/29	-0.18	1.82	3.64	5.79	7.98	10.23	12.89	15.61	19.63	24.76
2029/30	-0.16	1.75	3.91	5.95	8.19	10.47	12.81	15.85	19.66	25.90
2030/31	-0.35	1.69	3.73	5.68	7.82	10.32	13.23	16.26	19.77	25.85
2031/32	-0.33	1.71	3.68	5.72	7.88	10.28	12.93	16.25	20.29	26.14
2032/33	-0.26	1.77	3.88	6.09	8.30	10.50	13.04	16.51	20.79	26.83
2033/34	-0.57	1.57	3.76	6.08	8.45	10.93	13.82	16.99	21.02	26.60
2034/35	-0.26	1.87	3.94	6.12	8.41	10.89	13.88	17.04	21.02	27.62
2035/36	-0.53	1.74	3.99	6.23	8.62	11.11	14.13	17.43	21.52	27.66
2036/37	-0.31	1.86	3.96	6.16	8.58	11.17	14.14	17.33	21.51	27.61
2037/38	-0.32	1.93	4.10	6.52	8.92	11.62	14.62	18.10	22.22	28.71
2038/39	-0.55	1.71	4.04	6.35	9.03	11.75	14.81	18.16	22.79	29.19
2039/40	-0.37	1.80	4.19	6.48	9.16	11.97	15.09	18.75	22.98	29.15
2040/41	-0.56	1.69	3.96	6.61	9.37	12.21	15.26	19.02	23.31	29.90
2041/42	-0.39	1.97	4.36	6.79	9.33	12.11	15.38	19.16	23.84	30.42
2042/43	-0.47	1.82	4.26	6.97	9.54	12.24	15.80	19.54	24.09	30.52
2043/44	-0.50	2.12	4.69	7.16	9.92	12.91	16.03	19.93	24.74	31.43
2044/45	-0.25	2.13	4.58	7.23	9.99	12.78	16.16	19.90	24.68	31.73

A.3 Wimbleball Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.07	0.58	1.33	2.01	2.75	3.60	4.48	5.51	6.74	8.71
2016/17	-0.11	0.52	1.19	1.91	2.64	3.45	4.36	5.35	6.65	8.48
2017/18	-0.12	0.52	1.25	1.88	2.64	3.44	4.33	5.37	6.63	8.40
2018/19	-0.17	0.51	1.13	1.82	2.56	3.34	4.29	5.32	6.64	8.69
2019/20	-0.16	0.49	1.15	1.85	2.62	3.44	4.29	5.31	6.55	8.37
2020/21	-0.20	0.50	1.16	1.82	2.57	3.35	4.24	5.22	6.59	8.55
2021/22	-0.29	0.40	1.11	1.83	2.57	3.39	4.25	5.33	6.69	8.70
2022/23	-0.25	0.40	1.07	1.73	2.49	3.34	4.28	5.27	6.64	8.65
2023/24	-0.25	0.40	1.05	1.80	2.51	3.35	4.27	5.32	6.58	8.50
2024/25	-0.33	0.40	1.10	1.80	2.58	3.37	4.28	5.33	6.66	8.69
2025/26	-0.26	0.41	1.12	1.85	2.61	3.40	4.30	5.32	6.73	8.65
2026/27	-0.28	0.37	1.16	1.87	2.61	3.38	4.33	5.47	6.87	8.84
2027/28	-0.34	0.40	1.10	1.79	2.55	3.43	4.41	5.51	6.88	8.79
2028/29	-0.42	0.36	1.07	1.84	2.63	3.47	4.41	5.51	7.05	9.10
2029/30	-0.48	0.19	0.99	1.80	2.63	3.52	4.49	5.64	7.03	9.18
2030/31	-0.37	0.32	1.06	1.82	2.63	3.51	4.52	5.64	7.11	9.14
2031/32	-0.45	0.31	1.06	1.84	2.63	3.57	4.54	5.66	7.13	9.26
2032/33	-0.45	0.36	1.12	1.91	2.71	3.67	4.58	5.85	7.28	9.44
2033/34	-0.57	0.23	1.06	1.87	2.73	3.70	4.67	5.89	7.37	9.64
2034/35	-0.50	0.27	1.06	1.84	2.71	3.69	4.77	5.97	7.52	9.80
2035/36	-0.49	0.26	1.06	1.93	2.82	3.76	4.80	6.00	7.51	9.91
2036/37	-0.60	0.20	1.09	1.92	2.81	3.73	4.80	6.13	7.63	10.20
2037/38	-0.52	0.30	1.16	1.97	2.92	3.84	4.90	6.12	7.66	9.98
2038/39	-0.50	0.35	1.14	2.04	2.92	3.86	5.00	6.23	7.95	10.38
2039/40	-0.41	0.40	1.24	2.16	3.08	4.06	5.11	6.43	8.08	10.57
2040/41	-0.58	0.31	1.19	2.15	3.07	4.18	5.25	6.56	8.21	10.67
2041/42	-0.54	0.37	1.28	2.21	3.18	4.17	5.27	6.52	8.30	10.71
2042/43	-0.55	0.34	1.22	2.19	3.15	4.27	5.53	6.81	8.46	10.98
2043/44	-0.54	0.44	1.36	2.27	3.26	4.31	5.53	6.92	8.69	11.15
2044/45	-0.43	0.49	1.41	2.30	3.33	4.42	5.73	7.15	9.04	11.65

A.4 Bournemouth DYAA Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.03	1.44	2.95	4.45	6.07	7.96	9.98	12.31	15.16	19.61
2016/17	-0.07	1.28	2.88	4.54	6.11	7.99	9.94	12.56	15.53	19.67
2017/18	0.07	1.64	3.19	4.68	6.23	8.10	10.11	12.55	15.68	19.64
2018/19	-0.17	1.45	3.03	4.58	6.20	8.10	9.95	12.25	15.29	19.64
2019/20	0.07	1.53	3.04	4.62	6.22	8.12	10.14	12.51	15.35	20.07
2020/21	-0.02	1.50	3.11	4.69	6.28	8.00	9.96	12.26	15.39	19.81
2021/22	0.15	1.60	3.11	4.70	6.29	8.05	10.12	12.41	15.27	19.59
2022/23	-0.13	1.32	2.87	4.52	6.28	8.10	10.28	12.75	15.61	19.86
2023/24	0.08	1.58	3.10	4.58	6.33	8.08	10.11	12.53	15.82	20.05
2024/25	-0.09	1.65	3.26	4.81	6.43	8.25	10.25	12.64	15.65	19.76
2025/26	0.00	1.49	3.07	4.72	6.42	8.15	10.20	12.78	15.71	20.03
2026/27	-0.12	1.48	3.06	4.64	6.39	8.25	10.47	12.93	16.05	20.34
2027/28	0.12	1.65	3.29	4.88	6.59	8.44	10.50	12.98	15.97	20.47
2028/29	-0.08	1.41	2.82	4.44	6.22	8.07	10.15	12.55	15.46	19.80
2029/30	0.11	1.56	3.15	4.78	6.45	8.37	10.35	12.65	15.50	20.03
2030/31	-0.06	1.47	3.01	4.58	6.33	8.16	10.27	12.87	15.77	20.07
2031/32	0.08	1.63	3.14	4.84	6.61	8.47	10.58	13.00	15.98	20.26
2032/33	-0.01	1.58	3.16	4.80	6.46	8.47	10.46	12.90	15.95	20.61
2033/34	0.03	1.69	3.29	4.79	6.58	8.62	10.50	13.00	16.20	20.64
2034/35	0.04	1.56	3.09	4.89	6.60	8.65	10.77	13.18	16.24	20.75
2035/36	0.00	1.53	3.19	4.93	6.78	8.81	10.96	13.27	16.48	21.09
2036/37	-0.06	1.68	3.36	5.02	6.70	8.72	10.94	13.46	16.46	21.40
2037/38	-0.04	1.68	3.46	5.21	7.07	9.07	11.37	13.93	17.07	21.61
2038/39	0.02	1.64	3.38	5.10	7.07	9.11	11.37	13.90	17.22	22.18
2039/40	0.11	1.75	3.49	5.36	7.31	9.34	11.56	14.22	17.57	22.24
2040/41	0.05	1.76	3.52	5.41	7.27	9.43	11.68	14.12	17.57	22.47
2041/42	-0.04	1.80	3.56	5.38	7.28	9.43	11.84	14.72	18.09	22.50
2042/43	0.01	1.89	3.69	5.54	7.61	9.84	12.13	14.84	18.50	23.29
2043/44	-0.09	1.75	3.69	5.54	7.44	9.57	11.97	14.75	18.35	23.30
2044/45	-0.02	1.76	3.58	5.55	7.63	9.90	12.12	14.89	18.53	23.39

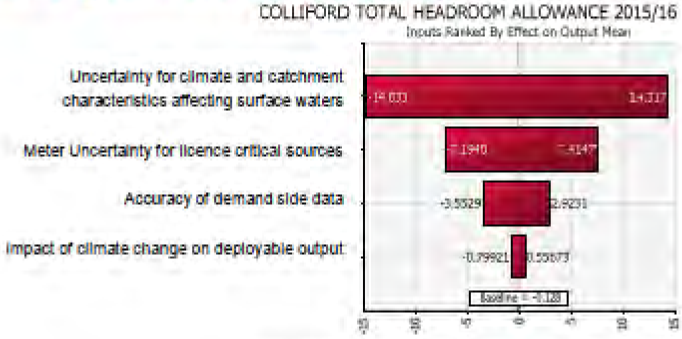
A.5 Bournemouth DYCP Headroom Allowance by Probability

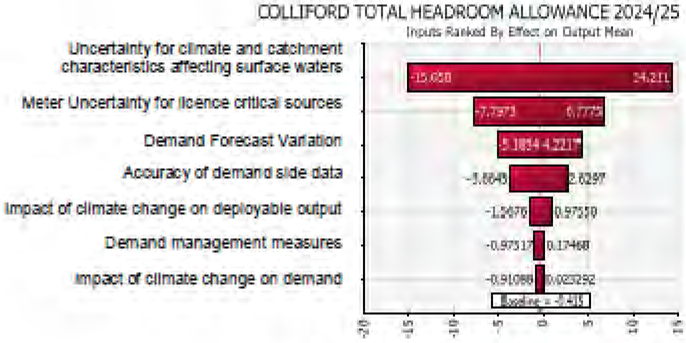
	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	0.03	1.55	3.11	4.97	6.84	8.92	11.11	13.74	17.13	21.80
2016/17	-0.01	1.68	3.46	5.13	6.87	8.87	11.08	13.60	16.77	21.80
2017/18	-0.01	1.68	3.41	5.09	7.04	9.07	11.15	13.63	16.49	21.39
2018/19	-0.02	1.66	3.40	5.26	7.18	9.11	11.43	13.81	16.97	21.91
2019/20	0.03	1.74	3.40	5.19	6.90	9.08	11.24	13.69	16.96	21.64
2020/21	-0.06	1.78	3.39	5.06	6.90	9.07	11.28	13.72	17.16	21.91
2021/22	0.12	1.76	3.52	5.30	7.11	9.18	11.25	13.79	16.87	21.66
2022/23	0.03	1.71	3.37	5.25	7.22	9.25	11.53	14.10	17.28	22.01
2023/24	0.09	1.72	3.44	5.22	7.08	9.13	11.29	13.85	17.27	22.35
2024/25	0.00	1.81	3.53	5.30	7.19	9.32	11.62	14.08	17.49	22.61
2025/26	0.02	1.74	3.48	5.24	7.08	9.15	11.56	14.42	17.79	22.88
2026/27	0.00	1.66	3.57	5.39	7.29	9.47	11.70	14.36	17.80	22.89
2027/28	0.04	1.83	3.64	5.43	7.31	9.46	11.72	14.63	18.27	22.96
2028/29	0.14	1.78	3.42	5.22	7.30	9.38	11.89	14.86	18.32	23.06
2029/30	0.13	1.98	3.70	5.62	7.44	9.61	11.96	14.60	17.85	22.89
2030/31	0.03	1.75	3.56	5.37	7.46	9.57	12.01	14.71	18.31	23.28
2031/32	-0.10	1.85	3.73	5.73	7.78	9.95	12.19	15.00	18.49	23.43
2032/33	0.04	1.93	3.79	5.52	7.58	9.82	12.27	15.18	18.65	23.92
2033/34	0.01	1.85	3.85	5.80	8.08	10.29	12.58	15.20	18.72	24.15
2034/35	0.07	2.11	3.99	6.02	8.14	10.37	12.70	15.83	19.43	25.05
2035/36	0.12	2.08	4.07	6.14	8.21	10.37	12.78	15.78	19.59	25.29
2036/37	0.08	1.97	3.95	5.98	8.11	10.56	13.32	16.33	20.37	25.90
2037/38	0.11	2.11	4.07	6.15	8.52	10.62	13.36	16.32	20.08	25.72
2038/39	0.04	2.21	4.27	6.37	8.67	10.96	13.60	16.47	20.41	26.11
2039/40	0.00	2.11	4.37	6.47	8.83	11.37	13.98	17.07	21.03	26.88
2040/41	0.12	2.16	4.32	6.42	8.88	11.33	14.02	17.10	20.99	27.56
2041/42	0.20	2.36	4.38	6.60	8.83	11.56	14.26	17.48	21.59	27.53
2042/43	-0.08	2.22	4.33	6.73	9.21	11.85	14.90	18.24	22.32	28.06
2043/44	-0.12	2.01	4.42	6.81	9.29	11.81	14.75	18.25	22.27	28.63
2044/45	-0.17	2.27	4.69	7.10	9.78	12.44	15.30	18.71	22.67	29.10

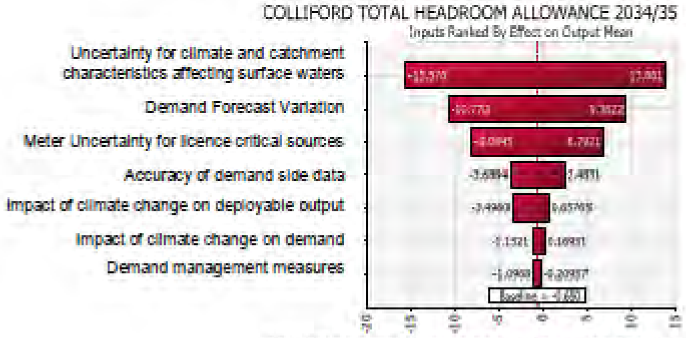
Appendix B Target headroom with and without climate change

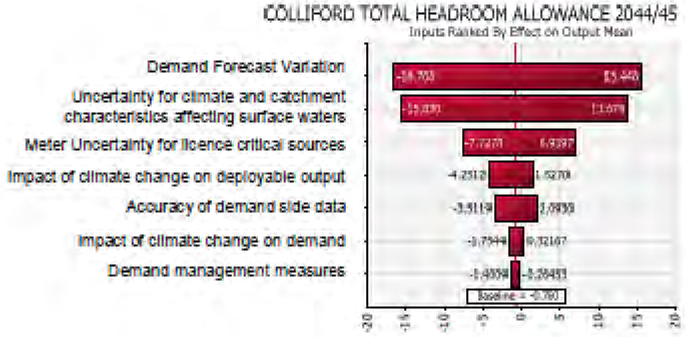
		Colliford			Roadford			Wimbleball			Bournemouth DYAA			Bournemouth DYCP		
Percentile	Year	Without Climate change	Climate change only	*Total check*	Without Climate change	Climate change only	*Total check*	Without Climate change	Climate change only	*Total check*	Without Climate change	Climate change only	*Total check*	Without Climate change	Climate change only	*Total check*
95TH PERC	2015/16	15.27	0.27	*15.53*	22.56	1.16	*23.72*	8.57	0.13	*8.71*	19.61	0.00	*19.61*	21.80	0.00	*21.80*
95TH PERC	2016/17	15.31	0.34	*15.64*	21.99	1.45	*23.44*	8.31	0.17	*8.48*	19.67	0.00	*19.67*	21.79	0.01	*21.80*
95TH PERC	2017/18	15.17	0.40	*15.58*	21.80	1.73	*23.53*	8.21	0.19	*8.40*	19.63	0.01	*19.64*	21.38	0.01	*21.39*
95TH PERC	2018/19	15.05	0.46	*15.51*	21.29	1.96	*23.25*	8.46	0.23	*8.69*	19.63	0.01	*19.64*	21.90	0.02	*21.91*
95TH PERC	2019/20	15.02	0.52	*15.54*	21.54	2.24	*23.78*	8.12	0.25	*8.37*	20.05	0.02	*20.07*	21.62	0.02	*21.64*
95TH PERC	2020/21	14.90	0.58	*15.48*	21.02	2.53	*23.55*	8.25	0.30	*8.55*	19.79	0.02	*19.81*	21.88	0.03	*21.91*
95TH PERC	2021/22	14.69	0.63	*15.32*	21.23	2.77	*24.00*	8.37	0.33	*8.70*	19.57	0.02	*19.59*	21.63	0.03	*21.66*
95TH PERC	2022/23	15.02	0.71	*15.73*	20.93	2.99	*23.92*	8.29	0.36	*8.65*	19.84	0.03	*19.86*	21.98	0.03	*22.01*
95TH PERC	2023/24	14.96	0.76	*15.72*	20.73	3.23	*23.96*	8.12	0.38	*8.50*	20.02	0.03	*20.05*	22.31	0.04	*22.35*
95TH PERC	2024/25	14.92	0.83	*15.76*	20.44	3.47	*23.91*	8.28	0.41	*8.69*	19.73	0.03	*19.76*	22.56	0.05	*22.61*
90TH PERC	2025/26	11.89	0.66	*12.55*	15.94	2.90	*18.84*	6.41	0.32	*6.73*	15.68	0.03	*15.71*	17.75	0.04	*17.79*
90TH PERC	2026/27	11.80	0.69	*12.49*	16.03	3.14	*19.17*	6.52	0.34	*6.87*	16.01	0.03	*16.05*	17.75	0.04	*17.80*
90TH PERC	2027/28	11.90	0.74	*12.64*	15.88	3.31	*19.18*	6.51	0.37	*6.88*	15.94	0.04	*15.97*	18.22	0.05	*18.27*
90TH PERC	2028/29	11.93	0.77	*12.70*	16.17	3.45	*19.63*	6.66	0.39	*7.05*	15.42	0.04	*15.46*	18.27	0.05	*18.32*
90TH PERC	2029/30	11.98	0.83	*12.80*	16.06	3.60	*19.66*	6.62	0.41	*7.03*	15.46	0.04	*15.50*	17.79	0.06	*17.85*
90TH PERC	2030/31	12.21	0.89	*13.10*	15.97	3.80	*19.77*	6.68	0.42	*7.11*	15.72	0.05	*15.77*	18.25	0.06	*18.31*
90TH PERC	2031/32	12.43	0.89	*13.32*	16.29	4.00	*20.29*	6.71	0.42	*7.13*	15.93	0.05	*15.98*	18.43	0.06	*18.49*
90TH PERC	2032/33	12.45	0.90	*13.35*	16.78	4.01	*20.79*	6.84	0.44	*7.28*	15.90	0.05	*15.95*	18.58	0.07	*18.65*
90TH PERC	2033/34	12.44	0.91	*13.35*	16.90	4.12	*21.02*	6.93	0.45	*7.37*	16.14	0.05	*16.20*	18.65	0.07	*18.72*
90TH PERC	2034/35	12.86	0.92	*13.77*	16.91	4.11	*21.02*	7.07	0.45	*7.52*	16.18	0.06	*16.24*	19.35	0.08	*19.43*
85TH PERC	2035/36	10.64	0.71	*11.35*	13.99	3.44	*17.43*	5.68	0.32	*6.00*	13.22	0.05	*13.27*	15.71	0.07	*15.78*
85TH PERC	2036/37	10.93	0.72	*11.65*	13.97	3.36	*17.33*	5.80	0.33	*6.13*	13.41	0.05	*13.46*	16.26	0.07	*16.33*
85TH PERC	2037/38	10.96	0.72	*11.68*	14.57	3.53	*18.10*	5.79	0.33	*6.12*	13.88	0.05	*13.93*	16.24	0.07	*16.32*
85TH PERC	2038/39	11.06	0.73	*11.79*	14.60	3.56	*18.16*	5.90	0.34	*6.23*	13.84	0.06	*13.90*	16.39	0.08	*16.47*
85TH PERC	2039/40	11.39	0.75	*12.14*	15.08	3.67	*18.75*	6.08	0.35	*6.43*	14.16	0.06	*14.22*	16.99	0.08	*17.07*
85TH PERC	2040/41	11.28	0.74	*12.01*	15.35	3.68	*19.02*	6.21	0.35	*6.56*	14.06	0.06	*14.12*	17.02	0.08	*17.10*
85TH PERC	2041/42	11.75	0.78	*12.53*	15.44	3.72	*19.16*	6.17	0.35	*6.52*	14.65	0.07	*14.72*	17.39	0.09	*17.48*
85TH PERC	2042/43	11.94	0.79	*12.74*	15.80	3.74	*19.54*	6.44	0.36	*6.81*	14.77	0.07	*14.84*	18.15	0.09	*18.24*
85TH PERC	2043/44	12.09	0.82	*12.92*	16.06	3.87	*19.93*	6.55	0.37	*6.92*	14.68	0.07	*14.75*	18.16	0.09	*18.25*
85TH PERC	2044/45	12.49	0.82	*13.31*	15.97	3.92	*19.90*	6.78	0.37	*7.15*	14.82	0.07	*14.89*	18.61	0.10	*18.71*

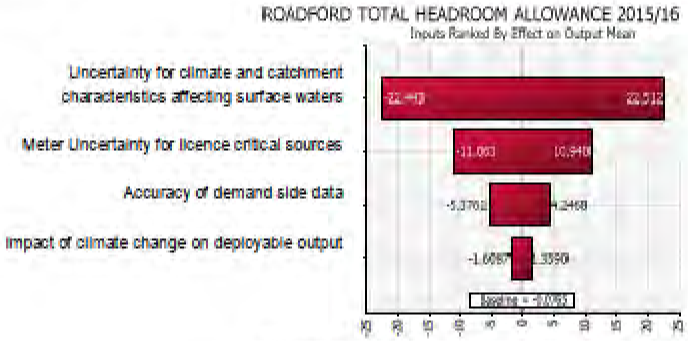
Appendix C @Risk Graphical Outputs

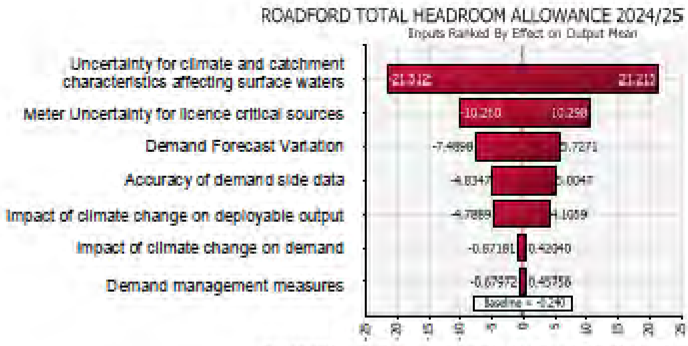









ROADFORD TOTAL HEADROOM ALLOWANCE 2015/16
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
Meter Uncertainty for licence critical sources
Accuracy of demand side data
Impact of climate change on deployable output
22.512
-11.083
-5.3702
-1.6087
-25
-20
-15
-10
-5
0
5
10
15
20
25


ROADFORD TOTAL HEADROOM ALLOWANCE 2024/25
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
Meter Uncertainty for licence critical sources
Demand Forecast Variation
Accuracy of demand side data
Impact of climate change on deployable output
Impact of climate change on demand
Demand management measures
-21.312
21.212
-10.210
10.298
-7.4898
-4.8347
-4.7889
4.1059
-0.87181
0.42040
-0.67972
0.45758
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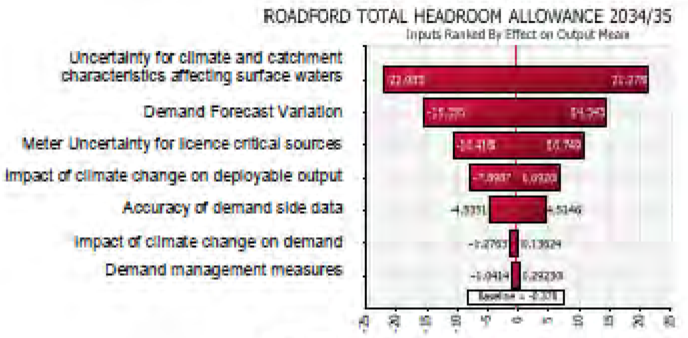
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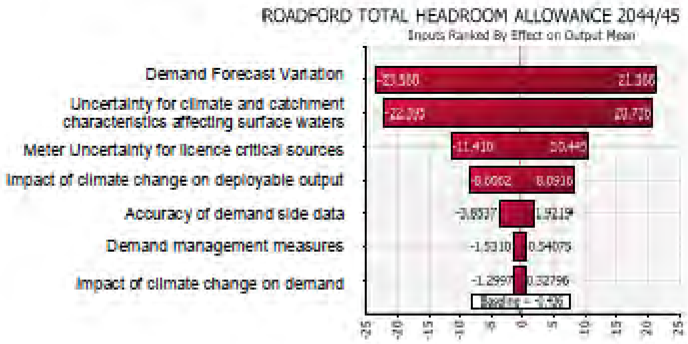
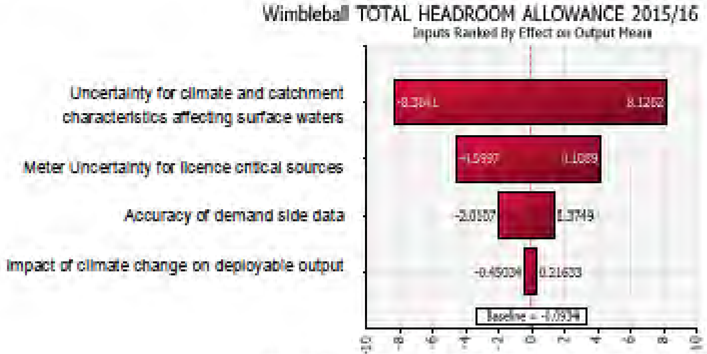
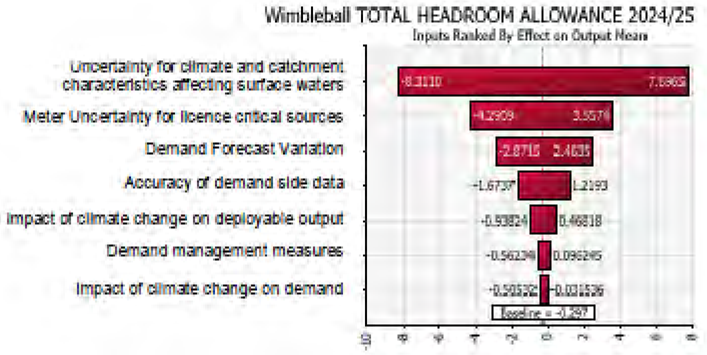
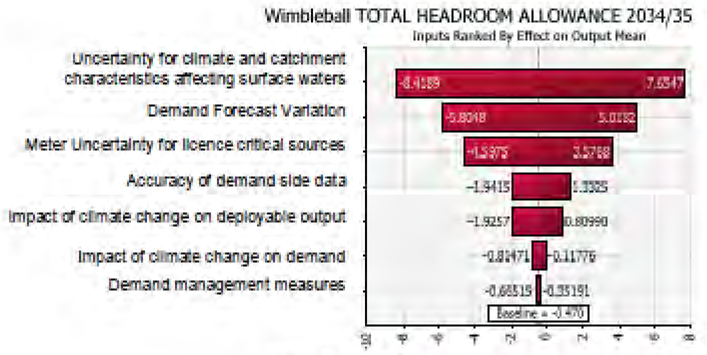
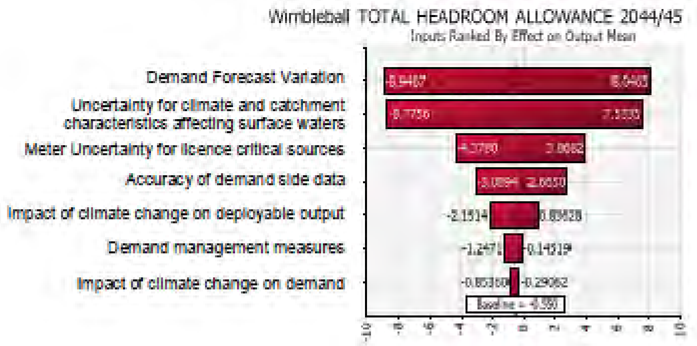
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
Demand Forecast Variation
Meter Uncertainty for licence critical sources
Impact of climate change on deployable output
Accuracy of demand side data
Impact of climate change on demand
Demand management measures
0.13824
0.29230


ROADFORD TOTAL HEADROOM ALLOWANCE 2044/45
Inputs Ranked By Effect on Output Mean
Demand Forecast Variation
Uncertainty for climate and catchment characteristics affecting surface waters
Meter Uncertainty for licence critical sources
Impact of climate change on deployable output
Accuracy of demand side data
Demand management measures
Impact of climate change on demand
-23.580
21.388
-22.049
20.720
-11.410
10.445
-8.0062
8.0910
-3.8837
1.9219
-1.5310
0.54075
-1.2997
0.32796
-25
-20
-15
-10
-5
0
5
10
15
20
25

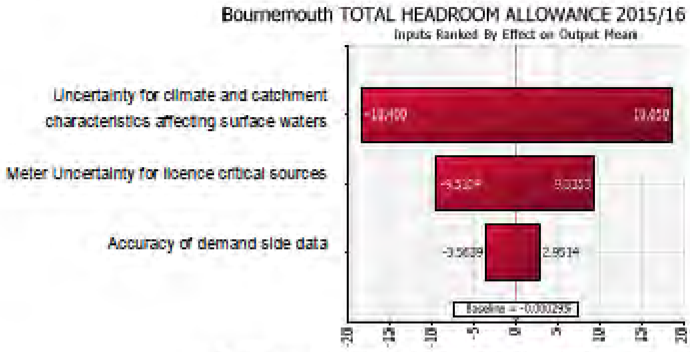


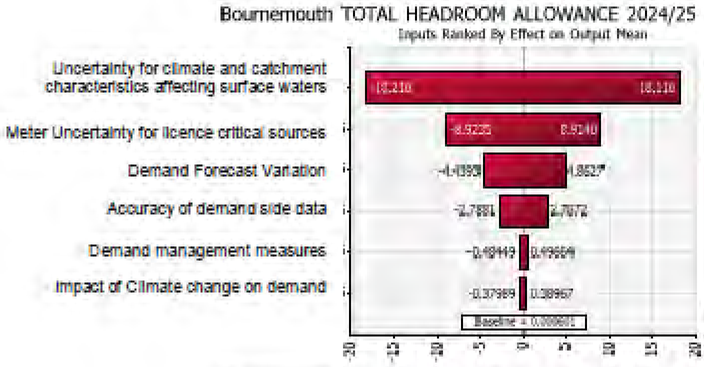


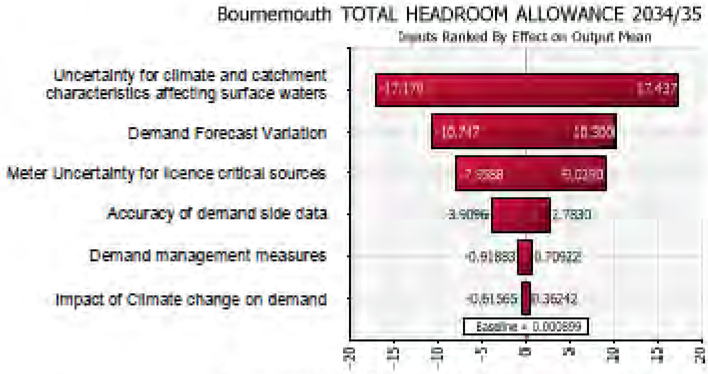


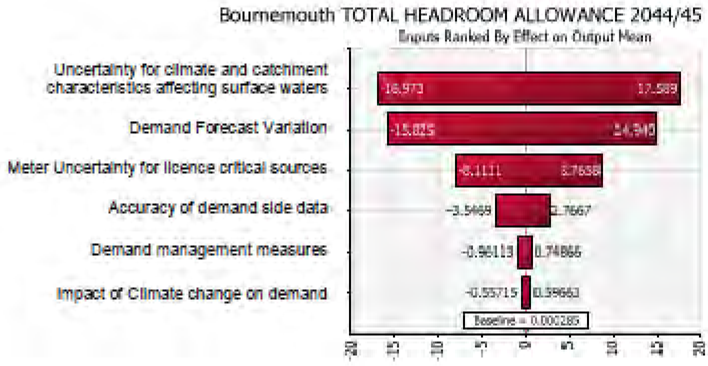


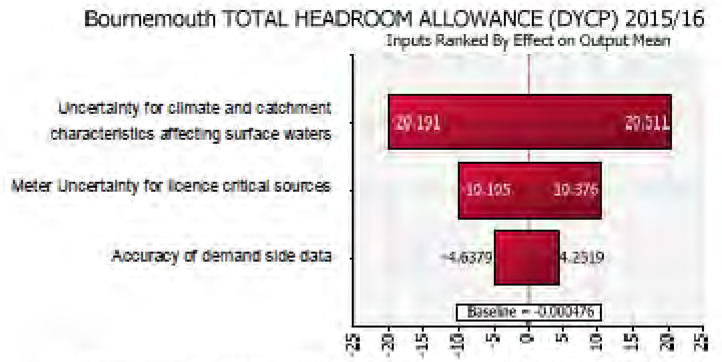
South West Water
Bournemouth Water


Bournemouth TOTAL HEADROOM ALLOWANCE 2015/16
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
Meter Uncertainty for licence critical sources
Accuracy of demand side data
-3.5639
2.9514
-20
-15
-10
-5
0
5
10
15
20


Bournemouth TOTAL HEADROOM ALLOWANCE 2024/25
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
Meter Uncertainty for licence critical sources
Demand Forecast Variation
Accuracy of demand side data
Demand management measures
Impact of Climate change on demand
-20
-15
-10
-5
0
5
10
15
20


Bournemouth TOTAL HEADROOM ALLOWANCE 2034/35
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
Demand Forecast Variation
Meter Uncertainty for licence critical sources
Accuracy of demand side data
Demand management measures
Impact of Climate change on demand
-20
-15
-10
-5
0
5
10
15
20


Bournemouth TOTAL HEADROOM ALLOWANCE 2044/45
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
Demand Forecast Variation
Meter Uncertainty for licence critical sources
Accuracy of demand side data
Demand management measures
Impact of Climate change on demand
-20
-15
-10
-5
0
5
10
15
20


Bournemouth TOTAL HEADROOM ALLOWANCE (DYCP) 2015/16
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
20.191
20.511
Meter Uncertainty for licence critical sources
10.105
10.376
Accuracy of demand side data
-4.6379
4.2519
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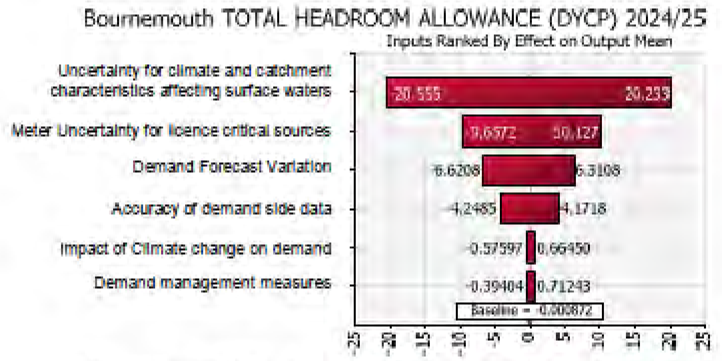
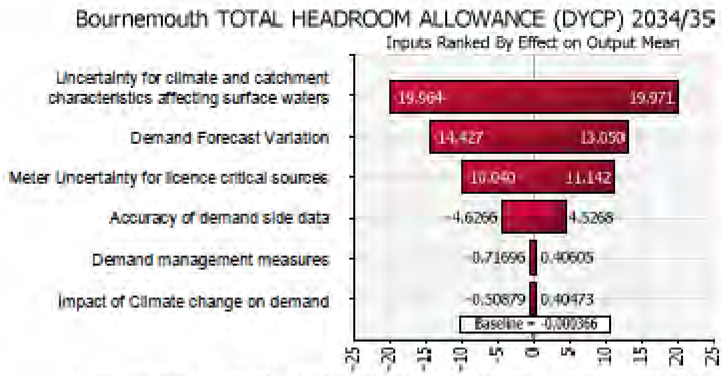
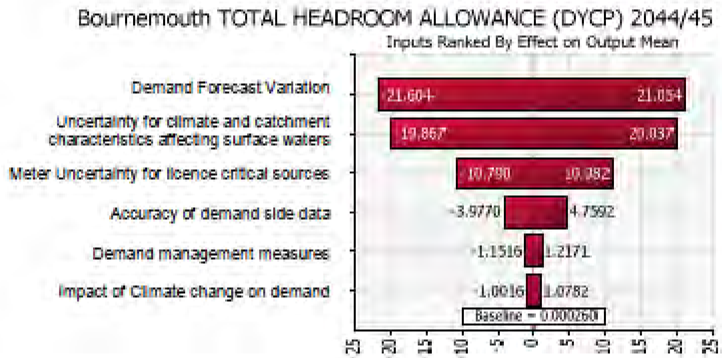
-25 -20 -15 -10 -5 0 5 10 15 20 25


Bournemouth TOTAL HEADROOM ALLOWANCE (DYCP) 2024/25
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
20.555
20.233
Meter Uncertainty for licence critical sources
9.6572
10.127
Demand Forecast Variation
-6.6208
6.3108
Accuracy of demand side data
-4.2485
4.1718
Impact of Climate change on demand
-0.57597
0.66450
Demand management measures
-0.39404
0.71243
Baseline = -0.000872
-25 -20 -15 -10 -5 0 5 10 15 20 25


Bournemouth TOTAL HEADROOM ALLOWANCE (DYCP) 2034/35
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
19.964
19.971
Demand Forecast Variation
14.427
13.050
Meter Uncertainty for licence critical sources
10.040
11.142
Accuracy of demand side data
-4.6266
4.5268
Demand management measures
-0.71696
0.40605
Impact of Climate change on demand
-0.50879
0.40473
Baseline = -0.000366
-25 -20 -15 -10 -5 0 5 10 15 20 25


Bournemouth TOTAL HEADROOM ALLOWANCE (DYCP) 2044/45
Inputs Ranked By Effect on Output Mean
Demand Forecast Variation
21.604
21.054
Uncertainty for climate and catchment characteristics affecting surface waters
19.867
20.037
Meter Uncertainty for licence critical sources
10.790
10.382
Accuracy of demand side data
-3.9770
4.7592
Demand management measures
-1.1516
1.2171
Impact of Climate change on demand
-1.0016
1.0782
Baseline = 0.000260
-25 -20 -15 -10 -5 0 5 10 15 20 25

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APPENDIX 5

Baseline position

A.5.1 Baseline WAFU and demand plus target headroom

Table A.5.1: Colliford WRZ

Financial year	WAFU (Ml/d)	Baseline demand + target headroom (Ml/d)
2016/17	163.58	160.61
2017/18	163.50	159.17
2018/19	163.41	158.39
2019/20	163.33	158.07
2020/21	163.25	157.82
2021/22	163.16	157.64
2022/23	163.08	157.54
2023/24	163.00	157.51
2024/25	162.91	157.48
2025/26	162.83	157.56
2026/27	162.74	157.84
2027/28	162.66	158.13
2028/29	162.58	158.24
2029/30	162.49	158.30
2030/31	162.41	158.30
2031/32	162.38	158.82
2032/33	162.35	159.34
2033/34	162.32	159.40
2034/35	162.29	159.47
2035/36	162.26	159.52
2036/37	162.24	159.98
2037/38	162.21	160.17
2038/39	162.18	160.45
2039/40	162.15	160.99
2040/41	162.12	161.05
2041/42	162.09	161.76
2042/43	162.06	162.16
2043/44	162.03	162.54
2044/45	162.00	163.14

Table A.5.2: Roadford WRZ

Financial year	WAFU (Ml/d)	Baseline demand + target headroom (Ml/d)
2016/17	248.48	241.02
2017/18	247.88	238.79
2018/19	245.29	237.25
2019/20	244.70	236.34
2020/21	244.11	235.53
2021/22	243.52	234.79
2022/23	242.93	234.13
2023/24	242.34	233.55
2024/25	241.75	232.98
2025/26	241.16	232.48
2026/27	240.57	232.35
2027/28	239.98	232.26
2028/29	239.38	232.34
2029/30	238.79	232.48
2030/31	238.20	232.46
2031/32	238.00	232.15
2032/33	237.79	231.85
2033/34	237.59	231.69
2034/35	237.39	231.50
2035/36	237.18	231.31
2036/37	236.98	231.16
2037/38	236.77	231.89
2038/39	236.57	231.94
2039/40	236.37	232.53
2040/41	236.16	232.80
2041/42	235.96	232.96
2042/43	235.75	233.36
2043/44	235.55	233.77
2044/45	235.34	233.77

Table A.5.3: Wimbleball WRZ

Financial year	WAFU (Ml/d)	Baseline demand + target headroom (Ml/d)
2016/17	90.52	87.36
2017/18	90.47	86.64
2018/19	90.41	86.14
2019/20	90.35	85.80
2020/21	90.29	85.51
2021/22	90.24	85.25
2022/23	90.18	85.05
2023/24	90.12	84.86
2024/25	90.06	84.70
2025/26	90.01	84.57
2026/27	89.95	84.61
2027/28	89.89	84.68
2028/29	89.83	84.74
2029/30	89.78	84.78
2030/31	89.72	84.76
2031/32	89.70	84.77
2032/33	89.68	84.78
2033/34	89.66	84.88
2034/35	89.64	84.95
2035/36	89.62	85.03
2036/37	89.60	85.30
2037/38	89.58	85.46
2038/39	89.56	85.69
2039/40	89.54	86.02
2040/41	89.52	86.28
2041/42	89.50	86.37
2042/43	89.48	86.79
2043/44	89.46	87.04
2044/45	89.44	87.40

Table A.5.4: Bournemouth WRZ - DYAA

Financial year	WAFU (Ml/d)	Baseline demand + target headroom (Ml/d)
2016/17	204.84	165.48
2017/18	204.84	165.03
2018/19	204.84	164.60
2019/20	204.84	164.19
2020/21	204.84	163.80
2021/22	204.84	163.43
2022/23	204.84	163.09
2023/24	204.84	162.77
2024/25	204.84	162.46
2025/26	204.84	162.18
2026/27	204.84	162.07
2027/28	204.84	161.97
2028/29	193.34	161.89
2029/30	193.34	161.83
2030/31	193.34	161.67
2031/32	193.34	161.54
2032/33	193.34	161.40
2033/34	193.34	161.26
2034/35	193.34	161.12
2035/36	193.34	160.97
2036/37	193.34	161.25
2037/38	193.34	161.82
2038/39	193.34	161.91
2039/40	193.34	162.34
2040/41	193.34	162.36
2041/42	193.34	163.08
2042/43	193.34	163.33
2043/44	193.34	163.38
2044/45	193.34	163.66

Table A.5.5: Bournemouth WRZ - DYCP

Financial year	WAFU (Ml/d)	Baseline demand + target headroom (Ml/d)
2016/17	225.77	214.63
2017/18	225.77	214.22
2018/19	225.77	213.84
2019/20	225.77	213.49
2020/21	225.77	213.16
2021/22	225.77	212.87
2022/23	225.77	212.62
2023/24	225.77	212.38
2024/25	225.77	212.16
2025/26	225.77	211.99
2026/27	225.77	212.05
2027/28	225.77	212.13
2028/29	219.35	212.24
2029/30	219.35	212.36
2030/31	219.35	212.36
2031/32	219.35	212.38
2032/33	219.35	212.41
2033/34	219.35	212.43
2034/35	219.35	212.44
2035/36	219.35	212.45
2036/37	219.35	213.21
2037/38	219.35	213.41
2038/39	219.35	213.79
2039/40	219.35	214.63
2040/41	219.35	214.90
2041/42	219.35	215.53
2042/43	219.35	216.55
2043/44	219.35	216.82
2044/45	219.35	217.55

APPENDIX 6

Future options

A.6.1 Different types of water management options

Table A.6.1 to A.6.5 below give a list of unconstrained types of water management options which is based on the UKWIR WR27 water resources planning tools project[A.6.1].

The different types of options can be divided into five categories:

(i) Interconnection with neighbouring water companies and water trading;

(ii) Customer side management options (reducing demand)

(iii) Distribution side management options (predominantly managing leakage)

(iv) Distribution expansion and production side management options (increasing supply)

(v) Resource management options (increasing supply)

Table A.6.1 to A.6.5 also show schemes we have considered further in our unconstrained set of options.

Table A.6.1: Types of interconnection between water companies and water trading options

Option	Scheme type	Scheme sub-categories/sub-components	Considered
1	Bulk transfers of raw or treated water across water company boundaries	• Renovation or increase of existing transfer or development of new bulk transfers by canal, river or pipeline	✓
2	Joint ("shared asset") resource	• Shared development across water company boundaries	✓
3	Asset Transfers	• Transfers of assets across industries and /or across water company boundaries	✓
4	Options to trade other (infrastructure) assets	• Other water trading and /or options to trade across industries and /or across water company boundaries	✓

[A.6.1] UKWIR (2012), *Water Resources Planning Tools 2012 Economics of Balancing Supply and Demand (EBSD) Report*, Report: 12/WR/27/6

South West Water Bournemouth Water

Table A.6.2: Types of customer side management options (reducing demand)

Option	Scheme type	Scheme sub-categories/sub-components	Considered
1	Compulsory metering	• Industrial premises • Commercial and public sector premises • Swimming pool owners • Sprinkler/hosepipe users • Households with an outside tap • Households in water-stressed areas • Households where a meter or meter box already exists	✓
2	Enhanced metering, Smart metering	• Targeted installation of water meters and a promotional campaign to increase optant rates and change of occupancy switchers	✓
3	Meter installation policy	• Installation of meters/meter boxes when premises change ownership - industrial - commercial and public sector - households	✓
4	Metering of sewerage flow (to manage water consumption and water wastage)	• Optional scheme • Compulsory scheme	✓
5	Introduction of special fees	• Introduction of separate additional fees for: - sprinkler users - hosepipe users - outside tap users - swimming pools	✓
6	Changes to existing measured tariffs	• Discontinued declining block rate tariffs • Increasing the volumetric charges • Introducing:- - rising block volumetric charges - summer/winter or other seasonal tariffs - daily/peak/off-peak tariffs for at least some seasons • charge only above a defined subsistence level of use (to protect low income families) • flow restrictor charging (tariff reduction for a restriction in domestic supply water pressure) • domestic user tariffs and/or commercial user tariffs	✓
7	Introduction of special tariffs for specific users	• Introducing “interruptible” industrial supplies • Introducing lower charges for major users with significant storage • Introducing higher-cost “ban-free” sprinkler or hose pipe licences • Introducing spot pricing for selected customers	✓
8	Water use audit and inspection (and identification of household and non-household water efficiency	• Domestic property water use – audit and retrofit, standalone, self audit packs, integrated Demand Management • Commercial property water use - audit integrated with Water Regulations Inspection, water use audit	✓

Option	Scheme type	Scheme sub-categories/sub-components	Considered
	opportunities)	• Institutional property water use audit and retrofit	
9	Targeted water conservation information (advice on appliance water usage)	• Industrial customers/bodies • Commercial customers • Households • Public sector (e.g. schools, hospitals, community groups) • Recreation facilities (parks and gardens, golf courses) • Designers of hot water systems, taps and water using appliances • Purchasers of water-using appliances (i.e. in showrooms) • Labelling water consumption of appliances	✓
10	Advice & information on direct abstraction and irrigation techniques	• Drip vs. spray irrigation • Direct abstraction • Other techniques for reducing evaporation	✓
11	Advice & information on leakage detection and fixing techniques	• Industrial • Commercial & public sector • Household • Agricultural	✓
12	Promotion of water saving devices	• Appliance exchange programmes - washing machine - dishwasher - WCs - other • Company subsidy to appliance manufacturers • Company subsidy to consumers for the purchase of water saving appliances • Encouraging or requiring greater use of water saving technology in new and/or existing buildings (industrial, commercial, public sector and household) - fitting of showers - low volume shower heads - limiting purchase/use of "power showers" - low flush toilets - dual flush toilets - fitting new toilets - composting toilets - waterless urinals - retrofitting existing toilets - shallow trap toilets - flush controller for urinals - timing devices - "people detectors" - self-closing taps (i.e. push operation taps that cut off the supply after a short time) - spray taps - toilet bags cistern dams (by displacing part of the cistern volume, reduce the flush volume) - hose activated by a spring loaded trigger mechanism - limited purchase/use of instantaneous water heaters/boilers	✓

Option	Scheme type	Scheme sub-categories/sub-components	Considered
		- research and development into water saving technology	
13	Water recycling	• Encouraging or requiring water recycling (i.e. direct use of untreated 'grey water'):- - industrial - commercial and public sector - household (e.g. using water from bath/showers/basins for toilet use) - fitting recycling systems in new houses - fitting recycling systems to existing houses	✓
14	Water efficiency enabling activities	• Sponsoring "waste-minimisation" projects • Tradable delivery entitlements • Water butts • Targeting gardeners for rainwater harvesting • Programme of re-washing customers' taps • Lobbying for tighter or company-specific water regulations • Improving the enforcement of water regulations • Implement water efficiency research (Waterwise) outcomes • Planning restrictions preventing new development	✓
15	Change in Level of Service to enhance Water Available For Use (WAFU)		✓

Table A.6.3: Types of distribution management options (managing leakage)

Option	Scheme type	Scheme sub-categories/sub-components	Considered
1	Customer supply pipe leakage reduction	• Identification of Major Supply Pipe Leaks • Fixing Major Supply Pipe Leaks - at water company expense - at customers' expense	✓
2	Leakage reduction	• Fixing of reported leaks • Find and fix - trunk mains - distribution mains - communication pipes - reservoir overflows	✓
3	Active Leakage Control (ALC)	• Increase in leakage detection and repair resources beyond the short-term Sustainable Economic Level of Leakage (SELL)	✓
4	Leak detection	• Telemetry • District metering	✓
5	Pressure reduction programmes (installation of		✓

Option	Scheme type	Scheme sub-categories/sub-components	Considered
	pressure reducing valves)		
6	Advanced replacement of infrastructure for leakage reasons		

Note: Options 1 to 4 are in our leakage curves (Appendix 3 and 7)

Table A.6.4: Types of distribution expansion and production side management options (increasing supply)

Option	Scheme type	Scheme sub-categories/sub-components	Considered
1	Distribution capacity expansion	• Trunk mains • Distribution mains	✓
2	Increase water treatment works (WTW) efficiency	• Reduce treatment works losses	✓
3	Washwater re-use - recycling of WTW process waste water discharges	• On site washwater recovery	✓
4	Increase WTW capacity	• Increasing WTW capacity to match licence constraint	✓
5	Re-introduce more regular use of existing licensed sources	• Sources may have not been regularly required (e.g. as a result of recent investment elsewhere in the system or changing water quality)	✓

Table A.6.5: Types of resource management options (increasing supply)

Option	Scheme type	Scheme sub-categories/sub-components	Considered
1	Direct river abstraction	• New river abstraction (with intake) and with licence application • Transfer of existing river licence to new or existing works • Modify existing abstraction licences	✓
2	New reservoir or development of existing source	• On-stream reservoirs • Pumped-storage reservoirs • Flood storage • River regulation reservoirs and/or direct supply reservoirs • Development of disused gravel pits (or redundant quarries) as reservoirs • Dam raising	✓

Option	Scheme type	Scheme sub-categories/sub-components	Considered
3	Groundwater sources	• New sources • Improve existing sources • Increase aquifer yield by reducing seawater intrusion into aquifers, by pumping or through introduction of a physical barrier	✓
4	Infiltration galleries		✓
5	Artificial Storage and Recovery wells (or Aquifer Storage and Recovery (ASR))		✓
6	Aquifer Recharge / Artificial Recharge (AR)		✓
7	Desalination	• Membrane separation (electrodialysis reversal, reverse osmosis) • Thermal processes (multistage flash distillation, multiple effect distillation, mechanical vapour compression)	✓
8	Bulk transfers of raw or treated water from sources inside and outside the company's own supply area	• Renovation or increase of existing transfers or development of new bulk transfers by canal, river or pipeline	✓
9	Tankering of water		✓
10	Redevelopment of existing resources with increased yields	• Changes to current system operation that may result in relatively cheap and simple operational changes that could yield benefits to the supply demand balance	✓
11	Re-use of existing private supplies (defence establishment sites/industrial sites) taken out of service		✓
12	Reclaimed water, water re-use, effluent re-use	• Reclaimed domestic wastewater • Reclaimed industrial and commercial wastewater (for domestic, commercial and industrial users) • Encouraging or requiring indirect waste water re-use (i.e. abstraction downstream from the discharge of treated waste water e.g. for agricultural irrigation and industrial cooling) • Encouraging or requiring direct waste water re-use (i.e. re-use of treated waste water via pipes or other transfer infrastructure)	✓
13	Imports (icebergs)	• Towing of icebergs from the Norwegian sea	✓
14	Rain cloud seeding		✓

Option	Scheme type	Scheme sub-categories/sub-components	Considered
15	Tidal barrage		
16	Rainwater harvesting	• Direct collection and storage of rainwater	✓
17	Abstraction licence trading		✓
18	Water quality schemes that may have the coincidental effect of increasing the Deployable Output (DO) of a source/works		✓
19	Catchment management schemes that promote improved water quality and / or increased yield of sources		✓
20	Conjunctive use operation of sources		✓

A.6.2 Interconnection with neighbouring water companies and water trading options

A.6.2.1 South West Water bulk supply options study[A.6.2]

A.6.2.1.1 Options not considered further

As described in Section 6.4, we employed consultants to analyse in more detail potential options for interconnection with neighbouring water companies.

Early on in the study, we identified that a number of options could be discarded for practical reasons or because the scheme formed part of another scheme. For completeness, these options are shown in Table A.6.6 below.

Table A.6.6: Options not considered further

Potential Scheme	Reference number*	Description
Gunnislake to Wessex Water Bulk Supply Options (15 Ml/d)	Option G3	Raw water link to Pynes WTW and treated water link to Taunton
	Option G4	Raw water link to new WTW at Taunton
Northbridge to Wessex Water Bulk Supply Options (5 Ml/d)	Option N2	Raw water link to Allers WTW and treated water link to Taunton
	Option N4	Raw water link to Taunton and treatment at Taunton
	Option N5	Treatment at Pynes WTW and treated water link to Taunton
	Option N6	Treatment at Pynes WTW, enhancement of Pynes main and new treated water link to Bridport
Combined Gunnislake and Northbridge Options (20 Ml/d)	Option GN1	Raw water link to Pynes and treated link to Taunton (20 Ml/d) (combined G3 and N5)
	Option GN2	Raw water link to Taunton (20 Ml/d) (combined G4 and N4)
Wessex Water to SWW Resilience Schemes	Option R1	Maundown to Tiverton treated water link main (10 Ml/d)
	Option R2	Taunton to Tiverton treated water link main (10 Ml/d)
	Option R4	Chard to Axminster treated water link main and link to Pynes main (4.5 Ml/d)
	Option R6	Bridport to Axminster treated water link (10 Ml/d)
	Option R7	Chard to Axminster treated water link (3 Ml/d) and 1.5 Ml/d link to Hook WTW
	Option R8	Chard to Hook WTW (1.5 Ml/d)
Bournemouth Water bulk supply options	Option B1	Bournemouth Water to Southern Water: via a pipeline through the New Forest (20 Ml/d)
	Option B2	Bournemouth Water to Wessex Water: Canford Bottom to Summerslade (20 Ml/d)
	Option B3	Bournemouth Water to Wessex Water: Ringwood to Codford (20 Ml/d)

Notes:
** Some initial options were discarded and hence non-sequential option reference numbers*

[A.6.2] Atkins (2017). '*South West Water Bulk Supply Options Study Phase 2 Report*'

A.6.2.1.2 Indicative costs of options considered further

An indicative Average Incremental Cost (AIC) was calculated for each of the above options. The costs are shown in Table A.6.7 below.

Table A.6.7: Indicative AIC for each option (extract from Atkins report[A.6.3])

ATKINS
South West Water Bulk Supply Options Study
Cost Model

South West Options - Bulk supply options - Ranked by AIC

		Scheme Capacity (Ml/d)	Capex (£)	Total Opex (£/annum)	Capex (£/Mld)	Total Opex (£/Ml)	New mains length (km)	Number of Pumping Stations	Total Pumping head (m)	Average Incremental Cost AIC (p/m³)
N6	Enhancement of Pynes main and WTW and 5Ml/d treated water link to Bridport	5	51,011,667	398,853	10,202,333	219	34km	3	295	134
N4	Raw water link from Northbridge to Taunton (5Ml/d)	5	74,602,925	329,230	14,920,585	180	51km	3	140	181
N2	Raw water link from Northbridge to Allers WTW and treated water link to Taunton (5Ml/d)	5	71,511,141	528,818	14,302,228	290	57km	2	355	184
GN1	Raw Water link to Pynes and treated link to Taunton (20Ml/d) (combined G3 and N5)	20	270,421,358	2,776,232	13,521,068	380	122km	6	764	184
GN2	Raw water link to Taunton (20Ml/d) (Combined G4 and N4)	20	282,445,358	2,999,028	14,122,268	411	122km	7	824	193
N5	Raw water link from Northbridge to Pynes WTW and treated link to Taunton (5Ml/d)	5	85,892,257	347,796	17,178,451	191	55km	3	240	204
G3	Raw water link to Pynes and treated water link to Taunton (15Ml/d)	15	258,777,307	2,614,100	17,251,820	477	120km	5	804	234
G4	Raw water link to Taunton (15Ml/d)	15	268,095,907	2,781,197	17,873,060	508	120km	6	804	243

South West Water Resilience Options - Ranked by AIC

		Scheme Capacity (Ml/d)	Capex (£)	Total Opex (£/annum)	Capex (£/Mld)	Total Opex (£/Ml)	New mains length (km)	Number of Pumping Stations	Total Pumping head (m)	Average Incremental Cost AIC (p/m³)
R1	Maundown to Tiverton treated water link (10Ml/d)	10	28,972,357	547,061	2,897,236	150	25km	1	160	388
R6	Bridport to Axminster treated water link (10Ml/d)	10	30,084,840	472,796	3,008,484	130	20km	1	290	407
R4	Chard to Axminster treated water link (4.5Ml/d)	4.5	17,876,710	162,629	3,972,602	99	16km	1	60	530
R2	Taunton to Tiverton treated water link (10Ml/d)	10	46,681,966	472,796	4,668,197	130	34km	2	255	613
R7	Chard to Axminster treated water link (3Ml/d) and 1.5Ml/d link to Hook WTW	4.5	18,850,654	162,629	4,189,034	99	17km	1	60	557
R8	Chard to Hook WTW (1.5Ml/d)	1.5	7,181,214	51,425	4,787,476	94	8km	1	50	639

Bournemouth Water Bulk Supply Options - Ranked By AIC

		Scheme Capacity (Ml/d)	Capex (£)	Total Opex (£/annum)	Capex (£/Mld)	Total Opex (£/Ml)	New mains length (km)	Number of Pumping Stations	Total Pumping head (m)	Average Incremental Cost AIC (p/m³)
B3	Bournemouth Water to Wessex Water. Ringwood to Codford treated water link (20Ml/d)	20	81,566,998	1,019,857	4,078,350	140	35km	1	140	57
B1	Bournemouth Water to Southern Water treated water link (20Ml/d)	20	75,768,453	1,279,786	3,788,423	175	32km	1	75	58
B2	Bournemouth Water to Wessex Water. Canford Bottom to Codford treated water link (20Ml/d)	20	126,764,984	1,762,511	6,338,249	241	51km	3	340	92

[A.6.3] *Ibid.* A.6.2

A.6.2.1.3 Conclusions

Gunnislake and Northbridge bulk supply options

The Gunnislake options are the most expensive of the options considered within this study due to the longest transfer lengths of over 130km, with indicative AIC values of 234-243p/m^3 for options G3 and G4 (15 Ml/d).

For the combined Gunnislake to Northbridge options the cost effectiveness of these schemes increases due to the increase in transfer volume from 15 Ml/d to 20 Ml/d, with indicative AIC values of 184-193p/m^3 for options GN1 and GN2.

The 5 Ml/d transfer options from Northbridge to Wessex Water (N2-N6) also have high indicative AIC values ranging from 134-204p/m^3. Option N6 for the transfer to Bridport has the lowest AIC at 134p/m^3 but is dependent on the assumptions made concerning the enhancement of the existing Pynes main to Axminster.

These values were compared to published AIC values for Bristol Water resource options in their WRMP14, which show an AIC value of 82p/m^3 for Cheddar reservoir (16Ml/d), 100p/m^3 for a bulk supply from Wessex Water (10 Ml/d) and 132p/m^3 for construction of a new reservoir at Chew Stoke (8 Ml/d). These values are all substantially lower than the estimated costs of the Gunnislake and Northbridge options above.

Wessex Water also has a number of available resource options in their WRMP14, all with AIC values below 100p/m^3 including Avonmouth boreholes (8 Ml/d) at 65p/m^3, Avonmouth effluent re-use (11 Ml/d) at 75p/m^3 and additional abstraction from the River Avon at 86p/m^3.

Although both Wessex Water and Bristol Water will have updated the above AIC values as part of the WRMP19 process, the consultant's report notes:-

> *"the cost estimates for the Gunnislake and Northbridge options to provide a bulk supply to Wessex Water for onward transfer to Bristol Water, are substantially higher than available cost data for more local Bristol Water and Wessex Water resource options. This is likely to be due to the very large transfer distances from SWW to Wessex Water"*

and

> *"Hence none of the Gunnislake or Northbridge options appear to be economically viable, when compared to more local resource options, noting that some of the differences between company AIC values will be due to differences in unit cost rates and allocation of risk"*

Furthermore, the Gunnislake and Northbridge options only include costs for the transfer of water from SWW to the Wessex Water supply area. Other significant costs would also be incurred within the Wessex Water supply area to allow water from Gunnislake or Northbridge to be transferred to Bristol Water by direct supply or displacement of current resources.

The consultant's report also notes:-

> *"Even if surplus water from SWW could be made available to Bristol Water at an economical price, using up all of the SWW surplus for transfer to another company could have negative consequences for SWW customers in terms of limiting the company's ability to meet future demand growth, as well as reducing the resilience and flexibility of water supply within their network"*

SWW resilience options

The Wessex Water to SWW resilience options have the highest AIC values ranging from 388-639p/m^3, due to the assumption that these schemes would only operate for a maximum of one month per year, and hence would deliver less water than the bulk supply options where it is assumed water would be delivered for 365 days per year. Hence comparison of the AIC values for the bulk supply and resilience options should be treated with caution.

It should also be noted that in practice, any such resilience scheme is likely to operate much less frequently than one month per year, although this level of operation has been adopted to give an indication of AIC values. Such schemes may only actually be required to provide back-up supplies once in every 5-10 years, but would still require ongoing maintenance costs. Likewise, ongoing sweetening flows are likely to be needed so that the back-up supplies can be operated at short notice if required. (Note at this stage of the analysis no allowance for sweetening flows has been included).

The lowest cost resilience scheme is R1 for the 10 Ml/d transfer from Maundown to Allers WTW, at 388p/m^3. The highest cost scheme is for the 1.5 Ml/d supply to back-up Hook WTW from Pole Rue at 639p/m^3 due to the low volume of water supplied.

In conclusion, the consultant's report notes:-

> *"None of the considered resilience schemes appear to be economically viable, given the long transfer lengths required and the ongoing maintenance effort required for schemes that may only operate very infrequently. Further consideration of the Hook option R8 may be appropriate given that this has the shortest transfer distance (8 km)"*

Bournemouth options

It is only likely to be feasible to implement one of the three identified Bournemouth WRZ bulk supply options due to limited spare resource availability within the Bournemouth WRZ. For the purposes of this study, 20 Ml/d has been assumed as an indicative value.

The AIC values for the above Bournemouth WRZ options range from 57-92p/m^3.

Option B1 comprises a 20 Ml/d transfer scheme to Southern Water. This would involve duplicating an existing pipeline across the New Forest. However, the consultant's report notes:-

> *"Laying a pipeline through the New Forest National Park would be highly controversial and a very strong case would be required to obtain consent from the New Forest planning authority. Additional costs for this option are also likely to be required to allow distribution of the transferred water within the Southern Water network, which have not been included within this study".*

Options B2 and B3 (the two Wessex Water transfer options), which consider the transfer of 20 Ml/d from Bournemouth WRZ to the Wessex Water central area link main at Summerslade and Codford, both include pipeline sections that follow the same routes as the recently constructed Wessex Water Grid scheme. Hence, the Atkins report notes:-

> *"Promotion of these two schemes could be very difficult in the short term with strong objections likely from landowners and other stakeholders".*

Option B2 would involve laying pipelines through the River Stour catchment from Canford Bottom to Summerslade Reservoir through the Canford Chase Area of Outstanding Natural Beauty. Option B3 would involve pipe laying along the river valleys of the River Avon and River Wylye near Salisbury, which are both SAC designated. In addition to the high environmental value of the pipeline routes and duplication of sections of the recently completed Wessex Water Grid scheme, both options would only transfer water as far as the Wessex Water central area link main between Maundown and Bath. Substantial additional costs would also be required to transfer the water onto Southern Water, which have not been included in this analysis.

Given all of the issues with options B2 and B3, the Atkins report notes:-

> *"It is considered that both options are very unlikely to be considered as viable transfer schemes"*
>
> *"It should also be noted that transferring any surplus volume to a neighbouring company, would also have negative impacts including reducing the company's ability to meet any future demand growth, and reducing the resilience and flexibility of water supply within the Bournemouth WRZ network."*

A.6.3 Customer side management options (reducing the demand for water)

A.6.3.1 Unconstrained list and screening of customer side management options

The unconstrained options which we considered were not feasible for inclusion in our plan are shown in Table A.6.8 below, along with the reasons for their rejection.

Table A.6.8: Unconstrained list of customer side management options (reducing demand)

No.	Option	Reason For Rejection																
		Water Resource Zone	Yield/demand reduction	Cost	Energy/carbon/environmental	Promotion/reliability of delivery	Flexibility	Physical and geological	Environment	Fisheries	Water quality	Customer relationship/participation	Customer affordability	Peak tourist season	National or sector policy	Difference from baseline	Innovation	Considered as part of another scheme
CU14	Introduction of special fees	All	-		-	-	-	-	-	-	-	X	X	X	X			
CU15	Seasonal tariffs	All	-	X	-	-	-	-	-	-	-	X	X					
CU16	Rising block tariffs	All	-		-	-	-	-	-	-	-	X	X	X				
CU17	Time of day tariffs	All	-		-	-	-	-	-	-	-	X	X	X				
CU18	Charge only above a defined subsistence level	All	-		-	-	-	-	-	-	-	X	X	X				
CU19	Premium applied to unmeasured tariff	All	-		-	-	-	-	-	-	-	X	X	X	X			
CU22	Social housing showers installation	All	-	X	-	-	-	-	-	-	-			X				
CU23	Combined energy and water retrofitting	All	-	X	-	-	-	-	-	-	-			X				
CU24	Holiday rental homes retrofit programme	All	-		-	-	-	-	-	-	-							X
CU25	Intensive targeting of areas	All	-		-	-	-	-	-	-	-						X	X
CU28	Targeted water conservation information	All	-		-	-	-	-	-	-	-					X	X	
CU29	Public sector and recreation facilities water efficiency advice	All	-	X	-	-	-	-	-	-	-							
CU30	Industrial/commercial customer water efficiency advice	All	-		-	-	-	-	-	-	-			X		X	X	

South West Water Bournemouth Water

No.	Option	Reason For Rejection: Water Resource Zone	Yield/demand reduction	Cost	Energy/carbon/environmental	Promotion/reliability of delivery	Flexibility	Physical and geological	Environment	Fisheries	Water quality	Customer relationship/participation	Customer affordability	Peak tourist season	National or sector policy	Difference from baseline	Innovation	Considered as part of another scheme
CU31	Long term water efficiency communications	All	-		-	-	-	-	-	-	-					X	X	
CU32	Demonstration gardens	All	-	X	-	-	-	-	-	-	-							
CU33	Adolescents showering campaign	All	-	X	-	-	-	-	-	-	-			X		X	X	X
CU34	Council and community landscape redesign advice	All	-	X	-	-	-	-	-	-	-							
CU35	Community/religious groups to promote water efficiency advice	All	-	X	-	-	-	-	-	-	-			X			X	
CU36	Holiday rental homes water advice pack	All	-		-	-	-	-	-	-	-						X	X
CU37	Holiday rental homes and hotels bespoke billing materials	All	-	X	-	-	-	-	-	-	-							
CU38	Irrigation advice	All	-	X	-	-	-	-	-	-	-			X				
CU39	Leak alarm devices	All	-		-	-	-	-	-	-	-			X		X	X	
CU40	Leaky loos fixing	All	-		-	-	-	-	-	-	-			X				X
CU41	Social housing leaky loos fixing	All	-		-	-	-	-	-	-	-			X				X
CU42	Bill reductions for water efficient device fitting	All	-	X	-	-	-	-	-	-	-			X	X			
CU43	Smart shower monitor	All	-	X	-	-	-	-	-	-	-			X				
CU44	Rebates on water efficient fixtures and fittings	All	-	X	-	-	-	-	-	-	-				X			
CU45	Free water butts	All	-	X	-	-	-	-	-	-	-						X	
CU46	Invest to save schemes	All	-	X	-	-	-	-	-	-	-			X				
CU47	Shower head exchange	All	-		-	-	-	-	-	-	-							X
CU48	Extension of free water saving devices for user self-install	All	-		-	-	-	-	-	-	-							X
CU49	Domestic rainwater harvesting system in new build households	All	-	X	-	-	-	-	-	-	-			X				

No.	Option	Reason For Rejection																
		Water Resource Zone	Yield/demand reduction	Cost	Energy/carbon/environmental	Promotion/reliability of delivery	Flexibility	Physical and geological	Environment	Fisheries	Water quality	Customer relationship/participation	Customer affordability	Peak tourist season	National or sector policy	Difference from baseline	Innovation	Considered as part of another scheme
CU50	Rainwater harvesting systems in commercial developments	All	-	X	-	-	-	-	-	-	-			X				
CU51	Grey water harvesting systems in commercial developments	All	-	X	-	-	-	-	-	-	-			X				
CU52	Grey water harvesting systems in domestic developments	All	-	X	-	-	-	-	-	-	-			X				
CU53	Community decentralised water source subsidies	All	-	X	-	-	-	-	-	-	-			X				
CU55	Extension of existing WaterCare+ scheme and tariffs	All	-		-	-	-	-	-	-	-							X
CU56	Subsidising drought tolerant plants	All	-	X	-	-	-	-	-	-	-							
CU57	Water saving incentives	All	-		-	-	-	-	-	-	-							X
CU58	Selective student enterprise	All	-	X	-	-	-	-	-	-	-		X	X				
CU59	Level of service reduction	All	-		-	-	-	-	-	-	-	X	X	X			X	
CU61	Whole-town water efficiency	All	-	X	-	-	-	-	-	-	-							X
CU63	Engagement to reconnect customers to the environment	All	-	X	-	-	-	-	-	-	-							
CU64	Engagement through gamification	All	-	X	-	-	-	-	-	-	-							

Table notes:

- \- *indicates that the option was not assessed against these criteria, which only apply to supply and transfer options.*
- [1] ***Yield / demand reduction:*** *The option does not generate a significant additional yield or resource*
- [2] ***Cost:*** *The option is unlikely to be attractive due to high costs with few other benefits*
- [3] ***Energy / carbon / environmental:*** *The option is unlikely to be attractive due to high energy costs, carbon emissions, or environmental costs*
- [4] ***Promotion / reliability of delivery:*** *The option is likely to be difficult to promote either because of known conflicts with a public policy or because of material likely objections from interested parties; or has highly known unreliable take-up from customers*

[5] ***Flexibility:*** *The option does not allow flexibility to deal with changing circumstances*

[6] ***Physical and geological:*** *The physical geography or geology of the region means the option is unlikely to be technically feasible*

[7] ***Environment:*** *There are likely to be significant environmental problems related to the options*

[8] ***Fisheries:*** *There are likely to be significant fisheries problems with the option*

[9] ***Water quality:*** *There are likely to be significant water quality problems with the option*

[10] ***Customer relationship / participation:*** *The option does not promote an enhanced relationship with customers*

[11] ***Customer affordability:*** *The option does not help customers with affordability or take control of their consumption and bills*

[12] ***Peak tourist season:*** *The option is unlikely to help reduce pressure on water and waste infrastructure during peak periods*

[13] ***National or sector policy:*** *The option is in conflict to national or sector policy guidelines*

[14] ***Difference from baseline:*** *The option is not sufficiently different from baseline activities*

[15] ***Innovation:*** *The option is not innovative*

[16] ***Considered as part of another scheme:*** *The option forms part of another scheme, which is being considered further*

A.6.3.2 Feasible customer side management options

This section provides further details of the feasible options that could form part of our final planning scenario. The options are summarised in Table A.6.9 below.

Table A.6.9: Feasible customer side management options

Ref.	Option description
CU20	Retrofit and advice service
CU21	Social housing retrofit
CU26	Holiday rental home visitor advice pack and certification scheme
CU54	Reduced infrastructure charge for water efficient developments
CU60	Community incentives
CU62	Social norms feedback on bills
CU65	Waste water treatment works final effluent re-use

A.6.3.3 Feasible options descriptions

Details of the options identified as feasible are described in more detail below.

The potential costs and benefits of the waste water treatment works final effluent re-use option were examined as part of a project undertaken for us by Aqua Consultants. All other options were developed by AMEC Foster Wheeler, with input from Waterwise. For all options we have assumed that there will be some optimism bias in the estimation of their potential demand saving benefits, so have reduced the benefits by 60% before consideration as part of our Plan.

CU20: Retrofit and advice service

Description

Wide-scale professional home visit and retrofit, promoted through mailshots to all billed households, online information and "refer a friend". Free of charge, pre-arranged home visit carried out by dedicated team with associated administrative and booking resources.

Home visit includes an audit of use, and fitting of appropriate free water saving devices. Products could include:

- Ecobetas
- Tap inserts
- Water efficient shower heads
- Trigger hose guns
- Shower timers

Some water companies have seen large savings through Ecobeta installation. As we have not carried out a widespread retro-fit programme in the past, this may offer significant scope for demand reduction.

Four variations of this option have been costed, for measured or unmeasured properties, and with or without checks and fixes of leaky loos.

Timing

Implemented over 5 years, starting in 2020/21.

Assumptions

Various trial programmes and reports have achieved differing average water savings:

- Thames Water assume an 11 l/property/day saving for measured households and 25 l/property/day for unmeasured
- H2Eco (Northumbrian Water) achieved 22 l/property/day measured saving on average, and 30 l/property/day average unmeasured saving
- OFWAT's original assumption for a home retrofit was 34 l/property/day

As South West Water have not carried out widespread retro-fit programmes to date, potential savings are assumed to be more closely aligned to those seen in the H2Eco projects.

All eligible properties are contacted. Likely uptake is based on the experience of other companies:

- Thames Water are now achieving uptake rates of up to 50%, but in AMP6 achieved rates of 20% for measured and unmeasured properties and 23% for newly metered properties
- Essex & Suffolk water achieved an uptake rate of 20% through mailing and ‘refer a friend’ schemes.

As South West Water have not carried out or promoted widespread retro-fit programmes to date, uptake rates are assumed to be more closely aligned to those seen by Essex & Suffolk water at 20%.

Assume home audit technicians can visit 4 properties a day, and that a team will be employed for this.

Decay of water savings is assumed, with a half-life of 10 years.

Table A.6.10: Summary of retrofit and advice service options

Ref.	Description	Maximum demand saving (Ml/d)	Capex (£k)	Opex (£k/yr)	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
CU20a	Retrofit (metered)	1.878	7,155	0	91	9
CU20b	Retrofit (unmetered)	0.520	1,495	0	65	-17
CU20c	Retrofit (metered+leaky loos fix)	2.795	7,155	0	57	-25
CU20d	Retrofit (unmetered+leaky loos fix)	0.893	1,495	0	32	-50

CU21: Social housing retrofit

Description

South West Water would partner with social housing providers to target homes for retro-fit and home audit visits. Bournemouth WRZ contained 21,000 social rented homes in 2011, while Devon and Cornwall contained 62,000 and 28,000 respectively. Working with these customers to help reduce water and energy bills has multiple benefits, including affordability.

Professional home visits would incorporate retro-fits and fixing of leaky loos. Severn Trent Water has been running PlugIn in partnership with several housing providers, the Environment Agency and Global Action Plan. Severn Trent Water provides the devices and materials needed for the retrofits, while the housing providers carry out the installations through targeted programmes, 'business as usual' during routine maintenance visits, or on change of occupancy.

Home visits would include an audit of use, and fitting of appropriate free water saving devices. Products could include:

- Ecobetas
- Tap inserts
- Water efficient shower heads
- Trigger hose guns
- Shower timers

Some water companies have seen large savings through Ecobeta installation. As we have not carried out a widespread retro-fit programme in the past, this may offer significant scope for demand reduction.

Timing

Implemented over 5 years, starting in 2020/21.

Assumptions

The cost of devices is covered by South West Water, and installation is undertaken by the housing provider, who shares the costs equally with South West Water.

Various trial programmes and reports have achieved differing average water savings:

- Thames Water assume an 11 l/property/day saving for measured households and 25 l/property/day for unmeasured

- H2Eco (Northumbrian Water) achieved 22 l/property/day measured saving on average, and 30 l/property/day average unmeasured saving
- OFWAT's original assumption for a home retrofit was 34 l/property/day

As South West Water have not carried out widespread retro-fit programmes to date, potential savings are assumed to be more closely aligned to those seen in the H2Eco projects.

We have assumed that 8,000 properties per year are contacted, and based on Sutton and East Surrey's Preston estate project, an uptake rate of 55% is assumed. This is higher than assumed in other retro-fit options, due to the partnership with housing providers.

Decay of water savings is assumed, with a half-life of 10 years.

Table A.6.11: Summary of social housing service option

Ref.	Description	Maximum demand saving (Ml/d)	Capex (£k)	Opex (£k/yr)	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
CU21	Social housing retrofit	0.378	624	0	32	-50

CU26: Holiday rental home visitor advice pack and certification scheme

Description

Work with Airbnb and similar accommodation providers to reduce water use in their properties. Airbnb report:

- 21,600 active listings in the South West
- 32 nights hosted for a typical listing
- 733,000 inbound guests
- 102% increase in inbound guests in the last year
- 72% of Airbnb guests say the environmental benefits of home sharing played a role in their choice to travel on our platform
- In the UK, 96% of hosts incorporate environmentally friendly practices in their hosting. 37% provide "green" cleaning products.

In Cape Town, South Africa, Airbnb are working with a water management consultant to help hosts learn and teach their guests about the current water shortage, restrictions on water use and water-saving techniques.

While savings will only be achieved for a portion of the time (i.e. when visitors are present), this is very likely to peak during the summer season when demands are highest.

Advice and 'social norms' feedback along with targeted advice for visitor water efficiency sent with bills. Seasonal messages can be provided through the 6-monthly billing cycle.

Properties apply for water efficiency certification to use in marketing and display on site. For example:

- Bronze – Advice, self install, and water efficiency materials to display at the property
- Silver – Pre-arranged professional home visit with retrofit and advice, along with water efficiency materials to display on site
- Gold – Challenging water calculator based target set for fixtures and fittings, in additional to water efficiency materials for display.

Timing

Implemented over 5 years, starting in 2020/21.

Assumptions

For social norms feedback an uptake of 91%, with an average saving of 2.2%.

Bronze certification level has an uptake of 20% with an average saving of 22 l/property/day (as for the retrofit options described in Section A.6.3.3, options CU20 & CU21). Silver certification level uptake of 20% with an average saving as for bronze level, plus leaky loo fixes. No savings have been included for gold certification at this stage as target consumption level will be challenging, leading to small numbers initially achieving this. Effectively this assumes that 40% of properties adopt either a self-install retrofit or a professional visit. This is a higher rate of uptake than other options, but is considered appropriate here due to the added sustainable marketing potential for the owners.

Decay of water savings on retrofits is assumed, but with a longer half life compared to other options of 15 years. A slower decay rate is assumed as owners may seek to use sustainability as a marketing point for their property, leading to improved maintenance and retention of devices. For savings achieved through social norms feedback, no decay is applied.

Table A.6.12 Summary of holiday rental home water efficiency option

Ref.	Description	Maximum demand saving (Ml/d)	Capex (£k)	Opex (£k/yr)	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
CU26	Holiday home rental water efficiency	0.110	312	0	46	-36

CU54: Reduced infrastructure charge for water efficient developments

Description

Current building regulations require a water consumption design standard of less than 125 l/person/d on new homes, as determined using the 'Water Calculator'. Incentivising a higher standard of design may therefore offer potential savings. Developers are offered a 50% discount on connection charge for building to a higher water efficiency standard. The water efficiency design level eligible for the discount can be ratcheted down at intervals to progressively raise standards.

The scheme would be promoted on the water company website and through communications to developers through a scheme of developer charges, or through existing relationships with larger developers. The 'Water Calculator' would then be used by developers to select devices and prove that these meet the required standard.

Selected audits would take place to ensure finished builds meet the design standards. Any leaky loos resulting from improper installation would be repaired at this time.

Timing

Implemented over the full duration of the Plan.

Assumptions

We have used a standard of 110 l/person/d for the first 5 years of the Plan, followed by 105 l/person/d for the next 5 years, and 100 l/person/d for the remainder.

Assume 5% of new properties are audited, home audit technicians can visit 4 properties a day and that a team will be employed for this.

Savings from leaky loo fixes are calculated separately to account for the assumed rate of occurrence.

Uptake rate is difficult to assess due to a limited number of trial schemes elsewhere in the water sector. Uptake of an incentivised scheme may be relatively high for larger developments. Since margins for developers are often small and applied at scale, the incentive may represent a significant sum. For smaller developments, a 50% reduction on connection fees may not be the deciding factor for water efficient design.

Reductions in demand are based on the difference between our projected measured demand in each year and the design standard.

Decay of water savings is assumed, with a half-life of 10 years.

Table A.6.13: Summary of reduced infrastructure charge option

Ref.	Description	Maximum demand saving (Ml/d)	Capex (£k)	Opex (£k/yr)	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
CU54	Reduced infrastructure charge	1.536	20,331	0	182	100

CU60: Community Incentives

Description

The aim of this option is to achieve larger scale behaviour change by concentrating efforts on specific areas, via wide-ranging engagement at community level of approximately 2,000 homes (chosen to reflect a typical parish). This approach is designed to create a legacy of water-wise communities.

In each community the programme is run over a year and measures success at the DMA level rather than relying on individual property metered consumptions. If communities cut their consumption by an agreed percentage then they will receive a sum of money to invest in community schemes. These incentives can be scaled according to the size of the community. A saving maintenance incentive is paid to the community in the third year if the demand reductions achieved are sustained.

Various methods of engagement would be used, including the use of community and social media, tailored promotional materials, self-install retrofits and water saving advice. This could include information on the sources of that community's water to reinforce the environmental link.

This approach is best approached in partnership with an environmental NGO or perhaps through an active community or parish group.

Timing

Two options were assessed, with the scheme run over 5 or 10 years, starting in 2020/21.

Assumptions

Incentives are based on a Southern Water case study:-

- 10% consumption reduction: £15,000
- 18% consumption reduction: £30,000
- 25% consumption reduction: £50,000

We have assumed that on average communities achieve and maintain a 10% reduction.

France's 'Familles à énergie positive' claimed an average 13% water saving (39 l/person/d), but from high initial consumption. It is unlikely that we could achieve this level of saving.

Decay of water savings is assumed, with a half-life of 10 years.

Table A.6.14: Summary of community incentives options

Ref.	Description	Maximum demand saving (Ml/d)	Capex (£k)	Opex (£k/yr)	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
CU60a	Community incentives (5yr)	0.564	162	64	7	-74
CU60b	Community incentives (10yr)	0.935	325	64	7	-73

CU62: Social norms feedback on bills

Description

This option involves providing customers with feedback about their water use via bills, and utilising a social norms approach to place this in the context of other customers similar to them. Specialist software will be employed to analyse consumption data and produce a short report that is sent to customers at 6 monthly intervals. The report includes advice on how to save water, relevant to the household and the season.

This option focuses on metered customers only, as water consumption data is required to provide feedback and comparisons, but our high metering level means that this would include a large number of properties.

This option would be best delivered through partnership with a company such as Advizzo, who would provide the systems necessary to make use of metered data. An ongoing annual systems maintenance cost might be applicable.

Timing

Implemented over 5 years, starting in 2020/21.

Assumptions

The primary case study to support this comes from South East Water's work with Advizzo. This trial saw an average saving of 2.2% over the winter period 2016/17. Potentially larger savings could be possible over summer months, but we have no evidence to include any uplift.

The option would be rolled out to every metered customer with an option to opt-out. We have assumed the same opt-out rate as for South East Water’s trial, which is 9%.

Because of the consistent messaging at 6-monthly intervals, a decay rate for water savings is not applied.

Table A.6.15: Summary of social norms feedback on bills option

Ref.	Description	Maximum demand saving (Ml/d)	Capex (£k)	Opex (£k/yr)	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
CU62	Social norms feedback on bills	1.462	90	40	-5	-87

CU65: Waste water treatment works final effluent re-use

Description

In 2016/17 we used over 16 Ml/d of potable water within our 640 waste water treatment works (WWTW). This water is used for purposes such as:

- Automatic cleaning of screens using spray bars
- Screening transfer in launders
- Manual cleaning operations using a hose pipe
- Polymer make up
- Polymer carrier water
- Lime make up and carrier water
- Automatic cleaning of thickeners/mechanical dewatering equipment
- On site facilities for operators e.g. toilet, shower, washing machine, kitchen

Some of these operations, such as on site facilities and polymer make up, require the use of potable water, but others could be undertaken using final effluent from the treatment process.

We commissioned Aqua Consultants to analyse our 11 highest consuming WWTWs to identify the potential for substituting potable water use with final effluent, and the likely costs of the work required to facilitate this.

Table A.6.16: Summary of WWTW final effluent re-use options

Ref.	WWTW	WRZ	Demand saving (Ml/d)	Capex (£k)	Opex (£k/yr)	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
CU65a	Ashford	Roadford	0.026	80	1.2	73	-9
CU65b	Buckland	Roadford	0.065	88	1.2	31	-51
CU65c	Brokenbury	Roadford	0.521	104	1.6	5	-78
CU65d	Camborne	Colliford	0.337	144	1.2	9	-73
CU65e	Camelshead	Roadford	0.275	91	1.2	7	-75
CU65f	Cornborough	Roadford	0.043	80	1.0	42	-40
CU65g	Countess Wear	Roadford	0.154	200	2.4	29	-53
CU65h	Ernesettle	Roadford	0.909	112	1.6	3	-79
CU65i	Marsh Mills	Roadford	0.186	104	2.0	14	-69
CU65j	Plymouth Central	Roadford	0.570	72	1.6	3	-79
CU65k	Radford	Roadford	0.443	80	1.2	4	-78

A.6.3.4 Summary of feasible options

A summary of all the customer side options described above and associated costs are shown in Table A.6.17 below

Table A.6.17: Summary of all customer side options

Ref.	Description	Maximum demand saving (Ml/d)	Capex (£k)	Opex (£k/yr)	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
CU20a	Retrofit (metered)	1.878	7,155	0	91	9
CU20b	Retrofit (unmetered)	0.520	1,495	0	65	-17
CU20c	Retrofit (metered+leaky loos fix)	2.795	7,155	0	57	-25
CU20d	Retrofit (unmetered+leaky loos fix)	0.893	1,495	0	32	-50
CU21	Social housing retrofit	0.378	624	0	32	-50
CU26	Holiday home rental water efficiency	0.110	312	0	46	-36
CU54	Reduced infrastructure charge	1.536	20,331	0	182	100
CU60a	Community incentives (5yr)	0.564	162	64	7	-74
CU60b	Community incentives (10yr)	0.935	325	64	7	-73
CU62	Social norms feedback on bills	1.462	90	40	-5	-87
CU65a	WWTW final effluent re-use (Ashford)	0.026	80	1.2	73	-9
CU65b	WWTW final effluent re-use (Buckland)	0.065	88	1.2	31	-51
CU65c	WWTW final effluent re-use (Brokenbury)	0.521	104	1.6	5	-78
CU65d	WWTW final effluent re-use (Camborne)	0.337	144	1.2	9	-73
CU65e	WWTW final effluent re-use (Camelshead)	0.275	91	1.2	7	-75
CU65f	WWTW final effluent re-use (Cornborough)	0.043	80	1.0	42	-40
CU65g	WWTW final effluent re-use (Countess Wear)	0.154	200	2.4	29	-53
CU65h	WWTW final effluent re-use (Ernesettle)	0.909	112	1.6	3	-79
CU65i	WWTW final effluent re-use (Marsh Mills)	0.186	104	2.0	14	-69
CU65j	WWTW final effluent re-use (Plymouth Central)	0.570	72	1.6	3	-79
CU65k	WWTW final effluent re-use (Radford)	0.443	80	1.2	4	-78

A.6.4 Managing leakage

Table A.6.18 shows the leakage reduction options in each WRZ in incremental 1 Ml/d steps from a representative current position, towards very low positions. These enable the assessment of the relative merits of leakage reduction profiles for each WRZ.

Table A.6.18: Feasible leakage reduction options

Ref No	Option name	WRZ	Description
LC1	Step 1 Colliford WRZ	C	Reduction of leakage from 30.3 to 29.3 Ml/d
LC2	Step 2 Colliford WRZ	C	Reduction of leakage from 29.3 to 28.3 Ml/d
LC3	Step 3 Colliford WRZ	C	Reduction of leakage from 28.3 to 27.3 Ml/d
LC4	Step 4 Colliford WRZ	C	Reduction of leakage from 27.3 to 26.3 Ml/d
LC5	Step 5 Colliford WRZ	C	Reduction of leakage from 26.3 to 25.3 Ml/d
LC6	Step 6 Colliford WRZ	C	Reduction of leakage from 25.3 to 24.3 Ml/d
LC7	Step 7 Colliford WRZ	C	Reduction of leakage from 24.3 to 23.3 Ml/d
LC8	Step 8 Colliford WRZ	C	Reduction of leakage from 23.3 to 22.3 Ml/d
LR1	Step 1 Roadford WRZ	R	Reduction of leakage from 42.3 to 41.3 Ml/d
LR2	Step 2 Roadford WRZ	R	Reduction of leakage from 41.3 to 40.3 Ml/d
LR3	Step 3 Roadford WRZ	R	Reduction of leakage from 40.3 to 39.3 Ml/d
LR4	Step 4 Roadford WRZ	R	Reduction of leakage from 39.3 to 38.3 Ml/d
LR5	Step 5 Roadford WRZ	R	Reduction of leakage from 38.3 to 37.3 Ml/d
LR6	Step 6 Roadford WRZ	R	Reduction of leakage from 37.3 to 36.3 Ml/d
LR7	Step 7 Roadford WRZ	R	Reduction of leakage from 36.3 to 35.3 Ml/d
LR8	Step 8 Roadford WRZ	R	Reduction of leakage from 35.3 to 34.3 Ml/d
LR9	Step 9 Roadford WRZ	R	Reduction of leakage from 34.3 to 33.3 Ml/d
LR10	Step 10 Roadford WRZ	R	Reduction of leakage from 33.3 to 32.3 Ml/d
LW1	Step 1 Wimbleball WRZ	W	Reduction of leakage from 11.4 to 10.4 Ml/d
LW2	Step 2 Wimbleball WRZ	W	Reduction of leakage from 10.4 to 9.4 Ml/d
LW3	Step 3 Wimbleball WRZ	W	Reduction of leakage from 9.4 to 8.4 Ml/d
LW4	Step 4 Wimbleball WRZ	W	Reduction of leakage from 8.4 to 7.4 Ml/d
LB1	Step 1 Bournemouth WRZ	B	Reduction of leakage from 20 to 19 Ml/d
LB2	Step 2 Bournemouth WRZ	B	Reduction of leakage from 19 to 18 Ml/d
LB3	Step 3 Bournemouth WRZ	B	Reduction of leakage from 18 to 17 Ml/d

Ref No	Option name	WRZ	Description
LB4	Step 4 Bournemouth WRZ	B	Reduction of leakage from 17 to 16 Ml/d
LCPR19	PR19 Colliford WRZ	C	15% reduction in Colliford WRZ by 2025
LRPR19	PR19 Roadford WRZ	R	15% reduction in Roadford WRZ by 2025
LWPR19	PR19 Wimbleball WRZ	W	15% reduction in Wimbleball WRZ by 2025
LBPR19	PR19 Bournemouth WRZ	B	15% reduction in Bournemouth WRZ by 2025
LCLRP	Leak plan Colliford WRZ	C	Colliford as part of SWW at 77 Ml/d by 2025
LRLRP	Leak plan Roadford WRZ	R	Roadford as part of SWW at 77 Ml/d by 2025
LWLRP	Leak plan Wimbleball WRZ	W	Wimbleball as part of SWW at 77 Ml/d by 2025
LBLRP	Leak plan Bournemouth WRZ	B	18 Ml/d by 2025

A.6.5 Metering

A.6.5.1 Unconstrained list and screening of metering options

Table A.6.19 shows metering options that we considered, but decided were not appropriate for inclusion in our Plan, along with the reason for rejection.

Table A.6.19: Rejected metering options

No.	Option	Reason For Rejection															
		Water Resource Zone	Yield/demand reduction	Cost	Energy/carbon/environmental	Promotion/reliability of delivery	Flexibility	Physical and geological	Environment	Fisheries	Water quality	Customer relationship/participation	Customer affordability	Peak tourist season	National or sector policy	Difference from baseline	Innovation
CU01	Compulsory metering	All	-	X	-	-	-	-	-	-	-	X		X			X
CU02	Metering of homes with outside tap and/or swimming pool	All	-		-	-	-	-	-	-	-	X				X	X
CU03	Meter remaining unmetered non-household customers	All	-		-	-	-	-	-	-	-	X					X

No.	Option	Reason For Rejection															
		Water Resource Zone	Yield/demand reduction	Cost	Energy/carbon/environmental	Promotion/reliability of delivery	Flexibility	Physical and geological	Environment	Fisheries	Water quality	Customer relationship/participation	Customer affordability	Peak tourist season	National or sector policy	Difference from baseline	Innovation
CU04	Target and meter high consumption areas	All	-		-	-	-	-	-	-	-	X					
CU05	Switch to smart non-household meters with advice	All	-	X	-	-	-	-	-	-	-						
CU06	Fixed Network Metering Infrastructure	All	-	X	-	-	-	-	-	-	-						
CU07	Switch to smart meters	All	-	X	-	-	-	-	-	-	-						
CU08	Enhanced promotion of smart meters	All	-	X	-	-	-	-	-	-	-						
CU09	Trial metering period	All	-		-	-	-	-	-	-	-	X		X			
CU10	Smart metering of bulk residential sites	All	-	X	-	-	-	-	-	-	-			X			
CU11	In-home display of real time consumption	All	-	X	-	-	-	-	-	-	-						
CU13	Metering of wastewater flows	All	-	X	-	-	-	-	-	-	-		X	X			

Table notes: refer to Table notes for Table A.6.8

A.6.6 Options to increase the supply of water within our WRZs

A.6.6.1 <u>Unconstrained list and screening of supply side management options at company level</u>

The UKWIR WR27 report[A.6.4] gives a framework for the unconstrained list of options which relate to increasing the supply of water within our WRZs. These

[A.6.4] *Ibid.* A.6.1

options could be Distribution Expansion and Production Side Management Options or Resource Management Options.

Our unconstrained lists of potential supply side options at a company level are shown below.

Table A.6.20 is colour coded to show the outcome of the options screening described in section 6.5 of the main report. Options that are considered infeasible are shaded in red, whilst those considered feasible for inclusion in our final planning scenario are shaded in green.

The options were initially screened at a company level to remove options that could not form part of the solution for the circumstances relevant to South West Water.

Options shaded green have been developed further at a WRZ level in A.6.6.2.

Table A.6.20: Screening of distribution expansion and production side management options - company level

Option	Scheme type	Scheme sub-categories/sub-components
1	Distribution capacity expansion	Considered further – see tables for individual WRZs below.
2	Increase water treatment works (WTW) efficiency	This option would include reducing treatment works losses. These vary across our region and are therefore considered separately at WRZ level.
3	Washwater re-use - recycling of WTW process waste water discharges	These vary across our region and are therefore considered separately at WRZ level.
4	Increase WTW capacity to licence maximum	See options below for each WRZ. Although these schemes would operate within existing licence conditions, there would be an increase in the volumes abstracted from those at present. However, in all cases we have taken account of information passed to us by the Environment Agency regarding the risk of deterioration.
5	Re-introduce more regular use of existing licensed sources	See options below for each WRZ. Although these schemes would operate within existing licence conditions, there would be an increase in the volumes abstracted from those at present. However in all cases we have taken account of information passed to us by the Environment Agency regarding the risk of deterioration.

Table A.6.21: Screening of resource management options - company level

Option	Scheme type	Scheme sub-categories/sub-components
1	Direct river abstraction	Considered further – see tables for individual WRZs.
2	New reservoir or development of existing source or development of disused mineral extraction workings	Considered further – see tables for individual WRZs. In recent years a number of sites in the region have reached the end of their useful lives as mineral extraction workings. When pumping stops, the pits flood giving them potential as water resources developments. However, a strategy based on the use of redundant mineral extraction sites must be flexible as it is essentially opportunistic. Scheme success depends on a site becoming available at the right time in the right place. No known specific schemes at present, although we keep abreast of any potential opportunities.
3	Groundwater sources	Considered further – see tables for individual WRZs.
4	Infiltration galleries	There are no suitable locations for this type of development in South West Water.
5	Artificial Storage and Recovery wells (or “Artificial Storage and Recharge”) (ASR)	Investigations indicate that local geology is not suitable for ASR schemes.
6	Aquifer Recharge (AR)	Investigations indicate that local geology is not suitable for AR schemes.
7	Desalination • Membrane separation (electrodialysis reversal, reverse osmosis) • Thermal processes (multistage flash distillation, multiple effect distillation, mechanical vapour compression)	High operating costs as well as likely high costs of improving local power distribution system, given predominantly rural nature of our area. Also very high replacement costs. Environmentally suspect - very high energy consumption, toxic chemicals and lack of suitable sites.
8	Bulk transfers (including changes to existing transfers, and transfers from sources both inside and outside the company’s own supply area) • By canal • By river • By pipeline	Considered further – see tables for individual WRZs. See Section 6.4 for further information on interconnection and water trading.
9	Tankering of water	Historical experiences of tankering in other parts of the country in 1995 revealed very high operating costs and practical difficulties.
10	Redevelopment of existing resources with	SWW currently uses, and will continue to use, sophisticated conjunctive management.

Option	Scheme type	Scheme sub-categories/sub-components
	increased yields (changes to system operation)	
11	Re-use of existing private supplies (defence establishment sites/industrial sites) taken out of service	A strategy based on the re-use of existing private supplies must be flexible as it is essentially opportunistic. The scheme's success depends on a site becoming available at the right time in the right place. No known specific schemes at present, although we will keep abreast of any potential opportunities. No specific schemes currently considered at WRZ level.
12	Reclaimed water, water re-use, effluent re-use	We commissioned a study to investigate the viability of supplying a large industrial estate in Exeter with a non-potable water supply using final effluent from a nearby waste water treatment works, treated to a high standard. The site was chosen as, with a high potential demand and proximity to a suitable works, it was more likely to be economically viable than other sites. The estimated capital costs of installing the required additional infrastructure make the scheme expensive in comparison to other options.
13	Imports (icebergs)	In the mid-1990s, SWW was approached by a Norwegian Company offering to ship high quality melted glacier water from Norway (a by-product of a hydrogeneration scheme). Discussions with the potential suppliers soon revealed extremely high capital and operating costs.
14	Rain cloud seeding	Not currently technically feasible or environmentally acceptable in the UK.
15	Tidal barrage	No suitable locations.
16	Rainwater harvesting	As described in section 6.5 - potential to deliver large savings, but at large cost. Any scheme will only be at a local level rather than forming part of a strategic scheme.
17	Abstraction licence trading	A strategy based on abstraction licence trading must be flexible as it is essentially opportunistic. The scheme's success depends on appropriate licences becoming available at the right time in the right place. No known specific schemes at present, although we will keep abreast of any potential opportunities. No specific schemes currently considered at WRZ level.
18	Water quality schemes that may have the coincidental effect of increasing the deployable output (DO) of a sourceworks	Currently no known opportunities for these types of option in our area.
19	Catchment management schemes that promote increased yield of sources	These schemes focus on improving water quality. In our area they will result in only small increases in the quantity of water available for supply at a local level. No specific schemes considered as a strategic solution at WRZ level.
20	Conjunctive use operation of sources	SWW currently uses, and will continue to use, sophisticated conjunctive management and therefore there are currently no further strategic practical opportunities for increases in WAFU.

A.6.6.2 Unconstrained list and screening of supply side management options at WRZ level

Consideration was given to potential options at a WRZ level, taking into account decisions made in Section A.6.6.1 above.

A.6.6.2.1 Colliford WRZ

Table A.6.22 to A.6.23 provide information on options which relate to increasing the supply of water in the Colliford WRZ. Options which are considered further in PR19 are shaded green, those which are inappropriate for PR19 are shaded red.

Further descriptions of each scheme are provided in Section A.6.6.3.

Table A.6.22: Unconstrained list of distribution expansion and production side management options - Colliford WRZ

Scheme Type	Scheme Option	Comment
Distribution capacity expansion	Gunnislake to St Cleer and St Cleer to Fox Park*	This would enable raw water to be abstracted at Gunnislake and treated at St Cleer WTW. Improvement of mains towards the west will enable further distribution of water across the county.
Increase water treatment works (WTW) efficiency		There is little scope to significantly increase WTW efficiency in the Colliford WRZ.
Washwater re-use - recycling of WTW process waste water discharges		Washwater is already re-used where appropriate.
Increase WTW capacity	Increase Restormel WTW capacity to 110 Ml/d*	Current capacity of Restormel WTW is 100 Ml/d, whereas the daily licence constraint is 110 Ml/d. Consider scheme in conjunction with Restormel licence variation and any future supplementary Colliford pumped storage resource management options.
Re-introduce more regular use of existing licensed sources	Re-introduce abstractions at Boswyn, Carwynen and Cargenwyn*	These are existing licensed sources which were not used for a number of years as a result of investment in Colliford Reservoir and associated works. The scheme would operate under the existing abstraction licences.
	Re-use of Rialton Intake/Porth Reservoir*	The previous Rialton WTW was unable to treat the poor quality water which resulted from diffuse pollution in the Porth catchment. A catchment management programme may be able to improve the water

Scheme Type	Scheme Option	Comment
		quality in Porth Reservoir to the extent that the source can be reintroduced and treated at a replacement WTW with a maximum output of 8 Ml/d. The scheme would operate under the existing abstraction licence.

Note:

* *Although these schemes would operate within existing licence conditions, there would be an increase in the volume actually abstracted. However, in all cases we have taken account of any information passed to us by the Environment Agency regarding the risk of deterioration.*

Table A.6.23: Unconstrained list of resource management options - Colliford WRZ

Scheme Type	Scheme Option	Comment
River abstraction	Restormel licence variation	The River Fowey catchment is an environmentally sensitive area but nevertheless studies carried out in 2007[A.6.5] have shown that there is some scope for additional total annual abstraction in certain circumstances.
New reservoir or development of existing source	Colliford Pumped Storage Scheme Stage 2	This option is based on the existing Colliford Pumped Storage Scheme and involves an additional intake and pumping station on the River Camel in the Nanstallon area. Water could be pumped to Restormel WTW. However, through the Water Industry National Environment Programme (WINEP), we have been asked to carry out investigations on abstractions in the Camel catchment. Results of these studies, due in the early 2020s, will help inform the potential feasibility of this option in the future.
New reservoir or development of existing source	Raise Porth Dam	Porth Reservoir has a large catchment and is strategically well placed to meet peak demands. A dam raising of 5 metres has been estimated to increase the yield of the reservoir by about 3.5 Ml/d. However, if the yield of the reservoir and associated water treatment works were increased, a significant investment would be required to utilise water outside the local supply area. This renders the scheme uneconomic in comparison to other options considered. The scheme is also unlikely to be supported by the Environment Agency whose

[A.6.5] Solomon, D., Sambrook, H. & Toms S. (2007), *Restormel abstraction and winter run salmon on the River Fowey*, South West Water/Environment Agency, June 2007.

Scheme Type	Scheme Option	Comment
		preference is for no additional storage.
New reservoir or development of existing source	Raise Drift Dam	A study carried out by in 1952 concluded that the dam could be raised by 7 metres providing an additional yield of 11 Ml/d. However, a preliminary environmental assessment undertaken by ARK Associates for AMP2 concluded that agriculture, landscape, ecology and recreation are all likely to be issues of concern and that further studies should be undertaken to determine the degree of impact. Since the reservoir is located in the extreme west of the Colliford WRZ, the cost of distributing the additional yield generated by dam raising would be high. This scheme is unlikely to be supported by the Environment Agency whose preference is for no additional storage.
New reservoir or development of existing source	Stithians Pumped Storage Scheme	This option has not been examined in detail but preliminary estimates indicate that it would not provide significant additional yield. The location of the source, in West Cornwall, is not ideal strategically.
Groundwater sources	Stannon - increase in licence (groundwater developments)	This option would involve an increase in abstraction licence from 4 Ml/d to 8 Ml/d in line with the permitted abstraction rate for Park Lake. An infrastructure upgrade would be required.
Groundwater sources	Other groundwater developments	This option has not been examined in detail but preliminary estimates indicate that it would not provide significant additional yield.
Bulk transfers (including changes to existing transfers, and transfers from sources both inside and outside the company's own supply area) • By canal • By river • By pipeline		See option above re potential for Gunnislake to St Cleer transfer. Given the geographical location of Colliford WRZ, there is limited opportunity for any other significant transfers.
Joint ("shared asset") resource		Limited opportunity given geographical location, no known opportunities.

A.6.6.2.2 Roadford WRZ

Table A.6.24 and Table A.6.25 provide information on options which relate to increasing the supply of water in the Roadford WRZ. Options which are considered further in PR19 are shaded green, those which are inappropriate for PR19 are shaded red.

Further descriptions of each scheme are provided in Section A.6.6.3.

Table A.6.24: Unconstrained list of distribution expansion and production side management options - Roadford WRZ

Scheme Type	Scheme Option	Comment
Distribution capacity expansion	Strategic mains Littlehempston WTW to South Devon	The current network is not a constraint, but would need to be considered as part of any scheme to increase the capacity of Littlehempston WTW. It has therefore not been considered separately. See below.
Distribution capacity expansion	Strategic mains Northcombe WTW to North Devon	The current network is not a constraint, but would need to be considered as part of any scheme to increase the capacity of Northcombe WTW. It has therefore not been considered separately. See below.
Increase water treatment works (WTW) efficiency		There is little scope to significantly increase WTW efficiency in the Roadford WRZ.
Washwater re-use - recycling of WTW process waste water discharges		Washwater is already re-used where appropriate.
Increase WTW capacity to licence maximum	Littlehempston WTW capacity increased to 100 Ml/d	This option would allow an increased volume of water to be transferred from the new Mayflower WTW to Littlehempston WTW through the distribution main through South Devon. This water, which originates from Roadford and Burrator Reservoirs and associated sources, would then be treated at the enlarged Littlehempston WTW for subsequent distribution in South Devon. This scheme should be considered in conjunction with the Littlehempston WTW to South Devon strategic main scheme and the Roadford pumped storage resource management option.
Increase WTW capacity to licence maximum	Northcombe WTW increase in capacity to 60 Ml/d	This scheme will enable more Roadford water to be treated at Northcombe WTW for subsequent distribution in North Devon. This scheme should be considered in conjunction with the Rivers Taw and Torridge study and Roadford pumped

South West Water Bournemouth Water

Scheme Type	Scheme Option	Comment
		storage resource management option.
Re-introduce more regular use of existing licensed sources	Re-introduce abstractions at small reservoirs in North Devon, e.g. Slade and Gammaton*	These are existing licensed sources which were not used for a number of years as a result of investment in Roadford Reservoir and associated works. The scheme would operate under the existing abstraction licences.
Groundwater sources	Uton source re-commissioning (with Coleford & Knowle licence transfer)*	This scheme would result in an increase in Deployable Output of approximately 0.9 Ml/d with the re-commissioning of Uton source with a potential additional 0.7 Ml/d (nominal rate) due to the transfer of the abstraction licences from Coleford and Knowle. Scheme comprises: Re-commissioning of the existing Uton borehole, drilling of a second Uton borehole and the transfer of abstraction licence permitted volumes across from Coleford and Knowle to Uton. A new treatment system (disinfection) would be required. This new supply would feed into the existing water supply network adjacent to the site.

Note:

* *Although these schemes would operate within existing licence conditions, there would be an increase in the volume actually abstracted. However, in all cases we have taken account of any information passed to us by the Environment Agency regarding the risk of deterioration.*

Table A.6.25 Unconstrained list of resource management options - Roadford WRZ

Scheme Type	Scheme Option	Comment
River abstraction	River Taw and/or Torridge abstractions	Possible long term option for high flow abstractions to reduce dependence on Roadford storage use in North Devon.
River abstraction	Abstractions from the upper River Tavy	Reduced flows in the headwaters of the Tavy are unlikely to be permitted for environmental and fisheries reasons.
River abstraction	Further abstraction at Lopwell	Increased abstractions from the River Tavy are unlikely to be permitted for environmental and fisheries reasons.
River abstraction	Reduce Gunnislake prescribed flow to Q95	Possible long term option, but likely to be difficult to promote.

Scheme Type	Scheme Option	Comment
River abstraction	Vary Avon licence to reduce compensation water	Reduced compensation flow unlikely to be permitted for environmental and fisheries reasons.
New reservoir or development of existing source	Roadford/Northcombe pumped storage from Gatherley (River Tamar)	This option would involve a pumped storage scheme for Roadford Reservoir based on an intake on the River Tamar at Gatherley. A pipeline would connect the new intake to the existing Lyd/Thrushel pipework and transfer water to Roadford Reservoir and/or directly to Northcombe WTW. Although the main abstraction would be from the River Tamar, there would also probably be a small abstraction from the River Thrushel / Lyd mainly for water quality reasons. This scheme makes more effective use of reservoir storage. This is a scheme that could take account of the potentially slightly higher winter flows that could result from climate change.
New reservoir or development of existing source	Re-introduce abstractions at small reservoirs in North Devon, e.g. Slade and Gammaton	These are existing licensed sources which were not used for a number of years as a result of investment in Roadford Reservoir and associated works. The scheme would operate under the existing abstraction licences.
New reservoir or development of existing source	Raise Avon Dam	This option would result in further inundation of Dartmoor National Park, and therefore difficult to promote.
New reservoir or development of existing source	Raise Meldon Dam	This option would result in further inundation of Dartmoor National Park, and therefore difficult to promote.
New reservoir or development of existing source	Raise Upper Tamar Dam	Significant benefits are only likely to be achieved if carried out in conjunction with a pumped storage scheme, which would result in further abstractions from the headwaters of the Tamar, which would arouse considerable opposition.
New reservoir or development of existing source	Further pumped storage of Wistlandpound from the River Bray or raising of Wistlandpound Dam	This could only be achieved by further abstractions from the headwaters of the Taw, which would probably arouse considerable opposition.
New reservoir or development of existing source	Pumped storage of KTT from the Teign	Studies indicate that only a relatively modest increase in Deployable Output would be obtained from such a scheme.
New reservoir or	Increased abstraction from Meldon	Computer modelling has shown that

Scheme Type	Scheme Option	Comment
development of existing source	Dam for transfer to Roadford Reservoir or direct to Northcombe WTW	significant benefits are not likely in drought years.
Groundwater sources	Other groundwater developments	The local geology does not support groundwater utilisation in sufficient quantities for public supplies.
Bulk transfers (including changes to existing transfers, and transfers from sources both inside and outside the company's own supply area) • By canal • By river • By pipeline		Limited opportunity for further material zonal transfers within our supply area. Given geographical location of Roadford WRZ, limited opportunity for significant transfers from outside our supply area.
Joint ("shared asset") resource		Limited opportunity given geographical location, no known opportunities.

A.6.6.2.3 Feasible options - Wimbleball WRZ

Table A.6.26 and Table A.6.27 provide information on options which relate to increasing the supply of water in the Wimbleball WRZ. Options which are considered further in PR19 are shaded green, those which are inappropriate for PR19 are shaded red.

Further descriptions of each scheme are provided in Section A.6.6.3.

Table A.6.26 Unconstrained list of distribution expansion and production side management options - Wimbleball WRZ

Scheme Type	Scheme Option	Comment
Distribution capacity expansion		No appropriate known schemes which would give an increase in Deployable Output (DO)
Increase water treatment works (WTW) efficiency		There is little scope to significantly increase WTW efficiency in the Wimbleball WRZ.
Washwater re-use - recycling of WTW process waste water discharges		Washwater is already re-used where appropriate.
Increase WTW capacity	Pynes WTW & intake*	This will option will increase the maximum capacity of Pynes WTW up to its licensed maximum of 67 Ml/d thereby improving its ability to utilise the yield of the Wimbleball/River Exe resources system. The raw water main currently restricts

Scheme Type	Scheme Option	Comment
		works output and therefore an additional main would be added from the intake. The expansion of Pynes will facilitate the transfer of water between the Wimbleball and Roadford WRZs.
Re-introduce more regular use of existing licensed sources	New/refurbished WTW at Capel Lane to use Squabmoor Reservoir	Poor water quality, small yield. Possible local option but not a strategic solution.
Re-introduce more regular use of existing licensed sources	Re-commissioning of Stoke Canon & Brampford Speke boreholes*	Utilises two drought sources north of Exeter and Pynes WTW. The Brampford Speke borehole has a licence to abstract 3.5 Ml/d all year round whilst the Stoke Canon source can pump at a peak rate of 4.5 Ml/d for up to 137 days. The re-commissioning of these boreholes would enable them to provide up to 8 Ml/d for part of the year. The abstracted water would either be discharged to the River Exe for abstraction at Northbridge Intake or supplied directly to the intake if a suitable pipeline is installed.

Note:

* *Although these schemes would operate within existing licence conditions, there would be an increase in the volume actually abstracted. However, in all cases we have taken account of any information passed to us by the Environment Agency regarding the risk of deterioration.*

Table A.6.27 Resource management options - Wimbleball WRZ

Scheme Type	Scheme Option	Comment
River abstraction	Variation to Northbridge & Bolham licences to increase abstractions	This potential option would increase the deployable output of the Wimbleball WRZ. However due to the sensitivity of the fisheries and environment in the lower River Exe and Exe estuary, any proposal will require extensive investigations.
River abstraction	Reduce Thorverton prescribed flow (PF)	This is an authorisation procedure which would increase the deployable output of the Wimbleball WRZ. However due to the sensitivity of the fisheries and environment in the lower River Exe and Exe estuary, any proposal will require extensive investigations.
River abstraction	Abstraction from the Culm	Similar in impact to a reduction in Thorverton PF. Not likely to result in a significant gain in yield.
River abstraction	Abstraction from the Creedy	Similar in impact to a reduction in Thorverton PF. Not likely to result in a significant gain in yield.

Scheme Type	Scheme Option	Comment
River abstraction	River Axe intake with reservoir storage	Following extensive geological, environmental and other studies in the 1990s, proposals for a reservoir in the lower Axe valley were rejected. Environment Agency preference is for no additional reservoir storage.
New reservoir or development of existing source	Raising Wimbleball dam & Stage 2 of Wimbleball Pumped Storage Scheme	Raising Wimbleball dam and Stage 2 of the Pumped Storage Scheme could lead to a significant increase in deployable output. The scheme would however need full environmental investigations due to the likely impact on the upper Haddeo and the further inundation of Exmoor National Park.
Groundwater sources	East Devon new source	The option is to drill a new groundwater source in East Devon. It is envisaged that this could yield up to 2 Ml/d. A new treatment plant would be required although it is assumed at this stage that no major pipeline to connect the supply to the existing network would be needed.
Bulk transfers (including changes to existing transfers, and transfers from sources both inside and outside the company's own supply area) • By canal • By river • By pipeline		Limited opportunity for further material zonal transfers within our supply area. Transfers from outside our area of supply currently believed to be not economically feasible – see Section 6.4.
Joint ("shared asset") resource		No known opportunities at present.

A.6.6.2.4 Bournemouth WRZ

It was identified early on in the WRMP19 process that the WRZ has a surplus supply demand balance throughout the planning period. The development of options in PR19 is therefore made against this background, along with the other factors identified in our screening processes, and our awareness of potentially exporting water to our neighbouring water companies.

Table A.6.28 and Table A.6.29 provide information on options which relate to increasing the supply of water in the Bournemouth WRZ. Options which are considered further in PR19 are shaded green, those which are inappropriate for PR19 are shaded red.

Further descriptions of each scheme are provided in Section A.6.6.3.

Table A.6.28 Unconstrained list of distribution expansion and production side management options - Bournemouth WRZ

Scheme Type	Scheme Description	Comment
Distribution capacity expansion	Strategic mains within Bournemouth WRZ	The current network is not a constraint, but would need to be considered as part of any scheme to increase the capacity of Bournemouth WRZ WTWs. It has therefore not been considered as a separate option.
Increase water treatment works (WTW) efficiency Washwater re-use - recycling of WTW process waste water discharges		It is recognised that both WTW efficiency, losses and washwater recycling are currently relatively high and would need to be considered as part of any scheme to increase the capacity of Bournemouth WRZ WTWs.
Increase WTW capacity to licence maximum	Bournemouth WTWs*	The current Water Available For Use (WAFU) in the Bournemouth WRZ is currently constrained by WTW capacity. Further investment to enable the WTWs to treat the maximum licensed abstraction would make more effective use of the sources available to Bournemouth WRZ and could also provide an opportunity for transferring surplus water to Southern Water's area of supply.
Re-introduce more regular use of existing licensed sources	Wimborne*	This source has not been used for a number of years. The scheme would operate under the existing abstraction licence.

Note:

* *Although these schemes would operate within existing licence conditions, there would be an increase in the volume actually abstracted. However, in all cases we have taken account of any information passed to us by the Environment Agency regarding the risk of deterioration.*

Table A.6.29 Unconstrained list of resource management options - Bournemouth WRZ

Scheme Type	Scheme Description	Comment
River abstraction New reservoir or development of existing source Groundwater sources	Increases in WAFU within the Bournemouth WRZ	Although the WRZ has a surplus supply demand balance throughout the planning period, it is recognised that in PR19, studies could be undertaken to increase the understanding of potential ways of increasing WAFU in preparation for PR24. These could include innovative licence changes to enable increases in WAFU over the critical period, without impacting on the environment.

Scheme Type	Scheme Description	Comment
Bulk transfers (including changes to existing transfers, and transfers from sources both inside and outside the company's own supply area) • By canal • By river • By pipeline	Imports from Southern Water Imports from Wessex Water	We have assumed there are no opportunities for this given Southern Water's supply demand balance position. Investigations have shown this as unlikely to be economically feasible - see Section 6.4. Exports from Colliford, Roadford or Wimbleball WRZs are assumed to be geographically impractical and not economically feasible.
Joint ("shared asset") resource		Potential opportunities in connection with the consideration of the potential transfer to Southern Water.

A.6.6.3 Feasible supply-side options

A.6.6.3.1 Summary

A summary of potentially feasible supply side options is given in Table A.6.30 below.

Table A.6.30: Summary of potentially feasible supply-side options

Ref.	Option description	WRZ[1]	Type[2]
C1	Gunnislake to St Cleer and St Cleer to Fox Park	C	DP
C2	Restormel WTW capacity increase to 110 Ml/d	C	DP
C3	Re-introduce abstractions at Boswyn, Carwynen & Cargenwyn	C	DP
C4	Re-use of Rialton Intake/Porth Reservoir	C	DP
C5	Restormel licence variation	C	R
C6	Stannon - increase in licence (groundwater developments)	C	R
R1	Duplication of distribution main through South Devon and Littlehempston WTW capacity increase to 100 Ml/d	R	DP
R2	Northcombe WTW capacity increase to 60 Ml/d	R	DP
R3	River Taw and/or Torridge abstractions	R	R
R4	Roadford/Northcombe pumped storage from Gatherley (River Tamar)	R	R
R5	Re-introduce abstractions at small reservoirs in North Devon (Slade, Gammaton and Melbury reservoirs)	R	R
R6	Uton source re-commissioning (with Coleford & Knowle licence transfer)	R	R
W1	Increase Pynes WTW and Intake to 67 Ml/d	W	DP
W2	Re-commissioning of Stoke Canon & Brampford Speke boreholes	W	DP

Ref.	Option description	WRZ[1]	Type[2]
W3	East Devon new source	W	R
B1	Significant investment at Bournemouth WTWs	B	DP
B2	Re-introduce Wimborne	B	DP
B3	Potential increases in WAFU e.g. innovative licence changes	B	R

Table notes:

[1]WRZ	*C*	*Colliford WRZ*
	R	*Roadford WRZ*
	W	*Wimbleball WRZ*
	B	*Bournemouth WRZ*
[2]Type	*DP*	*Distribution expansion and production management*
	R	*Resource scheme*

A.6.6.3.2 Options descriptions

The summary tables of feasible options shown in Section 6.8 of the main report identify those options which are being considered further by the Company in PR19.

This appendix provides more information on these options. On advice of our security manager, we have only included high level schematics. Detailed schematics are available, which we can only share with certain statutory bodies.

For each option additional information is provided including the following:

- general description of the option
- schematic map illustrating the option
- schematic map showing the WRZ which will benefit
- comments on the uncertainty of benefits
- comments on the flexibility of the option
- notes on investigation and implementation
- notes on constraints, links and interdependencies
- indicative cost information

The key used for tables measuring the social and environmental impacts of each option is as follows:

0 No impact envisaged

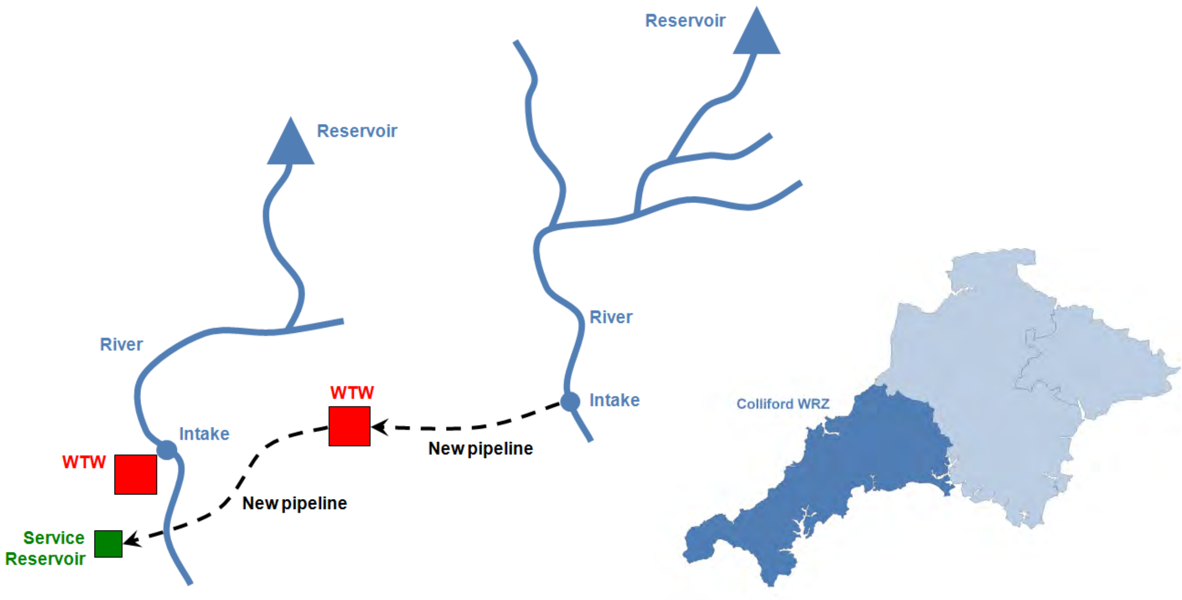
\+ Potential benefit

\- Potential impact

C1: Gunnislake to St Cleer and St Cleer to Fox Park

Option type: Distribution management
Indicative benefit: 8 Ml/d
Implementation: 3 years

Description of the option



The purpose of the Gunnislake to St Cleer raw water main is to enable water from the River Tamar (either natural flows or releases from Roadford) to be abstracted and treated at St Cleer WTW. The main from St Cleer WTW to Fox Park Service Reservoir (SR) will enable St Cleer WTW to supply water to the Cornwall spine main for subsequent distribution throughout much of the County.

Abstractions at Gunnislake would be made under the existing abstraction licence thereby making better use of existing licensed resources. The provision of a new raw water resource for St Cleer WTW will allow the treatment capacity to be better utilised. The mains will provide a further link between the Roadford and Colliford WRZs and thereby increase flexibility and security of supply.

The works required include:

- 35.5 km 600mm diameter pipeline
- variable speed pumps at Gunnislake
- alterations to pipework within pumping station

Area of benefit

The Colliford WRZ will benefit from this option.

Uncertainty of benefits

There is a reasonable level of confidence in the assessment of the benefits of this option.

Flexibility of option

The option enables the benefits of Roadford Reservoir to be shared with the Colliford WRZ.

Investigation & implementation

Environmental studies would be carried out ahead of the pipeline construction.

Constraints

There are no obvious constraints with this option.

Links and dependencies

The implementation of this option is not affected by links with, or dependencies on, other options.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	?/-	0	0	When construction works are carried out, there may be some short term disruption to biodiversity, key habitats and species – impacts would depend on the route chosen for the pipeline. The abstraction at Gunnislake on the River Tamar is not within any ecological designation, but this river does flow down into the Tamar Estuary which is designated as Plymouth Sound and Estuaries SAC, Tamar Estuaries Complex SPA and Tamar-Tavy Estuary SSSI (in a predominantly ‘favourable’ condition). However, this abstraction will not exceed the existing licence, so should not impact upon biodiversity or habitats.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				Gunnislake is within 5km of four other SSSIs: Greenscoombe Wood (unfavourable recovering); Hingston Down Quarry and Consols; Sylvia's Meadow; and Genofen Wood and West Down (all in a favourable condition). Mitigation – SWW are committed to protecting the environment and will undertake reviews of site sensitivities prior to undertaking any work, particularly with regards to the Plymouth Sound and Estuaries SAC, Tamar Estuaries Complex SPA and the SSSIs. Mitigation – works should minimise disruption and must take into account biodiversity, key habitats and species.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	-	0	0	The abstraction from Gunnislake is in the Cornwall and West Devon Mining Landscape World Heritage site (WHS). The construction works associated with laying a new pipeline may impact upon this cultural and historical landscape in the short term. There are also a number of Scheduled Monuments in the area where the new pipeline may be laid. Mitigation - works should minimise disruption to the WHS and take into account the setting and integrity of Scheduled Monuments.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	+/-	+/0	+/0	This option can be carried out within the existing abstraction licence and should enable the company to make better use of the resource, by sharing the benefits of the Roadford Reservoir with the Colliford WRZ. This option will supplement the Colliford WRZ. When pipes are replaced there is the potential to cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				Mitigation - Any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate regulations and guidelines.
4. Ensuring the appropriate and efficient use of land	?/-	0	0	It is likely additional land will be required for the development of this option. However, the works will be underground so long term impacts will be limited.
5. Limiting the causes, effects of, and adapting to climate change	+	+	+	This option may help the region adapt to climate change by making better use of the water resources and storage network.
6. Ensuring sustainable use of water resources	+	+	+	This option should enable the company to make better use of the resource by sharing the benefits of the Roadford Reservoir with the Colliford WRZ
7. Protection and enhancement of landscape character	?/-	0	0	There may be some short term visual impacts due to construction works on the Tamar Valley AONB and Cornwall AONB if the pipe is routed through these landscapes. Mitigation – try to avoid laying the pipe though the AONB. Where this is not possible, construction works must be carried out in a way that minimises disruption.
8. Protection and enhancement of human health	?/+/-	+	+	This option will provide a further link between Roadford and Colliford WRZs and thereby increase flexibility and continuity of clean drinking water supply. Due to construction works there is the possibility that this option may affect opportunities for recreation in the short term. Mitigation – replacement should minimise disruption and try to avoid affecting the public's opportunities for recreation.

Summary	
Positive	• This option can be carried out within the existing abstraction licence and should enable the company to make better use of the resource. • This option will supplement the Colliford WRZ. • This option may help the region adapt to climate change by making better use of the water resources and storage network.

	Summary
	• This option will provide a further link between Roadford and Colliford WRZs and thereby increase flexibility and continuity of clean drinking water supply.
Negative	• When construction works are carried out, there is likely to be some short term disruption to biodiversity, key habitats and species – impacts would depend on the route chosen for the pipeline. • Due to construction works there is the possibility that this option may affect opportunities for recreation in the short term. • The abstraction from Gunnislake is in the Cornwall and West Devon Mining Landscape World Heritage site. The construction works associated with laying a new pipe line may impact upon this landscape in the short term. • There are a number of Scheduled Monuments in the area where the new pipeline may be laid. • Due to construction works there is the possibility that this option may affect opportunities for recreation in the short term. • There may be some short term visual impacts due to construction works on the Tamar Valley AONB and Cornwall AONB.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Gunnislake to St Cleer and St Cleer to Fox Park	8	42,360	16,630	2,766	0	950	20,350	43	48

C2: Restormel WTW capacity increased to 110 Ml/d

Option type: Production management
Indicative benefit: 8 Ml/d
Implementation: 2 years

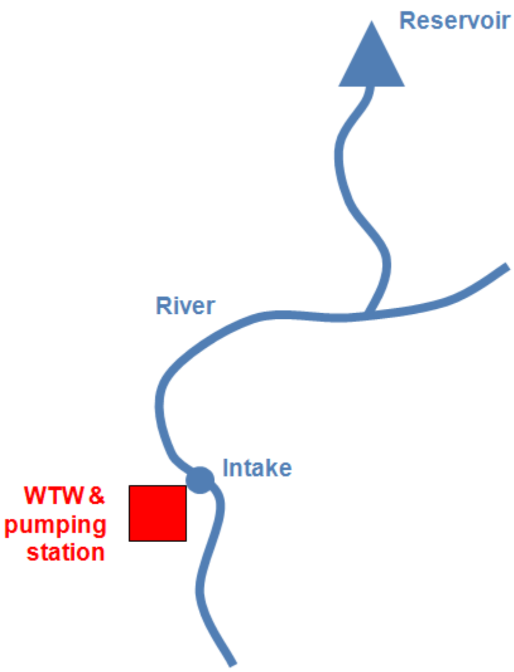
Description of the option

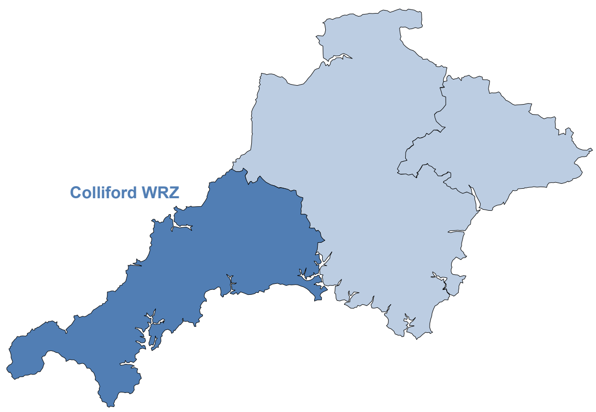
This option would take Restormel WTW up to its maximum licensed abstraction and enable more effective use to be made of the Colliford/River Fowey Resources system.

Given the current land constraints at the site, this option is likely to require significant investment and the use of innovative technology.

Works required include increased pumping facilities from the river to the WTW, increased water treatment capability and increased capacity of the waste water and sludge system.

The Colliford WRZ will benefit from this option.





Uncertainty of benefits

There is a reasonable level of confidence in the assessment of the benefits of this option, but see links below regarding links to other potential schemes.

Flexibility of option

This option will enable full use to be made of the Restormel abstraction licence. Restormel WTW is the largest in the Colliford WRZ and is able to provide water to much of Cornwall. An increase in the size of the works will provide very flexible benefits and an increase in resilience across the WRZ.

Investigation & implementation

An increase in the size of the works will require various engineering and process studies and the use of innovative modern water treatment options.

Constraints

There are no obvious physical constraints to this option, but see links and dependencies as below.

Links and dependencies

The scheme could be considered jointly with the Restormel licence variation resource management scheme (Option C5) to achieve the maximum WAFU benefit.

Note - Consideration could also be given to a new high level WTW near Colliford Reservoir as opposed to adding to the WTW capacity at Restormel WTW. However, this would require abstraction licence changes to enable the water to be abstracted directly from Colliford Reservoir as opposed to from Restormel.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	0	0	0	This option is within an existing licence and should not affect any sites designated for ecological reasons. Construction works are limited and should not have a significant impact. However, to obtain the maximum WAFU benefit, this scheme should be considered in conjunction with the Restormel licence variation resource management scheme (Option C5), therefore see comments against Option C5 in connection with this scheme.
2. Protection and enhancement of the historic, cultural and	0	0	0	This option is close to Lanhydrock House and Gardens and also to a number of Scheduled Monuments.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
industrial heritage resource				However, construction works are minimal and unlikely to impact upon cultural/historical heritage. Mitigation – ensure any works that do take place do not impact upon cultural/historical heritage.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	-/0	0	0	This option is within the existing licence, so no adverse impacts are predicted in relation to abstraction. When construction works are carried out, there is the potential to cause pollution to surface water and groundwater through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. Mitigation - any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.
4. Ensuring the appropriate and efficient use of land	0	0	0	Option is within existing South West Water land.
5. Limiting the causes, effects of, and adapting to climate change	0	0/+	0/+	This option would optimise use of available water resources and help adapt to climate change pressures on resources.
6. Ensuring sustainable use of water resources	0	0	0	This option will not affect losses from the system or water efficiency.
7. Protection and enhancement of landscape character	0	0	0	This option is not located in an area of landscape sensitivity, though it is close to Cornwall AONB. However, works are limited and should not have a significant impact upon local landscape.
8. Protection and enhancement of human health	+	+	+	This option would help ensure the continuity of clean drinking water supply.

Summary		
Positive	•	This option would help ensure the continuity of clean drinking water supply.
Negative	•	When construction works are carried out, there is the potential to cause pollution to surface water and groundwater through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site.
	•	If this scheme is progressed in conjunction with the Restormel licence variation scheme (Option C5), see comments against Option C5.
Mitigation	•	Any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation. Ensure any works that do take place to not impact upon cultural/historical heritage.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Restormel WTW capacity increased to 110 Ml/d	8	49,330	4,310	970	0	280	5,550	11	11

C3: Reintroduce abstractions at Boswyn and Cargenwyn for treatment at Stithians WTW

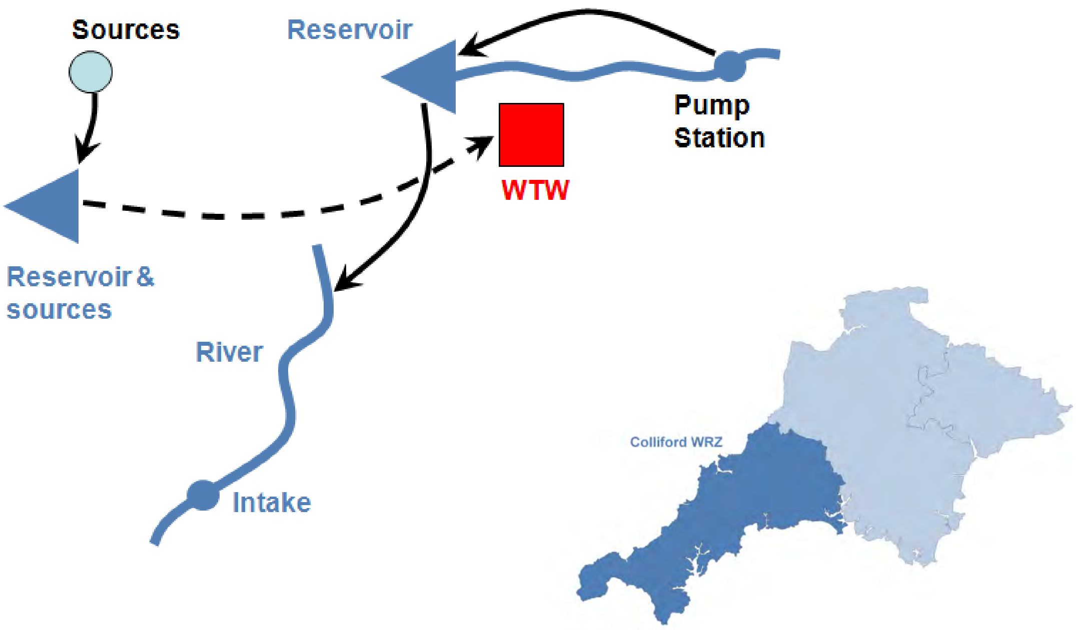
Option type: Production management
Indicative benefit: 3 Ml/d
Implementation: 2 years

Description of the option

The scheme entails linking a number of currently unused licensed sources to Stithians WTW. The sources may be able to be reliably re-introduced as a permanent scheme, rather than as a potential temporary drought scheme(s).

The main works associated with the linking of the sources will include:

- A permanent 6.6km 400mm diameter pipeline
- Pumping stations
- Mixing tanks



Area of benefit

The Colliford WRZ will benefit from this option.

Uncertainty of benefits

There is a reasonable level of confidence in the assessment of the benefits of this option.

Flexibility of option

This option will provide Stithians WTW with water from a number of different sources thereby increasing flexibility and robustness.

Investigation & implementation

Engineering and environmental studies of potential pipeline routes will be required ahead of implementation.

Constraints

No new abstraction licences will be required for this option.

Links and dependencies

The implementation of this option is not affected by links with, or dependencies on, other options.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	?/-	0	0	When construction works are carried out, there is potential for some short term disruption to biodiversity, key habitats and species. However, there are no sites designated for ecological reasons within approximately 4km of the proposed abstractions. Mitigation – Carry out ecological studies.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	?/-	0	0	The various abstractions are within 1km of Scheduled Monuments. There is potential that the construction works associated with laying the new pipelines could have a negative impact upon historic, cultural and industrial heritage resource. Mitigation – ensure that pipelines do not affect Scheduled Monuments.
3. Protection and enhancement of the	?/-	0	0	The proposed abstractions are within

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
quality and quantity of the surface water environment and the groundwater resource				the existing licence. When pipelines are constructed there is the potential to cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. Mitigation - Any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.
4. Ensuring the appropriate and efficient use of land	0	0	0	This option should not increase land take.
5. Limiting the causes, effects of, and adapting to climate change	0	0	0	No significant effects are likely.
6. Ensuring sustainable use of water resources	0	0	0	This option will not affect losses from the system or water efficiency.
7. Protection and enhancement of landscape character	?/-	0	0	When construction works are carried out, there is the potential for some short term disruption to the landscape. However, the option is not located in an area that is designated for landscape quality.
8. Protection and enhancement of human health	?/+/-	+	+	This option would ensure the continuity of clean drinking water supply. This option is unlikely to impact upon opportunities for recreation. There may possibly be some short term negative impacts if the construction works are located in a popular recreation area. Mitigation – works should minimise disruption and try to avoid affecting the public's opportunities for recreation.

Summary	
Positive	• This option would ensure the continuity of clean drinking water supply.
Negative	• Possible construction impacts on biodiversity and key habitats and species. • When pipelines are constructed there is the potential to cause pollution to surface and groundwater sources through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on

Summary	
	site. • Possible construction impacts on Scheduled Monuments. • When construction works are carried out, there is the potential for some short term disruption to the landscape. • This option is unlikely to impact upon opportunities for recreation. There may possibly be some short term negative impacts if the construction works are located in a popular recreation area.
Mitigation	• Carry out ecological studies. • Ensure that pipelines do not affect Scheduled Monuments. • Any fuel and oil storage on site for the purposes of operating machinery would comply with appropriate legislation. • Works should minimise disruption and try to avoid affecting the public's opportunities for recreation.

Indicative costs

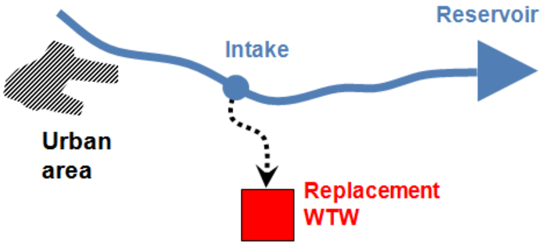
Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Reintroduce abstractions at Boswyn and Cargenwyn for treatment at Stithians WTW	3	17,780	4,340	1,600	0	250	6,190	33	35

C4: Re-use Rialton Intake / Porth Reservoir

Option type: Production management
Indicative benefit: 7 Ml/d
Implementation: 5 years +

Description of the option

The previous Rialton WTW was unable to treat the poor quality water which resulted from diffuse pollution in the Porth catchment. With the use of new WTW technology, along with a catchment management programme aiming to improve the water quality in Porth Reservoir, the source may be able to be reliably re-introduced as a permanent scheme, rather than as a potential temporary drought scheme.



Under the existing licence conditions, the source would have a maximum output of 10 Ml/d. The new works would operate under the existing abstraction licence.

Catchment management works include:

- agricultural clean water systems
- stream side fencing
- installation of best practice pollution control measures

- non-agricultural clean water systems

Capital works required include:

- Works to pump from Rialton Intake to the WTW facilities
- Development of a robust WTW process
- Potential land purchase for permanent WTW site

Area of benefit

The Colliford WRZ will benefit from this option.

Uncertainty of benefits

The feasibility of this option depends upon the success of the catchment management project improving the quality of the reservoir's receiving waters. If this project is successful, then there is a high level of confidence associated with the assessment of the Deployable Output of the option.

Flexibility of option

The option will provide direct benefits to Newquay and the surrounding area and by reducing the water taken from the spine main it will enable more spine main water to move westwards.

Investigation & implementation

A feasibility study of the catchment management programme is required. Assuming this programme is feasible there could be a lead-in time of perhaps 5 years before the benefits can be realised.

Constraints

The main constraints on this option relate to the level of participation of landowners and other interested parties within the catchment.

Links and dependencies

The implementation of this option is not affected by links with, or dependencies on, other options.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of	0	++	++	This option involves the clean up of the polluted Porth catchment (pollution from

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
biodiversity, key habitats and species				agriculture) through catchment management practices, therefore this should provide major benefits for the protection and enhancement of biodiversity, key habitats and species over a large area. Assuming this programme is feasible, there will be a lead-in time of 5 years.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	?/-	?/-	?/-	There are two Scheduled Monuments situated next to Porth Reservoir (Melangoose Camp and St Pedyr's Well) which may be impacted by the construction of the associated works for this option. Mitigation – avoid locating new pumping station in a location which may adversely impact upon Scheduled Monuments if possible.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	0	++	++	The clean up of this catchment will enhance the quality of the surface water environment and the groundwater resource. Assuming this programme is feasible, there could be a lead in time of 5 years.
4. Ensuring the appropriate and efficient use of land	-	+/-	+/-	This option could require extra land for the WTW, which could be a greenfield site. However, as this option involves the clean up of the catchment, there will also be benefits to the land. Assuming this programme is feasible, there could be a lead-in time of 5 years. Mitigation – investigate potential brownfield sites as an alternative to greenfield.
5. Limiting the causes, effects of, and adapting to climate change	0	+	+	This option may help the region adapt to climate change by making better use of the water resources. Assuming this programme is feasible, there could be a lead-in time of 5 years.
6. Ensuring sustainable use of water resources	0	++	++	This option will improve the sustainable use of water resources by cleaning up a currently polluted catchment.

South West Water Bournemouth Water

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				Assuming this programme is feasible, there could be a lead-in time of 5 years.
7. Protection and enhancement of landscape character	?/-	?/-	?/-	Construction works and the new pumping station may have a detrimental visual impact on the area. However, the pumping station area is not designated as a valuable landscape. The WTW location is unlikely to be a designated area. Mitigation – minimise disruption to the landscape caused by construction and avoid locating the pumping station and WTW in a highly visible location, or employ screening bunds.
8. Protection and enhancement of human health	0	++	++	This option will help ensure the continuity of clean drinking water supply (assuming this programme is feasible, there could be a lead-in time of 5 years). By cleaning up a polluted catchment, this has beneficial impacts on human health.

Summary	
Positive	• This option involves the cleanup of the polluted Porth catchment (pollution from agriculture), therefore this should provide major benefits for the protection and enhancement of biodiversity, key habitats and species. • The clean up of this catchment will enhance the quality of the surface water environment and the groundwater resource. • This option will improve the sustainable use of water resources by cleaning up a currently polluted catchment. • This option involves the clean up of the catchment which will benefit the land. • This option may help the region adapt to climate change by making better use of the water resources.
Negative	• This option will require extra land, which could be a greenfield site. • Construction works and the new pumping station may have a detrimental visual impact on the area. However, the area is not designated as a valuable landscape.
Mitigation	• Minimise disruption to the landscape caused by construction and avoid locating the pumping station and new WTW in a highly visible location, or employ screening bunds. • Avoid locating new pumping station and new WTW in a location which may adversely impact upon Scheduled Monuments if possible. • Investigate potential brownfield sites as an alternative to greenfield.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Re-use of Rialton Intake/Porth Reservoir	7	16,700	4,650	2,440	0	94	7,180	42	43

C5: Restormel licence variation

Option type: Resource scheme
Indicative benefit: 2 - 3 Ml/d
Implementation: 2 years

Description of the option

A study[A.6.6] carried out in 2007 has shown that the current operation of Restormel intake has an insignificant impact on winter salmon migration. This operation, which includes a take for supply and abstraction for the pumped refill of Colliford Reservoir, is controlled by authorised quantities (daily and annual maximum volumes) and flow conditions in the abstraction licence.

A further development of the existing scheme comprises operation within the existing licence conditions for prescribed flow, percentage take and daily maximum take, but without the annual authorised quantity limit. Removal of the maximum annual quantity would have the effect of allowing an abstraction (i.e. for supply plus Colliford recharge) of up to 110 Ml/d every day (as constrained by the existing infrastructure).

This scenario would require a licence variation to increase the maximum authorised annual quantity above the current 28,900 Ml/yr.

The above study found that the increased authorised annual abstraction would have limited impact on salmon, but environmental work would be required to support the necessary licence variation.

No capital costs are required for this option.

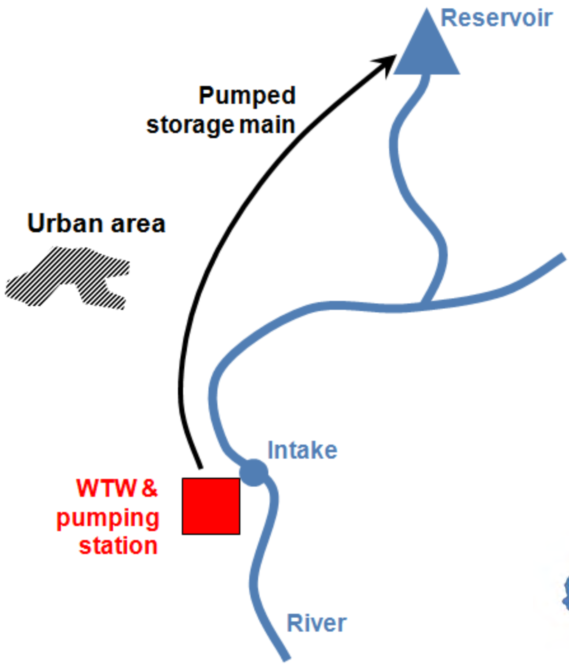
It is stressed that this option is exploratory at this stage, representing a potential opportunity for water resource development to support Colliford Reservoir. Significantly more work would be required in support of any formal application, including an environmental impact assessment (EIA) for any additional take beyond the current licensed volumes.

While it is concluded that the pumped storage scheme could be operated and extended with minimal environmental impact on salmon, it is important to note the potential environmental benefits of the scheme. For example:

- An application for a new abstraction licence is likely to include a review of the size and use of the Fisheries Water Bank.

[A.6.6] Solomon, D. Sambrook, H. & Toms, S. (2007), *Restormel abstraction and winter run salmon on the River Fowey, South West Water/Environment Agency, June 2007*

- Increasing the Deployable Output of the Colliford Scheme will remove, or at least delay, the requirement for other new water supply schemes with their associated risk of potential environmental impacts.
- There is a considerable bank of knowledge about the salmon and sea trout in the Fowey catchment and their responses to changes in flows.



Area of benefit

The Colliford WRZ will benefit from this option.

Uncertainty of benefits

The benefits of this option will depend upon the results of detailed studies in support of a full EIA together with discussions with the Environment Agency and other interested parties.

Flexibility of option

Additional abstractions at Restormel WTW would be extremely useful as the benefits can be spread throughout the Colliford WRZ.

Investigation & implementation

Detailed investigations and consultation with the regulator and interested parties are required for this scenario in addition to a licence variation.

Constraints

The main constraint on this option is its acceptability to the regulator and other interested parties.

Links and dependencies

This option should be considered in association with the expansion of Restormel WTW (Option C2).

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	?/+/-	?/+/-	?/+/-	As this option amounts to an increase in abstraction there may be an impact upon biodiversity, key habitats and species in the Fowey. However, this option proposes to increase the Deployable Output of the Colliford Scheme through abstraction of higher flows whilst protecting low flows. This option should not impact on any non-river sites designated for ecological reasons. Mitigation – detailed ecological surveys would need to be undertaken.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	0	0	0	This option is close to Lanhydrock House, Boconnoc Manor and a number of Scheduled Monuments. There are no construction works associated with this option, so no impacts are anticipated.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	+	+	+	See comments above, however, this option proposes to increase the Deployable Output of the Colliford Scheme through abstraction of higher flows whilst protecting low flows. Mitigation - detailed hydrological studies would be required.
4. Ensuring the appropriate and efficient use of land	0	0	0	This option should not require any extra land.
5. Limiting the causes, effects of, and adapting to climate change	+	+	+	This option has the potential to manage water resources in an environmentally sensitive and sustainable manner taking advantage of the predicted increased

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				winter rainfall due to climate change and therefore help the region to adapt to climate change.
6. Ensuring sustainable use of water resources	+	+	+	This option has the potential to manage water resources in an environmentally sensitive manner.
7. Protection and enhancement of landscape character	0	0	0	There are no construction works associated with this option, so no visual impacts on landscape are anticipated.
8. Protection and enhancement of human health	+	+	+	This option would ensure the continuity of the clean drinking water supply.

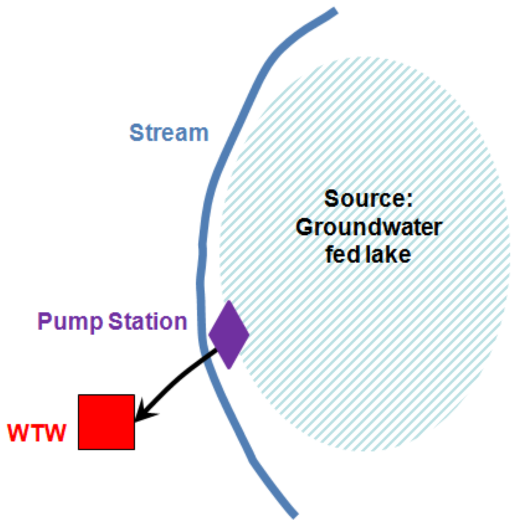
Summary	
Positive	• This option proposes to increase the Deployable Output of the Colliford Scheme through abstraction of higher flows whilst protecting low flows. • This option has the potential to manage water resources in an environmentally sensitive and sustainable manner and therefore help the region to adapt to climate change. • This option would ensure the continuity of the clean drinking water supply.
Negative	• As this option amounts to an increase in abstraction there may be an impact upon biodiversity, key habitats and species, particularly parts of the River Fowey, hence the need for an EIA.
Mitigation	• Detailed ecological surveys would need to be undertaken. • Detailed hydrological studies would be required.

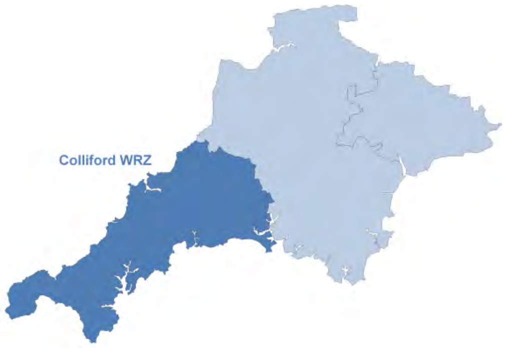
Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Restormel licence variation	3	6,900	138	660	0	0	790	11	11

C6: Stannon – increase in licence (groundwater developments)

Option type: Resource scheme
Indicative benefit: 4 Ml/d
Implementation: 2 years





Description of the option

Stannon Lake has an existing licence, renewed in 2017, to abstract at up to 4 Ml/d all year round. The water is pumped to one of two WTWs or Colliford Reservoir. As part of the licence renewal application, modelling was carried out to assess the resource potential of the source and the impact of abstraction on the environment. The findings indicated that the licence could be varied to provide more flexibility given the large storage in the lake. This approach was taken for the renewal of the licence of Park Lake (a lake in a similar hydrological setting to Stannon) permitting an 8 Ml/d abstraction rate for extended periods.

This scheme would comprise further modelling and environmental impact investigations to confirm that 8 Ml/d for extended periods is also sustainable. If an increase in the abstraction licence is achieved, infrastructure changes would be required to accommodate the increase in abstraction rate to 8 Ml/d.

Area of benefit

The Colliford WRZ will benefit from this option.

Uncertainty of benefits

The benefits of this option will depend upon the results of detailed studies in support of a full EIA together with discussions with the Environment Agency and other interested parties but could increase deployable output by up to 4 Ml/d.

Flexibility of option

Additional abstractions at Stannon would be extremely useful as the benefits can be spread throughout East Cornwall.

Investigation & implementation

Detailed investigations and consultation with the regulator and interested parties are required for this scenario in addition to a licence variation. The practicalities of transporting the additional water would need detailed consideration.

Constraints

The main constraint on this option is its acceptability to the regulator and other interested parties.

Links and dependencies

None

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	?/+/-	?/+/-	?/+/-	As this option amounts to an increase in abstraction there may be an impact upon biodiversity, key habitats and species in the Camel, however the high storage in the lake is likely to restrict impacts during critical low flow periods. Mitigation – detailed impact modelling and investigations.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	0	0	0	There are no known historic, cultural or industrial heritage sites in the vicinity of the lake.
3. Protection and enhancement of the quality and quantity of the surface water	+	+	+	See comments above, however, this option to increase abstraction will only be licensed if it can be shown that there is no detrimental impact on the

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
environment and the groundwater resource				environment. Mitigation - detailed hydrological studies as part of the licence application process.
4. Ensuring the appropriate and efficient use of land	0	0	0	This option should not require any extra land. We continue to regenerate this old china clay pit as part of our utilisation of the site.
5. Limiting the causes, effects of, and adapting to climate change	+	+	+	This option has the potential to manage water resources in an environmentally sensitive and sustainable manner taking advantage of the large lake storage which will limit impacts in low flow periods and therefore help the region to adapt to climate change.
6. Ensuring sustainable use of water resources	+	+	+	This option has the potential to manage water resources in an environmentally sensitive manner.
7. Protection and enhancement of landscape character	-	0	+	Infrastructure improvements will involve short term impacts on the landscape, but the increased significance of the site in water supply terms is likely to promote further site regeneration.
8. Protection and enhancement of human health	+	+	+	This option would ensure the continuity of the clean drinking water supply.

Summary	
Positive	• This option proposes to increase the Deployable Output of Stannon Lake through better use of storage water. • This option has the potential to manage water resources in an environmentally sensitive and sustainable manner and therefore help the region to adapt to climate change. • This option would ensure the continuity of the clean drinking water supply.
Negative	• As this option amounts to an increase in abstraction there may be an impact upon biodiversity, key habitats and species in the Camel, hence the need for an EIA as part of a licence application. • There could be short term impact on the landscape from infrastructure changes.
Mitigation	• Detailed hydrological studies would be required. • Detailed engineering studies would be required to confirm the impact of increasing abstraction capacity and supplies to local WTWs.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Stannon licence variation	4								11

Indicative AISC value is based on similar schemes. Revised costs will be re-calculated for the Final WRMP.

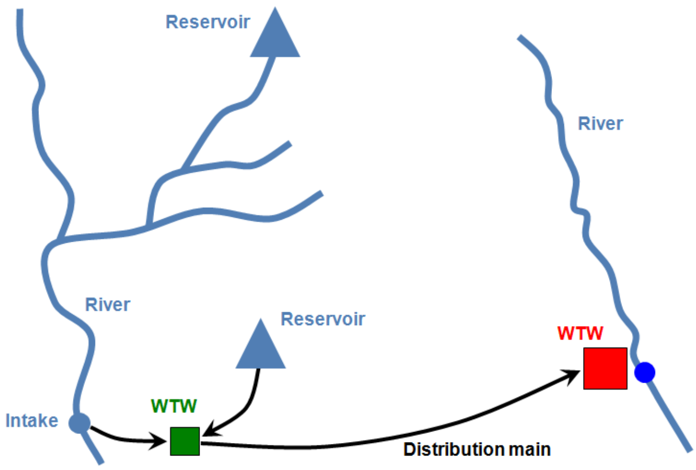
R1: Duplication of distribution main through South Devon and Littlehempston WTW capacity increase to 100Ml/d

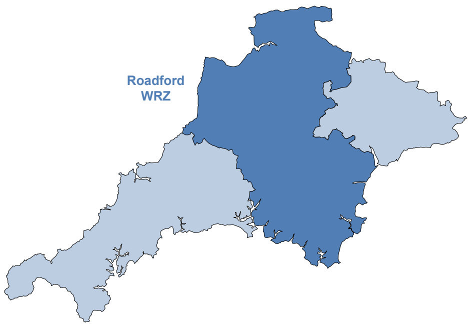
Option type: Distribution/production management
Indicative benefit: 16 Ml/d
Implementation: 3 years

Description of the option

The option would allow an increased volume of water to be transferred from the Roborough Tank to Littlehempston WTW through the South Devon Spine Main. The duplicate main would be 800 mm diameter, 38 km long with cross connections to existing main.

Water, which originates from Roadford and Burrator Reservoirs and associated sources, would then be treated at the enlarged Littlehempston WTW for subsequent distribution in South Devon. The Littlehempston WTW maximum capacity would be increased to 100 Ml/d which will require new clarifiers and rapid gravity filters, or the use of innovate technology.





Area of benefit

The Roadford WRZ will benefit from this option.

Uncertainty of benefits

There is a reasonable level of confidence in the assessment of the benefits of this option.

Flexibility of option

By reducing the limitation on the extent to which South Devon can be supported directly by the Roadford/Tamar/Burrator sources the option increases the flexibility of the supply system.

Littlehempston is able to provide water to a wide area and increasing the size of the works will result in an increase in the flexibility of the supply system in this area.

Investigation & implementation

An environmental impact assessment would be carried out before the pipeline option is implemented. Engineering and process studies will be required before the treatment works extension can be implemented.

Constraints

No new abstraction licences will be required for this option.

Links and dependencies

For the purposes of the supply demand balance the new pipeline and treatment works extension need to be considered as one option.

The scheme should also be considered in conjunction with the Roadford/Northcombe pumped storage from Gatherley (River Tamar) which would assist with providing the potential WAFU benefit.

This option is also likely to be necessary in order to realise the full benefits of the Roadford/Northcombe pumped storage from Gatherley option.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	-	0	0	Construction work associated with laying new pipeline and extending the treatment works would be likely to cause a short term disruption to biodiversity and key habitats and species. No medium or long term impacts are

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				anticipated. Littlehempston No ecological designated sites within approximately 5km. Mitigation – carry out ecological studies, particularly concerning any SSSIs and SACs along the proposed pipeline route.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	?/-	0	0	Construction work associated with laying new pipeline and extending the treatment works could impact upon the setting and integrity of local historic and cultural resources. No long term impacts are anticipated. Littlehempston Dartington Hall and Berry Pomeroy Castle Scheduled Monument are in the vicinity.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	?/-	0	0	This option does not require an increase in abstraction from the River Dart and so would not impact upon the available surface water resource. The upgrade of the chemical storage area and construction of the pipeline has the potential to cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. Mitigation – any chemicals, fuel and oil storage on site for the purposes of operating machinery would comply with the Control of Pollution (Oil Storage) (England) Regulations 2001 (Oil Storage Regulations). Measures to control runoff would be employed.
4. Ensuring the appropriate and efficient use of land	-	0	0	Construction works associated with this option are likely to impact upon valuable and sensitive land in the short term.
5. Limiting the causes, effects of, and adapting to climate change	0	0/+	0/+	This option will increase the flexibility of supply to South Devon helping to adapt to increased water supply pressures

Criteria	What is the predicted temporal effect Short term	Med term	Long term	Commentary (including cumulative effects and potential mitigation measures)
				from climate change.
6. Ensuring sustainable use of water resources	+	+	+	This option would provide better flexibility of the supply system whilst not affecting losses from the system or water efficiency.
7. Protection and enhancement of landscape character	-	0	0	Construction work associated with laying new pipeline and extending the treatment works are likely to have a negative visual impact upon the landscape in the short term. Littlehempston South Devon AONB is approximately 5km to the south.
8. Protection and enhancement of human health	+/-	+	+	This option would ensure the continuity of clean drinking water supply. This option may impact upon opportunities for recreation in the short term due to construction works. Mitigation – minimise construction impacts on recreation opportunities.

Summary	
Positive	• This option would ensure the continuity of clean drinking water supply. • This option would provide better flexibility of the supply system.
Negative	• Construction work associated with laying new pipeline and extending the treatment works would be likely to cause a short term disruption to biodiversity and key habitats and species – the option has the potential to impact upon a number of designated and sensitive sites. • Construction work associated with laying new pipeline and extending the treatment works could impact upon the setting and integrity of local historic and cultural resources. • Construction works associated with this option are likely to impact upon valuable and sensitive land in the short term. • This option may impact upon opportunities for recreation in the short term due to construction works. • The upgrade of the chemical storage area and construction of the pipeline has potential to cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. • Construction works associated with laying new pipeline and extending the treatment works are likely to have a negative visual impact upon the landscape.

Summary	
Mitigation	• Carry out ecological studies, particularly concerning any SSSIs and SACs. • Ensure that works do not impact upon the setting and integrity of cultural and historic resources. • Minimise construction impacts on recreation opportunities. • Any chemicals, fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation. • Measures to control runoff would be employed. • Minimise construction impacts on landscape.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Duplication of distribution main through South Devon and Littlehempston WTW capacity increased to 100 Ml/d	16	88,960	48,200	26,720	0	1,930	76,860	84	86

R2: Northcombe WTW capacity increase to 60 Ml/d

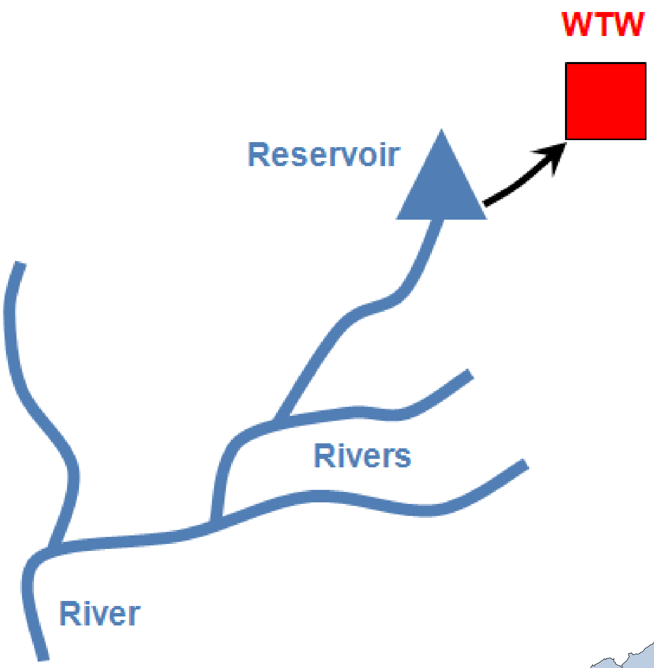
Option type: Distribution/production management
Indicative benefit: 10 Ml/d
Implementation: 2 years

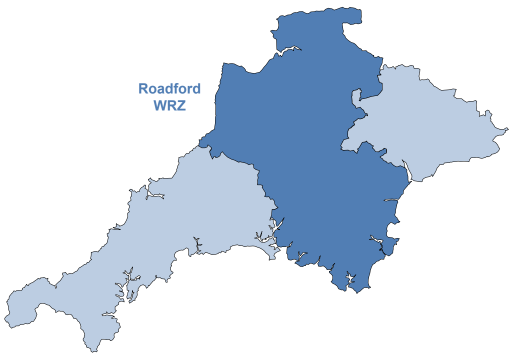
Description of the option

This scheme entails increasing the capacity of Northcombe WTW to 60 Ml/d. This will enable more Roadford water to be treated at Northcombe for subsequent distribution in North Devon.

The works required include:

- new raw water tank
- rapid gravity filters
- flat bottomed clarifiers





Area of benefit

The Roadford WRZ will benefit from this option.

Uncertainty of benefits

There is a reasonable level of confidence in the assessment of the benefits of this option.

Flexibility of option

An increase in the capacity of Northcombe WTW will improve the flexibility of the North Devon supply system.

Investigation & implementation

Engineering studies will be required ahead of the implementation of this option.

Constraints

No new abstraction licences are required for this option.

Links and dependencies

This option is necessary in order to realise the full benefits of the Roadford / Northcombe pumped storage from Gatherley option.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	0	0	0	This option involves increasing the capacity of Northcombe WTW within the existing licence. No impacts are anticipated on biodiversity, key habitats and species.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	0	0	0	This option is not anticipated to have any impact on historic resources or cultural heritage.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	0	0	0	This option will not require any changes to abstraction licences.
4. Ensuring the appropriate and efficient use of land	0	0	0	N/a
5. Limiting the causes, effects of, and adapting	+/-	+/-	+/-	This option improves the flexibility of the North Devon supply system which should aid the region’s adaptation to

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
to climate change				climate change by increasing the capacity of the WTW. Increasing the capacity of the WTW is likely to lead to the consumption of more energy at the WTW but may reduce overall energy consumption. Mitigation – consideration of energy efficiency including energy from renewables.
6. Ensuring sustainable use of water resources	0	0	0	This option would not affect water efficiency or losses from the supply network.
7. Protection and enhancement of landscape character	0	0	0	This option would not have an impact upon landscape.
8. Protection and enhancement of human health	+	+	+	The option would contribute to the continuity of a clean drinking water supply.

Summary	
Positive	• This option improves the flexibility of the North Devon supply system which should aid the region's adaptation to climate change by increasing the capacity of the WTW. • The option would contribute to the continuity of clean drinking water supply.
Negative	• Increasing the capacity of the WTW is likely to lead to the consumption of more energy at the WTW.
Mitigation	• Consideration of energy efficiency including energy from renewables.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Northcombe WTW capacity increase to 60 Ml/d	10	19,380	1,450	1,460	0	210	3,120	15	16

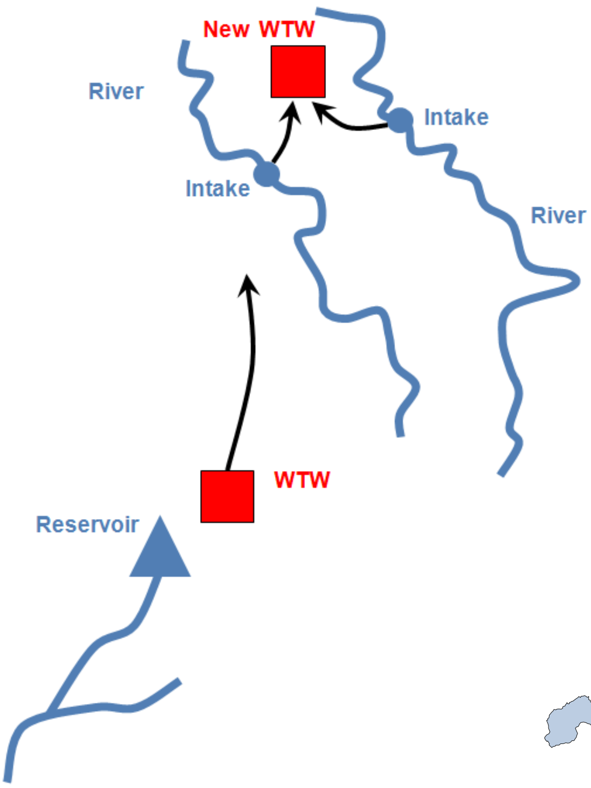
R3: River Taw and / or Torridge abstractions

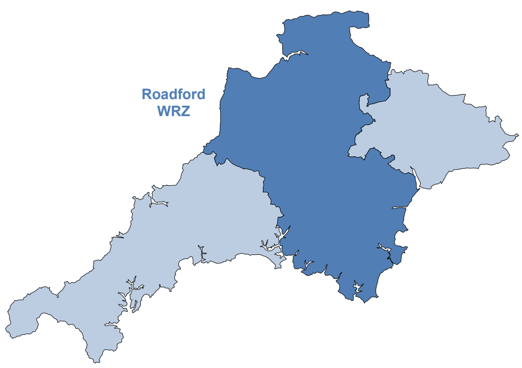
Option type: Resource scheme
Indicative benefit: 14 Ml/d
Implementation: 3 years

Description of the option

This option entails the construction of a new WTW in North Devon utilising abstractions from the Rivers Taw and/or Torridge.

The aquatic and associated environment will be protected by suitable prescribed flow conditions on new licences, to protect the low flows. The scheme could potentially provide a significant increase in the Deployable Output of the Roadford WRZ by reducing the dependence of North Devon on raw water from Roadford Reservoir treated at Northcombe WTW.





Area of benefit

The Roadford WRZ will benefit from this option.

Uncertainty of benefits

The most significant uncertainty associated with this option is its environmental acceptability. There are also uncertainties associated with finding suitable locations for the new WTW and the associated river intakes.

Flexibility of option

By reducing the dependence of North Devon on Roadford Reservoir in the periods of higher river flows, the option will allow Roadford storage to be used elsewhere thereby increasing the flexibility of the system.

Investigation & implementation

Extensive engineering and environmental studies will be required before this scheme can be implemented.

Constraints

New abstraction licences will be required for this scheme and permission to build a new WTW and associated infrastructure.

Links and dependencies

The implementation of this option should be considered in conjunction with the Roadford/Northcombe pumped storage from Gatherley option.

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Note: Consideration could also be given to laying a new pipeline and transferring the water to Northcombe WTW, as an alternative to investing in a new WTW.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	-	?/-	?/-	A new intake on the River Taw and/or Torridge has the potential to have a negative impact on biodiversity, key habitats and species; however, these abstractions would be subject to licences with suitable prescribed flow conditions. The construction of new pipelines and a new WTW would be expected to cause a short term detrimental impact on biodiversity, key habitats and species. Locations have not yet been specified

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				for potential abstractions or a site for a WTW, however these rivers feed into the Taw Torridge Estuary, which is designated as a SSSI (currently in a predominantly 'Favourable' condition), and Braunton Burrows which is a Biosphere Reserve, SAC and SSSI (currently in an 'Unfavourable – declining' condition). This would need to be taken into consideration in any licence applications. Mitigation – minimise disruption from construction. Mitigation – carry out ecological studies of the potential impact of abstraction on the estuary and Braunton Burrows.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	0	0	0	This option is not expected to impact upon historic, cultural and industrial heritage resource. Mitigation - the construction of the new pipelines and WTW should not be located in an area that would impact upon cultural heritage.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	?/-	?/	?/-	A new intake on the River Taw and/or Torridge has the potential to have a negative impact on biodiversity, key habitats and species; however, these abstractions would be subject to licences with suitable prescribed flow conditions. The construction of the WTW and associated pipelines has the potential to cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. Mitigation – any chemicals, fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.
4. Ensuring the appropriate and efficient use of land	- -	-	-	This option would require additional land use, most likely a greenfield site for a new WTW and short term disruption when laying new pipelines.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				Mitigation – minimise disruption from construction Mitigation – look at using a brownfield site for the new WTW if possible.
5. Limiting the causes, effects of, and adapting to climate change	+	+	+	By reducing the dependence of North Devon on the Roadford Reservoir, the option would allow the Roadford storage to be used elsewhere which would increase the flexibility of the system and therefore help the region to adapt to climate change.
6. Ensuring sustainable use of water resources	0	0	0	This option would not affect losses from the system or efficiency.
7. Protection and enhancement of landscape character	-	0	0	This option would be likely to have a detrimental impact on landscape in the short term due to visual impacts from construction. However, this area is not designated for landscape quality (assuming construction would be kept away from North Devon AONB on the coast). Mitigation – minimise disruption from construction.
8. Protection and enhancement of human health	?/+/-	+	+	This option would ensure the continuity of clean drinking water supply. Construction works associated with laying new pipeline and building a new WTW may have a short term impact on opportunities for recreation. Mitigation – minimise disruption from construction.

Summary	
Positive	• By reducing the dependence of North Devon on the Roadford Reservoir, the option would allow the Roadford storage to be used elsewhere which would increase the flexibility of the system and therefore help the region to adapt to climate change. • This option would ensure the continuity of clean drinking water supply.
Negative	• These rivers feed into the Taw Torridge Estuary, which is designated as a SSSI (currently in a predominantly 'Favourable' condition), and Braunton Burrows which is a Biosphere Reserve, SAC and SSSI (currently in an 'Unfavourable –

	Summary
	declining' condition). This would need to be taken into consideration in any licence applications. • The construction of the WTW and associated pipelines has the potential to cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. • Construction works associated with laying new pipeline and building a new WTW may have a short term impact on opportunities for recreation. • This option would be likely to have a detrimental impact on landscape in the short term due to visual impacts from construction. • This option would require additional land use, most likely a greenfield site for a new WTW and short term disruption when laying new pipelines.
Mitigation	• Any chemicals, fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation. • Minimise disruption from construction. • Look at using a brownfield site for the new WTW if possible. • Carry out ecological studies of the potential impact of abstraction on the estuary and Braunton Burrows. • The construction of the new pipelines and WTW should not be located in an area that would impact upon cultural heritage.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
River Taw and / or Torridge abstractions	14	91,200	21,720	5,400	0	460	27,580	30	30

R4: Roadford / Northcombe pumped storage from Gatherley (River Tamar)

Option type: Resource scheme
Indicative benefit: 14 Ml/d
Implementation: 3 years

Description of the option

This option would involve a pumped storage scheme for Roadford Reservoir based on an intake on the River Tamar at Gatherley. A pipeline would connect the new intake to the existing Lyd/Thrushel pipework which transfers water to Roadford Reservoir.

Although the main abstraction will be from the River Tamar, there will also be a small abstraction from the River Lyd mainly for water quality reasons.

The main features of the scheme are:

- Refurbishment of the existing intake and pump arrangements on the River Lyd to a maximum of 40 Ml/d.
- Construction of an intake and pumping station on the River Tamar at Gatherley, with a maximum abstraction rate of 125 Ml/d.
- Construction of a 900 mm diameter, 3.6 km pumping main from the intake, to join the existing Lyd/Thrushel pipeline.
- Construction of a link between the existing Lyd/Thurshel pipeline and the existing main from Roadford to Northcombe WTW.

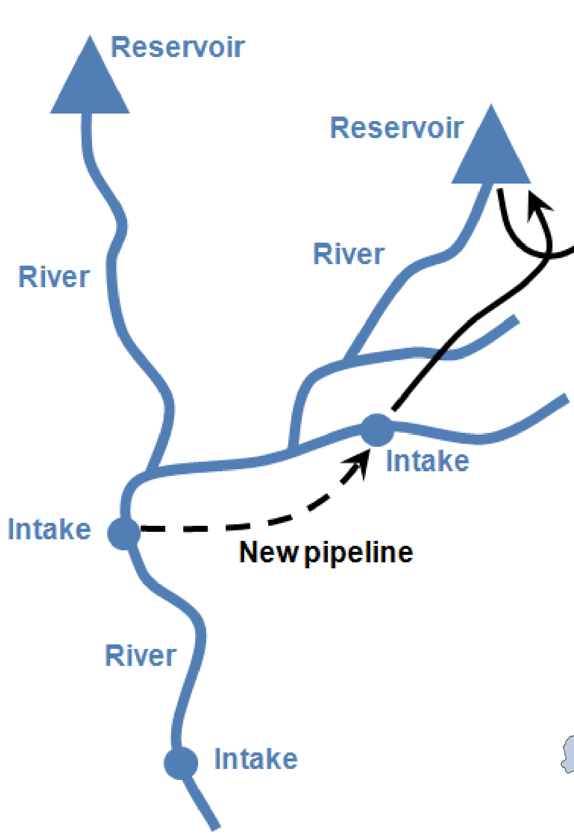
Two phases of the scheme are under consideration:

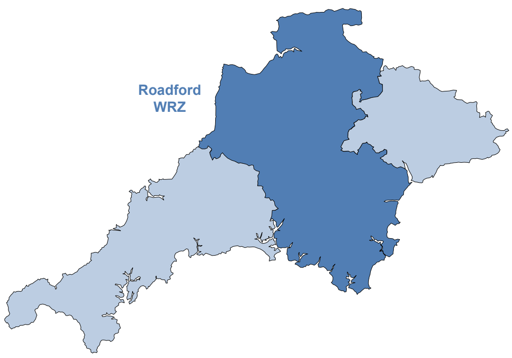
Phase 1: Will enable water from the River Lyd/Tamar to be **only** transferred to Northcombe WTW - rather than to Northcombe WTW and/or Roadford Reservoir. This will result in the benefit of the scheme being limited as although abstractions from Roadford will be minimised, no additional water will be added to Roadford storage.

Phase 2: Will enable water from the River Lyd/Tamar to be transferred to both Northcombe WTW and/or Roadford Reservoir. This will result in increasing the benefit of the scheme as additional water will be added to Roadford storage as well as abstractions from Roadford being minimised.

One of the main purposes of the phasing is to allow for an improvement in the water quality in the River Tamar through catchment management, before discharging water from the River Lyd/Tamar into Roadford Reservoir.

Abstractions are anticipated to be subject to prescribed flows and other conditions. On completion of Phase 2, the proposed scheme will allow Roadford to refill during dry winters, thus enabling it to become a single season reservoir and make more effective use of reservoir storage.





Area of benefit

The Roadford WRZ will benefit from this option.

Uncertainty of benefits

There is a reasonable level of confidence in the assessment of the benefits of this option, although precise benefits are dependent on the abstraction licence conditions.

Flexibility of option

Phase 1 of the scheme will enable more water to be distributed to North Devon, but this quantity will to some extent be limited by the demand in the area. Phase 2 will allow much more flexibility as the water will be put into storage and therefore can also be distributed in the southern part of the Roadford WRZ.

Investigation & implementation

Environmental studies will be required ahead of pipeline construction.

Constraints

New abstraction licences will be required for this scheme.

Links and dependencies

The benefits of this option cannot be fully realised until Northcombe WTW has been extended to 60 Ml/d.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	-	-	-	The construction of new pipelines and a new pumping station would be expected to cause a short term detrimental impact on biodiversity, key habitats and species. The Tamar flows down into the Tamar Estuary which is designated as a SAC and SSSI. This option may have a detrimental impact on biodiversity, key habitats and species in the long term, however appropriate abstraction licence conditions could minimise this. Mitigation – minimise disruption from construction. Mitigation – carry out ecological studies of the potential impact of abstraction.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	0	0	0	This option is not expected to impact upon historic, cultural and industrial heritage resource. Mitigation - the construction of the new pipelines and pumping station should not be located in an area that would impact upon cultural heritage.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	-	-	-	This option involves an increase in abstraction from the River Tamar. Construction of the pumping station and associated pipelines has the potential to

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. Mitigation - any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.
4. Ensuring the appropriate and efficient use of land	-	-	-	This option will require additional land for the development of a new pumping station and also there will be land disruption in the short term due to construction. Mitigation – minimise disruption from construction.
5. Limiting the causes, effects of, and adapting to climate change	+/-	+/-	+/-	This option may be able to take advantage of the predicted higher winter flows that could result from climate change and therefore, would help the region adapt.
6. Ensuring sustainable use of water resources	+	+	+	This option makes more effective use of reservoir storage whilst protecting lower flows.
7. Protection and enhancement of landscape character	-	0	0	This option would be likely to have a detrimental impact on landscape in the short term due to visual impacts from construction. However, this area is not designated for landscape quality (assuming construction works would be kept away from the Tamar Valley AONB which is approximately 2km to the south). Mitigation – minimise disruption from construction.
8. Protection and enhancement of human health	?/+/-	+	+	This option would ensure the continuity of clean drinking water supply. Construction works associated with laying new pipeline may have a short term impact on opportunities for recreation. Mitigation – minimise disruption from construction.

Summary		
Positive	•	This option may be able to take advantage of the predicted higher winter flows that could result from climate change and therefore, would help the region adapt.
	•	This option would ensure the continuity of clean drinking water supply.
	•	This option makes more effective use of reservoir storage whilst protecting lower flows.
Negative	•	Construction works associated with laying new pipeline may have a short term impact on opportunities for recreation.
	•	The construction of new pipelines and a new pumping station would be expected to cause a short term detrimental impact on biodiversity, key habitats and species.
	•	Construction of the pumping station and associated pipelines has the potential to cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site.
	•	This option would be likely to have a detrimental impact on landscape in the short term due to visual impacts from construction.
	•	This option involves an increase in abstraction from the River Tamar.
	•	This option will require additional land for the development of a new pumping station and also there will be land disruption in the short term.
Mitigation	•	Minimise disruption from construction.
	•	Any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.
	•	The construction of the new pipelines and pumping station should not be located in an area that would impact upon cultural heritage.
	•	Carry out ecological studies of the potential impact of abstraction.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Roadford / Northcombe pumped storage from Gatherley (River Tamar)	14	33,100	3,900	730	0	520	5,150	14	16

R5: Re-introduce abstractions from small reservoirs in North Devon (Slade, Gammaton and Melbury reservoirs)

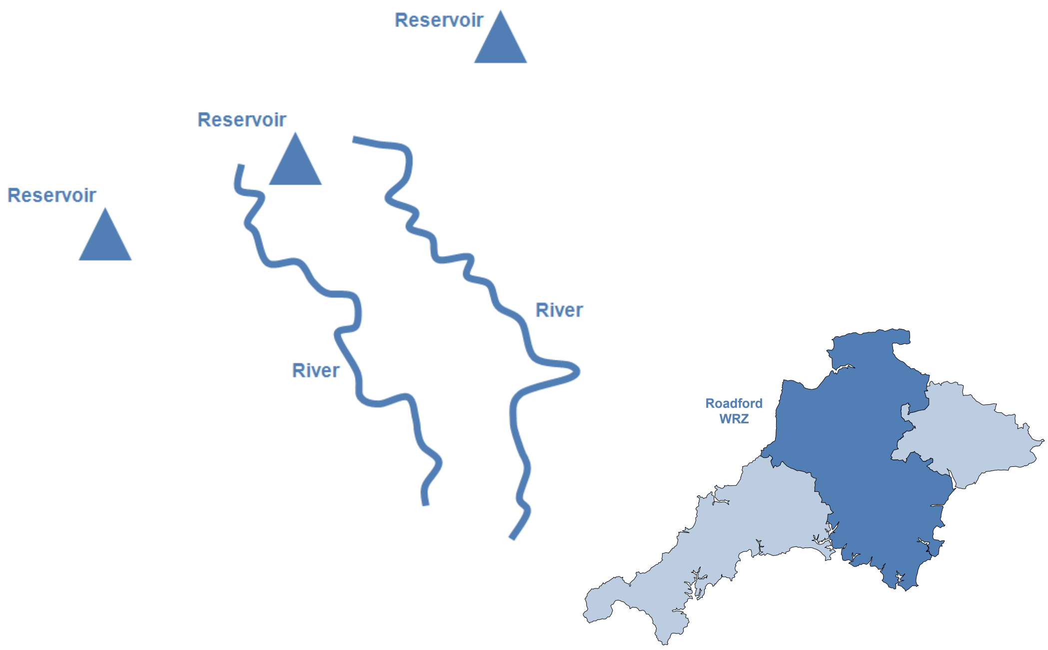
Option type: Resource scheme
Indicative benefit: 3 Ml/d
Implementation: 2 years

Description of the option

The scheme entails re-introducing a number of unused (but licensed) reservoir sources in North Devon.

Area of benefit

The Roadford WRZ will benefit from this option.



Uncertainty of benefits

There is a reasonable level of confidence in the assessment of the benefits of this option.

Flexibility of option

This option will provide North Devon with water from a number of different sources thereby increasing flexibility and robustness. It would reduce the dependence of North Devon on Roadford Reservoir, which would allow Roadford storage to be used elsewhere thereby increasing the flexibility of the system.

Investigation & implementation

Engineering and environmental studies of potential infrastructure sites and routes will be required ahead of implementation.

Constraints

No new abstraction licences will be required for this option. Permission to build new infrastructure would be required.

Links and dependencies

The implementation of this option should be considered in conjunction with the River Taw and/or River Torridge abstractions option (option R3).

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	?/-	0	0	When construction works are carried out, there is potential for some short term disruption to biodiversity, key habitats and species. Mitigation – carry out ecological studies.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	?/-	0	0	There is potential that the construction works associated with laying the new pipelines could have a negative impact upon historic, cultural and industrial heritage resource. Mitigation – minimise disruption from construction.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	?/-	0	0	As these abstractions already have licences, these abstractions are likely to have minimal negative impact on biodiversity, key habitats and species. The construction of any new assets required has the potential to cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. Mitigation – Any chemicals, fuel and oil storage on site for the purposes of

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				operating machinery would comply with the appropriate legislation.
4. Ensuring the appropriate and efficient use of land	0	0	0	This option should not increase land take because any new assets required should be able to be constructed on existing SWW land. The construction of any new assets required has the potential to cause short term disruption. Mitigation – minimise disruption from construction.
5. Limiting the causes, effects of, and adapting to climate change	0	0	0	By reducing the dependence of North Devon on Roadford Reservoir, the option would allow the Roadford storage to be used elsewhere which would increase the flexibility of the system and therefore help the region to adapt to climate change.
6. Ensuring sustainable use of water resources	0	0	0	This option would not affect losses from the system or efficiency.
7. Protection and enhancement of landscape character	?/-	0	0	This option would be likely to have a detrimental impact on landscape in the short term due to visual impacts from construction. Mitigation – minimise disruption from construction.
8. Protection and enhancement of human health	?/+/-	+	+	This option would ensure the continuity of clean drinking water supply. Construction works associated with any new assets required may have a short term impact on opportunities for recreation. Mitigation – minimise disruption from construction.

Summary	
Positive	• By reducing the dependence of North Devon on Roadford Reservoir, the option would allow the Roadford storage to be used elsewhere which would increase the flexibility of the system and therefore help the region to adapt to climate change. • This option would ensure the continuity of clean drinking water supply.
Negative	• The construction of any new assets required has the potential to cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. • Construction works associated with any new assets required may have a short term impact on opportunities for recreation. • This option would be likely to have a detrimental impact on landscape in the short term due to visual impacts from construction.
Mitigation	• Any chemicals, fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation. • Works should minimise disruption and try to avoid affecting the public's opportunities for recreation. • Carry out ecological studies. • The construction of any new assets required should not be located in an area that would impact upon cultural heritage.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Re-introduction of North Devon reservoirs	3								35

Indicative AISC value is based on similar schemes. Revised costs to be re-calculated for the Final WRMP.

R6: Uton source re-commissioning (with potential Coleford & Knowle licence transfer)

Option type: Resource scheme
Indicative benefit: 0.9 Ml/d
Implementation: 2 year

Description of the option

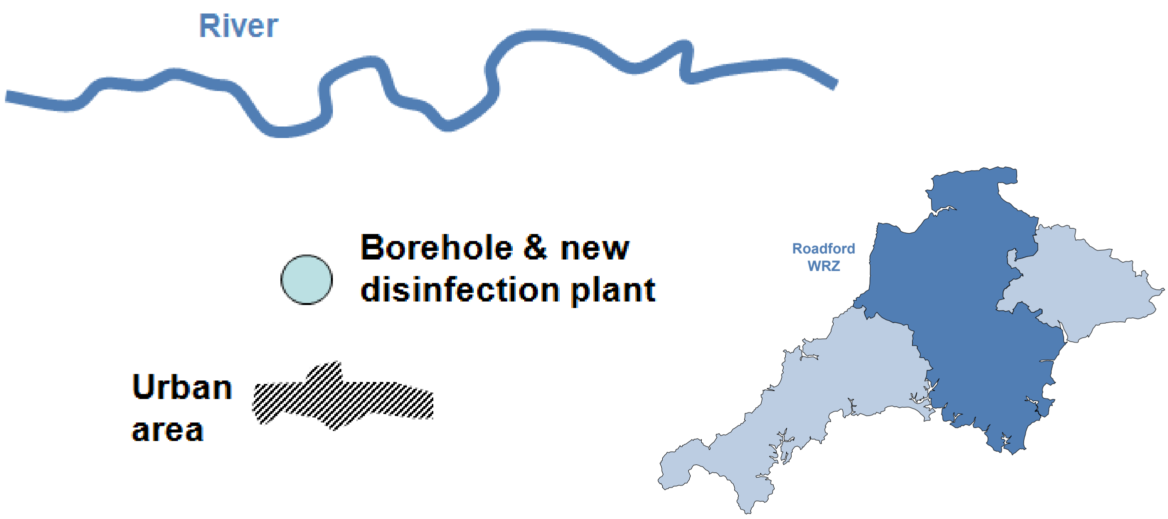
The disused pumping station and WTW at Uton has an abstraction licence for 0.9 Ml/d as an annual average. The original source (now backfilled) was replaced but never commissioned.

This scheme involves the commissioning of the current borehole and the installation of a modern disinfection plant.

There is also the potential to apply for an increase in the abstraction licence by an estimated 0.7 Ml/d through a transfer of licences from the disused neighbouring sources at Coleford and Knowle following the drilling of a second borehole. However, for the purposes of estimating costs, it has been assumed that the resource gain will be in line with the existing licence.

Works required include:

- Testing, equipping and commissioning of the existing borehole
- Installation of a disinfection plant
- Possible new borehole drilling



Area of benefit

The Roadford WRZ will benefit from this option.

Uncertainty of benefits

There is a good level of confidence in achieving an increase in Deployable Output of approximately 0.9 Ml/d through the existing borehole being equipped and commissioned. There are higher risks associated with the drilling of a second borehole and the transfer of abstraction licences from Coleford and Knowle.

Flexibility of option

This option utilises a former site with an existing source close to the supply network.

Investigation & implementation

An initial period of 3 months is required for testing to prove the yield and water quality of the existing source. The installation of treatment and equipping and commissioning will take a further 18 months.

Constraints

Water quality at the source may prove to be unacceptable for supply. Connections to the existing mains system will have to be checked carefully. The transferral of abstraction licences may not be granted.

Links and dependencies

The implementation of this option is not affected by links with, or dependencies on, other options.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	?/-	0	0	The drilling of a second borehole and commissioning of both boreholes with associated works may impact upon biodiversity, key habitats and species. However, there are no sites nearby that are designated for ecological reasons.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	0	0	0	There are no known heritage sites within the vicinity of Uton WTW.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	?	?	?	There are potentially existing water quality issues associated with land use and/or natural water quality. Any increase in Uton licence through a transfer from other sites would need to be assessed as environmentally sustainable. Mitigation – impact assessment based on the results of pumping trials on both boreholes.
4. Ensuring the appropriate and efficient use of land	-	-	-	No additional land is likely to be required.
5. Limiting the causes, effects of, and adapting to climate change	+	+	+	Re-commissioning this source would mean less energy consumption compared to the existing supply to this area. It would reintroduce a local water supply potentially reducing the demand on local reservoir sources and improving resilience to climate change impacts.
6. Ensuring sustainable use of water resources	+	+	+	By reintroducing a local groundwater supply, this would contribute to the sustainable use of water resources.
7. Protection and enhancement of landscape character	?/-	0	0	There may be some short term visual impacts on landscape due to the installation of a new disinfection plant and potential drilling of a second borehole. However, there are no areas designated for landscape quality nearby.
8. Protection and enhancement of human health	?/+/-	+	+	This option would ensure the continuity of clean drinking water supply.

Summary	
Positive	• This option would ensure the continuity of clean drinking water supply. • Re-commissioning this source (and possible consolidation of local licence volumes) would mean less energy consumption as a whole as it would re-introduce a local water supply consequently reducing pumping within the Roadford WRZ. • By reintroducing a local groundwater supply, this should contribute to the sustainable use of water resources.

Summary		
Negative	•	The construction works for the new treatment plant, eqippping of the existing source and potential drilling of a new borehole and associated works would be likely to have short term impact upon biodiversity, key habitats and species. However, there are no sites nearby that are designated for ecological reasons.
	•	There may be some short term visual impacts on landscape due to the drilling activities and construction of the treatment plant.
Mitigation	•	Limiting of impact of construction activities and drilling.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Uton recomm.	0.9	5,550	743	536	0	283	1,562	23	28

W1: Increase Pynes WTW & Intake to 67 Ml/d

Option type: Production management
Indicative benefit: 2.1 Ml/d
Implementation: 18 months

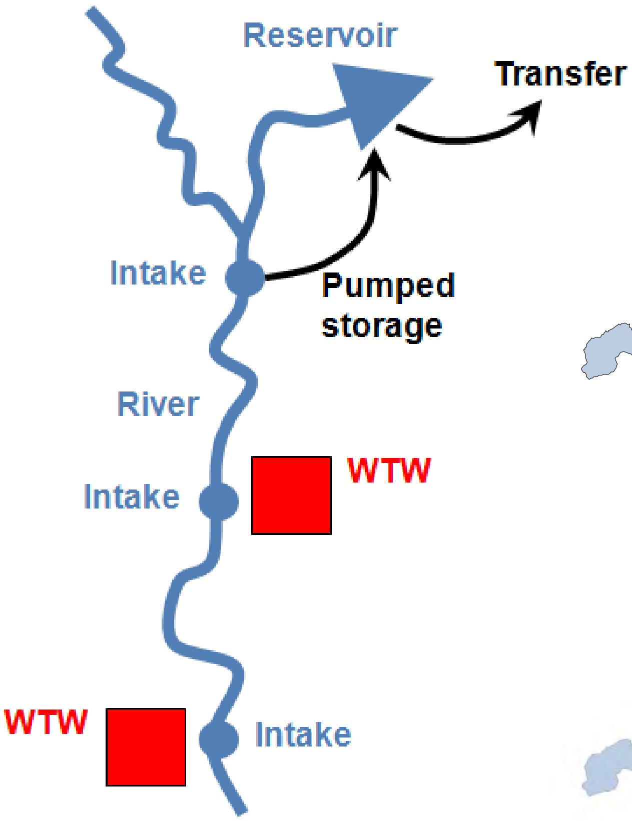
Description of the option

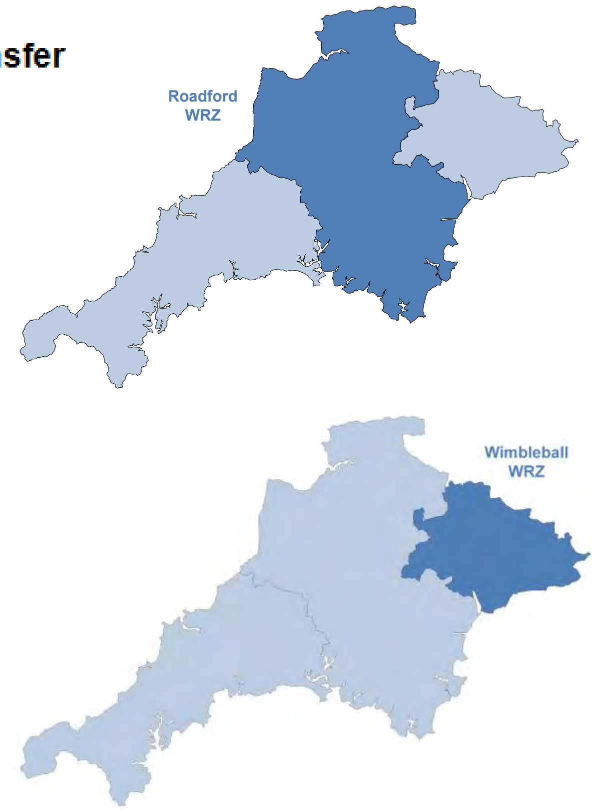
This option will increase the maximum capacity of Pynes WTW up to its licensed maximum of 67 Ml/d thereby improving the Company's ability to utilise the yield of the River Exe/Wimbleball resources system.

The raw water main currently restricts works output and therefore an additional main will need to be added from the intake. There are minimal civil engineering requirements at the intake and the existing building is adequate to house additional pumping needs.

The works required include:

- 7th filtration stream
- Washwater capacity increased by 125 m^3
- Generator to power filter gallery
- Alum pump capable of dosing to 125 ppm
- 3rd 6 Ml compartment to service reservoir
- Additional 200,000 litre sludge thickening tank required





Area of benefit

The expansion of Pynes will facilitate the transfer of water between the Wimbleball and Roadford WRZs and therefore both WRZs will benefit.

Uncertainty of benefits

There is a reasonable level of confidence in the assessment of the benefits of this option.

Flexibility of option

Pynes is a strategically important works which can treat water for use in both the Wimbleball and Roadford WRZs. The option therefore provides great flexibility.

Investigation & implementation

The enlargement of Pynes WTW and intake to 67 Ml/d does not require any change to existing abstraction licences.

Constraints

There are no significant constraints associated with this option.

Links and dependencies

This option would need to be considered in conjunction with other developments in the Wimbleball WRZ.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	-	0	0	When construction works are carried out, there is likely to be some short term disruption to biodiversity, key habitats and species. This option is in the vicinity of two SSSIs. The proposed additional abstraction is within the existing agreed licence; therefore impacts on biodiversity, habitats and species should be negligible. Mitigation - ecological studies to be undertaken, particularly if works may affect any SSSIs. Mitigation – works should minimise disruption and must take into account biodiversity, key habitats and species.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	0	0	0	When construction works are carried out, there is the possibility for some short term disruption to historic and/or cultural heritage resources. There are a number of Scheduled Monuments nearby, but none in the direct vicinity. Therefore, it is unlikely that this option will have any impact on historic resources or cultural heritage.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	?/-	0	0	When construction works are carried out, there is the potential to cause pollution to surface water and groundwater through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. The proposed increased abstraction is within the existing agreed licence,

South West Water Bournemouth Water

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				therefore additional negative impacts on surface water and groundwater are not anticipated. Mitigation - any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.
4. Ensuring the appropriate and efficient use of land	0	0	0	This option is within existing SWW land.
5. Limiting the causes, effects of, and adapting to climate change	+	+	+	This option contributes positively to the region's adaptation to climate change by improving the company's ability to utilise the yield of the River Exe/Wimbleball resources system.
6. Ensuring sustainable use of water resources	0	0	0	This option will not affect losses from the system or water efficiency.
7. Protection and enhancement of landscape character	-	0	0	When construction works are carried out, there is the potential for some short term disruption to the landscape. However, the option is not located in an area that is designated for landscape quality.
8. Protection and enhancement of human health	?/+/-	+	+	This option would help ensure the continuity of clean drinking water supply. This option is unlikely to impact upon opportunities for recreation. There may possibly be some short term negative impacts if the construction works are located in a popular recreation area. Mitigation – replacement and/or repair of pipes should minimise disruption and try to avoid affecting the public's opportunities for recreation.

Summary		
Positive	•	This option contributes positively to the region's adaptation to climate change by improving the company's ability to utilise the yield of the River Exe/Wimbleball resources system.
	•	This option would help ensure the continuity of clean drinking water supply.
Negative	•	When pipes are replaced there may be some short term disruption to biodiversity, key habitats and species.
	•	When pipes are replaced there is the potential to cause pollution to surface and groundwater sources through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site.
	•	There is the potential for some short term disruption to the landscape.
	•	There may possibly be some short term negative impacts on recreation opportunities if the construction works are located in a popular recreation area.
Mitigation	•	Replacement and/or repair of pipes should minimise disruption and must take into account any sensitive or designated sites, biodiversity and key habitats and species and try to avoid affecting the public's opportunities for recreation where possible.
	•	Ecological studies to be undertaken, particularly if works may affect any SSSIs.
	•	Mitigation - any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Increase Pynes WTW and Intake to 67 Ml/d	2.1	13,677	1,905	2,402	0	384	4,691	31	34

W2: Re-commissioning of Stoke Canon & Brampford Speke boreholes

Option type: Production management
Indicative benefit: 4.5 Ml/d
Implementation: 2 years

Description of the option

North of Exeter and Pynes WTW are two licensed boreholes currently used as drought sources. They can also be used during a pollution incident on the Exe pumping directly to the river through existing discharge outfalls.

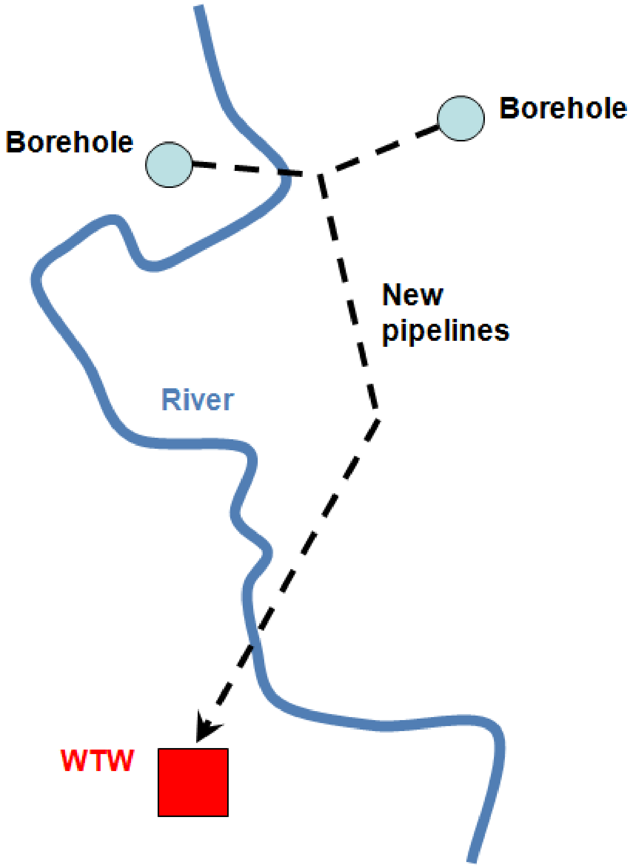
The Brampford Speke borehole has a licence to abstract 3.5 Ml/d all year round whilst the Stoke Canon source can pump at a peak rate of 4.5 Ml/d for up to 137 days. The re-commissioning of these boreholes would provide up to 8 Ml/d for specific periods of the year (equivalent to an indicative WAFU benefit of 4.5 Ml/d) either locally to the river for abstraction downstream or directly to Pynes WTW intake if a suitable pipeline was installed.

The works required include:

- Replacement headworks, pumps and motor control centres at each site

In order to pump direct to the WTW intake this would also require:

- 6 km pipeline to the main river intake



Schematic shows option with pipeline. Alternative option is to utilise existing discharge points to the river close to the boreholes for abstraction downstream at the WTW intake.

Area of benefit

The Wimbleball WRZ will benefit from this option.

Uncertainty of benefits

There is a high level of confidence in achieving an increase in Deployable Output of 4-5 Ml/d subject to the constraints mentioned below.

Flexibility of option

Implementation of this option will make it easier to use the boreholes as emergency sources to supply works in the event of pollution in the Exe. Direct connection of the boreholes to Pynes WTW will allow better use of the water through a reduced treatment requirement and reduced process loss.

Investigation & implementation

About three months will be required to test the boreholes to confirm yield and water quality prior to installing new pumping equipment and instrumentation and pipeline construction which is expected to last approximately 18 months.

Constraints

There are possible licensing issues relating to our operation of Wimbleball Reservoir if the preferred option is to use existing discharge points rather than install a pipeline to supply the WTW directly.

Links and dependencies

The implementation of this option is not affected by links with, or dependencies on, other options.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	-	?/-	?/-	When construction works are carried out, there is potential for some short term disruption to biodiversity, key habitats and species. These abstractions are in the vicinity of two SSSIs. Stoke Canon borehole is within approximately 2km of both SSSIs. Mitigation – works should minimise disruption and must take into account biodiversity, key habitats and species. Studies should identify if abstractions may impact on the two SSSIs before works commence.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	0	0	0	When construction works are carried out, there is the possibility for some short term disruption to the setting of historic and/or cultural heritage resources. There are a number of Scheduled Monuments nearby, but none in the direct vicinity. Therefore, it is unlikely that this option will have any impact on historic resources or cultural heritage.
3. Protection and enhancement of the quality and quantity of the	+/-	+	+	These boreholes provide emergency abstractions for operation in the event of a pollution incident on the Exe when

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
surface water environment and the groundwater resource				they would pump directly to the river through existing discharge outfalls. However, bringing them into service in an emergency would not be straightforward. Implementation of this option would make it easier to use the boreholes as emergency sources. The proposed boreholes are already licensed, but if operated to the river discussions with the EA will be required to consider the abstraction licence at Pynes intake which will need to change to accommodate the borehole abstraction. When pipes are laid there is the potential to cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. Mitigation - any fuel and oil storage on site for the purposes of operating machinery would comply with the Control of Pollution (Oil Storage) (England) Regulations 2001 (Oil Storage Regulations). All construction works would be undertaken in accordance with Environment Agency Pollution Prevention Guidelines
4. Ensuring the appropriate and efficient use of land	-	0	0	This assumes option with new pipeline chosen.
5. Limiting the causes, effects of, and adapting to climate change	0	0	0	There would be no significant effects.
6. Ensuring sustainable use of water resources	0	0	0	This option will not affect losses from the system or water efficiency.
7. Protection and enhancement of landscape character	?/-	0	0	When construction works are carried out, there is the potential for some short term disruption to the landscape. However, the option is not located in an area that is designated for landscape quality.
8. Protection and enhancement of human health	?/+/-	+	+	These boreholes currently provide water for drought situations or emergency abstractions for operation in the event of a pollution incident on the Exe when

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				they would pump directly to the river through existing discharge outfalls. However, bringing them into service in an emergency would not be straightforward. Implementation of this option would make it easier to use the boreholes as emergency sources, therefore, helping to ensure continuity of clean drinking water. Mitigation – replacement should minimise disruption and try to avoid affecting the public's opportunities for recreation.

Summary	
Positive	• Implementation of this option would make it easier to use the boreholes as emergency sources in a pollution incident. • Help to ensure continuity of clean drinking water.
Negative	• When construction works are carried out, there is likely to be some short term disruption to biodiversity, key habitats and species. • These boreholes are in the vicinity of two SSSIs. • There is the potential for some short term disruption to the landscape.
Mitigation	• SWW are committed to protecting the environment and will undertake reviews of site sensitivities prior to undertaking any work. • Works should be undertaken as swiftly as possible and must take into account biodiversity, key habitats and species. • Any fuel and oil storage on site for the purposes of operating machinery would comply with the Control of Pollution (Oil Storage) (England) Regulations 2001 (Oil Storage Regulations). All construction works would be undertaken in accordance with Environment Agency Pollution Prevention Guidelines. • Works should minimise disruption and try to avoid affecting the public's opportunities for recreation.

Indicative costs

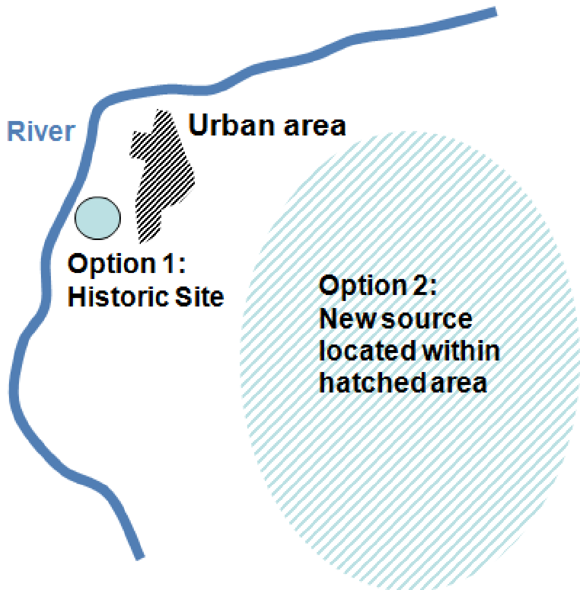
Costs for options for this scheme are being finalised as part of the Business Plan process and will be made available to Ofwat, but indicative costs based on an initial assessment of the required improvements are:

Indicative costs (pipeline scheme)

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Stoke Canon and Brampford Speke re-commission	4.5	27,749	3,225	880	0	118	4,223	15	15

W3: East Devon new source

Option type: Resource scheme
Indicative benefit: 2 Ml/d
Implementation: 18 months



Description of the option

Construction of a new groundwater source in East Devon with new treatment plant and connections to the existing network.

Area of benefit

The Wimbleball WRZ will benefit from this option.

Uncertainty of benefits

There is a reasonable level of confidence in the achievement of the benefits of this option but identifying a suitable location will require significant investigation.

Flexibility of option

A new source will be able to support our supplies in the East Devon area allowing more flexibility in our abstractions from the Otter Valley groundwater body.

Investigation & implementation

To identify a hydrogeologically suitable location.

Constraints

The new source will need to support our abstractions from the Otter Valley.

Links and dependencies

There are no interdependencies.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	-	-?	-?	This option will require a new abstraction licence and the source may affect any sites designated for ecological reasons. Construction works could have a short-term impact.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	-?	-?	-?	Any works could take place in the vicinity of cultural/historical heritage sites and therefore may have an adverse impact
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	-	0	0	The new source will require a new abstraction licence but this will only be granted if there are no significant impacts on surface water or groundwater. When construction works are carried out, there is the potential to cause pollution to surface water and groundwater through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. Mitigation - any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.
4. Ensuring the appropriate and efficient use of land	0	0	0	This option could be built within existing SWW land.
5. Limiting the causes, effects of, and adapting to climate change	0	0	0	This option has the potential to result in less pumping within East Devon, and help adapt to climate change pressures on resources.
6. Ensuring sustainable use of water resources	0/+	0/+	0/+	This source would utilise resources that will be at least as sustainable as existing

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				supplies.
7. Protection and enhancement of landscape character	0	0	0	The site chosen will ensure protection of the landscape character.
8. Protection and enhancement of human health	+	+	+	This option would help ensure the continuity of clean drinking water supply.

Summary	
Positive	• Development of a resource outside the Otter Valley will enable more flexible use of our Otter Valley sources with the potential to reduce their impact on the local environment. • This option would help ensure the continuity of clean drinking water supply.
Negative	• When construction works are carried out, there is the potential to cause pollution to surface water and groundwater through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. • Cultural, industrial and historic sites may be impacted if close to the development site.
Mitigation	• Any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation. • Ensure any works have a minimal impact upon cultural/historical/industrial heritage sites.

Indicative costs

Costs for options for this scheme are being finalised as part of the Business Plan process and will be made available to Ofwat, but indicative costs based on the recent Sidford borehole scheme are:

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
East Devon new source	2	11,675	1,707	1,117	0	66	2,890	24	25

B1: Significant investment at Bournemouth WTWs

Option type: Production
Indicative benefit: 22 Ml/d reducing to 10 Ml/d after 2028*
Implementation: 3 years

** The reduction in indicative benefit after 2028 is due to an abstraction licence reduction*

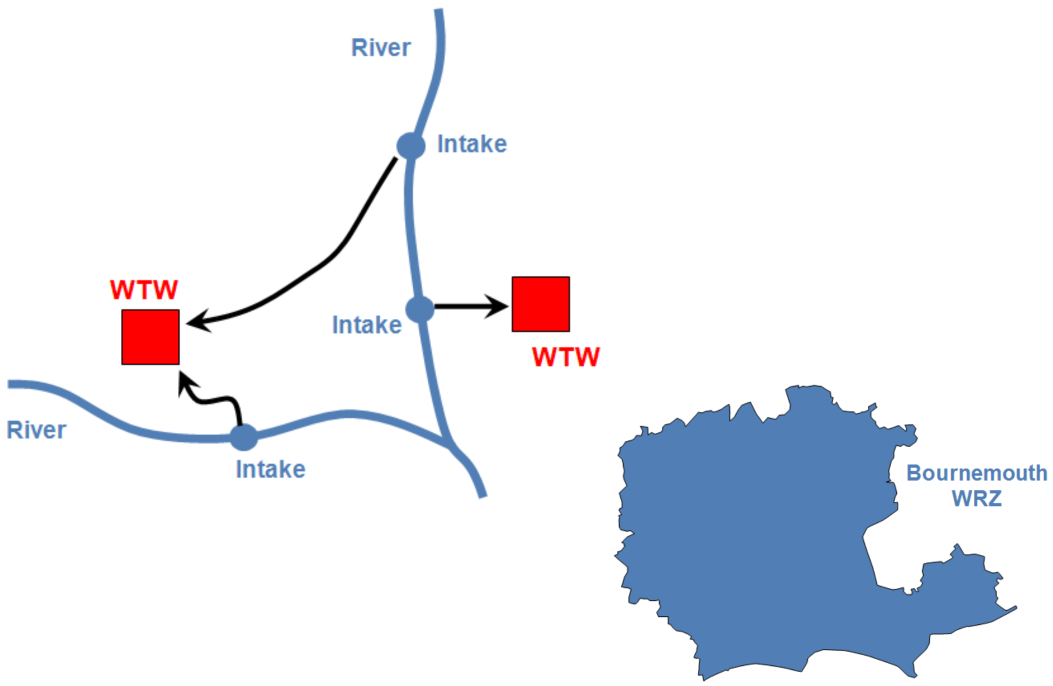
Description of the option

The current Water Available For Use (WAFU) in the Bournemouth WRZ is constrained by the WTW capacity.

As part of our PR19 Business Plan, we are proposing to make significant investment in the WTW capability in the Bournemouth WRZ area, given the age of the existing assets. As part of this work, it is also intended to take the opportunity of minimising WTW losses and making the maximum re-use of washwater.

Further investment to enable the WTWs to treat the maximum licensed abstraction would make more effective use of the sources available to Bournemouth WRZ and could also provide an opportunity for transferring surplus water to Southern Water's area of supply.

It is likely that any scheme will make best use of any new and innovative technology.



Area of benefit

The Bournemouth WRZ will benefit from this option, but could also enable the transfer of surplus water to Southern Water's area of supply.

Uncertainty of benefits

There is a reasonable level of confidence in the assessment of the benefits of this option, but see links below regarding links to other schemes.

Flexibility of option

This option will enable full use to be made of the abstraction licences from the River Stour and River Avon. An increase in the sizes of the works will also provide increased resilience across the WRZ.

Investigation & implementation

An increase in the size of the works will require various engineering and process studies and the use of innovative modern water treatment options.

Constraints

There are no obvious physical constraints to this option, but see links and dependencies as below.

Links and dependencies

The scheme is linked to our plans for making significant investment in the WTW capability in the Bournemouth WRZ area, given the age of the existing assets.

The scheme could be considered jointly with the potential transfer of supply demand surplus to Southern Water.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	0	0	0	This option is within an existing licence and should not affect any sites designated for ecological reasons. Construction works could have a short-term impact.
2. Protection and enhancement of the historic, cultural and	0	0	0	Ensure any works that do take place do not impact upon cultural/historical

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
industrial heritage resource				heritage.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	-/0	0	0	This option is within the existing licence, so no adverse impacts are predicted in relation to abstraction. When construction works are carried out, there is the potential to cause pollution to surface water and groundwater through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. Mitigation - any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.
4. Ensuring the appropriate and efficient use of land	0	0	0	Option could be built within existing Company land.
5. Limiting the causes, effects of, and adapting to climate change	0	0	0	This option would optimise use of available water resources and help adapt to climate change pressures on resources.
6. Ensuring sustainable use of water resources	0/+	0/+	0/+	This option will minimise washwater re-use, and increase WTW efficiency.
7. Protection and enhancement of landscape character	0	0	0	Improvements could be designed to have a positive impact upon local landscape.
8. Protection and enhancement of human health	+	+	+	This option would help ensure the continuity of clean drinking water supply.

Summary	
Positive	• This option would help ensure the continuity of clean drinking water supply.
Negative	• When construction works are carried out, there is the potential to cause pollution to surface water and groundwater through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site.
Mitigation	• Any fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation. Ensure any works that do take place do not impact upon cultural/historical heritage.

Indicative costs

Costs for options for this scheme are being finalised as part of the Business Plan process and will be made available to Ofwat.

B2: Re-introduce Wimborne

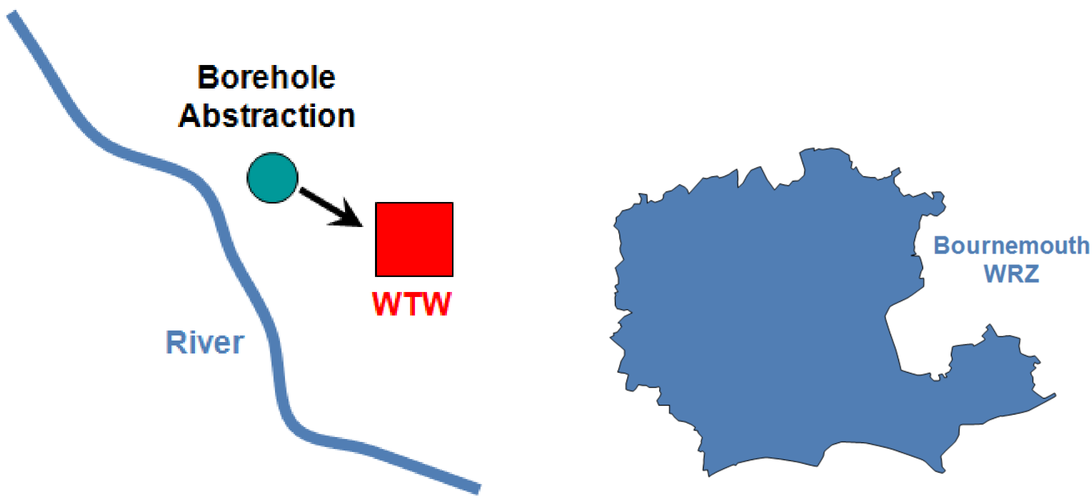
Option type: Production
Indicative benefit: 4.1 Ml/d
Implementation: 2 years

Description of the option

The scheme entails re-introducing a currently unused (but licensed) source near Wimborne.

Area of benefit

The Bournemouth WRZ will benefit from this option.



Uncertainty of benefits

There is a reasonable level of confidence in the assessment of the benefits of this option.

Flexibility of option

This option will provide further water into the Bournemouth WRZ thereby increasing flexibility and resilience. This scheme could also support an opportunity for transferring surplus water to Southern Water's area of supply.

Investigation & implementation

The source will require yield testing and water quality sampling to confirm its viability.

Constraints

No new abstraction licences will be required for this option.

Links and dependencies

The implementation of this option could be considered in conjunction with the investment at the Bournemouth WTWs.

Social & environmental impacts

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	0	0	0	This option is within an existing licence and should not affect any sites designated for ecological reasons.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	0	0	0	No new infrastructure is required, so there is no predicted risk to historic, cultural and industrial heritage sites in the vicinity. Mitigation – minimise disruption from construction.
3. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	?/-	0	0	As this abstraction is already licensed, there is likely to be a minimal negative impact on biodiversity, key habitats and species. Although no major construction works are envisaged, any potential construction acitivities could cause pollution to surface and groundwaters through the mobilisation of contaminants or the discharge of pollutants from the leakage of fuels and oils etc, stored on site. Mitigation – any chemicals, fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.
4. Ensuring the appropriate and efficient use of land	0	0	0	This option will not involve land acquisition. Any required development should be constructed on existing SWW land. The construction of any new assets required has the potential to cause short

Criteria	What is the predicted temporal effect Short term	Med term	Long term	Commentary (including cumulative effects and potential mitigation measures)
				term disruption. Mitigation – minimise disruption from construction.
5. Limiting the causes, effects of, and adapting to climate change	0	0	0	Operation of a new groundwater scheme would provide additional resource that could be used elsewhere. This would increase the flexibility of the system and therefore help the region to adapt to climate change.
6. Ensuring sustainable use of water resources	0	0	0	This option would not affect losses from the system or efficiency.
7. Protection and enhancement of landscape character	?/-	0	0	As no construction is envisaged there should be no risk to the character of the landscape. Mitigation – minimise disruption from construction if it is required.
8. Protection and enhancement of human health	?/+/-	+	+	This option would ensure the continuity of clean drinking water supply. There are not thought to be any risks with regard to opportunities for recreation.

Summary	
Positive	• By re-commissioning a disused groundwater source this will provide valuable flexibility and resilience to the Bournemouth WRZ. • This option would ensure the continuity of clean drinking water supply.
Negative	• Works could pose a pollution risk through the risk of spillage of fuels or other pollutants.
Mitigation	• Any chemicals, fuel and oil storage on site for the purposes of operating machinery would comply with the appropriate legislation.

Indicative costs

Costs for options for this scheme are being finalised as part of the Business Plan process and will be made available to Ofwat, but indicative costs based on an assessment of the existing infrastructure are:

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Wimborne recomm.	4.1								28

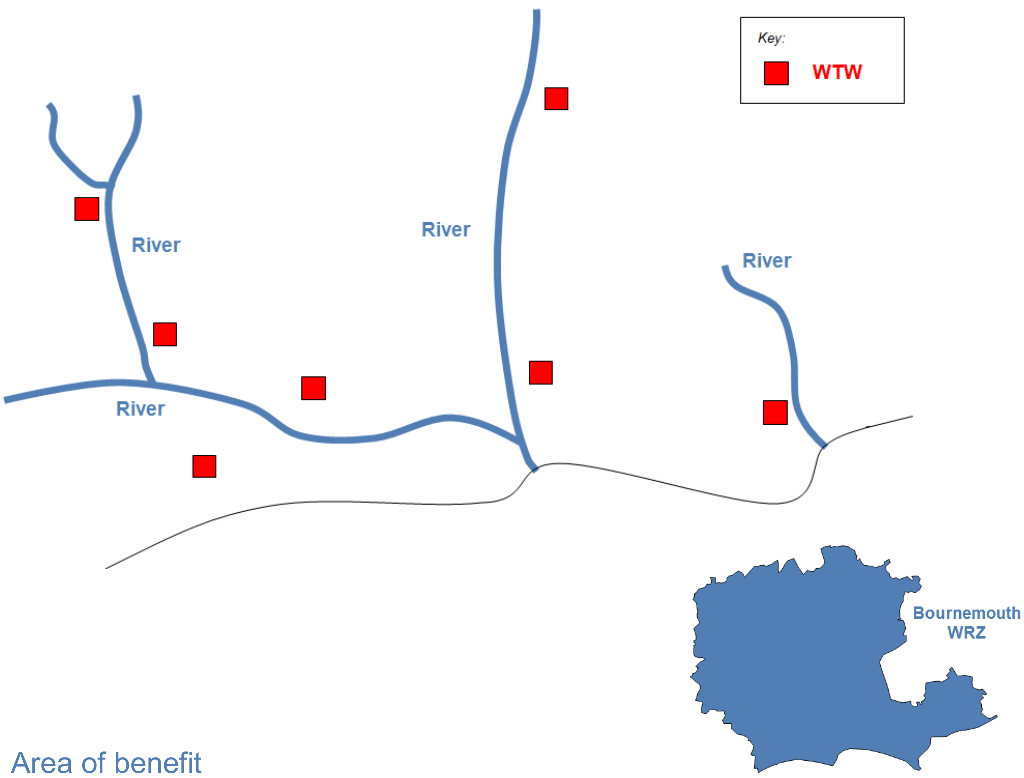
Indicative AISC value is based on similar schemes. Revised costs to be re-calculated for the Final WRMP.

B3: Potential increases in WAFU e.g. innovative licence changes

Option type: Resources
Indicative benefit: Could be of the order of 10 Ml/d
Implementation: 5 years

Description of the option

Although the Bournemouth WRZ has a surplus supply demand balance throughout the planning period, it is recognised that in PR19, studies could be undertaken to increase the understanding of potential ways of increasing WAFU in preparation for PR24. Changes could include innovative licence changes to enable increases in WAFU over the critical period. For example, consideration could be given to exploring options to make the current weekly licence constraint more flexible.



Area of benefit

The Bournemouth WRZ will benefit from this option. This scheme could also be of particular benefit should scheme B1 progress, which could increase the potential for a transfer of surplus water to Southern Water's area of supply.

Uncertainty of benefits

Currently unknown. Further work is required, particularly in the light of the links to other options.

Flexibility of option

Currently unknown. Further work is required, particularly in the light of the links to other options.

However, licence changes particularly over the critical period could give increased flexibility and resilience to both Bournemouth WRZ and Southern Water's area of supply.

Investigation & implementation

Any licence changes will require various environmental studies which will need to be discussed with the regulator and external stakeholders.

Constraints

There are no obvious physical constraints to this option, but environmental studies will need to be discussed with the regulator and external stakeholders to increase the understanding of environmental constraints.

Links and dependencies

The scheme could be considered jointly with any investment at Bournemouth WRZ WTWs and any potential transfer of a supply demand surplus to Southern Water.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
1. Protection and enhancement of biodiversity, key habitats and species	?/+/-	?/+/-	?/+/-	As this option amounts to an increase in abstraction there may be an impact upon biodiversity and key habitats. Mitigation – detailed environmental studies and ecological surveys would need to be undertaken.
2. Protection and enhancement of the historic, cultural and industrial heritage resource	0	0	0	No known impacts.
3. Protection and enhancement of the quality and quantity of the	+	+	+	See comments above regarding the need for environmental studies.

South West Water   Bournemouth Water

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
surface water environment and the groundwater resource				Mitigation - detailed hydrological, hydro-geological and environmental studies would be required.
4. Ensuring the appropriate and efficient use of land	0	0	0	This option should not require any extra land.
5. Limiting the causes, effects of, and adapting to climate change	+	+	+	This option has the potential to manage water resources in an environmentally sensitive and sustainable manner and therefore help the region to adapt to climate change.
6. Ensuring sustainable use of water resources	+	+	+	This option has the potential to manage water resources in an environmentally sensitive manner.
7. Protection and enhancement of landscape character	0	0	0	There would be no need for construction works associated with this option, so no visual impacts on landscape are anticipated.
8. Protection and enhancement of human health	+	+	+	This option would ensure the continuity of the clean drinking water supply.

Summary	
Positive	• This option has the potential to increase the Deployable Output of the Bournemouth WRZ, particularly during the critical period. • This option has the potential to manage water resources in an environmentally sensitive and sustainable manner and therefore help the region to adapt to climate change. • This option would ensure the continuity of the clean drinking water supply.
Negative	• As this option amounts to an increase in abstraction there may be an impact upon biodiversity, key habitats and species, and hence the need for an EIA.
Mitigation	• Detailed ecological surveys would need to be undertaken. • Detailed hydrological and hydro-geological studies would be required.

Indicative costs

Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Potential increases in WAFU e.g. innovative licence changes	10								11

Indicative AISC value is based on similar schemes. Revised costs will be re-calculated for the Final WRMP.

APPENDIX 7

Scenario analysis

A.7.1 Introduction

The scenario analysis was used to understand the sensitivity of our baseline supply demand balance to a range of future uncertainties and different policy choices.

For each scenario a revised supply demand balance was calculated. Where a deficit occurred this was closed through either leakage reduction or water resource options depending on the scenario.

From this the total NPV of the programme was calculated and the bill impact in 2025 was estimated.

The bill impact is for comparative purposes only as the actual bill impact will depend on our overall PR19 Business Plan. However, it is a useful guide for the relative impact of different programmes.

This analysis used our SELL model together with a supply demand financial model developed by Oxera. Our programme costs are given for the 25 year period of our planning horizon to compare the cost of different choices over the lifetime of the plan. This should not be compared with the 80 year period included in the AIC and AISC calc in the WRMP tables as the analyses are for different purposes.

As our baseline forecast is in surplus with the exception of a minor deficit in Colliford WRZ at the very end of the planning period, we did not look to optimise a solution using every possible feasible option in the scenarios as we do not think that is appropriate for our planning problem. Instead we focussed on the trade-off between leakage reduction and water resource options and the trade-off between how much of future uncertainties should we seek to mitigate as these are the key challenges in the planning problem.

As set out in Section 6, we already have high levels of metering and the scope for more metering is low. Customer preferences for extending smart metering is relatively low in terms of overall company priorities. We therefore did not seek to optimise plans around metering.

We did not seek to model different water efficiency choices in the scenario analysis. Our per capita or per household consumption is already low and therefore the total scope for water efficiency is both relatively low but also uncertain. Given there is no immediate supply demand deficit, we instead looked at water efficiency as a broader policy decision rather than one of traditional least cost planning. As shown in Section 8 the level of water efficiency was based on a range of broader factors and a comparison to leakage reduction costs.

As highlighted in Section 8, as our supply demand balance is becoming tight, part of our plan for the period to 2025 will be to develop a new financial modelling tool as we think in future plans some of the possible trade-offs between different choices in metering, water efficiency, leakage reduction and new water resource options will become more important.

A.7.2 Customer preferences - customer willingness to pay (Scenario 2)

This scenario examined the impact on the Sustainable Economic Level of Leakage (SELL) using customer willingness to pay data (See Appendix 1).

For each WRZ, the total private and environmental and social cost NPV of operating at different leakage levels in the programme was calculated for each WRZ.

The benefit customers place on leakage reduction through their willingness to pay was then subtracted from the NPV to give a net value – see Figure A.7.1. The willingness to pay for leakage reduction changes as leakage reduction increases and this was included in the analysis – see Table A.7.1.

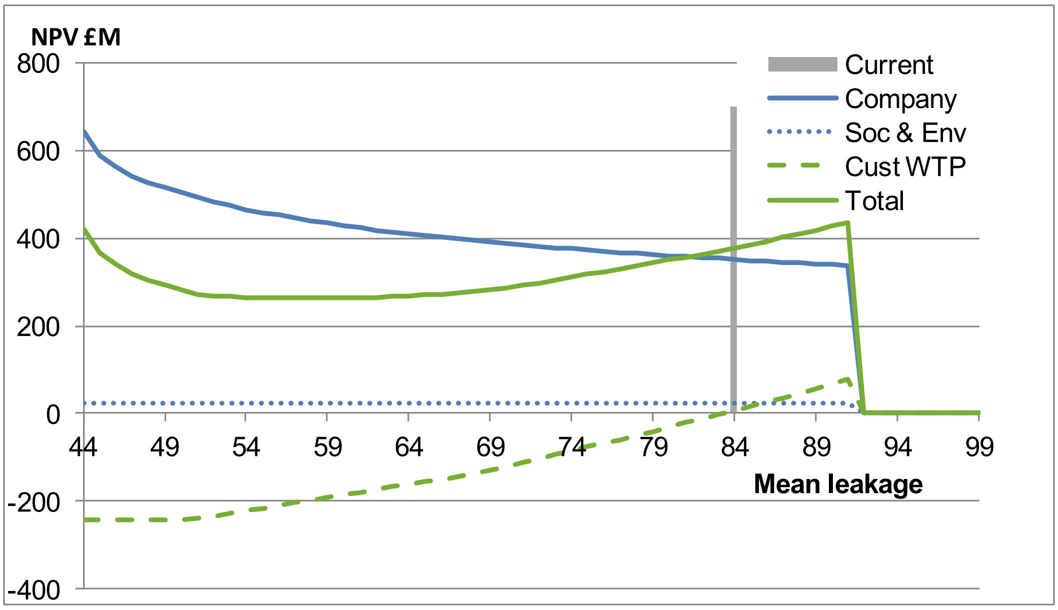
The results were then used to determine what level of leakage we could operate at if we built a programme based on WTP only. This leakage level was then assumed to be fully delivered in the period to 2025.

Table A.7.1: Willingness to Pay data

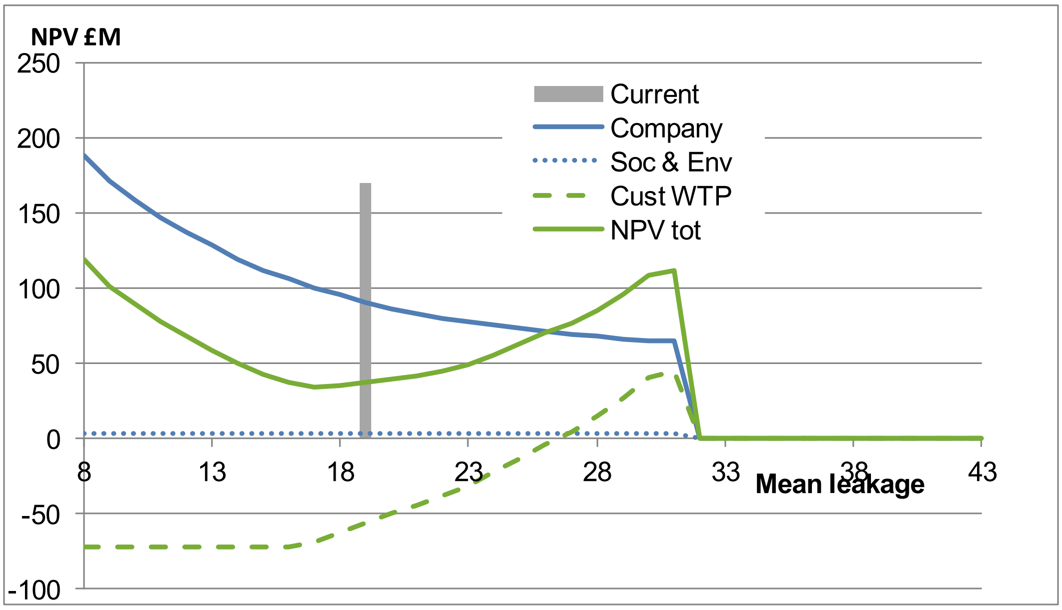
Leakage Level	Leakage level (SWW)	Leakage level (BW)	Willingness to Pay [£k/Ml/d]
>20% of DI	>84	>27	540
20% to 16% of DI	84 to 69	27 to 23	540
16% to 12% of DI	69 to 51	23 to 17	360
<12% of DI	<51	<17	0

Figure A.7.1: Impact of customer Willingness to Pay on leakage costs

a) SWW supply area



b) BW supply area



A.7.3 Resilience - plausible droughts (scenario 3a)

In this scenario we assessed the impact of future more extreme droughts on our supply system. Where a supply demand deficit occurred we looked at the cost of that would be through leakage reduction. In the results below we also show what the alternative water resource option would be.

A.7.3.1 Plausible drought flow sequences

Using the methodology adopted in our draft Drought Plan[A.7.1], utilising the historic 1975/76 flow sequences, we considered different types of plausible droughts that are more severe than our historic design drought, including:

- Extending the end of the 1975/76 drought (plausible drought references PD-1 and PD-2)
- Winter 1975/76 flows 10% drier than historic (plausible drought PD-3)
- Swapping 1977 and 1978 historic flows, to give a dry autumn/early winter following immediately after the 1975/76 drought (plausible drought PD-4)

Further information and river flow charts are provided in A.7.11.

Using our water resources models we calculated the WAFU for all of our WRZs under these plausible droughts by simulating the response of our water resources to flow sequences adjusted to model the above plausible droughts.

The impact on WAFU relative to the baseline WAFU of each plausible drought is shown in Table A.7.2 below for all WRZs. Note that in the analysis we assumed the same transfers between WRZs.

Table A.7.2: Impact on WAFU relative to the baseline WAFU (scenario 3a)

WRZ	WAFU impact of plausible drought (Ml/d)			
	PD-1	PD-2	PD-3	PD-4
Colliford	0	0	0	0
Roadford	17*	19*	3	0
Wimbleball	8*	10*	0	0
Bournemouth DYAA	0	0	0	0
Bournemouth DYCP	0	0	0	0

*Note – * these scenarios give rise to a supply demand deficit*

[A.7.1] South West Water (2017), *Draft Drought Plan*, October 2017.

A.7.4 Resilience - 1 in 200 year drought (Scenario 3b)

A.7.4.1 Return period for historic design drought

Section A.7.12 summarises the analysis by the Met Office on return periods of historic droughts and the plausible droughts. The return periods of the historic design drought in all of our WRZs are summarised in Table A.7.3 below.

Table A.7.3: Return periods for historic design drought

WRZ	Historic design drought for WRMP	Return period band (years)	% chance in any given year
Colliford	1975/76	40 - 135	2.50 – 0.74
Roadford	1975/76	175 - 220	0.57 – 0.45
Wimbleball	1975/76	110 - 125	0.91 – 0.80
Bournemouth	1975/76	130 - 150	0.77 – 0.67

A.7.4.2 Impact on WAFU of 1 in 200 year drought

Table A.7.4 shows the estimated impact on WAFU of a 1 in 200 year drought, with details on how the impact of a 1 in 200 year drought compares to the historic design drought and plausible droughts.

The results show all WRZs should be resilient to a 1 in 200 year event as there is no impact on WAFU.

Table A.7.4: Impact on WAFU of 1 in 200 year drought

WRZ	Impact on baseline WAFU for 1 in 200 year drought (Ml/d)	Notes
Colliford	0.0	None of the plausible droughts analysed impacted on baseline WAFU and these are all more extreme than a 1 in 200 year drought.
Roadford	0.0	The baseline WAFU is for the historic design drought (1975/76) and this drought has a return period of 1 in 175 – 220 years.

WRZ	Impact on baseline WAFU for 1 in 200 year drought (Ml/d)	Notes
Wimbleball	0.0	The baseline WAFU is for the historic 1975/76 drought which has a return period of 1 in 110 – 125 years and our analysis shows that there is some spare water available. All of our plausible droughts are more extreme than a 1 in 200 year drought. They all have return periods more rare than a 1 in 500 year drought. Some show a potential impact on WAFU. For the 1975/76 drought there is spare water available and our Drought Plan also shows licensed supply options that could be used in extreme dry weather to assist with resilience to a 1 in 200 year drought. This gives us confidence that the WRZ is resilient to a 1 in 200 year drought.
Bournemouth	0.0	None of the plausible droughts analysed impact on baseline WAFU and these are all more extreme than a 1 in 200 year drought.

A.7.4.3 Comparison of leakage and new water resource options

For Roadford and Wimbleball the droughts PD-1 and PD-2 placed the WRZs into deficit.

Table A.7.5 shows the costs of different choices of closing the deficits from our model. For reasons outlined below we used the leakage programme in our multi-criteria scoring, but we include the new water resource options for reference.

Table A.7.5: Costs of mitigating the plausible drought impacts

WRZ	Drought	Baseline programme cost [£m]	Deficit [Ml/d]	Cost of mitigation		
				Leakage [£m total]	Leakage [£m NPV]	New water resources [£m NPV]
Roadford	PD-1	151	15.2	90.7	53.9	30.7 to 76.9[A.7.2]
	PD-2	151	17.4	119.6	72.7	30.7 to 76.9[A.7.3]
	PD-3	151	1.4	2.3	1.2	3.2[A.7.4]
Wimbleball	PD-1	73.4	5.9	48.9	30.5	8.9[A.7.5]
	PD-2	73.4	8.0	70.0	52.8	11.8[A.7.6]
	PD-3	73.4	0	0	0	-

For the Roadford WRZ the cost of mitigation of plausible droughts is high. The total NPV of the Roadford baseline programme is £151m, and mitigation would add upwards of £30m to the programme.

The cost of mitigation is similar between leakage reduction and new water resource development. New water resource options could have the opportunity to be lower cost than leakage but more than one option would be needed.

In Wimbleball the cost of resource development is lower cost than meeting the deficit by leakage reduction. However, to meet the scale of the reduction two or more schemes would be needed. As with Roadford, for either leakage reduction or new water resource options the additional cost of mitigation is high.

In our multi-criteria assessment we chose the leakage scenario for our assessment. This was for the following reasons:

1. The level of leakage reduction is still within the economic range identified in the willingness to pay analysis.
2. In contrast the customer WTP for the new water resource options are £27m and £11m[A.7.7] for new water resource options in Wimbleball and Roadford respectively.
3. New water resource options have the lowest level of support from customers
4. As these plausible droughts have a low likelihood, new water resource options run the risk of being stranded assets, whereas leakage reduction is more flexible to adapt to future uncertainties

[A.7.2] Option R1 or option R2 + R3
[A.7.3] Option R1 or option R2 + R3
[A.7.4] Option R2
[A.7.5] Option W2+W5
[A.7.6] Option W1 + W2 + W5
[A.7.7] 25 year NPV based on the £0.1m/Ml/d customer WTP for new surface water resources

In forming our draft Plan as set out in Section 8, we recognise however the benefit that new water resource options could have if the level of leakage reduction in our plan does not materialise.

As such whilst we do not plan for these schemes now, we believe we should continue to develop the understanding of the possible options should they be needed in the future. Of these options, Brampford Speke groundwater source (option W2) in the Wimbleball area we think should be considered as a future resilience option due to its low cost and high deliverability. We will be considering this in more detail in our PR19 Business Plan.

A.7.5 Long-term balance – resource only plan and demand only plan (Scenario 4)

This scenario examined implementing water resource or demand reduction (through leakage reduction) to mitigate the impact of 10 years growth in demand.

Table A.7.6 sets out the volume of water that would mitigate the 10 year growth in demand in each WRZ.

Two programme were assessed. One programme examining the cost using leakage reduction and one using water resource options. Details of the costs of each option is given in Table A.7.7.

In contrast to the SWW WRZs we did not model a water resource option only plan for Bournemouth WRZ. This is because this scenario overlaps with the work in the Bournemouth WRZ to Southern Water transfer scenario.

Table A.7.6: Volumes of water to mitigate 10 year growth in demand

Description	Volume (Ml/d)
Colliford	1.7
Roadford	1.9
Wimbleball	0.5
Bournemouth	1.4

Table A.7.7: Costs of different programmes

Ref	Description	Estimated bill impact in 2025 (£/prop)	Additional benefit (Ml/d)	Additional cost over base line plan (£m NPV)
	Colliford			
4a	Resource only plan	<0.5	7	7.2[A.7.8]
4b	Demand only plan	0.5-1	1.7	3.5
	Roadford			
4a	Resource only plan	<0.5	9.8	3.1[A.7.9]
4b	Demand only plan	<0.5	1.9	3.7
	Wimbleball			
4a	Resource only plan	<0.5	4.5	4.2[A.7.10]
4b	Demand only plan	0.5-1	0.5	2.9
	Bournemouth			
4a	Resource only plan	-	-	-
4b	Demand only plan	2-3	1.4	7.5

Note: because new water resource options have specific yields, lowest cost schemes were selected but their yields may be greater than the volume of water needed to offset the 10 year growth in demand

A.7.6 Environment and markets – transfer to Southern Water (scenario 5a)

This scenario examined the impact of a 20 Ml/d transfer from Bournemouth WRZ to Southern Water.

It examined the supply demand balance with and without infrastructure investment.

This scenario did not look to examine what the least cost option was for a transfer, but rather to understand the feasibility of a transfer to Southern Water and the impact in a drought.

Details of this scenario are given in Section 7.

A.7.7 Environment and markets – environmental needs (scenario 5b)

There are several schemes listed in WINEP2 as requiring implementation, investigations and/or options appraisals. These could impact on WAFU. Potential

[A.7.8] Re-use Rialton Intake/Porth
[A.7.9] Northcombe WTW output increased to 60Ml/d
[A.7.10] Brampford Speke boreholes

impacts on WAFU of these schemes have been estimated and are summarised by scheme in Table 7.8 and by WRZ in Table A.7.9.

Table A.7.8: Potential impacts on WAFU of WINEP2 schemes

WRZ	Scheme name	Location affected	Potential Impact on WAFU (Ml/d)	
			Likely worst case	Case assumed for scenario
Roadford	Burrator - investigation into flow regime requirements	Burrator Reservoir	-12.0	-6.0
Roadford	Burrator - adaptive management trials	Burrator Reservoir	0.0	0.0
Colliford	College and Argal - identify mitigation measures	College and Argal Reservoirs	-3.0	-1.5
Roadford	Fernworthy - fishbank release	Fernworthy Reservoir	0.0	0.0
Roadford	KTT - adaptive management trials	KTT Reservoirs	-1.0	-0.5
Wimbleball	Otter catchment options appraisal	Otter Valley boreholes	-5.0	-2.5
Colliford	rCSMG investigation/ options appraisal - Camel catchment	Crowdy Reservoir, De Lank intake	-4.0	-2.0
Colliford	Stithians - identify mitgation measures	Stithians Reservoir, Kennal Vale intake	-4.0	-2.0
Roadford	Venford - identify mitigation measures	Venford Reservoir	0.0	0.0
Roadford	Wilsworthy Brook investigation/ options appraisal	Wilsworthy Leat	0.0	0.0
Roadford	Wistlandpound - identify mitigation measures	Wistlandpound Reservoir	-1.0	-0.5

Table A.7.9: Potential impacts on WAFU of WINEP2 schemes by WRZ

WRZ	Potential Impact on WAFU (Ml/d)	
	Likely worst case	Case assumed for scenario
Colliford	-11.0	-5.5
Roadford	-14.0	-7.0
Wimbleball	-5.0	-2.5
Bournemouth	0.0	0.0
Company	-30.0	-15.0

The costs of mitigating these options with leakage reduction are presented in Table A.7.10. We did not examine the costs of mitigating the impact with new water resource options as our assumption here is that if new sustainability reductions are in place, then new water resource options would not be available to us.

Table A.7.10: Scenario 5b results

WRZ	Programme Costs to mitigate risk	
	Baseline plan [£m NPV]	Scenario 5b [£m NPV]
Colliford	135	138
Roadford	162	169
Wimbleball	77	78
Bournemouth	97	97

Note: Total NPV used. Private and env and social costs

A.7.8 Data – leakage consistency and PR19 draft methodology (Scenario 6a)

This scenario tested the plan against two data changes.

<u>Leakage consistency (Scenario 6a)</u>

This scenario recalculated the demand forecast based on the new industry methodology for calculating leakage.

This gave rise to a small increase in DI due to the change in the elements of the water balance that made up the plan.

We looked to close any supply demand gap with leakage reduction. The costs of the plans is given in Table A.7.11.

PR19 Draft Methodology (Scenario 6b)

This scenario looks to implement a 15% reduction in leakage in each WRZ by 2025 to test the impact of the draft PR19 methodology.

Table A.7.11 shows the leakage reductions embedded into the demand forecast. This table also presents the cost of achieving this leakage reduction.

In the period to 2025 no WRZ has a supply demand deficit so the 15% reduction in leakage increased the surplus in each WRZ.

In all cases the leakage reduction is cost beneficial when compared to the customer willingness to pay value but the scale of reduction would lead to large bill increases early in the programme.

Table A.7.11: Scenario 6 results

Ref	Description	Estimated bill impact in 2025 (£/prop)	Total Leakage reduction by 2045 (Ml/d)	Additional cost to baseline plan (£m NPV)	Customer WTP (£m/Ml/d)	Customer WTP (£m NPV)
	Colliford					
6a	Leakage consistency	0	2.5*	0.2	0.54	3.3
6b	PR19 methodology	2-3	4.5	10.6	0.54	35.6
	Roadford					
6a	Leakage consistency	0	0.7*	0.8	0.54	0.9
6b	PR19 methodology	2-3	6.3	22.1	0.54	49.4
	Wimbleball					
6a	Leakage consistency	0	0	0	0.54	0
6b	PR19 methodology	3-4	1.7	10.0	0.54	13.6
	Bournemouth					
6a	Leakage consistency	0	0	0	0	0
6b	PR19 methodology	3-4	2.9	12.7	0.36	11.2

**These leakage reductions occur later in the programme beyond 2025 and include any other supply demand deficit to resolve. NPVs for 25 year programme period from SELL model.*

South West Water Bournemouth Water

A.7.9 Demand uncertainty – higher household and higher non-household demand (Scenario 7)

Alternative scenarios have been calculated for household and non-household demand being higher than forecast. The increase in total demand for each WRZ is provided in Table A.7.12.

Scenario 7a covers higher than expected household demand. Uncertainty analysis has been undertaken at the total household demand level using a Monte Carlo approach. Uncertainties in population and property numbers have been assessed in line with published guidance[A.7.11], while uncertainty in the micro-component model has been derived from error analysis within the modelling process.

Higher than expected non-household demand is covered in scenario 7b. This scenario has been derived assuming faster economic and demographic growth, with the growth rates of employment, GVA, and population all set to values at the top end of the plausible range.

Headroom uncertainty has been recalculated for both of these scenarios, because we have used demands towards the higher end of the plausible range. This means that the uncertainty profile of these components can no longer be assumed to be symmetrical.

Table 7.12: Assumed increases under higher demand scenarios

WRZ	Increase in total demand (Ml/d)	
	Scenario 7a	Scenario 7b
Colliford	10.0	3.7
Roadford	14.9	4.6
Wimbleball	5.8	2.0
Bournemouth	8.7	7.6
Company	39.4	17.9

All of our WRZs continue to show a surplus under scenario 7b, so there are no additional costs involved with mitigation of the risks. The costs of mitigating the high household scenario (7a) are shown in Table A.7.13 below.

[A.7.11] UKWIR, *"WRMP19 methods: Population, household property and occupancy forecasting"*, Ref 15/WR/02/8, 2015

Table A.7.13: Scenario 7 results

Ref	Description	Estimated bill impact in 2025 (£/prop)	Leakage reduction by 2045 (Ml/d)	Additional Cost to baseline (£m NPV)	Customer WTP (£m/Ml/d)	Customer WTP (£m NPV)
	Colliford					
7a	Higher household demand	0	3.8	3.4	0.54	7.2
7b	Higher non-household demand	0	0	0	0.54	0
	Roadford					
7a	Higher household demand	0	4.8	5.9	0.54	9.1
7b	Higher non-household demand	0	0	0	0.54	0
	Wimbleball					
7a	Higher household demand	0	0	0	0.54	0
7b	Higher non-household demand	0	0	0	0.54	0
	Bournemouth					
7a	Higher household demand	0	0	0	0.36	0
7b	Higher non-household demand	0	0	0	0.36	0

Note – the estimated bill impact in 2025 is zero since the supply demand deficit do not occur until later in the planning period. NPVs for 25 year programme period from SELL model.

A 7.10 Multi-criteria scoring

The performance of each plan in each scenario was assessed using a multi-criteria assessment. The scoring metrics used are presented in Table A.7.14.

The results for each WRZ are given in Table A.7.15 to A.7.18.

Table A.7.14: Multi-criteria scoring methodology

Financial		Customer and affordability			Deliverability		
Private costs	Env & Social costs	Bill impact	Alignment to customer preferences	Alignment to govt objectives	Cost certainty	Yield certainty	Flexibility
NPV	NPV	£/prop	Score	Score	Score	Score	H/M/L
Scored relative to the baseline scenario	Scored relative to the baseline scenario	£/prop change in year5 (to nearest 10p)	Number of activities that meet the top 5 customer preferences. Score out of 5	Number of activities that meet the top 4 government objectives. Score out of 4.	H = High. Plan within known cost range and schemes well understood. (Score = 3)	H = High. Plan within known yield range and schemes well understood. (Score = 3)	H - High. Plan flexible within AMP period (Score = 3)
Score = 3 = within +5%	Score = 3 = within +10%	L = Low. Bill impact <£0.5/prop. Score = 3	1. Leakage	1. Take a long-term, strategic approach to protecting and enhancing resilient water supplies	M = Medium. Costs have some uncertainty. But data to understand risk available. (Score = 2)	M = Medium. Schemes have some uncertainty. But data to understand risk available. (Score = 2)	M = Medium. Can flex between AMPs, but has limited flexibility within an AMP (Score = 3)
Score = 2 = within +5 to 10%	Score = 2 = within +10 to 20%	M = Medium. Some bill impact (£0.5 to £1/prop). Score = 2	2. (Dumb) meters	2. Consider every option to meet future public water supply needs	L = Low. Costs highly uncertain. Plan going beyond known knowledge or new schemes (Score = 1)	L = Low. Schemes highly uncertain. Plan going beyond known knowledge or new schemes (Score = 1)	L = Low. Plan not flexible in AMPs or between AMPs if uncertainties change (Score = 1)
Score = 1 = >+10%	Score = 1 = >+20%	H = High = Bill impact >£1/yr. Score = 1	3. Smart meters	3. Protect and enhance our environment acting collaboratively			
			4. Helping Customers Save Water	4. Promote efficient use of water and reduce leakage			
			5. Catchment management				
Max Score							
3	3	3	5	4	3	3	3
6		12			9		

Table A.7.14: Multi-criteria scoring methodology (cont)

Resilience		Markets and innovation	
Drought performance	Single source dominance	Bill impact	Alignment to customer preferences
H/M/L	H/M/L	£/prop	Score
H = High. Plan can meet all plausible droughts. Score = 3	H = High. Plan reduces single source dominance (Score = 3)	H = High. Plan has more than 1 option for promoting markets. (Score = 3)	H = High. Plan has option for direct procurement in AMP7. (Score = 3)
M = Medium, Plan can meet 1 in 200 yr drought (Score = 2)	M =Medium. Plan has some benefit to reducing some single source dominance (Score = 2)	M = Medium. Plan has 1 option for promoting markets. (Score = 2)	M = Medium. Plan has option in planning period for direct procurement. (Score = 2)
L = Low. Plan cannot meet 1 in 200 yr drought (Score = 1)	L = Low. Plan does not change current single source dominance. (Score = 1)	L = Low. Plan has no options for promoting markets. (Score = 1)	L = Low. Plan has no direct procurement opportunities (Score = 1)
Max Score			
3	3	3	3
6		6	

Table A.7.15: Multi-criteria scoring - Colliford

a) Base data

Scenario		Likelihood	Description	Data		
				Private costs	Env & Social costs	Bill impact in 2025
				NPV	NPV	£/prop
1a	Base Case (most likely)	M	1.1Ml/d leakage reduction at the very end of the period. For scoring purposes this is assumed to be a no investment plan	129	6	0
2	Customer WTP	-	Leakage reduced to 19 to 22Ml/d (8 to 11Ml/d reduction)	157.8 to 146	6.2 to 6.1	3-6
3a	Plausible Droughts	R	No leakage reduction, no new investment	129	6	0
3b	1in 200 year drought	L	No leakage reduction, no new investment	129	6	0
4a	Water resource only plan	M	Resource schemes to offset c1.7Ml/d	136	6	<0.5
4b	Demand only plan	M	Leakage reduction to offset 1.7Ml/d	132	6	0.5-1
5a	Southern transfer (BW only)					
5b	Environmental needs (WINEP2)	L	6.6Ml/d leakage reduction, starting in AMP8	132	6	0
6a	Leakage consistency	H	Reduces leakage by 2.49Ml/d at end of period	129	6	0
6b	PR19 Methodology (leakage reduced by 15%)	-	Reduces leakage by c4.5Ml/d by 2025	139	6	2-3
7a	Household demand - high forecast	L	Reduce leakage to offset growth (c3.8Ml/d) at end of the period	132	6	0
7b	Non-household demand - high forecast	L	Reduce leakage to offset demand growth (0Ml/d) at end of the period	129	6	0

Likelihood: R = Remote (<2%), L = low (2-20%); M = Medium (20 – 65%); H = high (85-90%); VH = very high (>90%). NPVs rounded to nearest significant figure.

b) Scores

Scenario		Likelihood	Financial		Customer and affordability			Deliverability			Resilience		Markets and Inn'n		Total
			Private costs	Env & Social costs	Bill Impact	Alignment to customer preferences	Alignment to govt objectives	Cost certainty	Yield certainty	Flexibility	Drought performance	Single source dominance	Promotes markets	Direct procurement	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
1a	Base Case (most likely)	M	3	3	3	1	0	3	3	3	2	1	1	1	**24**
2	Customer WTP	-	1	3	1	2	3	1	1	3	3	2	1	3	**24**
3a	Plausible Droughts	R	3	3	3	1	0	3	3	3	2	1	1	1	**24**
3b	1in 200 year drought	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**
4a	Water resource only plan	M	2	3	3	1	1	3	2	2	3	3	2	3	**28**
4b	Demand only plan	M	3	3	2	2	2	2	2	3	3	1	1	3	**27**
5a	Southern transfer (BW only)		-	-	-	-	-	-	-	-	-	-	-	-	**-**
5b	Environmental needs (WINEP2)	L	3	3	3	4	3	1	1	3	2	1	1	3	**28**
6a	Leakage consistency	H	3	3	3	2	2	3	3	3	2	1	1	1	**27**
6b	PR19 Methodology (leakage reduced by 15%)	-	2	3	1	2	3	1	1	3	3	2	1	3	**25**
7a	Household demand - high forecast	L	3	3	3	2	3	2	2	3	3	2	1	3	**30**
7b	Non-household demand - high forecast	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**

Likelihood: R = Remote (<2%), L = low (2-20%); M = Medium (20 – 65%); H = high (85-90%); VH = very high (>90%)

Table A.7.16: Multi-criteria scoring - Roadford

a) Base data

Scenario		Likelihood	Description	Data		
				Private costs	Env & Social costs	Bill impact in 2025
				NPV	NPV	£/prop
1a	Base Case (most likely)	M	No leakage reduction, no new investment	151	11	0
2	Customer WTP	-	Leakage reduced by c28 to 30Ml/d (c12 to 14Ml/d reduction)	204 to 221	11.6 to 11.6	6-10
3a	Plausible Droughts	R	Leakage reduction between 0 to 17Ml/d depending on scenario	150.9 to 223.7	11	0 -6
3b	1in 200 year drought	L	No leakage reduction, no new investment	151	11	0
4a	Water resource only plan	M	Resource schemes to offset c1.9Ml/d	154	11	<0.5
4b	Demand only plan	M	Leakage reduction to offset 1.9Ml/d	155	11	0-0.5
5a	Southern transfer (BW only)					
5b	Environmental needs (WINEP2)	L	5.4Ml/d leakage reduction, starting in AMP8	158	11	0
6a	Leakage consistency	H	Reduces leakage by 0.7Ml/d at end of period	152	11	0
6b	PR19 Methodology (leakage reduced by 15%)	-	Reduces leakage by c6.3Ml/d by 2025	173	12	2-3
7a	Household demand - high forecast	L	Reduce leakage to offset growth (c4.8Ml/d)	157	11	0
7b	Non-household demand - high forecast	L	Reduce leakage to offset demand growth (0Ml/d)	151	11	0

Likelihood: R = Remote (<2%), L = low (2-20%); M = Medium (20 – 65%); H = high (85-90%); VH = very high (>90%). NPVs to nearest significant figure.

b) Scores

Scenario		Likelihood	Financial		Customer and affordability			Deliverability			Resilience		Markets and Inn'n		Total
			Private costs	Env & Social costs	Bill Impact	Alignment to customer preferences	Alignment to govt objectives	Cost certainty	Yield certainty	Flexibility	Drought performance	Single source dominance	Promotes markets	Direct procurement	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
1a	Base Case (most likely)	M	3	3	3	1	0	3	3	3	2	1	1	1	**24**
2	Customer WTP	-	1	3	1	2	3	1	1	3	3	2	1	3	**24**
3a	Plausible Droughts	R	2	3	2*	2	3	1	1	3	3	2	1	3	**26**
3b	1in 200 year drought	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**
4a	Water resource only plan	M	3	3	3	1	1	3	2	2	3	3	2	3	**29**
4b	Demand only plan	M	3	3	3	2	2	2	2	3	3	1	1	3	**28**
5a	Southern transfer (BW only)				-	-	-	-	-	-	-	-	-	-	**0**
5b	Environmental needs (WINEP2)	L	3	3	3	4	3	1	1	3	2	1	1	3	**28**
6a	Leakage consistency	H	3	**3**	3	2	2	3	3	3	2	1	1	1	**27**
6b	PR19 Methodology (leakage reduced by 15%)	-	1**	3	1	2	3	1	1	3	3	2	1	3	**24**
7a	Household demand - high forecast	L	3	3	3	2	3	2	2	3	2	2	1	3	**29**
7b	Non-household demand - high forecast	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**

**mid-point score used as two drought cause a deficit and two do not; ** the impacts on costs in this WRZ is higher than in other WRZs resulting in a lower score.*

Likelihood: R = Remote (<2%), L = low (2-20%); M = Medium (20 – 65%); H = high (85-90%); VH = very high (>90%)

Table A.7.17: Multi-criteria scoring - Wimbleball

a) Base data

Scenario		Likelihood	Description	Data		
				Private costs	Env & Social costs	Bill impact in 2025
				NPV	NPV	£/prop
1a	Base Case (most likely)	M	No leakage reduction, no new investment	73	4	0
2	Customer WTP	-	Leakage reduced to 8 to 10Ml/d	94.8 to 88.1	3.9 to 3.9	3-10
3a	Plausible Droughts	R	Leakage reduction between 0 to 8Ml/d depending on scenario	73.4 to 126.2	4	0-13
3b	1in 200 year drought	L	No leakage reduction, no new investment	73	4	0
4a	Water resource only plan	M	Resource schemes to offset c0.5Ml/d	77	4	<0.5
4b	Demand only plan	M	Leakage reduction to offset 0.5Ml/d	76	4	0.5-1
5a	Southern transfer (BW only)					
5b	Environmental needs (WINEP2)	L	0.5Ml/d leakage reduction at the end of the planning period	74	4	0
6a	Leakage consistency	H	No leakage reduction, no new investment	74	4	0
6b	PR19 Methodology (leakage reduced by 15%)	-	Reduces leakage by c1.7Ml/d by 2025	83	4	3-4
7a	Household demand - high forecast	L	Reduce leakage to offset growth (c0.5Ml/d) at the end of the period	73	4	0
7b	Non-household demand - high forecast	L	Reduce leakage to offset demand growth (0Ml/d)	73	4	0

Likelihood: R = Remote (<2%), L = low (2-20%); M = Medium (20 – 65%); H = high (85-90%); VH = very high (>90%). NPVs to nearest significant figure.

b) Scores

Scenario		Likelihood	Financial		Customer and affordability			Deliverability			Resilience		Markets and Inn'n		Total
			Private costs	Env & Social costs	Bill Impact	Alignment to customer preferences	Alignment to govt objectives	Cost certainty	Yield certainty	Flexibility	Drought performance	Single source dominance	Promotes markets	Direct procurement	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
1a	Base Case (most likely)	M	3	3	3	1	0	3	3	3	2	1	1	1	**24**
2	Customer WTP	-	1	3	1	2	3	1	1	3	3	2	1	3	**24**
3a	Plausible Droughts	R	2	3	2*	2	3	1	1	3	3	2	1	3	**26**
3b	1in 200 year drought	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**
4a	Water resource only plan	M	2	3	3	1	1	3	2	2	3	3	2	3	**28**
4b	Demand only plan	M	3	3	2	2	2	2	2	3	3	1	1	1	**25**
5a	Southern transfer (BW only)				-	-	-	-	-	-	-	-	-	-	**-**
5b	Environmental needs (WINEP2)	L	3	3	3	2	3	3	3	3	2	1	1	1	**28**
6a	Leakage consistency	H	3	3	3	1	0	3	3	3	2	1	1	1	**24**
6b	PR19 Methodology (leakage reduced by 15%)	-	1	3	1	2	3	2	2	3	3	2	1	3	**26**
7a	Household demand - high forecast	L	3	3	3	2	3	3	3	3	2	1	1	1	**28**
7b	Non-household demand - high forecast	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**

**mid-point score used as two drought cause a deficit and two do not*

Likelihood: R = Remote (<2%), L = low (2-20%); M = Medium (20 – 65%); H = high (85-90%); VH = very high (>90%)

South West Water Bournemouth Water

Table A.7.18: Multi-criteria scoring - Bournemouth

a) Base data

Scenario		Likelihood	Description	Data		
				Private costs	Env & Social costs	Bill impact in 2025
				NPV	NPV	£/prop
1a	Base Case (most likely)	M	No leakage reduction, no new investment	94	3	0
2	Customer WTP	-	Leakage reduced by c1.5 to 2.5Ml/d	107.5 to 101.6	2.8 to 2.8	1.5-3
3a	Plausible Droughts	R	No leakage reduction, no new investment	94	3	0
3b	1in 200 year drought	L	No leakage reduction, no new investment	94	3	0
4a	Water resource only plan	H	not used			
4b	Demand only plan	M	Reduction in leakage of 1.39Ml/d (data as WTP)	102	3	2-3
5a	Southern transfer (BW only)		Cost of transfer assumed to be borne by SRN customers	94	3	0
5b	Environmental needs (WINEP2)	L	No leakage reduction, no new investment	94	3	0
6a	Leakage consistency	H	No leakage reduction, no new investment	94	3	0
6b	PR19 Methodology (leakage reduced by 15%)	-	Reduces leakage by c2.9Ml/d by 2025	107	3	3-4
7a	Household demand - high forecast	L	No leakage reduction, no new investment	94	3	0
7b	Non-household demand - high forecast	L	No leakage reduction, no new investment	94	3	0

Likelihood: R = Remote (<2%), L = low (2-20%); M = Medium (20 – 65%); H = high (85-90%); VH = very high (>90%). NPVs to nearest significant figure.

b) Scores

Scenario		Likelihood	Financial		Customer and affordability			Deliverability			Resilience		Markets and Inn'n		Total
			Private costs	Env & Social costs	Bill Impact	Alignment to customer preferences	Alignment to govt objectives	Cost certainty	Yield certainty	Flexibility	Drought performance	Single source dominance	Promotes markets	Direct procurement	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
1a	Base Case (most likely)	M	3	3	3	1	0	3	3	3	2	1	1	1	**24**
2	Customer WTP	-	1	3	1	2	3	2	1	3	3	2	1	3	**25**
3a	Plausible Droughts	R	3	3	3	1	0	3	3	3	2	1	1	1	**24**
3b	1in 200 year drought	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**
4a	Water resource only plan	M						-	-	-	-	-	-	-	**-**
4b	Demand only plan	M	2	3	1	2	2	1	1	3	3	2	1	3	**24**
5a	Southern transfer (BW only)		3	3	3	1	3	1	2	1	3	3	2	3	**28**
5b	Environmental needs (WINEP2)	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**
6a	Leakage consistency	H	3	3	3	1	0	3	3	3	2	1	1	1	**24**
6b	PR19 Methodology (leakage reduced by 15%)	-	1	3	1	2	3	2	1	3	3	2	1	3	**25**
7a	Household demand - high forecast	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**
7b	Non-household demand - high forecast	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**

Likelihood: R = Remote (<2%), L = low (2-20%); M = Medium (20 – 65%); H = high (85-90%); VH = very high (>90%)

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Bournemouth Water

A.7.11 Plausible droughts methodology

The plausible drought scenarios are summarised in Table A.7.19 below. The design drought for the SWW supply area is 1975/76, which is the worst drought in the historic flow record. 1978 was also dry. The worst drought in the historic flow record for BW is 1976.

Table A.7.19: Plausible drought scenarios

Scenario	Description
PD-1	Actual August 1976 baseflow recession extrapolated for 30 days, i.e. removing early to mid September historic rainfall
PD-2	Extension of baseflow recession from 20 Sept 1976 for 30 days, i.e. removing the late September and early-mid October historic heavy rainfall
PD-3	Flows during the period 1 Nov 1975 to 31 Mar 1976 reduced by 10%
PD-4	1977 and 1978 records swapped around, i.e. to give a dry year following the 1975/76 drought

Example hydrographs for the River Exe at Thorverton in the SWW supply area showing plausible drought scenario flows compared to historic flows are given in Figures A.7.2 to A.7.5 below. Figure A.7.6 shows an example hydrograph for the River Avon (Hampshire) in the BW supply area.

Figure A.7.2: Scenario PD-1: actual 1975-76 drought extended into September

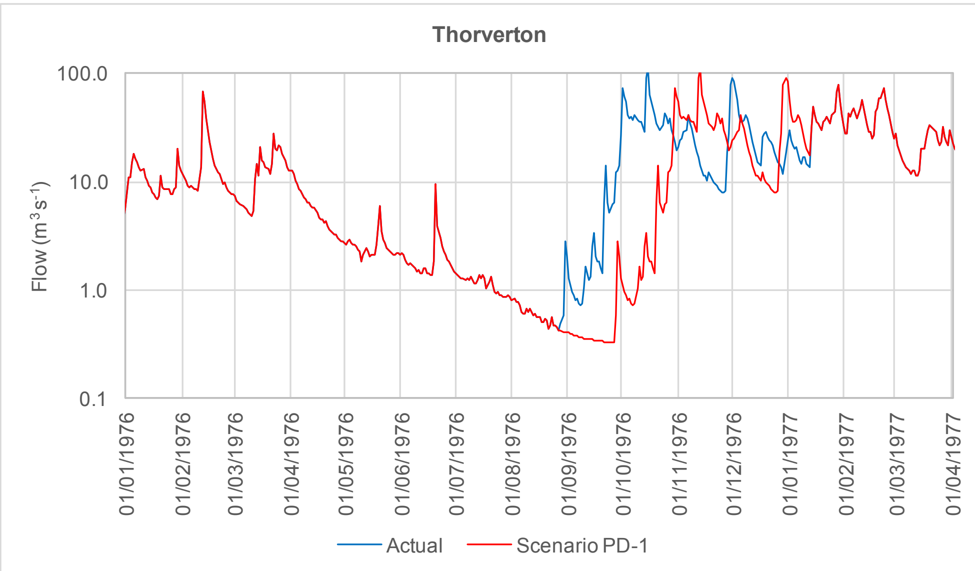


Figure A.7.3: Scenario PD-2: actual 1975-76 drought extended into October

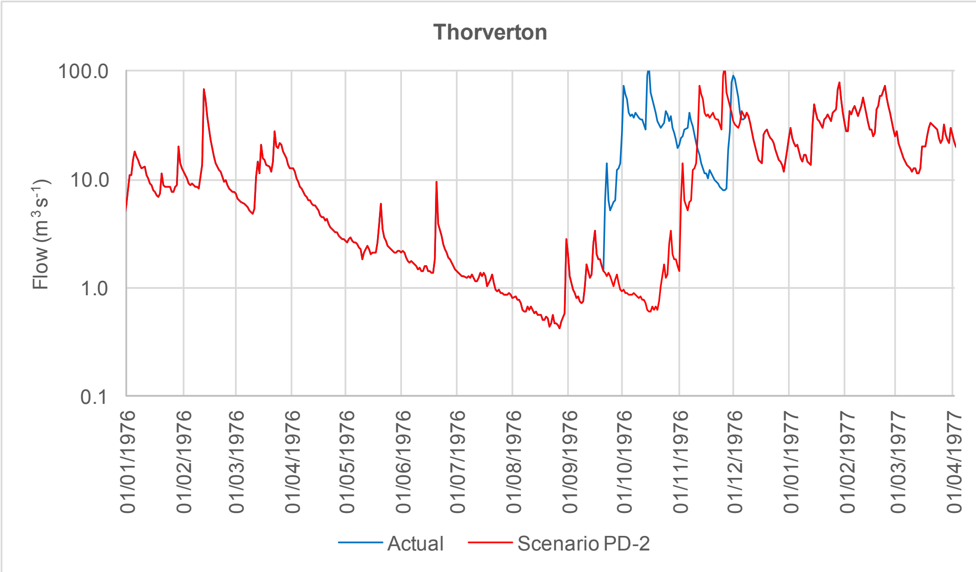


Figure A.7.4: Scenario PD-3: 10% less flow 1 November 1975 – 31 March 1976

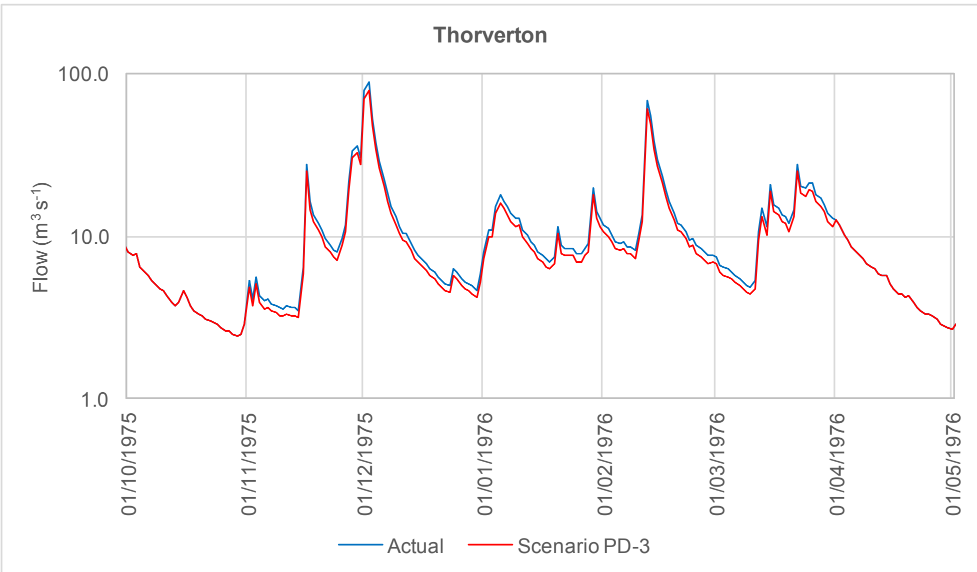


Figure A.7.5: Scenario PD-4: Swap 1977 and 1978 flows (to give three consecutive dry years)

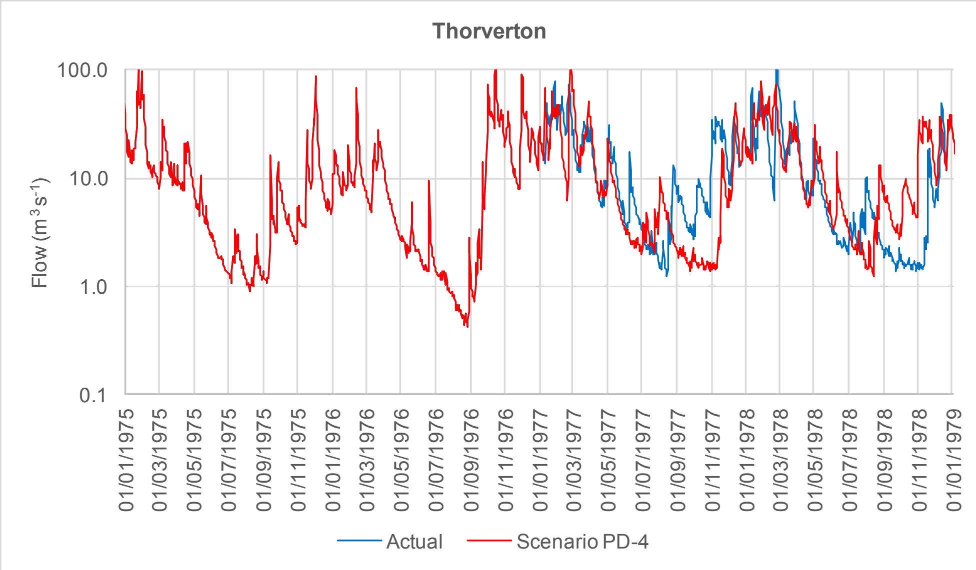
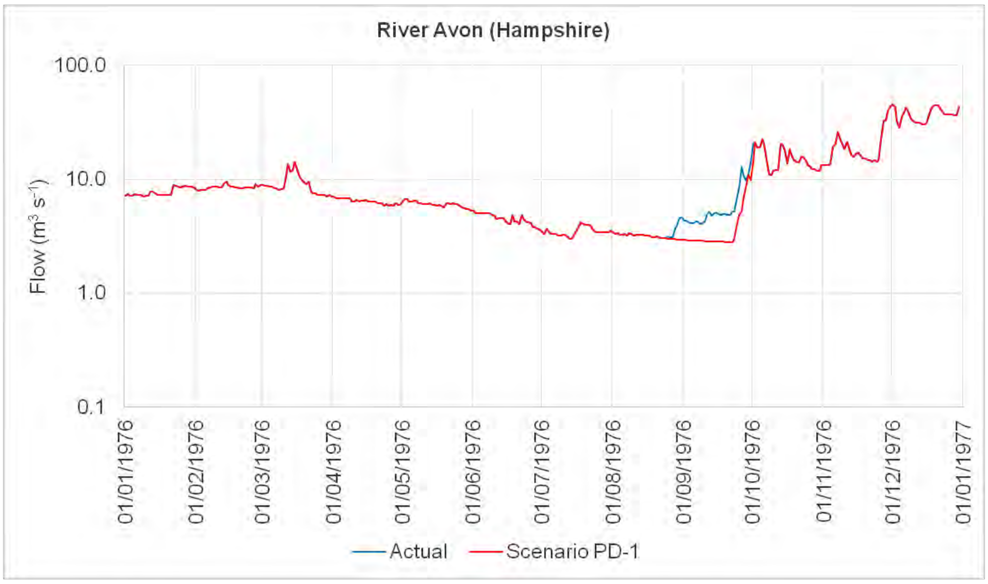


Figure A.7.6: Scenario PD-1: actual 1975-76 drought extended into September



For our groundwater sources, we commissioned Amec Foster Wheeler to assess the impact of these plausible drought scenarios on groundwater yields. They utilised groundwater modelling and analysed groundwater level records to identify that such plausible droughts would not reduce the deployable outputs of our groundwater sources.

A.7.12 A summary of the analysis carried out by the Met Office on return periods of historic and plausible droughts

Met Office

Severe Drought Analysis for Water Resource Management Plan and Drought Plan – v3.0.

For: South West Water
Date: October 2017
Author: Jill Dixon and Elizabeth Brock

Met Office

Executive Summary

As part of the Drought Plan and Water Resources Management Plan, Water Companies are required to consider droughts more severe than those recorded in the historical record and to understand the probability of these droughts occurring. South West Water (SWW) have considered historical droughts on record and, after analysing how SWW water resources systems behaved during these historical droughts, SWW derived a series of pragmatic plausible drought flow sequences.

This report assesses the probability of these plausible droughts occurring at their four Water Resource Zones (WRZs) - Roadford, Colliford, Wimbleball and Bournemouth. Two different but established techniques have been used to determine these probabilities:

- Extreme Value Analysis – using theoretical models, i.e. a Generalised Pareto Distribution (GPD) and a Peak Over Threshold (POT) method for fitting the data, using a drought index (frequentist approach). When results were not possible using this technique, a Bayesian model was used to gain extra insights for Colliford.
- Tabony Tables – established statistical analysis of rainfall data, assuming a log-normal distribution.

The results for the Historic Droughts (HD) were consistent between the techniques and the WRZ as shown in Table 1, although Colliford results suggested some lower return periods compared to the other WRZs. The Bayesian method suggests somewhat higher return periods.

		Roadford		Colliford			Wimbleball		Bournemouth	
Drought	**Length**	**EVA-F**	**Tabony**	**EVA-F**	**EVA-B**	**Tabony**	**EVA-F**	**Tabony**	**EVA-F**	**Tabony**
HD 75/76	18 months	175 - 220	85 (40-170)	40 -60	40-135	12 (6 – 24)	110-125	80 (40-160)	130-150	120 (60-240)
HD 84	5 months	30-35	40 (20-80)	25-35	25-50	40 (20-80)	15-20	25 (13-50)	~10	16 (8-32)
HD 89	5 months	10-11	13 (7-26)	20-25	20-40	30 (15-60)	<10	9 (5-18)	<10	9 (5-18)
HD 95	5 months	35-45	30 (15-60)	65-70	45-200	100 (50-200)	30-40	45 (23-90)	75-80	180 (90-360)

Table 1: The best estimate return period results (years) for the HDs for the four SWW WRZs based upon Frequentist (EVA-F) and Bayesian (EVA-B) EVA methods plus Tabony tables. Note the EVA values represent the range of best estimates and not confidence limits. The range of Tabony table estimates reflect their quoted accuracy of a factor of two (50% - 200%).

Met Office

The results of the EVA frequentist method suggest that there are difficulties in using this method to analyse the Plausible Droughts (PD) in the Colliford WRZ. This could be because of the location of the Colliford WRZ, which is in an extreme south westerly location, a relatively narrow land area and totally surrounded by the sea. This was therefore further explored using the EVA Bayesian analysis. As can be seen from the results in Table 2, the additional Bayesian analysis suggests that the Plausible Droughts PD1-3 are unusual events at Colliford; PD4 is not as unusual, which is the trend suggested by the Tabony Tables, although the return periods are significantly different.

Note, no Extreme Value Analysis (frequentist approach) results could be obtained for the 32-month drought periods as the high Plausible Drought indices values lay outside the bounds of the standard EVA results. However, as part of the further investigation into Bayesian techniques using only Colliford data, a 32 month result has been obtained. Future work could extend this for the other sites, although this analysis would incur extra costs.

	Roadford		Colliford			Wimbleball		Bournemouth	
Drought	**EVA-F**	**Tabony Tables**	**EVA-F**	**EVA-B**	**Tabony Tables**	**EVA-F**	**Tabony Tables**	**EVA-F**	**Tabony Tables**
PD1 18 months	1,500 – 4,000	1,000 (500 – 2,000)	Beyond maximum values (> 10,000)	500-1000	70 (35-140)	1,250-2,500	>> 1,000	5,000 - >10,000	>> 1,000
PD2 19 months	400-430	300 (150-600)	1,100 – 5,000	500-1000	125 (65-250)	525-675	1,000 (500-2,000)	850-1200	900 (450-1800)
PD3 17 months	900 - 1500	650 (325 – 1,300)	Beyond maximum value (> 10,000)	500-1000	75 (40-150)	700-1,000	> 1000 (500-2000)	350-550	1000 (500-2000)
PD4 32 months	-	16 (8-32)	-	75-200	7 (4-14)	-	9 (5-18)	-	12 (6 – 24)

Table 2: The best estimate return period results (years) for the PDs for the four SWW WRZs based upon Frequentist (EVA-F) and Bayesian (EVA-B) EVA methods plus Tabony tables.
Note the EVA values represent the range of best estimates and not confidence limits. The range of Tabony table estimates represent their quoted accuracy of a factor of two (50% - 200%).
>> 1,000 - significantly greater than 1,000 years. (Note Tabony tables do not estimate values beyond 1,000 years).

No account has been taken of possible future climate changes.

APPENDIX 8

Water resource strategy

A.8.1 Introduction

This Appendix sets out additional information on our proposed draft WRMP activities.

A.8.2 Overall multi-criteria performance score

Tables A.8.1 to A.8.4 show the multi-criteria score for the proposed Plan. For comparison purposes the performance of the baseline plan is also given.

The results show the Plan performs better than the baseline 'do nothing' plan. Compared to the different choices in the scenario analysis it also performs better overall than other choices. The Plan does not score the highest score in all performance areas but instead gives the best balance overall.

It should be noted that the bill impact is an estimate only. It intended for comparison purposes between different choices and is not the final bill impact. This will depend on a range of other factors as part of the PR19 Business Plan.

Note that the NPVs used in our SELL model and in WRMP Table 5 are for different purposes and as such contain small differences in how they analyse cost. They should therefore not be compared directly. The difference between the use of programme NPV and AISC NPVs in developing a plan is discussed in the UKWIR Economics of Balancing Supply and Demand report. As shown in the scoring, the final programme choice is not driven solely by the long term NPV.

Table A.8.1: Multi-criteria performance score – Colliford

Scenario		Likelihood	Description	Data		
				Private costs	Env & Social costs	Bill impact in 2025
				NPV	NPV	£/prop
1a	Base Case (most likely)	M	1.1Ml/d leakage reduction at the very end of the period. For scoring purposes this is assumed to be a no investment plan	129	6	0
8	Draft Plan	M	Leakage to 77Ml/d in SWW, water efficiency and STW re-use	138	6	>1

Scenario		Likelihood	Financial		Customer and affordability			Deliverability			Resilience		Markets and Inn'n		Total
			Private costs	Env & Social costs	Bill Impact	Alignment to customer preferences	Alignment to govt objectives	Cost certainty	Yield certainty	Flexibility	Drought performance	Single source dominance	Promotes markets	Direct procurement	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
1a	Base Case (most likely)	M	3	3	3	1	0	3	3	3	2	1	1	1	**24**
8	Draft Plan	M	2	3	1	4	4	2	2	3	3	2	2	2	**30**

Table A.8.2: Multi-criteria performance score – Roadford

Scenario		Likelihood	Description	Data		
				Private costs	Env & Social costs	Bill impact in 2025
				NPV	NPV	£/prop
1a	Base Case (most likely)	M	No leakage reduction, no new investment	151	11	0
8	Draft Plan	M	Leakage to 77Ml/d in SWW, water efficiency and STW re-use	164	12	0.5-1

Scenario		Likelihood	Financial		Customer and affordability			Deliverability			Resilience		Markets and Inn'n		Total
			Private costs	Env & Social costs	Bill Impact	Alignment to customer preferences	Alignment to govt objectives	Cost certainty	Yield certainty	Flexibility	Drought performance	Single source dominance	Promotes markets	Direct procurement	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
1a	Base Case (most likely)	M	3	3	3	1	0	3	3	3	2	1	1	1	**24**
8	Draft Plan	M	2	3	2	4	4	2	2	3	3	2	2	2	**31**

Table A.8.3: Multi-criteria performance score – Wimbleball

Scenario		Likelihood	Description	Data		
				Private costs	Env & Social costs	Bill impact in 2025
				NPV	NPV	£/prop
1a	Base Case (most likely)	M	No leakage reduction, no new investment	73	4	0
8	Draft Plan	M	Leakage to 77Ml/d in SWW, water efficiency (no STW re-use)	77	4	0.5-1

Scenario		Likelihood	Financial		Customer and affordability			Deliverability			Resilience		Markets and Inn'n		Total
			Private costs	Env & Social costs	Bill Impact	Alignment to customer preferences	Alignment to govt objectives	Cost certainty	Yield certainty	Flexibility	Drought performance	Single source dominance	Promotes markets	Direct procurement	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
1a	Base Case (most likely)	M	3	3	3	1	0	3	3	3	2	1	1	1	**24**
8	Draft Plan	M	2	3	2	4	4	2	2	3	3	2	2	2	**31**

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Table A.8.4: Multi-criteria performance score – Bournemouth

Scenario		Likelihood	Description	Data		
				Private costs	Env & Social costs	Bill impact in 2025
				NPV	NPV	£/prop
1a	Base Case (most likely)	M	No leakage reduction, no new investment	94	3	0
8	Draft Plan	M	Reduce leakage to 18Ml/d, water efficiency	104	3	1-1.5

Scenario		Likelihood	Financial		Customer and affordability			Deliverability			Resilience		Markets and Inn'n		Total
			Private costs	Env & Social costs	Bill Impact	Alignment to customer preferences	Alignment to govt objectives	Cost certainty	Yield certainty	Flexibility	Drought performance	Single source dominance	Promotes markets	Direct procurement	
			Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
1a	Base Case (most likely)	M	3	3	3	1	0	3	3	3	2	1	1	1	**24**
8	Draft Plan	M	1	3	1	4	4	2	2	3	3	2	2	2	**29**

A.8.3 Reduce leakage and the future demand for water

A.8.3.1 Leakage target in 2025

The analysis in Section 7 shows a long-term leakage level of 64 Ml/d for the South West Water supply area and 16 Ml/d for the Bournemouth supply area align to the level at which customers are willing to pay.

With no strict supply demand driver for leakage reduction the approach for our leakage target needs to take into account wider considerations.

Tables A.8.5 and A.8.6 present data on the performance of different leakage targets for possible delivery by 2025.

The performance is mapped against the metrics in the multi-criteria assessment. However, additional granularity is given to aid decision making in the short-term compared to the long-term picture.

Note that bill impacts are estimated based on the forecast costs. They are for comparative purposes only. Actual bill impacts will depend on other factor as part of the overall PR19 Business Plan and PR19 methodology.

The data show a trade-off between the level of leakage reduction, cost, affordability, resilience, deliverability and customer preferences. The lower the leakage reduction, the lower the cost and impact on affordability but the lower the benefit for resilience. Higher leakage reduction incur higher costs, higher bill impacts, and greater delivery risk, but have better performance on resilience and delivering customer preferences.

For the South West Water supply area, a leakage level between 76-78 Ml/d is considered to give the best balance of the different tensions at play. For the Bournemouth Water supply area a leakage level between 17-18 Ml/d is considered to give the best overall balance.

Taking all factors into account, our plan for 2025 is for an overall leakage target for the South West Water supply area of 77 Ml/d (the mid-point of the range). This represents a leakage reduction of 7 Ml/d from current levels. For the Bournemouth Water supply area we propose a leakage target of 18 Ml/d (1 Ml/d below current levels).

In total our proposed plan would reduce total leakage by 8 Ml/d from current levels – approximately 8%. We will then continue to reduce leakage to the long-term levels set out above.

Section A.8.7 below shows we suggest this leakage reduction will place our leakage at industry Upper Quartile performance in 2025 based on current performance. Section A.8.7 also estimates what other company performance might be in 2025 and this shows our plan would still achieve Upper Quartile performance.

Table A.8.5: Comparison of different leakage targets in 2025 – South West Water supply area

Leakage Level	Reduction	l/prop/d*	m3/km*	Financial	Customer and Affordability			Deliverability			Resilience		Markets and innovation	
				Delta Totex [5 yr]	Estimated bill impact in 2025**	Alignment to customer preferences	Alignment to government objectives	Cost Uncertainty (£m Totex Upper, 5yr)	Yield uncertainty	Flexibility	Drought performance	Single source	Promotes markets	Direct procurement
84	0%	Avg	UQ	0	0	Poor	Poor	+6	Low	Low	Low	Low	No	No
82	-2.4%	Avg	UQ	1.59	0-0.5	Poor	Poor	+6	Low	Low	Low	Low	No	No
80	-4.8%	Avg	UQ	3.41	0.5-1	Good	Good	+6	Low-Med	Med	Low-Med	Low-Med	No	No
78	-7.1%	Avg	UQ	5.46	0.5-1	Good	Good	+8	Med	Med-High	Med	Low	No	No
76	-9.5%	Avg	UQ	8.00	1-1.5	Good	Good	+12	Med-High	Med-High	Med	Med	No	No
72	-14.3%	UQ	UQ	11.06	>2.0	Best	Best	+14	High	Med	Med-high	Med	No	Yes

Table A.8.6: Comparison of different leakage targets in 2025 – Bournemouth Water supply area

Leakage Level	Reduction	l/prop/d*	m3/km*	Financial	Customer and Affordability			Deliverability			Resilience		Markets and innovation	
				Delta Totex [5 yr]	Estimated bill impact in 2025**	Alignment to customer preferences	Alignment to government objectives	Cost Uncertainty (£m Totex Upper, 5 yr)	Yield uncertainty	Flexibility	Drought performance	Single source	Promotes markets	Direct procurement
19	0%	Avg	Avg	0	0	Poor	Poor	+1.5	Low	Low	Low	Low	No	No
18	-5.3%	UQ	Avg-UQ	1.6	1-1.5	Good	Good	+1.6	Low	Low	Low	Low	No	No
17	-10.6%	UQ	UQ	3.5	2-3	Good	Good	+2.5	Med	Med	Low-Med	Low	No	No
16	-16.8%	UQ	UQ	5.5	3-4	Best	Best	+3.0	High	Med-High	Med	Med	No	Yes

** Based on 16/17 data. **Estimate of bill impact for comparative purposes only. For a simple calculation on bill impacts one can use the following assessment:*
Total increase in cost for a leakage target of 72 Ml/d = £11.06m over 5 years = £2.2m p.a. Total SWW Properties = c800k; impact on bill if all cost is operating cost is £2.2/0.8 = £2.7/prop. The actual bill impact calculated may differ slightly due to the underlying profile of the reduction within the 5 years and the totex split. Totex is opex, capex and opex savings. Excludes financing costs.

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This rate of leakage reduction in the short-term is faster than the long-term average – see Table A.8.7.

Table A.8.7: Comparison of the rate of leakage reduction

WRZ	Leakage Target (2019) [Ml/d]	Period 2020-25		Period 2025-45	
		Leakage Target (2025) [Ml/d]	Rate of Leakage reduction [Ml/d/AMP]	Leakage Target (2045) [Ml/d]	Rate of Leakage reduction [Ml/d/AMP]
SWW	84	77	7	64	3.25
BW	19	18	1	16	0.5

As can be seen from the data, higher or lower reductions in leakage could be selected. Taking all factors into account, the proposed targets are considered to be the best balance overall.

We will update the target in our final plan using the new leakage reporting methodology. As shown in Section 7, the move to the new reporting methodology does not have a significant effect on our overall supply demand balance.

A.8.3.2 Delivering the leakage reduction

Our leakage control to date has largely based on detection and repair and pressure management, with constant development undertaken to optimise the processes that support these activities.

Leakage monitoring, through District Meter Areas (DMAs), covers 100% of our network over the full reporting year. This ensures that all parts of the distribution system are closely and continuously monitored throughout the year. We have also invested in remote data collection telemetry for DMA reporting so that over 99% of our metered flows are available for monitoring on at the very least a 24 hour basis. Work is ongoing this AMP to increase the frequency of data collection; approximately 33% of our loggers are now transmitting data to our reporting software every hour and we are currently trialling 30 minute flow and pressure retrieval. This significantly improves our awareness of network events. Combined with strict repair partner Key Performance Indicator (KPI) targets, this has reduced the runtime of leaks, and therefore their potential to impact customer service.

Every DMA has an individual leakage target set which reflects both our leakage target and the unit cost of leak detection in each DMA. DMAs with a high level of leakage or inoperability are reviewed and where necessary they are redesigned to improve active leakage control targeting.

Establishing such comprehensive network coverage means a continuous picture of the distribution of leakage across the region is available. The currency of network data allows us to direct leakage detection staff more efficiently and to target network issues more expediently. Continued appraisal of the design and performance of our DMAs continues to drive meter replacements and installations as well as increasing the number of DMAs, which assists in improving the efficiency of leak detection activity. Smaller DMAs allow quicker identification and localisation of leakage, increases the accuracy of the leakage balance and aids reporting.

The effectiveness of leak detection staff is essential to successful leakage control especially given the intensive level of activity given that our leakage levels are low (e.g. on a Ml/d per km basis). All leak detectors receive comprehensive training and are provided with a wide range of current equipment. The company Business Intelligence and Data Warehouse initiative has delivered bespoke detection performance monitoring, bringing together disparate data sources to improve data availability and performance management through a new visualisation tool in Microsoft PowerBI. The PowerBI dashboards give up to date detection efficiency volume and cost information and significantly improve our ability to monitor detection performance. Detection staff have regular performance reviews and corrective action plans are instigated where appropriate. Equipment is regularly reviewed and trialled to ensure that staff are provided with the most efficient and accurate means of locating leaks.

We continue to employ mobile working for leak detection. Daily jobs are promoted from depots to field-based staff via a handheld device (EDA) and these devices allow the promotion of repair work remotely by detection staff to our repair partners. This reduces the time taken from awareness to resolution of a leak. The speed and quality of leak repairs is equally important and applies to both reported and detected leaks. We set KPIs for leak repair times and these are banded according to the assessed severity of the leak and the potential of disruption to customer service. Leak repair time performance is reported monthly and we produce a daily report to ensure that the number of leak repairs waiting to be carried out is within agreed service levels.

Our leakage monitoring and reporting system (a bespoke software tool called LASS) which was introduced in 2004/05 continues to be developed, improving the targeting of our leak detection resource and the reporting of leakage performance. In tandem with the Business Intelligence and Data Warehouse initiative we have implemented Microsoft SharePoint reports to supplement leakage reporting information from LASS with other company data sources to provide area teams with the best and most up to date information available to monitor leakage and control the detection and repair process.

In AMP6 SWW is investing significant extra funding to better understand the patterns of domestic and commercial customer consumption over the year. Extensive logging and analysis is taking place to understand seasonality in consumption and the relationship between commercial and domestic usage, plumbing losses and supply pipe losses. The extra customer logging will provide increased robustness in consumption figures, night use allowances and increased leak detection efficiency.

A.8.3.2.1 Customer supply pipe leakage

Our customer supply pipe repair policy since 2005 has provided one hour's free detection for commercial customers and contributions towards the cost of the repair or replacement of supply pipes for all privately owned domestic properties. The contributions are weighted in favour of replacement to encourage customers to replace pipework in which deterioration has occurred and which is likely to suffer repeat failure. This has been very successful with the majority of contribution claims now being for supply pipe replacements and it has markedly increased the rate of service pipe asset renewal. The contributions are conditional on the work being completed within the period of a waste notice which is issued for all supply pipe leaks; this encourages timely repair. The increase in household metering is assisting the identification of supply pipe leaks, as 85% of meters are installed in the highway.

In AMP6 the company has started to investigate supply pipe leakage (and internal losses) through a programme of high-resolution logging on customers in our Survey of Domestic Water Consumption. We are working with Artesia Consulting and the University of Exeter to investigate the components of demand and using high-resolution logging to better understand the prevalence of supply pipe leaks, how they develop and the volumes of water lost at a micro-component level. In addition, we have installed trial fixed networks at three sites across the region to make use of AMR meters that we are installing for consumption purposes. AMR meters can be set up to detect potential leaks at customer properties. We are therefore investigating the potential to detect customer supply leakage using these meters to transmit leak alerts back to the Company. This will allow quicker awareness of potential leakage.

We estimate that approximately 80% of leakage is from our distribution network and 20% from customer supply pipe leakage.

A.8.3.2.2 Pressure management

SWW continues to implement a pressure management strategy, concentrating pressure reduction in areas of our network where there is currently a high burst/leak frequency and pro-actively identifies areas which may become problematic for the company or customers in the future. In AMP6 we have been installing modulating controllers and permanent pressure logging in strategic DMAs to better understand, manage and mitigate high pressure and pressure variations for our customers.

Since the start of AMP5 our ongoing pressure management initiative has reduced our regional average zonal night pressure from 59m in 2010, which was among the highest in the industry, to 52m. We see long-term benefits from this work in leakage control but also in other company activities such as burst rates on both mains and communication pipes, a reduction in supply interruption, an increase in asset life and improved security of supply for customers.

We undertake a continuous programme of pressure logging to update the average zone pressures within each pressure managed area in the region every four years. Results are aggregated to give a property weighted average zone pressure for each DMA, which in turn are aggregated to depot and a regional average zone pressure. This enables us to better understand our network and where to target leakage control and pressure management resources.

Table A.8.8: Costs for phases of pressure reduction programme

Scheme name	Capex (£M)	Reduction (Ml/d)	Year of lowest NPV	NPV variation from base (£M)	Opex variation (£M per year)	Customer cost in year 2025 (£)
Phase 1	0.14	-0.95	2020	-0.3	-0.03	-0.02
Phase 2	0.22	-1.01	2020	-0.3	-0.03	-0.02
Phase 3	0.24	-0.99	2020	-0.3	-0.03	-0.02
Phase 4	0.28	-1.01	2020	-0.3	-0.03	-0.02
Phase 5	0.31	-0.99	2020	-0.1	-0.03	-0.01
Phase 6	0.36	-1.02	2020	-0.2	-0.03	-0.02
Phase 7	0.38	-1.01	2020	-0.1	-0.03	-0.02
Phase 8	0.41	-1.00	2020	-0.2	-0.03	-0.02
Phase 9	0.44	-0.99	2020	-0.1	-0.03	-0.01
Phase 10	0.48	-1.00	2020	-0.1	-0.03	-0.02
Phase 11	0.52	-1.00	2020	0.0	-0.03	-0.01
Phase 12	0.56	-1.01	2020	0.0	-0.03	-0.01
Phase 13	0.61	-1.00	2020	0.0	-0.04	-0.01
Phase 14	0.66	-1.01	2020	0.1	-0.03	-0.01
Phase 15	0.71	-1.01	2020	0.1	-0.03	-0.01
Phase 16	0.73	-0.98	2020	0.2	-0.03	-0.01
Phase 17	0.80	-1.01	2020	0.2	-0.03	0.00
Phase 18	0.86	-1.00	2020	0.2	-0.03	0.00
Phase 19	0.90	-1.00	2020	0.3	-0.03	0.00
Phase 20	0.98	-1.01	2045	0.4	0.00	0.00

Table A.8.8 shows the estimated long-term costs and benefits associated with phases of a programme of Pressure Reducing Valve (PRV) installation for South West Water. Each phase represents a group of similarly beneficial PRV placements in various WIS zones, based on volume saved per pound invested. The ELL model further considers the detailed WIS zone factors (e.g. Natural Rate of Rise (NRR) and marginal production costs) in order to estimate overall company costs.

We will be looking at how to further optimise our leakage delivery costs as part of the PR19 Business Plan in 2018.

A.8.3.3 Reduce our own demand for water

Our final plan includes actions to reduce our own demand for water. Table A.8.9 shows the sites where we plan to undertake this work. The individual sites may change over the 2020 – 2025 period if better sites are found. If on further investigation the sites proposed are not appropriate or the savings fall short of the forecast savings we will examine the alternative options to ensure we remain in a supply-demand surplus.

This flexible approach means we continually look to improve our water resource position and adapt as needed.

Table A.8.9: Proposed Water Re-use Schemes at STWs

Site names	WRZ
Brokenbury	Roadford
Camborne	Colliford
Ernesettle	Roadford
Plymouth Central	Roadford
Radford	Roadford

A.8.4 Ensure availability of existing sources and their resilience to future droughts

We will undertake two key areas of work to ensure we remain resilient to future droughts.

A.8.4.1 Investigate the resilience of existing drought management options to more extreme droughts

We have not had an extreme drought in our region since 1976 and by their very nature these events are rare. We therefore think in the next period we should undertake studies in each WRZ to understand in more detail how robust some of our existing drought options would be to these more extreme droughts that have yet to occur.

Table A.8.10 sets out potential investigations that will form part of this study. For completeness, this table also shows the other investigations into future options that we will undertake as part of our activity to develop our planning tools and understanding of future options.

Actual investigations may change during the planning period depending on the findings of the analysis, any specific operational requirements or new data. This work will not only support our future WRMPs but also the work for our future Drought Plans.

A.8.4.2 Update our understanding of future drought impacts

We will continue to update our understanding of future drought impacts. This will build on our existing plausible drought work to understand in more detail:

- What types of future droughts we could expect
- How they would affect our supply system
- What the return period of the events will be

For Bournemouth Water, this will assess whether stochastic type analysis are appropriate for future analyses. For SWW previous work suggests such approaches do not translate into useful results due to the characteristics of the system and regional weather patterns.

A.8.5 Develop our planning tools and understanding of future options

As set out in Section 8 we will develop our tools and understanding of future options for our next WRMP in 2024.

Table A.8.10 sets out specific water resource options we plan to investigate. We will review this list over the 2020 – 2025 period and update as needed. This will include SEA assessments as needed.

We will also work with Southern Water on the detail of a possible transfer from our Bournemouth Water supply area to their Hampshire Water Resource Zone. This will examine not only the technical aspects of a transfer but also the mechanisms by which it would be funded. This will ensure that should such a scheme be implemented the costs of developing it and its delivery is borne by the relevant beneficiaries.

Table A.8.10: Investigations and studies

Resource Zone	Indicative Investigation	Investigate resilience of existing drought management options to more extreme droughts *Existing Drought Plan option (no further licence required)*	Develop our planning tools and understanding of future options *Possible future water resource option (new licence required)*
Colliford	Re-use of Rialton Intake/ Porth Reservoir	✓	
	Stannon - increase in licence (groundwater developments)		✓
	Re- introduce abstractions at Boswyn, Carwynen and Cargenwyn	✓	
	Restormel licence variation		✓
Roadford	High level feasibility study on Roadford/ Northcombe pumped storage from Gatherely (River Tamar) or different site	✓	✓
	Re-use of small reservoirs in North Devon eg Slade, Gammaton		✓
	River Taw and/or Torridge abstractions		✓
	Uton source re-commissioning (with Coleford & Knowle re-commissioning)		✓
Wimbleball	Pynes WTW & Intake		✓ (within existing licence)
	East Devon new source		✓
Bournemouth	Investigate potential options for increasing WAFU	✓	✓
	Bournemouth Water to Southern Water transfer		✓

Note: For the avoidance of doubt, the fact that studies have been completed on options does not mean the current plan is to promote them

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A.8.6 Natural Capital assessment

It is important for the long term sustainability of our region and our water supplies that the environment is resilient to future challenges.

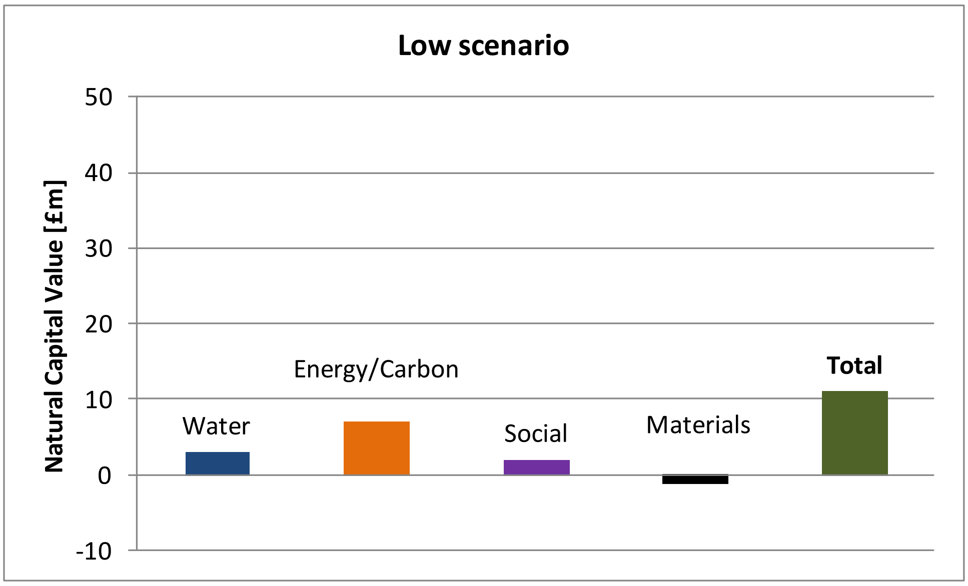
To complement our multi-criteria assessment we also undertook a high level assessment of the impact of our plan on natural capital. We are already playing a lead role in the Defra PIONEER projects and have worked with stakeholders in the development of a natural capital assessment for the North Devon area.

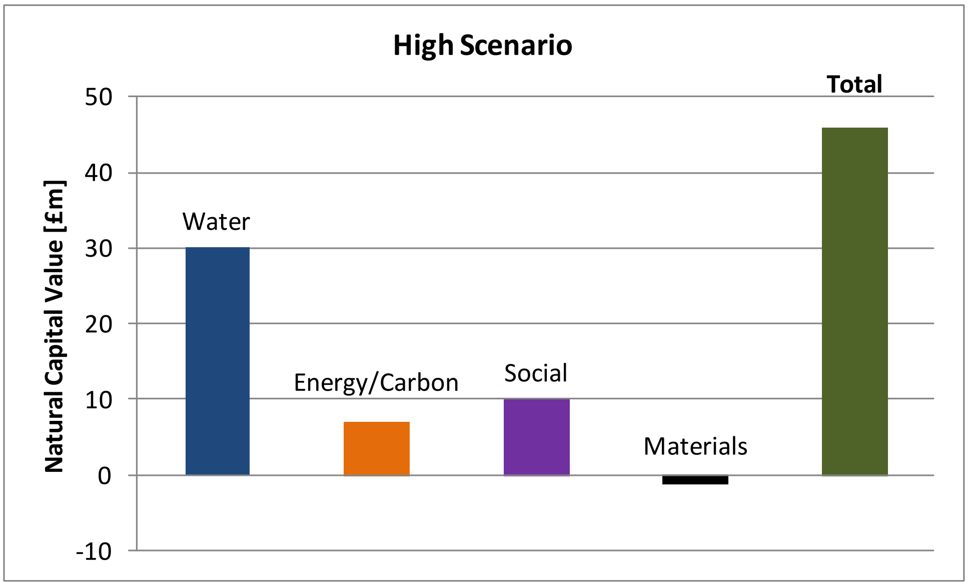
The calculation of Natural Capital is new for our Water Resources Management Plan and an area we plan to develop in the future. The results of the analysis are shown in Figure A.8.1 and show:

- the Plan as an overall positive benefit to natural capital
- the Plan improves natural capital between £11m and £46m
- the Plan has considerable natural capital benefits for the water and social environment service areas

We will continue to assess Natural Capital impacts of our activity as part of our PR19 Business Plan and continue to play a lead role in its application in the private sector. Further detail on the assessment is given below.

Figure A.8.1: Summary of Natural Capital assessment





A.8.6.1 <u>What is natural capital?</u>

Natural capital is the stock of natural resources existing within the environment. Ecosystem services are the goods and/or services that people can freely gain from natural resources (for example, water from rivers).

If natural capital is over exploited or under-maintained, the scope to continue to gain ecosystem services reduces over time. This has led to a rise in natural capital accounting, whereby analysts attempt to value the level of capital stock in order to determine whether it is stable, improving, or in decline.

While natural capital as a concept has been discussed from at least the 1970s, it has gained increasing focus from academics, regulators, and politicians in recent years. In 2011, the Government published 'The Natural Choice: securing the value of nature', within which the Government stated that the 'value of natural capital is not fully captured in the prices customers pay, in the operations of our markets or in the accounts of government or business. When nature is undervalued, bad choices can be made'.[A.8.1]

Our draft WRMP contains implications for the regional environment, as well as some implications for the global environment (for example, its impact on carbon).

The following sections set out to assess the impact of our Plan on natural capital.

[A.8.1] Defra (2011) *'The Natural Choice: securing the value of nature'*.

A.8.6.2 Natural capital accounting

Natural capital accounting is a nascent field. There is no single way to value natural capital stock. In part, this is due to the varied nature of the stock and its uses.

The Office of National Statistics (ONS) and the Department for Environment, Food and Rural Affairs (Defra) have been developing methods to value natural assets. The ONS has used the following categories of environmental service types and natural capital asset categories.

Table A.8.11: Environmental service types and natural capital asset categories

Associated environmental service type	Natural Capital asset category	Estimation method used
Provisioning services	Agricultural biomass	Residual value
	Fish	Residual value
	Timber	Stumpage price and volumes
	Water	Residual value
	Minerals	Residual value
	Oil, gas and coal	Price forecasts, associated expenditures, and volumes
	Wind energy	Residual value
	Hydropower	Residual value
Regulating services	Carbon Sequestration	Changes in land use and non-traded price of carbon
	Air pollution removal	Health damage cost per unit and volumes
Cultural services	Recreation	Expenditure on those using the services

Source: ONS (2016) 'UK natural capital: monetary estimates, 2016'

The residual value approach assesses the value of industry income which can be attributed directly to natural capital. It is calculated as the annual return (output) left after all costs of production and fixed capital returns have been deducted and adjustments for specific taxes and subsidies have been made.

Where specific asset life data are available, the ONS uses them in assessing the net present value (NPV) of natural assets. Where asset lives are not available, the ONS assumes a 25-year asset life for non-renewable assets and 50 years for all other assets. A discount rate of 3.5% is used for the first 30 years, declining to 3.0% thereafter.

The ONS's estimation methodology is still in development. There are a number of areas of natural capital that it does not currently reflect. For example:

- Unlike work undertaken by the EU Commission[A.8.2] so far, there has been limited explicit focus on biodiversity
- In some cases, the impact on businesses and consumers may be greater than the residual value of the industry assessed
- Public enjoyment of natural capital is only reflected through expenditure on recreation services, while many may enjoy a natural asset without directly incurring 'recreation' costs

Therefore, while this note uses the ONS's framework as a general guide, it also considers additional approaches to estimating natural capital.

A.8.6.3 Our Plan

Our Plan does not include any new resource schemes. The main intervention included is an 8% reduction in the level of leakage, and a series of water efficiency measures aimed at reducing average household consumption to approximately 129 litres per head per day across our whole operational area.

In total, these two measures result in the water savings set out in Table A.8.12 below:

Table A.8.12: Water savings from leakage and water efficiency measures in (Ml/d from 2019-20 base)

	2024-25	2029-30	2034-35	2039-40	2044-45
Water saved from leakage reduction	9	13	17	20	24
Water saved from water efficiency measures	2	2	3	3	3
Total water saved	**11**	**15**	**19**	**23**	**27**

Note: Water efficiency savings are the total net savings including those in embedded in the baseline forecast and our base activity

[A.8.2] EU Commission (2016) *'Mapping and Assessment of Ecosystems and their Services'*

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Table A.8.13 below sets out which natural capital asset categories are likely to be affected.

Table A.8.13: Impacts of draft WRMP by ONS category

Associated environmental service type	Natural Capital asset category	Does leakage / other demand reduction have an impact?
Provisioning services	Agricultural biomass	No – it is unlikely that the water savings will give an increase in agricultural output.
	Fish	Yes, but – whilst there may be day to day benefits to fish the benefit is difficult to quantify.
	Timber	No
	Water	Yes – water is saved.
	Minerals	Yes – some minerals are used in the interventions.
	Oil, gas and coal	No
	Wind energy	No
	Hydropower	No
Regulating services	Carbon Sequestration	Yes – lower demand reduces energy use
	Air pollution removal	Limited – some impact through reduced energy demand, for this analysis we have assumed this to be zero.
Cultural services	Recreation	No

In the following section, we estimate the effect on natural capital of the draft WRMP on saving water, and reducing carbon. Using the customer research data, an estimate was made of the social benefits (this is distinct from recreational benefits). It also assesses the extent that the interventions diminish natural capital through the use of input materials.

A.8.6.4 Estimating the effect on natural capital

In estimating the impact on natural capital of our Plan, we have first sought to identify the various different aspects of natural capital that could potentially be affected.

Table A.8.14: Natural capital areas that could be affected

Positive effects	Negative effects
1) ***Water*** - There will be more water available for public water supply, thus improving system resilience. 2) ***Energy/carbon*** - Energy usage will be lower (as less water will be treated and pumped), which means less depletion of energy resources, and less carbon being released. 3) ***Social*** - Society may gain intangible benefits from there being more water in the environment.	4) ***Materials*** - Leakage reduction requires the use of materials (e.g. plastic and concrete), both of which are partially comprised of non-renewable natural resources.

We explore valuation approaches for each of these factors below.

Water

Estimating the impact on natural capital of having more water in the environment can be estimated in different ways. We have used three different approaches in order to provide an overall range of the potential impact. The approaches we used are:

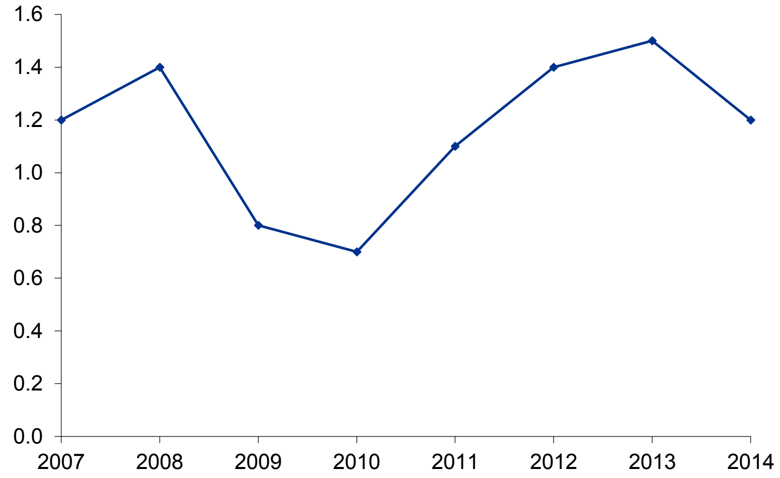
- A simplistic pro-rata of the ONS's national assessment.
- A high level assessment of the additional economic costs to South West Water should the water not be available.
- Based on the company's draft WRMP, an assessment of the next least cost way of providing an equivalent amount of water into the environment.

Each of the above approaches have methodological and data limitations (these are discussed below). By using three different approaches, we have been able to provide an indicative range.

Approach 1 – Pro-rata of the ONS's assessment

The ONS's assessment of water for natural capital is based on the value of water abstracted from the environment for use as part of public water supply. Figure A.8.2 below shows the ONS's recent valuations.

Figure A.8.2: Annual value of ecosystem service flows related to water abstracted for public use (2014 prices)



Source: ONS (2016) 'UK natural capital: monetary estimates, 2016'

The total level of water abstracted in 2014 was 5.75 billion m^3. This gives an average annual value per m^3 of £0.21. Taking the water savings set out above, and applying the ONS's approach to discounting, gives a NPV of just over £30 million (in 2016-17 prices[A.8.3]).

This is a simplistic approach as it assumes that:

- The 2014 value per m^3 would remain unchanged (as can be seen from Figure 1, there has been a fair degree of volatility in recent years, however, the fact that the 2014 figure is in line with the 8-year average gives us some degree of confidence that the year we have used is not completely inappropriate)
- The situation in our operating region is comparable to the national average
- A m^3 of water saved is of equal value to the average value of water, in reality, there are likely to be diminishing returns

<u>Approach 2 – impact on South West Water of less water</u>

In order to further explore the last two points of the above list, we have examined the draft WRMP to assess what effect reducing demand in our area is likely to have.

We estimate that failure to deliver the demand reductions would probably reduce temporary use bans to 1 in 15 year events (from 1 in 20), and drought orders/non-

[A.8.3] We have used CPIH to rebase the values.

essential use bans to about 1 in 30 years (from 1 in 40). The costs of such events are material.

We estimate that a temporary ban would result in a drop in revenues of around £5.4 million. While this would largely be recoverable through the wholesale revenue forecasting incentive mechanism (WRFIM), we would likely be subject to a penalty of 3% of the under-recovery. It is also estimated that we would receive a £1.6 million penalty from its outcome delivery incentives, and would need to incur around £1.7 million of totex in undertaking additional leakage reduction as part of our Drought Plan.

Drought orders would require an additional £3.2 million in leakage reduction, and between £3 million to £4 million in resource schemes in terms of additional activity. This assumes no supply-side drought orders are needed.

By assessing the change in risk of these events by the inclusion/exclusion of the demand reduction schemes, we estimate that the total cost would be around £3 million NPV (in 2016-17 prices).

This may somewhat understate the impact, as it excludes reputational cost, as well as the costs of communicating and enforcing the bans/restrictions. It also excludes the economic impact on the customers receiving a reduced service.

Approach 3 – alternative supply options

An alternative way of valuing the natural capital impact of having more water in the environment is to assess the costs of an alternative option of providing the water.

As part of this plan, we have assessed a range of potential supply side options. These range from £0.3 million per Ml/d to £4.8 million (NPV of future costs). The lowest price combination of options that would provide 27 Ml/d cost is £13 million. This may somewhat understate the cost, as it is based solely on expenditure, and does not include the natural capital impact involved in constructing these resources.

The three separate approaches we have used to estimate the natural capital value of having more water in the environment give a range of £2 million to £30 million (in 2016-17 prices).

Energy / carbon

In 2016-17, our water supply produced a total of 67.2 ktCO2e (kilotonnes of carbon dioxide equivalent) associated with the drinking water service[A.8.4]. This was produced across all areas of operation. However, the largest contribution to the carbon output is expected to be from the treating and pumping of water. If demand is reduced, then we would expect there to also be a fall in the amount of carbon used, as less water would be treated and pumped.

[A.8.4] South West Water (2017), *'Annual Performance Report and Regulatory Reporting'*, page 24.

In 2016-17, South West Water abstracted 167,000 Ml of water[A.8.5]. This works out to 0.4 tCO_2e per Ml. Therefore, the draft WRMP results in a reduction of carbon of approximately 40 million tCO_2e per year by 2044-45.

The ONS's approach to valuing carbon reduction is to monetise the reductions by using the non-traded price of carbon. Non-traded price of carbon has been estimated by the Department of Energy and Climate Change (DECC)[A.8.6] to be £60 per tonne of CO_2e (equivalent carbon dioxide)[A.8.7]. Then £70 in 2030, and £200 in 2050.

Taking the water savings in our Plan and applying the ONS's approach to discounting gives a NPV of just over £7 million (in 2016-17 prices).

Social

Valuing the intangible social benefits of having more water in the environment is not a straight forward undertaking. Getting customers to fully understand what the environment would look like with additional water requires a large degree of knowledge to be imparted to customers, and for those customers to be able to effectively envisage a complex scenario in the future.

Our customer research, suggests that reducing leakage is a high priority for customers[A.8.8] and customers may value a reduction in leakage of 1 Ml/d by around £540,000p.a. This valuation may include additional considerations beyond there simply being more water being in the environment, as water customers often view leakage as inherently wasteful. Therefore, this valuation of an additional Ml/d being available within the environment may somewhat overstate the intangible social benefits of there being more water in the environment.

Our customer research also places a valuation on abstracting from rivers (1 Ml/d is around £100,000p.a). Using this figure to value the benefit of reducing demand may somewhat understate the value that customers receive, as it excludes the fact that the additional water is in the environment is (largely) due to leakage reduction.

We have therefore taken both valuation figures to consider the social impacts as a range.

Taking the water savings in our Plan, we have estimated that the intangible benefits based on a willingness to pay to be between £2 million and £10 million (in 2016-17 prices).

[A.8.5] South West Water (2017), *'Annual Performance Report and Regulatory Reporting'*, page 94.
[A.8.6] Now largely subsumed by the Department for Business, Energy and Industrial Strategy.
[A.8.7] DECC (2009) *'Carbon Valuation in UK Policy Appraisal: A Revised Approach'*
[A.8.8] ICS and Eftec (2017) *'Water resources customer study'*, slides 41, 46, 52, and 55.

Materials

Reducing leakage requires a series of resources to be used, for example, plastic and concrete. The precise use of natural resources is difficult to quantify precisely.

To estimate the impact we have used the volume of additional work that will be undertaken as a result of the draft WRMP. We have used this volume data in combination with a series of emission factors included within a document provided by the company (we have not verified the accuracy of these factors)[A.8.9].

We currently undertake around 3,000 leakage repairs in an average year. This would increase by around 55% to meet the new leakage targets included within this Plan.

Using published data the average volume of $CO2$ produced per repair: 286 kg/$CO2$ from the worksites and 50 kg/$CO2$ from associated traffic delays. This equates to an additional 554,400 kg/$CO2$ produced each year (from when the new level of leakage is achieved).

We have profiled these volumes in line with the forecast leakage reduction, and applied the non-traded value of carbon used above to convert into monetary terms.

This gives a NPV of a cost of around £1 million (in 2016-17 prices).

This approach is may underestimate the overall impact on materials but shows that there is a negative environmental cost associated with the additional activity to reduce leakage.

A.8.6.5 Results

Table A.8.15 below summarises the costs and benefits that have been estimated in the previous section. The results show an overall positive benefit to natural capital.

[A.8.9] Strategic Management Consultants (2012) *'Review of the calculation of sustainable level of leakage and its integration with water resource management planning'*

Table A.8.15: Summary of cost benefit results (NPV £m, 2016-17 prices)

Asset category considered	Impact (positive = benefit)
1. Water	£3m to £30m
2. Energy / carbon	£7m
3. Social	£2m to £10m
4. Materials	(£1m)
Total	**£11m to £46m**

Note: figures may not reconcile due to rounding

As discussed above, natural capital accounting is a nascent field. There are many different approaches to valuing natural capital, and different approaches can deliver materially different results. The analysis for this Plan has been undertaken on a top-down basis making a number of simplifying assumptions.

These factors have led to our estimates having a relatively wide range. However, even assuming the low end of the range suggests that the draft WRMP will have a positive effect on natural capital. The overall cost of the programme of the Plan itself is in the order of £30m NPV over the planning period. This suggests that from a natural capital perspective it is cost beneficial overall.

The nature of the assumptions used in the calculation means that our Natural Capital estimate is likely to understate the full benefit, suggesting that the cost-benefit of the Plan will be better than we estimate here.

Further impacts on biodiversity, and specific water courses affected would likely improve the accuracy of the assessment and reinforce the positive benefit the Plan has when wider considerations are taken into account.

A.8.7 Performance Assessment

Our plan makes reductions in both leakage and per capita consumption. Tables A.8.16 and A.8.17 show the targets in our Plan give Upper Quartile performance based on current water company performance. We have also estimated what industry performance may be in 2024/25. We assume a national improvement of 10% in leakage[A.8.10] and a 5 l/p/d reduction[A.8.11] in per capita consumption. This also suggests that our Plan will maintain Upper Quartile performance.

[A.8.10] On the assumption that not all companies will need to meet the 15% reduction in leakage as proposed by the PR19 Draft Methodology. A 10% reduction is considered an appropriate national estimate.
[A.8.11] On the assumption that all companies will try to reduce per capita consumption

We will update these assessments for our Final Plan taking into account:

- Other company plans
- Any change in reporting methods e.g. leakage reporting methodology

Table A.8.16: Performance Assessment (Leakage)

Company	Leakage (l/prop/d)		Leakage (m^3/km)	
	16/17 (actual)	24/25 (-10%)	16/17 (actual)	24/25 (-10%)
Anglian	86		4.8	
Northumbrian	112		7.8	
Southern	80		6.4	
Severn Trent	122		9.2	
South West Water	102		5.5	
Thames Water	179		21.6	
Welsh Water	123		6.4	
Wessex	112		5.7	
United Utilities	133		10.5	
Yorkshire	129		9.3	
Affinity Water	116		10.4	
South Staffs inc. Cambridge	119		11.6	
Bournemouth Water	93		7	
Bristol Water	87		6.9	
Dee Valley Water	89		5.7	
Portsmouth Water	96		9.1	
Sutton and East Surrey	84		7	
South East Water	88		6.1	
Upper Quartile	**88**	**79**	**6.2**	**5.6**
Draft Plan				
SWW (84 Ml/d reducing to 77 Ml/d by 2025)	102	95.8	5.5	5.2
BW (19 Ml/d reducing to 18 Ml/d by 2025)	93	88.2	7.0	6.6
Combined SWW and BW	**100.1**	**94.2**	**5.8**	**5.5**
Overall Performance	**Av**	**Av**	**UQ**	**UQ**

Note: analysis will be updated for the Final Plan based on other company forecasts and any new information on leakage reporting methodologies

Table A.8.17: Performance Assessment (PCC)

Company	PCC (l/p/d)	
	16/17 (actual)	24/25 (5 l/p/d)
Anglian	136	
Northumbrian	141	
Southern	131	
Severn Trent	132	
South West Water	136	
Thames Water	146	
Welsh Water	145	
Wessex	141	
United Utilities	139	
Yorkshire	135	
Affinity Water	155	
South Staffs inc. Cambridge	127	
Bournemouth Water	144	
Bristol Water	144	
Dee Valley Water	135	
Portsmouth Water	145	
Sutton and East Surrey	160	
South East Water	151	
Upper Quartile	**134**	**129**
Draft Plan (SWW+BW)		
SWW		128
BW		132
Combined	**138**	**129**
Overall Performance	**Average**	**UQ**

APPENDIX 9

Assurance and water company checklist

A.9.1 Introduction

Three stages of assurance were undertaken for this Plan:

- Water company checklist - self assurance against the EA checklist
- Senior Manager review – review of each key element of the Plan, the assumptions and any issues
- Third party assurance – CH2M were commissioned to review the supply and demand forecasts and the decision making process. This used the EA checklist as a basis and gave an independent view of the quality of the Plan.

The assurance was undertaken to understand if there were any exceptions in the plan and if so their materiality. The Third Party assurance was also used to help understand areas that we could or should develop on as a business for future WRMPs.

The production of the WRMP itself was governed by the PR19 Steering Group. Progress on the WRMP and its approach to developing the Plan was regularly presented and challenged at the Steering Group. The WRMP was also a standing item on the company Customer Challenge Group (CCG) and its sub meeting with comments and feedback brought into the process. Table A9.1 shows the chronology of key governance meetings. This included presentation on our decision making process. A challenge log was kept for all our CCG meetings.

The final recommendations were presented to the governance meetings. Risks and issues in the Plan were presented, discussed and challenged.

Table A.9.1: Chronology of key governance meetings

Governance	Attendance	Date	Purpose
Water Future Customer Panel (Customer challenge Group)	CCW, EA, Natural England, regional stakeholders	Monthly	WRMP progress update
		April 17	Drought Plan and WRMP run through
		Sept 17	Progress update (emerging picture)
		Oct 17	Proposed key features of draft WRMP (leakage, water efficiency, metering)
Legislative, Resilience, Environment and Innovation (Customer challenge sub-group)	CCW, EA, Natural England, regional stakeholders	Apr 17	WRMP Emerging picture
		June 17	WRMP deep dive workshop
		Sept 17	WRMP scenario analysis and decision making process
		Nov 17	Recommended plan
Regulator	Environment Agency (Anne Dacey)	Oct 17	Summary of WRMP and key features
	Environment Agency (Area)	Various	Technical review meetings
	Environment Agency (Area and National)	Nov 17	Run through of proposed Draft Plan
	Ofwat	July 17	Overview of approach and issues
	CCW	Apr 17	Emerging picture on WRMP
		Aug 17	Overview of WRMP approach, and emerging picture
Risk Committee	SWW Directors	April 17	Deep dive into Water Resources and Resilience
Board		Monthly	WRMP progress update
		Nov 17	Final sign off
PR19 Steering Group	Chief Exec, SWW Managing Director and Executive team	Monthly (Jan 17 to Nov 17)	WRMP update – progress, risks, issues.
		Aug 17	Detailed review and key decision areas
		Oct 17	Recommendation on PR19 ODIs (leakage and PCC)
			Recommendation on metering
			Recommendation on Bournemouth Water to Southern Water transfer
		Nov 17	Recommended Plan and assurance results
SWW Executive Management Team	SWW Directors	Monthly	Progress review
		Sept 17	Results of scenario analysis and key decision areas
Sponsoring Director	SWW Director	Weekly	WRMP update – progress, risks, issues.

A.9.2 Water company checklist

A.9.1.1 Contents

We EA used the water company checklist to review the content of our plan. This is set out below. The commentary and colour coding is from self assessment and Senior Manager review combined.

Section	Question numbers
Section 1 – Planning for a secure supply of water (there are no checklist tables for Section 1)	-
Section 2 – Process of forming and maintaining a WRMP	1 - 36
Section 3 – Technical methods	37 - 86
Section 4 – Developing your supply forecast	87 - 147
Section 5 – Developing your demand forecast	148 - 203
Section 6 – Deciding future options	204 - 269

A.9.1.2 Table colour coding key

No concerns	Minor exceptions	Serious exception	Also part of our 2020 to 25 work plan

A.9.1.3 Our checklist

Section 2 – Process of forming and maintaining a WRMP

2.1 The legal requirements

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
1	You have considered and taken into account links between your WRMP and River Basin Management Plans.	S2.1, Page 3	S1	Y	
2	You have considered and taken into account links between your WRMP and your Business Plan.	S2.1, Page 3	S1.6	Y	
3	You have considered and taken into account links between your WRMP and your Drought Plan.	S2.1, Page 3	S1.6 and S8	Y	Our Plan includes specific actions to ensure our system remains resilient to future droughts

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
4	You have considered and accounted for links between your WRMP and the Environment Agency's drought plans and/or Natural Resources Wales' drought plans as appropriate.	S2.1, Page 3	See 3		
5	You have considered and taken into account links between your WRMP and flood risk management plans.	S2.1, Page 3	-	N	We will look at our resilience to flooding as part of our PR19 Business Plan
6	You have considered and taken into account links between your WRMP and any local plans produced by Local Authorities.	S2.1, Page 3	S3	Y	
7	You have considered and taken into account the requirements of the relevant legislation listed in section 2.1, including the WRMP Direction 2017 for water companies in England and WRMP (Wales) Directions 2016 for water companies in Wales.	S2.1, Page 3	S7	Y	We have included possible impact of future WINEPs in our scenario tests

2.2 *Early engagement with regulators, customers and interested parties*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
8	You have followed the principles of UKWIR's 'Decision Making Process' and 'Risk Based Planning' frameworks to: • characterise the problem you need to solve • choose the best decision making process for appraising the options available to you • determine your approach for dealing with risks in your plan • determine methods for supply, demand, outage and headroom calculations that are consistent with your chosen options appraisal method and risk composition.	S2.2, Page 4	Sections: 1.6, 2, 7, 8 A1, 2, A7, 8	Y	Our plan also sets out the work we will also be developing in this area for our next plan

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
9	You have prepared a method statement which clearly explains the choice and justification of methods, and communicated your statement to statutory consultees including the Environment Agency and/or Natural Resources Wales, Ofwat, licensed suppliers in your area that operate through your supply system any other relevant parties.	S2.2, Page 4	S1.3 S1.11 S7 A1 A7	Y	Section 1.3 sets out our overall process. Section 7 and Appendix 7 set out details of the decision making process.
10	You have engaged with the Environment Agency and/or Natural Resources Wales to discuss the approaches laid out in your method statement and have appropriately recorded the outcomes of this engagement.	S2.2, Page 3	A1	Y	
11	You have engaged with your Board, customers and other parties to discuss the approaches laid out in your method statement. You have appropriately recorded and incorporated the outcomes of this engagement.	S2.2, Page 3	S1.11 A9	Y	

2.3 *Hold a pre-consultation*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
12	You have held pre-consultation discussions with statutory consultees including the Environment Agency and/or Natural Resources Wales, Ofwat and licenced water suppliers that operate through your supply system, revising your proposed approach accordingly.	S2.3, Page 5	S1.11 A1	Y	We only received 2 responses to our pre-consultation letter. One from the Environment Agency and one from Devon County Council. Work on catchment management is included in our PR19 Plan, not our Water Resources Plan.
13	You have accounted for outcomes of pre-consultation discussions with other consultees (including consumers, companies with which you share supply or have bulk supply) and have revised your proposed approach accordingly.	S2.3, Page 5	S1.11 S7 S8	Y	Customer preferences are embedded into our decision making process. We set out specific engagement with Southern Water on a possible water transfer.
14	You have indicated how consultee feedback has been incorporated into the methods and approaches you will use to produce your draft plan.	S2.3, Page 5	S7 A1	Y	

2.4 Write a draft plan

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
15	You have accounted for pre-consultation outcomes and followed any written Directions received from the Secretary of State and/or Welsh Ministers. For water companies in England, follow the WRMP Direction 2017. For water companies in Wales, follow the WRMP (Wales) Direction 2016.	S2.4, Page 5		N/A	We have no specific Directions for our area.
16	You have used a logical structured layout for your draft WRMP and included a separate non-technical overview, and supported the main technical document with appendices.	S2.4, Page 5		Y	

2.5 Send your draft plan

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
17	You have appropriately flagged national security information or data within the draft WRMP, ready for redaction if necessary following security checking.	S2.5, Page 5		N/A	Our Plan was reviewed by our Security Manager and no information that would affect company or national security is included.
18	You have flagged commercially confidential or sensitive information or data that you prefer should not be published.	S2.5, Page 5		N/A	No commercial or sensitive information is included in our Plan.

2.6 Publish and distribute your draft plan

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
19	You have not published your draft plan until instructed to do so by the Secretary of State or the Welsh Ministers and have followed the WRMP Regulations 2007 in making your plan publically available.	S2.6, Page 6		N/A	
20	You have redacted sensitive information prior to publication.	S2.6, Page 6		N/A	

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
21	You have prepared a statement for issue with the draft plan, which explains where commercially sensitive information has been redacted and clearly explains the process for making representations on the draft plan.	S2.6, Page 6		N/A	There are no redactions for commercial sensitivity.
22	You have taken appropriate steps to advertise the publication of the plan and to explain its contents to key stakeholders at the start of or during the consultation period.	S2.6, Page 6		N/A	Pre consultation letter set out our proposed process. Further advertising will be done once confirmation to publish has been received.

2.7 *Carry out a public consultation on your draft plan*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
23	You have allowed for a consultation period appropriate for the complexity of the plan, and that gives you adequate time to prepare a response to consultation feedback by the specified deadline (26 weeks after publication).	S2.7, Page 6		N/A	We plan to consult for 12 weeks. Given the low complexity of our Plan and the lack of new water resource schemes, we think this is appropriate.

2.8 *Publish a statement of response*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
24	You prepared and published your statement of response by the specified deadline.	S2.8, Page 7		N/A	
25	You have considered all consultation responses in your statement and have explained whether/how you have acted on them and why.	S2.8, Page 7		N/A	
26	You have set out any changes due to other factors during the consultation period (for example, external influences).	S2.8, Page 7		N/A	
27	You have clearly set out the main changes you have made for the final plan and have accompanied your statement with an updated version of the draft plan if changes are substantive.	S2.8, Page 7		N/A	

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
28	You have notified any party that responded to the consultation as you publish the statement of response (and revised draft WRMP if necessary).	S2.8, Page 7		N/A	
29	You have considered the impact of any changes to your draft WRMP that might affect your Drought Plan, Business Plan or other plans.	S2.8, Page 7		N/A	

2.9 Send your draft final plan

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
30	You have submitted your statement of response and final draft plan (if different to the draft WRMP) to the Secretary of State or Welsh Ministers, repeating the checklist steps as given in Section 2.6. The final draft plan should take account of any additional works required by Defra or the Welsh Government or advised by the Environment Agency or Natural Resources Wales following your statement of response.	S2.9, Page 7		N/A	
31	You have undertaken any additional works as required by the Environment Agency or Natural Resources Wales following their review of your final draft plan, and have fully checked all changes.	S2.9, Page 7		N/A	
32	You have completed and submitted the WRMP tables alongside the final WRMP.	S2.9, Page 7		N/A	

2.10 Publish your final plan

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
33	You have accounted for any relevant Directions with regards to publishing your final plan and the appropriate permissions from the Secretary of State or Welsh Ministers have been given.	S2.10, Page 7		N/A	

34	You have notified any party that responded to the consultation as you publish the final plan.	S2.10, Page 7		N/A	

2.11 Revise and review your final plan

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
35	You have planned for annual review of the published plan in line with the Annual Review guidelines.	S2.11, Page 8		N/A	
36	You will consult with the Environment Agency and/or Natural Resources Wales on any material changes that you wish to make to your plan in future.	S2.11, Page 8		N/A	

Section 3 – Technical methods

3.1 Developing your plan

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
37	Your plan consistently complies with relevant government policy documents/publications.	S3.1, Page 9	S7, A 7	Y	Our decision making framework includes an assessment of the performance of our Plan against government policy.
38	You have provided a full explanation of the planning period assumed in the plan, which covers, as a minimum, the statutory period from 2020 to 2045.	S3.1, Page 9	S2	Y	
39	You have included a robust forecast of the water you have available to supply customers with for each year within the planning period, accounting for climate change, and demonstrating that supply is both efficient and sustainable. You have achieved this by following the steps in Section 4 of this checklist.	S3.1, Page 9	S4, A4	Y	
40	You have included a robust forecast of customers' demand for water during each year within the planning period, accounting for climate change. You have achieved this by following the steps in Section 5 of this checklist.	S3.1, Page 9	S3, A3	Y	We have also stress tested the performance of the plan against higher demands

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
41	You have allowed for uncertainties in your calculations and forecasts for both supply and demand over the planning period, and have used best practice methods to quantify uncertainty.	S3.1, Page 9	S4,S7 A4	Y	We use scenario tests to examine the robustness of our supply demand balance. At future WRMPs the role of uncertainty in decision making may be more important. As such our Plan includes the development of our tools to greater use of risk based analysis.
42	You have compared supply and demand to determine whether there is a surplus or deficit in any of your resource zones.	S3.1, Page 9	S5	Y	
43	If you are in surplus in any of your resource zones you have flagged to other water companies that water is available for trading.	S3.1, Page 10	S2.18 S7 A7.12	Y	
44	If you are in deficit in any of your resource zones, you have considered all reasonable options for addressing the deficit, including options for increasing supplies, reducing demand and cross-company/third party options	S3.1, Page 9	S6	Y	Without intervention the only deficit in our Plan is in Colliford. This is small (<1.5Ml/d) and not until the very end of the planning period (post 2040).
45	Where new options are required, you have given opportunity for neighbouring companies or third parties to bid into your plan.	S3.1, Page 10		N/A	
46	You have adopted options that support the environmental objectives set out in RBMPs and if required, have carried out a Habitats Regulations Assessment including appropriate assessments, and a Strategic Environmental Assessment (SEA).	S3.1, Page 10	S8, A8	Y	Our Plan will reduce the demand for water than would otherwise occur.
47	If you supply customers in Wales or your plan affects catchments in Wales, you have worked with Welsh Government and Natural Resources Wales with regards to understanding implications of the Environment (Wales) Act and Wellbeing of Future Generations (Wales) Act in developing your plan and how your plan contributes to Nature Recovery Plans.	S3.1, Page 10		N/A	
48	If you supply customers in England, you have adopted options that support the well-being of future generations, are compatible with Defra's long term plans for the environment including Biodiversity 2020, and whose social and environmental benefits/costs are properly understood and taken account of.	S3.1, Page 10	S8, A8	Y	Our Plan shows an overall benefit to natural capital.

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
49	You have included confirmed or likely sustainability changes that you have been informed about.	S3.1, Page 9	2.3, 5.1, A7.7,	Y	
50	You have demonstrated a system that can cope with droughts of a magnitude and duration that you reasonably expect to occur in your area over your chosen planning period and have considered contingencies for challenging but plausible droughts beyond the capabilities of your supply system (with relevant links to your Drought Plan) including whether they require options to provide additional resilience.	S3.1, Page 9	S7, A7	Y	
51	You have documented the impact of drought interventions on supply and demand and links with your Drought Plan.	S3.1, Page 9	S 1.4 and Table 10	Y	
52	You have accounted for the views of customers, other interested parties, statutory and non-statutory consultees in developing your plan.	S3.1, Page 10	S1.10, S7, S8 A7, A8	Y	
53	You have produced a flexible and adaptive plan that allows for risks and uncertainties in decisions, calculations and forecasts undertaken as part of the development of the plan.	S3.1, Page 10	S8, A8	Y	Our decision making process included an assessment of the flexibility of our Plan
54	You have gained Board buy-in with respect to the cost and long-term sustainability of proposals.	S3.1, Page 10	S1, S8, A9	Y	The Board and Executive team were actively engaged in the development of the Plan.
55	You have provided all the necessary supporting information at WRZ level and entered this in the water resources planning tables.	S3.1, Page 9	Tables	Y	

3.2 *Defining a water resource zone*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
56	You have defined your Water Resource Zones (WRZs) using the Environment Agency's WRZ assessment methods (Water Resource Zone Integrity, 2016).	S3.2, Page 10	S2 A2	Y	

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
57	You have demonstrated that, for each WRZ: • the abstraction and distribution of supply is largely self-contained (excepting agreed bulk transfers). • the majority of customers experience the same risk of supply failure and same level of service for demand restrictions. You have explained and justified any deviations from the above.	S3.2, Page 10	S2, A2	Y	

3.3 Problem characterisation

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
58	You have applied the problem characterisation step of the *WRMP 2019 Methods – Decision Making Process: Guidance* (UKWIR, 2016) to determine the nature of the planning problem (including scale and complexity) as well as related issues, risks and uncertainties.	S3.3, Page 10	S1.3, A 2	Y	Despite the low complexity we have adopted an intermediate method (multi-criteria decision making) for analysing our problem. Our Plan suggests that future problem characterisation could be more complex. As part of our Plan we are therefore developing our tools to more extended approaches should they be needed in the future.
59	You have demonstrated that the effort and cost you have given to the selection of a decision-making process is proportional to the problem. You have described the significance of the choice of decision making method and its wider implications with respect to the plan outcomes.	S3.3, Page 11	S1.3, S7 A2 A7	Y	
60	You have adopted processes outlined in *WRMP 2019 Methods – Decision Making Process: Guidance* (UKWIR, 2016) using methods that are most appropriate for your company.	S3.3, Page 11	S1.3, S7 A2 A7	Y	
61	You have explained how/why the solutions(s) you have identified have been arrived at, and given assurance that uncertainties have not been double counted.	S3.3, Page 11	S8, A8	Y	In our scenario test we removed any potential for double counting of uncertainty.
62	You have applied the *Economics of Balancing Supply and Demand [EBSD] method* (UKWIR, 2002) to determine a benchmark solution for comparison.	S3.3, Page 11	S7, A7	Y	See qu 58. Part of our Plan includes developing our financial modelling tools for use in future Plans should our planning problem become more complex.

3.4 Drought risk assessment

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
63	You have explained how you have followed the processes outlined in *WRMP 2019 Methods – Risk Based Planning: Guidance* (UKWIR, 2016) to identify an appropriate design drought.	S3.4, Page 11	S1.4	Y	
64	You have clearly set out and justified the risk composition you have selected for each WRZ and the reasons that lead you to select that option, including the availability of data where more complex risk compositions have been used.	S3.4, Page 11	S7, S8	Y	
65	Where different risk compositions are used in different parts of your supply system, you have explained this clearly and justified your reasoning. Also, where a more complex risk composition has been adopted but later abandoned to a simpler approach, this has been noted but your WRMP reflects the final risk composition adopted.	S3.4, Page 11		N/A	
66	You have included a drought resilience statement in your plan which is consistent with your chosen risk composition, and have explained how this reflects the hydrological risks that drought may impose on your supply system.	S3.4, Page 11	S1.4	Y	

3.5 Planning scenarios

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
67	You have demonstrated that your plan is based on the dry year annual average for demand.	S3.5, Page 12	S1.5, S3	Y	
68	You have reiterated the design drought you are basing your plan on for supply, and have based this on the drought risk assessment activities carried out under Section 3.4.	S3.5, Page 12	S1.5	Y	

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
69	If you have chosen to consider how you will deal with a period of peak strain (critical period), you have set out which WRZs this applies to, the reasons for this and have described the underlying factors that impact on the supply-demand balance during the critical period.	S3.5, Page 12	S1.5		All our WRZs consider DYAA estimates, whilst Bournemouth supply area also has critical periods taken into account
70	You have explained the assumptions made when assessing your baseline figures for your demand forecast. Your documentation includes assumptions about mains renewal and capital maintenance, your baseline forecast of consumer need, losses through leakage and operating losses. You have demonstrated that the baseline case represents what happens excluding any changes in operations or company policy.	S3.5, Page 12	S3.8.1	Y	
71	You have described how/where you have allowed for uncertainty in your demand forecast and how this is appropriate to your selected methods.	S3.5, Page 12	S4.1.2	Y	
72	You have explained the assumptions made when assessing baseline figures for your supply forecast. You have demonstrated that the baseline case represents the supplies that can be maintained through a design drought as appropriate for your company area.	S3.5, Page 12	S2 S7, A 2 A7	Y	
73	You have reported the baseline figures for supply and demand in the water resources planning tables at WRZ level.	S3.5, Page 12	Tables	Y	
74	For your final plan, you have explained any decisions related to developing options to manage or meet the forecast demand of your customers.	S3.5, Page 12	S6, S7, S8	Y	
75	You have documented each of the demand side options considered and the reason for choosing each option. If relevant, you have categorised your options as – change to existing policies, operations, infrastructure and resilience solutions (including drought measures and orders).	S3.5, Page 12	S8, A8	Y	There are both higher and lower cost plans that we could implement. The mix of options we have chosen we consider gives the best balance overall.

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
76	You have considered all available demand and supply side options in the process of developing your preferred plan. You have explained how you have done this, and demonstrated how third party and collaborative options with other companies have been evaluated. You have accounted for opportunities to improve resilience at regional level.	S3.5, Page 12	S6, S7	Y	
77	You have provided details of and explained your preferred programme of solutions to restore your supply-demand balance under a dry year average annual scenario.	S3.5, Page 12	S7, S8 A7, A8	Y	
78	You have provided details of and explained your preferred programme of solutions to restore your supply-demand balance under a critical period scenario, if relevant.	S3.5, Page 12		N/A	
79	Where you are in deficit in dry year average annual or critical period scenarios, you have demonstrated how you have addressed these deficits and how your plan allows you to be compliant with your statutory duties.	S.5, Page 12	S8, A8	Y	The only Zone where we have any deficit is Colliford but this is not until post 2040 and is small (<1.5Ml/d)
80	You have indicated clearly if you have included resilience solutions for more challenging but plausible droughts beyond the capabilities of your final plan.	S3.5, Page 12	S7, S8 A7,A8	Y	
81	If you are in surplus, and you have still decided to include options in your plan, you have explained the benefits from this (such as more efficient supply of water, improvements in long-term resilience, demand reduction etc.)	S3.5, Page 12	S8 A 8	Y	

3.6 Levels of service

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
82	For water companies wholly or mainly in England you have clearly set out your level of service as an annual percentage risk of restrictions, and set out if/how you expect it to change across the planning period as you implement supply-demand or resilience	S3.6, Page 13	S8.5	Y	We have given estimates of the impact on service levels.

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No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
	measures.				
83	You have presented evidence to demonstrate that your level of service is appropriate and have used appropriate assumptions and methodologies to develop your levels of service.	S3.6, Page 13		N/A	See 84
84	You have engaged with your customers and stakeholders and their views have been considered when developing your level of service. You have communicated your level of service appropriately.	S3.6, Page 13	S1.10 A1.6	Y	Customer consultation has confirmed that our existing levels of service are in line with their preferences.
85	For water companies in England, you have set out a reference level of service that would mean resilience to an event of approximately 0.5% risk of annual occurrence (1:200 year drought event). You have presented this as a scenario and explained how you have modelled the drought event used.	S3.6, Page 13	S7, A7	Y	
86	You have quantified the deployable output and incremental costs of your reference level of service scenario and explained how you have calculated these. You have set out if and how this could be achieved at any point in the planning period.	S3.6, Page 13	S7, A7	Y	There is no additional cost above the baseline scenario for meeting the reference level of service.

Section 4 – Developing your supply forecast

4.1 How to develop your supply forecast

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
87	Your approach to calculating your supply forecast is consistent with your risk composition choice, and the risk and uncertainty involved have been quantified using appropriate methods.	S4.1, Page 14	S2.1;	Y	See 58. Some WRZs may in the future be approaching borderline moderate degree of concern. As part of our Plan we are therefore developing our tools to more extended approaches should they be needed in the future.
88	You have discussed your approach to calculating your supply forecast as early as possible with the Environment Agency or Natural Resources Wales.	S4.1, Page 14	S2.1	Y	This was discussed in detail during pre-consultation meetings with the Agency

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
89	You have considered all individual components making up the supply forecast, and taken account of pressures on future supplies including (but not limited to): • climate change • abstraction licence changes due to abstraction reform or sustainability improvements • pollution or contamination implication for sources • development and new infrastructure • changes in contractual arrangements relating to transfers. You have clearly documented all assumptions made.	S4.1, Pages 14-15	S2	Y	
90	You have recorded in the water resources planning tables the quantities for all baseline supply components as well as the amount of water that your analysis indicates you can reliably supply.	S4.1, Page 14	Tables	Y	
91	As part of your supply assessment, you have determined and explained how your supply system behaves during the design drought.	S4.1, Page 14	S2.1.1 S1.6.4	Y	
92	You have explained links between your WRMP and your drought plan, including the likelihood of achieving planned levels of service and their impact on available supply.	S4.1, Page 14	S7	Y	
93	You have explained how drought interventions (drought permits and orders) that are contained within the drought plan have been dealt with in the WRMP in accordance with levels of service, and outlined any contingencies for extreme droughts that exceed the capability of your system to meet.	S4.1, Page 14	S1.4.1, S2.1.1 S1.6.4	Y	
94	For water companies in England you have not included benefits drawn from supply drought measures (e.g. drought permits and orders) in your baseline supply forecast.	S4.1, Page 14	2.7	Y	
95	For water companies wholly or mainly in Wales, you should have discussed inclusion of supply drought measures in baseline forecasts with Natural Resources Wales or Environment Agency.	S4.1, Page 14		N/A	

4.2 What should be included in your supply forecast?

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
96	You have provided a breakdown of your supply forecast for the dry year annual average scenario for all WRZs and presented this in the planning tables.	S4.2, Page 15	Tables	Y	
97	You have explained your decision to include a critical period, if relevant, and have provided a supply forecast for it.	S4.2, Page 15	S1.5	Y	Critical period only considered in Bournemouth WRZ
98	Where you abstract water for supply, your supply forecast for that WRZ sets out the deployable output, future changes to deployable output (e.g. from sustainability changes or climate change), transfers and future inputs from third parties, outage and other short-term losses, operational losses related to abstraction or treatments.	S4.2, Page 15	S2 & S5	Y	
99	Where you receive a raw or treated water import from a third party, your supply forecast reflects the contractual arrangements with this third party supplier.	S4.2, Page 15		N/A	
100	You have demonstrated that your supplier will be able to maintain supply during your design drought and that levels of service can be achieved. You have demonstrated that your supplier has assessed that their statutory and policy obligations can be met.	S4.2, Page 15		N/A	
101	You have expressed the supply forecast as the Water Available for Use (WAFU).	S4.2, Page 15	S2.7 & Tables	Y	

4.3 What should be covered in your deployable output assessment?

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
102	You have explained which factors constrain deployable output, such as hydrological yield, licensed quantities/constraints, pumping constraints, transfer issues, water quality and treatment.	S4.3, Page 15	S2.2.5.3 S2.2.6.5 S2.2.7.5 S2.2.8.6	Y	

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
103	You have identified where deployable output is constrained by licences that are time limited and due to expire in the period covered by the plan, and evaluated the risks of non-renewal.	S4.3, Page 15		N/A	
104	You have checked that licensed volumes are sustainable and that their use will not cause deterioration.	S4.3, Page 15	S7, App 7	Y	We have used the output from the WINEP2 process to determine the sustainability of our sources
105	Your method for deployable output determination is consistent with your risk composition and the methods outlined in *Handbook of source yield methodologies* (UKWIR, 2014) or *WRMP 2019 Methods – Risk Based Planning: Guidance* (UKWIR, 2016); you have fully explained and documented your choice of method and supporting techniques.	S4.3, Page 16	S2.2	Y	
106	You have described how deployable output will be affected by demand side drought restrictions according to the level of service you have planned for.	S4.3, Page 15	Table 10, S1.4.1, S2.1.1 and S1.6.4	Y	

4.4 *Your role in achieving sustainable abstraction*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
107	Your proposals support WFD obligations and RBMP objectives in relation to sustainable abstraction.	S4.4. Page 16	S2.3.2 and S6.8.3	Y	
108	You have determined if changes to your abstractions are required to meet RBMP objectives, and you have discussed the scope of changes with the Environment Agency or Natural Resources Wales as part of WINEP for PR19.	S4.4. Page 16	S2.3.2	Y	No changes required in AMP7
109	You have determined that all existing abstractions (including any planned increases to abstracted volumes with current licence limits, and any time limited licences) are compliant with RBMP objectives and any other legally binding environmental objectives.	S4.4. Page 16	S7, App 7	Y	Included in WINEP2 assessment

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No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
110	You have liaised with Environment Agency and/or Natural Resources Wales to determine if you have any abstractions from water bodies that are at risk from deterioration.	S4.4. Page 16	S7, App 7	Y	Included in WINEP2 assessment
111	You have reviewed potential mitigation measures for any waterbodies at risk and put into place plans to manage the risk of deterioration, or where deterioration has occurred because of your actions, you have put in place plans to restore the waterbody.	S4.4. Page 16	S2.3.2	Y	
112	You have completed all investigations and options appraisals in your PR14 water industry NEP for AMP6 by the agreed dates and included any options needed to manage any sustainability changes in your plan.	S4.4. Page 16		N/A	
113	You have considered any regulator measures to improve fish/eel passage or water quality and accounted for likely impact on supply forecasts.	S4.4. Page 16	S2.3.2	Y	

4.5 *Invasive Non-Native Species (INNS)*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
114	You have considered whether/how any current or future abstractions or operations might cause the spread of INNS and have determined measures to reduce the risk of this. You have liaised with Environment Agency and/or Natural Resources Wales to discuss the risk of INNS and reflected the outcomes of this in your plan.	S4.5. Page 17	S2.4 and A2.4	Y	No new raw water transfers are proposed. As part of our PR19 plans we are examining the risk on INNS in our existing supply system and the measures we should undertake to mitigate any risk.
115	For water companies in England, you have reflected the February 2017 position statement and its principles in your plan.	S4.5. Page 17	S2.4 and A2.4	Y	

4.6 How to include changes to your abstraction licence in your plan

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
116	You have liaised with the Environment Agency or Natural Resources Wales to determine the likely impact of sustainability measures on abstraction licences and agreed a mutually acceptable timescale for the implementation of new licence conditions.	S4.6. Page 17	S2.3.2	Y	We have no sustainability reductions in our supply areas identified at this time
117	You have determined the impact of any sustainability reductions on your deployable output and included these in your plan appropriately.	S4.6. Page 17		n/a	
118	You have assessed the impact of possible future sustainability changes on your plan through scenario testing and not included any uncertainty about sustainability changes within your plan.	S4.6. Page 17	S6	Y	We have made assumptions on a potential level of sustainability reductions and investigated their impact as part of our scenario testing
119	Where changes to abstraction licences or new options threaten security of supply and there are no alternatives, you have considered and prepared evidence for exemption under Article 4.7 of the WFD.	S4.6. Page 17		n/a	

4.7 Abstraction reform – evidence needs

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
120	For catchments managed by the Environment Agency, you have not included any changes to DO from abstraction reform. You have identified sources having unused licence volumes that are required for emergency purposes and have explained how you define these (e.g. drought source or other purposes).	S4.7, Page 17	S2.3.3 and Tables	Y	
121	For catchments managed by Natural Resources Wales, you have included evidence to justify retaining any of your daily or annual licensed volumes within your plan. You have discussed the evidence requirements with Natural Resources Wales.	S4.7, Page 17		N/A	

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
122	If you operate using licences within the three cross-border catchments (Rivers Dee, Wye and Severn), you have included information in your plan that justifies retention of any unused volumes associated with those licences.	S4.7, Page 17		N/A	

4.8 *Climate change*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Climate Change
123	You have determined the impact of climate change on river flows and groundwater recharge using one of the three methods set out in the guideline.	S4.8, Page 18	S2.3.5 A2.1	Y	The impact of climate change on river flows is highest in Colliford and Roadford. Roadford overall has the highest percentage impact from climate change. See 124.
124	You have assessed and clearly demonstrated the vulnerability and risks your sources and supplies face for each of your WRZs.	S4.8, Page 19	S2.3.5, App 2	Y	Part of our Plan includes investigations in Roadford. This is as a precautionary measure to ensure we have future options fully assessed in case they are needed.
125	You have set out and justified your assessment methods, outlined any assumptions made and clearly presented your results, explaining any differences in methodology between your resource zones.	S4.8, Page 19	S2.3.5, App 2	Y	
126	You have clearly explained whether and how climate change has been accounted for in your headroom assessment and have reported this separately.	S4.8, Page 19	S4, App 4	Y	
127	You have set out if/how you have used scaling methods to account for climate change that has already happened, and how this has affected your supplies.	S4.8, Page 19	S2.3.5.5	Y	
128	You have calculated the impacts of climate change on supply and have entered this into the water resources planning tables as changes to DO.	S4.8, Page 19	S2.3.5 and tables	Y	

4.9 Water transfers

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
129	You have quantified all water transfers including all raw and potable imports/exports and entered this in the water resources planning tables. You have noted the direction of transfers along with the potential to change the direction if needed.	S4.9, Page 18	Tables	Y	
130	You have documented agreed limits between supplier and recipient companies for all transfers, including any contractual variations that might apply (e.g. in times of drought).	S4.9, Page 18	Tables	Y	
131	You have documented the total volume available to you via transfer for each year of your plan (accounting for operational or infrastructure constraints that may reduce quantities).	S4.9, Page 18	Tables	Y	
132	You have assessed and documented the quality of transferred water and any impact of the transfer on the quality of receiving waters.	S4.9, Page 18	S2.1	Y	

4.10 Drinking water quality

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
133	You have supported objectives for drinking water in protected areas.	S4.10, Page 20	S2.5 and A2.3	Y	We are using catchment management to protect water quality. Treatment works can currently meet water quality requirements and we have developed our 25 year plan for drinking water quality.
134	You have checked that the drinking water arising from the water treatment regime applied meets the Standards of the Drinking Water Directive plus any other legislation.	S4.10, Page 20	S2.5 and A2.3	Y	
135	You have abided by Section 68(1) of the Water Industry Act 1991 in terms of quality of supplied water, and applied this to water from your own sources as well as transfers.	S4.10, Page 20	S2.5 and A2.3	Y	All treatment capacities were reviewed to confirm their performance. NOTE – we propose more work on a possible treated water transfer to Southern Water. This would require upgrading of our WTW for this to be supplied reliably in a drought and meet our drinking water requirements. The transfer is therefore NOT in our forecast plan as a final option. Our Plan sets out more work we will do on the transfer since we know that in some of Southern Water's scenarios it is selected in the 2025-2030 period.

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
136	You have considered appropriate measures to prevent deterioration of water quality in a protected area.	S4.10, Page 20	S2.5 and A2.3	Y	This is also covered in WINEP under drinking water protection areas. We have included investment for our catchment management in this part o our Business Plan
137	You have recorded how you have calculated treatment works losses and operational use for each WRZ.	S4.10, Page 20	S2.3.8	Y	
138	You have provided diagrams and other supporting evidence for complex major works that can be used in pre-consultation discussions with the Environment Agency or Natural Resources Wales.	S4.10, Page 20	S2.3.7	Y	The development of our new Plymouth WTW and the potential transfer to Southern Water have been included within our pre-consultation discussions
139	You have considered options to reduce losses where possible, especially if your plan has a supply-demand balance deficit.	S4.10, Page 20	S8.3.3 A8.3.3	Y	Part of our strategy to reduce demands overall
140	You have considered measures to protect supplies against long term risks of pollution.	S4.10, Page 20	S6.9	Y	Included in our catchment management programme within PR19. This is now normal capital maintenance expenditure.
141	You have considered measures to reduce the treatment process whilst still complying with the requirements of the drinking water regulations.	S4.10, Page 20	S6.9	Y	As above
142	You have demonstrated that all sources you may rely on have been correctly identified and measures taken to provide protection where necessary, e.g. SPZs around groundwater abstractions.	S4.10, Page 20	S2.5 A.2.3	Y	
143	You have applied your approach consistently across all WRZs.	S4.10, Page 20	S2.5	Y	

4.11 Outage

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
144	You have documented your outage allowance and your approach is in line with *WRMP 19 methods -Risk based planning* (UKWIR, 2016) or the *Outage allowances* (UKWIR 1995) approach.	S4.11, Page 20	S2.2, A2.38	Y	We plan to produce an annual outage report starting in 18/19. This will use a new data collection system that we have developed.
145	You have entered outage calculations in the water resources planning tables.	S4.11, Page 20	Tables	Y	
146	You have included details of options you propose for reducing outage,	S4.11, Page	S2.6, p2.22	Y	

	particularly in cases of a supply-demand balance deficit.	20	A2.2.2, pA.2.65		

4.12 Water available for use

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
147	You have clearly set out the total WAFU, and demonstrated how changes in deployable output, transfers, operational use and outage impact on the calculated total.	S4.12, Page 20	2.7	Y	

Section 5 – Developing your demand forecast

5.1 What should be covered in your demand forecasts?

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
148	You have provided a demand forecast for the dry year annual average where demand is unrestricted, which includes adjustments for likely future changes in demand due to factors such as climate change, population growth, household size, property numbers, and current company demand management policy/activity.	S5.1, Page 21	S 3	Y	See 164
149	You have provided a demand forecast for the critical period (if considered in your plan) that accounts for the factors you expect will drive demand during the critical period, such as seasonal changes or population growth.	S5.1, Page 21	S3	Y	
150	You have provided a demand forecast for the final plan dry year annual average which includes adjustments to reflect solutions identified through your options appraisal.	S5.1, Page 21	S 3	Y	
151	You have provided a demand forecast for the final plan critical period which includes adjustments to reflect solutions identified through your options appraisal.	S5.1, Page 22	S 3	Y	

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
152	You have explained how demand forecasts have been arrived at and documented any underlying assumptions, including how you have determined unrestricted demand.	S5.1, Page 22	S3	Y	
153	You have explained your reconciliation of current best estimates of demand with other parts of the water balance.	S5.2, Page 22	S3.3.2	Y	

5.2 *Forecast household demand*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
154	You have demonstrated how you have arrived at your forecast of population and property numbers and the assumptions on which these are based.	S5.2, Page 22	S3.3	Y	
155	You have demonstrated an understanding of what is driving future household demand and how you have estimated this.	S5.2, Page 22	S 3.4	Y	We also stress test our plan to higher demand forecasts
156	You have included forecast savings data for existing water efficiency initiatives in your baseline forecast.	S5.5, Page 22	S 3.4.6	Y	

5.3 *Forecast population, properties and occupancy*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
157	For water companies supplying customers in England you have aligned your method for forecasting population and property growth with the most recent local plans published for your area(s), and accounted for potential changes in published figures if a local plan is not yet finalised.	S5.3, Page 22	S3.3	Y	

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
158	Where no local plan project(s) exist to inform your plan, you have used other appropriate methods such as household projections for Dept. for Communities, Local Government, those produced for DCLG by the ONS or the methods outlined in *Population, household property and occupancy forecasting* (UKWIR, 2016). You have documented and explained assumptions and data sources used.	S5.3, Page 22	S 3.3	Y	
159	You have provided evidenced justification if your property forecasts deviate from planned figures.	S5.3, Page 22	S3.3	Y	
160	You have accounted for the planning period in your forecast property and population figures and have explained where/if different forecasting methods are applied for different time horizons, especially if your planning period is longer than 25 years.	S5.3, Page 23	S 3.3	Y	
161	For companies supplying customers in Wales, you have based your forecast population and property figures on the latest Local Authority population and property projections published by the Welsh Government. Your analysis of the uncertainties in your forecast population and property figures has been informed by local development plans in your supply area.	S5.3, Page 23		N/A	
162	You have demonstrated that your plan does not constrain supply such that it may not meet planned property forecasts.	S5.3, Page 23	S 3.3	Y	
163	You have engaged with local planning authorities to inform your analysis and understand uncertainties in your forecast population and property figures.	S5.3, Page 23	S 3.3	Y	
164	You have properly communicated limitations in your forecast and uncertainty associated with your forecast.	S5.3, Page 23	S 3.9	Y	As part of our Plan we also set out our work to develop risk based demand forecasts for future plans
165	You have described assumptions and supporting information that you have used to develop property and occupancy forecasts, including uncertainties.	S5.3, Page 23	S 3.3	Y	
166	You have explained how you have allocated unaccounted for populations for each WRZ, including your assumptions.	S5.3, Page 23	S 3.3.4	Y	We don't yet have available data on unaccounted for population for Bournemouth Water. This does not affect the decisions in the Plan as this Zone is in surplus.

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No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
167	You have accounted for local council and neighbourhood plans, when calculating future demand.	S5.3, Page 23	S 3.3.2	Y	

5.4 *Forecasting your customers' demand for water*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
168	You have selected a method for forecasting demand that is appropriate to each WRZ, based on the supply-demand situation, any problem characterisation approaches you have considered and the data available.	S5.4, Page 23	S3	Y	
169	Your method for forecasting demand is aligned with the following guidelines: • *WRMP-19 Household demand forecasting - Integration of behavioural change into demand forecasting and water efficiency practices* (UKWIR 2016). • *Customer behaviour and water use – good practice for household consumption forecasting* (UKWIR, 2012).	S5.4, Page 23	S 3.4	Y	
170	You have documented your reasons for choice of method, including your assumptions and their associated uncertainties.	S5.4, Page 23	S 3.4.2.1	Y	
171	You have demonstrated a forecast demand for the critical period scenario (if appropriate) as well as the dry year annual average.	S5.4, Page 23	S3	Y	
172	You have provided a breakdown of total consumption, per capita consumption and micro-components within the water resources planning tables.	S5.4, Page 23	Tables	Y	

5.5 Forecasting your non-household consumption

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
173	You have calculated a demand forecast for non-households.	S5.5, Page 23	S 3.5	Y	We also wrote to all retailers prior to the development of our forecasts to understand their plans
174	You have described your assumptions about customer/property types that you have considered as non-household and demonstrated that your decisions are aligned with part 17C of the Water Industry Act 1991 and guidance on non-household customers as reported in *Eligibility guidance on whether non-household customers in England and Wales are eligible to switch their retailer*. You have consulted with retailers of water to non-household customers.	S5.5, Page 24	S3.5.1	Y	
175	You have accounted for the likely other retailers to non-household sectors in your area following the changes introduced in April 2017 and have consulted with retailers of water to non-household customers.	S5.5, Page 24	S3.5.1	Y	
176	You have determined non-household demand into different economic sectors, for example by using the UK SIC codes or applying a service and non-service split approach.	S5.5, Page 24	S 3.5.3	Y	
177	You have assessed the likely new uptake of public water from non-household customers / sectors that previously used private supplies.	S5.5, Page 24	S 3.5.2	Y	
178	You have examined and taken account of planned or existing water saving initiatives by both the wholesaler and retailer and have determined in the likely saving in non-household demand.	S5.5, Page 24	S 3.5.1	Y	We wrote to all retailer prior to the development of our forecasts.
179	You have included forecast savings data for existing water efficiency initiatives in the baseline forecast that you have presented.	S5.5, Page 24	S 3.5.3	Y	

5.6 Forecasting leakage

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
180	You have determined baseline leakage over the planning period and explained your method in the WRMP	S5.6, Page 24	S3.6	Y	Note: in WRMP14 our baseline forecast included our plan to reduce leakage to 64Ml/d in SWW. For this Plan to make it more explicit our baseline forecast keeps leakage at our current target levels, we then develop our forward reduction profile based on analysis.
181	You have used *UKWIR Consistency of reporting performance measures (2017*) to forecast levels of leakage.	S5.6, Page 24	S7.2.1	N	Our baseline forecasts use our existing methodology. We have however stress tested our Plan against a forecast using the new methodology. The new reporting methodology does not affect the decisions in the Plan. We will move to the new methodology for the Final Plan and refresh the individual targets on leakage and pcc to reflect the new methodology.
182	If you are unable to use the guidance outlined in *Consistency of Reporting Performance Measures (UKWIR 2017),* you have explained why you have not used the revised approach for base year leakage, what steps you are taking to comply with the new approach and when this data will be available.	S5.6, Page 24	S3.6.1 A3.3	Y	
183	Where the revised approach to calculating base year leakage leads to uncertainty or significant changes in your base year or projected leakage, you have used scenarios to demonstrate how this affects your plan and any options you have selected.	S5.6, Page 25	S7.2.1	Y	We have included as stress test on the possible effect of the move to the leakage consistency reporting approach.
184	You have described how your approach to calculating base year leakage affects your ability to meet government aspirations to reduce leakage over the planning period.	S5.6, Page 25	S3.6 S 7	Y	We have also included tests for the Draft PR19 methodology to reduce leakage by 15%
185	You have accounted for any actions or policies that may reduce leakage (e.g. mains improvements) in your leakage forecast.	S5.6, Page 25	S 3.6	Y	We have not explicitly examined mains replacement as a leakage control tool for this Plan.
186	You have accounted for your customers' views on leakage reduction and their resulting willingness to participate in demand management activities.	S5.6, Page 25	S 7.3 S 7.4 S 8.3.2	Y	Our long term target is based on Customer Willingness to Pay
187	You have included all feasible options for further leakage control, and any other options you are actively investigating with support from your customers.	S5.6, Page 25	S 6.6	Y	

5.7 Other components of demand

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
188	You have included details on other components of demand, the methods you have adopted for their calculation and your source datasets.	S5.7, Page 25	S 3.7	Y	

5.8 Metering

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
189	You have reported household metering figures in the water resources planning tables.	S5.8, Page 25	Tables	Y	
190	For water companies in England, you have complied with the WRMP Direction 2017 with regard to household metering.	S5.8, Page 25	S3.2.3 S6	Y	We have assessed different meter options and the costs and benefits.
191	If you are in an area of serious water stress, you have considered the costs and benefits of compulsory metering.	S5.8, Page 25		N/A	
192	You have assessed which tariffs are appropriate to your company as part of your options appraisal and included in your plan as appropriate.	S5.8, Page 25	S 6	Y	As we have no short term supply demand deficit and we have low per capita consumption, tariffs need to be considered in a broader context with regard to their impact on affordability and vulnerable customers. The role of tariffs is therefore more relevant to our overall PR19 Plan.

5.9 Impacts of climate change

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
193	You have documented the allowance included in your plan for the impact of climate change on demand, including the assumptions on which this is based.	S5.9, Page 26	S3.4.5	Y	
194	If your allowance is outside expected impact range (<3%), you have robustly demonstrated and justified the reasons for this.	S5.9, Page 26		N/A	Impact up to 2.63%

5.10 Allowing for uncertainty

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
195	You have reduced uncertainty by using the most up to date methods and data when determining supply and demand forecasts.	S5.10, Page 26	S 5 and S 7	Y	We used scenario tests to stress test our plan
196	You have analysed, quantified and discussed any uncertainties associated with your calculations of dry year annual average demand (and critical period scenarios if applicable).	S5.10, Page 26	S 5	Y	High household demand forecasts could stress our system in the medium to long term. As a precautionary measure, our plan sets out the development of a risk based approach for future demand forecasts should our planning problem become more complex.
197	You have used risk-based planning techniques to assess individual components of uncertainty, avoiding any double counting for (e.g. for target headroom components) or omission of uncertainties.	S5.10, Page 26	S 7	Y	In the high household and non-household demand scenario tests we recalculated target headroom to avoid double counting of uncertainty.
198	Alternatively, if you have applied an older target headroom approach to assess individual components of uncertainty, you have justified why this is appropriate. You have evaluated target headroom with regards to risk appetite and have allowed risk to increase with time as adaptations will occur in practice.	S5.10, Page 26		N/A	
199	You have documented all assumptions and information used in the assessment of uncertainties and have discussed the relative significance of uncertainties showing which impact most on each WRZ.	S5.10, Page 26	S 5 and A 5	Y	The impact of future uncertainties is discussed for each Water Resource Zone separately.
200	You have considered options for reducing uncertainty in the planning period.	S5.10, Page 26	S8	Y	Our plan includes both mitigation actions to offset risk, but also development of our planning tools for future decision making. In Section 8 we set out how much uncertainty we mitigate.
201	You have communicated uncertainty such that customers can clearly understand the issues and risks.	S5.10, Page 26	S8 and Customer doc	Y	See customer doc
202	You have explained where there are any uncertainties related to non-replacement of time-limited licences (TLLs).	S5.10, Page 26	S5 and S7	Y	We have also looked at what future licence changes could be and how they could affect our forecasts
203	You have not included an allowance for possible future sustainability changes in headroom, and where relevant you have explored this through scenario analysis.	S5.10, Page 26	S5	Y	We have not included any impact.

Section 6 – Deciding future options

6.1 Considerations when choosing future solutions

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
204	You have considered all options that will address any deficit(s) between supply and demand in any WRZ at any time during the planning period. You have justified your preferred solution(s) in your final plan.	S6.1, Page 27	S6, S7 S8	Y	
205	You have distinguished whether options apply to the dry year annual average and/or critical period scenarios, and your final plan addresses deficits in all scenarios for all WRZs across the planning period.	S6.1, Page 27	S 6, S7 S8	Y	We present the forecasts for both DYAA and DYCP for Bournemouth Water. South West Water is only DYAA only.
206	You have considered options that will allow you to improve your service to customers, provide long-term best value, benefit the environment or collaborate with other water companies. You have justified your preferred solution(s) in your final plan.	S6.1, Page 27	S6, S7 S8	Y	Our water efficiency measures are chosen to give wider benefits than just the supply demand balance. We set out work with Southern Water on a possible new transfer.
207	You have documented all factors that have led you to consider options (whether in deficit or not) in your plan, including reasons.	S6.1, Page 27	S 6, S7 S8	Y	
208	You evaluated the environmental impacts of all possible and discarded options that could have unacceptable impacts that could not be overcome. You have further considered only those options that support achievement of RBMP objectives and would not result in deterioration.	S6.1, Page 27	S6, S7 S8	Y	
209	You have considered the need to undertake an SEA or HRA for each option, and if appropriate undertaken them as a result.	S6.1, Page 27	S 1.6.2	Y	We do not propose any water resource options now and we do not currently need SEAs. Our work shows that we may need to make decisions about future new water resource options in later Plans. We will therefore be developing these assessments in the 2020 to 2025 period for WRMP24.

6.2 Resilience options

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
210	You have evaluated whether options are needed to improve resilience to significant vulnerabilities which are not addressed within the planned level of service, and if needed explained this fully.	S6.2, Page 28	S 6.10	Y	
211	The hazards you considered when evaluating resilience options were those listed in *Resilience planning: good practice guide* (UKWIR, 2013), and you have also considered hazards other than drought.	S6.2, Page 28	S6.10	Y	No specific resilience options in WRMP19. These will be included in the PR19 Business Plan.
212	You have considered the results of the *Water Resources Long Term Planning Framework* (Water UK, 2016), and WRSE and/or WRE as appropriate and incorporated the outcomes into your plan.	S6.2, Page 28	S6.4	Y	
213	If resilience options have been considered, you have considered the costs and benefits and justified the solution.	S6.2, Page 28		N/A	No specific resilience options in WRMP19. These will be included in the PR19 Business Plan.
214	You have demonstrated customer support for the options you have proposed to improve resilience and the level of resilience the options will provide, and have a business case for the additional spending that resilience measures will involve.	S6.2, Page 28		N/A	No specific resilience options in WRMP19. These will be included in the PR19 Business Plan.
215	You have described the option(s) in detail and have conducted the appraisal of resilience options to the same standard as non-resilience options.	S6.2, Page 28		N/A	No specific resilience options in WRMP19. These will be included in the PR19 Business Plan.

6.3 Third party options

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
216	You have considered options, where appropriate, that involve engaging with third parties to help deliver solutions at lower cost, such as upstream services, leakage detection and demand management. You have used the Market Information Platform to assess third party bids (when available).	S6.3, Page 29	S7, A7	Y	In our multi-criteria assessments we assessed the opportunity that the Plan gives to Third Party delivery. Of all the options, a transfer to Southern Water from Bournemouth Water could be an opportunity for third party delivery. As this option needs further review, we intend to keep this delivery route open should it be needed in the future.

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217	You have subjected options involving third parties to the same scrutiny and testing as other options.	S6.3, Page 29		N/A	
218	Where relevant, your plans clearly sets out which options within the final planning scenario are third party options.	S6.3, Page 29		N/A	

6.4 *Upstream competition*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
219	For water companies in England, you have checked that there are no requirements with regards to reforms relating to competitive services for supply to/removal from your network following the Water Act 2014.	S6.4, Page 29	S1.6.7	Y	No known requirements

6.5 *Assessing solutions for your plan*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
220	Your appraisal of options follows the eight stage approach outlined in *WRMP 2019 Methods – decision making process guidance* (UKWIR, 2016).	S6.5, Page 29	All sections,	Y	
	1. Collate and review planning information.		S1-5	Y	
	2. Identify unconstrained options.		S6	Y	We will be further looking at how to optimise leakage options as part of PR19 to understand if the cost of leakage reduction can be further minimised.
	3. Problem characterisation and evaluate strategic needs/complexity.		S1, 7	Y	
	4. Decide modelling method.		S7	Y	
	5. Identify and define data inputs		S7	Y	
	6. Undertake decisions making modelling / options appraisal.		S7	Y	We have focussed mainly on the trade-off between new water resources, leakage reduction and different policy choices. Our plan does not seek to optimise all possible combination of options. As

					part of our plan we set out the development of more complex modelling should that be needed for future plans.
	7. Stress testing and sensitivity analysis.		S7	Y	
	8. Final planning forecast and comparison to EBSD benchmark		S8	Y	
221	You have demonstrated that your final planning forecast is your best value plan, not necessarily the least cost solution, accounting for all criteria that sensitivity analysis has established are important to the plan.	S6.5, Page 29	S8	Y	Multi-criteria assessment used

6.6 *Unconstrained list*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
222	You have developed an unconstrained list of all plausible technically feasible options, including drought measures, and have at least considered options presented in *WR27 Water resources tools* (UKWIR, 2012) and the EBSD method.	S6.6, Page 30	S 6	Y	
223	For water companies in England, you have included third party options (see 6.3) in the unconstrained list, and have demonstrated you have invited or considered third party collaborations or provide a clear explanation of why third party option have not been included.	S6.6, Page 30	S6.4	Y	

6.7 *Feasible list*

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
224	Your feasible list is a subset of your unconstrained list and you have demonstrated that all options on your preferred list are suitable for promotion.	S6.7, Page 30	S 6	Y	
225	You have communicated your feasible list to the Environment Agency and/or Natural Resources Wales as soon as possible and discussed it with them.	S6.7, Page 30	S6	Y	We do not propose any new water resource options.

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
226	You have clearly described the screening criteria you have used to identify feasible options and have applied these consistently to achieve a balance between the number of options included and availability of realistic choices.	S6.7, Page 31	S6.3	Y	
227	You have provided a full description of all feasible options that you have considered, including main operational features, expected implementation extent, conceptual diagram etc.	S6.7, Page 31	A6		For security reasons, details of specific schemes are not
228	You have compared each feasible option to the baseline case, and provided a profile of the extra water available over the 80 years from initial investment in the option.	S6.7, Page 31	A6, Table 5	Y	
229	Where you are transferring water / commissioning new sources and this increases the risk of non-compliance, you have included steps to mitigate those risks (e.g. INNS, discolouration, nitrates, pesticides).	S6.7, Page 31	S2.4	Y	Note - no new raw water transfers being proposed in our WRMP19
230	You have assessed the level of customer support for each option.	S6.7, Page 31	S1.10,A1	Y	
231	You have appropriately estimated the amount of time needed to investigate and implement the option and have proposed an earliest start date based on your review.	S6.7, Page 31	A 6	Y	Timeline for resource options given. Demand management options are assumed to be available with little lead in time. Leakage reduction is a continuum. We assess the yield uncertainty in the multi-criteria assessment.
232	You have appropriately assessed and reported the risks and uncertainties associated with each option, including the likelihood of reduced yield due to factors such as climate change, environmental constraints and customer behaviour. You have considered the flexibility of the option to adapt to future uncertainty.	S6.7, Page 31	S7, A 7	Y	Uncertainty and flexibility is included in the multi-criteria assessment
233	You have explained any factors or constraints specific to the option, and have highlighted any links or dependencies on other existing schemes, other options and any mutual exclusivity with another option.	S6.7, Page 31		N/A	
234	You have described how the option will be utilised and the impact on costs.	S6.7, Page 31		N/A	

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
235	You have assessed the environmental impacts of the option, including implications for RBMP objectives, and have undertaken and reported the outcomes of a Habitats Regulations Assessment (HRA) if the option has been found to potentially affect any designated site.	S6.7, Page 31	A6	Y	See 241
236	You have undertaken a cost-benefit appraisal of the option, including a cost breakdown over the 80 year period and covering capital, operating and financing costs. Your method is aligned to Ofwat's most recent guidance for PR19 and the WRPG, and gives Average Incremental Costs (AIC) based on maximum capacity costs divided by maximum capacity outputs expressed as net present value (NPV). You have explained how you arrived at your AIC figure.	S6.7, Page 31	S7, A7, S8, A8, Tables	Y	Costs calculated over an 80yr period and covers capital, operating and financing costs. Notes: 1. We have not included the potential water resource options in the Tables. As these are only considered as potential options, we have not included in the Table to avoid over emphasis on options that we currently do not plan to do. We have however included details of their costs in Appendix 6 for reference. 2. We provide AISCs with and without willingness to pay. This is because the latter can double count benefit with the environmental and social costs. BY providing the "with and without" it gives transparency on the underlying costs or different choices. 3. We have used the actual opex/capex split on options to allow costs to be compared on a comparable basis. We have also used this in our NPV calculations. In contrast the Ofwat regulatory model uses a constant PAYG/Non-PAYG ratio for all expenditure in the water service. This can lead to slight differences when calculating bills impacts of programmes if using the AICs vs. an actual financial model. We used the latter in our Plan as it better reflects the actual impact in the regulatory model.
237	As part of the cost-benefit appraisal, you have evaluated the environmental and social (including carbon) costs and benefits of the options and show either a monetised profile of Average Incremental and Social Costs (AISC), or a non-monetised assessment of impacts. You have stated your approach to calculation of AISC.	S6.7, Page 31	S7, A7, S8, A8, Tables	Y	See commentary on env and social costs in the Tables. Non-monetised impacts of our Plan is given in the multi-criteria assessment. As shown in the Natural Capital calculation, our approach may underestimate wider benefits (e.g. biodiversity). See 241.
238	For supply options, as part of your cost-benefit appraisal you have determined supplementary costs	S6.7, Page 31		N/A	We include high level costs of options in Appendix 6. We have not done detailed design costs as we do not propose new water resource options in the

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
	required to distribute the new supply (e.g. service reservoirs, pumping stations, mains upgrades), excluding costs associated with local infrastructure enhancements.				next 5 years.
239	You have evaluated whole-life costs that include treatment, pumping, network, storage, maintenance and operation costs (the latter included control measures relating to water quality optimisation, fluoridation, chemical stabilisation, aesthetic impacts on consumers and control of disinfection by-products.	S6.7, Page 32		N/A	See 238

6.8 Environmental and social impacts

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
240	You have considered the environmental and social impact of each option of the feasible list.	S6.8, Page 32	S3 (leakage) S6 (all options), A6	Y	
241	You have assessed impacts using a method that is proportionate to the scale of the problem and have fully justified your approach.	S6.8, Page 32	S6, A6	Y	Our method is proportional to our problem but should be developed further for future plans. Our proposed Plan is not sensitive to this at present as a) it is based on factors outside cost alone b) we have used customer willingness to pay to look at overall benefits and c) we do not propose and new water resource options.
242	You have applied an Ecosystem Services approach to environmental evaluation, if appropriate, and your method gives accountable and transparent outcomes that consider stakeholder needs.	S6.8, Page 32	S8, A8	Y	We have calculated the impact of our plan on Natural Capital.
243	You demonstrate that you have used the best available evidence and data in your assessment, and the conclusions you draw are robust, locally valid and justifiable.	S6.8, Page 32	S6, A6	Y	
244	You provide a clear audit trail of your appraisal of environmental and social impacts and explain the data you use, the results and recommendations from the appraisal.	S6.8, Page 32	S6, A6	Y	See 241

6.9 Solutions driven by changes to existing abstraction licences

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
245	You have worked with the Environment Agency or Natural Resources Wales to understand the cost effectiveness of solutions that are driven by changes to existing abstraction licences.	S6.9, Page 32		N/A	
246	You explain how any solution driven by changes to existing abstraction licences meets the objectives of the Habitats Directive, Wildlife and Countryside Act and Water Framework Directive and prevents any deterioration of water bodies.	S6.9, Page 32		N/A	
247	You have considered whether measures needed to meet sustainability and environmental objectives (e.g. related to HD, WCA and WFD) are cost-effective and cost-beneficial, and are supported by customers.	S6.9, Page 32		N/A	
248	You have explained how the cost has been evaluated (where cost include non-monetised costs) and that the benefit outweighs the cost, the option is not disproportionately costly and has the lowest overall costs even when accounting for the need for customer support.	S6.9, Page 33		N/A	

6.10 Deciding on a solution

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
249	You have explained the approach you have taken to arrive at the best solution(s), making use, as appropriate, of the UKWIR Decision Making process to develop a decision-making framework and identify methods to determine which solution(s) is/are best.	S6.10, Page 33	S7, S8	Y	Multi-criteria assessment used (Section 12.5 in the UKWIR Decision Making report). As part of our Plan we set out that we will be developing our tools in this area to help future plans.
250	You have used the EBSD method within the process of identifying best solution(s), e.g. to provide a benchmark against which outcomes of alternative methods can be compared.	S6.10, Page 33	S7, A7	Y	See performance of baseline scenario

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
251	You have explained which methods other than EBSD have been used within the process of identifying best solutions, including justification for their appropriateness, such as differences and improvements.	S6.10, Page 33	S7, A7	Y	We have used a multi-criteria approach to assess wider impacts As some of our WRZs may become intermediate category in the future, our Plan sets out development of new financial models to aid future decision making.
252	You have clearly and transparently set out the economic, social and environmental justifications for your final choice of solution, and demonstrated why you have decided on this approach and discounted others. You have provided a clearly reasoned justification for how the decision has been made, as well as the decision. Your explanations are able to be clearly interpreted by customers, interested parties and regulators.	S6.10, Page 33	S7, S8	Y	As we have no forecast supply-demand deficit the Plan has tensions between acting now to mitigating uncertainties or waiting. There are higher and lower cost plans but for the reasons outlined in the report we consider the proposed Plan is the best balance overall.
253	You have considered how future changes might affect the solution or whether any potential future changes might make it redundant.	S6.10, Page 33	S7	Y	
254	You have considered the resilience of the solution against a range of possible futures.	S6.10, Page 33	S7	Y	Each WRZ was stress tested
255	You demonstrate that the possible futures considered include potential future impacts of regional or cross sector demand.	S6.10, Page 33	S7	Y	Bournemouth Water transfer has been identified as a possible option to support Southern Water in the post 2025 period.
256	You have assessed the costs and benefits of the chosen solution, and have set out your assessment of whether the benefits of implementing the solution are greater than the costs. Your preferred solution is best value.	S6.10, Page 33	S8, A8	Y	The plan is not the lowest cost plan but the benefits are greater than the costs.
257	You have described the steps you have taken to carry out a Strategic Environment Assessment and Habitat Regulations Assessment for your chosen solution, or demonstrated why this is not needed. Where relevant, you have incorporated any outcomes from the SEA and/or HRA into your final plan.	S6.10, Page 33	S1.6	N	The plan does not propose any new water resource schemes or transfers. SEA is therefore not needed.
258	Where the option involves sharing resources, you have explained who will have ultimate rights to the water and why. You have also provided details of how the option will operate, funding mechanisms, legal arrangements, drought implications.	S6.10, Page 33	S8.5	Y	We propose to further develop the understanding of a water transfer to Southern Water. This will include details of how the option would operate and be funded.

6.11 Water Framework Directive

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
259	You have considered and prioritised solutions that promote the requirements of Article 7 of the WFD and are consistent with RBMP objectives and solutions, highlighting how you will or are working with others to achieve this.	S6.11, Page 33	S6	Y	We include catchment management as part of our PR19 Business Plan. Our WRMP focuses on demand reduction and thereby reduces our water footprint than would otherwise occur.
260	You have described how the impact of changes to the operation of existing sources and / or the impacts of new sources on WFD water body status has been established, and that you have rejected sources that might cause deterioration or prevent the achievement of good status.	S6.11, Page 33		N/A	
261	You have described any intended actions that may cause deterioration of status/potential or prevent good status/potential being achieved. You have discussed this with the Environment Agency or Natural Resources Wales and made a clear statement in the plan of any potential impacts of any intended actions.	S6.11, Page 33		N/A	
262	You have included targeted and cost effective restoration measures, and have considered how you will apply adaptive management measures solely or working in partnership with other relevant organisations.	S6.11, Page 33		N/A	

6.12 Testing your plan

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
263	You have explained the scenario testing you have undertaken to evaluate the resilience of your plan to a range of risks.	S6.12, Page 34	S7	Y	
264	Based on scenario testing, you have described the factors and risks having the most significant impact on your plan, and the possible timings of these impacts.	S6.12, Page 34	S 7, A7	Y	
265	You have explained the scenario testing you have undertaken to show the plan is robust to minor changes to supply and demand forecasts in the near future and to more	S6.12, Page 34	S7, A 7	Y	Supply-demand charts are given for all scenarios.

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
	moderate changes as the plan progresses.				
266	You have explained the scenario testing you have undertaken to compare your preferred plan with, or to identify, alternative options.	S6.12, Page 34	S 7, A7	Y	All scenarios are compared back to the baseline plan.
267	Based on scenario testing, you have justified how you will manage risk and future uncertainties (e.g. in response to new evidence becoming available), and what you will monitor to help manage these risks.	S6.12, Page 34	S 8, A8	Y	Our Plan proposes work in three areas to mitigate future uncertainties.
268	Based on scenario testing, you have explained when and why important decisions should be made within the period of the plan.	S6.12, Page 34	S7.6, S 8	Y	
269	You have explained how scenario testing demonstrates that you have not over-planned for a worst-case scenario that is very unlikely.	S6.12, Page 34	S7	Y	Likelihoods are given against each scenario. Our Plan sets out the development of further risk based tools for future plans in case our WRZs move into the intermediate complexity category.

A.9.3 Senior Manager review

Each part of the plan was reviewed by the Senior Manager responsible for the Plan.

The areas set out in the EA checklist were reviewed as well as more detailed operational assumptions in the underlying forecasts and analysis. This included, but was not limited to:

- Review of assumptions behind each WTW capacity
- Review of the weekly demand profiles
- Review of outage
- Comparison of actual demand trends vs forecasts
- Review of optant forecasts

No material issues were found to affect the decisions in this Plan, however a number of areas were identified for development to help the decision making in future plans. These have been included in the completed checklist and embedded in our forward Plan.

A.9.4 CH2M

Third Party assurance was undertaken on our Plan. This used the same EA checklist as outlined above.

No materials exceptions were found, but some observations were made. These are given below.

Overall, the assurance noted that whilst there is no immediate supply demand problem, the analysis has identified new emerging uncertainties in the future around demand, resilience against the most extreme droughts, new sustainability reductions and the on-going uncertainty of climate change on supply. In doing so it highlighted some WRZs could in future move from low risk to intermediate risk if these uncertainties were to materialise. The assurance recommended the need to consider moving towards applying more risk-based decision making approaches in WRMP24.

We have included this feedback in developing our Plan and set out the developments of our tools and assessment of options. Specifically this focuses on the development of risk based tools for demand forecasting and also on the financial modelling. This pro active approach means we will continue to plan ahead to ensure that we maintain the balance between supply and demand effectively in the future.

Supply

- Based on a good data and historic evidence base (within the constraint of some concern over the quality of historic rainfall records)
- Availability, in-house, of a water systems simulation model (MISER) that is run and maintained by an experienced in-house modelling team
- Revised processes used by BW for WRMP14 to bring them in line with processes being used by SWW
- Explored the resilience of supply to drought scenarios and potential sustainability reductions

Observations:

- Impact of climate change on river flows is highest in the Colliford and Roadford WRZ's (they are in the orange vulnerability zone in the climate change vulnerability diagram; see Section 2.3.5) – does this signal an emerging issue?

  We have addressed this in our Plan by continuing to develop our programme to understand the impact of more extreme droughts on our supply system
- We noted that the EA commented that the SWW outage allowances seem to be low and requested SWW re-examine these – SWW reports that it has a new in-house tool, the 'Site Performance Tracker', which has been operational since early 2017 and should enable SWW to gain a better understanding of the type frequency and magnitude of outage events and potential mitigation options

  We have included updates to outage as part of our Plan.

Demand

- Based on a reasonable assessment of available data and evidence base (within the constraints of the quality of available data on housing growth projections)
- Revised processes used by BW for WRMP14 to bring them in line with processes being used by SWW
- Explored the resilience of demand to high HH and non-HH growth and leakage consistency measures

Observations:

- Use of deterministic non-HH forecasts in which the variability of demand over recent years is of the same order as the difference between the 'low' and 'high' consumption forecasts – we have noted that: (i) SWW has bounded its forecasts with two scenarios: a low-consumption scenario and a high consumption scenario; and (ii) a commitment by SWW in their

WRMP19 strategy to improve the way in which uncertainty is dealt within the process of demand (especially non-HH) forecasting

Our Plan includes developing more risk based approaches for demand forecasting. This will help give more detail on the level of risk from changes in the demand in future plans

Decision making process

- Good use of scenario analysis to explore WRZ resilience to stress-events given that despite WRZ's being in balance now, the supply demand balance has some small sensitivity in the medium to long term to low probability events
- Systematic approach following the ethos of risk-based decision making
- Inclusion within WRMP19 strategy for 2020 – 2025 of actions to develop SWW planning and decision-making tools

Observations

- Explaining more clearly how the scenario-based resilience assessment (where scenarios are 'strategic' samples from an uncertain future) relates to the selection of headroom and outage allowances

  We have set out additional detail in Section 8 and Appendix 8 the level of uncertainty outside of headroom our Plan accounts for. We have also set out in our Plan the further development of the risk analysis for future plans.

APPENDIX 10

Glossary of terms used in the WRMP

A.10.1 Glossary of terms used in the WRMP

Term	Description
Above ground supply pipe losses	Losses from the pressurised system after the *point of consumption.*
Abstraction	The removal of water from any *source*, either permanently or temporarily.
Abstraction licence	The authorisation granted by the Environment Agency under the terms of an *abstraction licence.*
AISC	See *Average Incremental Social Costs*
AMP5	Asset Management Plan 5 – the period 2010/11-2014/15 (also referred to as *K5*)
AMP6	Asset Management Plan 6 – the period 2015/16-2019/20 (also referred to as *K6*)
Annual average daily demand	The cumulative demand in a year, divided by the number of days in the year.
Aquifer	A geological formation, group of formations or part of a formation that can store and transmit water in significant quantities.
Atrazine	A herbicide which is widely used globally, but no longer used in the UK.
Average Incremental Social Costs (AISC)	The net present value (NPV) of the option costs, including social and environmental costs, divided by the net present value of the option capacity or output.
Capex	Capital expenditure.
Catchment area	The area of land whose rainfall feeds a particular river, lake or reservoir.
Communication pipe	That part of the *service pipe* between the distribution main and the highway boundary.
Consumption	*Water delivered billed* less *underground supply pipe losses*. Consumption can be split into *customer use* plus *total plumbing losses*.
Customer use	*Consumption* less *total plumbing losses*.
Customer-side management	The implementation of policies or measures which serve to control or influence the *consumption* or waste of water by the end user.

Term	Description
Demand management	The implementation of policies or measures which serve to control or influence the *consumption* or waste of water.
Demand management option	A single measure, or a combination of measures (eg a public awareness campaign using both leafleting and radio advertising), taken to influence the demand for water.
Deployable Output	The output of a commission *source* or group of sources or of bulk supply as constrained by: • environment • licence, if applicable • pumping plant and/or well/aquifer properties • raw water mains and/or aqueducts • transfer and/or output main • treatment • water quality for specified conditions and demands
Distribution input	The amount of water entering the distribution system at the *point of production*. This is the quantity usually measured as *demand* by customers.
Distribution losses	Made up of losses on trunk mains, service reservoirs, distribution mains and *communication pipes*. Distribution losses are *distribution input* less *water taken*.
Distribution management	Management of the transmission, storage, distribution and mains supply pipe of potable water.
Distribution System Operational Use (DSOU)	Water knowingly used by a company to meet its statutory obligations, particularly those relating to water quality. Examples include mains flushing and air scouring.
District Metering Area (DMA)	An area that is permanently defined by closed valves or other physical constraints in which distribution losses are measured and managed.
DMA	See *District Metering Area*
Drawdown period	The length of time during which the contents of a reservoir are always less than a target refill storage volume.
GAC	See *Granular Activated Carbon*
Granular Activated	An adsorbent filtration media used to remove trace organic

Term	Description
Carbon (GAC)	compounds from water
Greywater	Water that can be considered for non-potable re-use.
Groundwater	Water within the saturated zone of an aquifer.
Households	Properties (normally occupied) receiving water for domestic purposes which are not factories, offices or commercial premises.
Hydrological yield	The unconstrained output of a *source* that can be sustained by the catchment or aquifer feeding the source.
Internal metering	Meters fitted within the household boundary which measure *consumption* but do not record *underground supply pipe losses*.
Internal plumbing losses	Losses from the non-pressurised system after the *point of consumption*.
K5	The period 2010/11-2014/15. Also referred to as *AMP5*.
K6	The period 2015/16-2019/20. Also referred to as *AMP6*.
Leakage	The sum of *distribution losses* and *underground supply pipe losses*.
Level of service	The design standard used by a company for the security of supply to customers. It is expressed in terms of the average frequency with which: • a customer might experience demand restrictions such as hosepipe bans • the Company might apply for drought orders or permits.
Licence variation	The authorisation granted by the Environment Agency to change the terms of an *abstraction licence.*
Local reservoir	Small reservoir supplying a local area. Usually supported by a *strategic reservoir*.
Maximum Likelihood Estimation (MLE)	A statistical technique where a *reconciliation item* is distributed to the largest and least certain components of an estimate of the magnitude of a variable. The technique can be applied to the reconciliation of a *water balance*, for example.
Megalitre (Ml)	Measure of volume; one million litres
Meter optants	Properties in which a meter is installed at the request of its occupants.
Micro-component	The process of deriving estimates of present or future consumption based on expected changes in the individual

Term	Description
analysis	components of customer use.
MLE	See *Maximum Likelihood Estimation*
Net present value (NPV)	The NPV of an investment is the discounted value of expected income less cost.
Non-households	Properties receiving water for domestic purposes but which are not occupied as domestic premises eg factories, offices and commercial premises, cattle troughs. They also include properties containing multiple households which receive a single bill (eg a block of flats).
NPV	See *Net Present Value*
Opex	Operating expenditure.
Outage	A temporary loss of *Deployable Output*. (Note that outage is temporary in the sense that it is retrievable, and therefore *Deployable Output* can be recovered. The period of time for recovery is subject to audit and agreement. If an outage lasts longer than 3 months, analysis of the cause of the problem would be required to satisfy the regulating authority of the legitimacy of the outage.)
Outage allowance	The value of allowable outage expressed in Ml/d.
PCV	See *Prescribed Concentrations or Values*
Peak demand	The highest demand that occurs, measured either hourly, daily, weekly, monthly, yearly, over a specified period of observation.
Planned outage	A foreseen or pre-planned *outage* resulting from a requirement to maintain *sourceworks* asset serviceability.
PMA	See *Pressure managed area*
Point of consumption	The point where the *supply pipe* rises above ground level within the property – usually the inside stopcock or an *internal meter*.
Point of delivery	The point at which water is transferred from mains or pipes which are vested in the water supplier into pipes which are the responsibility of the customer. In practice this is usually the outside stopcock, boundary box or *external meter*.
Point of production	The point where treated water enters the distribution system.
Prescribed Concentrations or Values (PCV)	The numerical value assigned in the "Water Supply (Water Quality) Regulations 2000 (England)" defining the maximal or minimal legal concentration or value of a parameter

Term	Description
Pressure Managed Area (PMA)	An area, defined by closed valves or other physical means, within which hydraulic pressure is monitored, controlled and managed.
PR14	Periodic Review 2014
Production management	Management of the storage, transmission and treatment of raw water.
Pumped storage	A means of increasing the natural refill of a reservoir by pumping water to the reservoir from another catchment.
Q95	The river flow which is equalled or exceeded for 95% of the time. Also referred to as the "95 percentile".
Raw water exported	Raw water exported from a specified geographical area.
Raw water imported	Raw water imported from a specified geographical area.
Raw water losses	The net loss of water to the resource system(s) being considered, comprised of mains/aqueduct (pressure system) losses, open channel/very low pressure system losses, and losses from break-pressure tanks and small reservoirs.
Raw water operational use	Regular washing-out of mains due to sediment build-up and poor quality of source water.
Reconciliation item	The difference between the estimates of the magnitude of a variable and the sum of the estimates of the individual components of that variable.
Saturated zone	The zone in which the voids in a rock or soil are filled with water at a pressure greater than atmospheric.
SEA	See *Strategic Environmental Assessment*
Selective metering	Metered charging of a defined subset of *households*, such as a town, or a region or particular types of customers eg sprinkler users.
SELL	See *Sustainable Economic Level of Leakage*
Service pipe	The sum of the *communication pipe* and the *supply pipe*.
Source	A named input to a *resource zone*. A multiple well/spring source is a named place where water is abstracted from more than one operational well/spring.
Sourceworks	All assets used between and including the point of abstraction and the point at which water is first fit for purpose. These include:

Term	Description
	• abstraction works • reservoir and river intakes • boreholes • raw water storage • pumping plant and mains • water treatment plant • treated water storage • treated water pumping plant
Strategic Environmental Assessment (SEA)	A study of the effects of certain plans, policies and programmes on the environment.
Strategic Reservoir	A large or dominant reservoir (cf *local reservoir*) supplying water directly or indirectly over a wide area. South West Water has three strategic reservoirs: Wimbleball, Colliford and Roadford.
Supply pipe	That part of the *service pipe* not within the boundary of the highway.
Supply pipe losses	The sum of the *underground supply pipe losses* and *above ground supply pipe losses*.
Sustainable Economic Level of Leakage (SELL)	The Sustainable Economic Level of Leakage (ELL) is the point at which the cost of further leakage reduction is just equal to the additional benefit gained. The calculation of SELL includes the social and environmental costs and benefits associated with leakage. It relies on two key relationships: • The costs of the various activities for controlling leakage e.g. finding and repairing leaks, and how they vary with the level of leakage • The impact that different leakage levels have on the costs of delivering water to customers (treatment and pumping costs) and the timing of planned new supply, treatment and demand management (including water efficiency) schemes
Target headroom	The minimum buffer that a prudent water company should allow between supply and demand to cater for specified certainties (except those due to outages) in the overall supply demand balance.
Total leakage	The sum of *distribution losses* and *underground supply pipe losses*.
Total plumbing losses	The sum of *above ground supply pipe losses* and *internal*

South West Water Bournemouth Water

Term	Description
	plumbing losses.
Total treated water losses	The sum of *distribution losses, underground supply pipe losses* and *total plumbing losses*.
Underground supply pipe losses	Losses between the *point of delivery* and *the point of consumption*.
Unplanned outage	An *outage* caused by an unforeseen or unavoidable legitimate outage event affecting any part of the *sourceworks* and which occurs with sufficient regularity that the probability of occurrence and severity of effect may be predicted from previous events or perceived risk. Note that the definitive list of legitimate unplanned outage events is: • pollution of source • turbidity • nitrate • algae • power failure • system failure Other events should be classified elsewhere, for instance as planning allowances.
Voids	Empty properties not currently containing a *household* or *non-household*.
WAFU	See *Water Available For Use*
Water Available For Use (WAFU)	The value in Ml/d calculated by the deduction from *Deployable Output* of allowable *outages* in a resource zone.
Water balance	The allocation of total *distribution input* across its constituent components (eg in the current year or base year of a demand forecast).
Water delivered	Water delivered to the *point of delivery*.
Water delivered billed	*Water delivered* less *water taken unbilled*. It can be split into *unmeasured household, measured household, unmeasured non-household* and *measured non-household water delivered billed*.
Water Resource Zone (WRZ)	The largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall.

Term	Description
Water taken	*Distribution input* minus *distribution losses*.
Water taken legally unbilled	Water taken legally but not charged for, such as water taken from hydrants for fire fighting.
Water taken unbilled	*Water taken illegally unbilled* plus *water taken legally unbilled.*
WRZ	See *Water Resource Zone*
WTW	Water Treatment Works
WWTW	Waste Water Treatment Works

APPENDIX 11

Relevant legislation for water company Water Resources Management Plans

A.11.1 Relevant legislation

As detailed in the Environment Agency guideline[A.11.1], we have taken account of the following legal requirements when producing our draft WRMP19.

Section 2 - Process of forming and maintaining a water resources management plan

This section contains information on the steps required to develop and publish your water resources management plan (WRMP) from early engagement with regulators and customers through to publishing your final plan. Once published, you will need to report on the plan annually. You can find more information about how to do this on the annual review page.

2.1. The legal requirements

In preparing and publishing a WRMP you must take account of:

- Water Industry Act 1991, sections 37A - 37D and any secondary legislation made, and any ministerial directions given, under this legislation;
- Water Resources Management Plan Regulations 2007 (2007 regulations) and directions given by the Government.

In addition, you must take account of the following legislation as relevant to your plan:

- Strategic Environmental Assessment Directive
- Habitats and Wild Birds Directives
- Water Framework Directive (WFD)
- Drinking Water Directive
- Water Industry Act 1991
- Water Resources Act 1991
- Environment Act 1995
- Well-being and Future Generations (Wales) Act 2015
- Environment (Wales) Act 2016
- The Eels (England and Wales) Regulations 2009
- Wildlife and Countryside Act 1981
- Countryside and Rights of Way Act 2000
- Natural Environment and Rural Communities Act 2006
- EU Regulation (1143/2014) on invasive alien (non-native) species (2015)

Your WRMP will have strong links with other plans. You must consider and explain how your WRMP links to:

- River Basin Management Plans
- Water company business plan
- Your drought plan
- Environment Agency and/or Natural Resources Wales drought plans where relevant
- Flood risk management plans
- Local plans produced by local authorities

If your area is wholly or mainly in:

- England, you must send your draft and final WRMP to the Secretary of State. If your plan will also affect sites in Wales you must send it to the Welsh Ministers in addition to the Secretary of State.

[A.11.1] Environment Agency and Natural Resources Wales (2017), *Water resources planning guideline – April 2017*

TABLES

Available on request