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South West Water Bournemouth Water

Final Water Resources Management Plan August 2019

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Introduction

This report is South West Water's Final Water Resources Management Plan (WRMP). 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 vary 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 fulfil this strategy. This strategy 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. This Final Plan takes into account the feedback from the consultation on our Draft Plan.

This Plan covers the period up until 2044/45 and has a base year of 2017/18.

The published version of the 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.

Changes made to the WRMP between Draft and Final versions

As part of the consultation process, we have addressed the points raised in the representations we received. In our Statement of Response we stated how we would revise our Plan. The key changes made in the Plan are listed below:

Section / Appendix	Changes
Executive summary	• Our Strategy has been updated to include our 15% leakage reduction target, increased water efficiency measures, the impact of the leakage consistency methodology and clarifications on how we have followed the DEFRA Directions. We have also included information regarding our collaboration on regional water resources planning with other water companies, with specific detail on our proposed water transfer between our Bournemouth WRZ and Southern Water.
1	• We have provided significant additional detail on our customer research within our Final Plan.
2	• We have updated our Final Plan to include the reduced process water losses from planned improvements at key Bournemouth WRZ water treatment works (WTW).
3	• The Final Plan includes more detail on how we will reduce Per Capita Consumption (PCC). • The Final Plan contains updated information on our metering strategy.
4	• The Headroom assessment has been updated using 2017/18 demand data.
5	• The Baseline supply demand assessment has been updated using 2017/18 demand data.
6	• Details on the potential for third party water efficiency and leakage options have been included in our Final Plan. • Details on a potential Bournemouth WRZ to Southern Water transfer have been included in our Final Plan. This has been updated to reflect that in the Draft Plan this was a scenario, whilst we assume in our final strategy that this transfer will go ahead. • In the Final Plan we have included a summary of improvements at key WTW resulting in reduced losses. • We have updated information on our catchment management strategy and activities with details of the programme included in PR19. • Further details on the Stannon Lake proposal are presented.
7	• Broader scenario testing is a key change for the Final Plan, along with a detailed risk assessment for our Otter Valley sources. • The Final Plan also includes a full description of our water efficiency proposals. • More details on the WINEP3 schemes and estimated impacts on WAFU should investigations indicate that changes to abstraction licences are required.

Section / Appendix	Changes
	• More information on how our WRZs are impacted by different types of droughts, as well as more discussion on the types of plausible droughts chosen, their return periods, and impacts. • We have included in our Plan more information on how Wimbleball WRZ is resilient to a 1 in 200 year drought of the type that impacts this WRZ the most. • We have included a section on the impact of severe weather events.
8	• Details of our revised overall strategy incorporating a stretching 15% leakage target by 2025 has been included, with a detailed delivery plan. Targets have been updated for the PR19 Draft Determination. • Further information in the Final Plan on our proposal to reduce leakage by 25% by 2045 in line with customers' willingness to pay. • We have also considered the impact of a 50% reduction by 2045 in line with the National Infrastructure Commission (NIC) proposal published in January 2018. • More details have been added regarding measuring water efficiency benefits of proposals. • The Final Plan includes a new section on the impact of the broader resilience of our system to non-supply demand risks. • Further information on our potential collaborative working as part of the West Country Water Resources Group is included. • We have included details of the natural capital impact of our Plan. • The overall impact of leakage and demand reduction on risk mitigation has been assessed within this Plan.
Data Tables	• All Data tables have been updated.
Appendix 12	• This is a new Appendix, which includes additional information on the Isles of Scilly.
Appendix 13	• This is a new Appendix, which sets out how our Plan complies with the Defra Directions.

Summary of Final Water Resources Management Plan

It is our priority to ensure we operate a resilient, high quality 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 water supply
- Our forecast 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.

Overview of South West Water

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) which covers parts of Dorset, Hampshire and Wiltshire.

Water resources in the SWW supply area consist of three large reservoirs, a number of smaller reservoirs, river intakes and some groundwater sources which are predominantly in

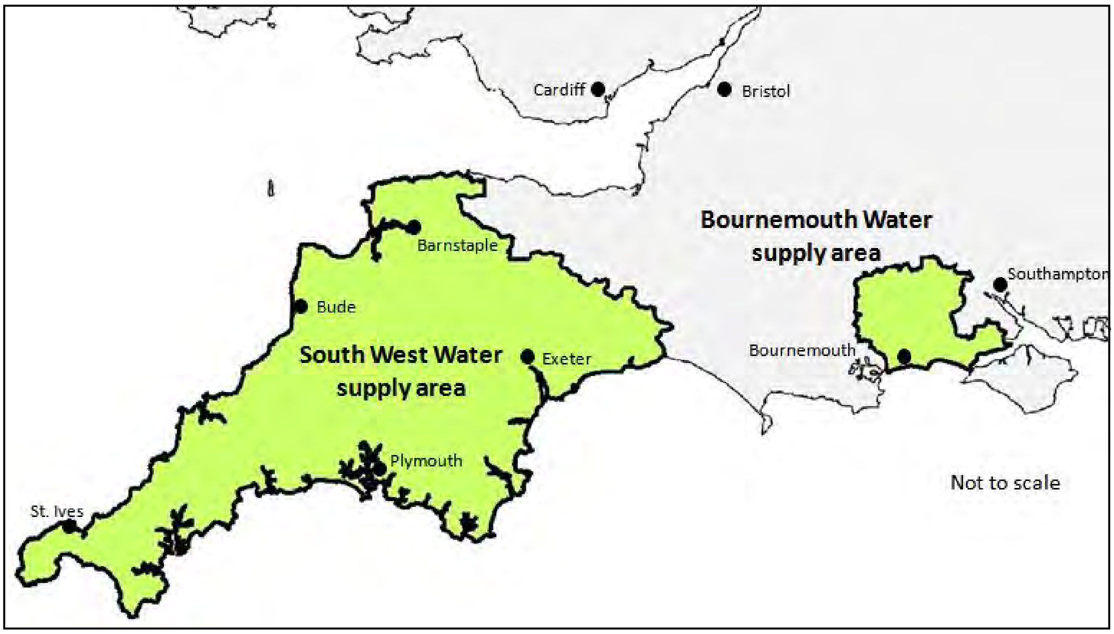
East Devon. To the east, water resources in the BW supply area are largely made up from river abstraction with some groundwater.

The SWW supply 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 BW supply area is a single WRZ and again we operate our sources conjunctively 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)

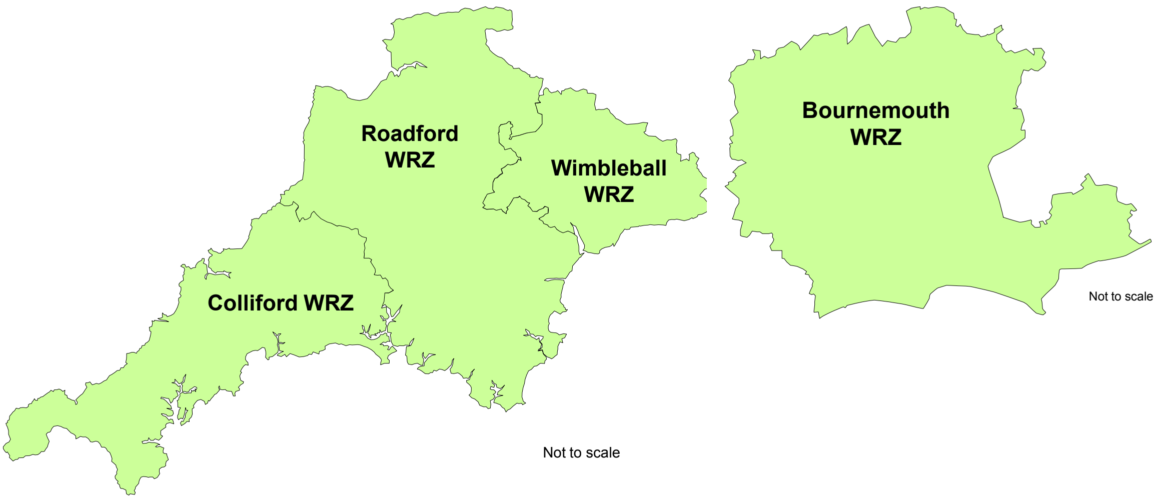


Table A: Planned Levels of Service

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.

The key feedback from stakeholders on the Draft Plan was a request to see a 15% leakage reduction by 2025 and additional water efficiency activity. We have included this in this Final Plan.

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 (CCG) 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. We also undertook a consultation on our Draft Plan. Our response to the feedback received was included in our Statement of Response and has been incorporated into this Final Plan.

The key feedback from stakeholders on the Draft Plan was a request to see a 15% leakage reduction by 2025 and additional water efficiency activity. We have included this in this Final 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 planning 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.

Figure B: 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**

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.

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

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 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 flat 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.

For this Final Plan we have used the new reporting approach for leakage consistency reporting as defined by Ofwat.

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 (PR19) 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	95^{th}
2020 – 2025	95^{th}
2025 – 2030	90^{th}
2030 – 2035	90^{th}
2035 – 2040	85^{th}
2040 – 2045	85^{th}

Baseline position and possible options

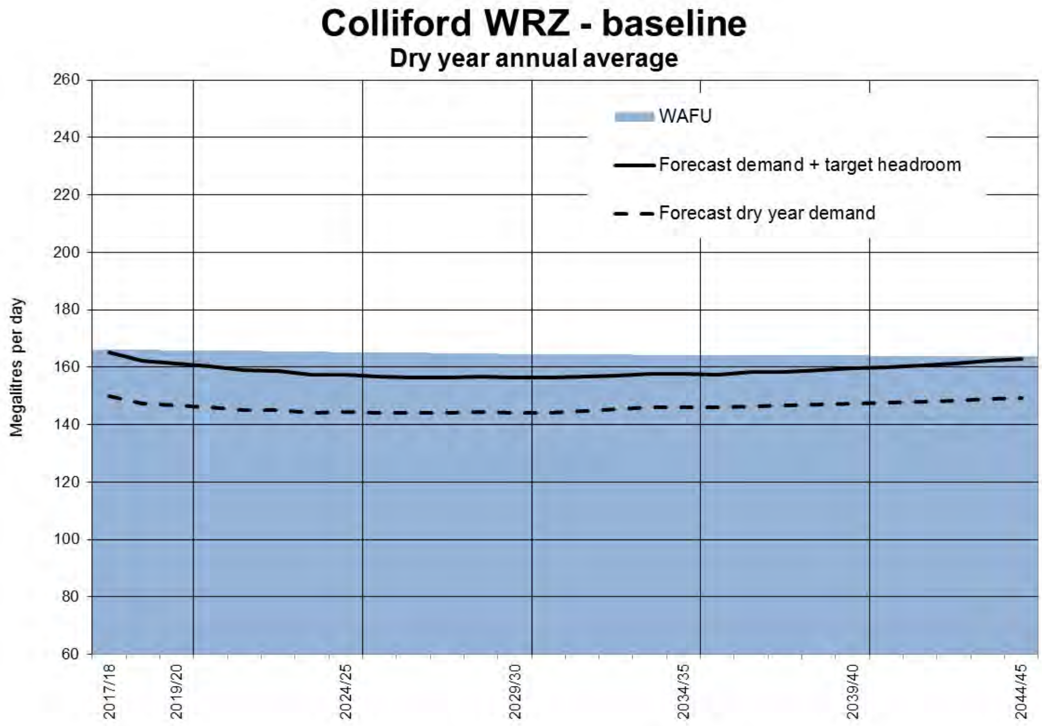
Baseline supply demand balance

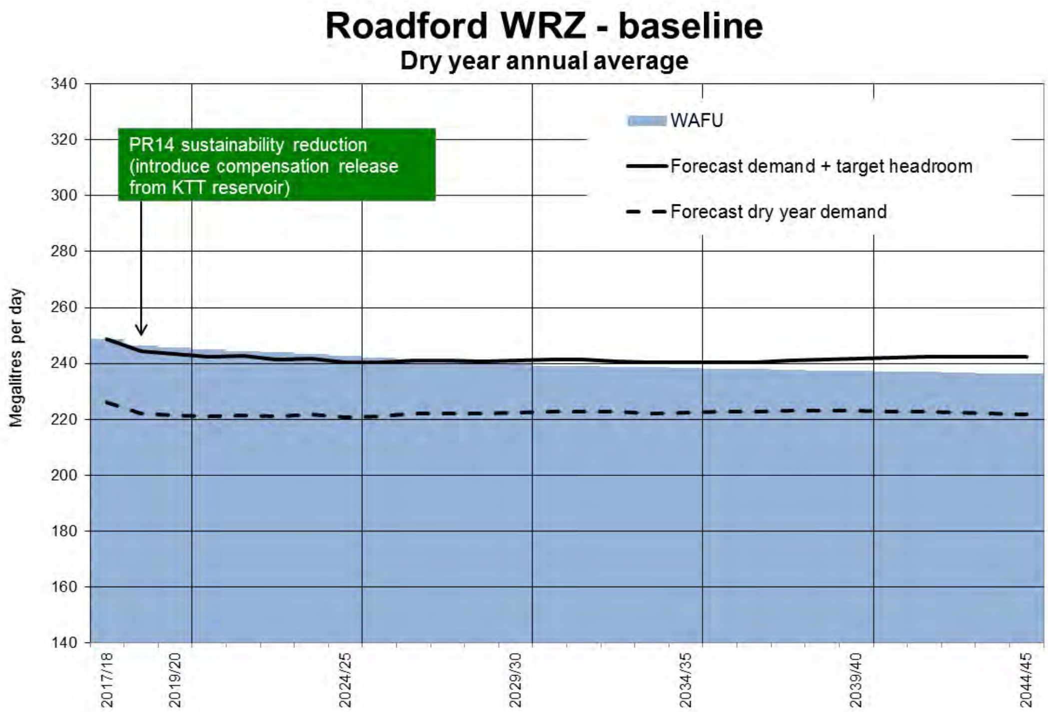
We used the water supply and demand forecasts together with climate change and target headroom values to forecast our baseline supply demand position for the next 25 years. This forecast is the supply demand balance should no new interventions be undertaken – see Figure C. The results show:

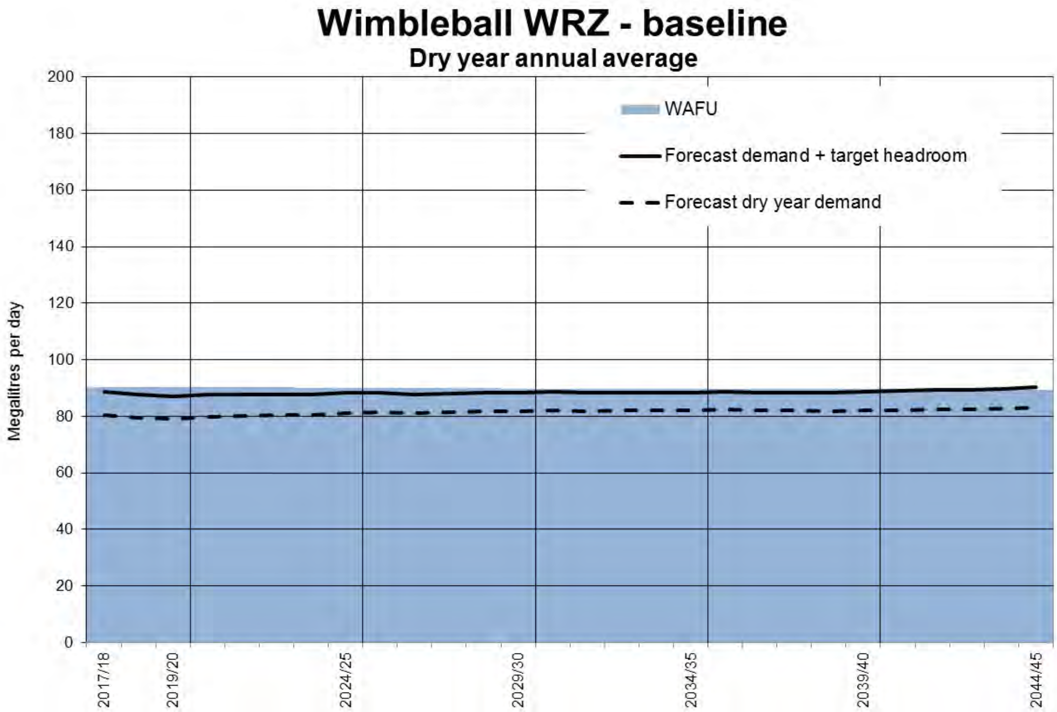
- Colliford and Bournemouth WRZs are in surplus throughout the planning period even with no intervention
- With no intervention, Wimbleball WRZ is in surplus until the very end of the planning period with a minor deficit (0.7 Ml/d) in 2044/45
- Roadford WRZ drops into deficit in 2028/29 and remains in deficit from then until the end of the planning period if no intervention were made

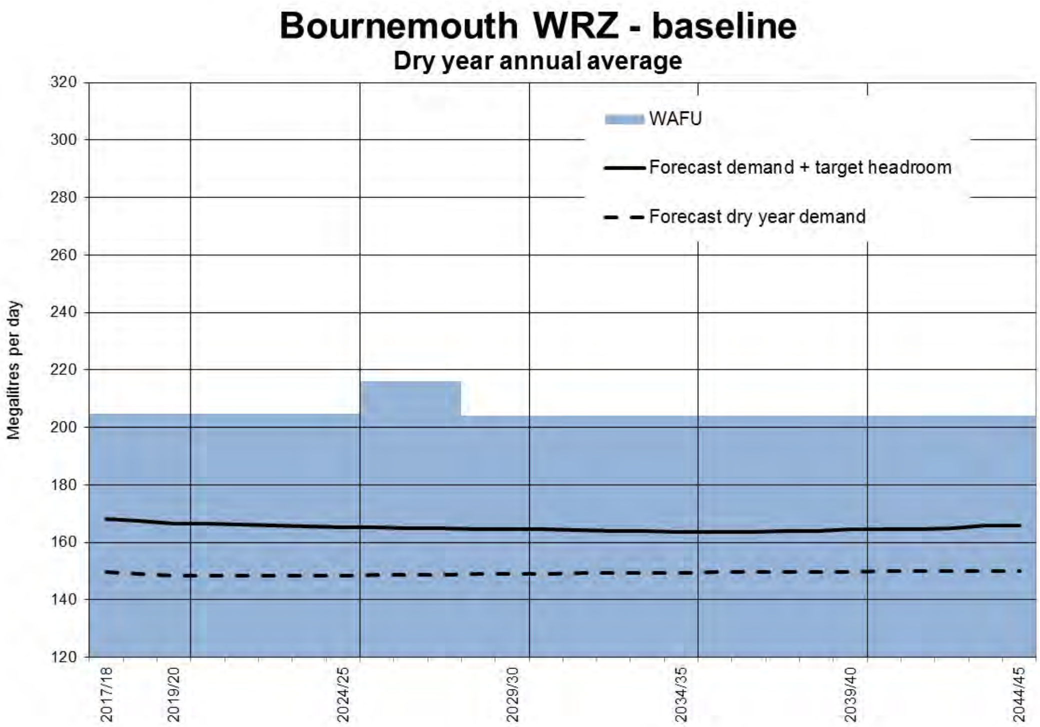
The surplus position in the near term shows there are no significant immediate concerns in the base case. With the exception of Roadford, the lowest cost solution in all zones would be for no intervention.

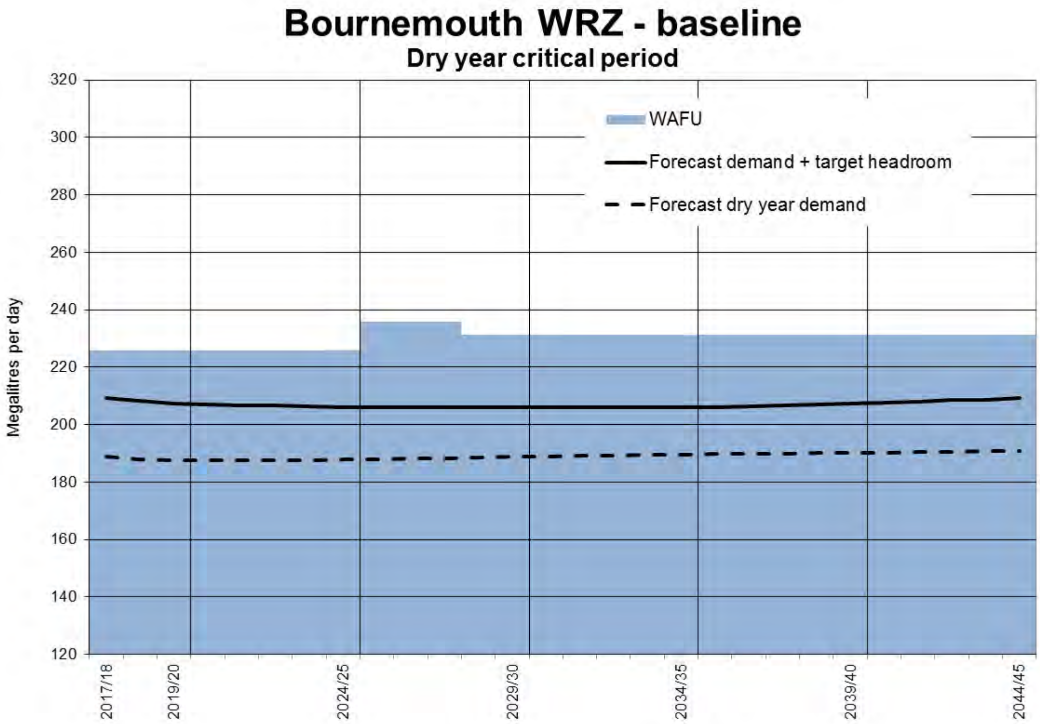
Figure C: Baseline supply demand forecasts






Wimbleball WRZ - baseline
Dry year annual average
Megalitres per day
200
180
160
140
120
100
80
60
40
20
0
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45
WAFU
Forecast demand + target headroom
Forecast dry year demand


Bournemouth WRZ - baseline
Dry year annual average
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45
WAFU
Forecast demand + target headroom
Forecast dry year demand



Understanding the options

We have costed and assessed possible water resource, water transfer, leakage and water efficiency options that could be implemented for any supply demand deficit.

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 in the near term, 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. This was then used with the customer and stakeholder feedback on our Draft Plan.

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 have some sensitivity 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

Modelling was 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 C. Each scenario was compared to the baseline 'do nothing' scenario as a reference.

The results showed:

- Where the scenarios show we have a shortfall between supply and demand, solutions based on leakage reduction perform well
- Water resource based solutions can have higher overall cost than demand management options and are less flexible, but they have greater cost certainty and perform better on improved resilience

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

- Customer support for leakage reduction is high. Leakage rates using willingness to pay were cost beneficial in the range:
    - SWW: 57-65 Ml/d
    - BW: 16-19 Ml/d

  These are consistent with the findings from the Draft Plan. However, large short-term reductions in leakage would lead to significant bill increases in AMP7
- A 15% reduction in leakage by 2025 was the favoured solution by stakeholders and customers in the feedback on the Draft Plan and performs better than a plan with no intervention
- There is water available in the Bournemouth WRZ which could be used to supply Southern Water

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. This also helps deliver wider objectives such as achieving water neutrality.

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	● 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	● green	● green	● green	● green	● green	● green	● green
4b	Demand only plan	● green	● green	● green	● green	● green	● green	● green
4c	PCC @ 100 l/p/d	● green	● green	● green	● green	● green	● green	● green
4d	PCC @ 86 l/p/d	● green	● green	● green	● green	● green	● green	● green
4e	PCC @ 62 l/p/d	● green	● green	● green	● green	● green	● green	● green
5a	Southern Water transfer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5b	Environmental needs (best case)	● green	● green	● green	● green	● green	● amber	● amber
5c	Environmental needs (worst case)	● green	● green	● green	● amber	● amber	● amber	● amber
6a	Leakage consistency measures	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6b	PR19 methodology (15% leakage reduction)	● green	● green	● green	● green	● green	● green	● green
6c	15% leakage reduction (final costs)	● green	● green	● green	● green	● green	● green	● green
6d	NIC recommendation	● 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	● amber

Note: green = no supply demand deficit; amber = small supply demand deficit (<3%); red = large supply demand deficit (>3%)

b) Roadford WRZ

Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	🟢	🟢	🟢	🟡	🟡	🟡	🟡
2	Customer willingness to pay	🟢	🟢	🟢	🟢	🟢	🟢	🟢
3a	Plausible droughts (4 droughts)	🔴	🔴	🔴	🔴	🔴	🔴	🔴
3b	1 in 200 year drought	🟢	🟢	🟢	🟡	🟡	🟡	🟡
4a	Resource only plan	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4b	Demand only plan	🟢	🟢	🟢	🟡	🟡	🟡	🟡
4c	PCC @ 100 l/p/d	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4d	PCC @ 86 l/p/d	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4e	PCC @ 62 l/p/d	🟢	🟢	🟢	🟢	🟢	🟢	🟢
5a	Southern Water transfer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5b	Environmental needs (best case)	🟢	🟢	🟢	🟡	🔴	🔴	🔴
5c	Environmental needs (worst case)	🟢	🟢	🟢	🔴	🔴	🔴	🔴
6a	Leakage consistency measures	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6b	PR19 methodology (15% leakage reduction)	🟢	🟢	🟢	🟢	🟢	🟢	🟢
6c	15% leakage reduction (final costs)	🟢	🟢	🟢	🟢	🟢	🟢	🟢
6d	NIC recommendation	🟢	🟢	🟢	🟢	🟢	🟢	🟢
7a	High household demand	🟡	🟡	🟡	🔴	🔴	🔴	🔴
7b	High non-household demand	🟢	🟢	🟢	🟡	🟡	🟡	🟡

Note: green = no supply demand deficit; amber = small supply demand deficit (<3%); red = large supply demand deficit (>3%)

c) Wimbleball 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)	● amber	● amber	● amber	● red	● red	● red	● red
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	● amber
4c	PCC @ 100 l/p/d	● green	● green	● green	● green	● green	● green	● green
4d	PCC @ 86 l/p/d	● green	● green	● green	● green	● green	● green	● green
4e	PCC @ 62 l/p/d	● green	● green	● green	● green	● green	● green	● green
5a	Southern Water transfer	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5b	Environmental needs (best case)	● green	● green	● green	● amber	● amber	● amber	● red
5c	Environmental needs (worst case)	● green	● green	● green	● red	● red	● red	● red
6a	Leakage consistency measures	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6b	PR19 methodology (15% leakage reduction)	● green	● green	● green	● green	● green	● green	● green
6c	15% leakage reduction (final costs)	● green	● green	● green	● green	● green	● green	● green
6d	NIC recommendation	● green	● green	● green	● green	● green	● green	● green
7a	High household demand	● green	● green	● amber	● amber	● amber	● amber	● red
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%)

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 (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	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4b	Demand only plan	Green	Green	Green	Green	Green	Green	Green
4c	PCC @ 100 l/p/d	Green	Green	Green	Green	Green	Green	Green
4d	PCC @ 86 l/p/d	Green	Green	Green	Green	Green	Green	Green
4e	PCC @ 62 l/p/d	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	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6b	PR19 methodology (15% leakage reduction)	Green	Green	Green	Green	Green	Green	Green
6c	15% leakage reduction (final costs)	Green	Green	Green	Green	Green	Green	Green
6d	NIC recommendation	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 C: Overview of multi-criteria scoring of sensitivity analyses

Ref	Theme	Scenario title	Final Plan C	R	W	B	Total	Draft Plan total
1a	Baseline	Baseline	24	24	24	24	96	96
2	Customer preferences	Customer willingness to pay	24	24	24	25	97	97
3a	Resilience	Plausible droughts	24	22	26	24	96	100
3b	Resilience	1 in 200 year drought	24	24	24	24	96	96
4a	Long-term balance	Resource only plan	28	29	28	0	85	85
4b	Long-term balance	Demand only plan	27	28	25	24	104	104
4c	Long-term balance	PCC @ 100 l/p/d by 2045	25	25	25	25	100	-
4d	Long-term balance	PCC @ 86 l/p/d by 2045	24	24	24	24	96	-
4e	Long-term balance	PCC @ 62 l/p/d by 2045	24	24	24	24	96	-
5a	Environment and markets	Southern Water transfer	-	-	-	28	28	28
5b	Environment and markets	Environmental needs (best case)	30	26	24	24	104	108
5c	Environment and markets	Environmental needs (worst case)	28	24	20	24	96	-
6a	Data	Leakage consistency measures	-	-	-	-	-	-
6b	Data	PR19 methodology (15% leakage reduction)	25	24	26	25	100	100
6c	Data	15% leakage reduction (final plan costs)	28	28	28	26	110	-
6d	Data	NIC recommendation	21	21	21	21	84	-
7a	Demand uncertainty	High household demand	30	29	24	24	107	111
7b	Demand uncertainty	High non-household demand	28	24	24	24	100	96

Note: for a given scenario, the scores may differ in each WRZ. This is because the impacts of the scenario can affect each WRZ differently. C = Colliford WRZ; R = Roadford WRZ; W = Wimbleball WRZ; B = Bournemouth WRZ, Draft Plan total = Draft Plan equivalent score

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. We have included the feedback from the Draft Plan consultation in this Final Plan.

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 D. 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 132; this compares to 96 for the baseline plan (see Table E). This is an improved performance to the Draft Plan which had a score of 121. 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 - £46m over the planning period.

Short-term plan (2020-2025)

The proposed plan is to undertake a series of 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 15% from 2020 levels** – following feedback on the Draft Plan we have increased the level of leakage reduction from 8% by 2025 to 15% based on Ofwat's Draft Determination definition. 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. 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. Performance of leakage reduction will be measured in line with the PR19 Final Determination methodology.
  - **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 in demand growth and environmental needs.
  - **Help customers reduce their water use** – following feedback on our Draft Plan we have increased the focus on water efficiency. We will 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 127 l/p/d by 2025 (133l/p/d dry year equivalent). We will also support the tourism sector with a targeted programme for water efficiency. Performance of our reduction in PCC will be measured in line with the PR19 Final Determination.
  - **Continue to increase meter penetration** – following feedback on our Draft Plan we have increased the focus on water efficiency with the aim of installing meters on all unmeasured properties and giving customers a choice to switch through dual billing. We will 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. We will also keep under review the any changes in the integrity of our Resource Zones as part of the annual review.
  - **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. 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. We would also do more detailed costings of other feasible options and this would include a natural capital assessment. This will be done in conjunction with the development of the new Regional Water Resource Plans due in the 2020-2025 period.
- **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.
- **Explore opportunities for an Abstraction Incentive Mechanism (AIM) scheme in Bournemouth WRZ** – following feedback on our Draft Plan we have included activity to examine the opportunity for an AIM scheme in the Bournemouth WRZ.

The plan we propose pushes our performance in a number of key areas. The proposed combination of activities 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
- Strong 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, and links directly to the development of Regional Water Resource Plans.

Bournemouth WRZ to Southern Water Transfer

Our Draft Plan showed there was a potential opportunity for a 20 Ml/d transfer to Southern Water subject to removal of Water Treatment Works infrastructure constraints. Our 2019 Periodic Review Business Plan includes investment in new Water Treatment Works which makes the potential transfer to Southern Water viable without placing the Bournemouth WRZ into deficit.

This option is included as a potential scheme in the Southern Water Water Resource Management Plan. This Final Plan includes this transfer as part of our strategy.

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. This will be taken forward through the regional West Country Water Resources planning group.

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 it again at our next update in 2025.

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

- **<u>Reduce leakage and the future demand for water</u>**
  - **Reduce leakage further** – continue to reduce leakage in the long-term to 72 Ml/d in SWW and 18 Ml/d in BW or meet external policy targets. This is consistent with customers' willingness to pay to reduce leakage.
  - **Continue to help customers reduce water consumption** – continue rollout of meters to ensure meters are replaced when at end of life and continue water efficiency support to help customers reduce the demand for water.
- **<u>Optimise our use of water resources and ensure we are resilient to future droughts</u>**
  - **Continue to ensure our assets can perform as needed during drought conditions.**
- **<u>Develop our planning tools and understanding of future options</u>**
  - **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

A 'do nothing' plan in the short term 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 Final 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 – especially for the Roadford WRZ. These will help future decision making. Water resource options can act as a contingency should they be needed in the future if, for example, leakage and demand reduction do not achieve the benefits expected – particularly in the Roadford Zone where the updated sensitivity analysis in this Final Plan further affirms the risks identified in the Draft Plan.

The Final 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 Plan and our approach to developing it were regularly presented at the company Customer Challenge Group (CCG) with comments and feedback brought into the process.

Development of the Plan 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 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 and protecting vulnerable customers.

External assurance was completed on the Draft Plan by CH2M and all the relevant comments from the consultation feedback have been incorporated in this Final Plan. For the

Final Plan we updated the self assurance using the Environment Agency checklist and Senior Management review as there were no material changes to the supply demand problem or the activity in the strategy other than the additional leakage and water efficiency activity requested by customers and stakeholders.

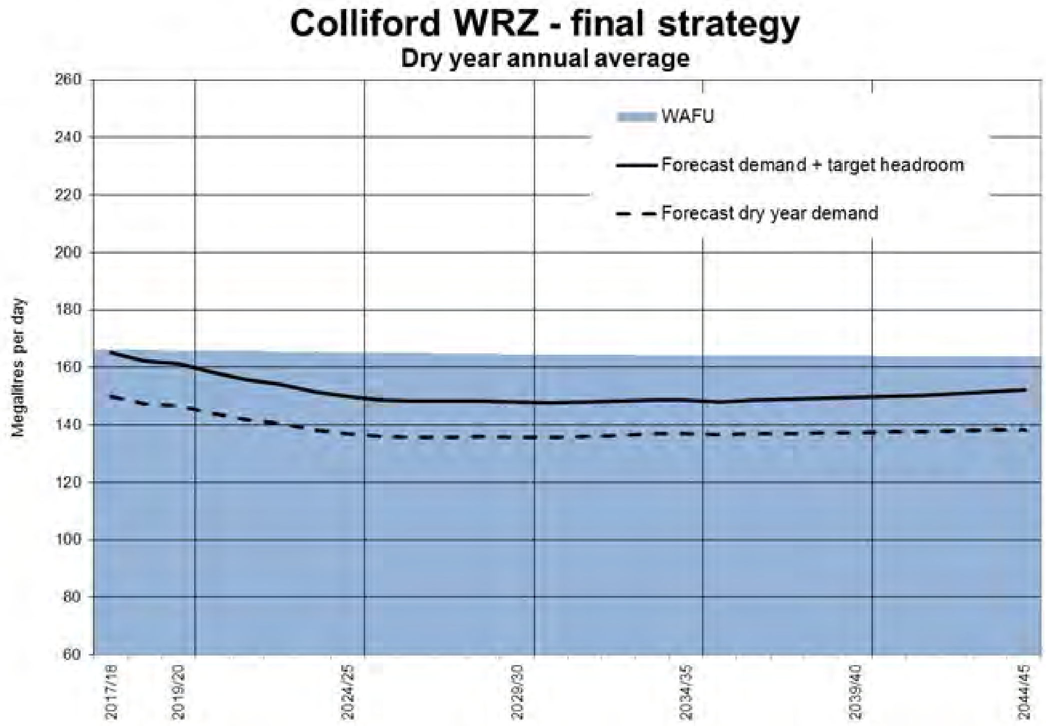
Table D: Summary of water resource strategy and plan

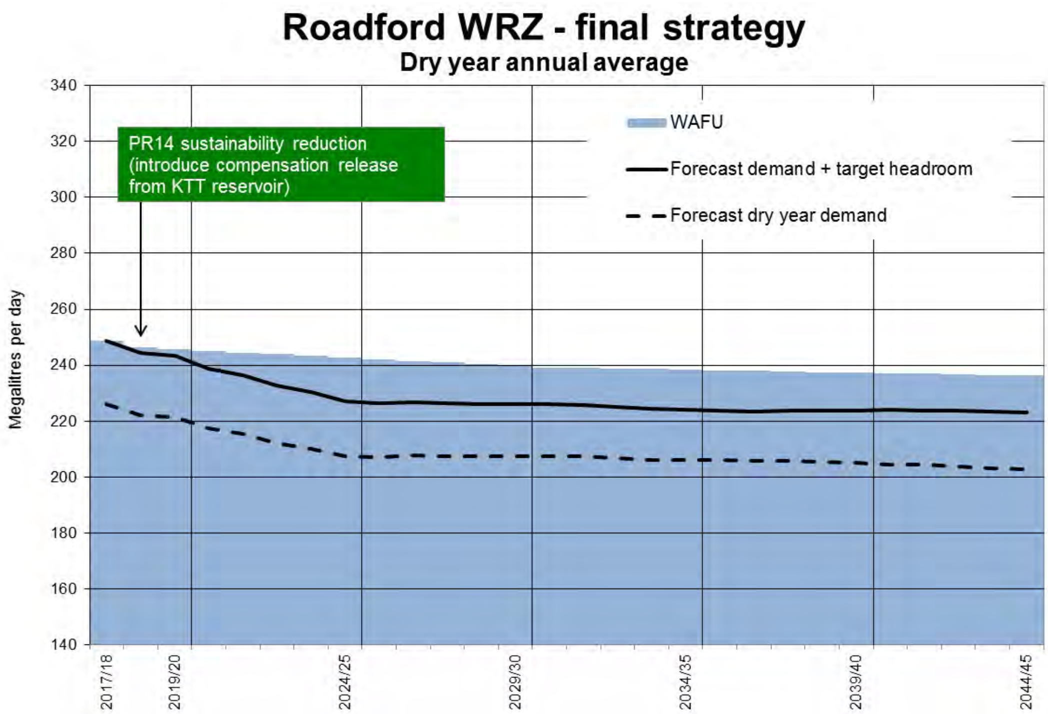
Strategy	Why	Short-term (2020-2025)				
		Resources	Leakage	Demand management	Transfers	Other
Reduce leakage and the future demand for water	Low cost options to manage future risks Consistent with customer preferences Consistent with Government and regulatory policy	-	Reduce leakage by 15% from 2020 to 2025	Support customers to reduce overall average per capita consumption to 127 l/p/d (133l/p/d dry year) or less 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 with a view to giving all customers the option of a metered bill by 2025 Reduce our consumption of water at 5 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	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 that demand savings are less than expected	High level feasibility study on a Roadford pumped storage scheme*. This will include natural capital assessment Undertake a feasibility study on a possible water transfer to Southern Water	-	Increase understanding of potential demand management savings in drought conditions Investigate opportunity for a Bournemouth WRZ AIM scheme	Support the development of the new Regional Water Resources Management Plans Continue to develop the 20 Ml/d transfer to Southern Water	Develop uncertainty based demand forecasts Produce new financial decision making tools Produce annual outage report

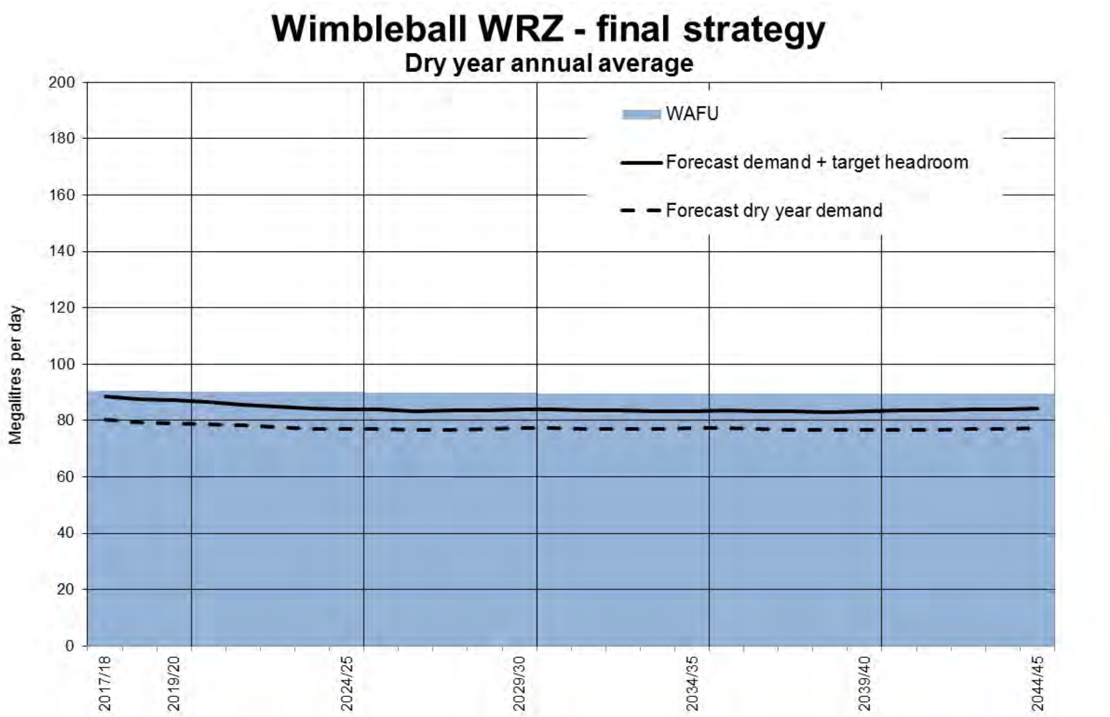
** For the avoidance of doubt this is not a promotion of this scheme.*
*** inc. Slade reservoir, Challacombe, Brampford Speke, WImborne*

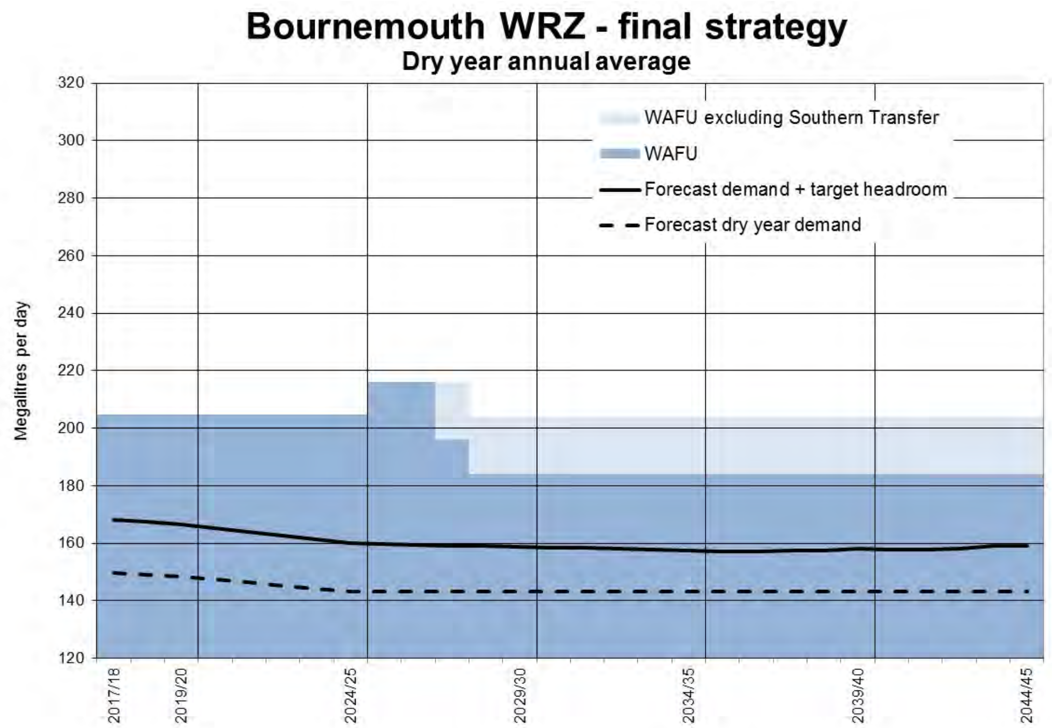
Strategy	Why	Medium to Long-term (2025-2045)				
		Resources	Leakage	Demand management	Transfers	Other
Reduce leakage and the future demand for water	Lowest cost options to manage future risks Consistent with customer preferences Consistent with Government and regulatory policy	-	Reduce leakage by c25% by 2045 or meet external policy targets	Continue to promote water efficiency and metering, reducing normal year PCC to 120 l/p/d (125 l/p/d in a dry year) or less or meet external policy targets	-	-
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 that 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 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
Megalitres per day
WAFU
Forecast demand + target headroom
Forecast dry year demand
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Bournemouth WRZ - final strategy
Dry year annual average
Megalitres per day
WAFU excluding Southern Transfer
WAFU
Forecast demand + target headroom
Forecast dry year demand
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

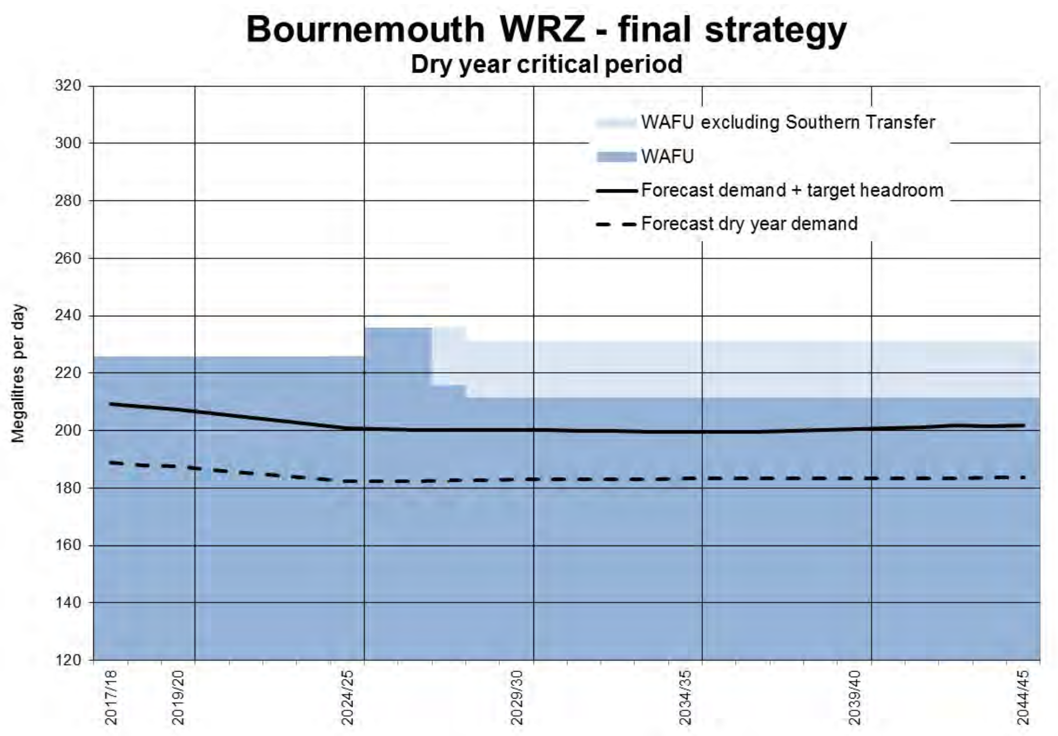


Table E: Overall Draft Plan performance

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
8b	Final Plan	Final Plan	33	33	33	33	132

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.

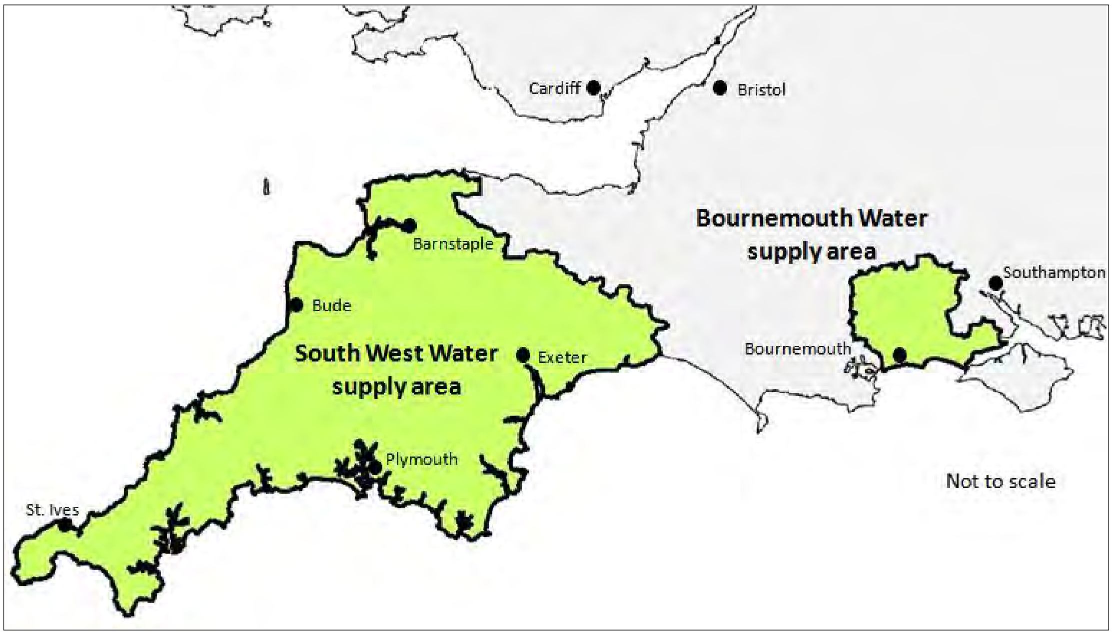
SWW provides drinking water to a population of 1.7 million across Devon and Cornwall and parts of Dorset and Somerset (SWW supply area) and since our merger with BW in 2016, we also supply approximately 0.45 million customers in the Bournemouth area (BW supply area).

Within the SWW supply area, we provide on average about 445 million litres of water each day (445 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, which covers parts of Dorset, Hampshire and Wiltshire, we provide on average 145 million litres of water each day (145 Ml/d). The water resources in this area are principally river abstractions, supported by groundwater sources.

Our total water supply area is presented in Figure 1.1.

Figure 1.1: Our water supply areas



In April 2020 we will become responsible for the water supply of the Isles of Scilly. Ofwat has confirmed that the development of a water resources plan for the islands does not need to be included in this Plan, but this will be undertaken and included in future updates of the Plan. Further information is provided in Appendix 12.

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 centred 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 BW 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 resource 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 WRMP 1. BL Licences 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 (WTW), 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. 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

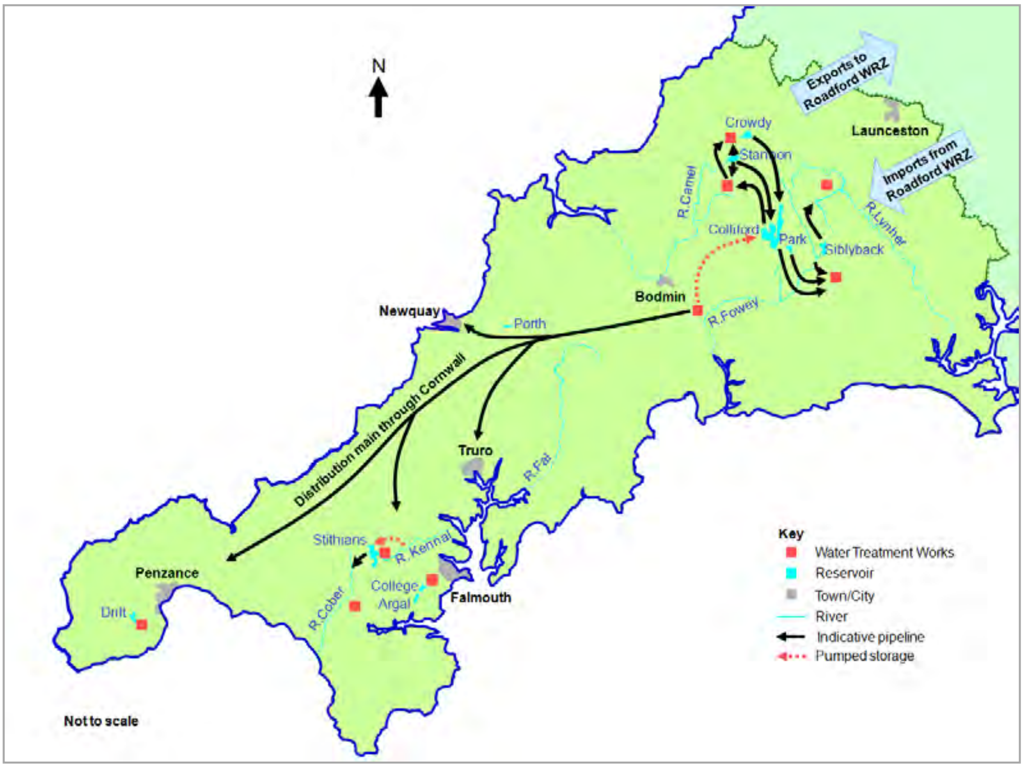


Figure 1.5: Colliford Reservoir

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 bulk transfers between the neighbouring Colliford and Wimbleball WRZs.

We release water from these reservoirs within this zone to either directly supply WTWs, or supplement flows in the local river system to support abstractions further downstream.

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

Figure 1.6: Key components of Roadford WRZ

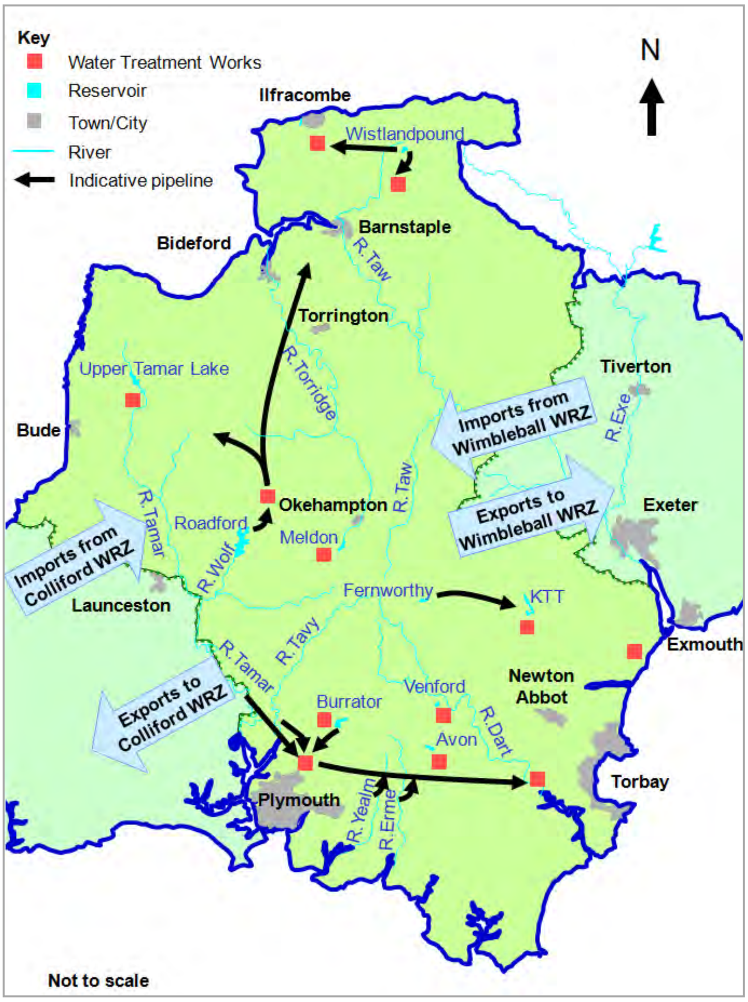


Figure 1.7: Roadford Reservoir

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 over the winter months.

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

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

Figure 1.8: Key components of Wimbleball WRZ

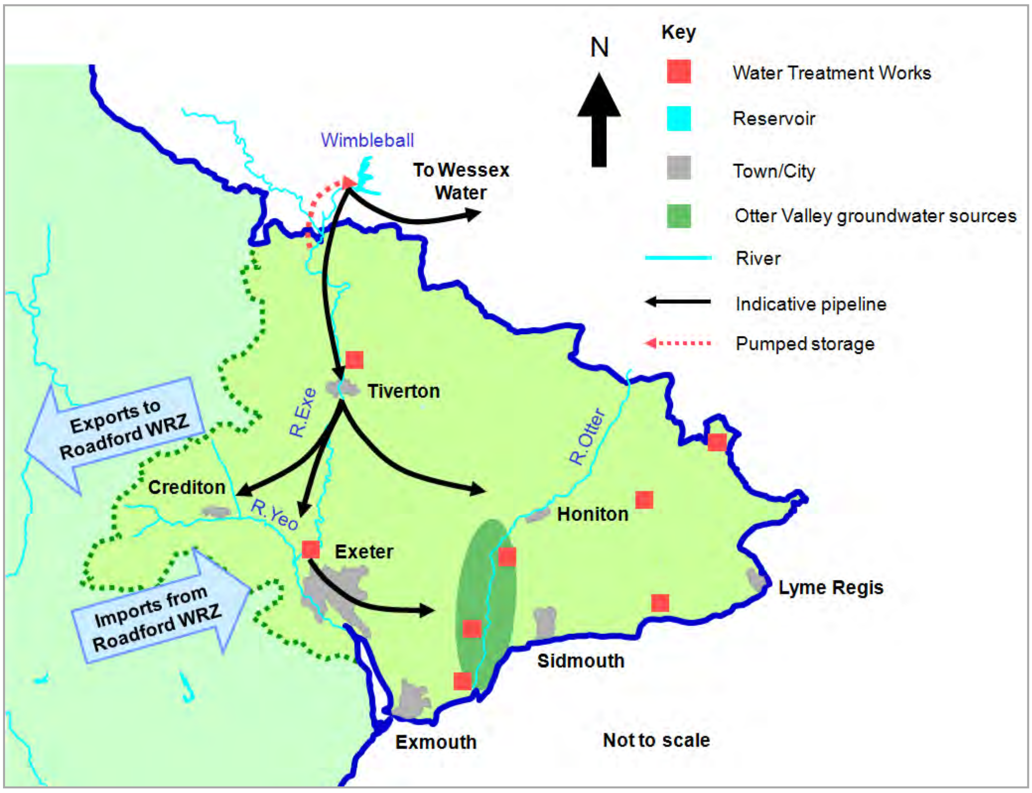


Figure 1.9: Wimbleball Reservoir

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. Figure 1.11 shows the River Stour in Dorset.

Figure 1.10: Key components of Bournemouth WRZ

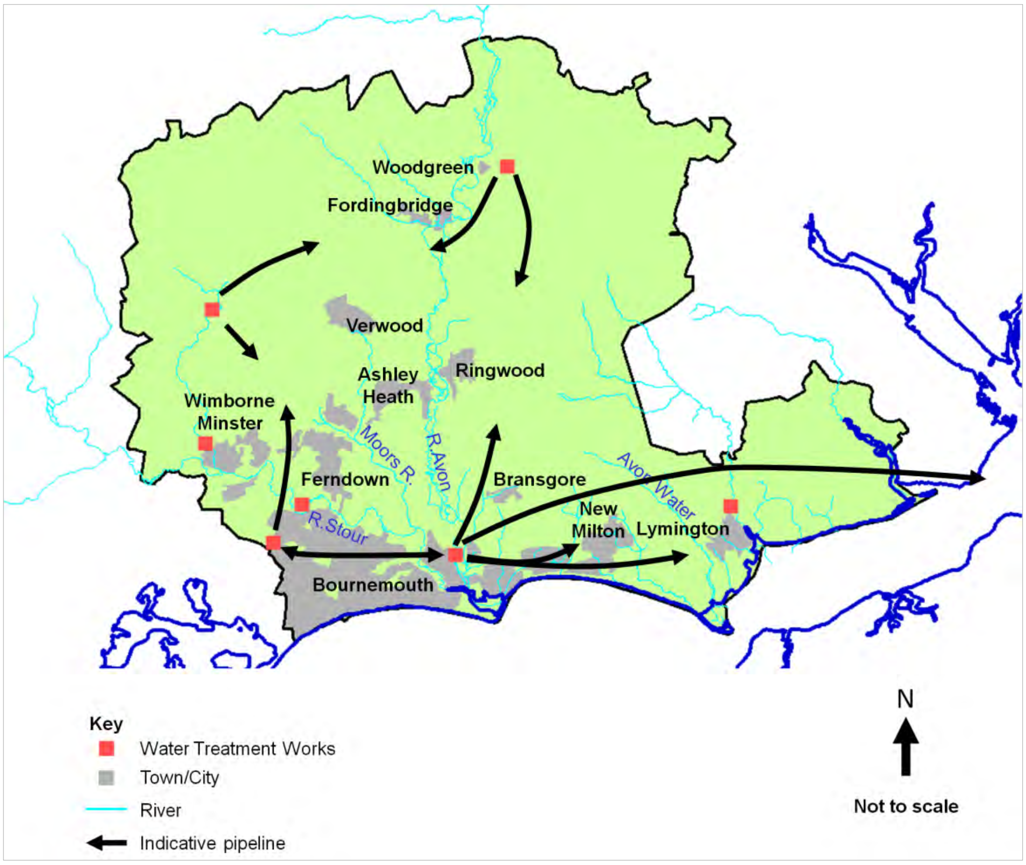


Figure 1.11: River Stour (Dorset)

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 BW 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.

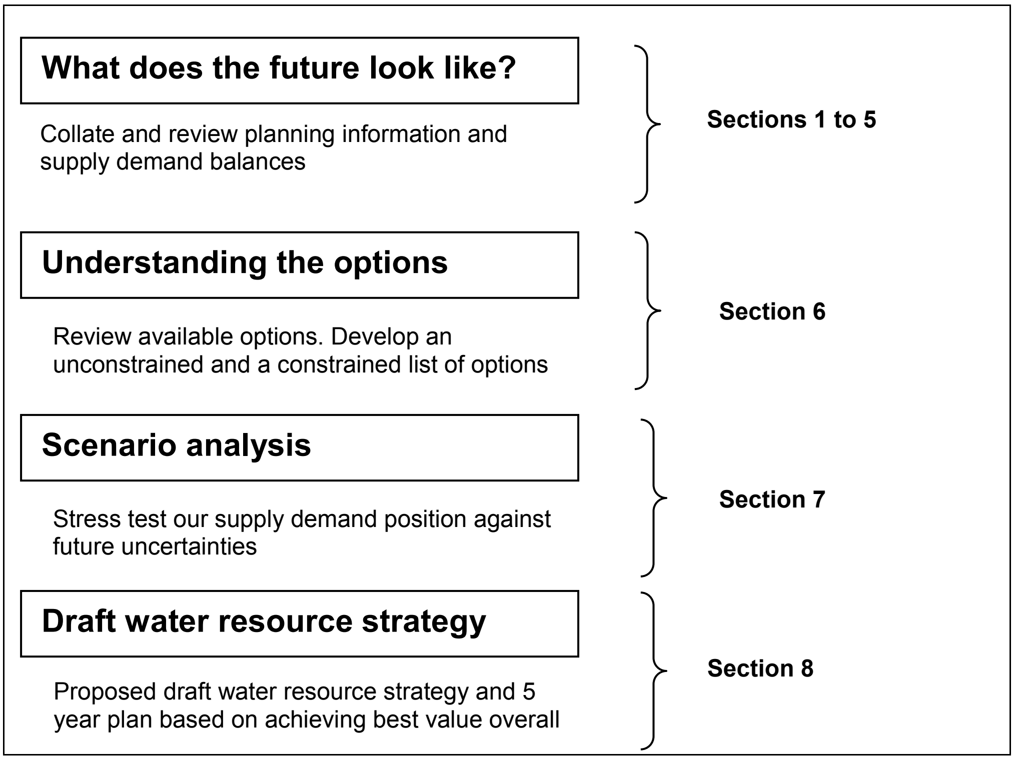
Our WRZ assessment confirmed that there are no changes to our WRZs in both supply areas from those used in our previous WRMP (2014)[1.7].

[1.5] *Ibid. 1.1*
[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. 1.3*

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



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 details.

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 (SWW and BW) are currently 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).

Using 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 Drought resilience statement

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 Water Available For Use (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:

- SWW WRZs – dry year annual average (DYAA)
- Bournemouth WRZ – dry year annual average (DYAA) and dry year critical period

In the SWW supply 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 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 produced.

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 were submitted in the PR19 Business Plan in September 2018.

Performance commitments in areas such as leakage, per capita consumption and drought resilience in this Plan were included in 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 will 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 result in corresponding changes to the forecasts in the WRMP.

1.6.2 Strategic Environmental Assessment and Habitats Regulations

Government expectations are for water companies 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 Plan 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 BW supply areas (see Section A.1.3). On this basis, there are no further requirements for specific work as part of this Plan relating to a 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 SWW and BW 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). Within 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
- Consider every option to meet public water supply needs
- Protect and enhance our environment, acting collaboratively
- Promote efficient water use and reduce leakage

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

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 WRMP development 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 for 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 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.

1.6.7 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 our network following the Water Act 2014.

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

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 WRMP.

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.

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

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

Table 1.1: 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)[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 our historic design drought (1975/76), being at least 1 in 40 years in our SWW supply area WRZs and at least 1 in 100 years in BW supply area.
[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 WRZs do not currently enter the Zone C of our drought triggers based on our worst historic 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 the development of new groundwater 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.

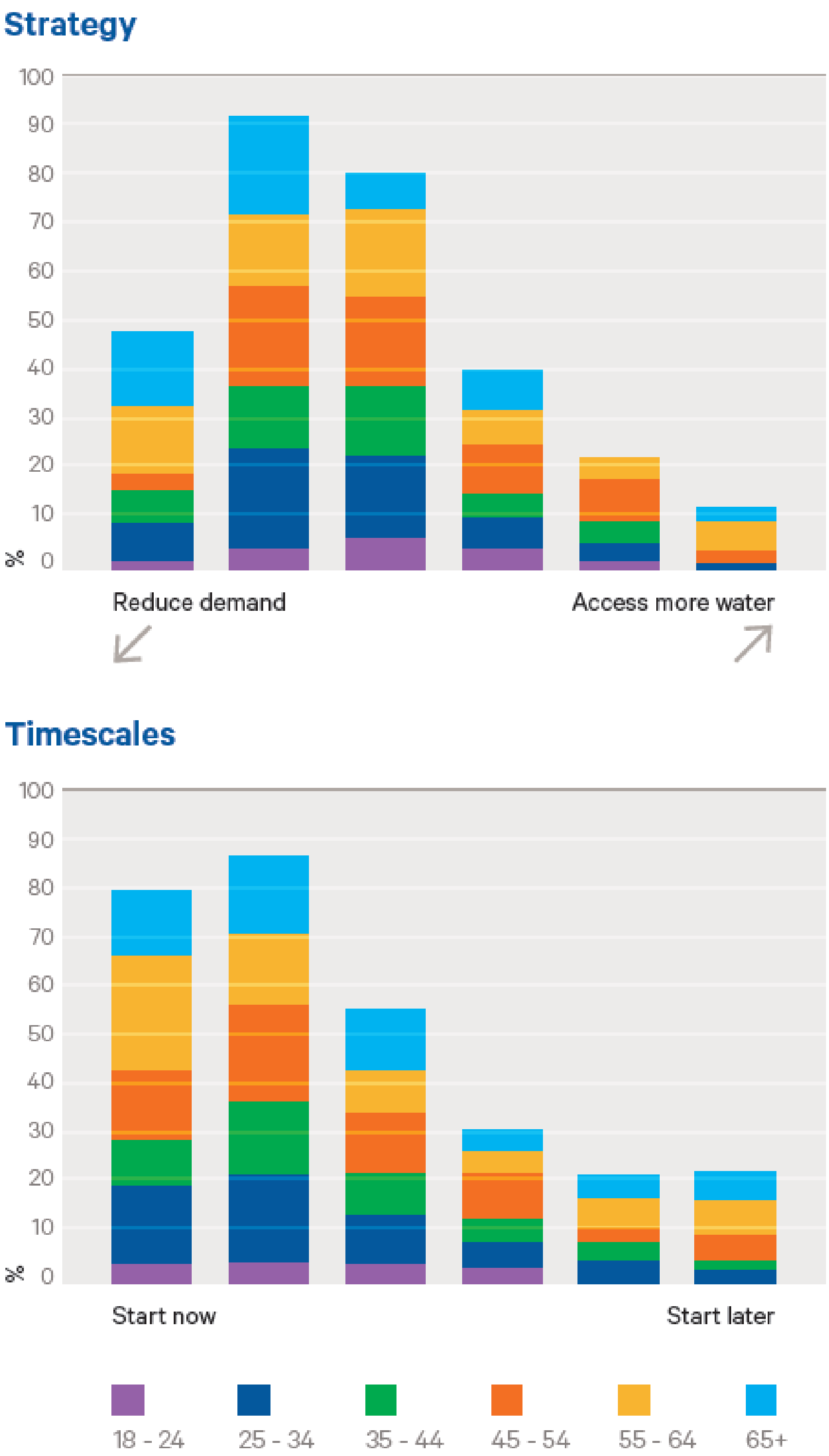
This was well received by customers and the greater reach and data richness of this approach to normal surveys gave further insight into how customers would like us to develop our plans.

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 Plan. This included stakeholders across both the SWW and BW supply areas. It also set out the timings for the publication of our Plan.

One response was received from Devon County Council and one response was received from the Environment Agency. Their comments and feedback have been incorporated into our Plan.

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

We also helped initiate a new 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 to understand opportunities for water trading. The Terms of Reference are given in Section A.1.7.3.

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 WRZ 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, a strong supply demand position in the South West historically has meant previous plans have not had any controversial schemes or any significant supply risk to resolve. However, for this Plan 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 Customer Challenge Group, 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 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 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 Environment Agency 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 Environment Agency 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 modelling was used to determine resources deployable output
- The modelling 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 abstraction 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 allowance 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 (AIM) scheme

2.1 General information

In developing our water supply forecast we show our supply of water in the base year (2017/18) and what it is likely to be throughout the planning period (i.e. 2017/18 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, for example changes to abstraction licences, infrastructure and the impacts of climate change.

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 (i.e. the SWW supply area) and for both the dry year annual average 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 less complex 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. We discuss this in Section 1.6.4. For example, long-term storage drawdowns for each of our strategic reservoirs were generated from historic river flows for our Drought Plan. They are also critical to our WRMP in relation of our levels of service assessment and plausible drought analysis. These are provided in Section A.2.6.

As specified in the Environment Agency guideline[2.4], 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 DO assuming our planned level of service as set out in Section 1.8 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.

[2.4] *Ibid. 2.3*

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.

2.2 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 (i.e. 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. All our WTWs are included, as well as the treated water distribution network 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

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[2.5] See Section 2.7 for definition of WAFU
[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

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tourism and warm dry weather during summer months, amongst other factors. 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 whilst meeting our standard levels of service.

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 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 e.g. 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 Environment Agency, to investigate if the dry conditions experienced within the period of the reliable flow record are representative. The work indicated that the SWW 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 dry year annual average DO and dry year critical period 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 hindcast 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 historic recorded flow period as mentioned above.

[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

2.2.4 DO assessment

We have assessed DO for each of our WRZs 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 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 6.2.1.2.

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 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 Reservoir does not refill in 1976 and for a number of years thereafter.

2.2.6.5 Constraint on 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

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[2.12] *Ibid. 2.10*
[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. 2.10*

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:

- Saltash transfer from Roadford WRZ to Colliford WRZ
- Treated water transfers between Roadford WRZ and Wimbleball 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 2,132 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

[2.16] *Ibid. 2.13*
[2.17] *Ibid. 2.14*
[2.18] *Ibid. 2.10*
[2.19] *Ibid. 2.13*
[2.20] *Ibid. 2.14*

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:

- Wessex Water abstractions from Wimbleball Reservoir for direct piped transfer
- Treated water transfers between Roadford WRZ and Wimbleball WRZ
- Tiverton to North Devon transfer from Wimbleball WRZ to Roadford WRZ
- 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 <u>DOs for our WRZs (baseline profile without reductions)</u>

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 2017/18 per WRZ. These DO figures include sustainability reductions that came into effect before 2017/18, but do not include any other reductions to the baseline DO. These reductions are discussed in Section 2.3.

Table 2.1: Baseline DOs (baseline profile without reductions) for the 2017/18 base year in each WRZ

Submission	Baseline DO (2017/18) in each WRZ (Ml/d)				
	Colliford DYAA	Roadford DYAA	Wimbleball DYAA	Bournemouth DYAA	Bournemouth DYCP
WRMP14	158.76	254.39*	103.61	230.30	268.43
WRMP19	166.68	253.54*	104.25	226.13	249.32

** with sustainability reductions that came into effect before 2017/18*

The differences 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 demand 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. Also, as part of the system modelling to determine WAFU/DO, 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.

In Roadford WRZ, these demand changes, together with sustainability reductions that came into effect in 2016/17, have resulted in a slight decrease 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 WRMP19. 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 2018 significant environmental monitoring and analysis has 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. We will be working with the Environment Agency to identify the environmental impact of all current SWW abstractions in the Otter Valley and identifying the best licensing strategy to ensure compliance with River Basin Management Plan (RBMP) objectives including Good Ecological Status (GES) for 2027.

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 has provided water companies with information on actions that companies need to complete to contribute towards meeting environmental obligations. The latest release of WINEP (WINEP3) includes information on measures which could impact on DO.

WINEP3 has identified a number of studies or improvements at some of our surface water abstraction intakes to assist fish passage and fish screening. We have taken 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 which will result in no impact on DO.

The Environment Agency has not included some currently disused abstraction sites in WINEP3, even though they could pose a risk of deterioration if recommissioned. However, as these sites do not currently contribute DO to our baseline water resources balance there is no potential impact on our estimates of DO.

For our area, WINEP3 has not identified any required changes to our abstraction licences in the 2020 - 2025 period 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, WINEP3 has identified a number of sites which require further investigation in the 2020 - 2025 period 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 have taken account of these schemes in the preparation of

[2.21] *Ibid. 2.3*

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.

Table 2.2: Water resources schemes identified in WINEP3

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 have been 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 pumped 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	-

We believe that the above actions support the WFD and River Basin Management Plans (RBMPs) 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 and are proposing further revocations in early 2019.

All actions identified in the 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 DO 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 DO.

2.3.4 Abstraction Incentive Mechanism (AIM)

There are currently no AIM schemes within the SWW or BW 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 Environment Agency River Basin Management Plan (RBMP) 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 SWW supply area, we consider that if an appropriate scheme could be found we should trial its operation. Similarly, although no current AIM scheme exists in our BW supply area, we are actively investigating the potential for such a scheme in this supply area.

[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 DO of our resources by the 2080s. In doing so, we have followed the Environment Agency guideline[2.24] 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 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
- 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 guideline[2.26]. 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 output from the Met Office Regional Climate Model (HadRM3-PPE), the FFGWL

[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

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 Future Flows daily river flow time series were used to produce 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). Most 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 DO from these sources is considered insignificant. This was confirmed in the latest modelling, which is described in Section A.2.1.

AMEC Foster Wheeler Ltd (previously ENTEC and now WOOD) 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 guideline[2.30].

Otter sandstone

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

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

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. Reduced spring flows due to climate change are estimated to have an impact on DO of between 0.8 and 1.6 Ml/d.

Saline intrusion risk

We specifically commissioned AMEC Foster Wheeler Ltd 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 Environment Agency 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 DO ranging from 2.5 to 3.1 Ml/d. Whilst the predictions of recharge show high variability from scenario to scenario, the assessment of the underlying impact of rising sea levels always results in reductions in DO.

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 scenarios. 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 DO, 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 the 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 alternative 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 in WAFU as a result of climate change by the 2080s (%)
Colliford	3.0
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 Environment Agency scaling 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 Environment Agency scaling method from the start of the planning period gives a WAFU estimate for 2017/18 of 243.9 Ml/d. Using the WRMP14 scaling method gives a WAFU estimate for 2017/18 of 248.9 Ml/d. We feel that it is more appropriate to use the WRMP14 scaling method because it provides a more gradual move to the climate change projection than using the Environment Agency 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 3.4.5. and 3.5.5.

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 modelling of water supply forecasts, 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 scheme 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 modelling, for example our new water treatment works for Plymouth (Mayflower WTW). The new treatment works is 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 Bournemouth WRZ we are working with Southern Water to develop an option for a Bournemouth WRZ to Southern Water transfer. Currently, whilst the water is available hydrologically, we have WTWs output limitations that would restrict such a transfer in a drought. Improvements at key WTWs are included in our PR19 Business Plan and the benefits of these improvements to WAFU in Bournemouth WRZ will make water available for such a transfer, provided suitable infrastructure changes can be implemented.

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 and 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		WRMP19	
	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

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

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 our Bournemouth WRZ 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 (WINEP3). This work area examines our companywide approach, of which our WRMP is an integral component.

Figure 2.1: SWW supply area with sites identified that may have a significant INNS risk

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 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[2.39] 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.

[2.39] South West Water (2015), *Drinking Water Safety Planning (DWSP) Methodology Update 2015*

For example, in our SWW 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 WRZ, we have carried out detailed investigations as part of the National Environment Programme to identify the factors contributing to the risk of *Cryptosporidium* 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 DO, 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 Resources Planning guidelines[2.42,2.43], the Environment Agency WRMP19 methods paper[2.44] and supporting guidance in the UKWIR WR27 DO 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 outage events experienced at individual sources/WTWs 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 WTWs. 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.

[2.40] *Ibid. 2.3*
[2.41] *Ibid. 2.1*
[2.42] *Ibid. 2.3*
[2.43] Environment Agency (2012), *Water Resources Planning Guideline*.
[2.44] *Ibid. 2.2*
[2.45] *Ibid. 2.13*

2.6.1 Outage Categories

The outage categories adopted for the analysis covering all four WRZs 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 spate.

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

The outage values taken forward into SWW's supply demand balance analysis for WRMP19 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 compares the current level of outage assessed with that from the previous WRMP for both the SWW and BW supply areas.

Table 2.8: Outage allowance at the 95th percentile - comparison with previous results

Submission	Outage allowance at the 95th percentile, DYAA (Ml/d)	
	SWW supply area	BW supply area
WRMP14	7.00	5.58
WRMP19	6.84*	1.93

**For WRMP19, 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 SWW supply area WRZs is in line with that identified in our last plan. However, in Wimbleball WRZ, of the three specific types of outage associated with groundwater sources that were previously included in the outage calculation for this 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 WTWs.

2.6.4 Improving our understanding 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 WTW outage events. The WTW Reliability Tracker (Section A.2.2.2) which has been under development and partly operational since early 2017, captures daily events by type, duration and impact on WTW 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 2017/18 base year in each WRZ

WRZ	Baseline WAFU (2017/18) (Ml/d)	
	WRMP14	WRMP19
Colliford	157.62	166.20
Roadford	248.01	248.88
Wimbleball	89.14	90.47
Bournemouth DYAA	211.08	204.84
Bournemouth DYCP	246.96	225.77

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

In the SWW supply area the changes in WAFU between WRMP14 and WRMP19 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 WRMP19.

In the Roadford and Wimbleball WRZs there has been very little change in WAFU between WRMP14 and WRMP19. 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. Also, 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.

In the BW supply area both the DYAA and DYCP WAFU have decreased between WRMP14 and WRMP19. 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. 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. Improvements at key WTWs in the BW supply area are included in our PR19 Business Plan. These improvements will remove these infrastructure constraints and hence increase WAFU.

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 can 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, because 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, water resources systems in the Colliford, Roadford and Wimbleball WRZs are not particularly sensitive to peak demand. 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 (2017/18). A water balance is completed each year. This includes an assessment of the amount of water that we output from our WTWs, 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 WTWs leaves a residual. This must be accounted for to produce robust estimates for future forecasts.

To account for the residual (termed the 'water balance gap', or WBG) and reconcile our estimates of demand with WTW 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 redistributed 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 WBG for 2017/18 of 8.62 Ml/d has been redistributed as shown in Table 3.1. Bournemouth Water's WBG was 2.70 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	153.94	1.00	154.94
Unmeasured household consumption	74.19	1.94	76.13
Measured non-household consumption	81.13	0.53	81.66
Unmeasured non-household consumption	1.87	0.06	1.93
Leakage	101.03	1.32	102.35
Distribution system operational use	4.99	0.16	5.15
Water taken legally unbilled	17.64	0.58	18.21
Water taken illegally unbilled	5.32	0.69	6.01
Sum of components	440.10	6.28	446.38
Distribution input	448.72	-2.34	446.38

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

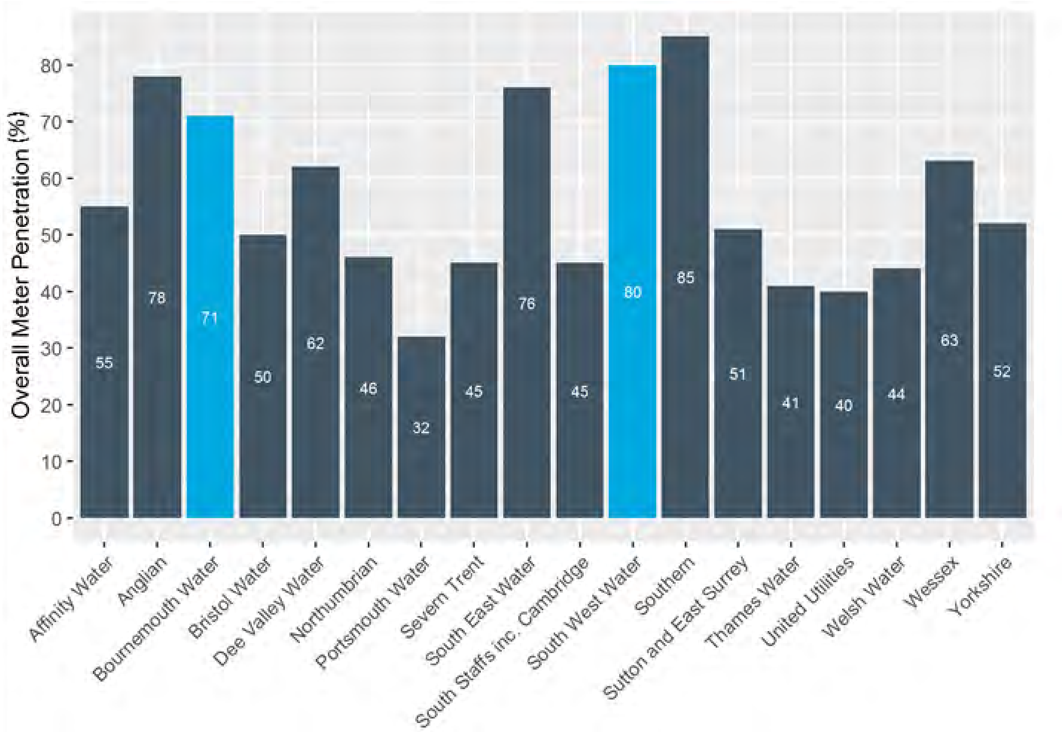
Demand component	Estimate (Ml/d)	WBG adjustment (Ml/d)	Reconciled estimate (Ml/d)
Measured household consumption	40.19	0.27	40.46
Unmeasured household consumption	20.68	0.68	21.36
Measured non-household consumption	59.16	0.39	59.55
Unmeasured non-household consumption	0.94	0.06	1.00
Leakage	22.04	0.21	22.25
Distribution system operational use	0.99	0.07	1.06
Water taken legally unbilled	0.88	0.06	0.94
Water taken illegally unbilled	0.02	0.00	0.03
Sum of components	144.91	1.73	146.64
Distribution input	147.61	-0.97	146.64

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 80% of South West Water's and 71% of Bournemouth Water's household customers paying by metered billing. 96% of non-household customers are metered.

Figure 3.1: Comparison of industry metering levels (2017/18)



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 7,400 households switching during 2017/18. In the Bournemouth WRZ we also exercise our right to install a meter on change of occupancy. During 2017/18 700 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 SWW supply area, we have exercised this right since 1990 when we asked sprinkler and swimming pool owners to register with us. This resulted in meters being installed at 5,700 properties. We continue to install meters at properties which have sprinklers or swimming pools, but with most of these properties now being metered, the number of new meter installs for this reason is now very small.

3.2.3.2 Metering policy modelling

We undertook modelling to help understand the most appropriate metering policy for the future. This modelling considered several factors to inform our decisions:

- **Meter type** – We currently install meters that support automated meter reading (AMR). Traditional meters require staff to read 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. As well as making meter reading quicker, it eliminates billing errors originating from misreading the meter or transcribing the reading incorrectly. AMR meters reduce the cost to read but do cost more than traditional meters.
- **Meter replacement schedule** – As meters age, they can become 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.
- **Additional policies** – We currently operate a meter optant policy, which allows household customers to switch to metered billing free of charge. We evaluated other 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.

The measures used to assess the performance of different policies included:

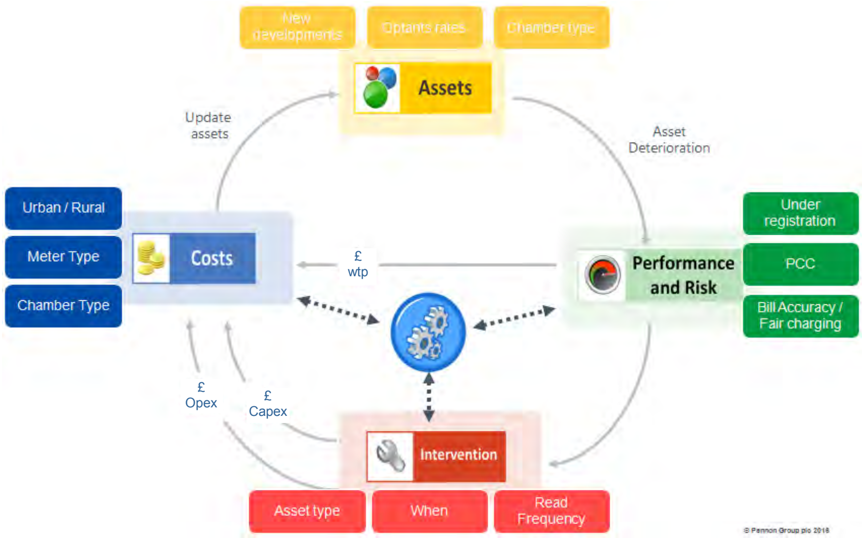
- **Per-Capita Consumption (PCC)** – The impact of metering on PCC. This has been calculated by determining the average reduction in water use between a metered and unmetered property.
- **Bill accuracy** – Increased deployment of AMR meters reduces reading errors.
- **Customer supply pipe leakage** – The AMR meters that we currently deploy include alarms, 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.
- **Meter under-registration** – As meters age they tend to lose accuracy, and under-estimate flow rates. More regular replacement of aging meters reduces this under-registration.
- **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.

The modelling therefore included the relative benefits to the supply demand balance of the metering policy, which helped us to:

- Understand the replacement needs of our existing meter stock for the next 25 years
- Develop an economically sustainable meter replacement programme - using cost benefit analysis informed by customer willingness to pay, to determine the extent of the replacement programme
- Understand how different meter policies in 2020-25 affect our longer-term costs for managing these assets

Figure 3.2 shows the overall structure of the metering model. This is the same model as used in our Draft WRMP.

Figure 3.2: Overview of Metering Financial Model

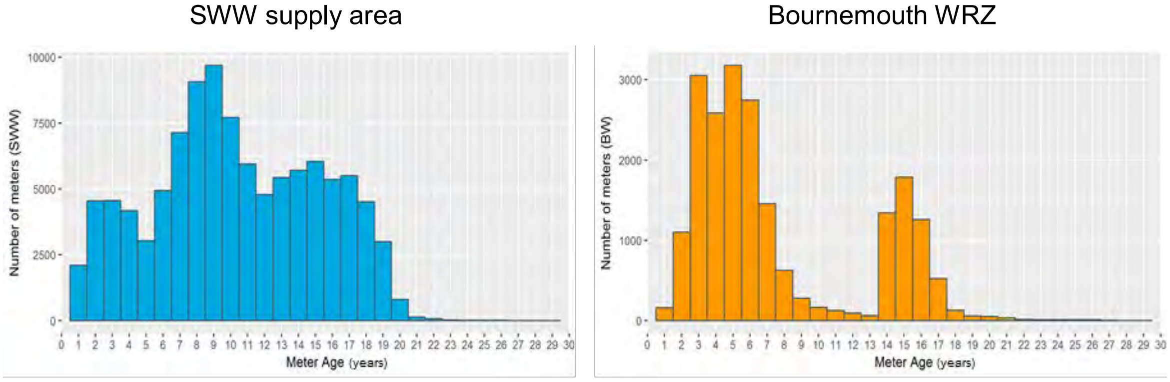


For the Final WRMP we have updated our future metering investment programme considering:

- Our customer research and feedback on the Draft WRMP
- Board aspirations to improve overall customer experience and efficiency, move to a full AMR metered policy and allow all unmeasured customers the option of a metered bill
- Updated financial modelling, including the latest costs of meter replacement

We have had high levels of meter penetration for some time, therefore the age of the meters is a very important input into developing our metering strategy. Figure 3.3 shows the relative age of our meters. Meters have a typical useable life of 15 - 20 years, so over the planning period of the WRMP all the meters installed to date are expected to need replacement.

Figure 3.3: Current meter age profile



With high levels of meter penetration, the proposed leakage reduction and water efficiency strategies, there is no strict supply demand driver for further metering in our Final WRMP. The assessment of the metering programme is instead driven by the overall best value solution for customers, considering the costs of delivery now and in the future, the direct benefits of different choices and the impact that technology change can have on the service they receive.

Figure 3.4 shows the costs of different metering programmes based on different meter replacement policies and technology types. This is a more detailed breakdown of the key strategies set out in our Draft WRMP. The policies are:

- **Preferred option** (16-year replacement age, all AMR) which would reduce under-registration by replacing all meters as soon as they reach the end of their serviceable life with AMR meters. This policy would install AMR meters for optants and new connections. All replacements would be AMR meters.
- **Baseline option** (20-year replacement age, all standard) which replaces meters at the very end of their serviceable life (20 years) with standard meters. The policy would still install AMR meters for optants and new connections.
- **Optimised option** (minimise under-registration with all AMR) which seeks to minimise under-registration each year by replacing meters on a cost benefit basis (replacement cost vs under-registration benefit) and installing AMR meters for replacements (where practical), optants and new connections.

The results show a trade-off between the frequency of replacement, the costs of the programme and the benefits that are realised. Our modelling indicated that the optimised option would deliver better performance in leakage and comparable performance in consumption but at a lower cost.

Figure 3.4: Comparison of the cost of different metering replacement policies

3.2.3.3 Our future metering programme

Our preferred metering strategy is to adopt the optimised programme for meter replacement, but with additional investment for metering remaining unmeasured properties. This is an extension of the programme described in our Draft Plan and current metering policy but uses the economy of scale of the replacement programme to increase meter installs. Key features of this programme are:

- **Replacements -** We plan to replace existing meters to maintain an average asset life of 18 years. The replacement programme will focus on the most cost-effective areas for batch replacement to minimise the unit cost of replacement. This will prioritise external meters in densely populated areas where batch replacement can be carried out in a fast, cost efficient manner. AMR meters will be used where possible.
- **New connections -** We will install external AMR meters on all new connections. This is a continuation of our existing policy.
- **Optants -** We will continue our free meter optant policy. All optant meters will be AMR meters where possible.
- **Metering of unmeasured properties** – As part of our area-based meter replacement programme we will also look to install meters on unmeasured properties. We will then provide a metered bill in addition to the unmetered one, allowing these customers to switch to metered billing should they choose. As the decision of whether to opt remains with the customer, not all these installs will result in a customer switching to metered billing.
- **Replacement of difficult or hazardous to read meters** – Our Plan includes the replacement of meters which are installed in places which make them dangerous to read (such as busy roads) or make regular reads difficult.

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 uneconomical to install meters at around 10% of household properties[3.2]. The outcome of our programme is that we expect 90% of households to pay metered bills by the end of the period, with all meters being AMR, and all remaining customers on an assessed charge. Our forecast of the progression of metering in our region is shown in Figure 3.5. The solid lines on the chart show meter switchers and the dashed lines show % household metering.

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

Figure 3.5: Rate of switching from unmeasured to measured billing and the impact on percentage metering

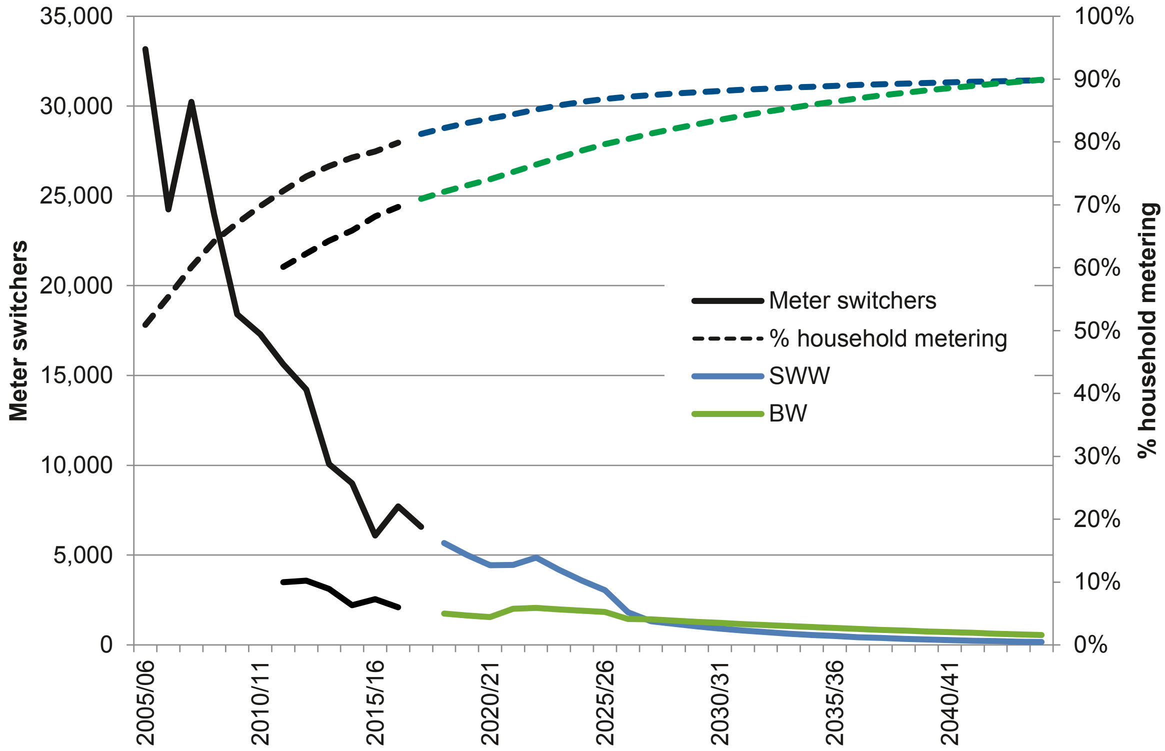


Table 3.3: 2020 to 2025 metering programme

Meter	Type	Number installed	Technology	Capex £m	Opex £m
Replacements		25,001	AMR/mechanical	12.9	<0.1*
New connections		43,914	AMR	0.95**	7.9
Other installs	Optants				
	Metering of unmeasured properties	64,450***	AMR	17.3	4.8
	Replacement of difficult or hazardous to read meters				
Total		133,365		31.2	12.7

Note: For the purposes of commercial confidentiality, the unit costs for each option type are excluded.
* Opex costs are already in base opex. Opex costs exclude impact on leakage and cost of water to prevent double counting in other cost areas.
** Includes developer contribution.
*** This refers to the number of meters installed, As the decision to opt remains with the unmeasured customers residing in the properties we meter under our new policy, not all the meters installed will lead to a customer switching from unmetered to metered billing. Our demand forecasts assume that 31,033 properties will move to metered billing over the 2020 to 2025 period.

Table 3.4: Overall metering programme

	Total installs	Total capex £m	Total Opex £m
Replacements	790,686	126.3	<0.5
New connections	202,281	8.6	50.9
Other installs	73,120	24.2	16.8

Note: costs as included in PR19 Business Plan Submission. New connections includes developer contributions.

3.2.3.4 Non-household metering policy

Non-household customers have 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, 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 a 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.

We have however selected a package of water efficiency measures that we believe 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 SWW supply area 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.

Our BW supply area covers parts of Dorset, Hampshire and Wiltshire, and is around a tenth the size of the SWW supply area. The population of the BW supply area is around a quarter of that living in the SWW supply 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 several different sources:

- **Local authority plans**: We reviewed published plans from all the 14 local authorities in the SWW supply area and 5 in the BW 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 has 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 SWW supply 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 soon, 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] UKWIR (2015), *WRMP19 methods: Population, household property and occupancy forecasting*, Ref 15/WR/02/8

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 WRZ.

We compared the historic rate of housing growth in the SWW supply area with that predicted by both the local authority plans and DCLG projections (see Figure 3.6). 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 2018/19 to date indicates that outturn figures are likely to be similar to those for the base year.

The SWW supply area is covered by 14 local authorities, and the latest plans of these authorities cover different periods. The step change reductions in the local authority plan housing projections in Figure 3.7 relate to the end dates of the various plans, which do not extend to the end of the water resource planning period.

Local authority forecasts for the period to 2026 are on average 8% higher than current levels of new connections. A small proportion of this difference can be explained by new properties being connected to private water supplies (we estimate that just over 1% of properties in our region are not connected to our water network). The remainder of this difference is likely to indicate some optimism within local authority plans. Household new connections have been close to 8,000 properties per year for the last two years and are continuing at a similar level for 2018/19 so far. There are no indications of increases beyond this level, and we assume that this represents the highest level that the local economy can support. We have therefore assumed that the rate of new connections suggested by the local authority plans to 2026 will not be achieved, but that these completions will occur over a longer period, with the next few years seeing similar levels of developer activity to that currently observed.

Figure 3.6: Comparison of housing growth projections for the SWW supply area

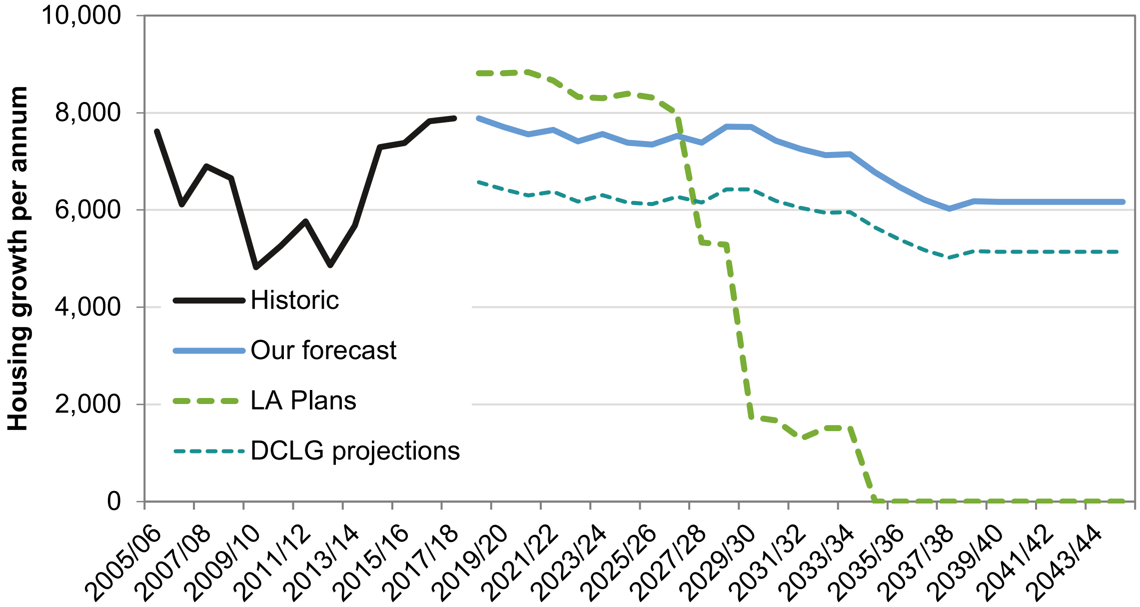
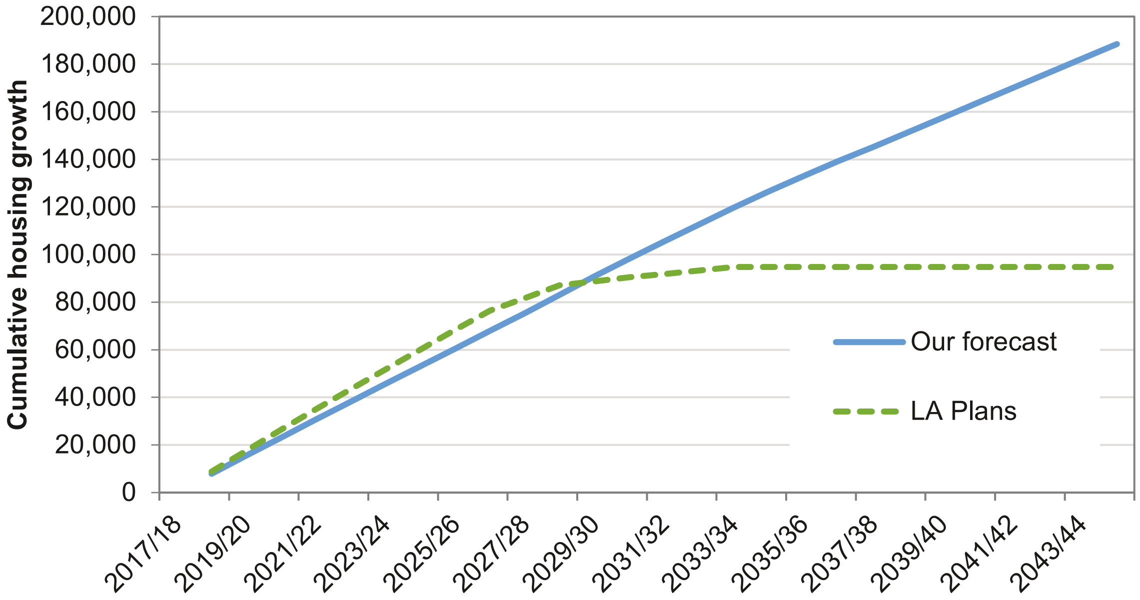


Figure 3.7: Cumulative housing growth projections for the SWW supply area



At the beginning of 2017/18 we changed the new connections policy in the Bournemouth WRZ. Previously properties such as a block of flats were counted as a single new connection, but we now meter and count each individual dwelling within the block as an individual property (matching the policy used within the SWW supply area). This increased the reported number of household new connections by around 500, and forecasts have been rebased between our Draft and Final plans to include this change. Figure 3.8 shows the impact of this change by plotting new connections numbers under both the old and new policies. Figure 3.9 shows cumulative housing growth.

Plans from the five local authorities covering the Bournemouth WRZ are in varying levels of completeness, and we do not currently have the same level of engagement with developers in the area as we do in the SWW supply area. As the plans covering most of the area run to 2026, we have consolidated the development described within 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.

The local authority plans significantly exceed historic new connections rates, even taking the change in policy into account, and activity in 2018/19 so far shows no significant deviation from 2017/18 levels. There are no indications of increases beyond this level, and we assume that this represents the highest level that the local economy can support. We have therefore assumed that the rate of new connections suggested by the Bournemouth area local authority plans to 2026 will not be achieved, but that these completions will occur over a longer period, with the next few years seeing similar levels of developer activity to that currently observed.

Figure 3.8: Comparison of housing growth projections for Bournemouth WRZ

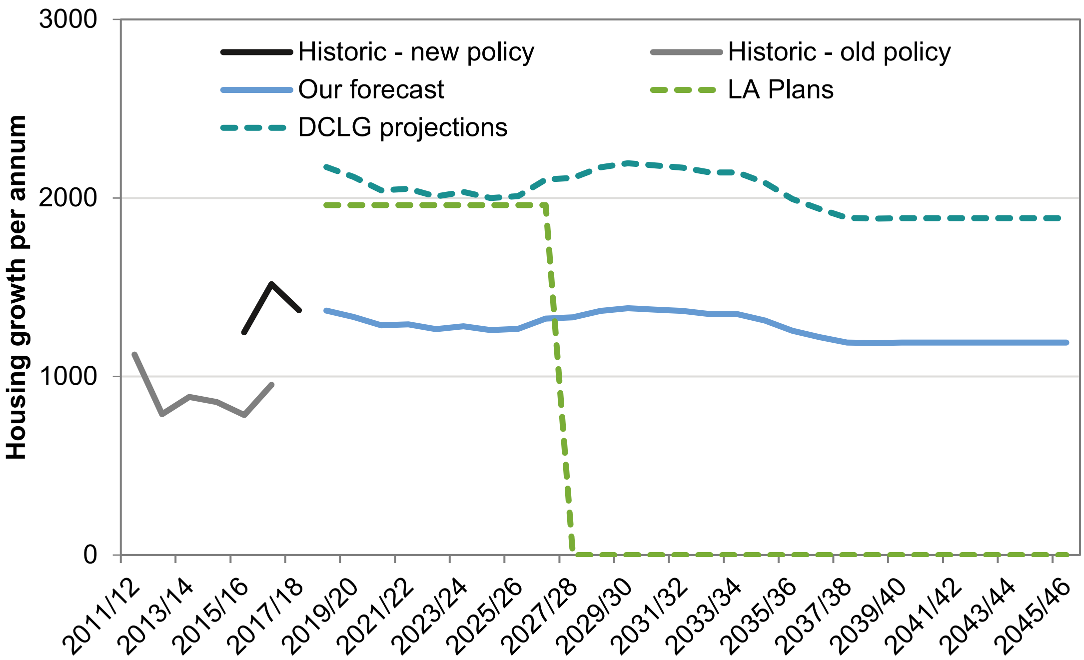
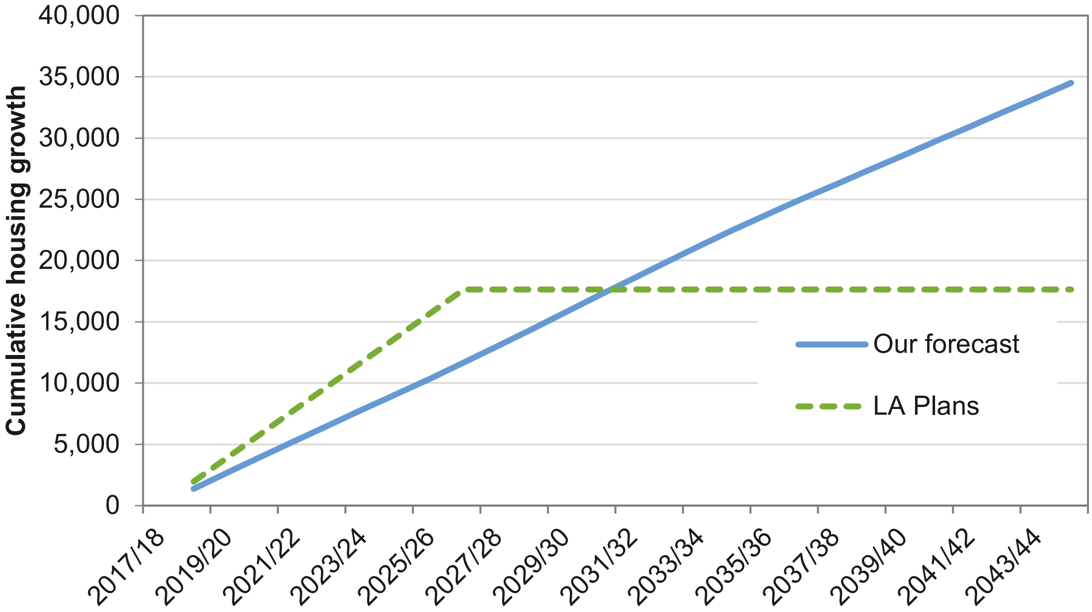


Figure 3.9: Cumulative housing growth projections for Bournemouth WRZ



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

Figure 3.10 and Figure 3.11 show our forecast of the number of household properties connected to the SWW and BW supply area networks for the planning period. In 2017/18 there were 764,000 household properties connected to the SWW supply area network and 193,000 connected to the Bournemouth WRZ network. This is forecast to reach 951,000 and 228,000 respectively in 2044/45.

Figure 3.10: Total household properties connected to the South West Water supply system

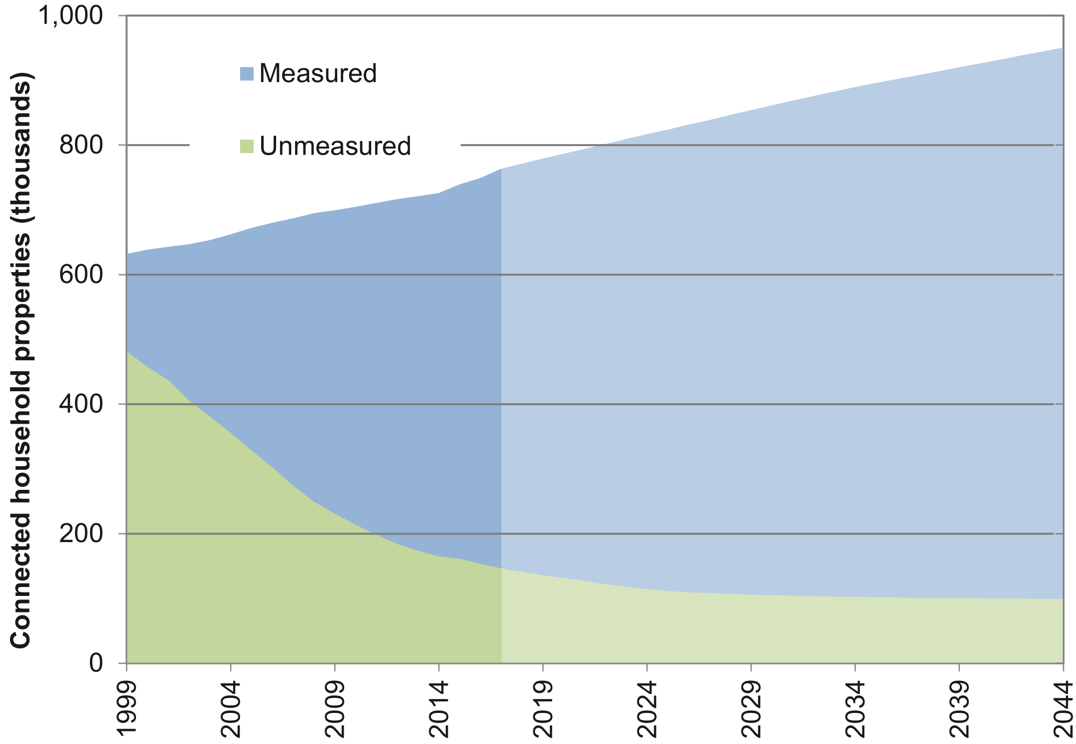
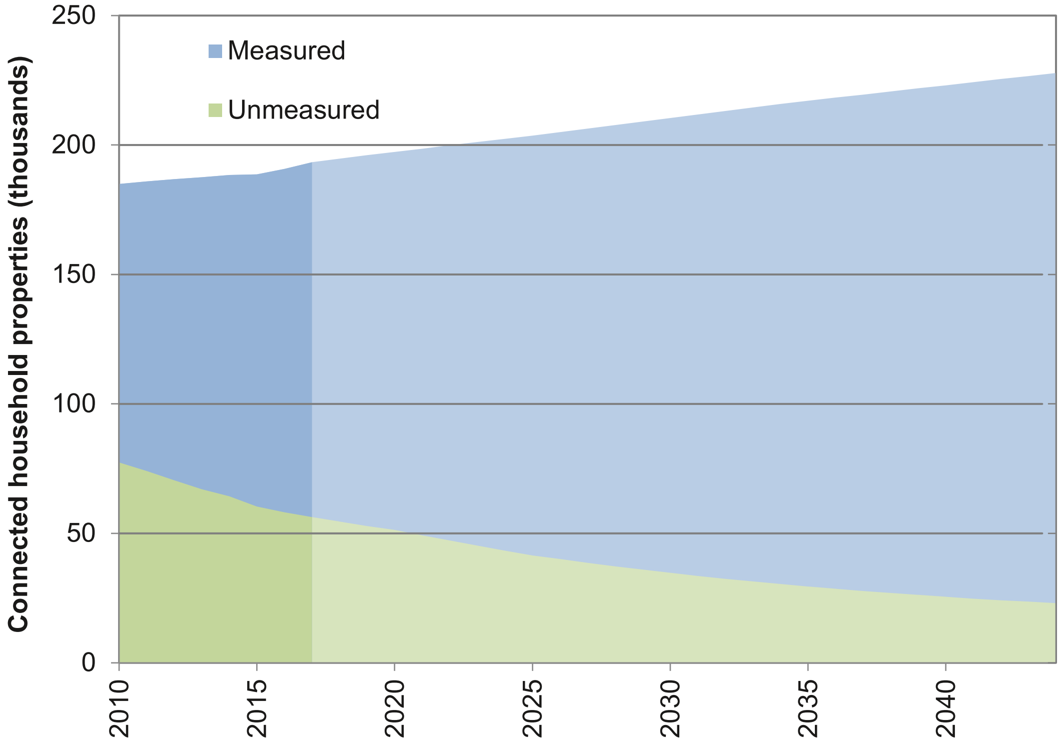


Figure 3.11: Total household properties connected to the Bournemouth Water supply system



At any one time, some 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 2017/18 0.5% of metered households were void compared to 2.9% of unmeasured households, an overall household void rate of 1.0%. 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 0.7% in 2044/45.

As shown in Figure 3.7 and Figure 3.9 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 WRZs 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 in the future and update our development database as required.

3.3.4 Population

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

- **2016 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 2016.
- **2016-based population projections**: The ONS provide population projections at local authority level. The 2016-based projections are the latest available, but we have rebased these forecasts to the 2016 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.

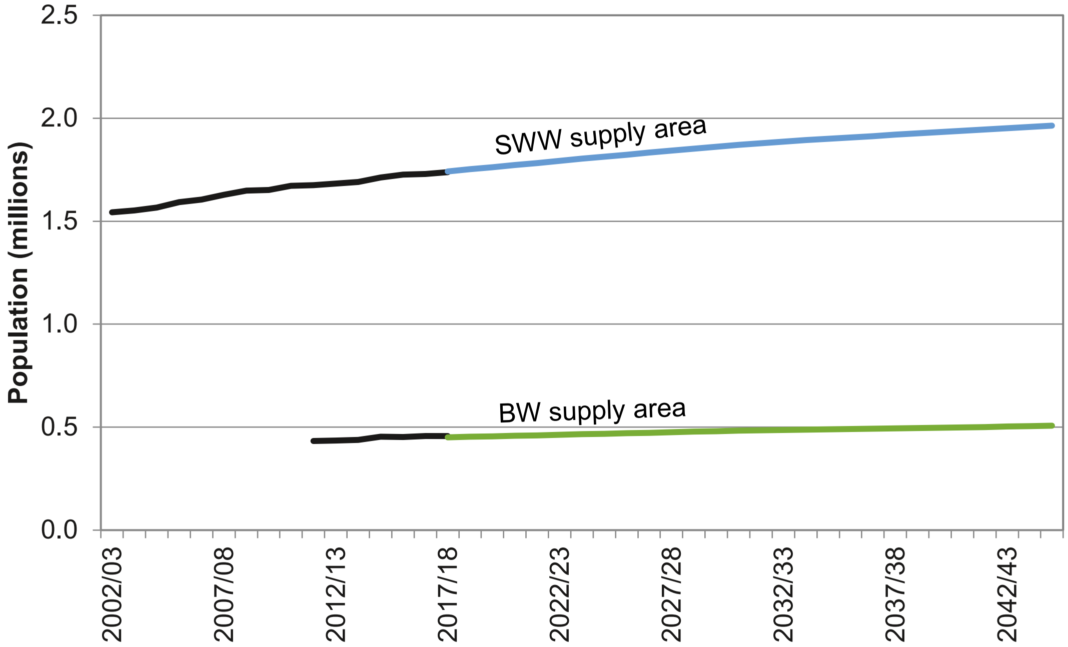
A report produced for us by the School of Geography at the University of Leeds identified some categories of population in the SWW supply area that are not covered by ONS population estimates, and which are important for us to consider. These categories are EU accession country migrants, visitors overstaying 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 and have information on the number of properties connected to them. We contacted the authorities in the SWW supply 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 SWW supply area population that is not served by us of 1.3%. No analysis of private water supplies in the Bournemouth WRZ has been made, therefore we have assumed that all population in that area is connected to our network.

The population we serve for water supply in the SWW supply area was estimated to be 1.74 million in 2017/18, and 0.45 million in the Bournemouth WRZ. Using the data described above, these populations are forecast to grow to 1.96 million and

0.51 million respectively in 2044/45. Our forecast of population growth is shown in Figure 3.12.

Figure 3.12: Growth of the resident population in the area we supply with water



We estimate that currently 2.0% 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 2.0 in 2044/45.

To estimate the AHS of measured and unmeasured properties within the SWW 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 factor of

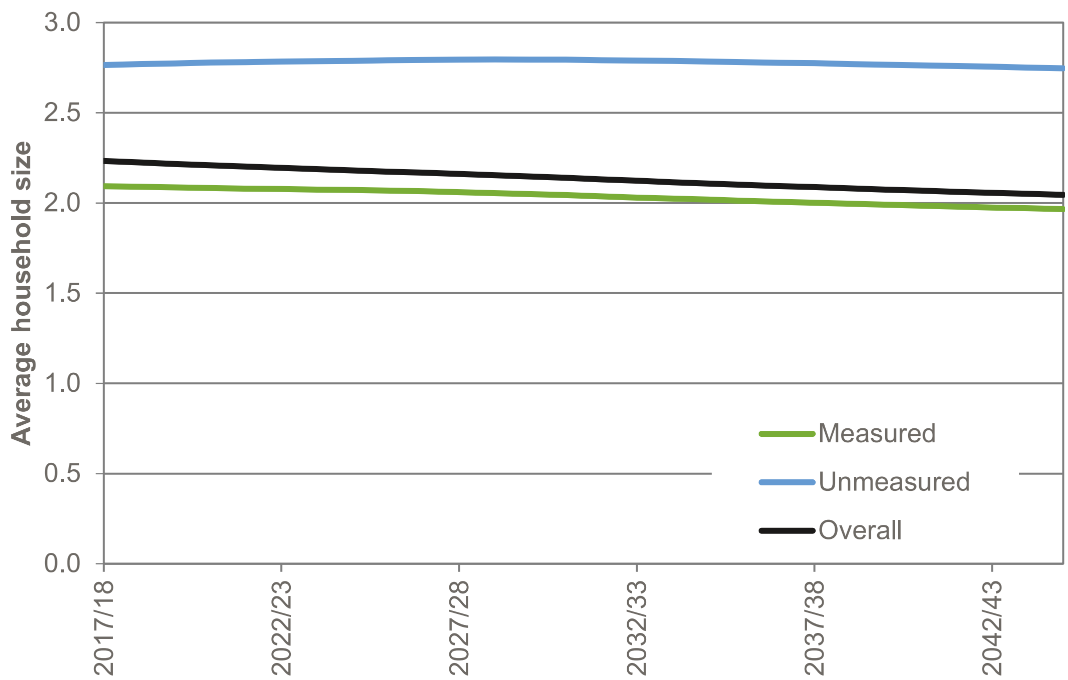
4.2% was required to be applied to the survey AHSs to match the ONS estimate. AHS is calculated for our region rather than for each WRZ individually, as the area we serve does not differ enough demographically to justify individual estimates.

AHS estimates for the Bournemouth WRZ have been based on the forecasts produced for the 2014 WRMP. 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 -2.4% was applied to the previous AHS forecast to match the ONS estimate. Options to improve understanding of the AHS in the Bournemouth WRZ will be investigated during 2019 and, as set out in Section 8, form part of our overall approach in producing risk-based demand forecasts in the future.

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 3.13 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 increases 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 close to the overall level.

Figure 3.13: 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 SWW supply area and Bournemouth WRZ are shown in Figure 3.14 and Figure 3.15 respectively.

PCC in our Company area is close to the national average PCC which is currently 141 litres/head/day.

Figure 3.14: Historic PCC for SWW supply area measured and unmeasured households

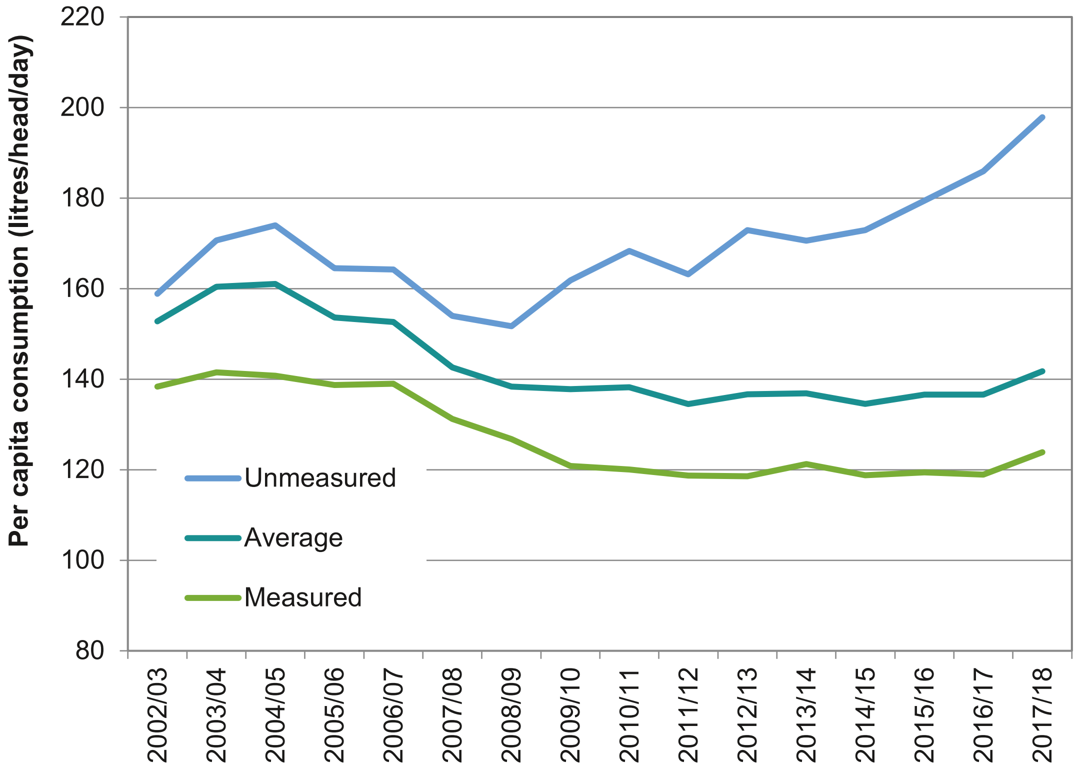
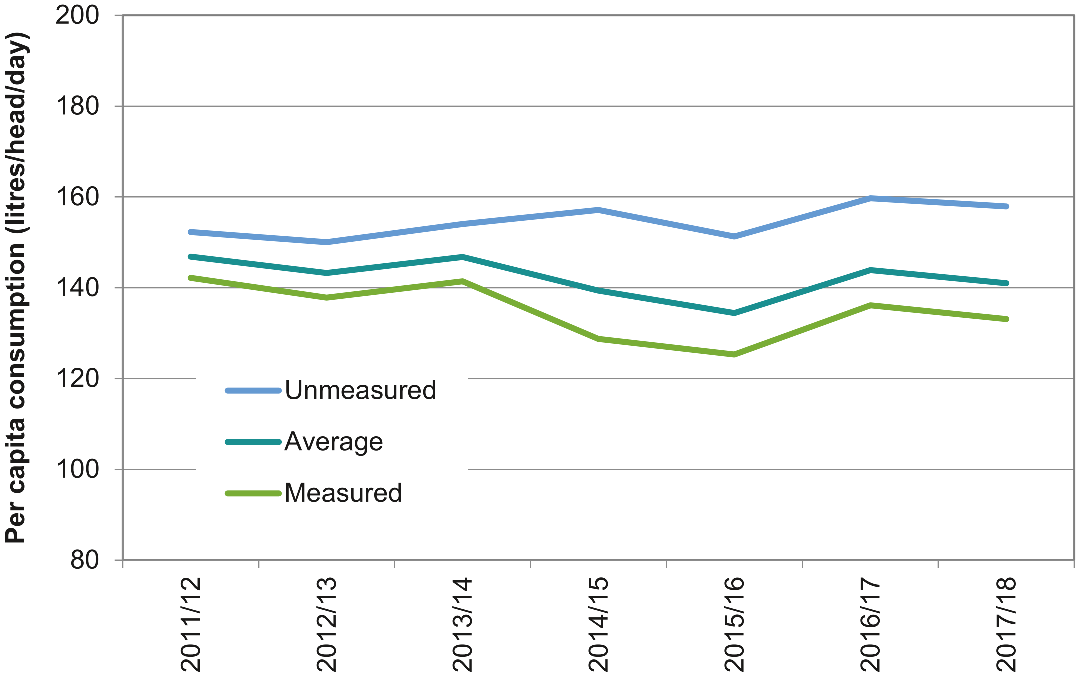


Figure 3.15: Historic PCC for Bournemouth WRZ measured and unmeasured households



3.4.1.1 Estimation of historic unmeasured PCC in the SWW supply 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 WRZ. 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 in and around 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 1,000 loggers are returning detailed daily consumption data. One of the advantages of this improved source of data is that we can 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 estimate unmeasured household consumption. The monitor comprises 27 individual areas, comprising of 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 SWW supply area into the Bournemouth WRZ, correcting for this bias, while collecting more detailed data.

3.4.1.3 Estimation of historic measured PCC

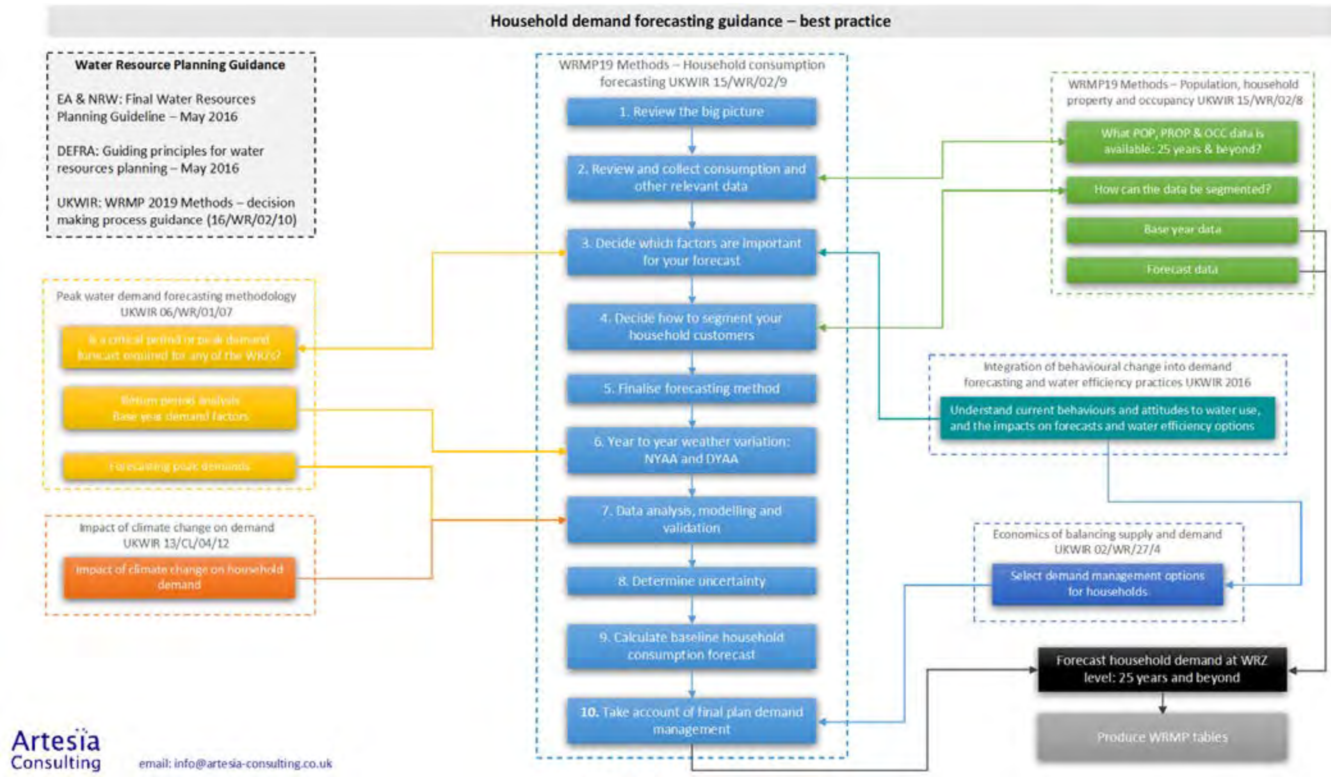
Over recent years the proportion of household customers paying measured bills led us to start a measured household consumption monitor in the SWW supply area, which we now operate in parallel with the long-running unmeasured one. Loggers are currently being installed at survey properties on the measured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

Whilst the data we obtain from the measured household consumption monitor is very useful in understanding customer consumption, it is not the best source from which to calculate measured PCC. Instead we use our billing data, as this enables us to account for the consumption of the entire measured household population rather than the limited sample within our survey. 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. 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 forecasts, with the approach shown in Figure 3.16. This section gives a 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 3.16: 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 customers 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.

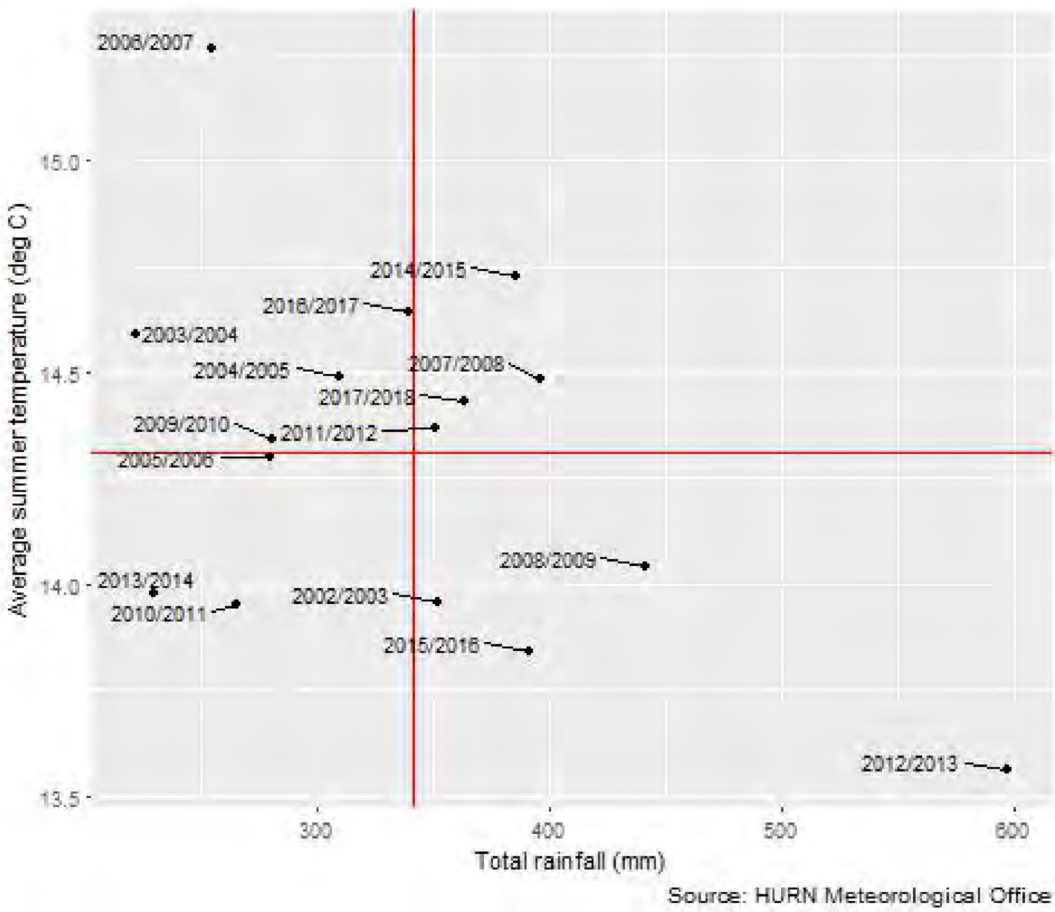
3.4.2.3 Understanding how weather affects household consumption

It is 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.

Firstly, we looked at how the summers in recent years compared to average. Figure 3.17 shows how the summer rainfall and average temperatures have varied recently against the average. This indicates that the base year of 2017/18 was typical at the Met Office's Hurn weather station, 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: Camborne, Chivenor and Yeovil.

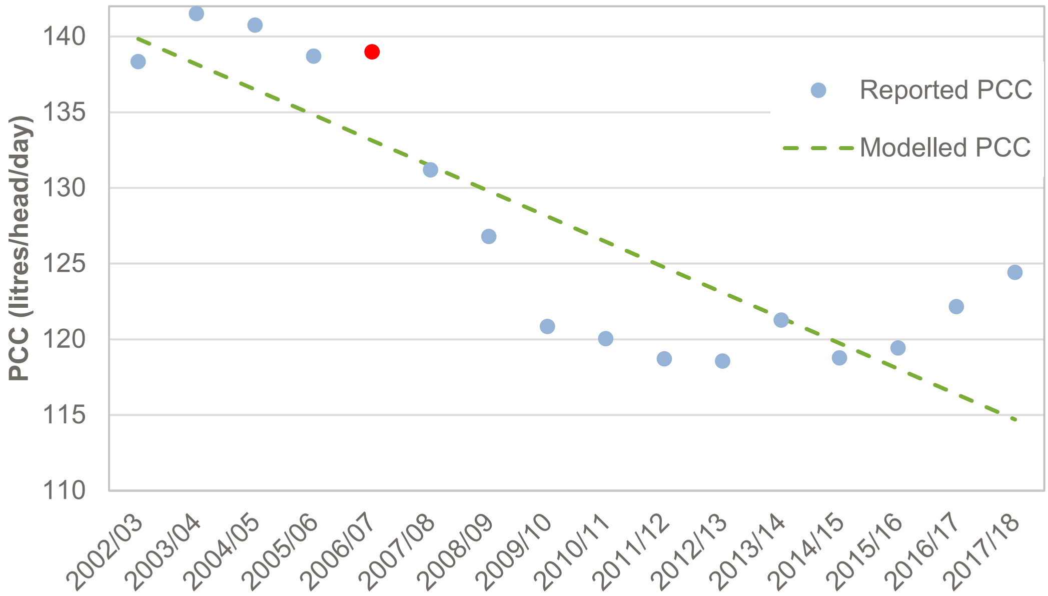
[3.4] UKWIR (2015), *WRMP19 methods: Household consumption forecasting*, Ref 15/WR/02/9

Figure 3.17: Quadrant analysis of recent summers for data from the Met Office's Hurn weather station. The red cross indicates the average for the period from 2002/03 to 2017/18.



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 4.4%. This is illustrated in Figure 3.18.

Figure 3.18: Chart showing recent reported measured PCC in the South West Water supply area. The red data point shows the dry year of 2006/07.



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 SWW supply area, the biggest impact was on properties such as family farms, which are both a home and a business premises. These were reclassified as household rather than non-household. These properties have higher consumption than normal households, so their inclusion in the household category increased PCC compared to previous years. This increase can clearly be seen in Figure 3.18. A similar increase was seen in the Bournemouth WRZ. Additionally, the 2017/18 data shows a deviation from the existing trend.

This increase in PCC made normalisation of the base year figure to what might have been expected in 2017/18, had average weather conditions been experienced, very difficult. Weather conditions in 2017/18 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 were not 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) are not. To correctly capture both 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 3.4.2.2. Finally, we calibrated these data to overall average per household consumption (PHC) in the base year of 2017/18.

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 several 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.

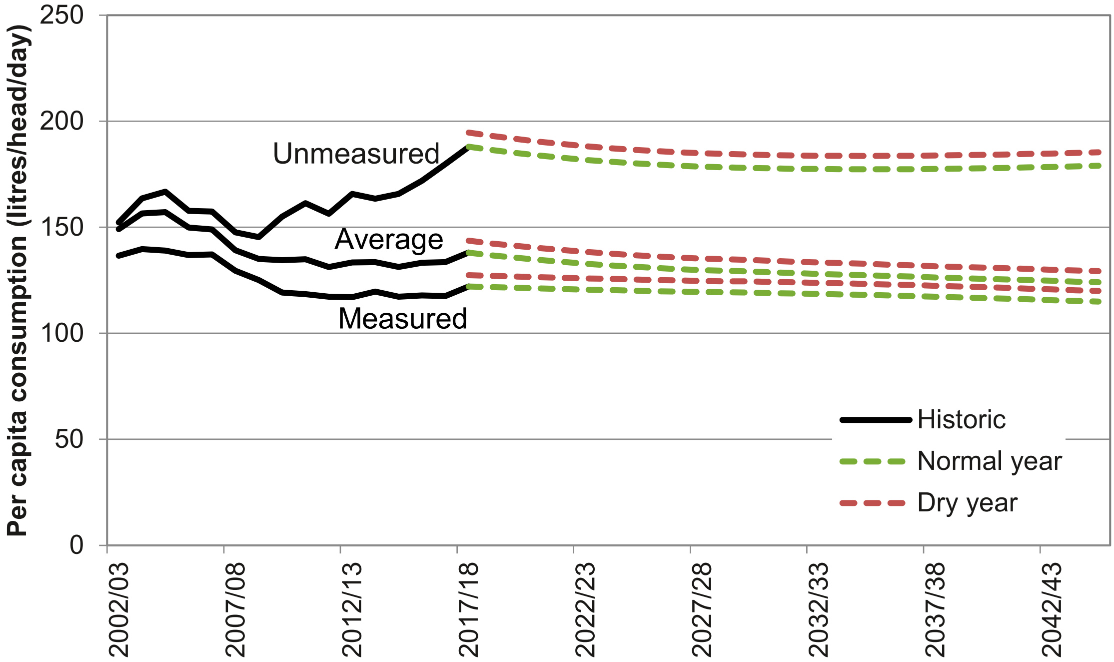
[3.5] UKWIR (2016), *Integration of behavioural change into demand forecasting and water efficiency practices*, Ref 16/WR/01/15

3.4.3 Household consumption forecasts

Our baseline PCC forecasts for the SWW supply area and Bournemouth WRZ are shown in Figure 3.19 and Figure 3.20 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 SWW supply area, we forecast that average PCC in a normal year will fall from 138 litres per person per day currently, to 124 in 2044/45 (144 to 129 in a dry year). For the Bournemouth WRZ we expect to see a reduction from 140 to 129 litres per person per day (146 to 135 in a dry year).

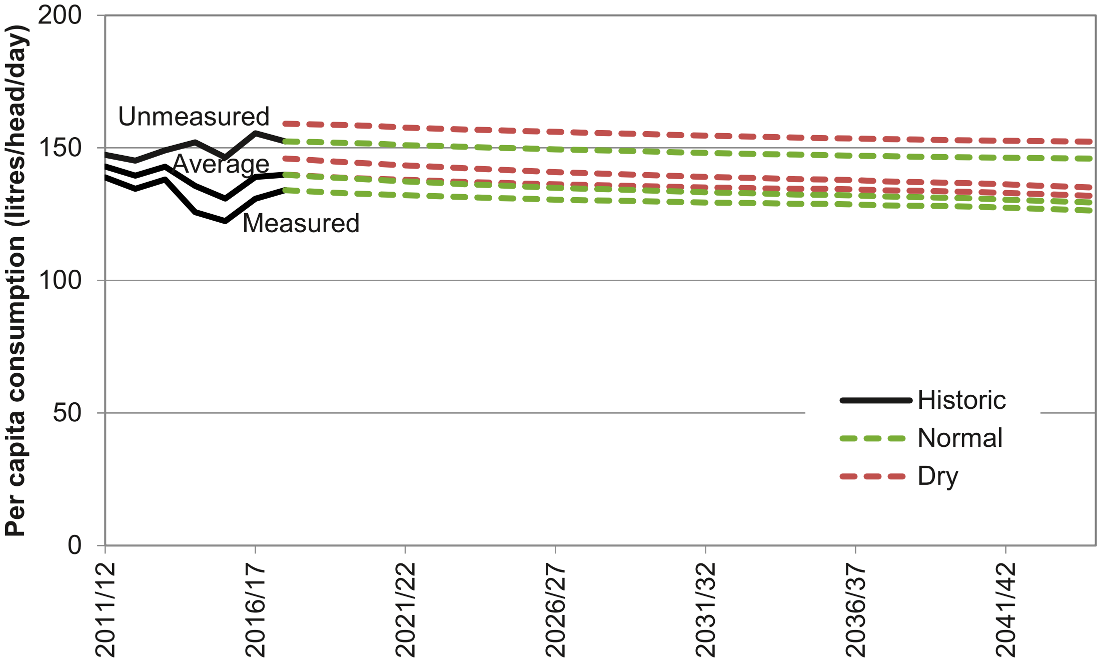
Ofwat has published new requirements for future leakage and PCC reporting[3.6]. While we expect the impact of PCC consistency reporting on estimated PCC to be small, under leakage consistency reporting measures we will expect to see our base year PCC fall noticeably. The new reporting measures will see some of our water balance gap reassigned to leakage, meaning that there will be less of an adjustment to PCC, particularly unmeasured. This is described further in Section 3.6. To allow a consistent comparison with historic figures in Figures 3.19 and 3.20 below, we have applied a factor to historic estimated PCC to approximate the impact that consistency reporting would have had in the past.

Figure 3.19: Per capita consumption forecasts for the SWW supply area



3.6 UKWIR (2017), *Consistency of reporting performance measures*

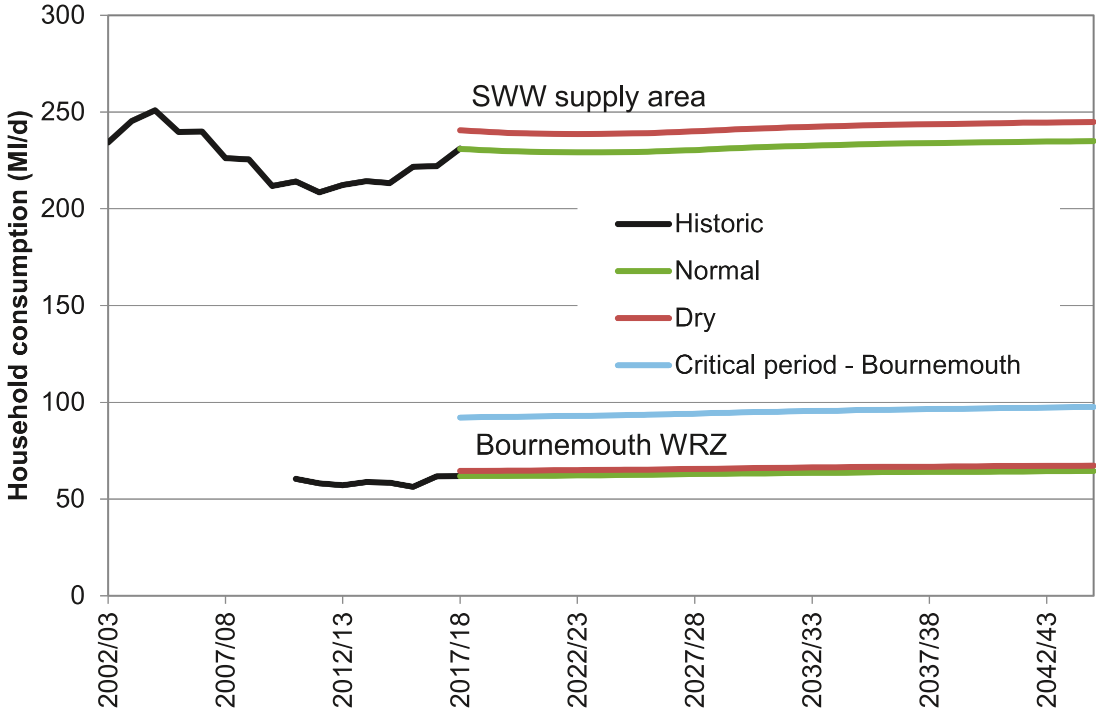
Figure 3.20: Per capita consumption forecasts for the Bournemouth WRZ



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 SWW supply area will rise from 231 Ml/d currently to 235 Ml/d in 2044/45. In the Bournemouth WRZ we expect it to rise slightly from 62 Ml/d to 64 Ml/d. Our forecasts are shown in Figure 3.21.

The large rise in household consumption seen in the SWW supply 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 WRZ 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 3.21: 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 2017/18 data from our annual performance report we assume that when a customer switches to metered billing, underground supply pipe leakage is reduced by 39% in the case of households and 50% 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*[3.7] 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 2017/18 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 talks on request
- Targeted promotions to our region's gardeners, for example water butts advertised through our website and bill message promotions
- The promotion of free water saving devices for household customers to self-select via our water conservation website
- Tools 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
- The pilot community water saving incentive scheme, GreenRedeem, launched in July 2017, is in its second year. So far, 18% of the 3,200 South West Water customers who were eligible have joined and are being rewarded for using less water at home. Despite the low take-up, member engagement remains steady and the pilot itself has yielded learning points that will be applied to any further potential widening of the scheme

[3.7] UKWIR (2013), *Impact of climate change on water demand*, Ref 13/CL/04/12

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 final strategy.

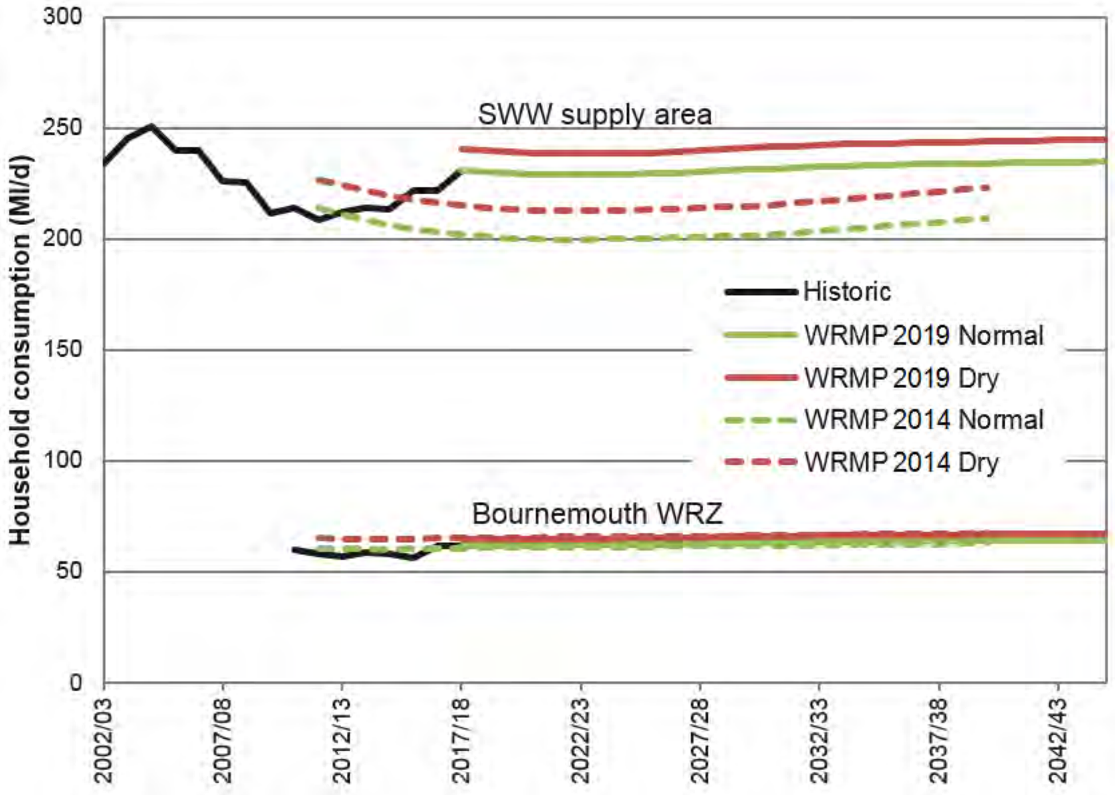
3.4.7 Comparison with 2014 WRMP household consumption forecasts

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

The previous forecast for the SWW supply area 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 led to a step-change increase in household consumption.

The Bournemouth WRZ historic trend shows a similar step-change increase as in the SWW supply 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 3.22.

Figure 3.22: Comparison of household consumption forecasts with those in our 2014 WRMP



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

We have made several improvements to 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 SWW 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 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[3.8] on the types of properties that would be 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 category to the household category. This movement was undertaken in 2015/16 in the SWW supply area, 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 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 predicted 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 forming the majority. There is little reliance on agricultural irrigation within the region, so farms moving to potable water irrigation are not considered likely to impact us.

None of the WRZs in the SWW supply area have a strong reliance on other non-service industries, however the Bournemouth WRZ contains one 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, 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.

[3.8] Ofwat (2016), *Eligibility guidance on whether non-household customers in England and Wales are eligible to switch their retailer*

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

Our non-household consumption forecasts were produced for us by Servelec Technologies. 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 several 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 strategy, we regularly liaise with them. Because of this communication, we do not envisage any significant change in their consumption over the planning period and have assumed a continuation of their 2017/18 consumption.

Currently only about 2% 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 0.9% of remaining unmeasured non-household customers will opt in to metering each year.

The proportion of unmeasured non-households that were void was 19.6% during 2017/18, much higher than the 5.4% void rate in measured non-households. We have assumed these void rates for the duration of our forecasts but, due to the continuing migration of unmeasured non-households to the measured category, the overall void rate drops slightly from 6.0% in the base year to 5.9% in 2044/45.

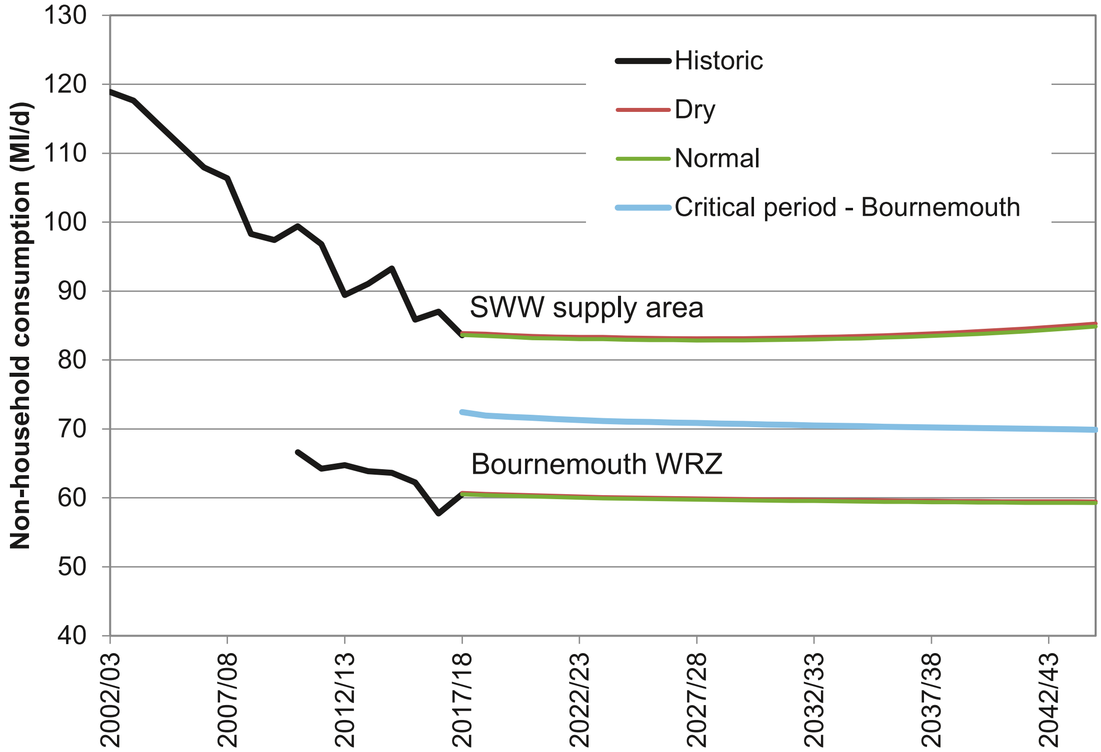
We tested the sensitivity of our supply demand balance to higher non-household demand in Section 7 to understand if it is material to our Plan.

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 SWW supply area is forecast to rise slightly from 84 Ml/d currently to 85 Ml/d in 2044/45. In the Bournemouth WRZ, we expect a slight fall from 61 Ml/d to 59 Ml/d. Our forecasts are summarised in Figure 3.23.

The large reduction in non-household consumption seen in the SWW supply 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 3.4.3 above.

Figure 3.23: 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*[3.9]. One of the conclusions of this report was:

"*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*."

Analysis undertaken in the production of our non-household demand forecasts suggests that the likely impact of climate change on non-household demand is small. An uplift of 0.1% in 2044/45 has been applied.

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

Figure 3.24 shows a comparison of our new non-household consumption forecasts with those from our 2014 plan.

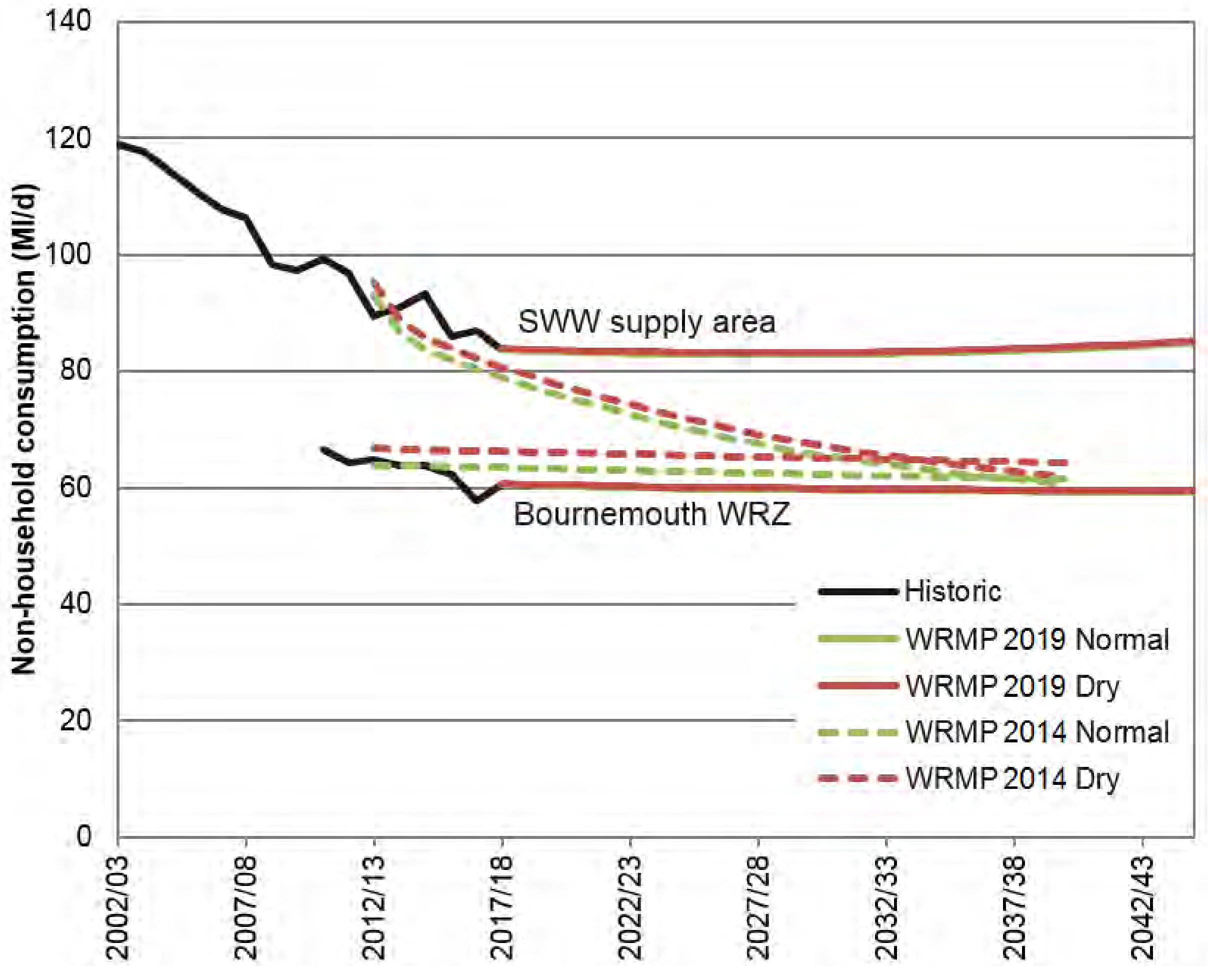
The previous forecast for the SWW supply area was too low compared to our historic reported figures. The first reason for this difference is that the historic trend

[3.9] *Ibid.3. 7*

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 SWW supply 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. Hence there is no non-household consumption critical period demand for us to compare our latest forecast to, so critical period demands are not shown in Figure 3.24.

Figure 3.24: Comparison of non-household consumption forecasts with those in our 2014 WRMP



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 seven different non-household categories, consisting of four service sector groupings, two non-service ones, and an unknown category.

We have considered 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*[3.10] report. Complying with this new guidance requires significant investment in flow monitoring, and different management procedures.

In our Draft Plan we used a base year of 2016/17, for which we could only estimate the likely impact of moving to the new consistency methodology. During 2017/18 we have been estimating leakage according to both the new and old methodologies, giving us a better understanding of the impact of the change. This has enabled us to base this Final Plan on the new consistency methodology.

We have shown the impact of the leakage consistency reporting to our water balance calculation components in Table 3.5. All components are affected because the change to estimated leakage affects the water balance gap, and hence the change made to each component to close the gap. We have shown the impact of these changes on per capita consumption in Table 3.6. We will also be moving to compliance with PCC consistency reporting in 2020, but while this is expected to increase confidence in our estimates, we do not predict that it will significantly change them.

The scale of the changes required to achieve consistency mean that we will only be fully compliant in 2020, and some changes may still occur to our leakage estimate as we move towards a fully compliant position.

Details of our current position with regards to compliance with the new guidance are shown in Section A.3.3.

[3.10] UKWIR (2017), *Consistency of reporting performance measures*

Table 3.5: Estimated impacts of leakage consistency methodology on 2017/18 water balance components

Demand component (Ml/d)	Existing methodology	Leakage consistency methodology
Measured household consumption	197.69	195.40
Unmeasured household consumption	142.73	141.21
Measured non-household consumption	102.11	97.49
Unmeasured non-household consumption	3.11	2.92
Leakage	107.25	124.60
Distribution system operational use	6.61	6.21
Water taken legally unbilled	20.34	19.15
Water taken illegally unbilled	7.40	6.04
Distribution input	587.24	593.01

Table 3.6: Estimated impacts of leakage consistency methodology on 2017/18 per capita consumption

Per capita consumption (l/person/d)	Existing methodology	Leakage consistency methodology
Unmeasured	187.73	179.23
Measured	126.03	124.57
Average	141.92	138.64

3.6.2 Determining base year leakage

Our leakage control is based on continuous monitoring of night flow data across our WRZs. We use over 2,500 meters over 1,000 enclosed monitoring areas, known as District Metered Areas (DMAs), with an average of 1,000 properties in each. Our flow meters continuously collect 15-minute data, with more than 99% of this data being regularly 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 software which provides reports on DMA prioritisation, data collection problems, and is the reporting tool for regulatory returns.

We calculate the level of leakage by analysing DMA night flows, from which we subtract the domestic and commercial night use of the properties in the area. The night flow readings are converted into daily leakage figures by adjusting for the different pressure regimes that occur in the DMA between day and night. A weekly leakage figure is calculated using an average of the individual daily values for each

DMA. These figures can be aggregated to WIS (Water into Supply) zones, WRZs, and into a regional figure for our entire supply area.

Trunk mains DMAs are included within the SWW supply area reporting network, and either reported using the leakage calculation methodology detailed above or given a leakage estimate based on an industry standard methodology. In the Bournemouth WRZ trunk mains DMAs sit outside the normal DMA reporting coverage and estimates are used. We strive to report and monitor trunk mains to ensure water delivered from our WTWs is delivered as efficiently as possible.

Service reservoirs are outside of the DMA network, so losses are accounted for separately as part of our leakage control strategy. Losses are monitored by volumetrically comparing inlet and outlet flows at each reservoir. This method has the benefit of recording all losses associated with the service reservoirs, whether from overflows, structural seepage or leaks in the mains. It also avoids the operational disturbance and risk to supply from static drop testing (where inlet and outlet valves are closed and the reservoir level is monitored to see if it falls).

Trunk main and service reservoir losses are added to the leakage figures, and the weekly figures averaged to calculate the reported annual leakage.

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 94.92 Ml/d in the SWW supply area, and 21.28 Ml/d in the Bournemouth WRZ (corresponding to 81 Ml/d and 19 Ml/d under the current calculation methodology). 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 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 zone 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 zones into leakage zones according to resources and WTWs.

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:

- Calculation is currently based on leakage stated under the existing methodology. Results are converted to new leakage reporting consistency figures using estimated conversion factors. These factors change each year as the result of increased movement towards a leakage consistency compliant position, until 2020/21 when they are fixed at a 1.12 factor for the SWW supply area, and 1.10 for the Bournemouth WRZ.
- It is based upon the principle 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.
- Carbon costs: Until April 2019 costs for carbon are under the government Carbon Reduction Commitment (CRC). The average cost for carbon under this scheme for SWW is £4.14 per Ml. From April 2019 the government is replacing this with the Climate Change Levy (CCL); under this scheme the carbon cost per Ml will be £5.23. These costs are / will be included in the charges payable to respective energy suppliers – the government then recoups these scheme charges from the energy supplier. Thus, the unit costs for water production and distribution are already fully inclusive of carbon.
- 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 SELL, 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 reducing variations in leakage level from 0.20 Ml/d 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 were examined
- The results gave the relationship between cost and leakage level for all WRZs
- In Section 7, additional supply demand scenarios are 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 profiles 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

3.6.4.2 Innovations in leakage reduction and the effect on the ALC cost curve

To meet the reductions in leakage that we have set, a suite of innovative initiatives has been brought together. These are fully listed in Appendix 6. These initiatives are intended to support the Active Leakage Control (ALC) activities in driving down leakage to new levels not previously attained.

As an example, one of these initiatives is the selective use of pressure management in key areas of the distribution network. It has a projected benefit of 4.1 Ml/day, capital expenditure at £8m, with an ongoing operational cost for maintenance activities of £20k per annum.

The likely combined effects of all these new activities on the ALC cost curve (pre-consistency) for the combined SWW WRZs, and separately for the Bournemouth WRZ, have been examined and a new approximation of the combined 'ALC plus innovations' curve has been determined.

Figure 3.25 and Figure 3.26 illustrate the likely effect on leakage for the SWW supply area. In Figure 3.25 the impact of innovations in leakage control have resulted in the original cost of ALC at 84 Ml/day now being applicable at the new target of 71 Ml/day (shown by the black line in Figure 3.25). The curve is based on leakage above policy minimum so the rest of the ALC curve has been rebased to reflect this. These innovative schemes come with their own new Opex costs; for AMP7 this cost is estimated at £3.55m (an annual cost of £0.71m). When added to the new ALC cost curve the overall costs of leakage control are approximated by the solid green line. Figure 3.26 shows the broader range of leakage values and illustrates the new cost curve, this is very similar in shape overall but more efficient than the plain ALC curve around the target range. A similar approach was taken for the Bournemouth WRZ.

Figure 3.25: SWW supply area – ALC cost curve modified to include innovations (detail)

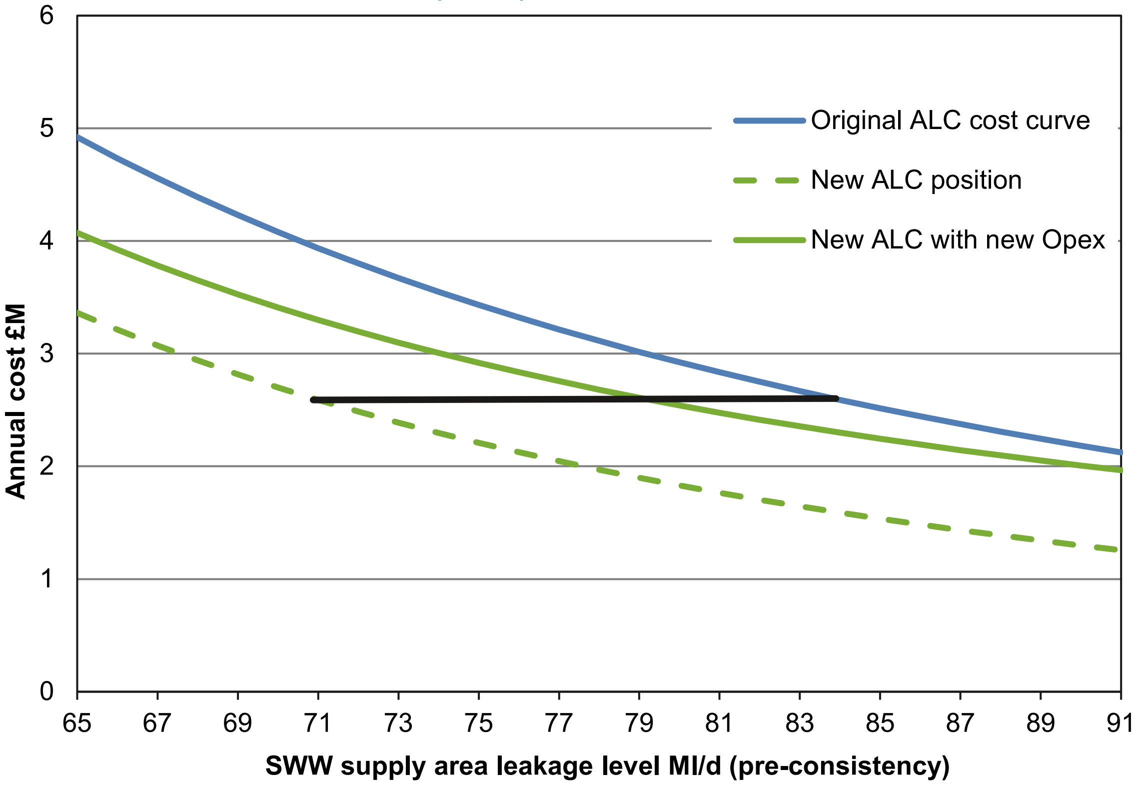
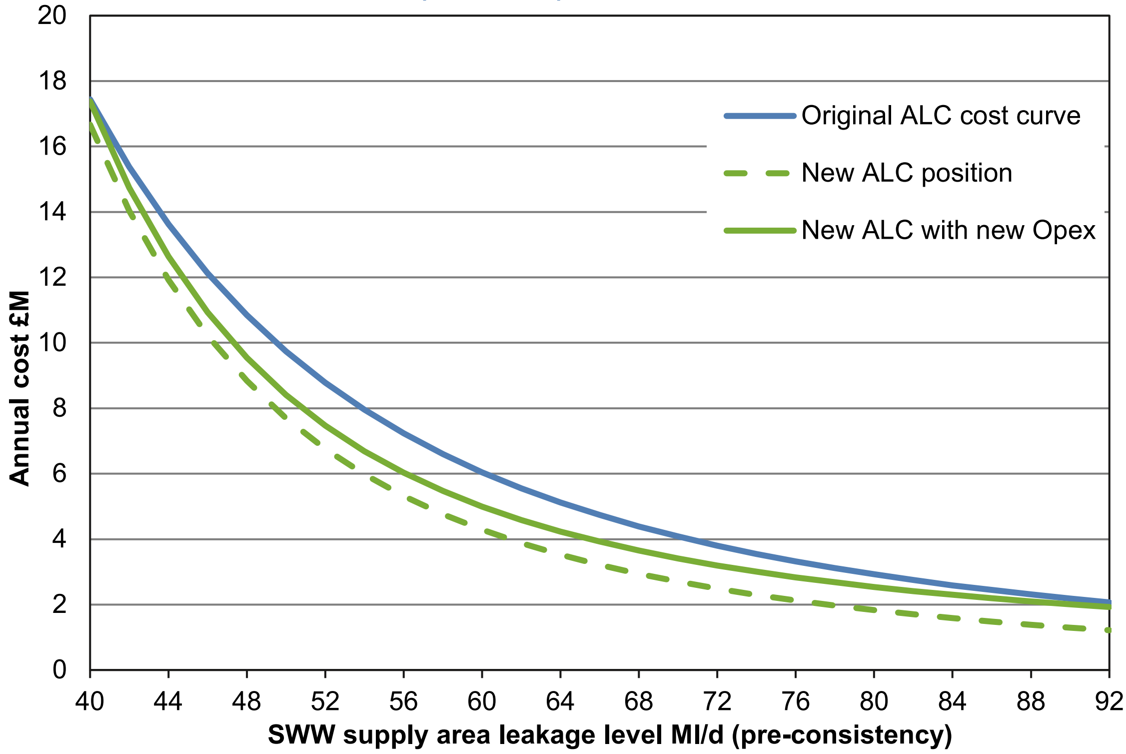


Figure 3.26: SWW supply area – ALC cost curve modified to include innovations (extended)



3.6.4.3 Sample result: the base case from the SELL model

Figures 3.27 and 3.28 show the results for our baseline forecasts.

In the baseline scenario the least cost leakage levels for the SWW and BW supply areas were constrained by available supply, rather than being at a point where total company costs have begun to increase with leakage. For SWW this represents a mean annual constraint to leakage 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 BW, the baseline scenario has a mean constraint of 28 Ml/d and a range from 32 Ml/d to 22 Ml/d (all values are pre-consistency).

The current leakage level in the SWW supply area is 84 Ml/d and 19 Ml/d in the Bournemouth WRZ. The model shows that it would currently be lower cost to operate at a higher leakage level.

Figures 3.27 and 3.28 below show the effects of the modified ALC curve including the innovation opex costs as discussed in 3.6.4.2. The dashed blue lines represent the standard costs with the unmodified ALC curve whereas the solid blue lines illustrate the impacts of innovations, and the resultant NPV at these mean leakage levels.

Customers value leakage reduction highly and the (dashed and solid) green lines in Figures 3.27 and 3.28 show the impact on the net costs, 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 SWW supply area and 16 to 19 Ml/d in Bournemouth WRZ (all figures are pre-consistency). This is discussed in more detail in Section 7.

Figure 3.27: SWW supply area – costs over 25 years at a given mean leakage level

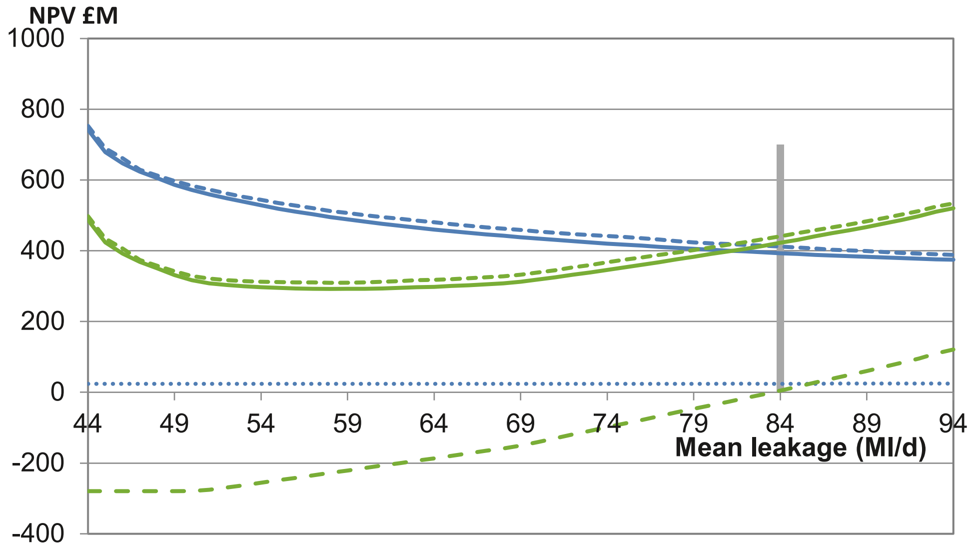
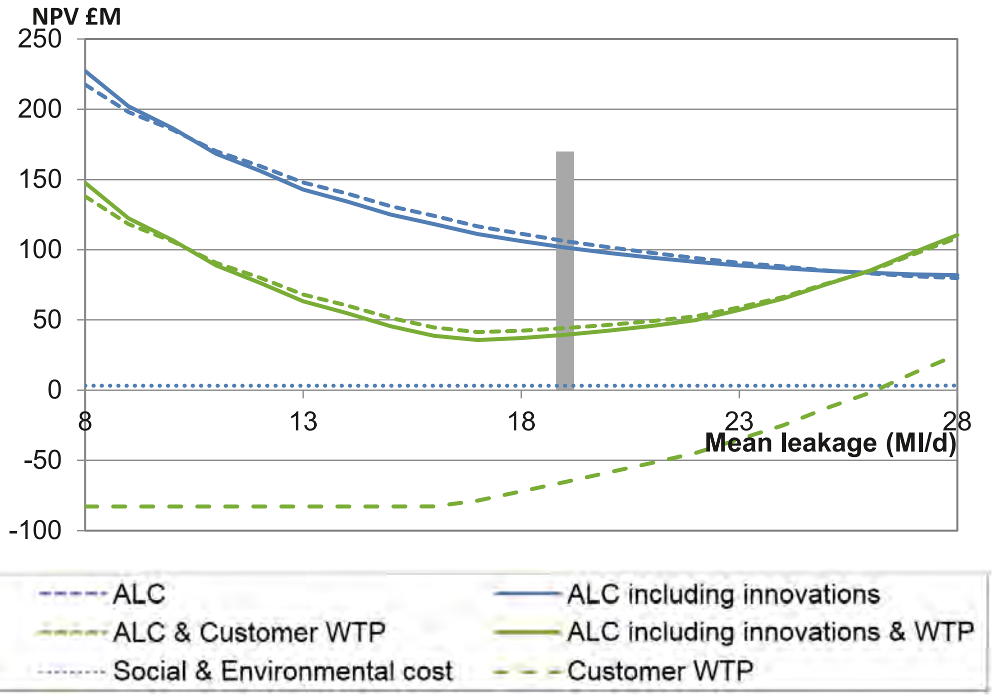


Figure 3.28: BW supply area – costs over 25 years at a given mean leakage level



A full set of charts for scenarios at WRZ level is supplied in Section A.3.5.

3.6.5 Meeting our leakage target

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. 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.

The scenario analysis in Section 7 explores different policy choices on leakage reduction and uses 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 firefighting 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 6 we present options for reducing our own water use at waste water treatment works.

3.7.2 Distribution system operational use

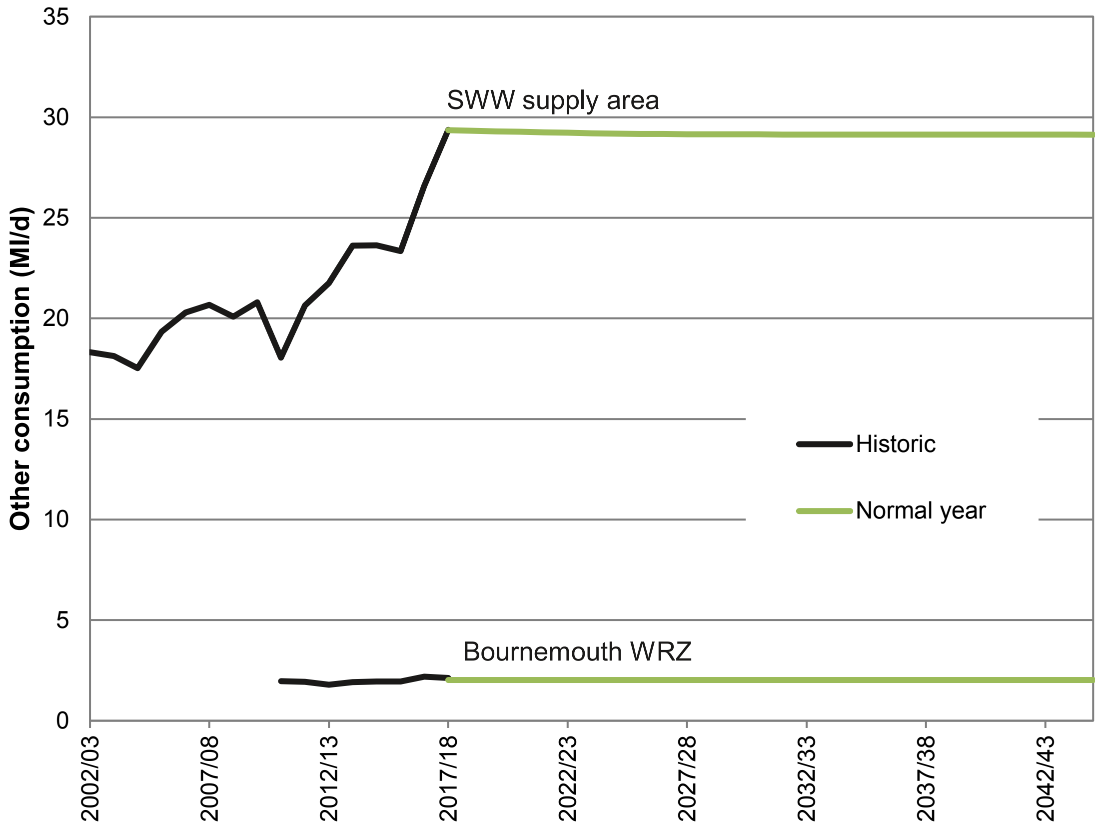
This component of demand covers the water that we use in the operation and maintenance of our distribution system, for purposes such as mains flushing and service reservoir cleaning. We have assumed that the volume of water we use for these purposes will remain at the current level for the duration of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

3.7.3 Overall forecast of other components

The total forecast of these other components is shown in Figure 3.29. 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 negligible. Likewise, the critical period forecast for the Bournemouth WRZ does not differ significantly from the normal year forecast, so is also not shown separately. 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 waste water treatment works. In Section 8 we set out which ones of these we have included in our proposed Plan to reduce their consumption and reduce the overall demand for water on our system.

Figure 3.29: Forecast of other components of demand



3.8 Total demand

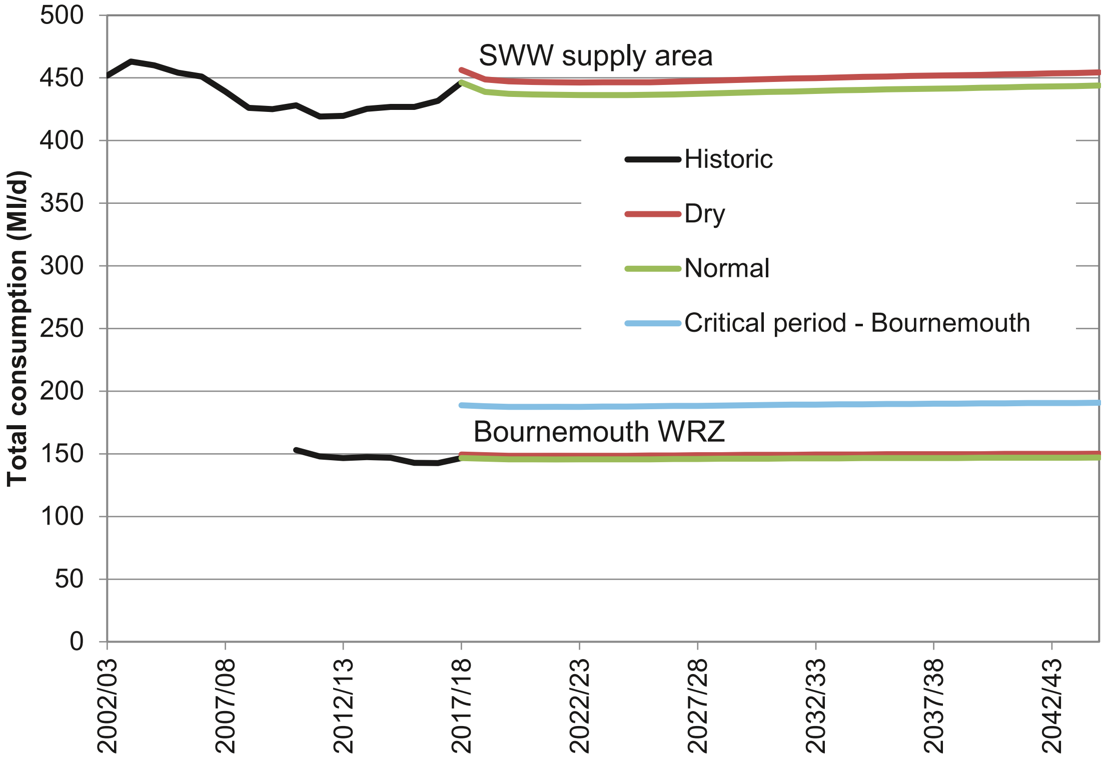
3.8.1 Summary of forecast demand

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 84 Ml/d in the SWW supply 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 WRZs.

We predict that total demand will initially fall slightly, initially driven by planned reductions in leakage over the period to 2020, and 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 fall from its current level of 446 Ml/d in the SWW supply area to 444 Ml/d, while remaining relatively flat at around 147 Ml/d in the Bournemouth WRZ. Our total forecast demand is shown in Figure 3.30.

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

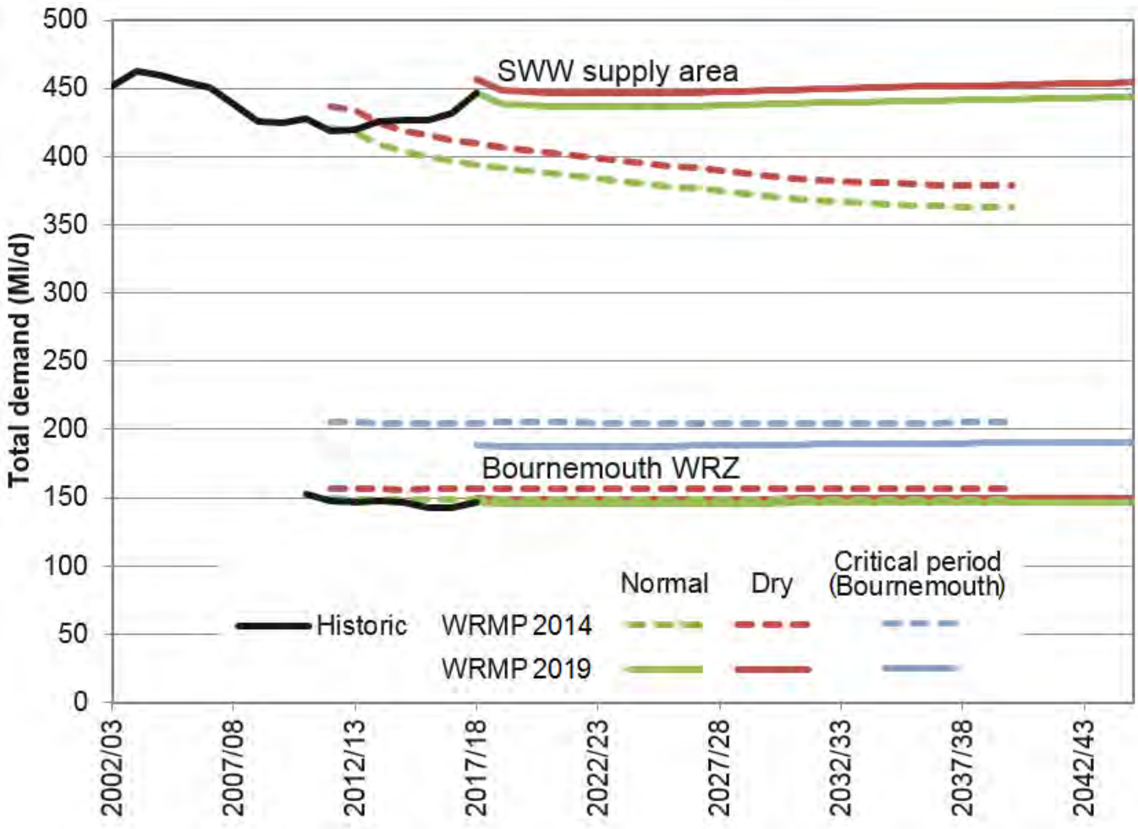
Figure 3.30: Total baseline demand forecast



For comparison purposes, Figure 3.31 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 the SWW supply area. 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 the decision-making process on leakage reduction more transparent.

Figure 3.31: Total baseline demand forecast shown against 2014 WRMP forecasts



3.8.2 Profile of annual demand

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 because of freezing and subsequent leakage. However, in all our WRZs, this level of demand has historically always been similar to or 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 actions that we plan to undertake before our 2024 WRMP 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 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 challenge that higher (or lower) demand has on our 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'[4.1]. 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] Environment Agency (June 2012), *Water Resources Planning Guideline*

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"[4.2] 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 summarised in Table 4.2. For comparison purposes, the assumptions made for the WRMP14 headroom analysis are also shown.

[4.2] UKWIR (2003), *An Improved Methodology for Assessing Headroom*

Table 4.2: Summary of assumptions informing the headroom analysis – WRMP14 and WRMP19

Factor	WRMP14	WRMP19
	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 WRZs.	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	SWW: no allowance included: groundwater DO assessments use actual pumping rates rather than nominal pumping capacities or groundwater sources are constrained by licence. BW: main groundwater sources constrained by licence therefore this component does not apply.	No change.
S6/2 - Meter uncertainty for licence critical sources	SWW: 95% probability that the reading is within ±5%. Error is distributed normally around a mean of 0 Ml/d. BW: standard deviation of ±2% of the total DO, distributed normally around a mean of 0 Ml/d.	No change for SWW. Bournemouth WRZ uncertainty increased to ±5%.
S6/3 - Uncertainty for aquifer constrained groundwater sources	SWW: no allowance included: Wimbleball WRZ 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	SWW: 95% probability that the value is within ±10%. Error is distributed normally around a mean of 0 Ml/d. BW: not included.	No change for SWW. Same uncertainty applied to Bournemouth WRZ.

Factor	WRMP14	WRMP19
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	No allowance included.	No change.
	<u>Demand related</u>	
D1 - Accuracy of sub-component data	SWW: 95% probability that the recording is within ±2.5%. Error is distributed normally around a mean of 0 Ml/d. BW: standard deviation of ±2% distributed normally around a mean of 0 Ml/d.	No change for SWW. Bournemouth WRZ uncertainty increased to ±2.5%.
D2 - Demand forecast variation	SWW: triangular distribution starting with 0 variation in first year, leading linearly to ±15% at the end of the planning period. BW: uncertainty from the baseline demand forecast used.	No change for SWW. WRMP14 SWW uncertainty applied to Bournemouth WRZ.
D3 - Uncertainty of impact of climate change on demand	SWW: increase in consumption by 1% at the end of the planning period, ±20% for headroom – triangular distribution. BW: 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	SWW: assumed saving of 0.75 Ml/d every year throughout the planning period. Estimated pro rata on the basis of forecast DI between the three WRZs. Triangular distribution with 0 as most likely, ±10%. BW: not included.	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.

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[4.3]. 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.

The Wimbleball WRZ is a conjunctive use system. While there are no rainfall-runoff models for the surface water systems which dominate, the Otter Valley groundwater model does have a rainfall-runoff component.

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[4.4]. This is the case for our groundwater sites in the Otter Valley and this methodology was used to produce monthly yields for our groundwater sources. This identified that the impact was negligible due to the high storage in the sandstone aquifer. These groundwater yield profiles were then input into our conjunctive use models in order to model climate change impacts on WAFU for each WRZ.

Further details of the methodology are provided in Appendix 4.

[4.3] Environment Agency, June 2016. *Estimating impacts of climate change on water supply*
[4.4] *Ibid. 4.3*

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 or Critical Period 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. WAFU, demand and headroom for each of our WRZs is presented in Section 5.

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[4.5] which promote the use of a glide path approach. The level of risk allowed for in the short-term is consistent with Ofwat requirements[4.6] 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 this whilst taking wider factors into 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.

[4.5] Environment Agency and Natural Resources Wales (2017), *Interim WRPG update, FINAL-April 2017*
[4.6] 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)	0.96	2.67	4.57	6.52	8.57	10.97	**13.68**	16.91	21.61
Roadford WRZ (Ml/d)	2.36	4.88	7.62	10.20	13.01	16.38	**20.38**	25.26	32.05
Wimbleball WRZ (Ml/d)	0.38	1.32	2.33	3.37	4.46	5.65	**7.10**	8.99	11.68
Bournemouth WRZ DYAA (Ml/d)	1.84	3.73	5.84	7.97	10.52	13.15	**15.92**	19.20	24.54
Bournemouth WRZ DYCP (Ml/d)	2.29	4.51	6.87	9.32	12.12	15.27	**18.36**	22.70	29.11

** 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

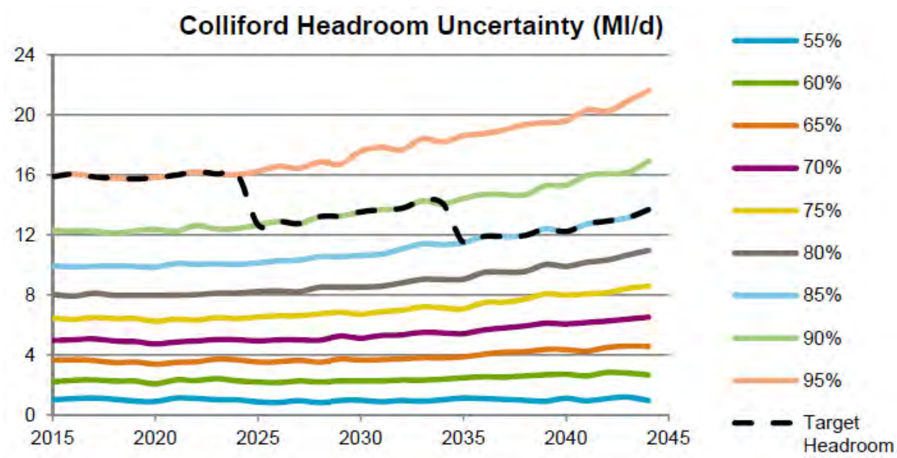


Figure 4.1b: Headroom uncertainty and varying risk percentiles and target headroom for Roadford WRZ

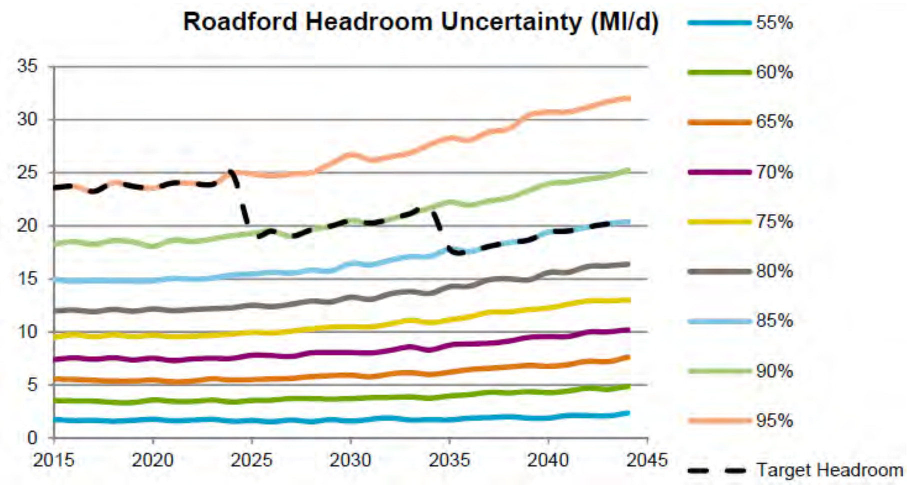


Figure 4.1c: Headroom uncertainty and varying risk percentiles and target headroom for Wimbleball WRZ

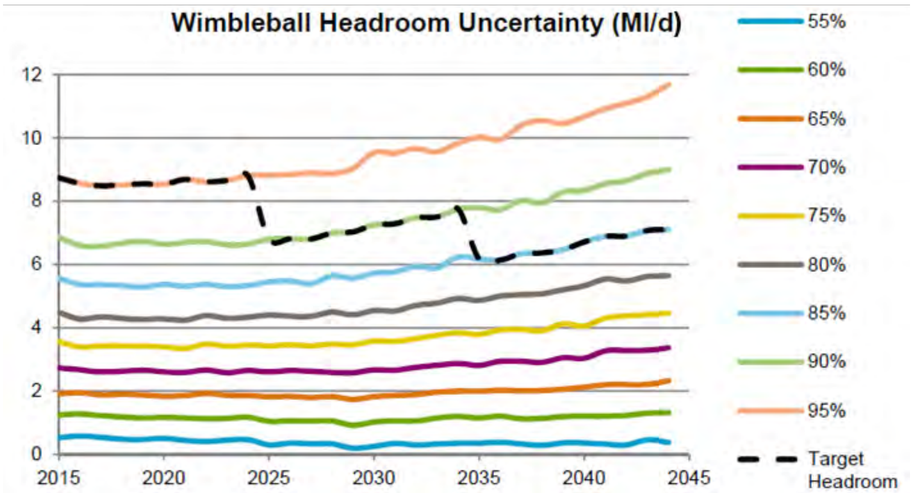


Figure 4.1d: Headroom uncertainty and varying risk percentiles and target headroom for Bournemouth WRZ DYAA

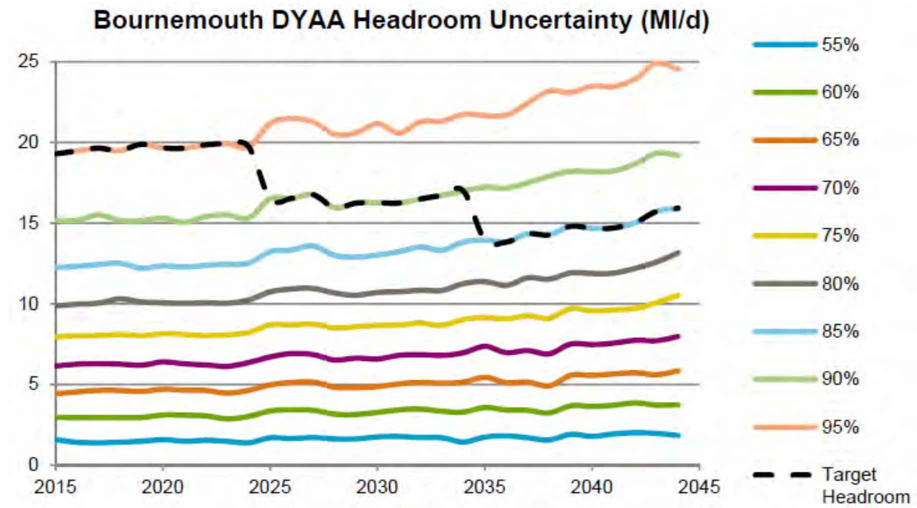
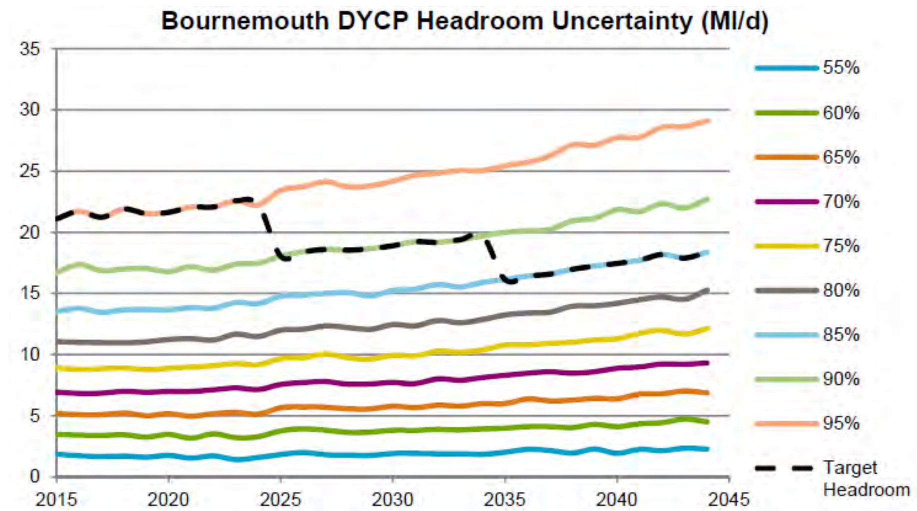


Figure 4.1e: Headroom uncertainty and varying risk percentiles and target headroom for Bournemouth WRZ DYCP



4.2.3 Target headroom and the impact of individual components

We have used a Monte Carlo approach to the assessment of target headroom in accordance with the guideline[4.7]. 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 misleading. The sum of headroom values calculated from individual Monte Carlo

[4.7] *Ibid.* 4.3

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 significance 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, accuracy of supply side data) 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 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.

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

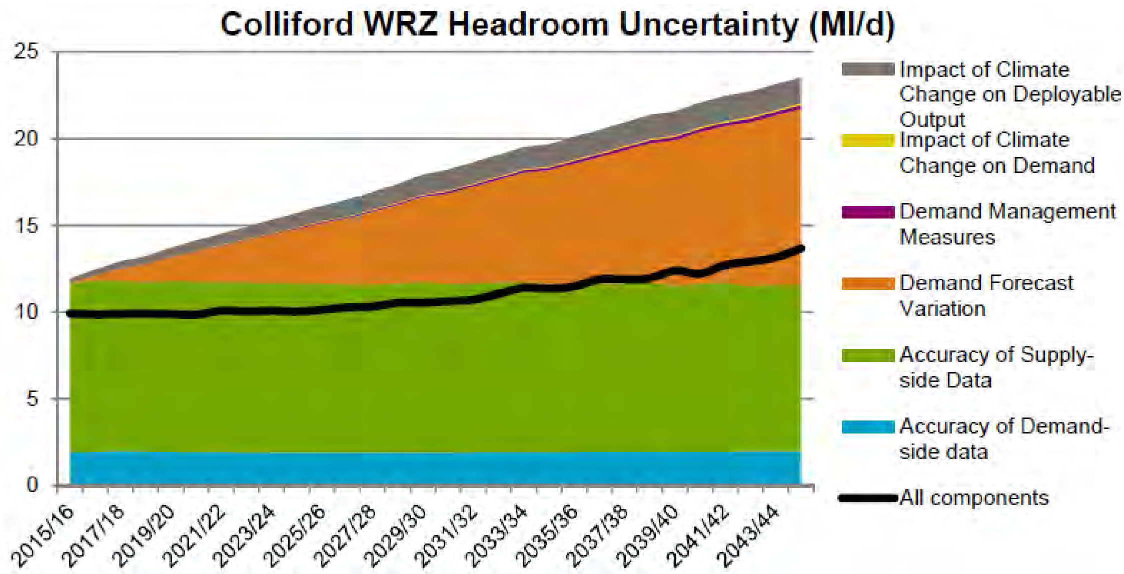


Figure 4.2b: Relative contributions of different components to target headroom for Roadford WRZ

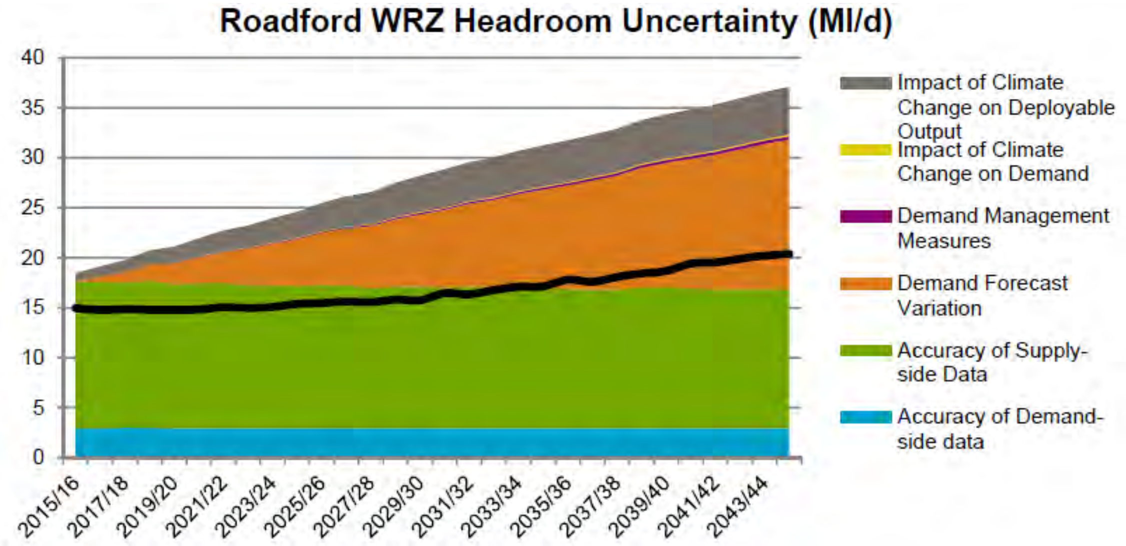


Figure 4.2c: Relative contributions of different components to target headroom for Wimbleball WRZ

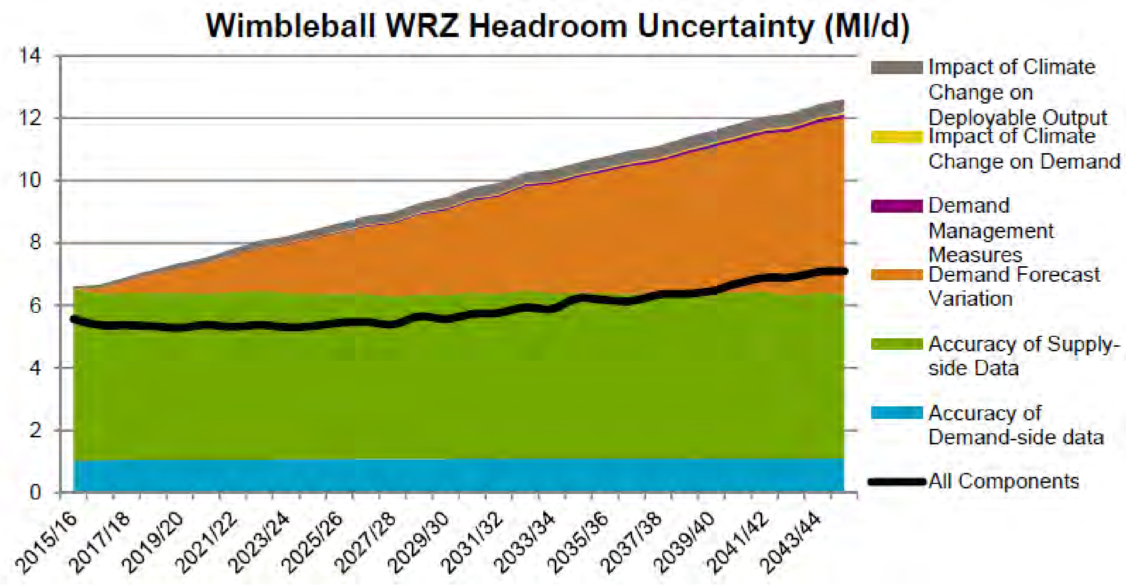


Figure 4.2d: Relative contributions of different components to target headroom for Bournemouth WRZ DYAA

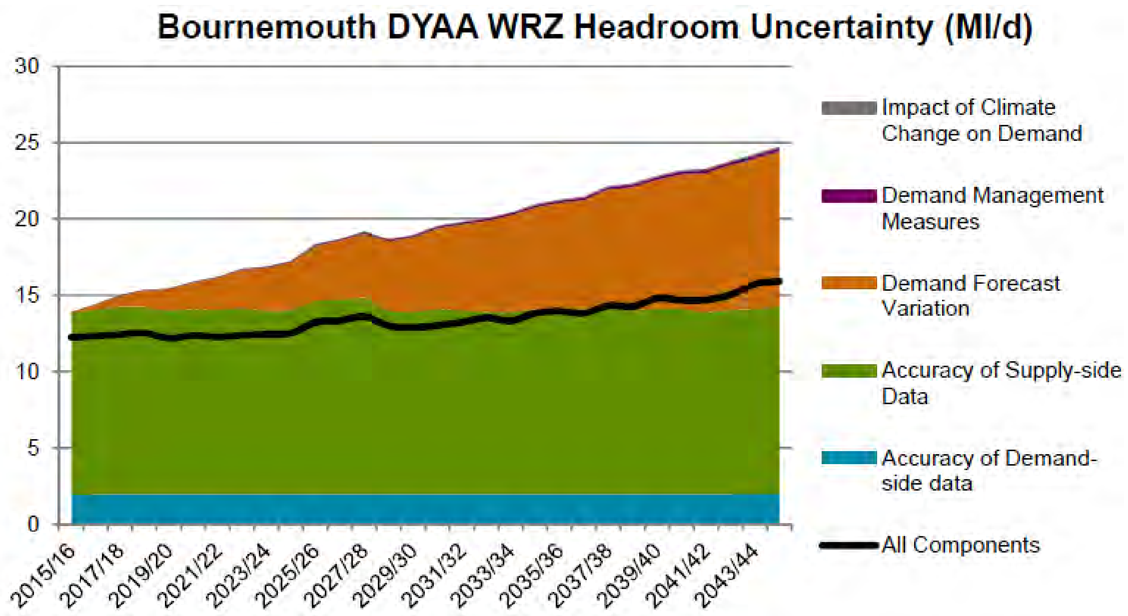
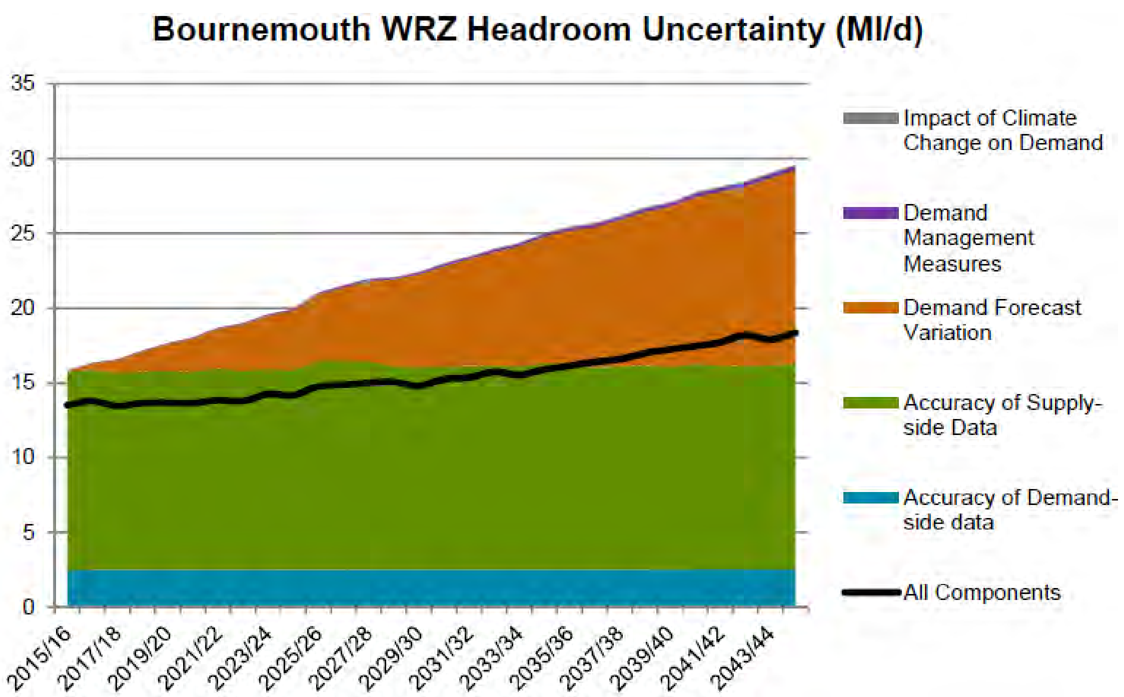


Figure 4.2e: Relative contributions of different components to target headroom for Bournemouth WRZ DYCP



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 Water Resources Planning Guideline[4.8]. 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 over the forecast period of demand uncertainty and the accuracy of supply side data 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 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 WRMP19 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 WRMP19 headroom analyses, in order to provide a like for like comparison.

[4.8] *Ibid.* 4.3

Table 4.4: Headroom allowance summary and comparison with previous results

WRZ	Headroom allowance in WRMP14 (Ml/d)		Headroom allowance in WRMP19 (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	15.87	13.68
Roadford	23.72	21.52	23.59	20.38
Wimbleball	6.66	7.50	8.73	7.10
Bournemouth (DYAA)	2.40*	3.90*	19.29	15.92
Bournemouth (DYCP)	2.80*	5.50*	21.10	18.36

** 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 WRMP19 headroom values for the 95th and 85th percentiles, overall the headroom allowance for WRMP19 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 WRMP19 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 WRMP19.

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	2.6	9.8
Roadford	3.9	28.7	5.0	19.2
Wimbleball	4.2	31.5	1.5	5.4
Bournemouth (DYAA)	N/a	N/a	0	0.5
Bournemouth (DYCP)	N/a	N/a	0	0.5

4.3.2 Changes to assumptions for individual components for 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 WRZ did not take into account S6/4. We have included S6/4 in the WRMP19 headroom analysis for Bournemouth WRZ because this component represents uncertainty in flow estimation. 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.

As shown in Section 5, however, the increase in target headroom for Bournemouth WRZ between WRMP14 and WRMP19 does not cause the baseline supply demand forecast to go into deficit at any point in the planning period.

5. Baseline position

- Our Final Plan includes our updated demand and supply forecasts
- Our baseline forecasts show that Colliford and Bournemouth WRZs are in surplus throughout the planning period even with no intervention
- With no intervention, Wimbleball WRZ is in surplus until the very end of the planning period with a minor deficit of 0.7 Ml/d in 2044/45
- Roadford WRZ drops into deficit in 2028/29 and remains in deficit from then until the end of the planning period if no intervention were made

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 SWW WRZs is higher than previously forecast, due to the levelling out of long-term trends of reducing household and non-household consumption that had been observed when we produced our last plan
- 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*

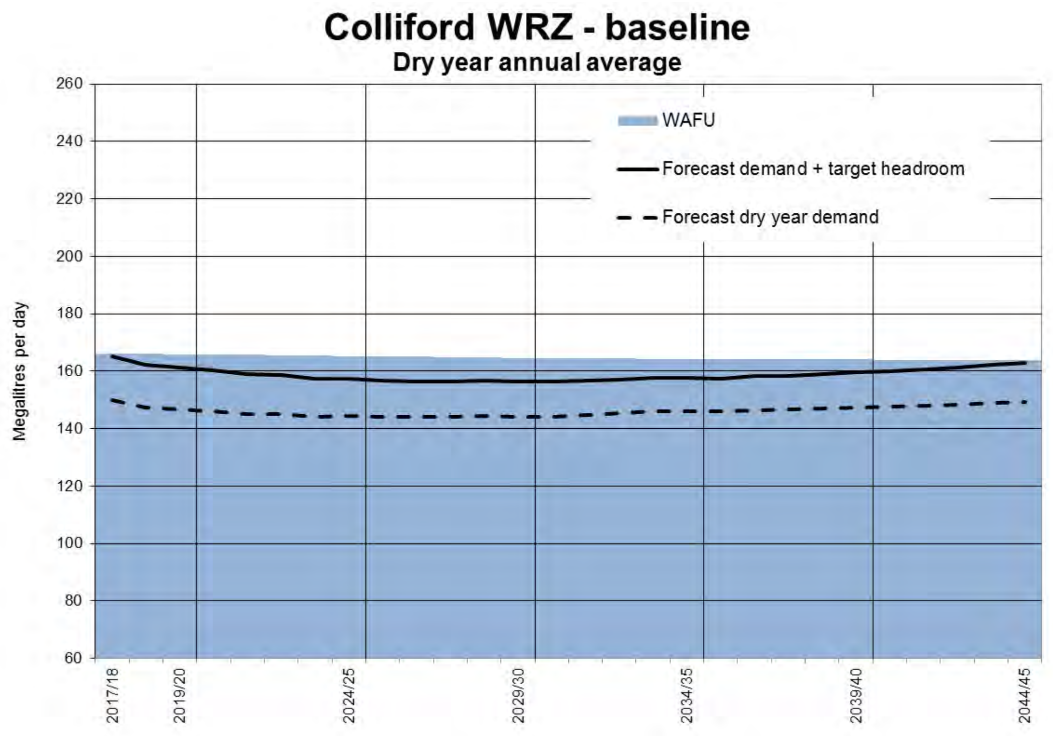
Other changes to target headroom between WRMP14 and this Plan are summarised in the relevant sub-sections below and described in more detail in Section 4.

The charts 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 with no intervention, resulting in the WAFU remaining above demand plus target headroom throughout the planning period.

Figure 5.1: Colliford WRZ baseline supply demand position



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.

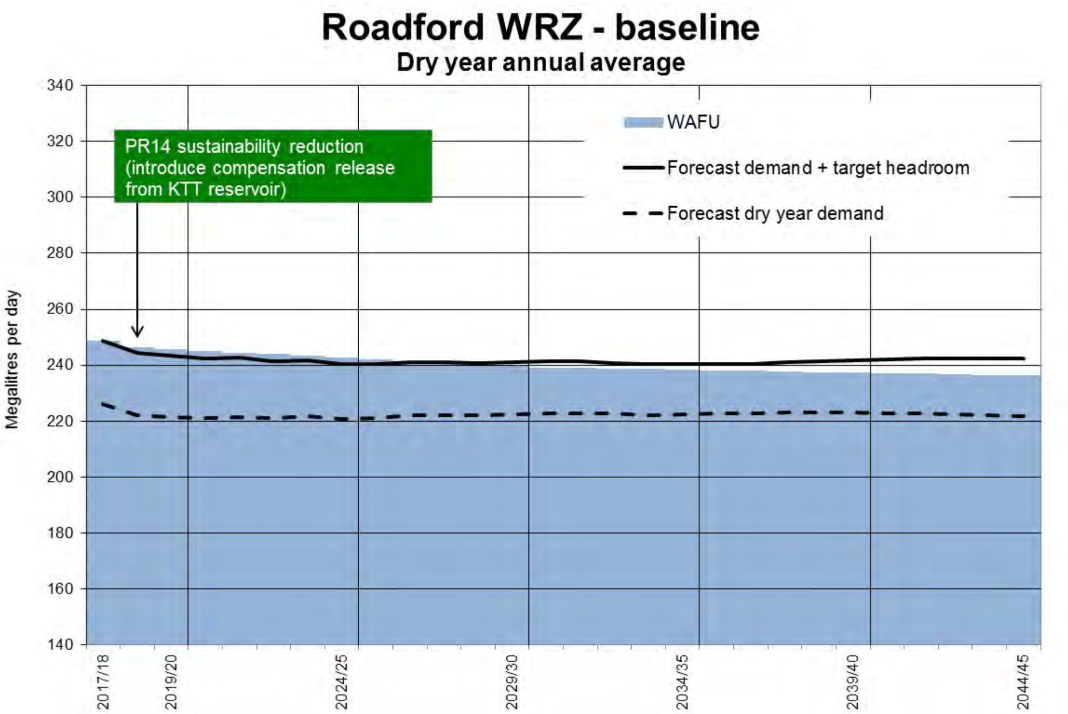
Target headroom has increased between WRMP14 and this Plan, the main reason for this increase being the change to the acceptable level of risk selected (as described in Section 5.1 above and in Section 4).

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.

5.1.2 Roadford WRZ

Figure 5.2 below shows how forecast demand plus target headroom in Roadford WRZ compares to the WAFU. 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.

Figure 5.2: Roadford WRZ baseline supply demand position



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

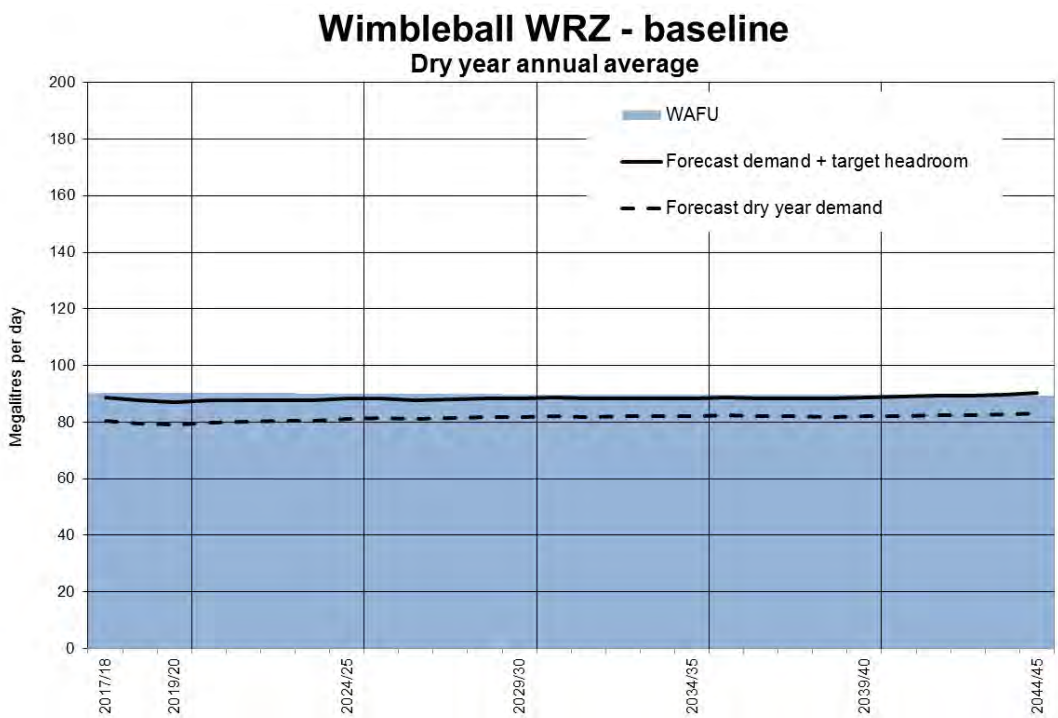
Target headroom has increased between WRMP14 and this Plan, the main reason for this increase being the change to the acceptable level of risk selected (as described in Section 5.1 above and in Section 4).

The increases in demand and target headroom in this Plan have resulted in this WRZ dropping into deficit in 2028/29 and remaining in deficit from then until the end of the planning period if no intervention were made. This compares to a small surplus in the Draft Plan. The deficit occurs due to the higher baseline demand.

5.1.3 Wimbleball WRZ

Figure 5.3 below shows how forecast demand plus target headroom in Wimbleball 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 by 2044/45 (0.7 Ml/d) if no intervention were made.

Figure 5.3: Wimbleball WRZ baseline supply demand position



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

Target headroom has increased between WRMP14 and this Plan, the main reason for this increase being the change to the 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, with a minor demand deficit by 2044/45 (0.7 Ml/d). This compares to a small surplus in the Draft Plan.

5.1.4 Bournemouth WRZ

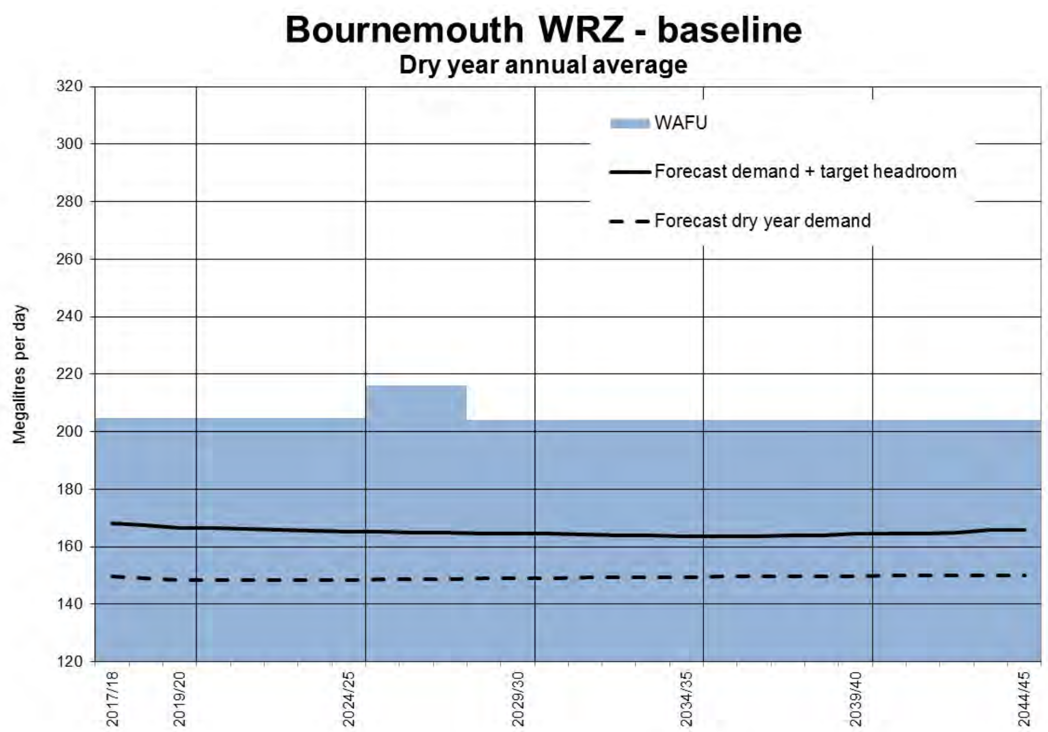
In the BW supply area both the DYAA and DYCP WAFU have decreased between WRMP14 and WRMP19. For this Plan, we did a full review of WTW capacities and WTW losses and operational use. This showed that during the peak demand period infrastructure constraints limit our WAFU. See Section 2.7 for details.

Target headroom has increased between 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.

Figure 5.4: Bournemouth WRZ baseline supply demand position - DYAA



There is no impact of climate change on WAFU throughout the planning period. WAFU increases in 2025/26, as a result of improvements at key WTWs in this WRZ, which will both increase WTW capacity and reduce raw water losses. This investment was confirmed as part of the PR19 Business Plan submission which was completed after publication of the Draft WRMP. There is a drop in WAFU in 2028/29 due to a reduction in the weekly licence limit on one of the abstraction licences.

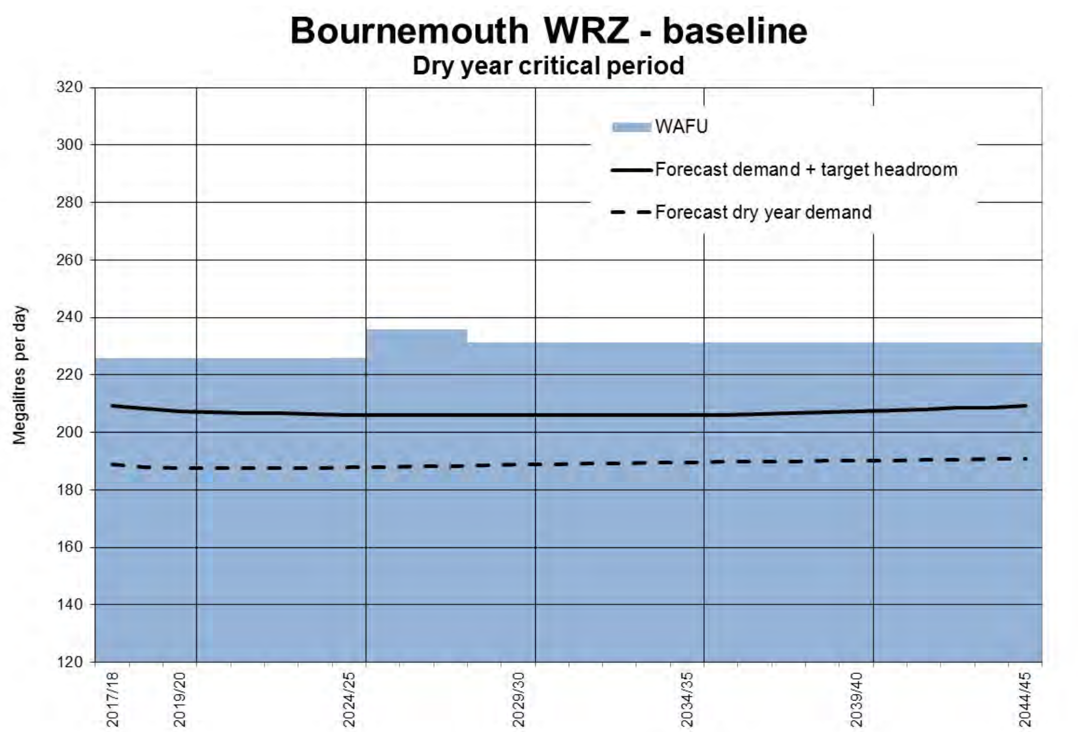
The decrease in WAFU and the increase in target headroom have resulted in a smaller supply demand surplus in this Plan.

Between the Draft and Final Plan Southern Water confirmed the need for a new water transfer. The improvements at key WTWs in Bournemouth WRZ result in sufficient surplus to provide Southern Water with a 20 Ml/d transfer, which is planned to come on line in 2027/28. The effect of this transfer on the supply demand balance is shown in the final strategy charts in Section 8.8.

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.

Figure 5.5: Bournemouth WRZ baseline supply demand position - DYCP



There is no impact of climate change on WAFU throughout the planning period. WAFU increases in 2025/26, as a result of improvements at key WTWs in this WRZ, which will both increase WTW capacity and reduce raw water losses. As stated in Section 5.1.4.1 above, this investment was confirmed as part of the PR19 Business Plan submission which occurred after the Draft WRMP submission. 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.

Between the Draft and Final Plan Southern Water confirmed the need for a new water transfer. The improvements at key WTWs in Bournemouth WRZ result in sufficient surplus to provide Southern Water with a 20 Ml/d transfer, which is planned to come on line in 2027/28. The effect of this transfer on the supply demand balance is shown in the final strategy charts in Section 8.8.

5.2 Baseline plan performance

With the exception of a very small deficit at the very end of the planning period in Wimbleball WRZ, Colliford, Wimbleball and Bournemouth WRZs are all in surplus. Roadford WRZ drops into deficit in 2028/29 and remains in deficit until the end of the planning period if no intervention were made.

Feedback on the Draft WRMP was that customers and stakeholders would like to see a 15% reduction in leakage by 2025 and supported our long-term reduction of c25%. The reduction in leakage will ensure that all our WRZs will be in surplus throughout the planning period, without the need for any other supply or demand options.

Notwithstanding this, in Section 7 we stress test the supply demand balance to different uncertainties or policy choices. We have done this through a range of scenario tests.

Even though the required leakage reduction negates the need for any other demand or supply options, 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 and approach

In the previous chapters we have assessed our available supply against our forecast demand to give an understanding of our forecast baseline supply 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 dry year critical period. There is therefore no need for us to distinguish between options in respect of these scenarios.

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

We have not explicitly considered options to reduce outage for water resources planning. Our outage is already very low and we forecast no supply demand deficit, as a result of our proposed leakage and water efficiency programme. We have a PR19 performance commitment on outage and therefore there is no additional risk to security of supply.

6.1.1 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 are based on the UKWIR WR27 water resources planning tools project[6.3].

[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

We divided the different types of options into the following categories:

(i) Interconnection with neighbouring water companies and water trading options
(ii) Customer side management options (reducing demand)
(iii) Customer side management options (metering)
(iv) Distribution side management options (including managing leakage)
(v) Distribution expansion and production side management options (increasing supply)
(vi) Resource management options (increasing supply)

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

For each category, 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.

6.1.2 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 feasible options appropriate to the circumstances relevant to our WRZs, screening criteria need to be derived and applied.

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

Figure 6.1: Screening approach to identify feasible options

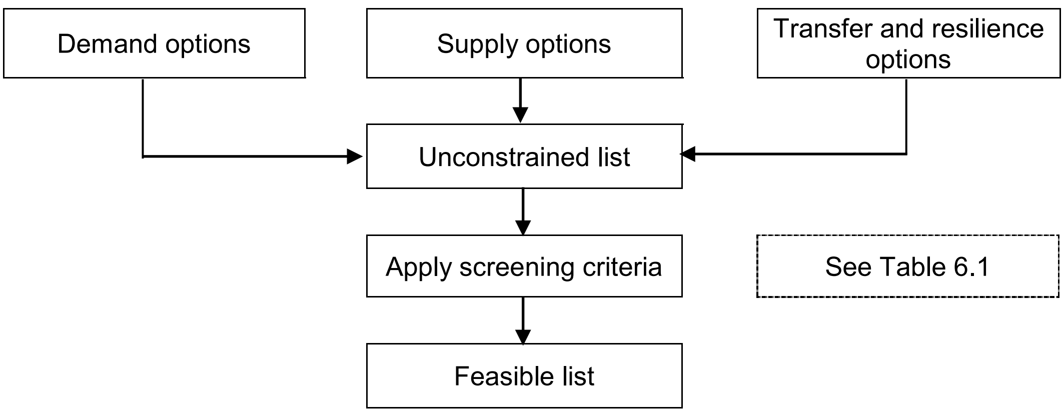


Table 6.1: Screening criteria

Theme	Screening criteria	Reason for rejection
Demand, 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 likely material objections from interested parties; or where poor take-up from customers would be expected
	5. Flexibility	The option does not allow flexibility to deal with changing circumstances
Supply and transfer options only	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 option
	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
Demand options only	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 allow better 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 with 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[6.4]

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

[6.4] *Innovation: the option is not innovative or new to SWW.* We already undertake a range of low cost high benefit demand management measures. We want future schemes that are more innovative and deliver multiple benefits across affordability, vulnerability and improved customer service. For example, intensive targeting of water conservation information or targeting areas is something we already undertake as part of our Drought Plan and dry weather work so, in our opinion, is not providing sufficiently innovative future demand management options for the purposes of this Plan.

Our baseline supply demand position does not show significant supply demand deficit in three WRZs, but one WRZ (Roadford) has a deficit starting after the next planning period, from 2028/29, 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.

6.1.3 Commercially confidential information on options

No options or information on specific options have been withheld on the grounds of commercial confidentiality.

6.2 Options

6.2.1 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[6.5] report.

6.2.1.1 Conjunctive use and interconnection options with neighbouring water companies

6.2.1.1.1 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 provide a WAFU benefit across water company boundaries. Further development of strategic interconnections within our own WRZs is covered in Section 6.2.5.

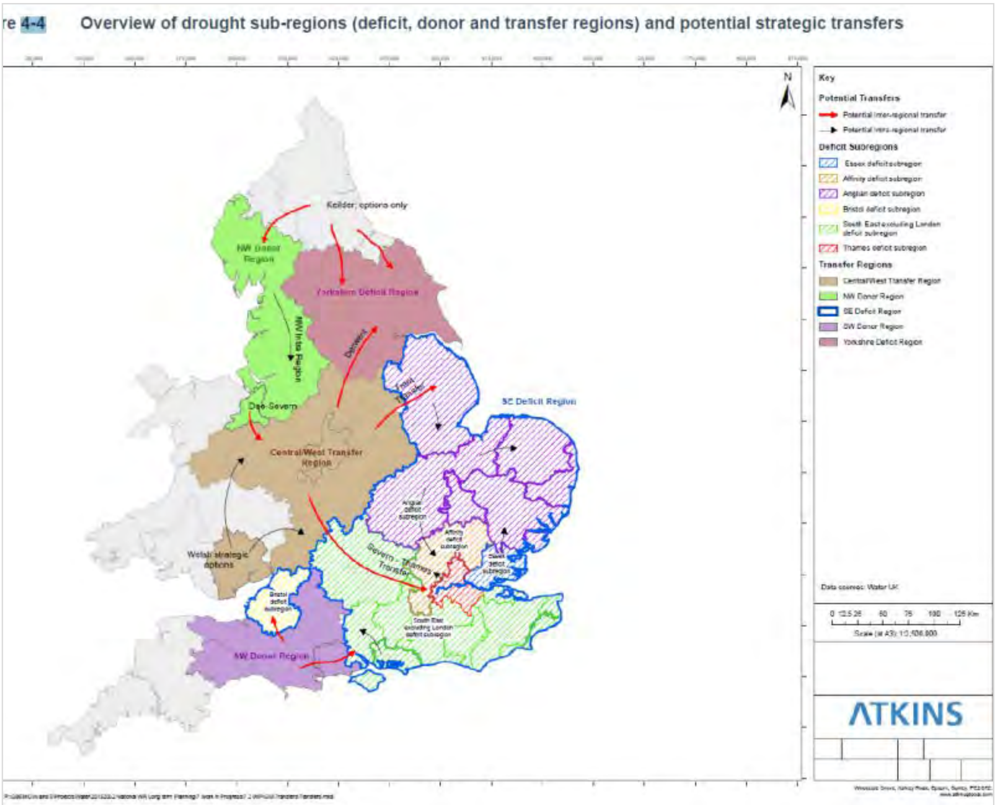
There are no boundaries with other water companies for Colliford WRZ. Roadford WRZ has a small boundary with Wessex Water over the Exmoor National Park, but no network connections in this area. Wimbleball WRZ has a boundary with Wessex Water. Bournemouth WRZ has a boundary with both Wessex Water and Southern Water.

[6.5] *Ibid.* 6.3

6.2.1.1.2 Water Resources Long Term Planning Framework, Water UK Report [6.6]

Water UK's report[6.7] 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 in Figure 6.2, the South West Donor region includes our Wimbleball and Bournemouth WRZs and indicates the potential to provide transfers to the South East Excluding London area (SEEL), as well as Bristol Water. SEEL includes Southern Water's area of supply.

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

6.2.1.1.3 Unconstrained options for interconnections with neighbouring water companies

As covered in Section 6.2, the UKWIR WR27 report[6.8] gives a framework for options relating to interconnection between water companies and water trading.

In 2017, taking into consideration the findings of the report, we worked with consultants[6.9] 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 via Wimbleball WRZ.

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 (up to 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
Combined Gunnislake and Northbridge options (up to 20 Ml/d)	R and W	Option GN1	Raw water link to Pynes and treated link to Taunton (up to 20 Ml/d) (combined G3 and N5)
		Option GN2	Raw water link to Taunton (up to 20 Ml/d) (combined G4 and N4)
Wessex Water to SWW resilience schemes	Wx	Option R1	Maundown to Tiverton treated water link main (10 Ml/d)
		Option R2	Taunton to Tiverton treated water link main (10 Ml/d)

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

Potential scheme	Donor WRZ	Reference number*	Description
		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 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
Wx Wessex Water
B Bournemouth WRZ

**The rejection of some initial options has resulted in 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 options (G3, G4, N2, N4, N5, N6, GN1, GN2)

The Gunnislake options are the most expensive of the options considered within this study, due to the longest transfer lengths of over 130 km, with indicative Average Incremental Cost (AIC) values of 234 - 243p/m^3 for options G3 and G4 (up to 15 Ml/d).

For the combined Gunnislake and Northbridge options, the cost effectiveness of these schemes increases, due to the increase in transfer volume from up to 15 Ml/d to up to 20 Ml/d, with indicative AIC values of 184 - 193p/m^3 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 (R1, R2, R4, R6, R7, R8)

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 (8 km)"*

Bournemouth WRZ bulk supply options (B1, B2, B3)

The available resources from the Bournemouth WRZ are currently constrained by WTW capacities. The available resource could be increased following significant investment at the WTWs. This is further covered in Sections 2.7 and 6.2.1.2.

For the purposes of this section, it is assumed investment will have occurred and that a potential transfer of the order of 20 Ml/d is available. Therefore, although three options were considered (B1, B2, B3), 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 58p/m^3 and would involve a 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

None of these potential additional costs were included within the AICs for these options. Further details on these options are provided in Section 6.2.1.2.

6.2.1.1.4 *Infeasible or rejected interconnection options 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.

All options were screened using the criteria in Table 6.1, 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 in Table 6.3, along with the reasons for these options not being considered further.

Table 6.3: Summary of infeasible or rejected interconnection options with neighbouring water companies

No.	Option	Reason for rejection[1]															
		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
G3 and G4	Gunnislake to Wessex Water Bulk Supply Options	R	X	X	X	X		X	X								
N2, N4, N5 and N6	Northbridge to Wessex Water Bulk Supply Options	W	X	X	X	X		X	X								
GN1 and GN2	Combined Gunnislake and Northbridge Options	R and W	X	X	X	X		X	X								
R1, R2, R4, R6, R7 and R8	Wessex Water to SWW Resilience Schemes	W	X	X	X	X		X	X								

[1]*See Table 6.1 for "reason for rejection" descriptions.*

South West Water Bournemouth Water

6.2.1.1.5 Feasible interconnection options with neighbouring water companies

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 options with neighbouring water companies

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)

Throughout 2018, these potential schemes have been subject to on-going discussion and development with Southern Water. Details on the current understanding of the form and viability of these options is provided below.

6.2.1.2 Bournemouth WRZ to Southern Water transfer

6.2.1.2.1 Transfer scheme development

In order to meet the requirements of the Water Framework Directive (legislation which supports leaving more water in the environment), Southern Water will see a large reduction in the amount of water it is able to abstract during a drought. This will come into force in 2027, leaving Southern Water with a deficit in their Western area, which borders the Bournemouth WRZ.

Our forecasts show a surplus in our Bournemouth WRZ, offering the potential to transfer water to Southern Water and help alleviate their deficit. To investigate this potential further we undertook a high-level study of this, and other, inter-company transfer options to support our Draft Plan. Following this, we commissioned Atkins to complete a second stage study to further develop the transfer options, working with Southern Water and Wessex Water. The major aspects that this study considered were:

- A transfer from our Bournemouth WRZ
- The use of our network within the Bournemouth WRZ to transfer 15 Ml/d from Wessex Water
- Pipe routing options, particularly with consideration to avoiding the New Forest National Park
- The advantages and disadvantages of treated and raw water transfers

The findings of this study were presented at a meeting of the West Country Water Resources Group on 22nd May 2018, and details of the possible options identified were passed to Southern Water on 15th June.

A summary of the feasible options is shown in Table 6.5.

Table 6.5: Feasible options for a transfer to Southern Water

Scheme	Maximum transfer volume (Ml/d)	Transfer to Southern Water	Capital Cost Estimate (£m)
1	20	20 Ml/d from Bournemouth WRZ	101
2	35	20 Ml/d from Bournemouth WRZ + 15 Ml/d from Wessex Water	144
3	45	20 Ml/d from Bournemouth WRZ + 15 Ml/d from Wessex Water + 10 Ml/d from additional surplus	167

The availability of a 20 Ml/d transfer is subject to the upgrade of a major WTW in the Bournemouth WRZ, which is included in our Business Plan for completion between 2020 and 2025. We expect this upgrade to reduce process losses at the site by around 8 Ml/d, which in addition to the unused abstraction licence volume, will support this transfer.

Southern Water has confirmed that the 20 Ml/d transfer from our Bournemouth WRZ has been selected for their plan, with a start date of 2027. The cost of this scheme is included in their plan, and no costs appear in our WRMP. The size of the scheme means it meets the Direct Procurement for Customers threshold and could also be delivered through a 3rd party market provider.

6.2.1.2.2 Scheme design and feasibility work

There is significant additional design and feasibility work needed before the transfer could be promoted, and details are included in the Southern Water plan. Most notable is the need for a WFD no-deterioration study; discussions with the Environment Agency regarding this commenced in May 2018, with a view to understanding what this should contain. The outcome of this investigation will be important to understand if water can be shared between the two companies.

This scheme would create a major link between Southern Water's supply area and the Bournemouth WRZ, which is already linked to Wessex Water's supply area through a resilience main. Therefore, work will also be needed to model the way in which the different company supply systems can be operated conjunctively to optimise efficiency and resilience. Detailed design of the scheme will also need to examine further opportunities to make water available e.g. through the supply of non-potable water to non-household customers.

The proposed transfer does not affect our final strategy; we have no proposed water resource schemes and the drivers for the chosen demand management options are unaffected by the transfer. Our Final Plan is therefore not sensitive to a decision for or against the transfer.

6.2.1.2.3 Transfer reliability

The supply system in the Bournemouth WRZ has no material raw water storage to buffer periods of peak demand, so is therefore constrained by critical period demand. Whilst there is potential for more water available on annual average conditions, from a licence and water resource availability perspective, the system cannot sustain transfers greater than 20 Ml/d without causing a supply demand deficit in the WRZ.

Tables 6.6 and 6.7 set out the total raw water available and the WAFU (i.e. after taking account of losses, outage and existing exports) in the Bournemouth WRZ after the WTW improvement works have been completed and after a reduction to the limits on one of Bournemouth WRZ's abstraction licences comes into force in 2028.

Post-2028, demand plus target headroom is forecast to be highest at the end of the WRMP19 planning period, at 214.13 Ml/d. WAFU is 235.86 Ml/d. Therefore, the supply demand balance is forecast to be 21.73 Ml/d in surplus.

Table 6.6: Total raw water available from 2028 in the Bournemouth WRZ

Source	WTW	Available abstraction (Ml/d)
Stour (Longham)	WTW B	31.82
Avon (Matchams)	WTW B	63.65
Avon (WTW A)	WTW A	113.65
Stanbridge	Stanbridge	12.50
Ampress	Ampress	2.73
Hale (Woodgreen)	Woodgreen	17.55
Total raw water available		**241.90**

WAFU is summarised in Table 6.7 below.

Table 6.7: Total WAFU in the Bournemouth WRZ

WAFU component	Volume (Ml/d)
Total raw water available	241.90
Losses (assume 3%)	7.26
Outage	1.93
Existing exports	1.27
Total WAFU	**231.44**

6.2.2 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.

6.2.2.1 Third party options

Our Company website contains a specific area for the development and delivery of markets for both water resources and bioresources. (https://www.southwestwater.co.uk/commercial-services/bioresources/).

For water resources this includes the publication of our water resources data. We have also developed a clear and transparent process for third parties to bid into our current and future plans (https://www.southwestwater.co.uk/commercial-services/bioresources/water-resources-market-opportunities/).

This process sets out the details of our future plans and allows third parties to bid for either supply or demand-side schemes.

We have used this process, as it ensures that all potential third parties are treated equally with no undue preference or discrimination. We consider this is appropriate for the potential development of a future bilateral market.

We have had one contact for a potential third party option during 2018 – Hawks Tor Lake in Cornwall. We have contacted the potential provider for details on the site. Subject to assessment of the option, we will look to include this in future plans, but it will not feature in this Final Plan because the available licensed quantities and sustainable yield have yet to be determined.

Our Draft Plan had no planned supply-side schemes and Section 8 of our Final Plan confirms this. As such, the opportunity for third party options is less than in other parts of the country where supply schemes are planned. However, the following sections set out details of how we are looking to use the market for the actual delivery of our Plan.

6.2.2.2 Bid assessment framework

We have produced and published our bid assessment framework (https://www.southwestwater.co.uk/commercial-services/bioresources/).

This sets out how we will look to procure supply-side and demand-side interventions going forward. Specifically, this confirms which solutions within our Plan we will look for third party delivery for. This includes the leakage and water efficiency parts of our Plan.

6.2.2.3 Direct Procurement for Customers

Direct Procurement for Customers (DPC) has the potential to benefit customers by providing an option for delivering the largest and most expensive new assets at lower cost, and allows scope for greater innovation, allowing new providers to offer new ideas.

We instructed KPMG to undertake an independent assessment for the opportunities for DPC in our Plan. This assessed the opportunity for DPC on two key WTW investments in AMP7/8. These sites removed the current constraint on WTW capacity that constrains a transfer from Bournemouth WRZ to Southern Water.

Details of the assessment are given in Appendix 6.

In addition, Section 8 of this Plan confirms a 20 Ml/d transfer to Southern Water in 2027. This scheme is of sufficient size to potentially be suitable for third party delivery, or part of the National Infrastructure Commission's (NIC's) recommendation for a new market in water transfers in 2019. Whilst the costs of this scheme are not included in our Plan, we will work with Southern Water and other parties on any third party delivery option for this scheme.

6.2.3 Customer side management options (reducing the demand for water)

The *Guiding principles for water resources planning*[6.10] 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.

6.2.3.1 Unconstrained list of customer side management options (reducing the demand for water)

As described in Section 6.1, the UKWIR WR27 report[6.11] gives a framework for options relating to customer side management options, which are aimed at reducing 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 looking at 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 Table 6.8 below.

[6.10] Defra (2016), *Guiding principles for water resources planning*
[6.11] *Ibid.* 6.3

Table 6.8: Unconstrained list of customer side management options (reducing the demand for water)

Ref.	Option description
CU14	Introduction of special fees
CU15	Seasonal tariffs
CU16	Rising block tariffs
CU17	Time of day tariffs
CU18	Charge only above a defined subsistence level
CU19	Premium applied to unmeasured tariff
CU20a	Retrofit (metered)
CU20b	Retrofit (unmetered)
CU20c	Retrofit (metered+leaky loos fix)
CU20d	Retrofit (unmetered+leaky loos fix)
CU20e	Retrofit (metered+leaky loos fix, 1,500 properties per annum)
CU21	Social housing retrofit
CU22	Social housing showers installation
CU23	Combined energy and water retrofitting
CU24	Holiday rental homes retrofit programme
CU25	Intensive targeting of areas
CU26	Holiday home rental water efficiency
CU28	Targeted water conservation information
CU29	Public sector and recreation facilities water efficiency advice
CU30	Industrial/commercial customer water efficiency advice
CU31	Long term water efficiency communications
CU32	Demonstration gardens
CU33	Adolescents showering campaign
CU34	Council and community landscape redesign advice
CU35	Community/religious groups to promote water efficiency advice
CU36	Holiday rental homes water advice pack
CU37	Holiday rental homes and hotels bespoke billing materials
CU38	Irrigation advice
CU39	Leak alarm devices
CU40	Leaky loos fixing
CU41	Social housing leaky loos fixing
CU42	Bill reductions for water efficient device fitting
CU43	Smart shower monitor
CU44	Rebates on water efficient fixtures and fittings
CU45	Free water butts

Ref.	Option description
CU46	Invest to save schemes
CU47	Shower head exchange
CU48	Extension of free water saving devices for user self-install
CU49	Domestic rainwater harvesting system in new build households
CU50	Rainwater harvesting systems in commercial developments
CU51	Grey water harvesting systems in commercial developments
CU52	Grey water harvesting systems in domestic developments
CU53	Community decentralised water source subsidies
CU54	Reduced infrastructure charge
CU55	Extension of existing WaterCare+ scheme and tariffs
CU56	Subsidising drought tolerant plants
CU57	Water saving incentives
CU58	Selective student enterprise
CU59	Level of service reduction
CU60	Community incentives
CU62	Social norms feedback on bills
CU61	Whole-town water efficiency
CU63	Engagement to reconnect customers to the environment
CU64	Engagement through gamification
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)
CU66	Non-household retail water efficiency

6.2.3.2 Infeasible or rejected customer side management options (reducing the demand for water)

All options were screened using the criteria in Table 6.1 to identify options that are considered not feasible for inclusion in our final planning scenario. The large number of options considered required an initial high-level appraisal against these criteria, before the most promising options were analysed in greater detail. A summary of the infeasible or rejected customer side management options is given in Table 6.9 below.

Table 6.9: Infeasible or rejected customer side management options (reducing the demand for water)

		Reason for rejection (See Table 6.1 for "reason for rejection" descriptions)																
No.	**Option**	**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	X		X	
CU15	Seasonal tariffs	All		X		X		-	-	-	-	X	X					
CU16	Rising block tariffs	All		X		X		-	-	-	-	X	X	X				
CU17	Time of day tariffs	All	X	X		X		-	-	-	-	X	X	X				
CU18	Charge only above a defined subsistence level	All		X		X		-	-	-	-	X	X	X	X			
CU19	Premium applied to unmeasured tariff	All				X		-	-	-	-	X	X	X	X			
CU22	Social housing showers installation	All		X				-	-	-	-			X				
CU23	Combined energy and water retrofitting	All		X				-	-	-	-			X	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				-	-	-	-						X	
CU30	Industrial/commercial customer water efficiency advice	All						-	-	-	-						X	X
CU31	Long term water efficiency communications	All						-	-	-	-					X	X	

South West Water
Bournemouth Water

		Reason for rejection (See Table 6.1 for "reason for rejection" descriptions)																
No.	**Option**	**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**
CU32	Demonstration gardens	All	X	X				-	-	-	-							
CU33	Adolescents showering campaign	All		X				-	-	-	-			X		X	X	X
CU34	Council and community landscape redesign advice	All	X	X				-	-	-	-							
CU35	Community/religious groups to promote water efficiency advice	All	X	X				-	-	-	-			X				
CU36	Holiday rental homes water advice pack	All						-	-	-	-							X
CU37	Holiday rental homes and hotels bespoke billing materials	All		X				-	-	-	-							X
CU38	Irrigation advice	All	X	X				-	-	-	-							
CU39	Leak alarm devices	All						-	-	-	-			X		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

South West Water
Bournemouth Water

No.	Option	**Reason for rejection** (See Table 6.1 for "reason for rejection" descriptions)																
		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
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		-	-	-	-			X				
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		-	-	-	-			X				
CU53	Community decentralised water source subsidies	All		X				-	-	-	-			X	X			
CU55	Extension of existing WaterCare+ scheme and tariffs	All						-	-	-	-							X
CU56	Subsidising drought tolerant plants	All	X	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	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				-	-	-	-							

6.2.3.3 Feasible customer side management options (reducing the demand for water)

Options that are feasible and we have determined could form part of our final planning scenario are summarised in Table 6.10 below.

Table 6.10: Feasible customer side management options (reducing the demand for water)

Ref.	Option description
CU20a	Retrofit (metered)
CU20b	Retrofit (unmetered)
CU20c	Retrofit (metered+leaky loos fix)
CU20d	Retrofit (unmetered+leaky loos fix)
CU20e	Retrofit (metered+leaky loos fix, 1500 properties per annum)
CU21	Social housing retrofit
CU26	Holiday home rental water efficiency
CU54	Reduced infrastructure charge
CU60	Community incentives
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)
CU66	Non-household retail water efficiency

A description of the each of the feasible options is given in Section A.6.3.1.

Information on the cost of each option is shown in the accompanying tables to this report. The cost information is also summarised in Section 6.3.

6.2.4 Managing leakage

The *Guiding principles for water resources planning*[6.12] 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.

6.2.4.1 Feasible leakage reduction options

In Section A.6.4, we present in Table A.6.16 the leakage reduction options in each WRZ in incremental 1.1 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.

The Final Plan is also presented, being a combination of:

- The innovative schemes to support Active Leakage Control (ALC)
- ALC towards the 15% reduction for year 5 and further reductions thereafter.

A summary of these options is given in Table 6.11 below.

[6.12] *Ibid.* 6.9

Table 6.11: Feasible leakage reduction options

Reference number	Option name	WRZ	Description
LC – LB Innovation	Innovation	C R W B	Schemes supporting ALC
LC1- LC10	Steps 1 - 10 Colliford WRZ	C	Reduction of leakage from 32.8 to 21.6 Ml/d
LR1 – LR10	Steps 1- 10 Roadford WRZ	R	Reduction of leakage from 46.3 to 35.1 Ml/d
LW1 – LW4	Steps 1 - 4 Wimbleball WRZ	W	Reduction of leakage from 11.6 to 7.2 Ml/d
LB1 - LB4	Steps 1 - 4 Bournemouth WRZ	B	Reduction of leakage from 20.9 to 16.5 Ml/d
WFP C – WFP BW	WRMP Final Plans (ALC + Innovation)	C R W B	15% leakage reduction by 2025

Information on the costs of the option is shown in the accompanying tables to this report. The cost information is summarised in Section 6.3.

6.2.5 Metering

The Defra *Guiding principles for water resources planning*[6.13] ask companies to consider and demonstrate that we are supporting customers to manage demand. Our metering strategy contributes to this objective.

6.2.5.1 Unconstrained list of metering options

As described above, the UKWIR WR27 report[6.14] gives a framework for the unconstrained list of options, related 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.

The unconstrained list of metering options has been split between infeasible or rejected metering options (Section 6.2.5.2) and feasible metering options (Section 6.2.5.3).

[6.13] *Ibid.* 6.10
[6.14] *Ibid.* 6.3

6.2.5.2 Infeasible or rejected metering options

We rejected several of these options for reasons such as customer acceptability and cost. The rejected options and the reasons for their rejection are shown in Table 6.12 below.

Table 6.12: Rejected metering options

		Reason for rejection[1]															
No.	Option	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
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			

[1]*See Table 6.1 for "reason for rejection" descriptions.*

6.2.5.3 Feasible metering options

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.

6.2.6 Increasing the supply of water within our WRZs

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 6.2.1.

6.2.6.1 Unconstrained list – company level

As described above, the UKWIR WR27 report[6.15] 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 at company level, are shown in Tables 6.13 (distribution expansion and production side) and 6.14 (resource).

Table 6.13: Unconstrained list of distribution expansion and production side management options - company level

Option	Scheme description
1	Distribution capacity expansion
2	Increase water treatment works (WTW) efficiency
3	Washwater re-use - recycling of WTW process waste water discharges
4	Increase WTW capacity to licence maximum
5	Re-introduce more regular use of existing licensed sources

Options 1 – 5 in Table 6.13 above are considered at WRZ level. For details see Section 6.2.6.4.

[6.15] *Ibid.* 6.3

Table 6.14: Unconstrained list of resource management options - company level

Option	Scheme description
1	Direct river abstraction
2	New reservoir or development of existing source or development of disused mineral extraction workings
3	Groundwater sources
4	Infiltration galleries
5	Artificial Storage and Recovery wells (or “Artificial Storage and Recharge”) (ASR)
6	Aquifer Recharge (AR)
7	Desalination • Membrane separation (electrodialysis reversal, reverse osmosis) • Thermal processes (multistage flash distillation, multiple effect distillation, mechanical vapour compression)
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
9	Tankering of water
10	Redevelopment of existing resources with increased yields (changes to system operation)
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
13	Imports (icebergs)
14	Rain cloud seeding
15	Tidal barrage
16	Rainwater harvesting
17	Abstraction licence trading
18	Water quality schemes that may have the coincidental effect of increasing the deployable output (DO) of a sourceworks
19	Catchment management schemes that promote increased yield of sources
20	Conjunctive use operation of sources

6.2.6.2 Infeasible or rejected supply-side management options – company level

All options were then screened using the criteria in Table 6.1 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 in Table 6.15 below.

Table 6.15: Summary of infeasible or rejected supply-side management options – company level

		Reason for rejection[1]															
No	**Option**	**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**
4	Infiltration galleries	All	X					X				-	-	-	-	-	-
5	Artificial storage and recovery wells	All	X					X				-	-	-	-	-	-
6	Aquifer recharge	All	X					X				-	-	-	-	-	-
7	Desalination	All		X	X				X			-	-	-	-	-	-
9	Tankering of water	All	X	X	X							-	-	-	-	-	-
10	Redevelopment of existing resources with increased yields (changes to system operation)	All	X									-	-	-	-	-	-
12	Reclaimed water, water re-use, effluent re-use	All		X		X						-	-	-	-	-	-
13	Imports (icebergs)	All	X	X	X	X						-	-	-	-	-	-
14	Rain cloud seeding	All	X	X		X						-	-	-	-	-	-
15	Tidal barrage	All	X	X	X	X			X			-	-	-	-	-	-
16	Rainwater harvesting	All	X	X								-	-	-	-	-	-
18	Water quality schemes that may have the coincidental effect of increasing the deployable output (DO) of a sourceworks	All	X									-	-	-	-	-	-
19	Catchment management schemes that promote increased yield of sources	All	X									-	-	-	-	-	-

[1] *See Table 6.1 for "reason for rejection" descriptions.*

6.2.6.3 Potentially feasible supply-side management options – company level

Options at a company level that are feasible and we have determined could form part of our final planning scenario are summarised in Tables 6.16 (distribution expansion and production side) and 6.17 (resource).

Details of each scheme are given in Appendix 6, Section A.6.6.1.

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 lifetime 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 6.16: Feasible list of distribution expansion and production side management options - company level

Option	Scheme description
1	Distribution capacity expansion
2	Increase water treatment works (WTW) efficiency
3	Washwater re-use - recycling of WTW process waste water discharges
4	Increase WTW capacity to licence maximum
5	Re-introduce more regular use of existing licensed sources

Table 6.17: Feasible list of distribution resource management options - company level

Option	Scheme description
1	Direct river abstraction
2	New reservoir or development of existing source or development of disused mineral extraction workings
3	Groundwater sources
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
11	Re-use of existing private supplies (defence establishment sites/industrial sites) taken out of service
17	Abstraction licence trading
20	Conjunctive use operation of sources

6.2.6.4 Unconstrained list and screening of supply-side management options – WRZ level

Consideration was given to potential options at a WRZ level, taking into account decisions made in Sections 6.2.6.1 – 6.2.6.3 above (company level supply side options).

6.2.6.4.1 Unconstrained list and screening of supply-side management options – Colliford WRZ

Tables 6.18 and 6.19 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 details of each scheme are provided in Section A.6.6.2.5.

Table 6.18: 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 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 6.19: 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[6.16] 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 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	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

[6.16] 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
source		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 and licence conditions in place for Park Lake. An infrastructure upgrade would be required. Further details are provided in Section A.6.6.2.5, Option C6.
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.

6.2.6.4.2 Unconstrained list and screening of supply-side management options – Roadford WRZ

Tables 6.20 and 6.21 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.6.6.2.5.

Table 6.20: 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 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 type	Scheme option	Comment
		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 6.21: 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.
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

Scheme type	Scheme option	Comment
		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 development of existing source	Increased abstraction from Meldon Dam for transfer to Roadford Reservoir or direct to Northcombe WTW	Computer modelling has shown that 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.

6.2.6.4.3 Unconstrained list and screening of supply-side management options – Wimbleball WRZ

Tables 6.22 and 6.23 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.6.6.2.5.

Table 6.22: 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 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 Pynes 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 6.23: 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.
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 6.2.1.1.4.
Joint ("shared asset") resource		No known opportunities at present.

6.2.6.4.4 Unconstrained list and screening of supply-side management options – 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.

Tables 6.24 and 6.25 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.6.6.2.5.

Table 6.24: Unconstrained list of distribution expansion and production side management options - Bournemouth WRZ

Scheme type	Scheme option	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 WTW losses are currently relatively high. Hence WTW efficiency and washwater re-use 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 6.25: Resource management options - Bournemouth WRZ

Scheme type	Scheme option	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.
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 6.2.1. 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.

6.2.6.5 Infeasible or rejected supply-side management options – WRZ level

All options were screened using the criteria in Table 6.1, 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 in Table 6.26 below with reasons for rejection.

Table 6.26: Summary of infeasible or rejected supply-side management options – WRZ level

No	Option	Reason for rejection[1]															
		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
6	Colliford Pumped Storage Scheme Stage 2	C				X			X	X		-	-	-	-	-	-
7	Raise Porth Dam	C	X	X	X	X					X	-	-	-	-	-	-
8	Raise Drift Dam	C		X	X	X			X			-	-	-	-	-	-
9	Stithians reservoir pumped storage scheme	C	X								X	-	-	-	-	-	-
10	Groundwater developments in Colliford WRZ	C	X					X			X	-	-	-	-	-	-
11	Bulk transfers in Collliford WRZ	C										-	-	-	-	-	-
12	Abstractions from the upper River Tavy	R	X			X			X	X		-	-	-	-	-	-
13	Further abstractions from Lopwell on the Tavy	R	X			X			X	X		-	-	-	-	-	-
14	Raise Avon Dam	R				X			X			-	-	-	-	-	-
15	Raise Meldon Dam	R				X			X			-	-	-	-	-	-
16	Raise Upper Tamar Dam	R	X			X			X			-	-	-	-	-	-
17	Further pumped storage of Wistlandpound from Bray	R	X			X				X		-	-	-	-	-	-
18	Pumped storage of KTT from the River Teign	R	X	X	X	X						-	-	-	-	-	-
19	Meldon Reservoir to Northcombe main	R	X	X	X							-	-	-	-	-	-
20	Groundwater developments in Roadford WRZ	R	X								X	-	-	-	-	-	-
21	Bulk transfers in Roadford WRZ	R										-	-	-	-	-	-
22	New/refurbished Capel Lane WTW & Squabmoor		X	X	X	X					X	-	-	-	-	-	-
23	Variation to Northbridge & Bolham licences	W				X			X	X		-	-	-	-	-	-
24	Reduce Thorverton prescribed flow	W				X			X	X		-	-	-	-	-	-

No	Option	Reason for rejection[1]															
		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
25	Abstraction from the River Culm	W	X			X			X	X		-	-	-	-	-	-
26	Abstraction from the River Creedy	W	X			X			X	X		-	-	-	-	-	-
27	River Axe intake with reservoir storage	W	X	X	X	X		X	X			-	-	-	-	-	-

[1]*See Table 6.1 for "reason for rejection" descriptions.*

6.2.6.6 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 6.27 below. Details of each option are given in Appendix 6, Section A.6.6.2.5.

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 lifetime of this Plan. However, the supply-side options act as a contingency should they be needed in the future if, for example, demand savings and leakage reduction do not achieve the benefits expected.

We will undertake further studies on these options in preparation for PR24. During these studies, we will take into account the latest WFD obligations and RBMP objectives and develop detailed costings.

Table 6.27: 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 e.g. 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
BW1	Re-introduce Wimborne	B	DP
BW2	Potential increases in WAFU e.g. 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*

6.2.7 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[6.17]. 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[6.18]. The programme is being delivered through Westcountry 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.

Since the Draft Plan we have finalised our programme of catchment management for the 2020 to 2025 period. We propose to increase catchment management from 11 to 16 catchments. Our planned programme is summarised in Tables 6.28 to 6.30 below.

Table 6.28: New WINEP schemes and investigations

Catchment schemes (x4)	Driver code primary	Driver code secondary	Completion date	Description
Stithians Wistlandpound Burrator Roadford	DWPA[6.19]	NERC[6.20]	31/03/2025	Schemes to reduce nutrient inputs to reservoirs/rivers and so reduce the scale and frequency of algal blooms, and release of geosmin and MIB. Measures must also deliver benefits for SSSIs, S41 NERC habitats and/or species and from natural flood management measures.

[6.17] *South West Water Upstream Thinking 2010-2015*
[6.18] *South West Water looking after the land to protect our rivers, 2015-20*
[6.19] Drinking Water Protected Area
[6.20] Natural Environment Research Council

Table 6.29: On-going catchment schemes – not WINEP

Supply area	Ongoing catchment schemes (x11)	Driver code	Completion date	Description
SWW	Argal/College Barnstaple Yeo Cober Dart Drift Fernworthy Exe Tamar Otter Fowey	Not WINEP	31/03/2025	Ongoing schemes for water quality and supply resilience (pesticides, nutrients, sediments, DOC, carbon, etc.). Measures also to deliver benefits for S41 NERC habitats and/or species and multiple benefits from natural flood management.
BW	River Stour (Metaldehyde Scheme)			Continue to support the Stour CSF Officer in work to control Metaldehyde inputs into the Stour, working across the catchment and in cooperation with Wessex Water and Stakeholder groups. Budget for CSF and resources for incentives/swop schemes.

Table 6.30: River Axe investigation (wastewater driver)

WINEP CSMG[6.21] catchment scheme (x1)	Driver Code	Completion date	Description
Axe SAC	HD_INV[6.22]	31/03/2022	Investigation and appraisal to identify technical feasibility of improvement to achieve CSMG Long Term Targets (LTT). May involve u/s & d/s monitoring of STWs, modelling, technology trials to meet 0.1 mg/l at 4 sites, technology trials and potential catchment solutions.

The central ethos of Upstream Thinking (UST) remains partnership and a Stewardship of Natural Capital Approach with new farmer behaviour incentives and cost-beneficial outcomes in UST Phase 3. New Upstream Thinking incentive and engagement innovations for AMP7 are set out below.

Innovation in farmer engagement to increase investment targeting and efficiency

SWW has worked with the University of Exeter's SWEEP[6.23] programme (funded by NERC) in an assessment of market mechanism incentives and farmer behaviour. An understanding of these principles enabled their application in the development of the new market-led catchment outcome initiatives, proposed in UST Phase 3.

[6.21] *Common Standards Monitoring Guidance*, Natural England
[6.22] Habitats Directive Investigation
[6.23] South West Partnership for Environment & Economic Prosperity (SWEEP)

In future, we want to continue to drive farming performance to comply with environmental standards and regulations, but we will also be looking to target further investment and to buy "cleaner and slower" water services from farmers in the following ways:

a) **Support progressive and well-planned farm businesses** which are focused on efficient use of nutrients and chemicals; i.e. those which have a long-term business plan for economic viability which is not based only on increased production. Post-Brexit farmers who are aware of their scenario options and are able to move their business to a new sustainable model.

b) **Work with farmers who are able to exploit new market opportunities** for quality production and Natural Capital outcomes and those who seek to utilise assurance schemes.

c) **Develop new ways of incentivising farmers to produce clean water outputs** to ensure value for money for the water customer. New ways of purchasing clean water services such as *shared-output schemes* in catchments with streams feeding directly into reservoirs. These schemes will encourage groups of farmers to work together to ensure no breaches of specified levels of key pollutants in feeder streams.

d) **Encourage farmers to take a Natural Capital approach to their businesses** and to work with the UK government's new, post-Brexit agricultural support schemes to increase the standing stock of Natural Capital on their farms.

   Where there are clear mutual benefits, i.e. where increasing the condition or stock of the Natural Capital on a farm will lead to increases in water quality, supply or catchment resilience, SWW is a possible co-buyer of the resultant Environmental Goods and Services (EGS) that flow from the improvements.

e) **Develop the role farmers could play in catchments in the deployment of natural flood risk measures** where urban (or rural) water systems are being overrun by wider catchment flows.

f) **Look for new opportunities to develop catchment wide nutrient management agreements with farmers** in catchments with challenges from agriculture and wastewater treatment for phosphate, ammonia and nitrogen, impacting on river water and bathing water quality.

Specific innovations included in our Plan are:

<u>**Innovation 1:**</u> **New Natural Capital led investments** with Partners in our Drinking Water Protected Area (DWPA) catchments in the North Devon Pioneer Area (Barnstaple Yeo and Wistlandpound), detailed in the catchment plans. These will be farmer-led outcome-based incentive schemes to deliver water quality improvements through natural capital improvements. The aim is to explore innovative financing and new business models for farms, which would enable them to move from negative impact on the Natural Capital of the area, towards positive impacts.

New nutrient reduction schemes linked to incentive payments and based on common shared outcomes will then be extended to other catchments. They will reward groups of farmers who achieve set levels of water quality performance in defined areas or catchments. The reward levels will be determined through the application of incentive mechanisms or reverse bidding.

Innovation 2: A peatland restoration Payments for Ecosystem Service (PES) reward scheme on Dartmoor Commons in partnership with the Duchy of Cornwall. This will draw upon carbon saving accreditations under the Peatland Code and use these outputs to reward participating farmers with revenues as an engagement mechanism. This is a follow up to the first working PES scheme in the uplands in the UK pioneered by SWW on Exmoor in 2010-15. This will enable SWW to deliver its WINEP investigations and actions on Dartmoor.

Innovation 3: We will trial ecosystem service payments via the En–trade reverse auction platform in the River Axe catchment, to enable innovation in catchment management for phosphates to offset wastewater treatment works emissions and the need for further phosphate stripping plant investment. En-trade will be used for trial distribution of on farm measures for the removal of excess diffuse phosphorus (P), alongside traditional advisor led initiatives.

The principal benefits from catchment management are on water quality. Whilst there are water quantity benefits, we are unable to quantify precisely how the schemes impact upon our deployable output and water available for use.

As such these activities are not included as specific water resource schemes in our Plan because the quantity benefit cannot be accurately measured for the purposes of strategic planning. However, catchment management forms a critical part of our overall approach to managing long-term supply security.

Our overall plans also include a continued programme for peatland restoration. This includes the £2m programme to deliver part of the Defra peatland restoration programme. Overall details can be found here:

https://www.southwestwater.co.uk/about-us/latest-news/news-2018/2million-funding-boost-for-ambitious-three-moors-project/

6.2.8 Resilience schemes

The Environment Agency's *Water resources planning guideline*[6.24] advises us to consider whether we require solutions to increase resilience. These resilience options are options that address vulnerabilities that are not already being addressed, as a result of a supply demand deficit (i.e. through a planned level of service). The Environment Agency's guideline[6.25] advises water companies to

[6.24] *Ibid.* 6.1
[6.25] *Ibid.* 6.1

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 resilience as part of our wider PR19 business planning work, taking into account the UKWIR's 'Resilience planning: Good practice guide summary report'[6.26].

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 6.31 below.

Table 6.31: 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	

[6.26] UKWIR (2013), *Resilience Planning: Good Practice Guide - Summary Report*, 13/RG/06/2

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 6.31. 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.

We are also undertaking work to increase our understanding of how other currently disused licensed sources, such as Brampford 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 6.2.1.1.3. However, at present such schemes do not appear to be economically feasible and have therefore not been considered further.

6.2.9 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.

6.3 Feasible options summary

A summary of our specific feasible options is shown in Tables 6.32 to 6.35 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 6.32: Feasible interconnection and water trading options

Ref.	Option description	Indicative AIC (p/m^3)
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 6.2.1.1.3 above regarding practical aspects of the pipeline routes

Table 6.33: 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	34 to 97	-48 to 15
CU21	Social housing retrofit	4	-79
CU26	Holiday rental home visitor advice pack and certification scheme	16	-66
CU54	Reduced infrastructure charge for water efficient developments	148	66
CU60	Community incentives	2	-81
CU62	Social norms feedback on bills	-6	-88
CU65	Waste water treatment works final effluent reuse	-6 to 40	-50 to -4
CU66	Non-household retail water efficiency	17	-65

Table 6.34: Feasible distribution management options (leakage)

No.	Option description	AISC exc. WTP (p/m^3)	AISC inc. WTP (p/m^3)
LC - LB Innovation	Innovations supporting ALC	53 to 87	-79 to -10
LC1 - LC10	Reduction of leakage from 32.8 to 21.6 Ml/d	29 to 62	-103 to -70
LR1 - LR10	Reduction of leakage from 46.3 to 35.1 Ml/d	29 to 71	-103 to -61
LW1 - LW4	Reduction of leakage from 11.6 to 7.2 Ml/d	71 to 145	-60 to 13
LB1 - LB4	Reduction of leakage from 20.9 to 16.5 Ml/d	66 to 95	-68 to 95
WFP C - WFP BW	15% leakage reduction by 2025	35 to 57	-75 to -49

Table 6.35: Feasible options to increase the supply of water within our WRZs[(i)]

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
BW1	Re-introduce Wimborne	B	DP	28
BW2	Potential increases in WAFU e.g. 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) Includes both distribution expansion and production management and resource management options

7. Scenario testing

- In our Draft Plan we stress tested each of our WRZs against a range of different future scenarios
- For the Final Plan we have updated the supply demand forecasts and included additional stress tests including:
  - National Infrastructure Commission (NIC) scenario of 50% leakage reduction by 2045
  - Stretching PCC reductions to 100, 86 and 62 l/per/day by 2045
  - Best and worst case scenarios for environmental needs
  - The impact on the cost of the programme of a 15% leakage reduction by 2025 using a revised leakage delivery programme
- For each scenario, we produced a plan that would maintain the supply demand balance over the planning period and compared the performance of each
- The results are in line with the findings from the Draft Plan and show that at a strategic level our WRZs have some sensitivity 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
- The results show that the feedback on the Draft Plan to reduce leakage to 15% by 2025 is not the lowest cost solution, but does help to mitigate all or part of the impact of the future uncertainties identified
- The results show that meeting the NIC expectation on leakage reduction or PCC reductions to below 100 l/p/d can materially improve resilience, however the cost and risk of such strategies are currently high
- The results confirm there is opportunity for a treated water transfer from Bournemouth WRZ to Southern Water, subject to investment to remove current water treatment works constraints
- Due to the inherent uncertainty associated with achieving significant leakage water efficiency savings in the long-term, the updated analysis confirms the additional toolkit of actions in the Draft Plan to mitigate future risks are appropriate; including:
  1. Investigation of a pumped storage scheme at Roadford Reservoir
  2. Development of our planning tools and testing the resilience of our sources to future droughts

- In addition, we have considered a range of risks within the Wimbleball WRZ which could impact on our Otter Valley sources.

7.1 Introduction

Our baseline supply demand forecast shows all WRZs are in surplus without any intervention, with the exception of a small deficit in Wimbleball WRZ at the very end of the planning period and a small deficit in Roadford WRZ from 2028/29.

Feedback on the Draft Plan was supportive of a 15% leakage reduction target by 2024/25 and additional water efficiency. This would offset the small deficits in the baseline scenario. Notwithstanding this, for this Final Plan we have updated the scenario analysis undertaken in our Draft Plan. 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 any 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[7.1].

This includes an indicative bill impact in 2025 based on change in operating and capital costs. Actual bill impacts will depend on a range of factors outside our control such as the allowed regulatory cost of capital. 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 Final Plan (see Section 8) and the actions we set out in the Draft Plan.

7.2 Scenarios tested

We stress tested our baseline plan against 17 different scenarios as set out in Table 7.1, with full details in Appendix 7.

This included an additional seven scenarios based on feedback from the Draft Plan and included stress tests on:

- National Infrastructure Commission scenario of 50% leakage reduction by 2045
- Stretching PCC reductions to 100, 86 and 62 l/per/day by 2045
- Best and worst case scenarios for environmental needs

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

- The impact on the cost of the programme of a 15% leakage reduction by 2025 using a revised leakage delivery programme

We have undertaken further assessment of a range of risks to the borehole sources in the Otter Valley catchment which are facing a number of specific risks. This is summarised in this section but full details are given in Appendix 7.

Compared to the Draft Plan, two scenarios have been removed. These were:

- Leakage Consistency Methodology - this was removed because the Final Plan is based on the new leakage reporting methodology
- Southern Water Transfer – this was removed as the need for the transfer was confirmed by Southern Water in their plan.

For each scenario in Table 7.1 a supply demand balance was produced reflecting the changed assumptions. Where a supply demand deficit occurred, solutions to address this were produced. In the case where leakage reductions are included these remain based on existing costs except for Scenario 6c which uses the final forecast leakage costs for our 2020 to 2025 period.

The retention of existing leakage costs in all but Scenario 6c was done to make transparent the difference between the Draft and Final Plan approaches to leakage.

As the 15% leakage reduction by 2025 itself is driven by feedback on the Draft Plan and not on the economics of the solution or the results of the sensitivity, the Final Plan and the relative conclusions of the scenario tests are not sensitive to this assumption as the decisions are not being driven by cost.

In the case of reductions in PCC to 100 l/p/d or less and the NIC recommendation in leakage to 50% by 2045, data on the costs and activities to do this are not reliable. As such in these scenarios, only the impact on the supply demand balance and risk are assessed.

7.2.1 Leakage consistency scenario

As detailed in Section 3, for the Final Plan we have used the new leakage consistency approach in our demand forecasts. To allow comparison with the Draft Plan we include data on the leakage figures using the old methodology for reference.

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	Resilience	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	Long-term balance	Demand only plan	Plan using only leakage reduction to offset 10 years of demand growth	Policy	All	M
4c*	Long-term balance	PCC @ 100l/p/d	Plan using a long-term target of household PCC at 100 l/p/d by 2045	Policy	All	M
4d*	Long-term balance	PCC @ 86l/p/d	Plan using a long-term target of household PCC at 86 l/p/d by 2045	Policy	All	L
4e*	Long-term balance	PCC @ 62l/p/d	Plan using a long-term target of household PCC at 62 l/p/d by 2045	Policy	All	R
5a	Environment and markets	Southern transfer***	Impact of 20 Ml/d transfer to Southern Water	Policy	BW Only	H
5b*	Environment and markets	Environmental needs (best case)	Impact of potential changes in abstraction from National Environment Programme studies (best case)	Data	All	M
5c*	Environment and markets	Environmental needs (worst case)	Impact of potential changes in abstraction from National Environment Programme studies (worst case)	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	Data	PR19 draft methodology	The impact on the supply demand balance of a 15% reduction in leakage by 2025	Policy	All	H
6c*	Data	15% leakage reduction (final costs)	The impact on the supply demand balance of a 15% reduction in leakage by 2025 using a final Business Plan costs	Policy	All	H
6d*	Data	NIC recommendation	50% reduction in leakage by 2045	Policy	All	L
7a	Demand uncertainty	High household demand	High forecast for household demand (1 standard deviation from best	Data	All	L

Ref	Theme	Scenario title	Description	Policy choice or data	WRZs	Likeli-hood**
			estimate).			
7b	Demand uncertainty	High non-household demand	Forecast built upon faster economic growth (GVA 2.5% p.a.; employment growth 0.6% p.a)	Data	All	L

** denotes additional scenario for the Final Plan*
*** Likelihood: R = Remote (<2%), L = Low (2-20%); M = Medium (20 – 65%); H = High (85-90%); VH = Very High (>90%)*
**** scenario not needed for the Final Plan*

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. As identified in the Draft Plan, this WRZ is currently resilient to droughts and should be able to accommodate droughts with a return period of 1 in 200 years.

As identified in the Draft Plan, without intervention this WRZ does have some sensitivity in the medium to long-term to:

- New environmental needs (5a and 5b)
- High household demand (7a)

The WRZ has very minor sensitivity to high non-household demand but not until 2044. The feedback on the Draft Plan was a stakeholder preference to reduce leakage by 15% by 2025. Leakage reductions of this level give rise to a supply demand surplus of 12 Ml/d by 2025 and offset the risks from the above sensitivities.

With regard to policy decisions, based on current leakage costs, the customer willingness to pay data supported leakage reductions to 19 – 22 Ml/d. If delivered in the period to 2025 on current costs, this would have an estimated bill impact by 2025 in the order of £6/property[7.2] and performs poorly with regard to deliverability. The proposed Final Plan reduces the long-term cost of the leakage reduction by approximately 4.6% compared to the Draft Plan.

[7.2] Indicative bill impact in 2025 based on change in operating and capital costs. Bill impacts are for comparison purposes only and relative to a ‘do nothing’ scenario. Overall bill impacts for our future plans reside within our PR19 Business Plan.

Reductions in PCC to 100l/p/d or less and a reduction in leakage of 50% by 2045 give rise to a supply demand surplus of between 16 to 40 Ml/d by the end of the planning period but performs poorly with regard to understanding the cost and the deliverability.

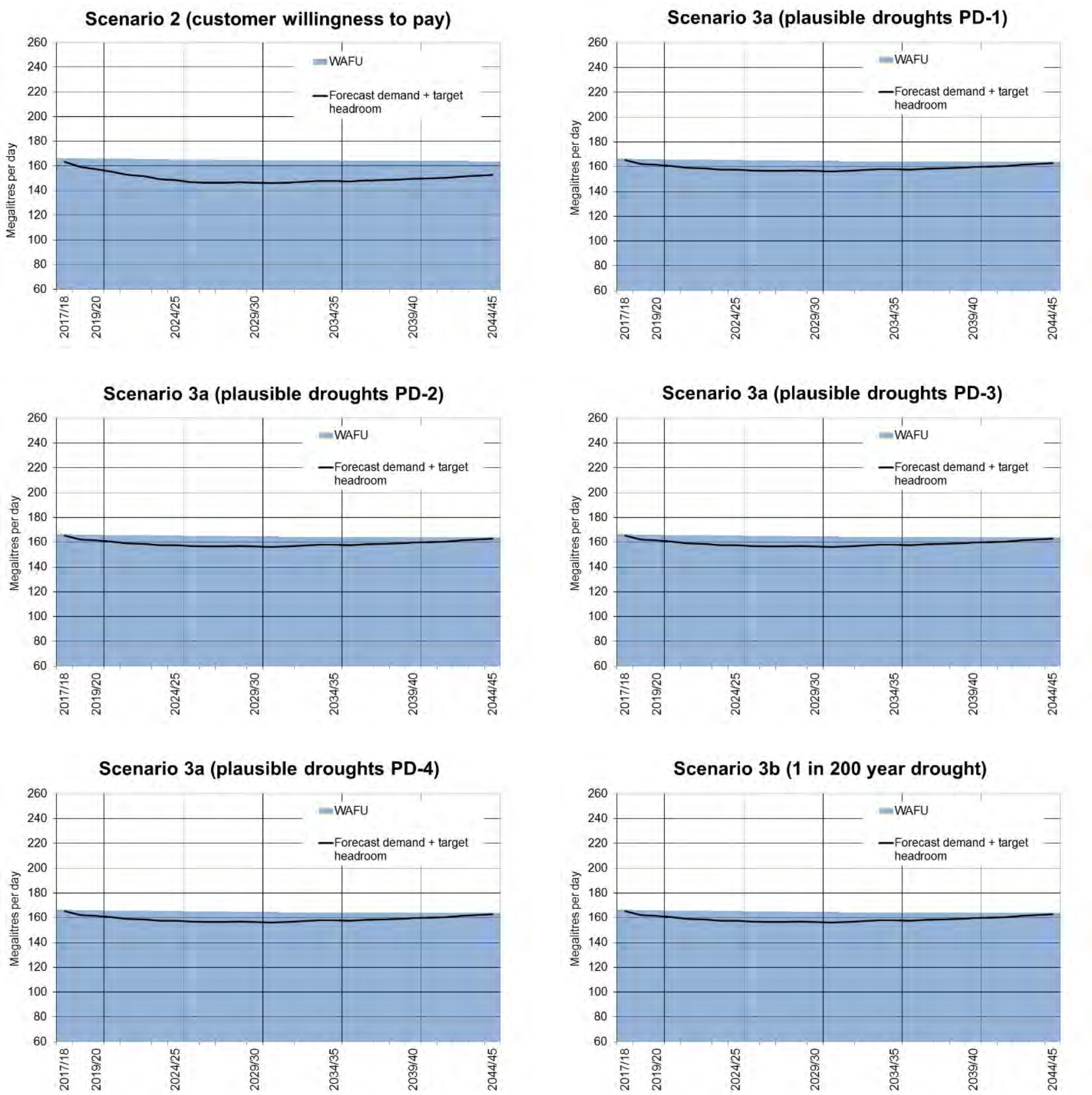
The results of the scenario tested are discussed in detail below.

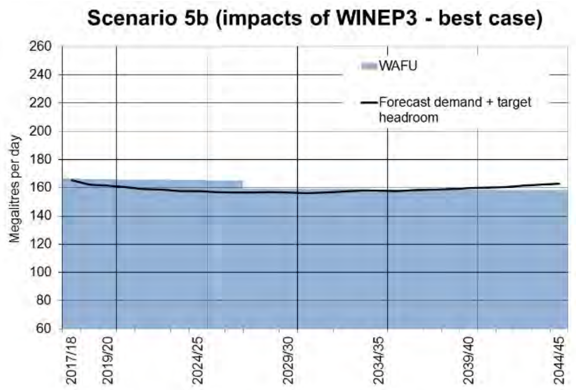
Table 7.2: Results of scenario analysis: Colliford WRZ

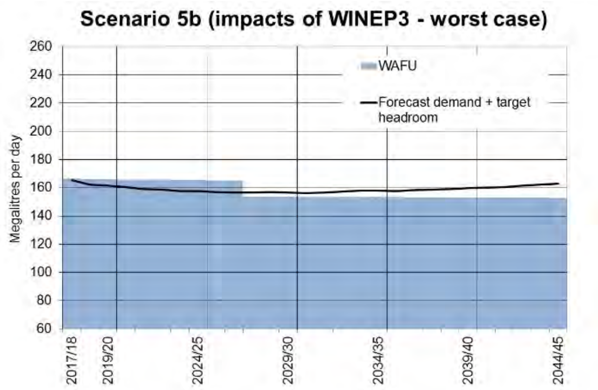
Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
2	Customer willingness to pay	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
3a	Plausible droughts (4 droughts)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
3b	1 in 200 year drought	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
4a	Resource only plan	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
4b	Demand only plan	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
4c	PCC @100l/p/d	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
4d	PCC @86l/p/d	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
4e	PCC @62l/p/d	● (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 (best case)	● (green)	● (green)	● (green)	● (green)	● (green)	● (amber)	● (amber)
5c	Environmental needs (worst case)	● (green)	● (green)	● (green)	● (amber)	● (amber)	● (amber)	● (amber)
6a	Leakage consistency measures	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6b	PR19 methodology (15% leakage reduction)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
6c	15% leakage reduction (final costs)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)	● (green)
6d	NIC recommendation	● (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)	● (amber)

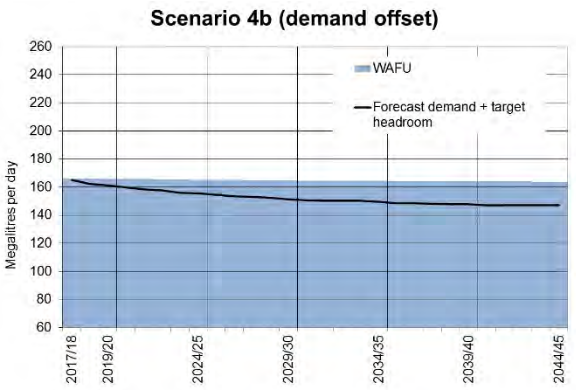
Note – green = no supply demand deficit; amber = small supply demand deficit (<3%); red = large supply demand deficit (>3%)

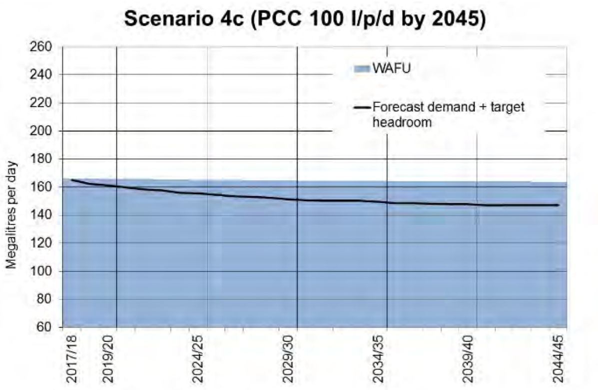
Figure 7.1: Results of scenario analysis: Colliford WRZ

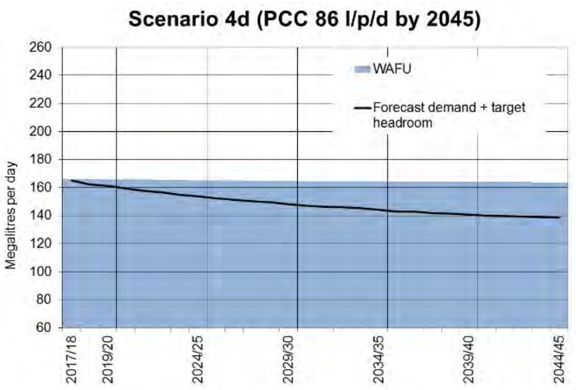


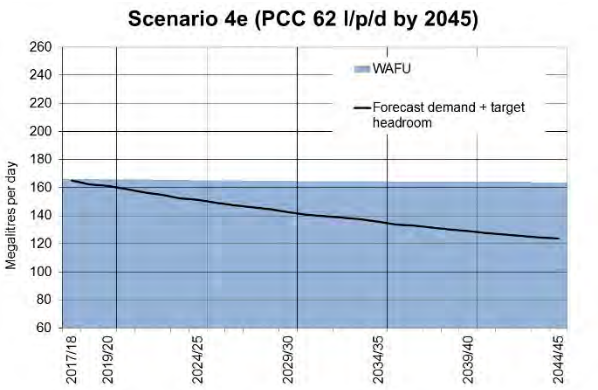

Scenario 5b (impacts of WINEP3 - best case)
WAFU
Forecast demand + target headroom
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

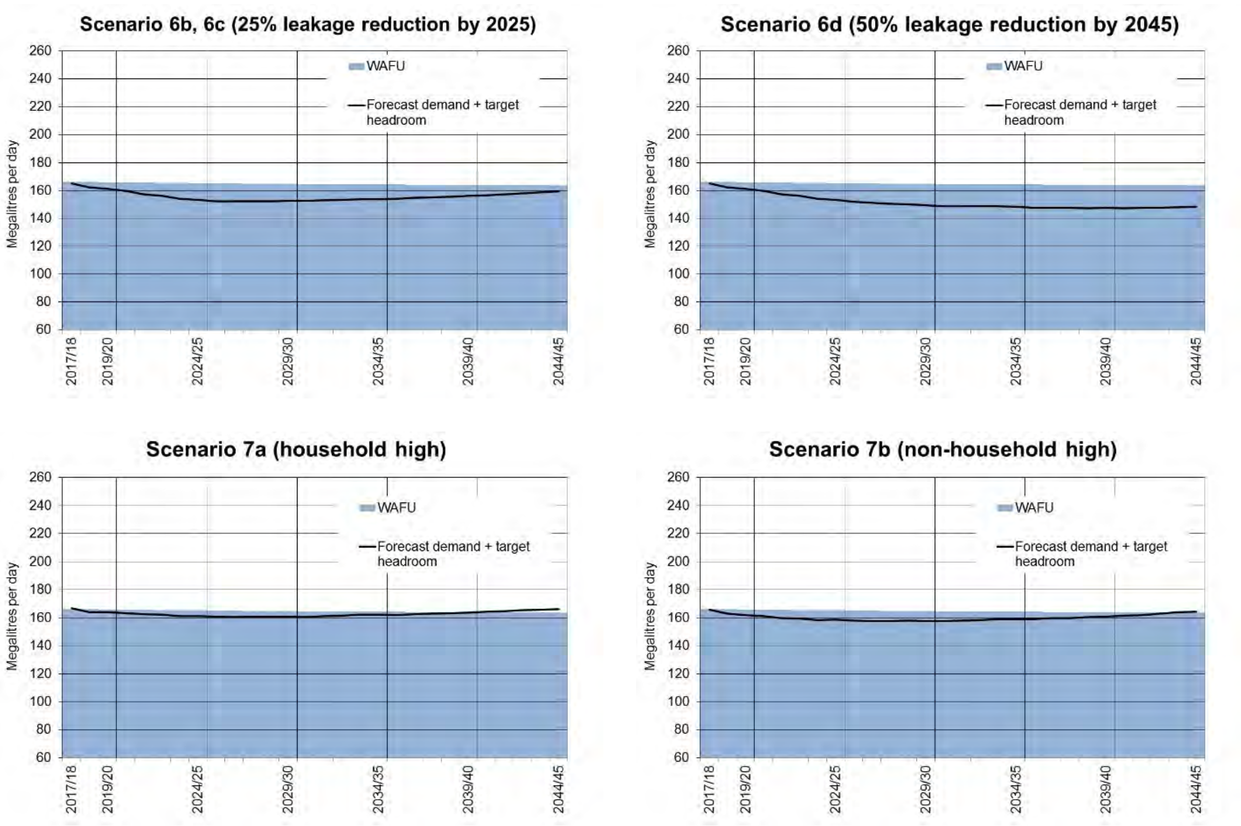

Scenario 5b (impacts of WINEP3 - worst case)
WAFU
Forecast demand + target headroom
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 4b (demand offset)
WAFU
Forecast demand + target headroom
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 4c (PCC 100 l/p/d by 2045)
WAFU
Forecast demand + target headroom
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 4d (PCC 86 l/p/d by 2045)
WAFU
Forecast demand + target headroom
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 4e (PCC 62 l/p/d by 2045)
WAFU
Forecast demand + target headroom
Megalitres per day
260
240
220
200
180
160
140
120
100
80
60
2017/18
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[7.3]. The results are updated from the Draft Plan to show current costs of leakage control and the Final Plan costs following further optimisation of the leakage programme.

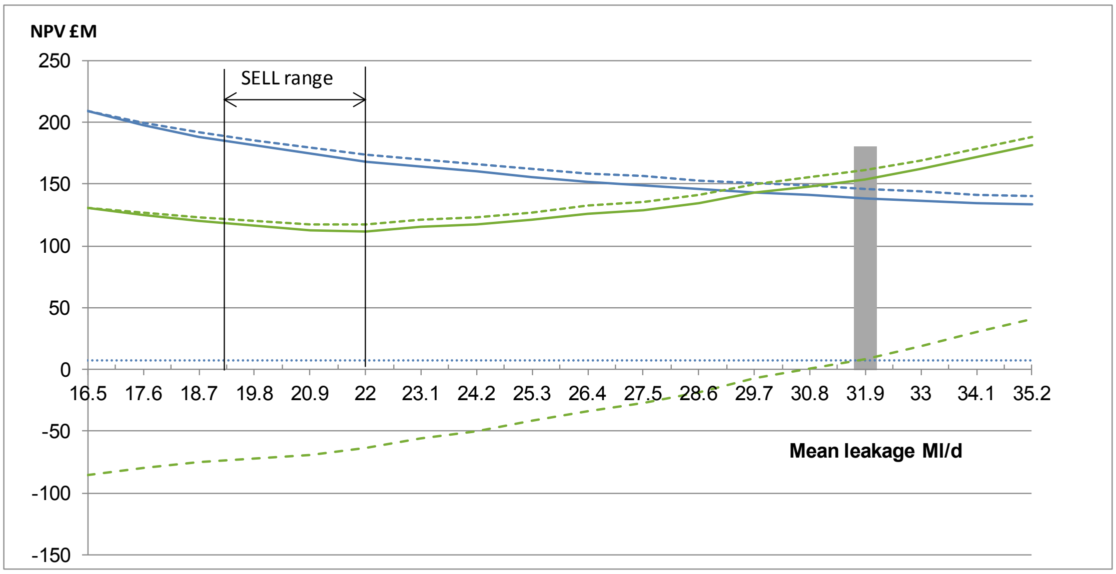
The results show that leakage reduction from current levels down to 22 – 19 Ml/d is cost-beneficial – shown by the NPV reducing as leakage reduces from present day levels. When leakage reduces below 19 Ml/d the NPV of the programme increases, indicating the cost of further reductions in leakage is higher than customer willingness to pay.

The results of this analysis show that, whilst there is no immediate supply demand driver for leakage reduction, the value customers place upon these reductions means further reductions are cost-beneficial.

[7.3] 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 17 Ml/d[7.4] 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



Note: 2019/20 leakage forecast is 31.5 Ml/d.

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 final Drought Plan[7.5] and as used in our Draft WRMP. These have return periods of up to 1 in 1000[7.6].

[7.4] Based on the supply demand balance forecast if 10 Ml/d midpoint of the WTP range) were achieved by 2025.
[7.5] South West Water (2018), *Final Drought Plan 2018*
[7.6] See Section A.7.12.

The second (Scenario 3b) considered a 1 in 200 year drought. Further details on these drought scenarios are given in Appendix 7.

The results (see Figure 7.1) show that the WRZ can support these more extreme droughts without going into deficit. This is consistent with the Draft Plan that showed only a slight deficit occurring at the end of the planning period. This suggests that the WRZ should be robust to both historical and potentially more extreme droughts.

The lowest cost plan for this scenario is for no intervention. This is the same as the Draft Plan.

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 scenario seeks to keep the supply risk to customers constant. Following feedback on the Draft Plan, the scenario also tested the impact of reducing PCC to very low levels over the long-term.

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

Reduction in per capita consumption to 100l/p/d or less gives rise to additional supply surplus of between 17 and 40 Ml/d. It is currently not possible to reliably calculate the cost of these reductions, but the results show that they do increase resilience to future drought events or other uncertainties.

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 baseline plan (£m NPV)
4a	Resource only plan	<0.5	7	7.2[7.7]
4b	Demand only plan	0.5-1	1.7	3.5
4c	PCC @100l/p/d	-	16.5	-
4d	PCC @86l/p/d	-	25.2	-
4e	PCC @62l/p/d	-	40.2	-

The overall performance of these plans 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 (WINEP). Following feedback on the Draft Plan, we updated this scenario to include more explicit best and worst case scenarios.

The results show:

- As per the Draft Plan, the supply demand balance is sensitive to future sustainability reductions
- On the best case scenario, reductions of 5.5 Ml/d would leave a small surplus of 2.8 Ml/d in 2017 but without intervention would go into a small deficit from 2040 onwards
- On the worst case scenario, reductions of 11 Ml/d would place the WRZ into a deficit of ~2.7 Ml/d from 2027 which would grow to approximately 10 Ml/d by the end of the planning period if not abated
- The deficit could be resolved by leakage reduction of an additional ~3 Ml/d above a base 'do nothing' case. This would be achieved by the feedback on the Draft WRMP for a 15% leakage reduction by 2025.

We have assessed this worst case 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.

[7.7] Re-use Rialton Intake/Porth

7.3.1.6 Scenario 6 – Data (PR19 methodology, 15% leakage reduction final costs and NIC recommendation)

This scenario examined the sensitivity of the baseline supply demand balance to the following:

- PR19 methodology – the impact of a 15% reduction in leakage by 2025 based on current costs
- 15% leakage reduction (final costs) – the impact of reducing leakage by 15% by 2025 in line with feedback on the Draft WRMP, but also with latest leakage cost forecasts
- NIC recommendation – reduction in leakage by 50% by 2045 in line with the NIC recommendation

The results are presented in Figure 7.1 and Table 7.4. The results show:

- The PR19 methodology of a 15% leakage reduction by 2025 based on current costs would increase the supply surplus from 7.8 Ml/d to 12.1 Ml/d. The Draft Plan showed this would increase the total cost by £10.6m over the planning period and have an estimated bill impact in 2025 of £2-3/prop at current costs
- A 15% reduction but using latest cost forecasts would give a surplus of 12.1 Ml/d by 2025 but would cost 4.6%[7.8] lower in the long-term than the equivalent reduction in the Draft Plan
- A reduction in leakage of 50% by 2045 would give a long-term surplus of 16 Ml/d. The cost of this scenario is uncertain, but based on current leakage costs this would be in the order of at least an additional £50m NPV and goes outside the customer willingness to pay range[7.9]

A 15% leakage reduction by 2025 increases the supply demand surplus, compared to that which would occur from a strict least cost programme, in the order of 4 Ml/d.

The implementation of the NIC recommendation for a 50% leakage reduction by 2045 gives rise to an increased supply demand surplus of c16 Ml/d by 2045, compared to the baseline of 1 Ml/d but goes outside the cost-beneficial range (see Figure 7.2). The cost and deliverability of such a reduction however are uncertain.

In all cases, additional reductions in leakage help to offset the risks from losses of supply availability from new environmental needs or other external risks.

The overall performance of this plan taking wider factors into account is presented in Section 7.5.

[7.8] See figure 7.2. Like for like, the long-term NPV of operating at 15% reduction in leakage is 4.6% lower in the Final Plan than the Draft Plan.
[7.9] See Figure 7.2. A 50% leakage reduction would mean long-term operation at c16 - 17 Ml/d. This has an increase in the order of £50m+ NPV relative to costs today.

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	-	-	-	-	-
6b	PR19 draft methodology	2-3	4.5	10.6	0.54	26.5
6c	15% leakage reduction (final costs)	-	4.7	3.0*	0.54	28.9
6d	NIC recommendation	-	16-17	50+	-	-

Note: Scenario 6b is as per the Draft Plan and uses the pre-consistency leakage. This is to allow direct comparison with the Final Plan and Scenario 6c. 15% leakage reduction for scenario 6c is higher than the Draft Plan, as uses the new consistency leakage number. Costs for scenario 6d are estimated from Figure 7.2. *Total long-term NPV is 4.6% lower than the Draft Plan.

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 post 2040 with a small deficit of -2.4 Ml/d by 2045 if not mitigated
- The supply demand balance is not sensitive to higher non-household demand, this would give only <1 Ml/d deficit and not until 2044 if not mitigated

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 feedback from the Draft WRMP is for a 15% leakage reduction by 2025 and continued reduction thereafter. Collectively these mitigate these risks.

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 in the short term without intervention, but as identified in the Draft Plan it does have sensitivity to a number of factors. The updated analysis from the Draft Plan reinforces the sensitivities identified.

Specifically, the WRZ has sensitivity to:

- More extreme droughts (> 1 in 200 year return period)
- New environmental needs
- Higher household demand

These give rise to a supply-demand deficit in the medium to long-term post 2030 if left unmitigated. The impact of the supply demand balance is larger than the Draft Plan due to the higher base year demand. This also gives rise to greater sensitivity in the short term to droughts more extreme than 1 in 200 years than in the Draft Plan.

The feedback on the Draft WRMP for a 15% leakage reduction and more water efficiency gives rise to a planned surplus of 16 Ml/d by 2025 and the long-term reductions lead to a surplus of 13 Ml/d. This mitigates the risk from the environmental needs and higher household demand, as well as some of the risks from the more extreme droughts. This is presented in Section 8.

With regard to policy decisions, customer willingness to pay data supports leakage reductions to 30 - 33 Ml/d. If delivered within the next five years this would have an estimated bill impact in the order of £10/prop.

Reductions in PCC to 100l/p/d or less and a reduction in leakage of 50% by 2045 give rise to a supply demand surplus of between 17 and 53 Ml/d by the end of the planning period.

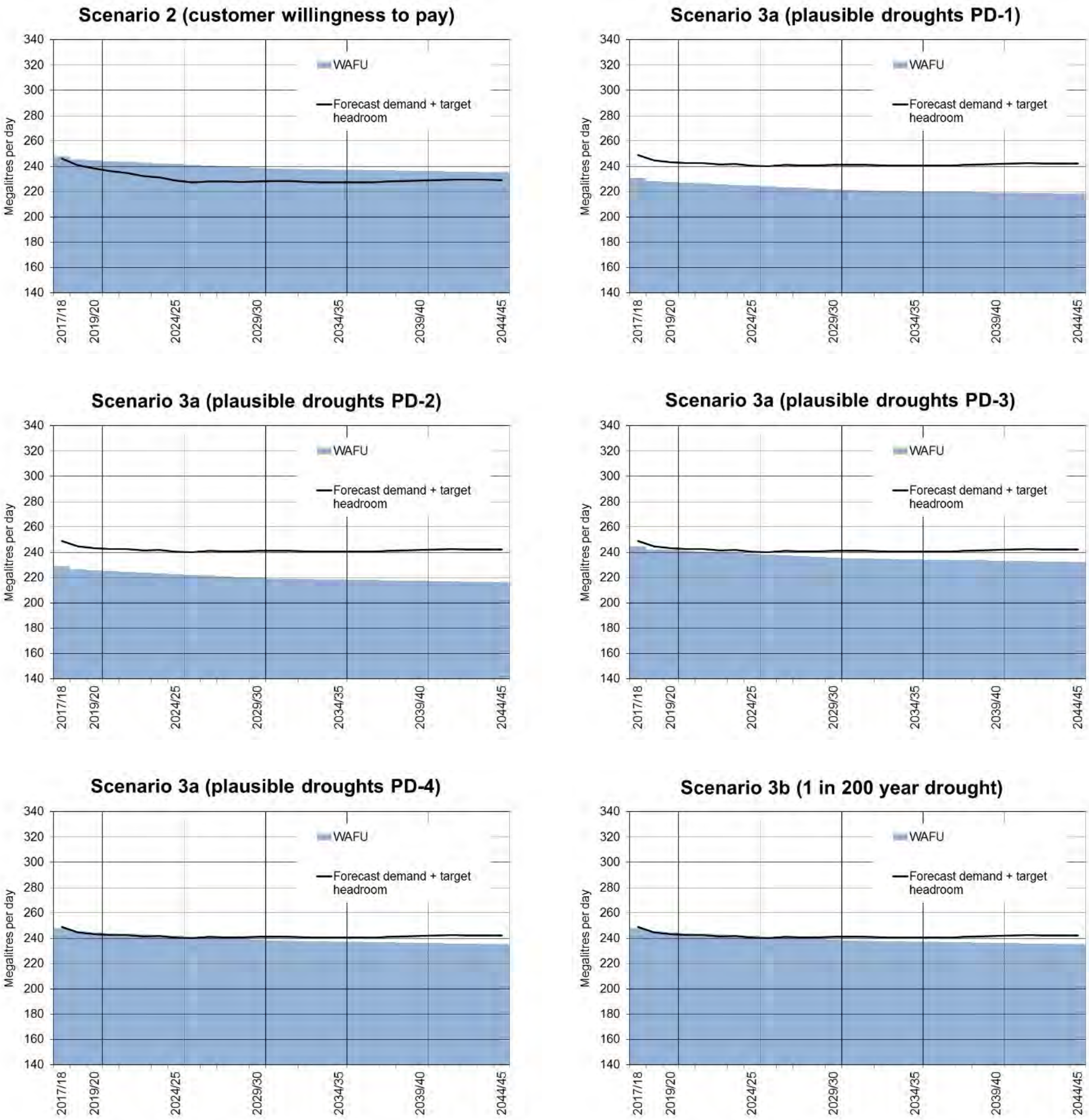
Each of the scenarios is discussed below.

Table 7.5: Results of scenario analysis: Roadford WRZ

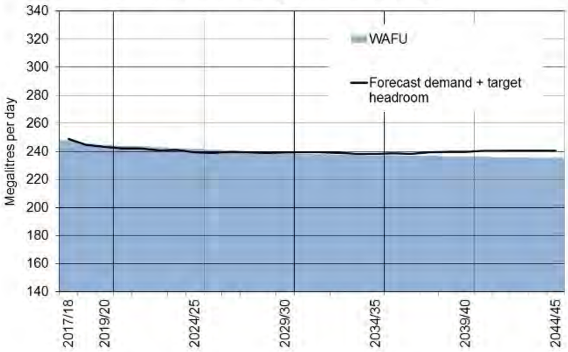
Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	● green	● green	● green	● amber	● amber	● amber	● amber
2	Customer willingness to pay	● green	● green	● green	● green	● green	● green	● green
3a	Plausible droughts (4 droughts)*	● red	● red	● red	● red	● red	● red	● red
3b	1 in 200 year drought	● green	● green	● green	● amber	● amber	● amber	● amber
4a	Resource only plan	● green	● green	● green	● green	● green	● green	● green
4b	Demand only plan	● green	● green	● green	● amber	● amber	● amber	● amber
4c	PCC @100l/p/d	● green	● green	● green	● green	● green	● green	● green
4d	PCC @86l/p/d	● green	● green	● green	● green	● green	● green	● green
4e	PCC @62l/p/d	● 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 (best case)	● green	● green	● green	● amber	● red	● red	● red
5c	Environmental needs (worst case)	● green	● green	● green	● red	● red	● red	● red
6a	Leakage consistency measures	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6b	PR19 methodology (15% leakage reduction)	● green	● green	● green	● green	● green	● green	● green
6c	15% leakage reduction (final costs)	● green	● green	● green	● green	● green	● green	● green
6d	NIC recommendation	● green	● green	● green	● green	● green	● green	● green
7a	High household demand	● amber	● amber	● amber	● red	● red	● red	● red
7b	High non-household demand	● green	● green	● green	● amber	● amber	● amber	● amber

Note:
** Four different droughts were tested. Three showed a deficit; one did not until 2030. 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 = larger supply demand deficit (>3%)

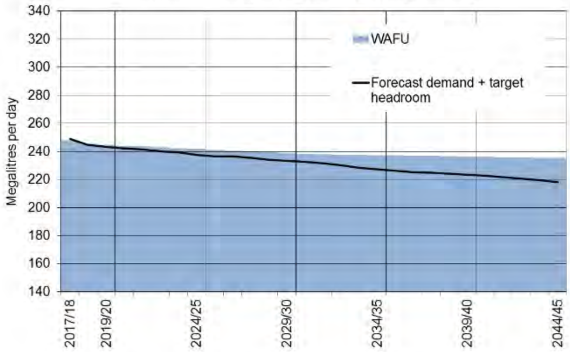
Figure 7.3: Results of scenario analysis: Roadford WRZ



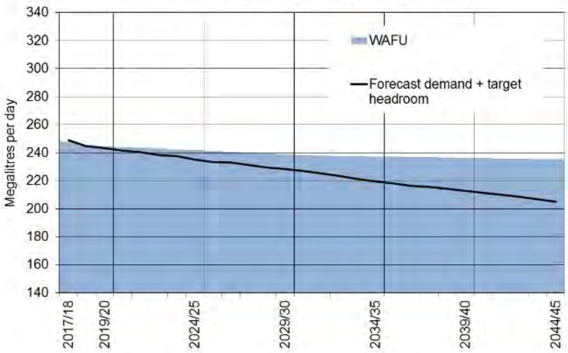
Scenario 4b (demand offset)



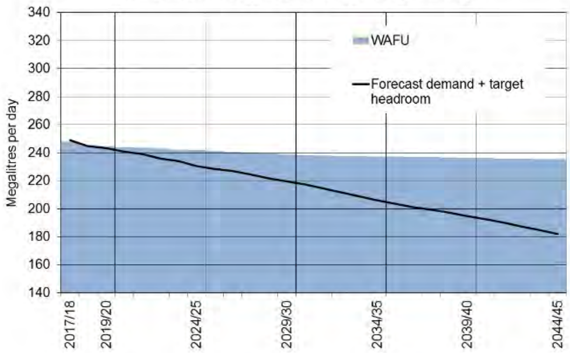
Scenario 4c (PCC 100 l/p/d by 2045)



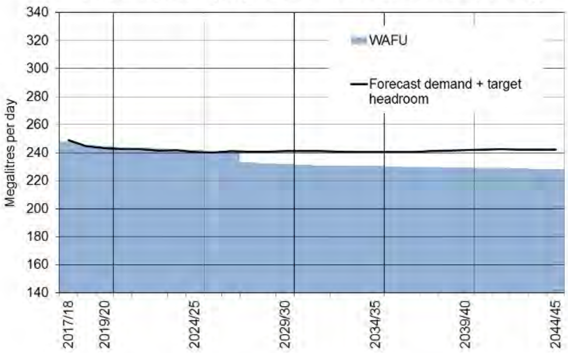
Scenario 4d (PCC 86 l/p/d by 2045)



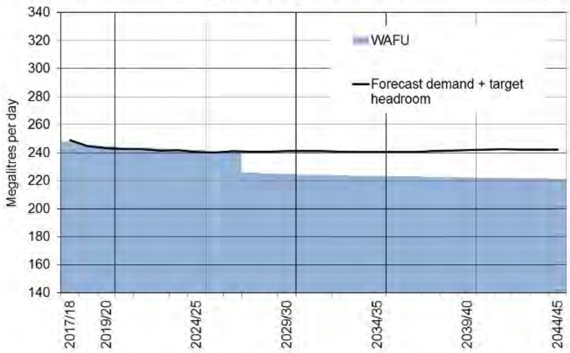
Scenario 4d (PCC 62 l/p/d by 2045)



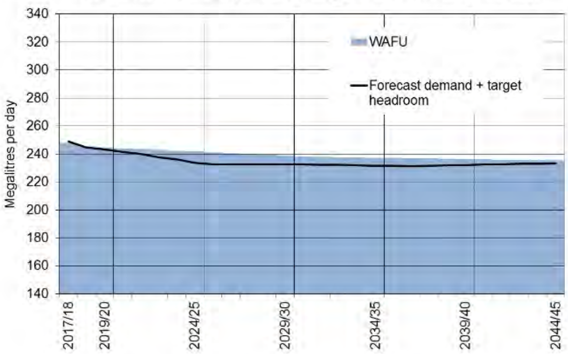
Scenario 5b (impacts of WINEP3 - best case)



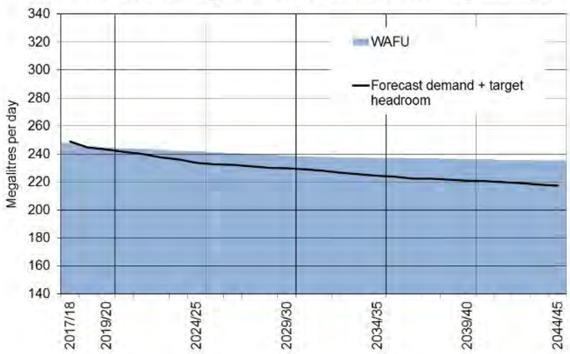
Scenario 5b (impacts of WINEP3 - worst case)

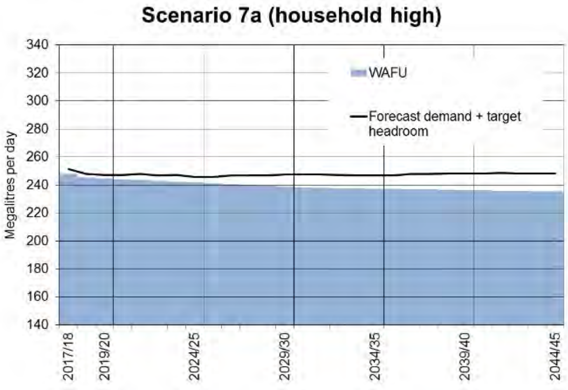


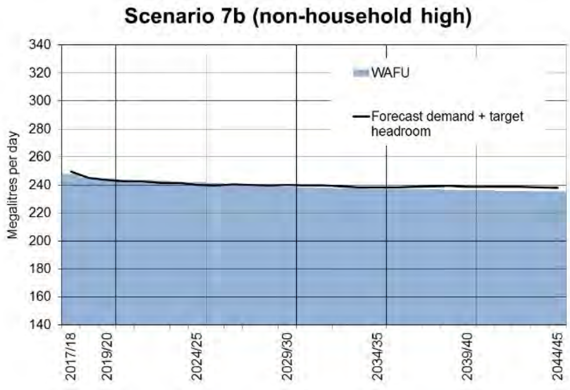
Scenario 6b, 6c (15% leakage reduction by 2025)



Scenario 6d (50% leakage reduction by 2045)







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.

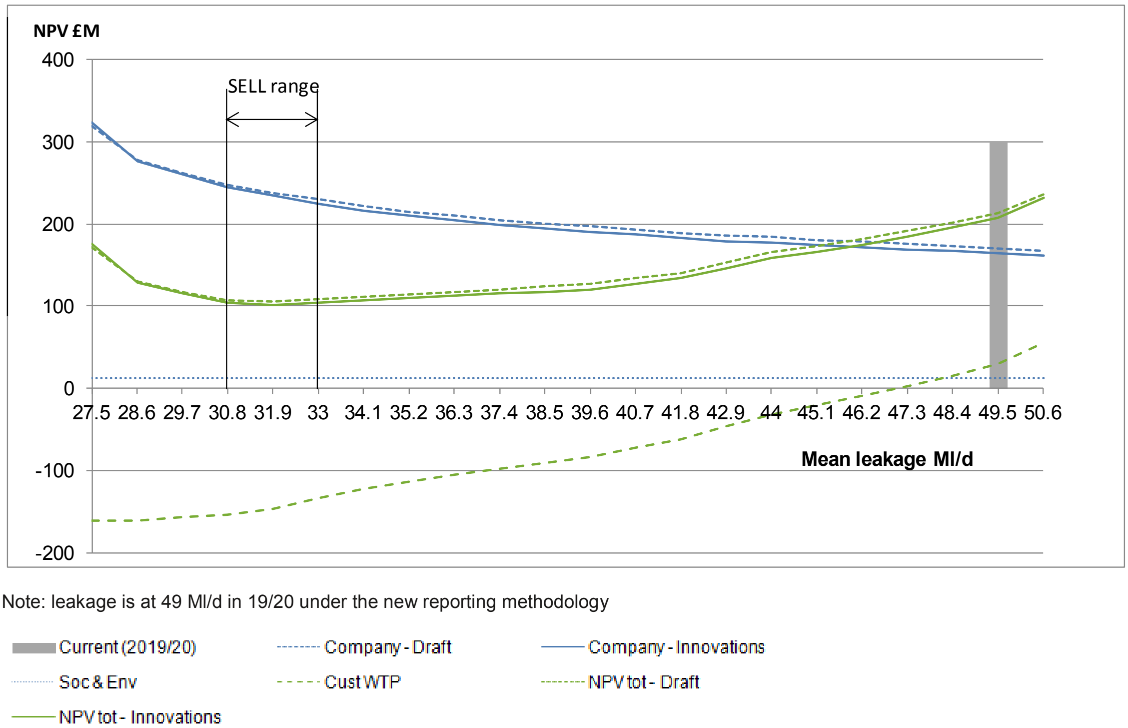
Figure 7.4 shows the NPV of operating at different leakage levels in the Roadford WRZ. The figure presents the private costs (i.e. the costs to the company) and the net cost taking into account the customer willingness to pay[7.10]. The results are updated from the Draft Plan to show current costs of leakage control and the Final Plan costs following further optimisation of the leakage programme.

The results show that leakage reduction from the current levels down to 30 - 33 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 30 Ml/d the NPV of the programme increases indicating the cost of further reductions in leakage is higher than customer willingness to pay.

The analysis shows 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 a supply demand surplus of around 6 Ml/d by 2044/45[7.11] and have an estimated bill impact of up to £10/property. The overall performance of this programme, including the impact on customer bills, is given in Section 7.5.

[7.10] The net cost is given by the company costs minus the customer willingness to pay (i.e. the benefit)
[7.11] WAFU of 235 Ml/d vs. DI+Target Headroom of 229 Ml/d

Figure 7.4: Roadford WRZ scenario analysis – Scenario 2 – programme costs



Note: leakage is at 49 Ml/d in 19/20 under the new reporting methodology

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 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 Drought Plan. These have return periods of between 1 in 400 and 1 in 4,000[7.12].

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.

As highlighted in the Draft Plan, the results (see Figure 7.3) show that without intervention the WRZ can go into supply demand deficit for the plausible droughts. However, the higher starting demand shows the potential deficit is higher than that

[7.12] See Section A.7.12.

in the Draft Plan if no intervention were made. Table 7.6 shows a summary of the impacts of the more extreme droughts.

The WRZ should be able to meet a 1 in 200 year drought up to 2027, but thereafter would be in potential supply demand deficit up to 6.9 Ml/d if no intervention were made.

The feedback from the Draft Plan was for a 15% leakage reduction by 2025 and increased water efficiency. This leads to a final supply demand surplus of 16 Ml/d by 2025 and 13 Ml/d by 2045. This surplus will offset the risk from a 1 in 200 year drought and approximately 50% of the risk from other more extreme droughts. For further details see Section 8.

These results for the Final Plan confirm the findings in our Draft Plan and reinforces our strategy should be to reduce demand, but also to develop better understanding of the risks from drought events, as well as investigate the feasibility of a pumped storage scheme at Roadford Reservoir. This toolkit of actions will be used to inform future plans at the next WRMP in 2024/25.

Table 7.6: Roadford WRZ scenario analysis – Scenario 3 results

Ref	Description	Return period (1 in X)	Likelihood within 25 year period[7.13]	Maximum supply demand deficit (Ml/d)	Cost of mitigation (£m)[7.14]	Implied service benefit	Customer valuation[7.15]
3a	Plausible drought: PD-1	1,500 – 4,000	0.6 to 1.7%	23.9	>£100m	2%	>£1.6bn
	Plausible drought: PD-2	400 – 430	5.7 to 6.1%	25.9	>£100m	2%	>£1.6bn
	Plausible drought: PD-3	900 – 1,500	1.7 to 2.7%	9.9	£25-30m	1%	£873m
	Plausible drought: PD-4	-	-	6.9	£10-15m	1%	£873m

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. No return period for PD-4 using EVA approach.

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 scenario seeks to keep the supply risk to customers constant. The scenario also tested the impact of reducing PCC to very low levels over the long-term.

[7.13] Based on at least 1 event in 25 years.
[7.14] Based on leakage cost curves in Figure 7.4.
[7.15] 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 2% if planning for the larger deficits and 1% for smaller deficits.

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 only plan would offset some, but not all, of the long-term supply demand deficit in the Roadford WRZ. In contrast a resource led plan would offset all of the supply demand deficit
- 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
- Large scale reductions in PCC would give rise to a material supply demand surplus in the WRZ

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 baseline plan (£m NPV)
4a	Resource only plan	<0.5	9.8	3.1[7.16]
4b	Demand only plan	<0.5	1.9	3.7
4c	PCC @100l/p/d	-	17	-
4d	PCC @86l/p/d	-	30	-
4e	PCC @62l/p/d	-	53	-

Reduction in per capita consumption to 100l/p/d or less give rise to additional supply surplus upwards of 17 Ml/d. It is currently not possible to reliably calculate the cost of these reductions or their feasibility, but the results show that they do increase resilience to future more extreme drought events.

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 (WINEP3). For the Final Plan we have updated this scenario following feedback on the Draft Plan for a more explicit assessment of the impact of a best and worst case environmental needs.

[7.16] Northcombe WTW output increased to 60 Ml/d

The results show:

- As identified in the Draft Plan, the supply demand balance is sensitive to future sustainability reductions
- On the best-case scenario, reductions of 7 Ml/d would place the WRZ into deficit of 8 Ml/d in the period post 2027
- On the worst-case scenario, reductions of 14 Ml/d would place the WRZ into a deficit of 15 Ml/d in the period post 2027
- The deficit could be resolved by leakage reduction

The feedback on the Draft WRMP was for additional leakage reduction of 15% by 2025 and further water efficiency. As shown in Section 8 this gives rise to a surplus of 14 Ml/d by 2027. This would therefore offset the best case and the majority of the worst case scenario for environmental needs.

The confirmation of the sensitivity in this Plan to environmental needs further supports the proposed strategy to reduce the demand for water, but also to investigate the feasibility of a possible pumped storage scheme for Roadford Reservoir to help mitigate future losses of supply.

7.3.2.6 Scenario 6 – Data (PR19 methodology, 15% leakage reduction final costs and NIC recommendation)

This scenario examined the sensitivity of the baseline supply demand balance to two data changes:

- PR19 methodology – the impact of a 15% reduction in leakage by 2025 based on current costs
- 15% leakage reduction (final costs) – the impact of reducing leakage by 15% by 2025 in line with feedback on the Draft WRMP, but also with latest leakage cost forecasts
- NIC recommendation – reduction in leakage by 50% by 2045 in line with the NIC recommendation

The results are presented in Figure 7.3 and Table 7.8. The results show:

- The PR19 methodology of a 15% leakage reduction by 2025 would give a supply demand surplus of 8 Ml/d and based on current costs would increase the total cost by £22m over the planning period and have an estimated bill impact in 2025 of £2-3/prop.
- A 15% reduction but using latest cost forecasts for this Final Plan would give a surplus of 8 Ml/d by 2025 and this would cost 3.6%[7.17] lower than the equivalent reduction in the Draft Plan.

[7.17] See figure 7.4. Like for like, the long-term NPV of operating at 15% reduction in leakage NPV is 3.6% lower in the Final Plan than the Draft Plan.

- A reduction in leakage of 50% by 2045 would give a long-term surplus of 18 Ml/d. The cost of this scenario is uncertain, but based on current leakage costs this would be in the order of £100m NPV[7.18] and goes outside the customer willingness to pay range

A 15% leakage reduction by 2025 increases the supply demand surplus, compared to that which would occur from a strict least cost programme, in the order of 7 Ml/d.

The implementation of the NIC recommendation for a 50% leakage reduction by 2045 gives rise to an increased supply demand surplus of c18 Ml/d by 2045, but goes outside the cost-beneficial range (see Figure 7.4). The cost and deliverability of such a reduction remain uncertain.

In all cases, additional leakage reductions help to offset the risks from losses of supply availability from new environmental needs or other external risks.

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	-	-	-	-	-
6b	PR19 draft methodology	2-3	6.3	22.1	0.54	36.8
6c	15% leakage reduction (final costs)	-	7.1	8.9	0.54	44.6
6d	NIC recommendation	-	~25	>£100m	-	-

Note: Scenario 6b is as per the Draft Plan and uses the pre-consistency leakage. This is to allow direct comparison with the Final Plan and scenario 6c. Note that the 15% reduction in leakage is higher than the Draft Plan, as it uses the new leakage consistency forecasts.

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,

[7.18] See Figure 7.4 and increase in NPV from today's costs to those at a leakage level of 25 Ml/d.

this scenario recalculated the target headroom allowance reducing the demand uncertainty, as described in Section 4.

The results show:

- The Final Plan confirms the WRZ has some sensitivity to higher household demand
- Higher household demands could see the WRZ go into deficit, which if not mitigated would lead to a long-term deficit in the order of 13 Ml/d
- The supply demand balance is sensitive to higher non-household demand, however, a 10% increase in non-household demand would only lead to a 2.5 Ml/d deficit by 2044/45 if left unmitigated

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 feedback on the Draft Plan for a 15% reduction in leakage by 2025 and then continued reductions to approximately 25% by 2044/45 mitigates all the risk from the increased potential for higher demand.

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 fairly robust in the short to medium term even with no intervention. The WRZ should be able to sustain the impact of a drought with a return period of 1 in 200 years even without intervention.

However, as identified in the Draft Plan, the updated analysis for the Final Plan shows the WRZ however, does have some sensitivity to:

- More extreme droughts (> 1 in 200 year return period)
- New environmental needs
- Higher household demand

With the exception of the most extreme droughts and environmental needs, the sensitivity to the supply demand balance is small in the medium-term.

The feedback on the Draft WRMP for a 15% reduction in leakage by 2025, more water efficiency coupled with the long-term reduction in leakage of approximately 25%, offsets most of the supply demand deficit from the individual sensitivities.

With regard to policy decisions, the willingness to pay data supports leakage reductions to 8 – 10 Ml/d from a current level.

Reductions in PCC to 100l/p/d or less and a reduction in leakage of 50% by 2045 give rise to a supply demand surplus of between 6 and 23 Ml/d by the end of the planning period.

Each of the scenarios is discussed below.

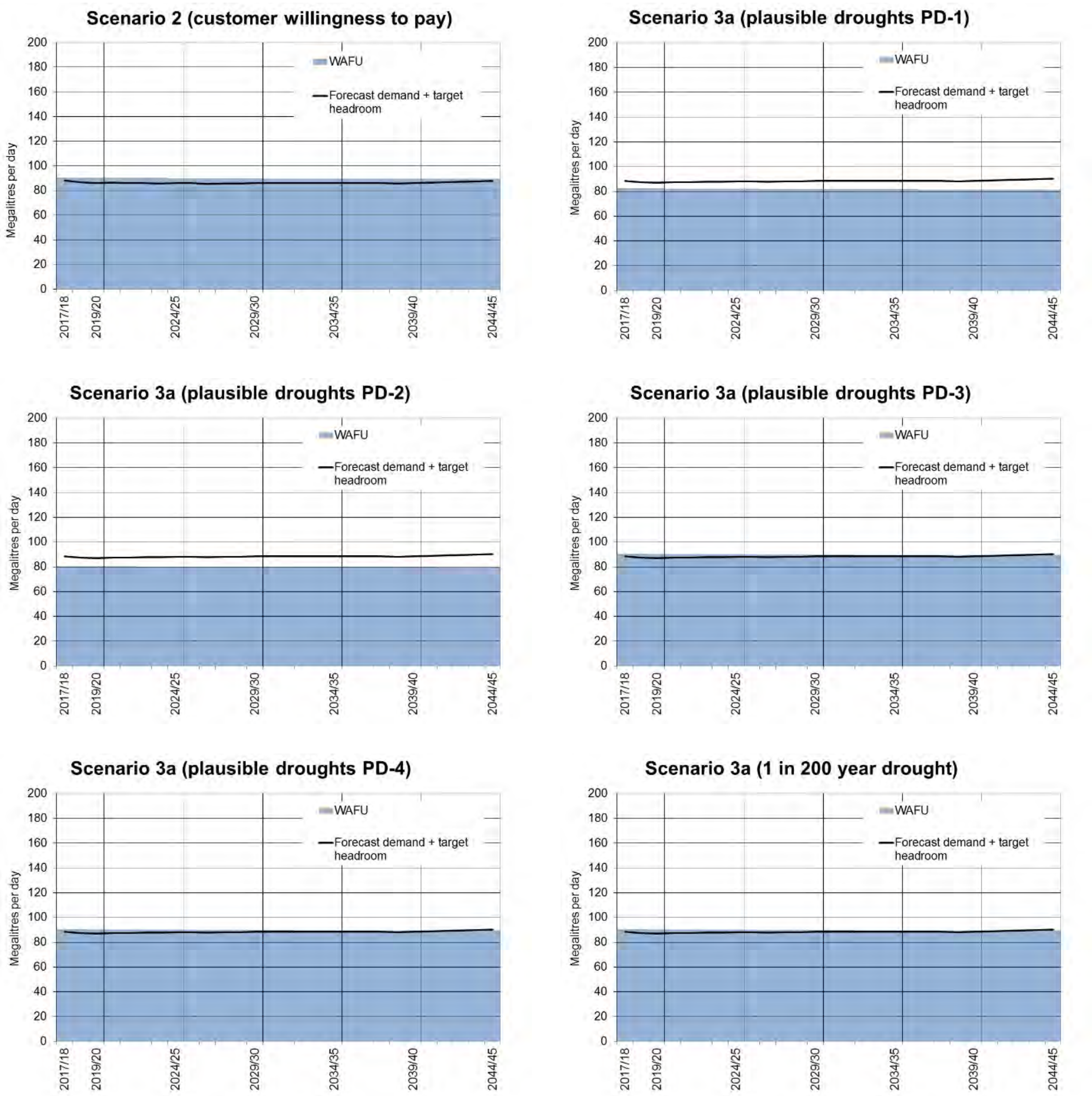
Table 7.9: Results of scenario analysis: Wimbleball WRZ

Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	● green	● green	● green	● green	● green	● green	● amber
2	Customer willingness to pay	● green	● green	● green	● green	● green	● green	● green
3a	Plausible droughts (4 droughts)*	● amber	● amber	● amber	● red	● red	● red	● red
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	● amber
4c	PCC @100l/p/d	● green	● green	● green	● green	● green	● green	● green
4d	PCC @86l/p/d	● green	● green	● green	● green	● green	● green	● green
4e	PCC @62l/p/d	● 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 (best case)	● green	● green	● green	● amber	● amber	● amber	● red
5c	Environmental needs (worst case)	● green	● green	● green	● red	● red	● red	● red
6a	Leakage consistency measures	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6b	PR19 methodology (15% leakage reduction)	● green	● green	● green	● green	● green	● green	● green
6c	15% leakage reduction (final costs)	● green	● green	● green	● green	● green	● green	● green
6d	NIC recommendation	● green	● green	● green	● green	● green	● green	● green
7a	High household demand	● green	● green	● amber	● amber	● amber	● amber	● red
7b	High non-household demand	● green	● green	● green	● green	● green	● green	● amber

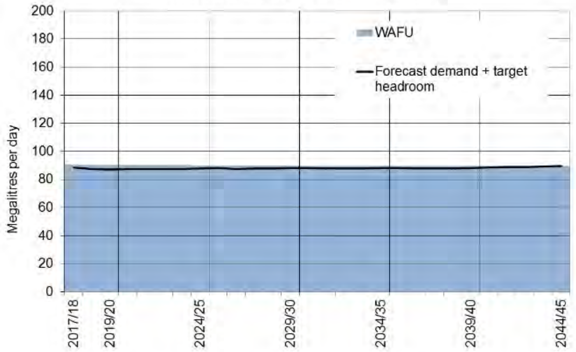
Note:
** Four different droughts were tested. Two showed deficit; two did not. For presentation purposes an average is included here, but full details are given below.*
green = no supply demand deficit; amber = small supply demand deficit (<3%); red = large supply demand deficit (>3%)

South West Water Bournemouth Water

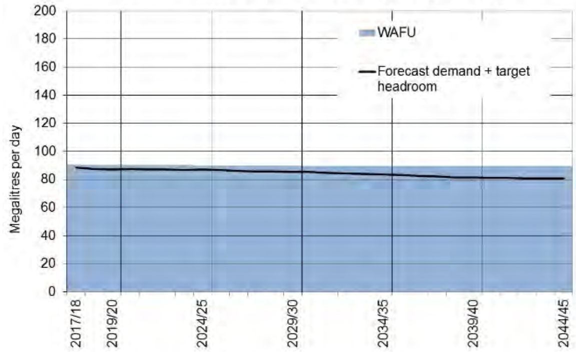
Figure 7.5: Results of scenario analysis: Wimbleball WRZ



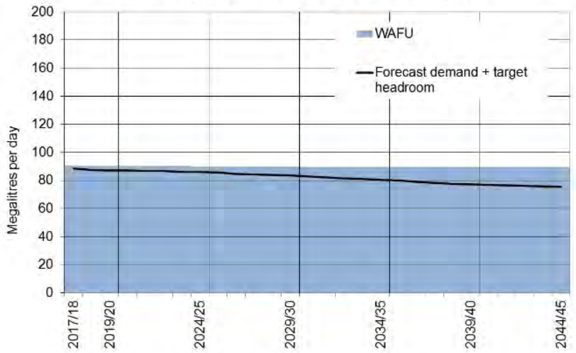
Scenario 4b (demand offset)



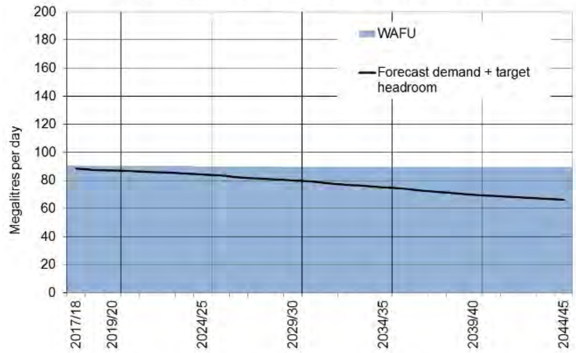
Scenario 4c (PCC 100 l/p/d by 2045)



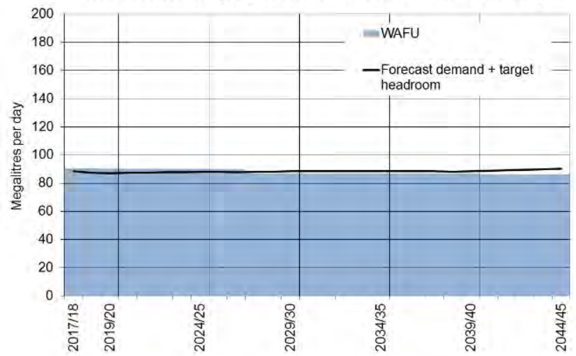
Scenario 4d (PCC 86 l/p/d by 2045)



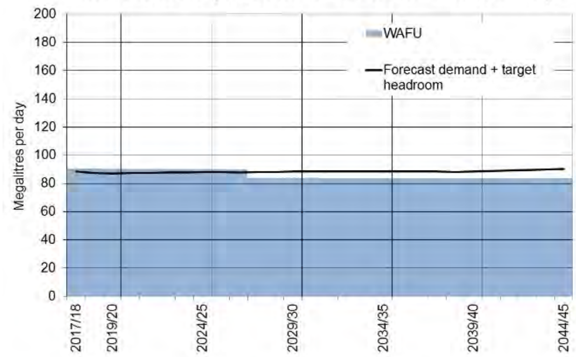
Scenario 4e (PCC 62 l/p/d by 2045)



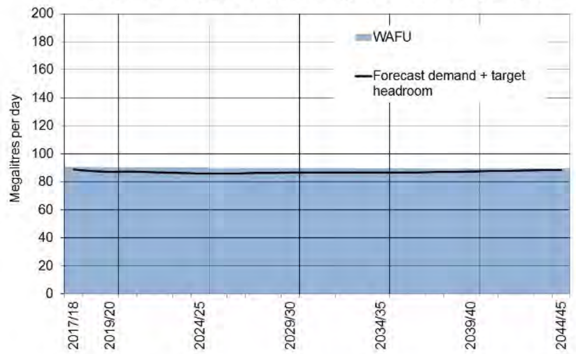
Scenario 5b (impacts of WINEP3 - best case)



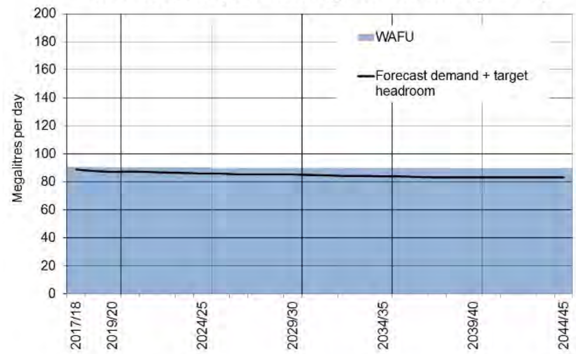
Scenario 5b (impacts of WINEP3 - worst case)

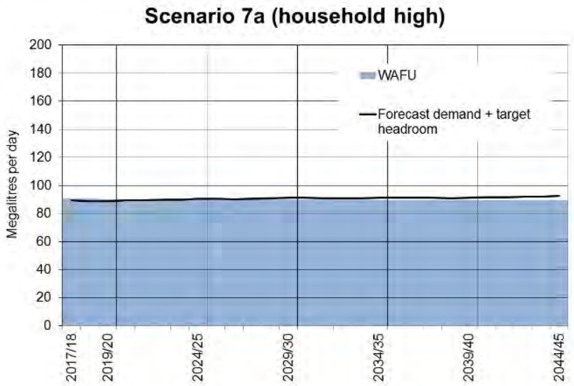


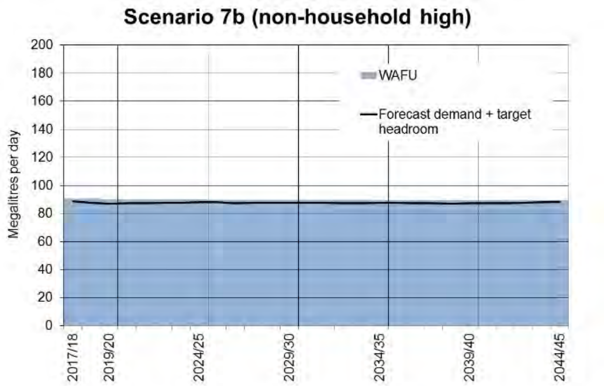
Scenario 6b, 6c (15% leakage reduction by 2025)



Scenario 6d (50% leakage reduction by 2045)







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 customer willingness to pay[7.19]. The results are presented on current leakage costs and those for this Final Plan.

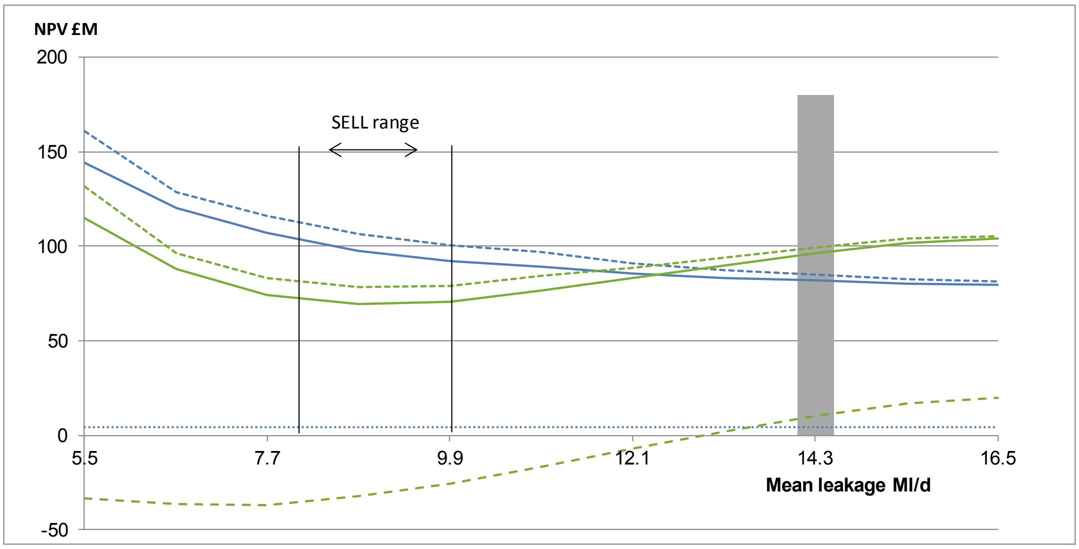
The results show that leakage reduction to 8 - 10 Ml/d is cost-beneficial. This is because the willingness to pay based NPV reduces as leakage falls from its present day value. When leakage reduces below 8 Ml/d the NPV of the programme increases indicating the cost of further reductions in leakage is 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 leakage value would generate a supply demand surplus of around 6 - 7 Ml/d[7.20]. The performance of this scenario taking into account wider factors, such as cost and deliverability is assessed in Section 7.5.

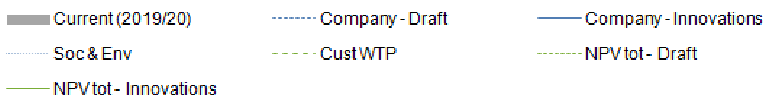
[7.19] The net cost is given by the company costs minus the customer willingness to pay (i.e. the benefit)
[7.20] As leakage would reduce from 14.4 Ml/d down to 8 - 10 Ml/d – on average an additional 5 Ml/d on top of the existing surplus. This give a supply demand surplus at 2025 of between 6 and 7 Ml/d.

South West Water Bournemouth Water

Figure 7.6: Wimbleball WRZ scenario analysis – Scenario 2 – programme costs



Note: current leakage for 19/20 is 14.4 Ml/d on new leakage consistency reporting



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 Drought Plan. These have return periods of between 1 in 525 and 1 in 2,500[7.21].

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 until the final years of the planning period and then only by a deficit of <1 Ml/d.

However, the WRZ does 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, as per the Draft Plan PD-2 gives rise to a material supply demand deficit and has a small likelihood over the whole planning period, and PD1 with a

[7.21] See Section A.7.12.

lesser but still material deficit. If mitigated through leakage reduction, this risk would cost in excess of £50m NPV over the 25 year planning period to mitigate (see Figure 7.6).

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[7.22]	Maximum supply demand deficit (Ml/d)	Cost of mitigation (£m)	Implied service benefit	Customer valuation [£m] [7.23]
3a	Plausible drought: PD-1	1,250 – 2,500	1% to 2%	8.7	>50m	2%	700+
	Plausible drought: PD-2	525 - 675	3.6 to 4.7%	10.7	>50m	2%	700+
	Plausible drought: PD-3	700 – 1,000	2.5 to 3.5%	0.7	N/A	N/A	N/A
	Plausible drought: PD-4	-	-	0.7	N/A	N/A	N/A

The small deficits in PD3 and PD4 are not considered material and therefore for the purposes of this plan are not costed. No return period available for PD-4 using EVA.

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. This scenario was updated for the Final Plan to also test the impact of reducing PCC to very low levels over the long-term.

The results of the scenario are given in Table 7.11 and show:

- Compared to a baseline plan a demand option led plan 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

[7.22] Based on at least 1 event in 25 years.
[7.23] 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

- 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
- Large scale reductions in PCC give rise to additional supply demand surplus.

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 baseline plan (£m NPV)
4a	Resource only plan	<0.5	4.5[7.24]	4.2
4b	Demand only plan	0.5-1	0.5	2.9
4c	PCC @100l/p/d	-	8.7	-
4d	PCC @86l/p/d	-	14.0	-
4e	PCC @62l/p/d	-	23.2	-

Note: additional benefit from PCC reduction are given as the supply demand surplus at 2044/45.

Reduction in per capita consumption to 100l/p/d or less give rise to additional supply surplus of between 9 and 23 Ml/d. It is currently not possible to reliably calculate the cost of these reductions or their deliverability, but the results show that they do increase resilience to future drought events or offset other risks.

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. We therefore tested the impact of reductions occurring in 2027. Following feedback on the Draft Plan we updated this scenario to more formally set out best and worst case scenarios.

The results confirm the findings of the Draft Plan and show:

- The supply demand balance is sensitive to future sustainability reductions
- On the best case scenario, reductions of 3 Ml/d would just place the WRZ into deficit
- On the worst case scenario, reductions of 6 Ml/d would place the WRZ into deficit, and if unmitigated would lead to a deficit of 6.7 Ml/d by 2044/45

[7.24] Brampford Speke boreholes

The feedback on the Draft Plan was for a 15% reduction in leakage by 2025 and more water efficiency. As shown in our Final Plan supply demand balance, this gives a surplus of 6.4 Ml/d by 2027 helping to offset the risk of the impact of future environmental needs.

7.3.3.6 Scenario 6 – Data (PR19 methodology, 15% leakage reduction final costs and NIC recommendation)

This scenario examined the sensitivity of the baseline supply demand balance to the following:

- PR19 methodology – the impact of a 15% reduction in leakage by 2025 based on current costs
- 15% leakage reduction (final costs) – the impact of reducing leakage by 15% by 2025 in line with feedback on the Draft WRMP, but also with latest leakage cost forecasts
- NIC recommendation – reduction in leakage by 50% by 2045 in line with the NIC recommendation and a new sensitivity for this Final Plan.

The results are presented in Figure 7.5 and Table 7.12. The results show:

- The PR19 methodology of a 15% leakage reduction by 2025 based on current costs would increase the supply surplus from 1.9 to 4 Ml/d by 2025 and maintain a positive supply demand balance for the whole period. It would increase the total cost by £10.6m over the planning period and have an estimated bill impact in 2025 of £3-4/prop
- A 15% reduction but using latest cost forecasts would give a surplus of 4 Ml/d by 2025 but this would cost 5.6%[7.25] lower than the equivalent reduction in the Draft Plan
- A reduction in leakage of 50% by 2045 would give a long-term surplus of 6.4 Ml/d. The cost of this scenario is uncertain, but expected to be in excess of £40M NPV and goes outside the customer willingness to pay range (see Figure 7.6). In addition the deliverability is uncertain.

In all cases, additional leakage reductions help to offset the risks from losses of supply availability from new environmental needs.

The overall performance of this plan taking wider factors into account is presented in Section 7.5.

[7.25] See figure 7.6. Like for like, the long-term NPV of operating at 15% reduction in leakage NPV is 5.6% lower in the Final Plan than the Draft Plan.

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	-	-	-	-	-
6b	PR19 draft methodology	3-4	1.7	10.0	0.54	10.3
6c	15% leakage reduction (final costs)	-	1.5	0.9	0.54	9.1
6d	NIC recommendation	-	7-8	>40	-	-

Note: Scenario 6b is as per the Draft Plan and uses the pre-consistency leakage. This is to allow direct comparison with the Final Plan and scenario 6c

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.

The updated results for the Final Plan reinforce the findings in the Draft Plan:

- The supply demand balance has some sensitivity to higher household demand
- Higher household demands could see the WRZ go into deficit in 2025 to 2030 if not mitigated with a long-term deficit at the end of the planning period of 3.2 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).

7.3.4 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.

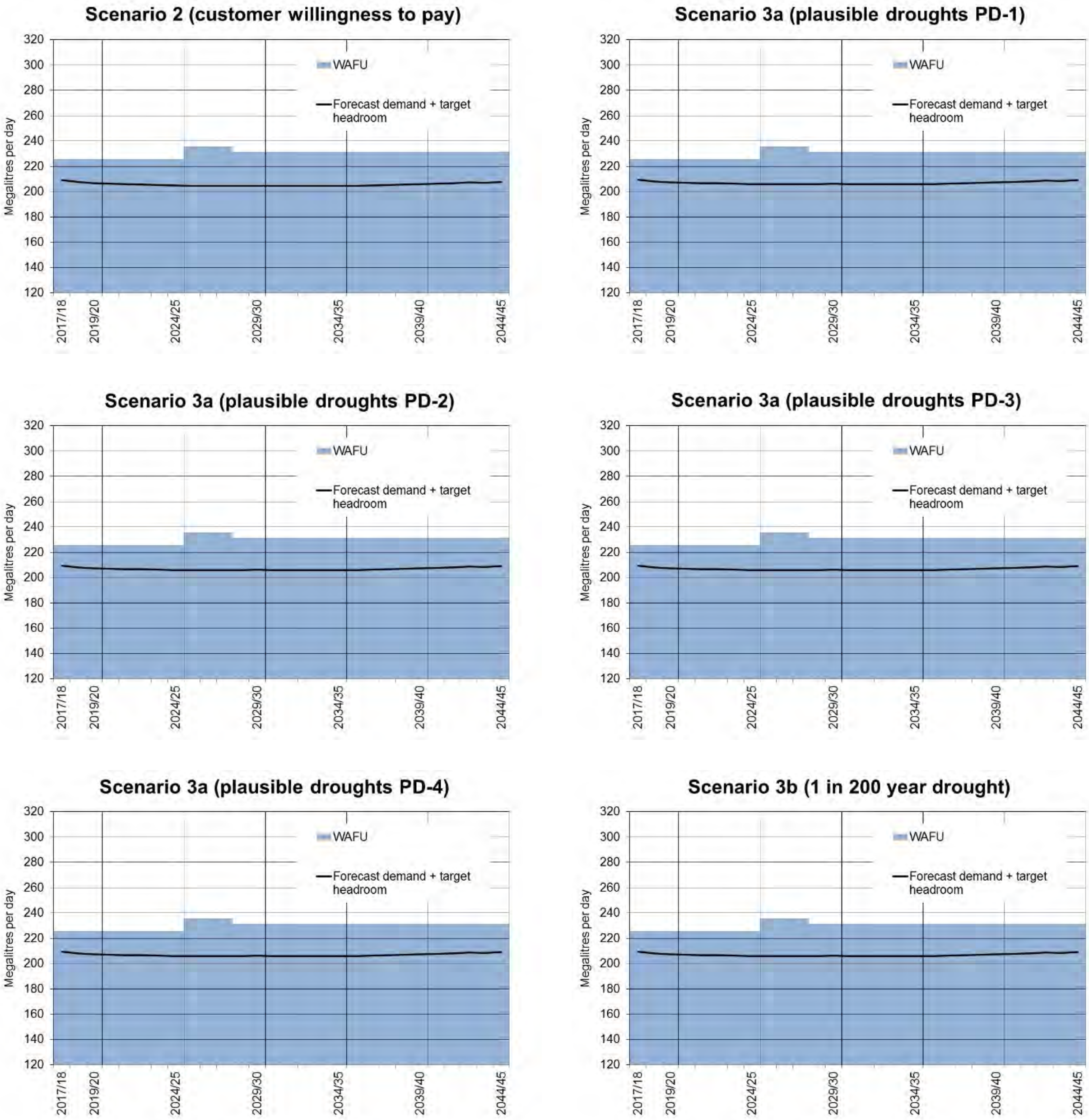
Compared to the Draft Plan, the new water treatment works investment was included in all scenarios for Bournemouth WRZ.

Table 7.13: Results of scenario analysis: Bournemouth WRZ

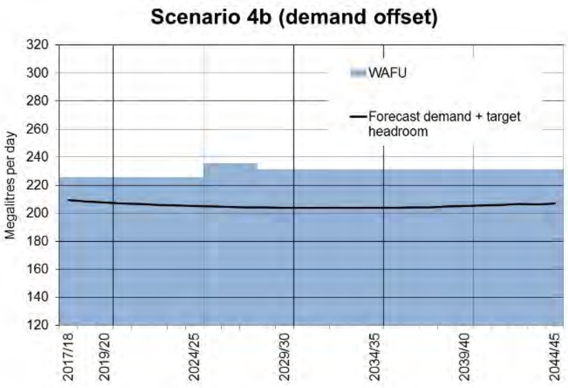
Ref	Description	2017	2020	2025	2030	2035	2040	2045
1a	Baseline	🟢	🟢	🟢	🟢	🟢	🟢	🟢
2	Customer willingness to pay	🟢	🟢	🟢	🟢	🟢	🟢	🟢
3a	Plausible droughts (4 droughts)	🟢	🟢	🟢	🟢	🟢	🟢	🟢
3b	1 in 200 year drought	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4a	Resource only plan							
4b	Demand only plan	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4c	PCC @100l/p/d	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4d	PCC @86l/p/d	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4e	PCC @62l/p/d	🟢	🟢	🟢	🟢	🟢	🟢	🟢
5a	Southern transfer	🔵	🔵	🔵	🔵	🔵	🔵	🔵
5b	Environmental needs	🟢	🟢	🟢	🟢	🟢	🟢	🟢
6a	Leakage consistency measures	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6b	PR19 methodology (15% leakage reduction)	🟢	🟢	🟢	🟢	🟢	🟢	🟢
6c	15% leakage reduction (final costs)	🟢	🟢	🟢	🟢	🟢	🟢	🟢
6d	NIC recommendation	🟢	🟢	🟢	🟢	🟢	🟢	🟢
7a	High household demand	🟢	🟢	🟢	🟢	🟢	🟢	🟡
7b	High non-household demand	🟢	🟢	🟢	🟢	🟢	🟢	🟢

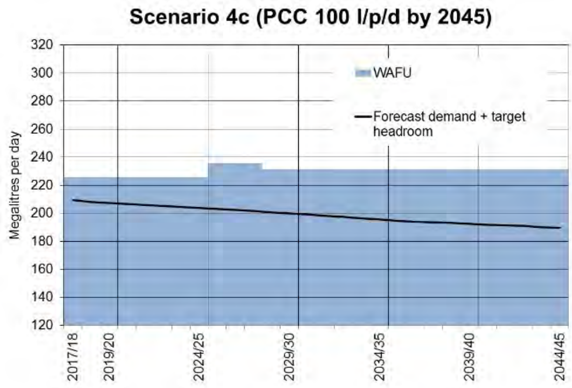
Note:
green = no supply demand deficit; amber = small supply demand deficit (<3%); red = large supply demand deficit (>3%); blue = can be met with infrastructure improvements.

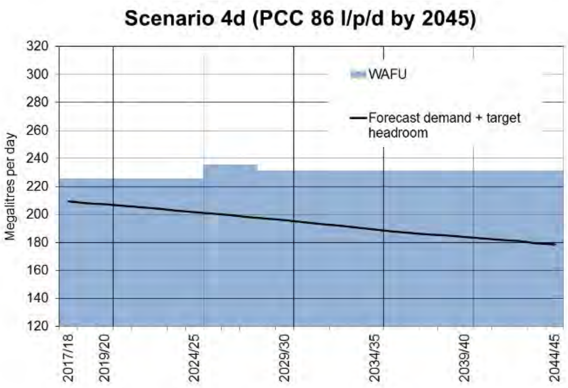
Figure 7.7: Results of scenario analysis: Bournemouth WRZ

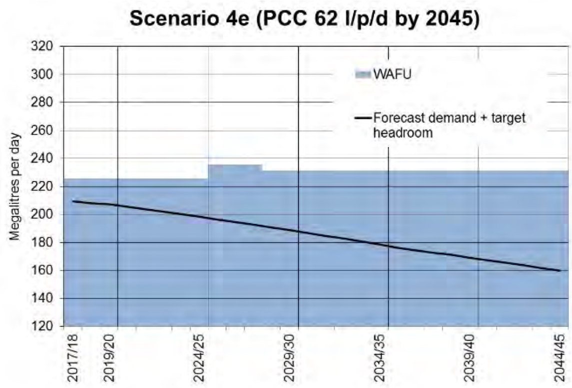


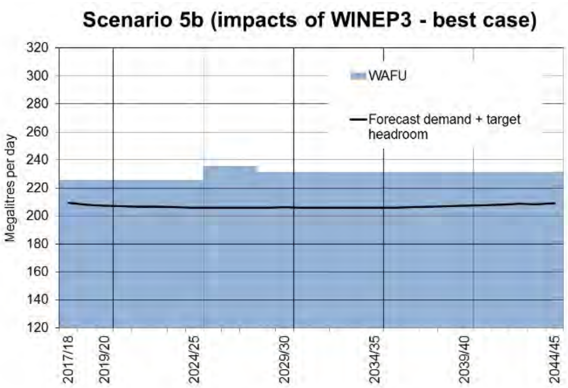
South West Water
Bournemouth Water

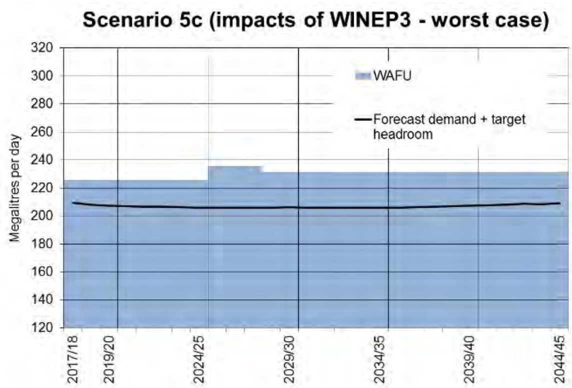

Scenario 4b (demand offset)
WAFU
Forecast demand + target headroom
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

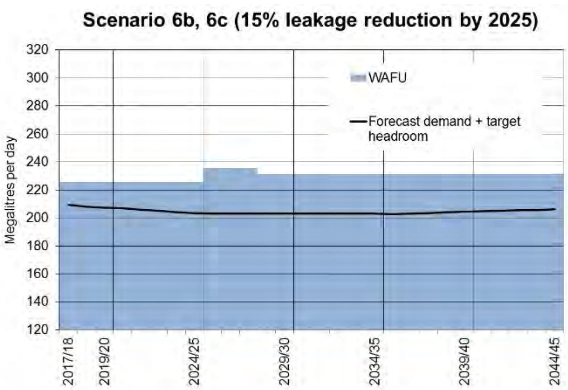

Scenario 4c (PCC 100 l/p/d by 2045)
WAFU
Forecast demand + target headroom
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

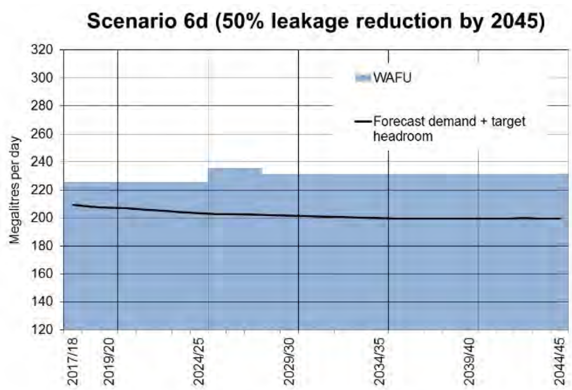

Scenario 4d (PCC 86 l/p/d by 2045)
WAFU
Forecast demand + target headroom
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

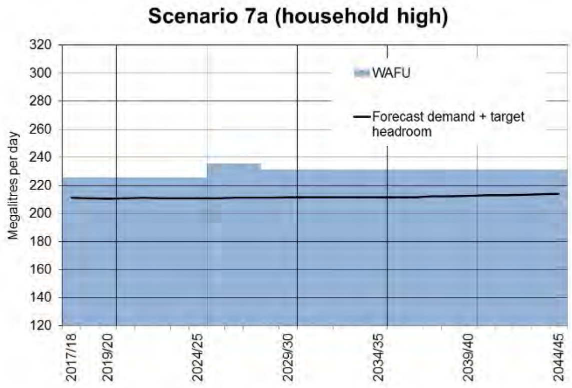

Scenario 4e (PCC 62 l/p/d by 2045)
WAFU
Forecast demand + target headroom
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45

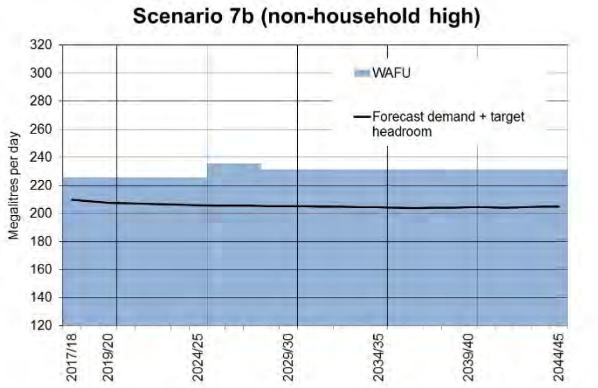

Scenario 5b (impacts of WINEP3 - best case)
WAFU
Forecast demand + target headroom
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 5c (impacts of WINEP3 - worst case)
WAFU
Forecast demand + target headroom
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 6b, 6c (15% leakage reduction by 2025)
WAFU
Forecast demand + target headroom
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45


Scenario 6d (50% leakage reduction by 2045)
WAFU
Forecast demand + target headroom
Megalitres per day
320
300
280
260
240
220
200
180
160
140
120
2017/18
2019/20
2024/25
2029/30
2034/35
2039/40
2044/45



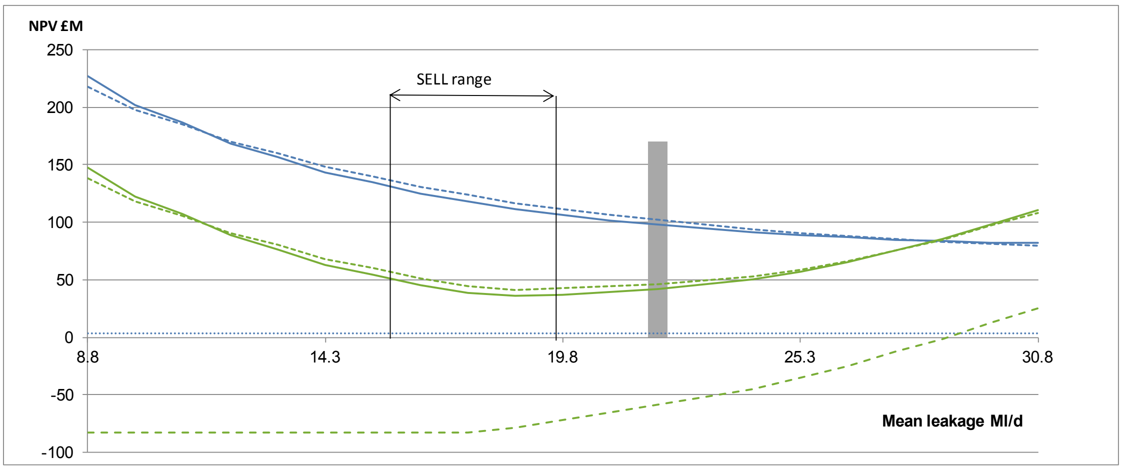


7.3.4.1 Summary

The Bournemouth WRZ is robust in all the scenarios. The additional investment planned at the water treatment works means the WRZ has sufficient water available to meet all the scenarios.

The SELL range is largely unchanged from the Draft Plan at 15 - 20 Ml/d (vs. 15 - 18 Ml/d) which is a function of the change in the leakage consistency reporting methodology on the leakage values (Figure 7.8).

Figure 7.8: Scenario results – Willingness to pay



Note: current leakage target is 21.3 Ml/d in 19/20 under the new leakage consistency reporting

Current (2019/20) | Company - Draft | Company - Innovations
Soc & Env | Cust WTP | NPV tot - Draft
NPV tot - Innovations

South West Water
Bournemouth Water

7.3.4.2 Transfer to Southern Water

A 20 Ml/d transfer from the Bournemouth WRZ is included in Southern Water's final plan as one of their options to close their supply demand deficit in their Hampshire WRZ. In their plan it is programmed to come on line in 2027.

To ensure alignment across company boundaries it is therefore included in our Final Plan for this WRZ commencing at the same date – see Section 8.

Two engineering studies have already been completed for this transfer. These have examined different possible supply routes and volumes with a preferred option.

The further development of the feasibility of the transfer is planned as part of the work programme for the West Country Water Resources Group. There are a range of detailed studies to further develop the transfer. These include, but are not limited to:

- Detailed assessment of water availability in extreme droughts aligned to Southern Water's drought vulnerability
- Environmental impact assessment, including a no deterioration study
- Evaluating options for re-use via Wessex Water STWs
- Assessing the impact of the transfer on the resilience of Wessex Water and Bournemouth Water systems in extreme droughts
- Evaluating further options including Severn to Bristol Water transfer

These activities plan to complete over the period to 2021 in order to feed into the next WRMP in 2024. Within these activities a critical element will be the environmental impact assessment and whether or not any transfer causes deterioration in the classification of the Avon or Stour due to the additional abstraction compared to current operation.

As any transfer to Southern Water is currently not contingent on any other water resource investment in the Bournemouth WRZ, the decision to go ahead or not with the transfer does not affect this Plan for this WRZ. However, developing the transfer is complex and it does affect the decisions on the size of the new WTW in Bournemouth. If further options, such as re-use, were to be developed with Wessex Water, this could also affect the operational and investment of the Bournemouth WRZ. These different options and issues will be developed as part of the West Country Water Resources Group and used to develop the options feasibility further ahead of WRMP24 to confirm the final configuration and viability of any transfer.

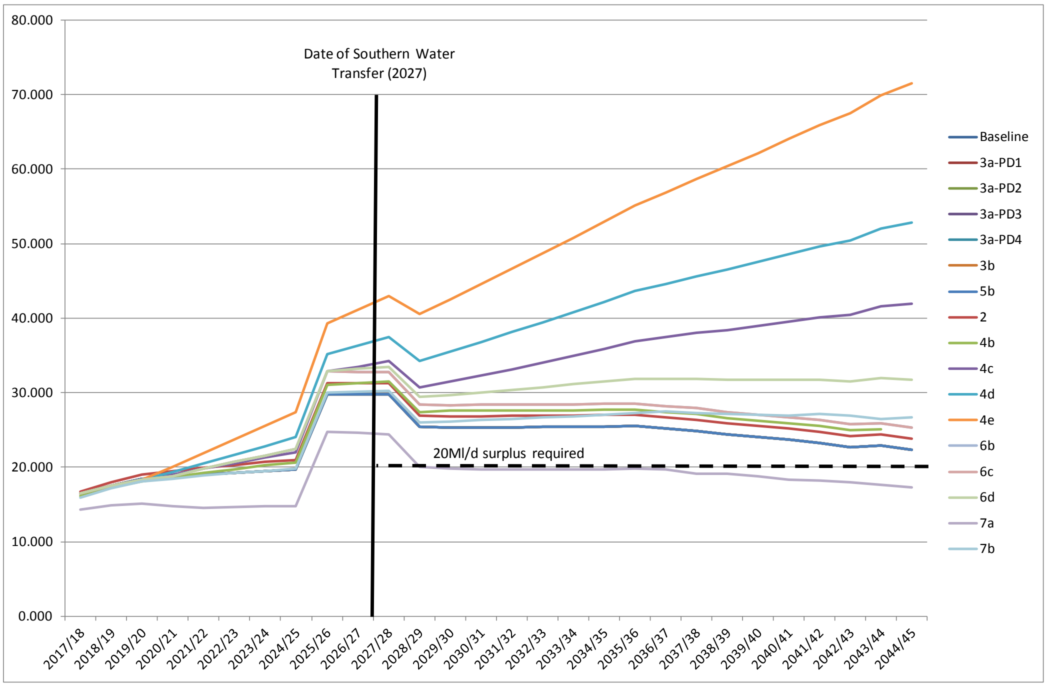
<u>Supply demand balance with the Southern Water Transfer</u>

If the above studies show the transfer will be viable, Figure 7.9 shows the impact on the supply demand surplus/deficit for all of the scenarios tested above. Overlain on this is the additional demand a 20 Ml/d transfer to Southern Water would incur. The results show that:

- Under all scenarios bar one the supply demand surplus is in excess of 20 Ml/d
- Under one scenario – higher household demand –the surplus is 17.3 Ml/d, leaving a potential shortfall for the transfer of 2.7 Ml/d

The feedback on our Draft Plan for a 15% leakage reduction by 2025 and additional water efficiency means that the final supply demand balance without the transfer results in a surplus in excess of 30 Ml/d on critical period. This more than offsets the supply demand risk from the higher household demand scenario identified above without jeopardising the transfer reliability.

Figure 7.9: Scenario supply demand surplus with no interventions (Critical Period)



7.4 Multi-criteria decision making process

The scenarios described above for each WRZ 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.

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.

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 WRZ. This gave a total score for each scenario for each of the five metrics set out above.

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 in 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 7.10 to 7.13. 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. 15% leakage reduction (final costs)
- 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 poorly on affordability, due to the high actual cost in customer bills, and on deliverability but does deliver higher scores on resilience and customers than the baseline plan
- Large scale reductions in PCC perform well on resilience and markets and innovation, but more poorly on financial and deliverability than the baseline plan
- The reductions in the proposed cost of leakage reduction means the scenario of a 15% leakage reduction performs better overall and better than in the Draft Plan, albeit both the Draft and Final Plan have low scores on cost and yield certainty
- The NIC recommendation for a 50% reduction in leakage significantly increases the supply demand surplus but at additional cost and delivery uncertainty than other plans.

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

Performance of this scenario is unchanged from the Draft Plan. This scenario performs well financially, as there is little investment needed to balance supply and demand and not until after AMP7. It also performs well on deliverability, as there is little intervention needed. However, it performs poorly in alignment to customer and affordability, as it does not align to customer or government preferences in the short term. 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)

Performance of this scenario is unchanged from the Draft Plan. 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)

Performance of this scenario is slightly changed from the Draft Plan. In the case of Roadford WRZ, performance is lower, as higher starting demands means that without intervention this WRZ would go into deficit on all plausible droughts. This requires additional investment in the short term, leading to lower financial scores due to the additional cost incurred and lower scores on flexibility, as leakage reductions would be needed in the short-term.

The performance of the 1 in 200 year scenarios is unchanged from the Draft Plan. For Colliford, Bournemouth and Wimbleball there is no supply demand shortfall or only a small deficit at the end of the period. The costs and activity needed to address are therefore in the future and small. 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 the case of Roadford, there is some sensitivity in the medium term to a 1 in 200 year event if no intervention is made. This would be resolved through small levels of leakage reduction in the future.

7.5.4 Long-term balance (water resource only and demand only plan)

The water resource and demand only plans performance is unchanged from the Draft 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 new scenarios assessing long-term reductions in PCC are on par with the baseline plan. They give rise to an additional supply demand surplus and perform better on resilience and innovation and markets. However, they perform poorly with regard to deliverability and financial performance – the latter as the costs are currently uncertain.

Our conclusion is, therefore, that large scale reductions in demand give rise to considerable benefits, but they do carry significant risks if the savings do not materialise and the costs of delivery are uncertain. The links with Drought Plans would also need to be understood, since the drought management actions assume water savings, which if embedded in underlying water use, may not be available in a drought.

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 is identical to the Draft Plan.

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 (best case) scenario performs better than the baseline scenario however, as a whole, performance is lower than the Draft Plan. This is because more investment is needed to offset the loss of supply, leading to higher costs in the Roadford and Wimbleball WRZs.

The environmental needs (worst case) performs worse overall than the best case and in the case of Wimbleball worse than the baseline itself. The two WRZs where there is the biggest difference are in Roadford and Wimbleball WRZ. In both WRZs high reductions in resource availability could give rise to a material supply demand risk in the future and reductions in the resilience of supply in these areas. The lower performance score in these areas is due to the higher cost of intervention to ameliorate the deficit and also the reduced flexibility that this brings into the Plan.

7.5.6 Data (PR19 methodology, 15% reduction final plan costs and NIC recommendation)

The adoption of the PR19 methodology to reduce leakage by 15% by 2025 based on current costs shows a clear trade-off. In all WRZs 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.

The scenario of a 15% reduction in leakage based on final costs performs better from a financial perspective and marginally better on deliverability. However, it still contains deliverability risk.

The NIC recommendation performs well on areas, such as resilience, since it provides significant additional volumes of water. However, it performs poorly on cost and deliverability. The scale of the reduction is outside the range of data available on reliable cost prediction. Detailed information on how the savings would be delivered is also not available.

7.5.7 Demand uncertainty (household and non-household high demand forecast)

The non-household high demand forecast does not materially change the baseline programme. This performs well on financial and deliverability measures since intervention is small but scores lower on resilience, alignment with customer preferences and promotion of markets and innovation.

In contrast, as highlighted in the Draft Plan, all SWW WRZs show some long-term sensitivity to higher household demand forecasts. Compared to the Draft Plan, Roadford WRZ is more sensitive to higher demands. The timing of any risk to the supply demand balance if no intervention is made is not material (<3%) until after AMP8. The level of mitigation needed is modest and these programmes perform well overall. This performs well with regard to customer preferences and government guidelines, cost, and deliverability. The latter two aspects are because timing of the intervention means that the cost of the programme is not significant in the short-term and the scale means that the uncertainty on the delivery is not significant.

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. Overall this programme is the highest performing programme in the scenario analysis. This is because it is taking a balanced view across all elements that affect the supply demand balance.

Table 7.15: Results of multi-criteria assessment

Ref	Theme	Scenario title	Final Plan C	Final Plan R	Final Plan W	Final Plan B	Final Plan Total	Draft Plan total
1a	Baseline	Baseline	2	2	2	2	96	96
2	Customer preferences	Customer willingness to pay	2	2	2	2	97	97
3a	Resilience	Plausible droughts	2	2	2	2	96	100
3b	Resilience	1 in 200 year drought	2	2	2	2	96	96
4a	Long-term balance	Resource only plan	2	2	2		85	85
4b	Long-term balance	Demand only plan	2	2	2	2	104	104
4c	Long-term balance	PCC @ 100l/p/d	2	2	2	2	100	-
4d	Long-term balance	PCC @ 86l/p/d	2	2	2	2	96	-
4e	Long-term balance	PCC @ 62l/p/d	2	2	2	2	96	-
5a	Environment and markets	Southern Water transfer				2	28	28
5b	Environment and markets	Environmental needs (best case)	3	2	2	2	104	108
5c	Environment and markets	Environmental needs (worst case)	2	2	2	2	96	-
6a	Data	Leakage consistency measures					-	-
6b	Data	PR19 methodology (15% leakage reduction)	2	2	2	2	100	100
6c	Data	15% leakage reduction (final plan costs)	2	2	2	2	110	-
6d	Data	NIC recommendation	2	2	2	2	84	-
7a	Demand uncertainty	High household demand	3	2	2	2	107	111
7b	Demand uncertainty	High non-household demand	2	2	2	2	100	96

Note: for a given scenario, the scores may differ in each WRZ. This is because the impacts of the scenario can affect each WRZ differently. A comparison with the Draft Plan is given in Appendix 7.
C = Colliford WRZ; R = Roadford WRZ; W = Wimbleball WRZ; B = Bournemouth WRZ, Draft Plan total = Draft Plan equivalent score

Figure 7.10: Colliford: Results of multi-criteria assessment

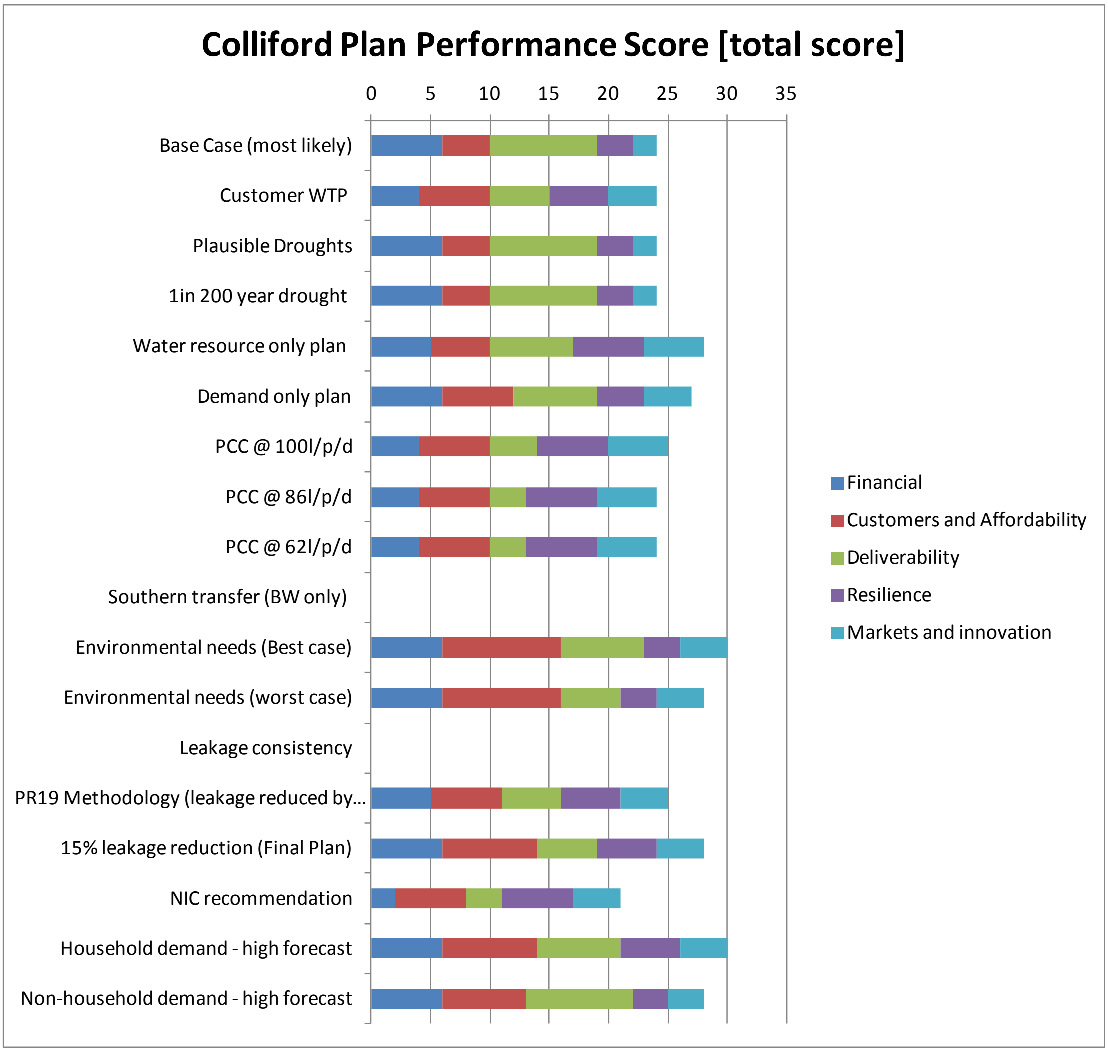


Figure 7.11: Roadford: Results of multi-criteria assessment

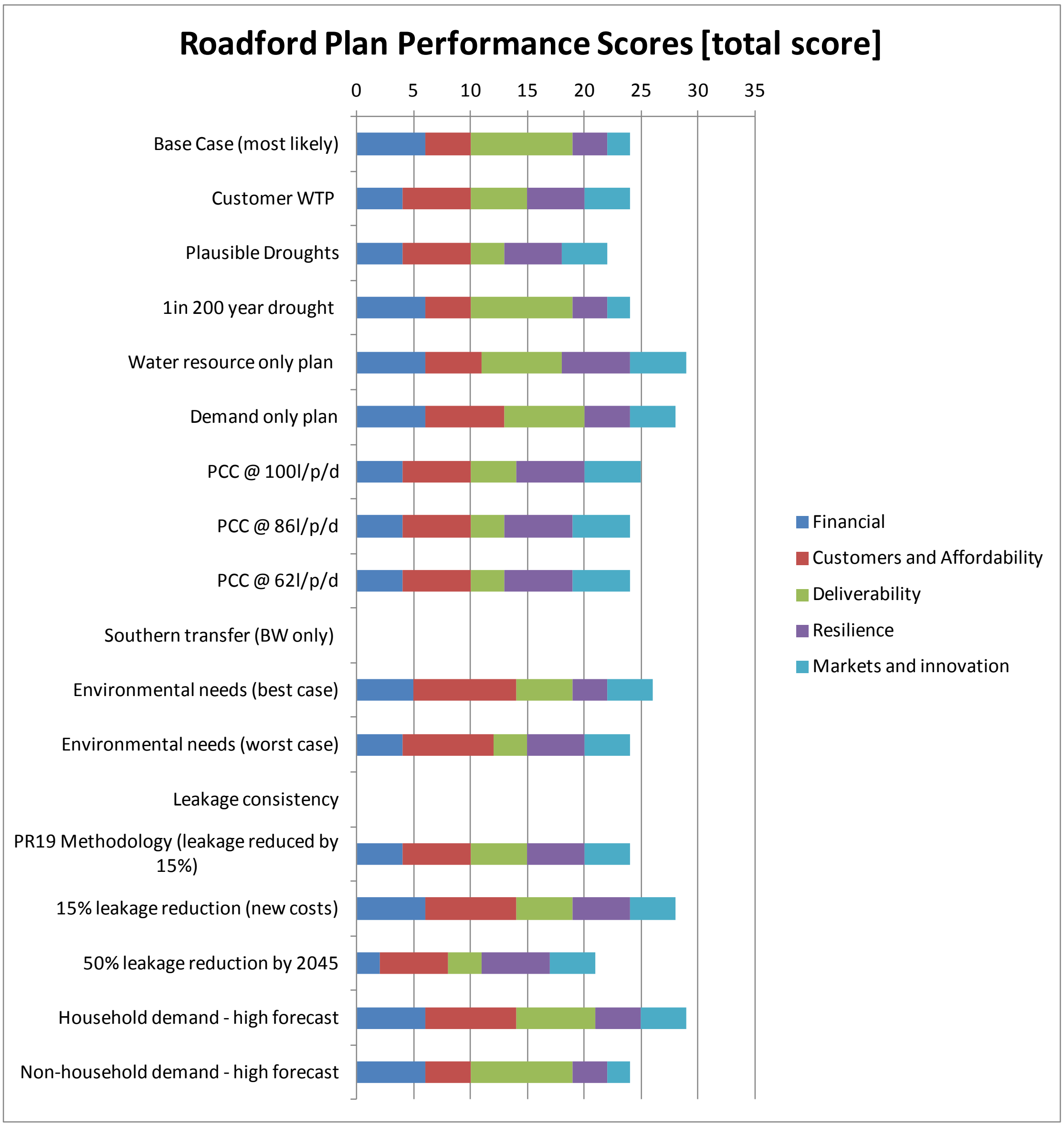


Figure 7.12: Wimbleball: Results of multi-criteria assessment

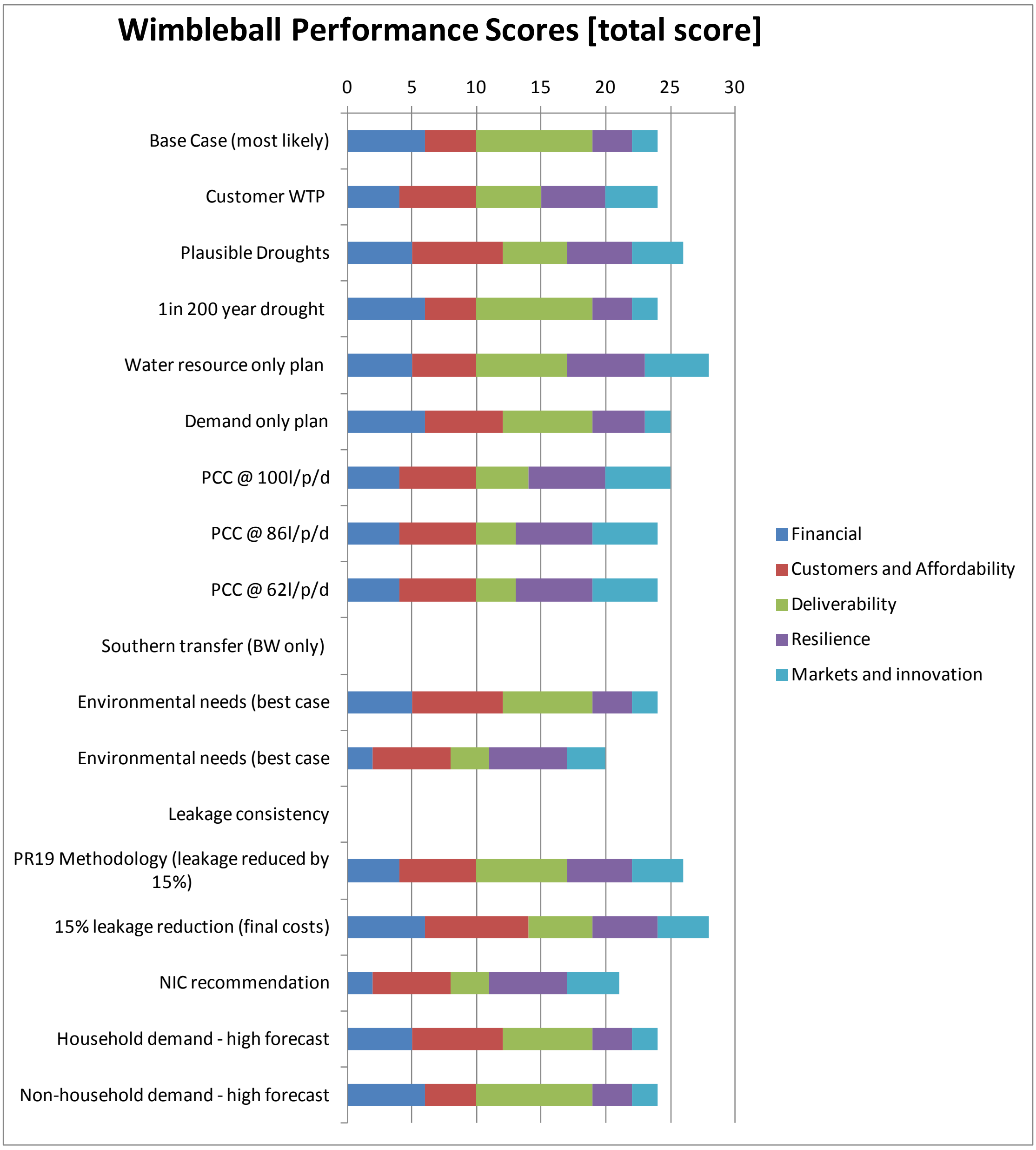
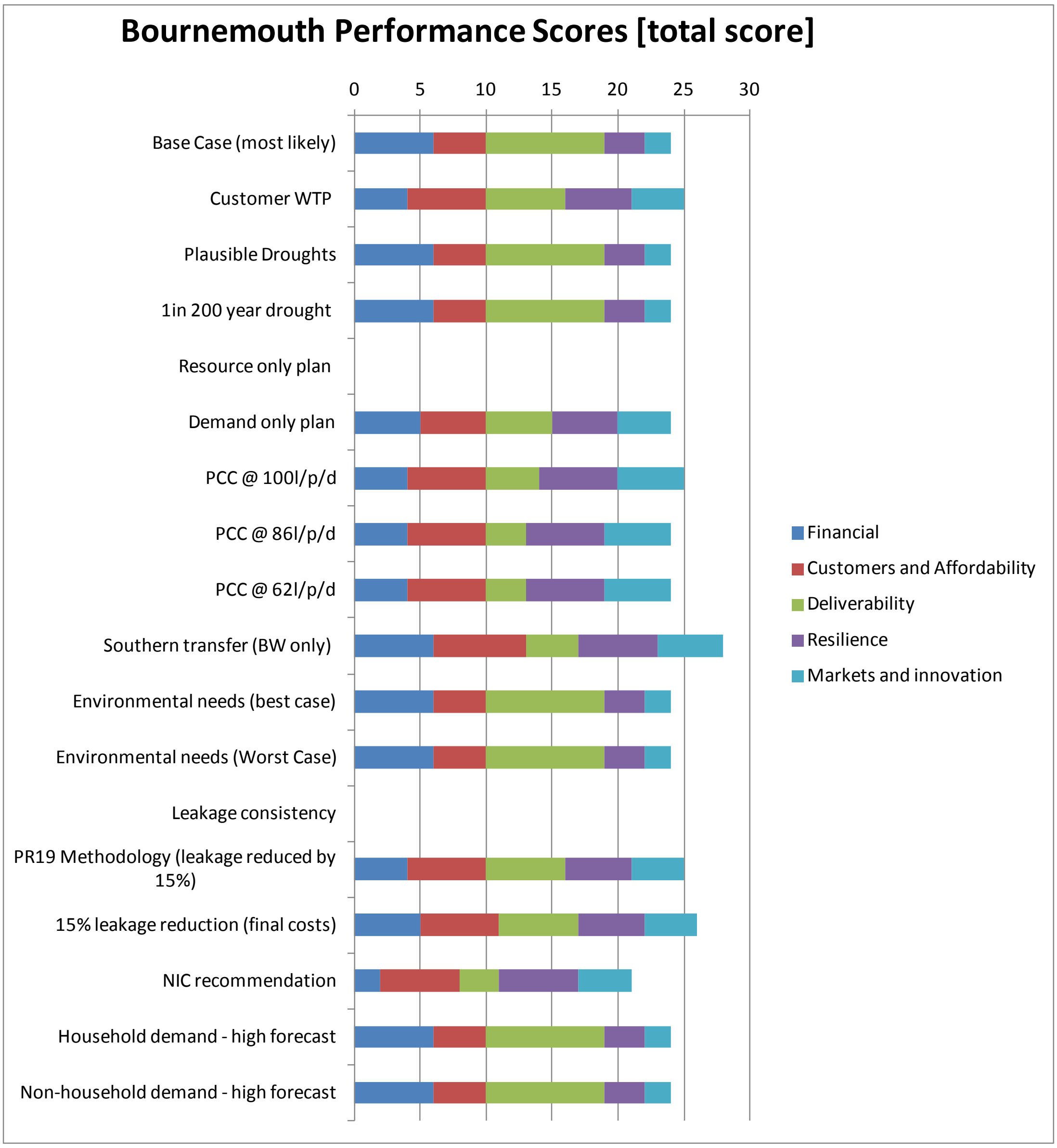


Figure 7.13: Bournemouth: Results of multi-criteria assessment



7.6 Otter Valley risk assessment

Following feedback on our Draft Plan we have undertaken a more detailed assessment of a range of different risks in the Otter Valley. This is presented in detail in Appendix 7.

The assessment of the overall water resource position is that current supply, including the transfer of water via Pynes WTW, is able to meet predicted peak demand, but with only a very limited surplus of circa 2 Ml/d (8%) above target headroom.

The following potential risks to water availability in the Otter Valley were identified as part of this assessment:

1. WINEP3 licence reductions
2. Potential saline intrusion & the longer-term impact of climate change
3. Deterioration of borehole performance due to asset age
4. Temporary outages which result from river flooding events
5. Deterioration in nitrates concentration and other key water quality parameters

The multiple risks to water resource supply in the Otter Valley and in the broader Wimbleball WRZ will require a range of mitigation measures, some addressing specific risks while others have wider benefits.

7.6.1 WINEP 3 licence reductions

The Environment Agency have previously identified that a 6 Ml/d reduction in abstraction is required to meet WFD drivers, specifically addressing impacted flows in the Lower Otter. This is currently being reassessed through the update of the Otter Valley groundwater model but is not expected to change significantly from the previous figure.

Given the local reliance on the Otter Valley sources and the limited surplus it is desirable that we retain existing water available to maintain adequate confidence in local security of supply. In practice this means being able to abstract sufficient water at critical times of high demand from a variety of sources. Whilst we would not wish to be overly reliant on any one source, the importance of certain sources cannot be understated. In particular, it is important that we have the ability to abstract at current levels from certain wellfields during periods of peak demand.

We are therefore considering a number of innovative licence changes which would enable us to continue to meet peak demand whilst reducing the overall long-term impact of abstraction from key groundwater sources. This includes the implementation of the Otter Valley Abstraction Incentive Mechanism (AIM) scheme, which will result in a reduction in the hydrological impact of abstraction on the Lower Otter.

7.6.2 Saline intrusion risk and the longer-term impact of climate change

There is the potential for saline intrusion to affect Wellfield O, which is located closest to the coast. Saline intrusion risks include short duration threats, such as embankment breach, which can be managed through operational measures (e.g. temporarily changing sources) provided there is sufficient resilience in the system. In the longer term, the risk of saline intrusion due to climate change-induced sea level rise has been shown, by groundwater modelling, to increase significantly in the second half of this century.

The Lower Otter Restoration Project (LORP) is a managed realignment scheme which, if progressed, would result in the extension of the Lower Otter Estuary further up the Lower Otter Valley. The initial assessment of the impact of LORP on saline intrusion, commissioned by the Environment Agency, suggests a limited increased risk of intrusion, as a result of implementing the scheme. The work completed to date makes no assessment of the potential future increase in risk to the closest borehole sources following implementation of the scheme under a range of future climate change scenarios.

Mitigation measures currently comprise monitoring trends in salinity in an observation borehole located to the east of the affected wellfield to provide early warning of saline intrusion risk. If the LORP scheme were to progress, additional monitoring would be required to the west of the wellfield to address the risk of saline intrusion from the Otter Estuary.

An increased risk of saline intrusion, identified by the early warning monitoring network, could lead to reductions in abstraction capacity. Any subsequent reduction in abstraction could necessitate the operation of alternative, more costly sources. Any serious long-term threat to the sources has the potential to result in a 7Ml/d loss of resource, which would precipitate the development of alternative sources at significant additional cost.

7.6.3 Deterioration of borehole performance due to asset age

The performance of a number of the existing public supply boreholes in the Otter Valley has significantly deteriorated as they approach the end of their expected asset life. Ongoing work to identify suitable alternative sources, either in the Otter Valley or elsewhere in East Devon, suggests that whilst it may be possible to gain 1-2 Ml/d of additional water, although water quality remains a significant constraint.

7.6.4 Temporary outages which result from river flooding events

Two sources are subject to periodic short-term outages due to floodplain inundation from the River Otter. These losses are currently mitigated by the increased operation of another borehole in the same wellfield. We are currently investigating the potential to reduce the impact of these outages by implementing changes to the operational approach at a number of sources in the affected wellfield. Future increases in outage frequency due to climate change, if significant, are likely to require the establishment of a new borehole located outside of the Otter floodplain.

7.6.5 Deterioration in nitrates concentration and other key water quality parameters

Nitrate levels in the Otter Valley groundwater body are variable with a small number of borehole abstractions being relatively close to, or above, the standard for public water supply. Nitrate levels in the final treated water are currently managed to ensure compliance using a combination of nitrate stripping and multi-source blending.

Upward trends in nitrate are being observed at a small number of boreholes. If there were to be further increases in nitrate, this might lead to the requirement to use water from alternative sources or explore additional treatment options. We are currently working to minimize the risk through the implementation of a number of catchment management projects and research studies with the aim of reducing the amount of nitrate entering the groundwater system in the medium to long term.

7.6.6 Residual risks and mitigation measures

Once mitigation measures have been implemented, there will still be critical residual risks in terms of potential WINEP reductions and climate change. There is also a potential increased risk from the LORP scheme.

Any agreed WINEP reductions will come into effect in 2025 and we are continuing to investigate options to offset the impact of these. Climate change is a significant risk in the long-term, with the likelihood of significant consequences increasing with time. This therefore requires an ongoing adaptive approach to mitigation. We will work with the Environment Agency to develop an improved early warning monitoring system to identify and manage any increase in saline intrusion risk resulting from long term climate change or shorter term direct interventions.

Maintaining and developing a high degree of resilience will be critical to ensuring we are able to meet existing and future customer demands. Given the current small surplus within the Otter Valley and the relatively limited availability of water in the wider Wimbleball WRZ, any reduction in the current peak licence abstractions would increase the risk to supply.

Future demand management measures will remain important. Further detail of these, which include the proposed 15% reduction in leakage fed back on our Draft Plan, a range of customer side management options and extending metering, is provided in Section 6 and Appendix 6.

The development of infrastructure changes, including importing extra water and/or developing new sources, would be a high cost response, with additional carbon footprint and unproven environmental benefit. The cost of developing the infrastructure required to transfer additional water from outside the Otter Valley is significant, with a high-level estimate of over £10m for the capital works alone. There are also likely to be significant socio-environmental impacts associated with this response.

7.6.7 Outcome of the Otter Valley risk assessment

Given the additional risks facing the Otter Valley abstractions, the current additional 2 Ml/d available above target headroom represents a reasonable additional buffer to ensure resilience of supply. A reduction in supply capability in 2025 to fully meet the current estimate of environmental need would result in a significant supply demand deficit requiring major investment in infrastructure.

The results of the sensitivity test suggest the following approach is required to progress towards meeting the Environment Agency environmental targets on the Lower Otter:

1. Demand reduction measures (including 15% leakage reduction)
2. Innovative/smarter abstraction management approaches (including the AIM scheme)
3. Further review of the environmental benefit of increasing flows in the Lower Otter.

We will be working on an options appraisal with the Environment Agency to confirm the best approach, which will be agreed by 2022, leading to an investment case which will be included in PR24.

The risk assessment highlights a number of impacts for which the associated risks will change over time e.g. LORP and/or where the underpinning understanding will continue to develop e.g. climate change predictions. We will therefore update the Otter Valley risk assessment on an annual basis as part of the WRMP review process, to ensure we are able to take into account any new information and/or data that may become available.

7.7 Conclusion

The scenario analysis was used to understand how robust the performances of the baseline forecasts are to future uncertainties. The assessment was updated from the Draft Plan with the latest cost forecast and additional stress tests.

Overall the South West Water WRZs show a relatively robust supply demand balance even without investment. This is consistent with our problem characterisation which shows we are relatively low risk. The Draft Plan showed that all the SWW WRZs however show some 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

This is confirmed in the updated analysis in the Draft Plan, however the impact of these sensitivities is higher than previously assessed and occurs earlier in the planning period. The principal driver is higher starting demand.

Within the WRZs, Roadford WRZ continues to have the highest sensitivity to future uncertainties with potential supply demand deficits occurring in the 2030 period onwards. This is consistent with the Draft Plan and supports the original actions within the draft strategy to develop more risk based tools, test the resilience of options to future drought and undertake a study on the feasibility of a pumped storage scheme at Roadford as a precaution should the future uncertainties arise.

The assessed likelihood of the above scenarios is low (hence the low risk categorisation), but were these uncertainties to occur, they would cause supply demand deficits to appear perhaps as early as 2030. In addition, whilst the WRZs can be resilient to one of the stress tests, the analysis suggests that should the stresses occur in tandem it could potentially affect the supply demand balance adversely. For example, new environmental needs combined with higher household demand and an extreme drought in any one year is likely to stress the system.

The Bournemouth WRZ is robust to the scenarios tested, and the results show that a transfer to Southern Water of the order of 20 Ml/d can be met with the new WTW investment planned. Such a transfer would allow better use of water across the South-East Region to help meet future demand and other environmental needs. There is however a range of studies that still need to be completed to confirm the environmental viability of the option and to explore other water sources (such as re-use) and this will need to be developed through the West Country Water Resources Group.

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. This is seen in the higher scores for those programmes mitigating environmental needs, higher household demands and programmes with additional leakage reduction compared to a strict least cost plan. 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 it is clear the 15% leakage reduction by 2025 fed back as the preferred choice from the Draft Plan, would mitigate many of the key uncertainties in the programme such as higher household demand, more environmental needs or more extreme droughts.

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 versus 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

- Our overall strategy is to maintain the balance between supply and demand over the next 25 years and beyond by:
    - Reducing leakage and the future demand for water
    - Ensuring availability of existing sources and their resilience to droughts
    - Developing our planning tools and understanding of future options
- By 2025 we will:
    - Reduce leakage by 15% from the 2019/20 forecast position.
    - Reduce normal year per capita consumption to 127l/p/d by 2025 (133l/p/d in a dry year)
    - 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 modelling tools to inform future plans
    - Continue to promote water transfer options, including a detailed study into a Bournemouth Water to Southern Water 20Ml/d transfer through the West Country Water Resource Group
- Post 2025 we will:
    - Further reduce leakage to 24% lower than current levels by the end of the planning period with a view to reducing to the NIC recommendation of 50%
    - 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 132 vs. a baseline score of 96. Performance is higher than the Draft Plan due to lower leakage delivery costs and additional water efficiency activity.
- 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 despite no forecast supply-demand deficit driver
- The plan aligns to feedback from customers and stakeholders on our Draft Plan and with broader policy objectives. It is not a strict least cost plan however, and the targets included include greater delivery risk than those in the Draft Plan.

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 the following:

- Colliford and Bournemouth WRZs are in surplus throughout the planning period even with no intervention
- With no intervention, Wimbleball WRZ is in surplus until the very end of the planning period with a minor deficit in 2044/45
- Roadford WRZ drops into deficit in 2028/29 and remains in deficit from then until the end of the planning period if no intervention were made

However, the stress testing (Section 7) shows that all the WRZs in the SWW supply area have some 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 Final Plan for the short-term and medium to long-term planning periods, respectively. Table 8.1 includes the activities we will undertake following feedback on our Draft Plan. Table 8.3 and Figure 8.1 show the performance of the Plan using the multi-criteria assessment used in the scenario analysis. These show that the proposed Final Plan performs well overall when all factors are taken into account but is not the lowest cost plan. This is discussed further in Section 8.5.

There are both higher and lower cost plans, and plans that could contain more or less risk mitigation. The Final Plan is considered to give good value overall and takes into account the feedback from customers, stakeholders and regulators on the Draft Plan.

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 15% from 2020 to 2025	Support customers to reduce overall average per capita consumption to 127 l/p/d (133l/p/d dry year) or less 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 with a view to giving all customers the option of a metered bill by 2025 Reduce our consumption of water at 5 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	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 that demand savings are less than expected	High level feasibility study on a Roadford pumped storage scheme*. This will include natural capital assessment Undertake a feasibility study on a possible water transfer to Southern Water	-	Increase understanding of potential demand management savings in drought conditions Investigate opportunity for a Bournemouth WRZ AIM scheme	Support the development of the new Regional Water Resources Management Plans Continue to develop the 20 Ml/d transfer to Southern Water	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.*
*** inc. Slade reservoir, Challacombe,Brampford Speke, WImborne*

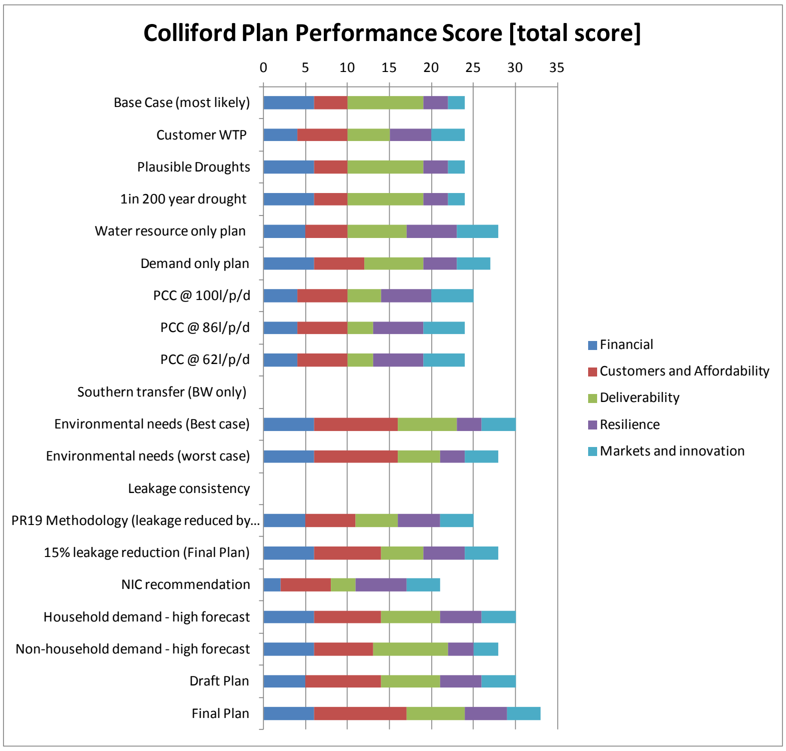
Table 8.2: Summary of the overall plan – medium to long-term (2025-2045)

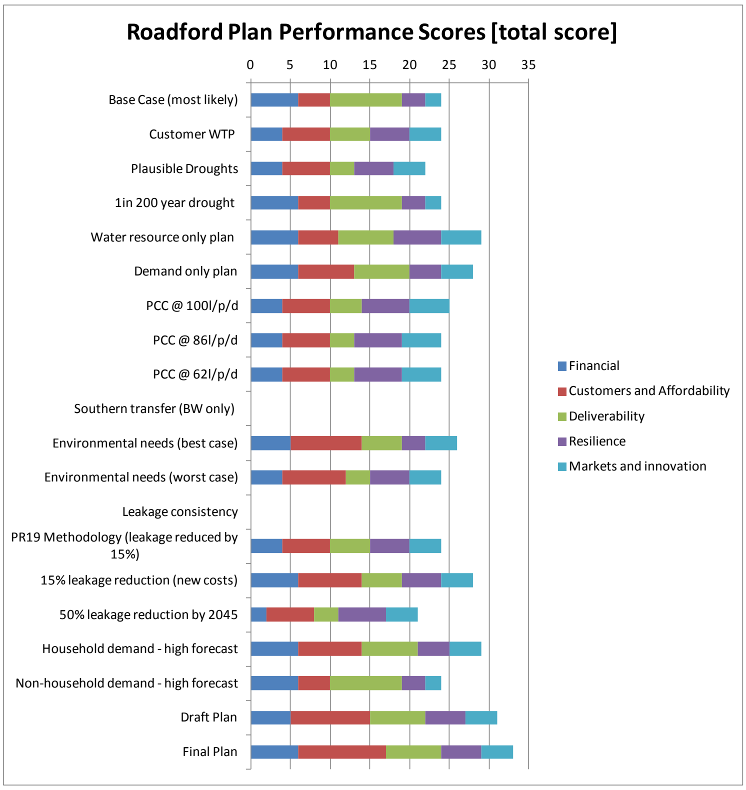
Strategy	Why	Medium to Long-term (2025-2045)				
		Resources	Leakage	Demand management	Transfers	Other
Reduce leakage and the future demand for water	Lowest cost options to manage future risks Consistent with customer preferences Consistent with Government and regulatory policy	-	Reduce leakage by c25% by 2045 or meet external policy targets	Continue to promote water efficiency and metering, reducing normal year PCC to 120 l/p/d (125 l/p/d in a dry year) or less or meet external policy targets	-	-
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 that 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 delivery of a transfer to Southern Water in the 2025 to 2030 period	Continue to develop risk based approaches

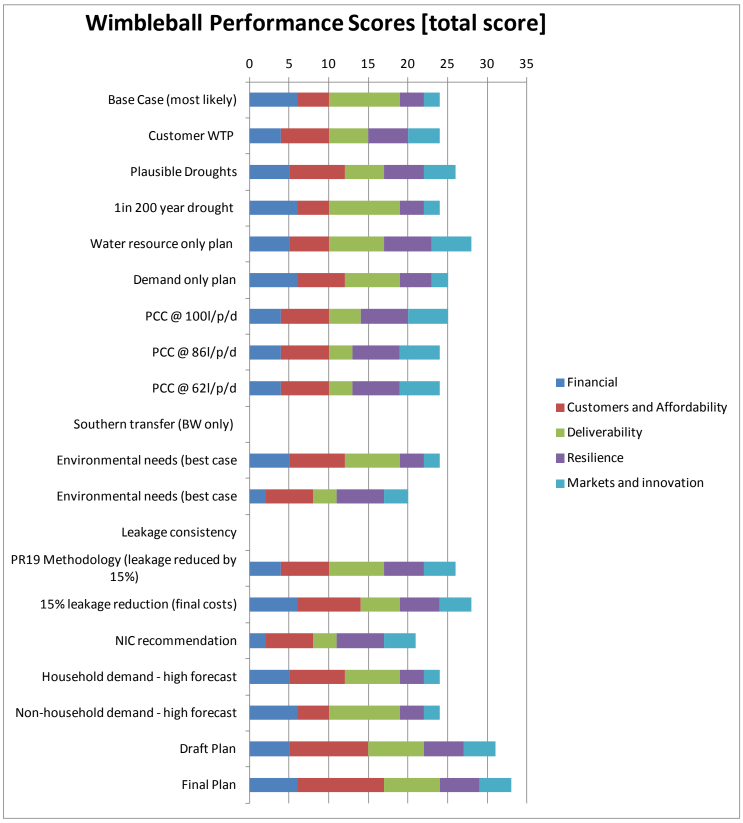
Table 8.3: Performance of the proposed plan – multi-criteria scores

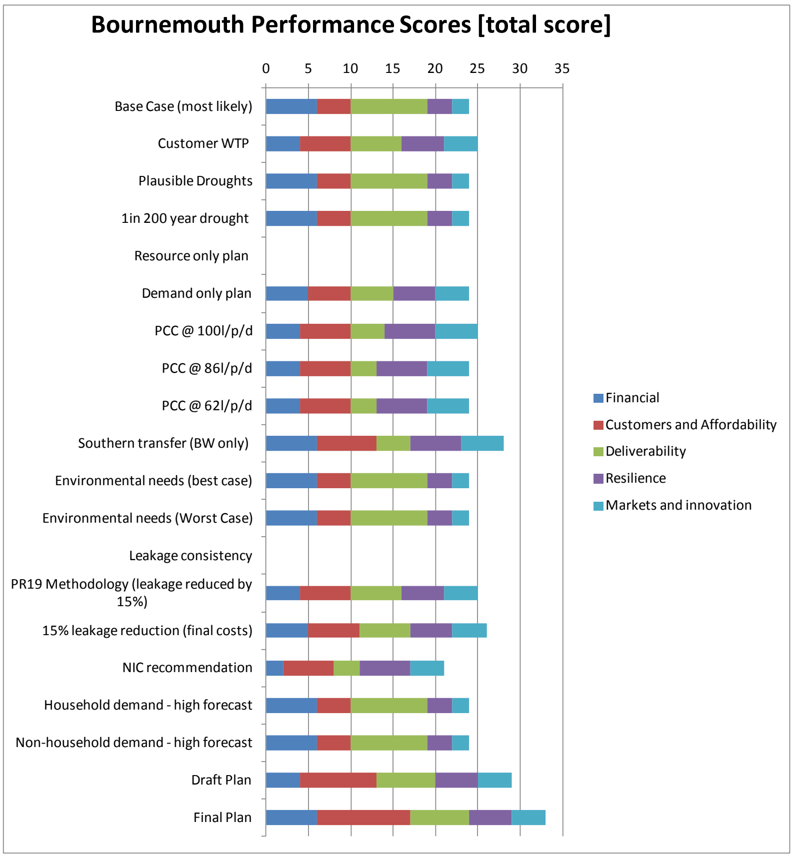
Ref	Theme	Scenario	Colliford	Roadford	Wimbleball	Bournemouth	Total
1a	Baseline	Baseline	24	24	24	24	96
8	Draft Plan	Draft Plan	30	31	31	29	121
8b	Final Plan	Final Plan	33	33	33	33	132

Figure 8.1: Performance of the proposed plan – multi-criteria scores – by WRZ




Roadford Plan 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
PCC @ 100l/p/d
PCC @ 86l/p/d
PCC @ 62l/p/d
Southern transfer (BW only)
Environmental needs (best case)
Environmental needs (worst case)
Leakage consistency
PR19 Methodology (leakage reduced by 15%)
15% leakage reduction (new costs)
50% leakage reduction by 2045
Household demand - high forecast
Non-household demand - high forecast
Draft Plan
Final Plan
Financial
Customers and Affordability
Deliverability
Resilience
Markets and innovation


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
PCC @ 100l/p/d
PCC @ 86l/p/d
PCC @ 62l/p/d
Southern transfer (BW only)
Environmental needs (best case
Environmental needs (best case
Leakage consistency
PR19 Methodology (leakage reduced by 15%)
15% leakage reduction (final costs)
NIC recommendation
Household demand - high forecast
Non-household demand - high forecast
Draft Plan
Final 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
PCC @ 100l/p/d
PCC @ 86l/p/d
PCC @ 62l/p/d
Southern transfer (BW only)
Environmental needs (best case)
Environmental needs (Worst Case)
Leakage consistency
PR19 Methodology (leakage reduced by 15%)
15% leakage reduction (final costs)
NIC recommendation
Household demand - high forecast
Non-household demand - high forecast
Draft Plan
Final Plan
Financial
Customers and Affordability
Deliverability
Resilience
Markets and innovation

8.2 Overall strategy

Our previous WRMP14 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 and the feedback on our Draft Plan, 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 in our WRZs. 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.

Feedback on our Draft Plan is that customers and stakeholders prefer a plan with 15% leakage reduction by 2025 and we have built that into our Final Plan.

However, leakage is only one component of the total demand for water. We consider that at a strategic level we should look to reduce the overall demand for water, including both 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 or where future sensitivities such as new environmental needs to occur simultaneously. This is a risk that could cause supply demand deficits and a possible degradation in the level of service (see Section 7).

In order for the supply demand balance to be maintained, we need to mitigate these risks that affect our overall water resources availability. This could, for example, be addressed by the introduction of new water resources schemes. 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 complement our Drought Plan, our understanding of the environmental impacts of our water resource options and will mitigate the risk around new environmental needs.

Table 8.4 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 8.4: 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

The following sections set out our Final Plan. All leakage figures are using the new Ofwat leakage consistency methodology for reporting.

8.3.1.1 Long-term plan (2025-2045)

Our proposed long-term plan is to reduce leakage by approximately 25% by 2045. This is equal to 89-90 Ml/d under the new leakage reporting methodology.

We have chosen this target for the following reasons:

- It aligns to the cost-beneficial level supported by customers (see Section 7)
- It sets a stretching long-term target and thereby requires sustained improvement in our performance
- It mitigates some, but not all the risk in the Plan which is consistent with the WRMP guidelines to not plan on a worst-case scenario
- The target allows the rate of change to be adapted in each five-year planning period to reflect forecast risks.

A significantly higher level of leakage (i.e. a less challenging reduction) would not be supported, as shown in the customer research data, although it would have lower costs.

In our scenario analysis we tested the 50% leakage reduction strategy by 2050 as recommended in the NIC report 'Preparing for a Drier Future'. With a starting leakage of 116Ml/d (19/20 annual average) this equates to a leakage level of 58Ml/d by 2050. Relative to the Final Plan this increases total supply demand surplus by a further approximately 30Ml/d.

We have not included this as our Final Plan for the following reasons:

- We are currently unable to cost how this could be delivered
- We are currently unable to assess how this would be delivered thereby placing supply security at risk

However, our Final Plan sets a stretching target from today but remains flexible allowing the rate and level of leakage reduction to be reviewed at each subsequent WRMP to ensure it adapts to the risks to maintaining the supply demand balance or government policy objectives.

The Final Plan is not sensitive to the choice of further increases in the level of leakage reduction above the target included. A lower leakage level in the long-term merely increases the level of supply demand surplus. We consider this is important, since it is not the leakage target that is important in the Plan but rather a reduction in leakage in Ml/d terms. It is this reduction in water losses that mitigates the future risks to the supply demand balance.

8.3.1.2 Short-term plan (2020-2025)

Following feedback on our Draft WRMP, our Final Plan includes a 15% leakage reduction between 2020 and 2025. This compares to an 8% reduction included in our Draft Plan.

Table 8.5 presents the leakage profile including the 19/20 Ofwat performance commitment baseline leakage figure in the Draft Determination. This allows direct comparison between our Final WRMP and our Business Plan.

Table 8.5: AMP7 leakage reduction profile (combined SWW and BW supply areas)

Performance commitment: Leakage	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
DD Baseline (Ml/d)	119.5					
DD Performance commitment level (Ml/d)		115.9	112.3	108.7	105.1	101.5
Baseline (% reduction)	0					
Performance commitment level (% reduction)		3	6	9	12	15
Annual Leakage level [Ml/d]	116.2	114.0	106.7	105.4	103.2	95.9

Note: 2019/20 baseline leakage is the three-year average consistent with the Ofwat reporting methodology for PR19. The annual values included in the Final WRMP are set consistent with the Draft Determination. Performance against leakage targets will be measured consistent with the PR19 Final Determination – see Appendix 8.

To deliver the target, at the time of publication a total of 49 projects that could improve efficiency and delivery were assessed - see Table 8.6. These were those projects used in Scenario 6c.

The schemes are a mix of improved productivity as well as new technology. For example, we already have an incentive mechanism for leak detection, but we can revise this to an alternative model. They build on actions already included in our current leakage policy:

- Find and Fix – distribution
- Find and fix – customer side
- Find and Fix – Trunk mains
- Pressure management
- Leak and detection incentive regime
- Synergy from targeted asset replacement for bursts/interruptions to supply or resilience risk

The benefit of mains replacement and pressure management to reduce leakage was assessed separately using the asset optimisation model DEAM (Distribution Economic Assessment Model). This models the collective cost and benefit of mains replacement and pressure management on the full range of network service metrics – leakage, low pressure, discolouration and interruptions to supply. This optimiser seeks the most cost-beneficial level of activity to deliver multiple benefits. The output was included within the list of schemes. These are highlighted as synergy projects in Table 8.6.

There are a number of wider innovations already underway in our leakage programme but these were not included for the purposes of forecasting as the benefits are less certain. These will be rolled out if proved successful. These include:

- Use of LIDAR and thermal imaging to detect leaks
- Partnership operation with Western Power for combined aerial leak/power cable maintenance
- Advanced inspection and acquisition logging techniques to pin-point leaks on our trunk mains and distribution network
- An accelerated pressure management programme across our South West region

The delivery programme was built based on their ranked cost-benefit but also if there are wider customer benefits. Some activities with a relatively low unit cost (e.g. E6 Acceleration of pressure management schemes) have either already been undertaken during 2018 due to the dry weather mitigation or are part of the overall water efficiency activity programme and therefore are not included to prevent double counting. We have then packaged these for delivery under 7 different workstreams:

- **Increasing efficiency and productivity** with a focus on more effective programme management to foresee risks and put in place corrective actions as well as ensure the individual plan elements are delivered as cost-beneficially as possible
- **Delivering targeted leakage management** at a more granular level by splitting larger DMA's into smaller areas, better defined targets, and regular progress monitoring with area managers
- **Improving our understanding of water use** to improve the accuracy of our leakage calculations
- **Making the most of technology and data analytics** to extend its use both internally for reporting/analysis and in the field for leakage detection staff
- **Reducing the amount of water we deliver** to minimize losses throughout the distribution network
- **Minimising customer losses and unnecessary consumption** by improving the way we handle the customer leakage process and empowering the customer to reduce unnecessary consumption through customer engagement tools
- **Synergies** and delivering reduction through other investments such as pressure management and metering schemes and distribution management

The collective impact is that it aims to achieve the 15% reduction for the same cost in AMP7 as the current programme in AMP6. As leakage costs increase as leakage reduces this equates to a stretching efficiency target in excess of 15% compared to current costs.

Table 8.6: Leakage schemes to deliver 15% reduction by 2025

Selected
Must do / Enabler
Opex Cost
Synergy

Area	Code	Description	Reduction (Ml/d)	Cost (£k)	Confidence	Cost Benefit
n/a	Z2	Pressure Management	4.1	0	6	n/a
n/a	Z3	Meters (additional £3M)	0.53	0	6	n/a
3	C5	Develop company plumbing losses analysis using IHM and SAM data	0.00	20.00	8	0.00
6	F1	Expand asset management team capabilities to create and update dashboards	0.00	75.00	8	0.00
1	A2	Enhanced expenditure reporting and budgeting at DMA level	0.00	0.00	7	0.00
1	A3	Review procurement contacts to reduce costs of leakage equipment	0.00	320.00	7	0.00
4	D1	Enhance understanding of abstraction to distribution input process using uncertainty modelling and seek opportunities to improve efficiency	0.00	400.00	7	0.00
5	E4	Carry out more detailed reviews of leaks and pipe/tap repairs at WWTW to better understand underlying cause	0.00	100.00	7	0.00
5	E1	Restructure the categorization of leaks to enable better prioritization	0.00	100.00	6	0.00
2	B1	Improve the benchmarking of DMA's through collaboration with area teams, progress monitoring and development of DMA performance dashboard	0.30	10.00	6	33.33
4	D3	Improve the accuracy of water balance calculations at DMA level through the use of RAPID data and enhanced reporting of seasonality.	0.18	10.00	6	55.56
4	D4	Ensure the reliability of domestic consumption data by outsourcing the management of loggers	0.18	42.00	6	233.33
3	C1	Produce a work management system in PowerBI for the customer leakage process	0.25	150.00	7	600.00
1	A1	Targeting spending and reducing overspend through improved management of repair contracts	0.30	1250.00	7	4166.67
1	A8	Introduction of consumption targets at operational area level	0.85	0.00	5	0.00
2	B2	Develop the methodology used to set DMA targets by linking targets to economics	0.50	0.00	5	0.00
2	B4	Develop methodology used to measure seasonal variation in consumption	0.75	20.00	7	26.67
1	A12	Team restructuring to align priorities, manage workload more efficiently, and reduce expenditure on contractors	1.68	175.00	7	104.17
4	D5	Apply uncertainty to trunk main flow balances to identify areas of leakage and prioritize repairs	0.40	50.00	6	125.00
1	A11	Scheduling of monthly meetings between reporting team and area managers	0.30	38.00	7	126.67
3	C2	Build a customer self service online portal to show usage and leakage repair tools	3.20	500.00	8	156.25
1	A9	Develop a consistent reporting approach and make information more accessible	0.50	88.00	7	176.00
1	A7	Rewarding leakage team for achievement of internal targets	0.50	150.00	8	300.00
2	B5	Develop sub-DMA's to target interventions on leakage hot spot s	0.75	250.00	7	333.33
2	B3	Increase the use of noise loggers on high leakage/high maintenance DMA's to enhance leakage detection	0.30	100.00	9	333.33
3	C4	Improve customer case management and engagement	0.45	175.00	6	388.89
1	A6	Incentivizing leakage detection staff	0.30	125.00	8	416.67

4	D2	Improvement measurement of household night use by expanding the samples of individual household monitor (IHM) and Small Area Monitors (SAM)	0.18	125.00	9	694.44
2	B6	Increase network knowledge of high users/extra properties/illegal usage using 'customer knowledge' teams	0.50	350.00	8	700.00
6	F5	Develop analytical tools to detect network issues quicker and analyse long term seasonality trends	0.30	210.00	6	700.00
6	F4	Deployment of tablets & mapping equipment linked to corporate BI, GIS & Work management tools,Delivery IT training to field teams	0.10	100.00	6	1000.00
1	A13	Succession planning and knowledge sharing to improve leak detection performance	0.50	750.00	10	1500.00
6	F2	Improve data reporting processes and make use of advanced analytical methods to identify problems	0.25	500.00	6	2000.00
4	D6	Better and more accurate quantification of water use on company activities	0.15	50.00	5	333.33
4	D7	Reduce the size of trunk mains DMAs to reduce inoperable volumes and increase localisation of leaks	0.95	375.00	7	396.41
3	C6	Provide customers with tools to identify and repair leaks	0.20	100.00	9	500.00
5	E6	Acceleration of the pressure management programme in high leakage/pressure areas	1.70	1000.00	2	588.24
4	D8	Log more WWTWs to comply with consistency reporting and improve our reporting of company water use	0.83	500.00	7	603.38
5	E7	Reduce average repair times by 1days for P2 leaks	0.77	500.00	3	650.00
4	D9	Monitor and identify patterns of overflow or leakage on SRs to reduce DI	0.77	527.00	7	688.89
5	E8	Reduce average repair times by 5days for P3 leaks	0.69	500.00	4	722.47
4	D11	Develop bespoke SWW MUR dataset for use in consistency reporting	0.15	150.00	8	1000.00
1	A14	Giving the central team more authority on reporting of long-term BF DMA's to reduce DI	1.48	1496.60	8	1013.24
1	A15	Link detection/repair performance to nightlines	0.98	1750.00	6	1787.54
3	C8	Use analytics on logger & RAPID data to identify customers with excessive usage	0.12	250.00	8	2083.33
3	C9	Give detectors simple devices such as the leak frogs to quickly sweep problem areas within DMAs	0.07	200.00	7	2913.75
3	C10	Re-introduce private leak repair commitment (all leaks)	2.5	9000.00	7	3600.00
3	C11	Re-introduce private leak repair commitment (leaks > 15lpm)	0.25	1000.00	7	4000.00
1	A16	Giving the central team more authority on reporting of long-term BF DMA's to reduce DI	1.48	5986.40	8	4052.94
5	E9	Reduce average repair times by 10days for P4 leaks	0.12	500.00	4	4155.41
3	C12	Trial AMR/leak alerts in areas of poor pipework and high outbreaks of customer leaks	0.04	500.00	6	11363.64

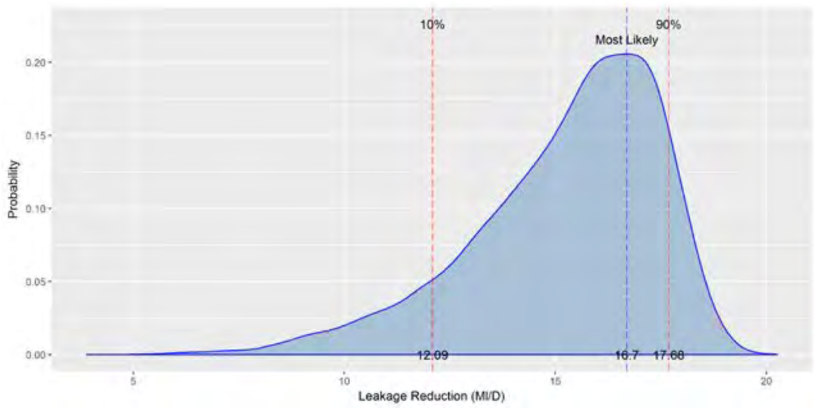
8.3.1.3 Risk Analysis

As the delivery of any programme is uncertain, we undertook a risk analysis on the proposed leakage reductions by 2025. For each part of the programme we assessed the range of possible outcomes and costs of delivery. This was then modelled using detailed PERT (Program Evaluation and Review Technique) assessment and Monte Carlo simulation.

The outcome of our simulation is shown as the net benefit (leakage reduction) across all projects (see Figure 8.2). The distribution shows that:

- the most likely reduction we will achieve is 16.7 Ml/d
- We have a 90% chance of achieving a reduction of at least 12.09 Ml/d, and
- We have a 10% chance of achieving a 17.66 Ml/d reduction

Figure 8.2: Risk analysis of net benefit of leakage reduction

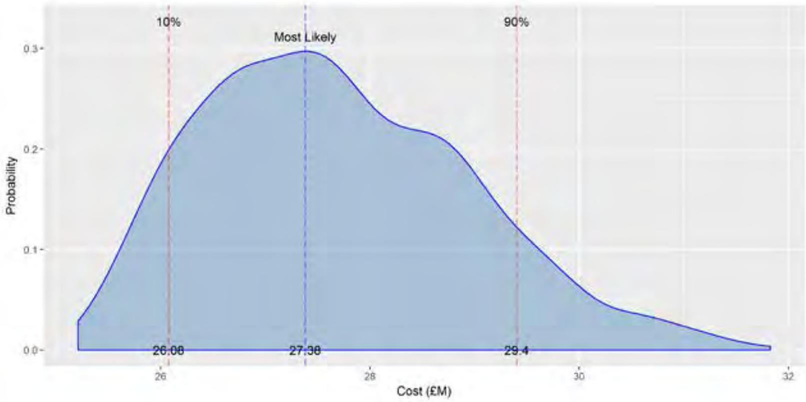


The leakage distribution shows that over 75% of the total leakage reduction needed in the targets in our Draft Determination is covered by the activities already identified. There is however a strong positive skew. As the leakage target is fixed, this means the target is particularly stretching since the Company takes the risk and financial penalty of not delivering the leakage target in this Plan. This risk also confirms the other key elements of our strategy for the developing feasibility of other options, testing resilience of existing schemes to droughts and the development of future decision making tools in order to balance the supply-demand risk should leakage reductions not materialise to the extent expected.

We performed the same simulation based on our estimations of the cost of each project and took account of the potential variability in the costs of traditional leakage management. The output is shown in Figure 8.3 below which shows:

- The most likely cost was found to be £27.38M
- There is a 90% chance that the programme will cost at least £26.06M, and
- There is a 10% chance that the programme will cost £29.4M

Figure 8.3: Risk analysis of net benefit of leakage reduction, including costs of each project



8.3.2 <u>Water efficiency</u>

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 other areas of service. The scenario analysis also showed that our WRZs have some sensitivity to higher demands.

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.

For clarity, in the following sections we present PCC as both the normal year value and the dry year value. We present the former since our PR19 performance commitments are based on actual observed PCC values – not dry year values – in order that there is a direct link between the WRMP and the Business Plan. We will report on performance on meeting the PCC target consistent with the Final Determination approach – see Appendix 8.

8.3.2.1 Short-term (2020-2025)

Following feedback from our Draft Plan we have increased our programme of water efficiency to drive further reductions in the demand for water. Table 8.7 summarises the changes from our Draft to Final Plan.

Table 8.7: Comparison of Draft and Final Plan water efficiency programmes

Activity	Saving on average PCC in 2025 (l/p/d)	
	Draft WRMP	Final WRMP
Community water saving initiatives	0.21	1.21
Social norms feedback	0.55	1.98
Social housing retro-fit	0.17	1.13
Tourism water efficiency	0.01	0.03
Total saving	**0.94**	**4.35**

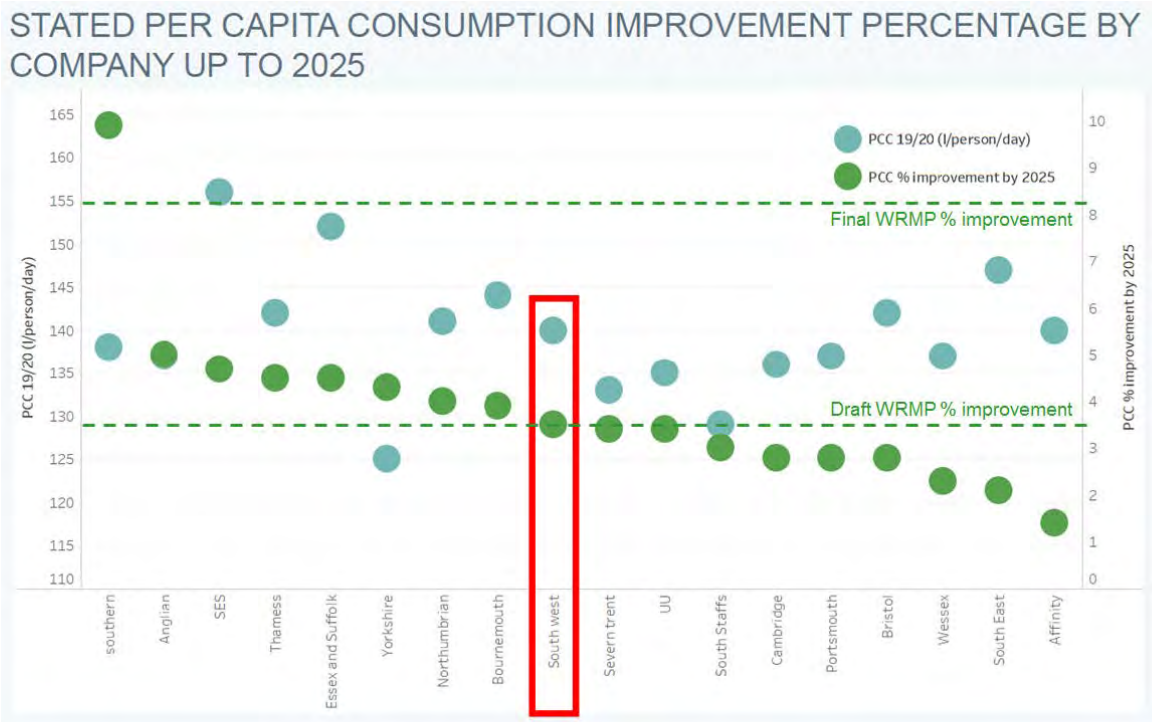
In our Final Plan, we have included a programme four times the size of that in the Draft Plan. This increases the PCC reduction from 0.94 l/p/d shown in our Draft Plan to 4.35 l/p/d. We propose to do this by increasing the scale of the programme identified in the Draft Plan. We have chosen to retain the options as they are either:

- The most cost-effective option
- Support the protection of low income or vulnerable customers
- Deliver better customer experience

The scale of the programme has been based on setting a stretching overall % reduction in PCC relative to other companies. We have done this using data from the Draft Plan – see Figure 8.4 below, where green dashed lines indicate the differences between the Draft and Final WRMP for South West Water PCC % improvement by 2025.

The Draft Plan showed the maximum reductions in PCC were of the order of 8 - 9%.

Figure 8.4: Comparison of Company Draft WRMP dry-year PCC and PCC reductions[8.1]



We have chosen this approach, rather than a specific PCC target, for the following reasons:

- With the proposed reductions in leakage we have no forecast supply demand deficit - the choice on water efficiency is therefore not driven by closing a deficit or strict cost-benefit
- We already have high levels of meter penetration - the choice on water efficiency is therefore not driven by a lack of measured customers to reduce PCC
- As highlighted by the recent Ofwat consistency review, all companies calculate PCC differently. The choice on water efficiency target based on comparing absolute PCC values is therefore unlikely to be comparing like for like

We therefore used the principle of the change in PCC as the most sensible approach to set out a programme in performance rather than an absolute target. This is in line with our strategy for achieving the target issued by Ofwat to companies of a 15% leakage reduction.

[8.1] "South West Water - Comparative ambition - Leakage and PCC", PA Consulting Group, 2018.

The combined effect of an 8% reduction in PCC and the metering programme is that our Final Plan reduces normal year PCC from 138 l/p/d in 17/18 to 127 l/p/d (dry year PCC from to 144 l/p/d to 133 l/p/d) in 2025. Note that this is the annual figure, not the Ofwat 3-year rolling average performance commitment.

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 or meet the priorities of customers. Further, it does not create a culture that values water.

A plan with higher water efficiency could also be included but with no supply demand driver, this is poor value overall for customers.

In addition to the above actions, we are proposing a water efficiency scheme to target non-household consumption, although this will not impact PCC. This will comprise a partnership with non-household retailers to encourage the delivery of more water efficiency audits to their customers.

The overall programme of water efficiency measures is given in Table 8.8 below.

We will provide an update on progress on water efficiency in our annual WRMP update each year.

Table 8.8: Overall cost of water efficiency programme

Activities	Programme totals			
	Water Saving (Ml/d)	Opex (£m)	Opex Saved (£m)	Capex (£m)
Community water saving initiatives Social norms feedback Social housing retro-fit Tourism water efficiency	10.04	0.20	1.10	2.91

8.3.2.2 Long-term (2025-2045)

Our long-term plan is to continue to promote water efficiency improvements with our customers.

For our Final Plan we have included a more ambitious long-term water efficiency programme, targeting reduction in PCC to a normal year target of 120l/p/d (125 l/p/d in a dry year) at the end of the planning period.

We have chosen this target based on data in the Artesia report “The long-term potential for deep reductions in household water demand” (2018). Under Scenario 0 this report set out a target of 105 l/p/d target by 2065. If demand reduced equally between to this date it would be equivalent to 120 l/p/d by 2045. We used this to set our target as with the proposed leakage reduction, there is no strict supply demand driver with the leakage reduction included in the demand forecasts.

We have used a target rather than a % reduction as this sets a specific goal and is not sensitive to the short-term variations, such as changes in regulatory reporting of PCC for consistency of approaches across companies.

This target is delivered through the full rollout of community incentive schemes and a retrofit programme across the region, as this delivers more local engagement and wider benefits. The exact nature of this long-term plan will be influenced by the analysis of the outcomes of our planned 2020-25 programme, along with information from the wider industry, and further innovation. As part of our overall plan we have partnered with Exeter University to develop the Exeter centre for Water, Waste and Environmental Resilience. This brings together trans-disciplinary departments and includes a specific work programme for water efficiency. We will be using the academic and industry research to develop the programme to deliver longer term reductions with a particular focus on behavioural incentives using the expertise from the University.

The scenario analyses in Section 7 show the additional headroom that could be created from either different government targets or future customer preferences. Coupled with the metering programme included in our Final Plan, this means we will be able to update our programme on water efficiency in each future WRMP and move to the long-term goal above or any external target that may be set in the future.

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.

We do not anticipate any significant changes in outage across the planning period.

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)[8.2] 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:

- 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

[8.2] These include Brokenbury STW, Cambourne STW, Ernesettle STW, Plymouth Central STW and Radford STW.

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[8.3].

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 8.9). 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 8.9: Cost of STW re-use schemes vs equivalent leakage reduction in AMP7

	STW own re-use costs	Equivalent additional leakage costs[8.4]
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 8.10 shows the total expected benefit from these activities by 2025 and between the Draft and Final Plan. Key features of the planned activities are:

- In total they mitigate 42 to 65% of the key risks causing supply demand deficits, which were identified in the scenario analysis. This is an increase in resilience compared to the Draft Plan.
- Compared to the Draft Plan there is improved risk mitigation in Wimbleball, Colliford and Bournemouth.
- The level of risk mitigation in Roadford is lower than the other Zones but consistent with that from the Draft Plan.

The Final Plan does not plan to mitigate all risks identified in Section 7, but does seek to mitigate risks early.

[8.3] Based on customer willingness to pay for water efficiency and re-use.
[8.4] Costs based on further reduction of 3 Ml/d in Roadford WRZ from 5 - 7 Ml/d (See WRMP Table 5)

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[8.5]. This is consistent with the findings from our research on customer preferences and the feedback on the Draft Plan.

In doing so, the proposed plan delivers 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.

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, and 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.

Table 8.10: Overall impact of leakage and demand reduction on risk mitigation

	Colliford WRZ	Roadford WRZ	Wimbleball WRZ	Bournemouth WRZ (CP)	Total
Activities by 2025 (in Ml/d)					
- Total Reduction in DI by 2025**	8.85	15.08	4.71	6.06	34.70
Risks (over planning period)[8.6] (in Ml/d)					
- Plausible droughts	0	6.9 to 25.9	0.7 to 10.7	0	7.6 to 36.6
- Environmental needs (best case)	4.6	13.9	3.7	0	22.2
- High household demand	2.43	12.9	3.2	5.02*	23.6
- Total	7.03	33.7 to 52.7	7.6 to 17.6	5.02	53.4 to 82.4
Risk covered by 2025 (%)[8.7]	100% *(54%)*	29 to 45% *(22% to 50%)*	27 to 62% *(10% to 17%)*	100% *(51%)*	42 to 65% (24% to 42%)

*Note: Figures in italics are from the Draft Plan. *the increase in demand as no supply-demand shortfall in this scenario. **additional reduction in DI in 2024/25 due to the Final Plan; given by FP 2024/25 DI – BL 2024/25 DI.*

[8.5] Note that in the main the activities chosen are cost beneficial (i.e. customer willingness to pay > cost of the option).
[8.6] Risk is defined as the total Ml/d surplus or deficit value in 2045 for each of the scenarios assuming no intervention is made.
[8.7] For further technical discussion on risk mitigation see Appendix 8.

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. These compliment the reductions in demand to reduce risk we consider are a key part of a holistic water resource plan.

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 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.

We have already commenced this work through the development of options over the dry summer of 2018 and revisiting pumped storage drought permit readiness for Roadford Reservoir, we will also look at testing existing or temporary sources such as Slade Reservoir, Brampford Speke, Challacombe, Stannon and Wimborne. We will also look at the integrity of our Resource Zones each year as part of the annual WRMP review.

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.

This includes the activity needed for the future Drought Plans. This is published in our current Drought Plan.

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.

In doing so we will be working with the West Country Water Resources Group to ensure that future plans link to the new Regional Water Resource Plans.

8.5.1 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.

  Feedback from the Draft WRMP included a request to include a natural capital assessment for this scheme. We have included this in our Final Plan.

- Detailed feasibility study on a Bournemouth WRZ to Southern Water transfer

  As highlighted in Section 6 and 7, a water transfer to Southern Water has been identified as a 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. We have already helped form the West Country Water Resources Group and developed a work programme to help inform future WRMPs which includes this transfer as well as other studies on resource sharing. More details are given in Appendix 8.

- 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.

  This has already commenced in 2018 with the rollout of the ‘savewatersavemoney’ calculator to over 10,000 customers in our region to give a more granular and spatial information on customer discretionary water use.

- Investigate opportunity for a Bournemouth WRZ AIM scheme

  Feedback on our Draft WRMP included a request to investigate the opportunity for an AIM scheme in the Bournemouth WRZ. We have updated our Final Plan to include this.

- 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. This already started in 2018 and we included the annual figures in our 2018 WRMP annual update.

8.5.2 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.

8.6 Levels of service across the planning period

Table 8.11 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 8.6 – 8.10) 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 8.10. Specific details on the year on year service levels are given in Appendix 13.

Table 8.11: 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)[8.8]	1 in 20 years (5%)*	> 1 in 40 years (< 2.5%)*	> 1 in 100 years (< 1%)*
Supply-side Drought Orders or Drought Permits[8.9]	1 in 20 years (5%)*	> 1 in 100 years (< 1%)*	> 1 in 100 years (< 1%)*
Demand-side Drought Orders[8.10]	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[8.11]	> 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.

[8.8] Formerly termed hosepipe bans. Return period calculated based on our historic design drought (1975/76), being at least 1 in 40 years in our SWW supply area WRZs and at least 1 in 100 years in BW supply area.
[8.9] 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.
[8.10] 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.
[8.11] 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 WRMP and an area we plan to develop in the future. The results of the analysis are given in detail in Appendix 8 and show:

- the Plan as an overall positive benefit to natural capital
- the Plan improves natural capital between £11m and £46m[8.12]

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. The Final Plan has more water savings included than the Draft Plan and therefore the natural capital benefit will be closer to the upper end of the benefit range (£46m) calculated for the Draft Plan.

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 has been estimated here.

Further impacts on biodiversity and the 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.

Table 8.12 summarises the natural capital value calculations. The charts in Figure 8.5 show the lower and upper limits of the calculated natural capital value range for each asset category.

Table 8.12: Summary of cost benefit results (NPV £m, 2016-17 prices)

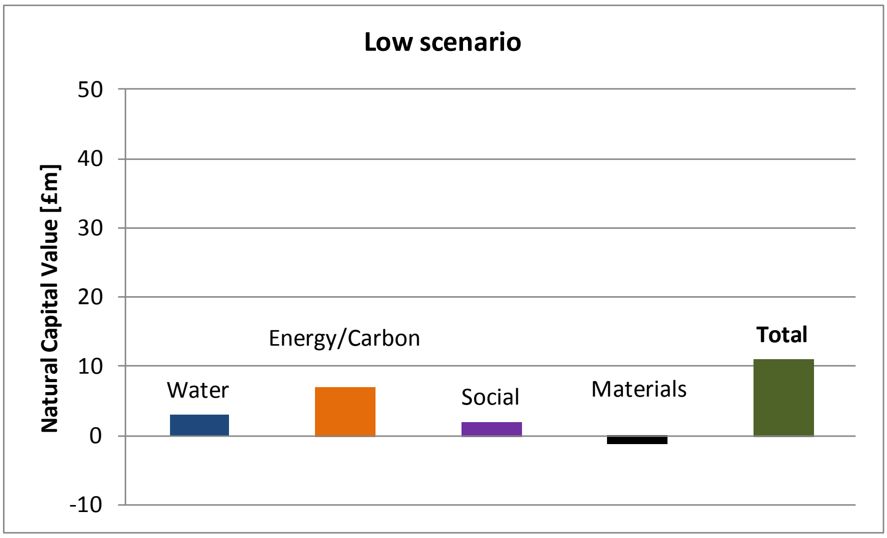
Asset category considered	Impact (positive = benefit)
1. Water	£3m to £30m
2. Energy / carbon	£7m
3. Social	£2m to £10m
4. Materials	-£1m
Total	**£11m to £46m**

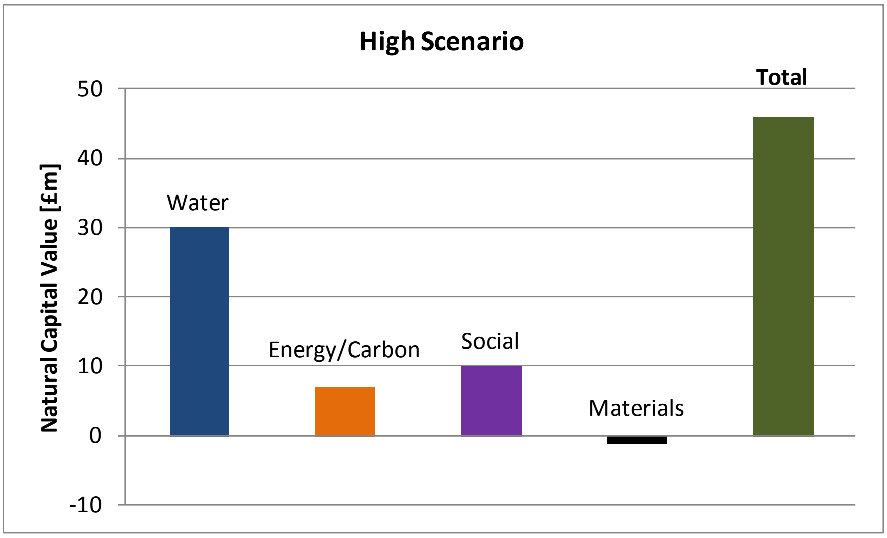
Note: figures may not reconcile due to rounding

[8.12] We have retained the natural capital valuations from the Draft Plan. Although the Final Plan has brought in additional leakage reduction and pcc reduction in the near term, and additional pcc reduction in the long term, this will only re-enforce that the plan has a positive natural capital contribution. Given the range of the natural capital values and the positive nature of the Final Plan we chose not to reassess the impact.

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 8.5: 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 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.

The overall performance of our proposed plan is shown in Figure 8.1 and shows strong performance across all performance metrics. Figures 8.6 to 8.10 show our final supply demand forecasts.

By selecting a range of leakage reduction, water efficiency activity and the inclusion of the water transfer option with Southern Water, this Plan performs better overall than a baseline plan with no intervention.

The Final Plan builds in the feedback from customers, stakeholder and regulators given on our Draft Plan. It undertakes some action now to mitigate risks to our service for future generations, but is flexible and adaptable to risks or future Government policy, such as defined leakage targets.

There are lower or higher cost plans, and plans that could mitigate more or less risk. The Final Plan is considered to be an appropriate balance of competing needs that are often in tension but it will ensure that we continue to deliver a safe and reliable water supply to customers for future generations.

This Final Plan is also directly aligned to our overall Periodic Review 2019 Business Plan submission. All activity and targets included in this Final Plan are also included in the Business Plan.

Figure 8.6: Final supply demand forecasts – Colliford WRZ (DYAA)

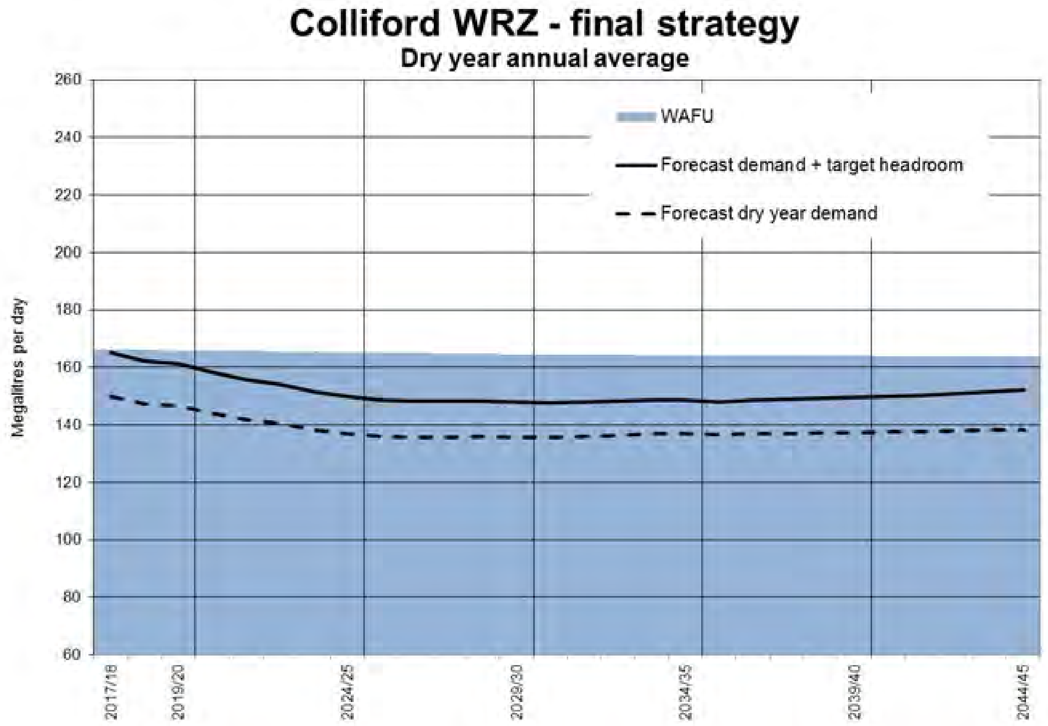
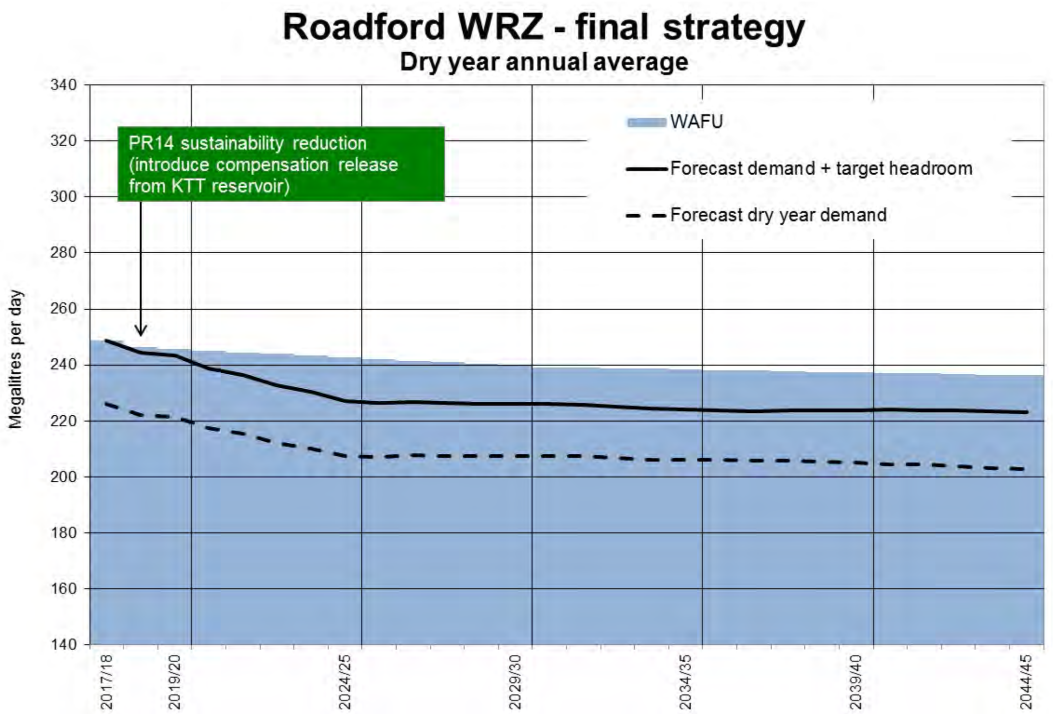


Figure 8.7: Final supply demand forecasts – Roadford WRZ (DYAA)



South West Water Bournemouth Water

Figure 8.8: Final supply demand forecasts – Wimbleball WRZ (DYAA)

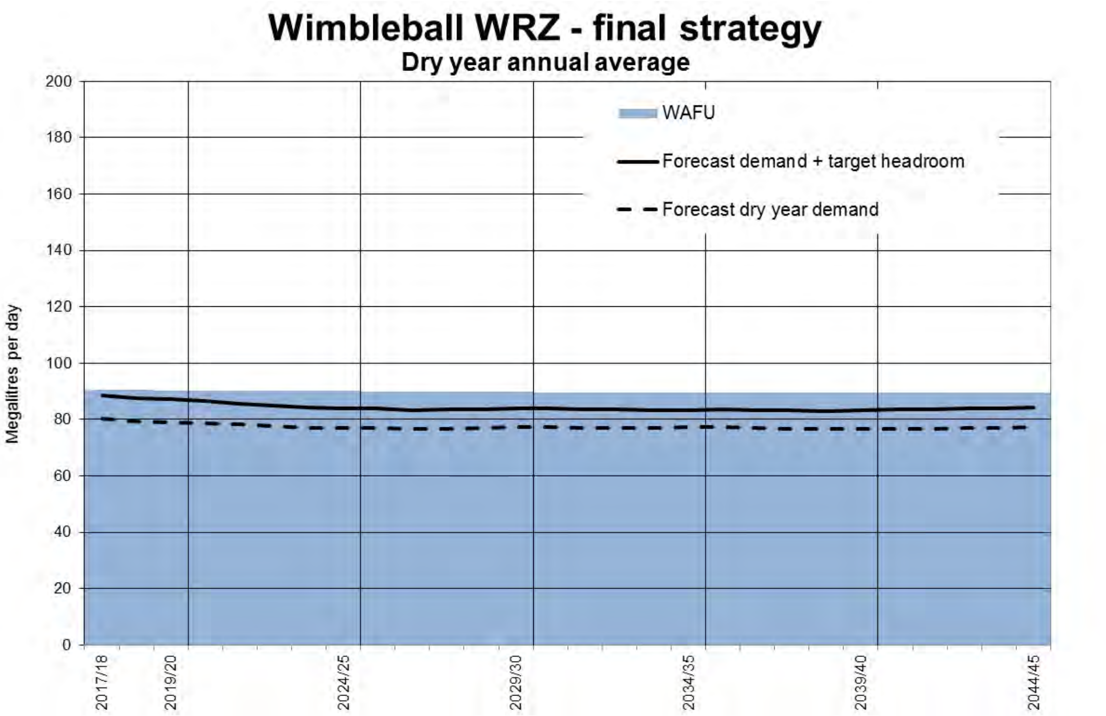


Figure 8.9: Final supply demand forecasts – Bournemouth WRZ (DYAA)

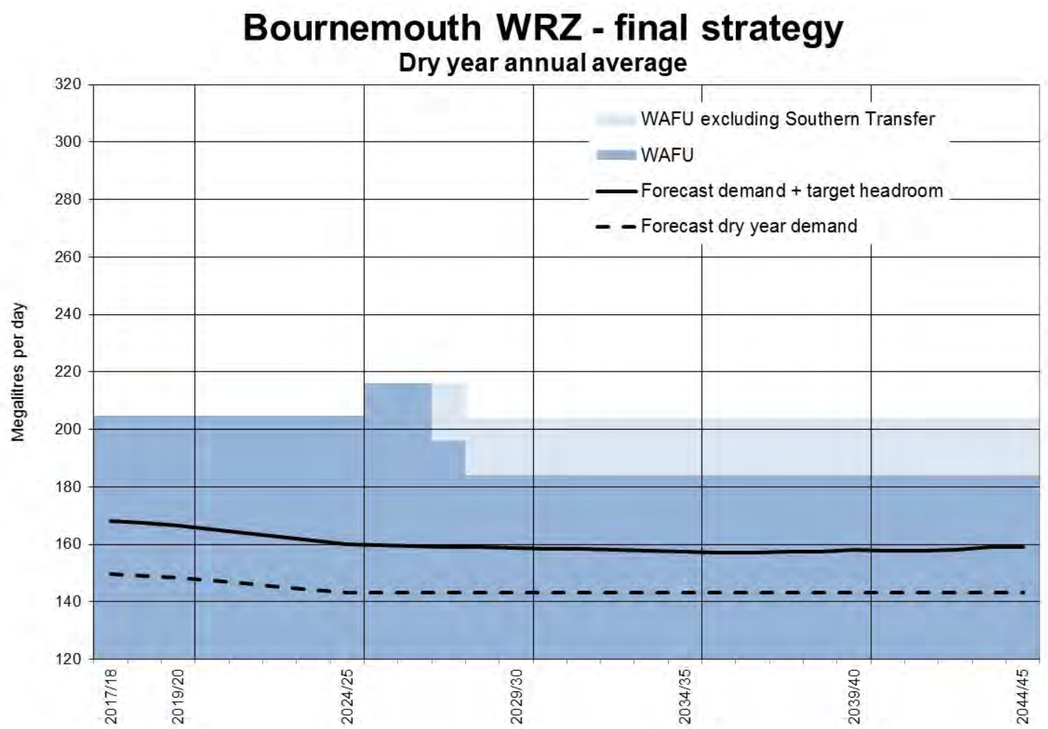
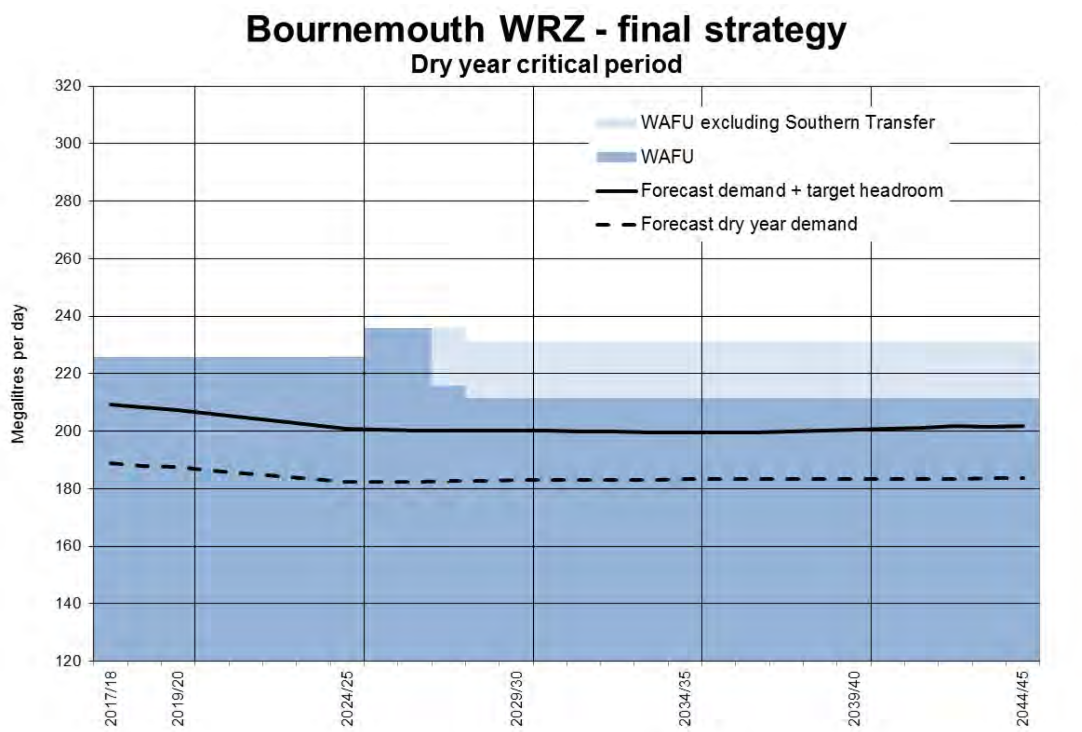


Figure 8.10: Final supply demand forecasts – Bournemouth WRZ (DYCP)



APPENDIX 1

General information on plan content and development

A.1.1 Water resource zone integrity

A.1.1.1 South West Water supply area

This section sets out our work on Water Resources Zone Integrity.

Water Resource Zone Integrity

Provision of Evidence to Environment Agency

July 2016

southwestwater.co.uk

SOUTH WEST WATER

Contents

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*

Figure 1 SWW Water Resource Zones

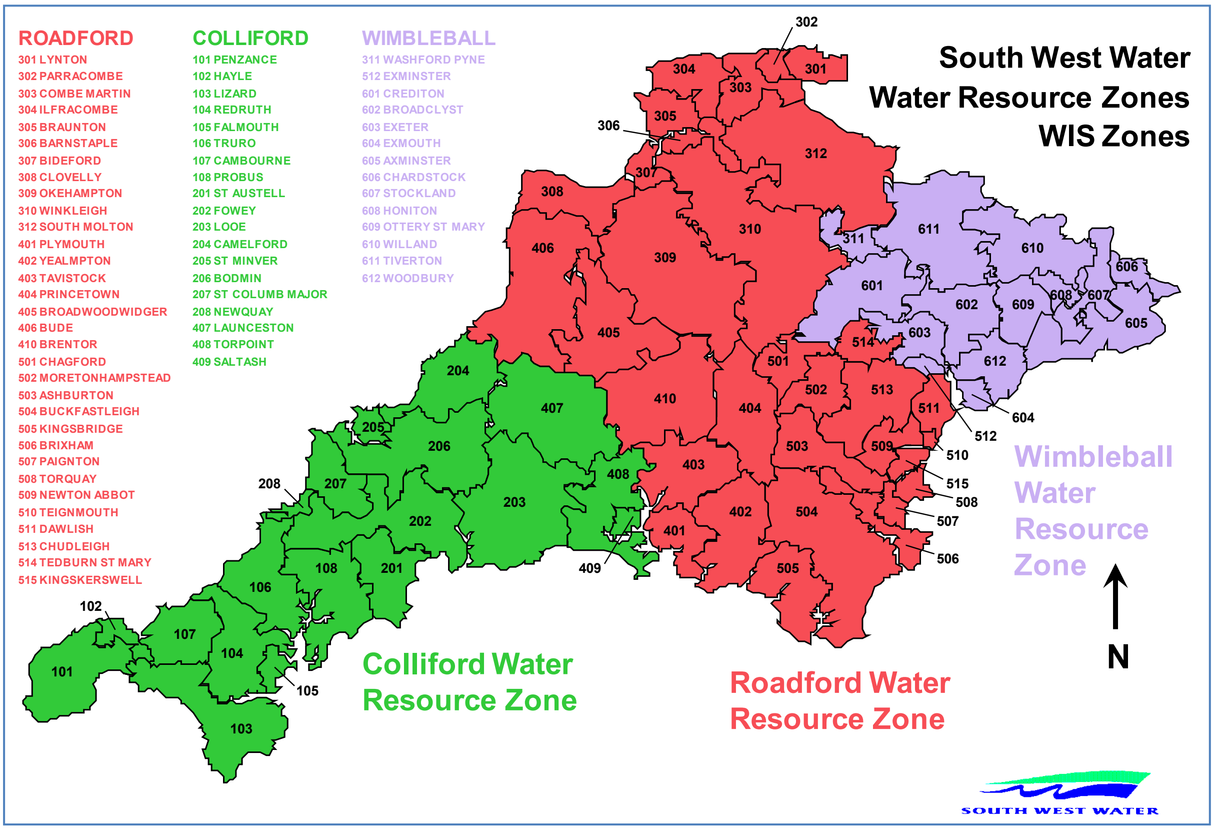
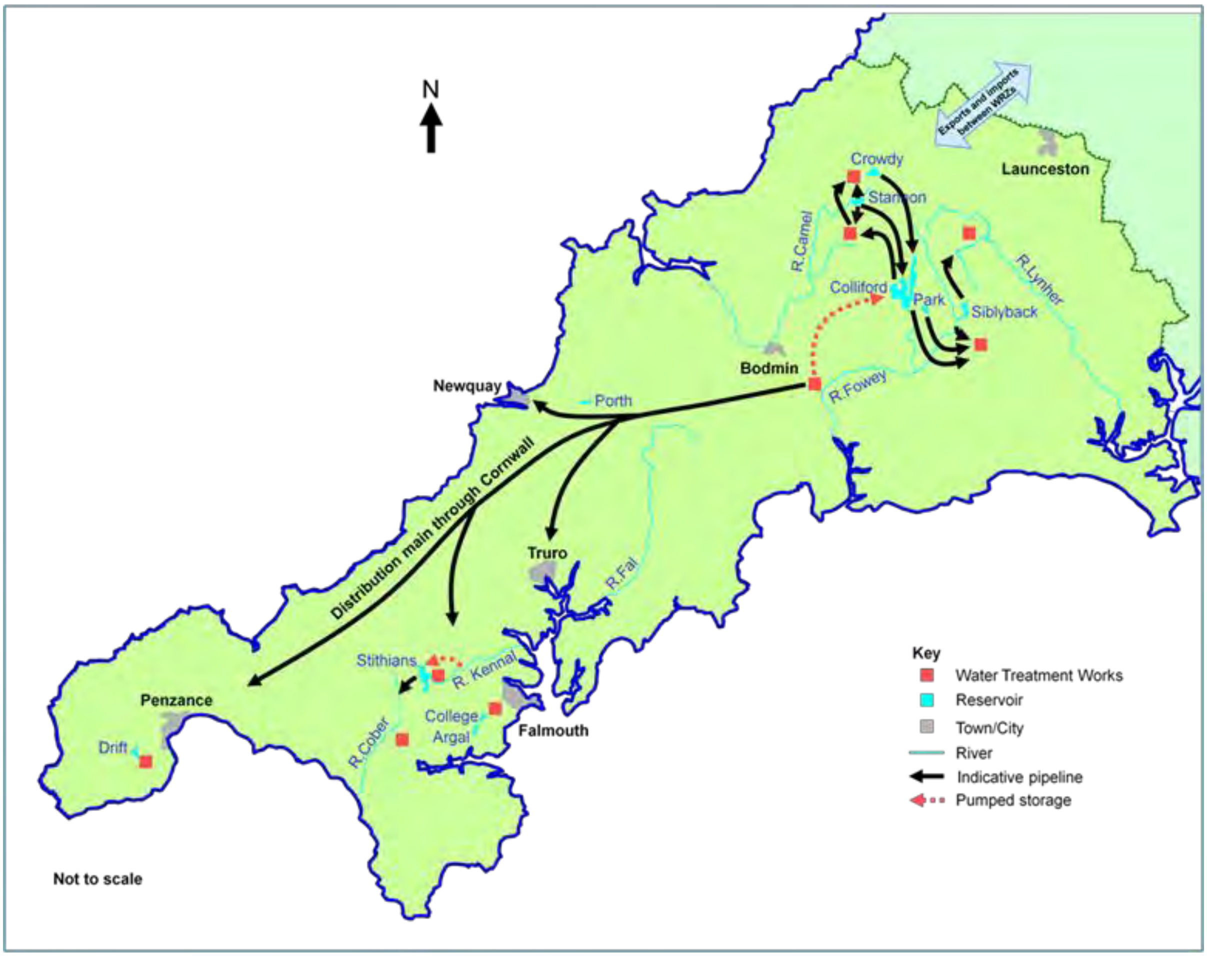


Figure 2 Key components of the Colliford Water Resource Zone



SOUTH WEST WATER

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).*

Figure 4 Key components of the Wimbleball Water Resource Zone

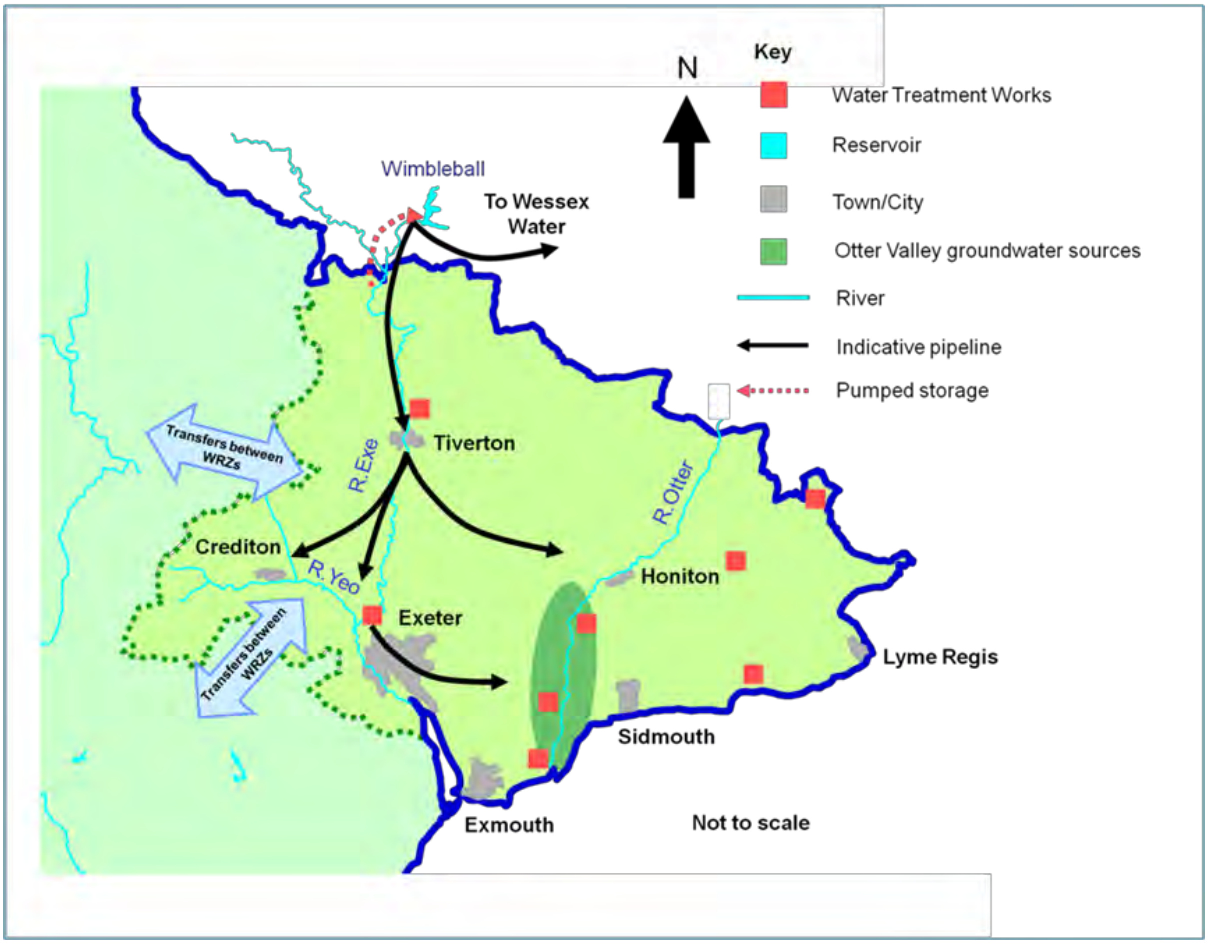


Figure 5 Extract from the auditor's report to OFWAT from SWW, March 2008

ATKINS

Business Analysis Doc Ref: C-80375/MWH/SWT.PR51
South West Water Date: 31 March 2008
Report on the Company's Draft Water Resources Plan Page 6 of 58

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.

Appendix Extract from Final Water Resources Planning Guideline May 2016

3.2. Defining a water resource zone

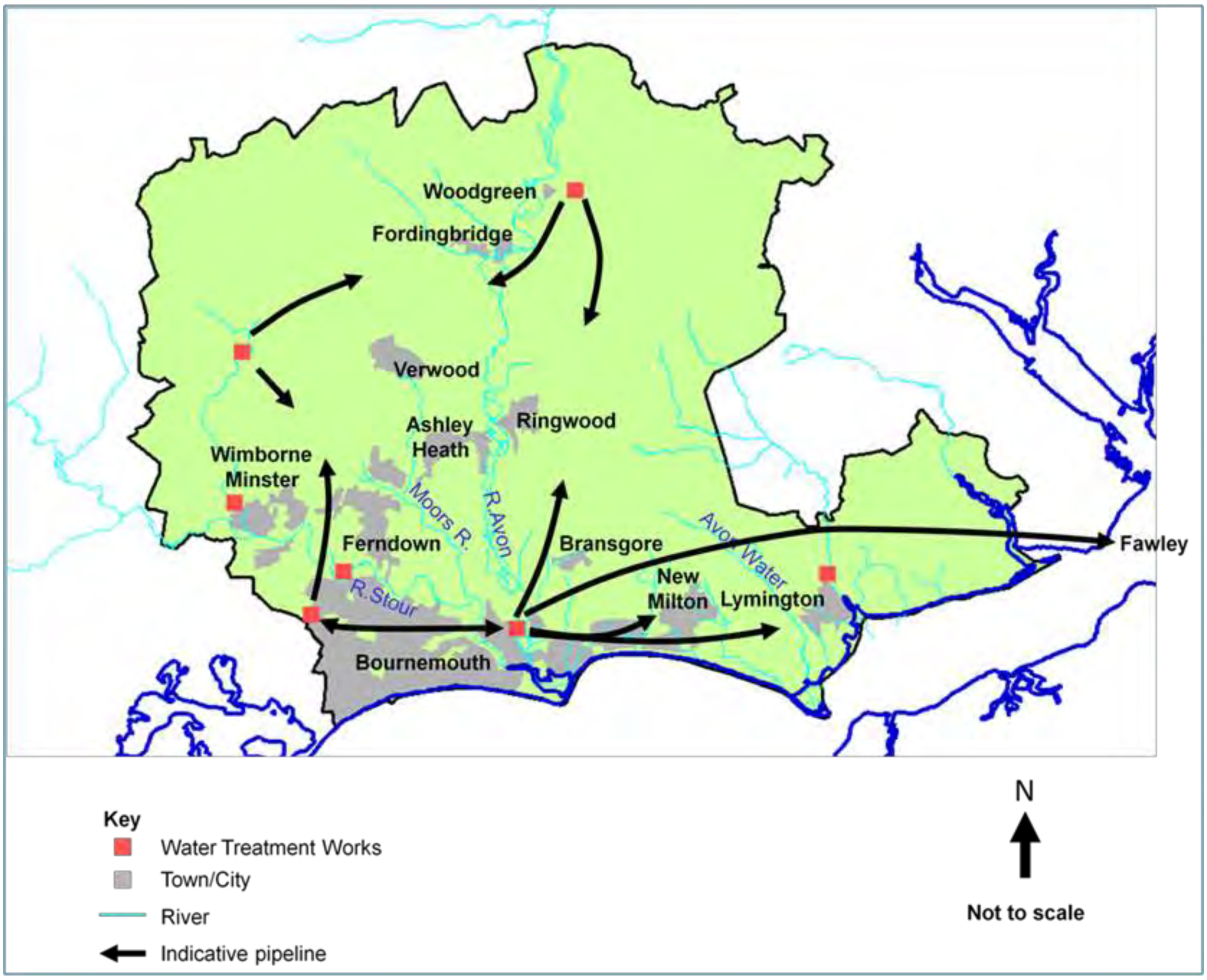
Your plan should be built up of assessments undertaken at a water resource zone (WRZ) level. The WRZ describes an area within which the abstraction and distribution of supply to meet demand is largely self-contained (with the exception of agreed bulk transfers). You may divide your supply area into one 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.1.1: 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 Bournemouth Water 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 Bournemouth Water customers for the defined 1 in 20 level of service.

A.1.2 Problem characterisation

This section sets out our assessment of the problem characterisation.

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.

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[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*

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+)				

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?	✓			

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)[15].

[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 2019:

Strategic Environmental Assessment Scoping Report

Project Number: 60539035

November 2017

Prepared for: South West Water

Quality information

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Limitations

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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.

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

	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.

South West Water

Strategic Environmental Assessment of Water Resources Plan 2009

Summary Document

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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

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.

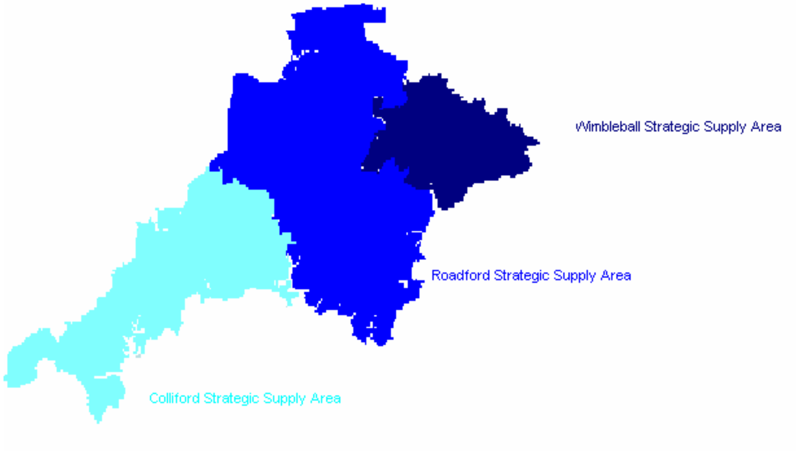
SEA is a decision-support tool, providing information on the environmental effects of the WRP. The output of the SEA process informs both the Plan makers and interested parties of possible significant environmental effects (both positive and negative) of the Plan and its reasonable alternatives. The 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)



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[1] South West Water (2009): *Strategic Environmental Assessment of Water Resources Plan – Environmental Report*. Report Number DV53405/ER3

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

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

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.

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

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

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	-/+/?	+	+

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

(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.

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 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.

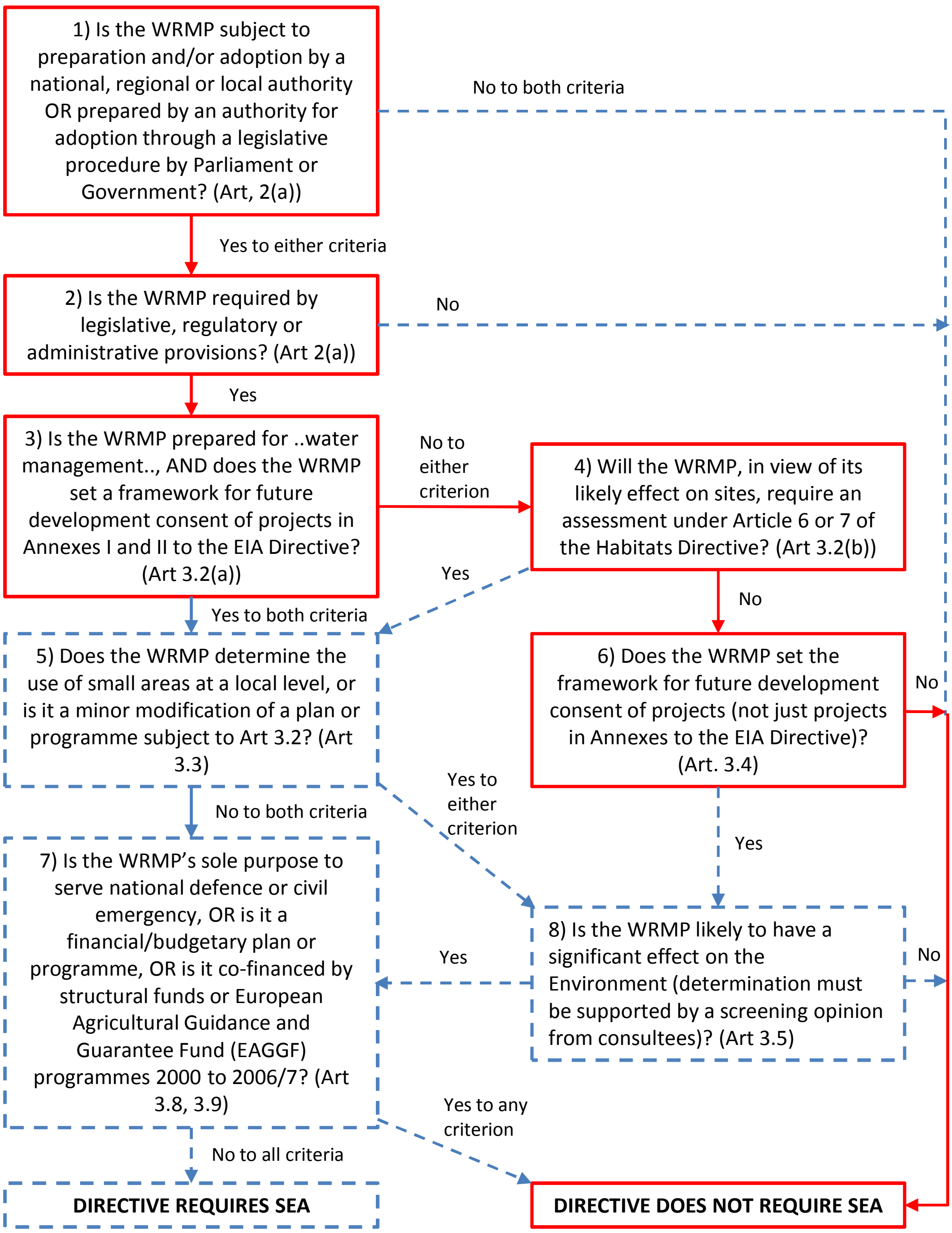


Figure 1 Flow diagram illustrating the decision-making process to apply the SEA Directive to WRMPs with the path relevant to SBW highlighted in red (adapted from UKWIR Guidance, 2012).

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 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.

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.

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.

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 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.

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 Qualitative research

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 multi-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

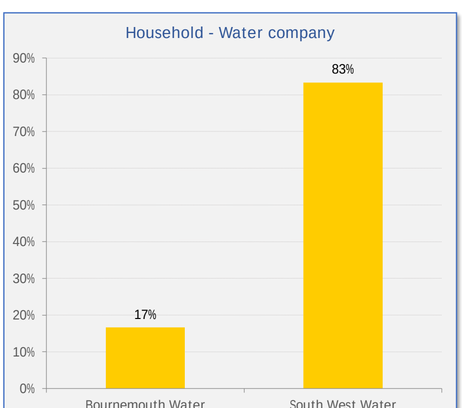
Full details of the quantitative research are available separately on request, but highlights are presented below.

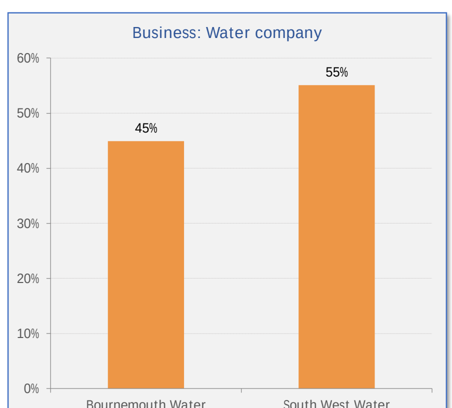
Background

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

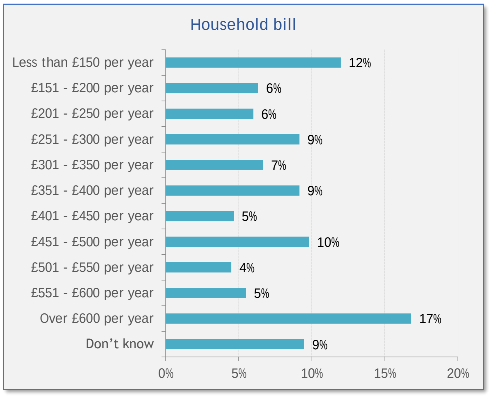
Both household and business samples cover the SWW and Bournemouth regions

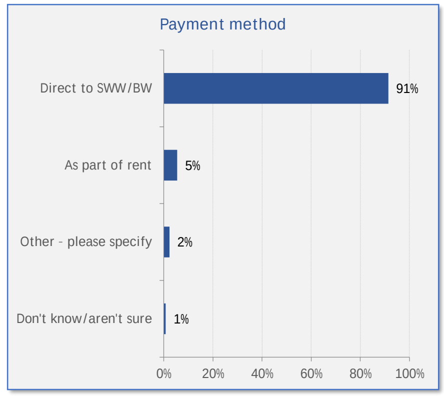




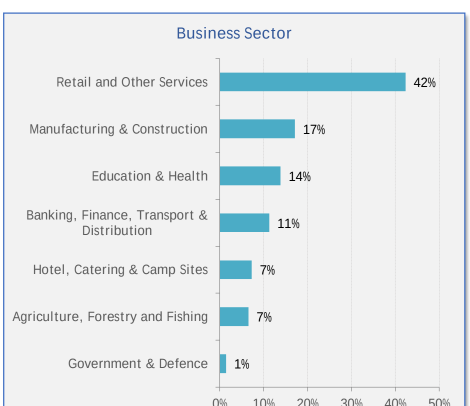
So the results can be applied to both regions

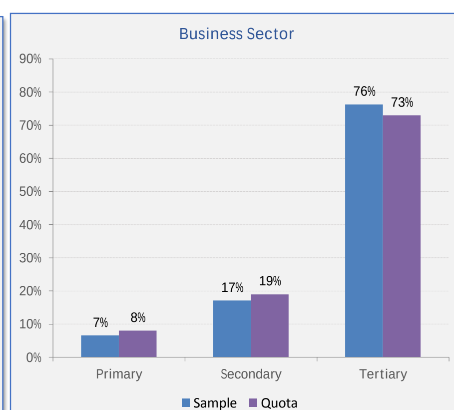
Household - Good range of bills covered in the research



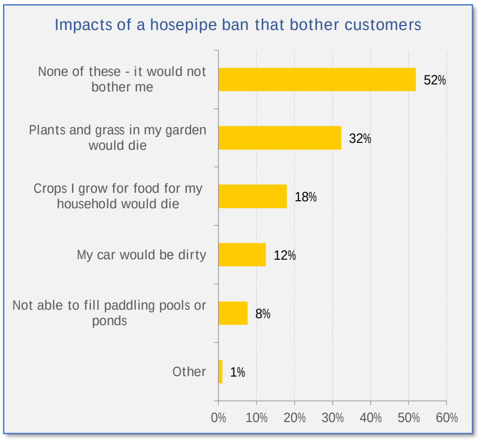


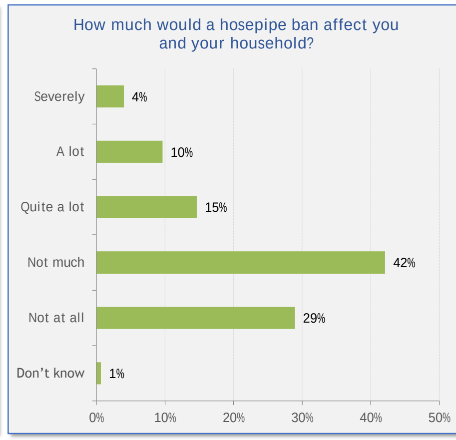
Businesses - sample is a good mix of businesses which aligns with the quotas set



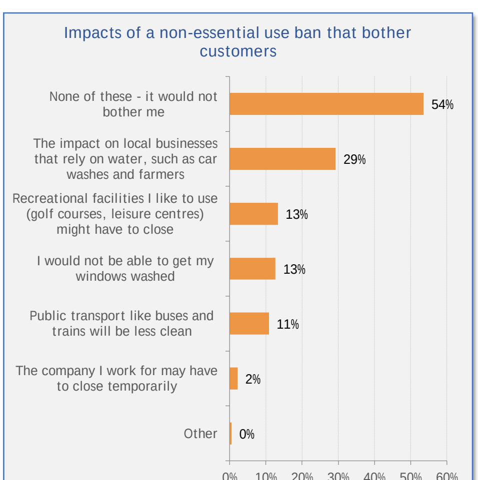


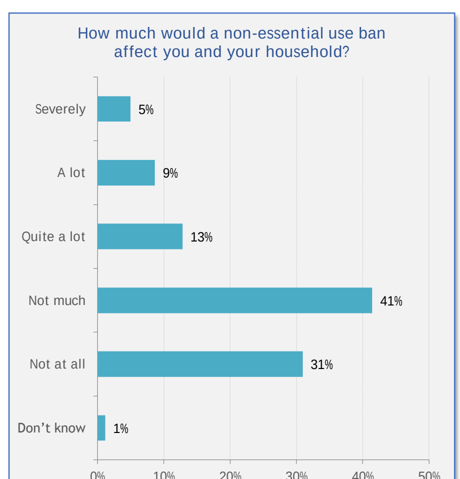
HOUSEHOLD: Views on hosepipe bans - most households not bothered much or at all by these



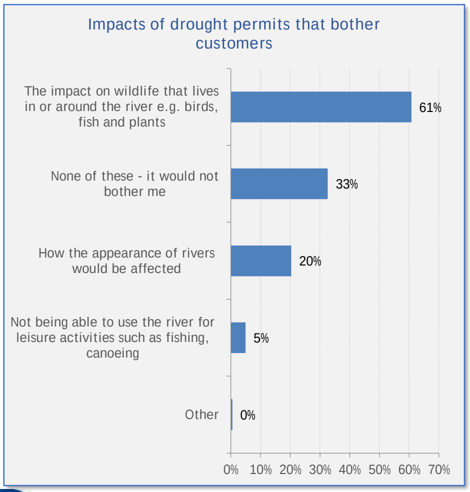


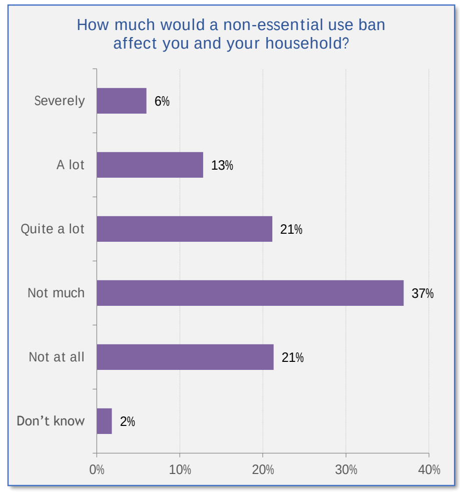
HOUSEHOLD: Views on non essential use ban - again most households not too bothered or inconvenienced





HOUSEHOLD: Views on drought permits - again this is not something that many households are bothered by





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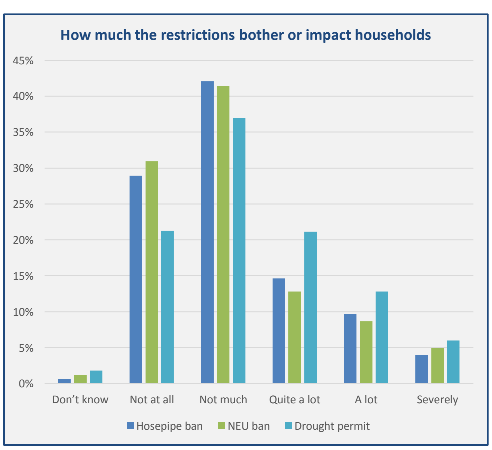
HOUSEHOLD: Comparing the results we can see that Drought Permits are the restriction of most concern



- 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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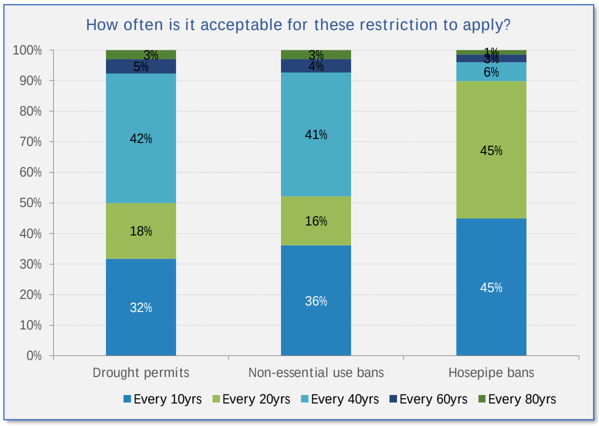
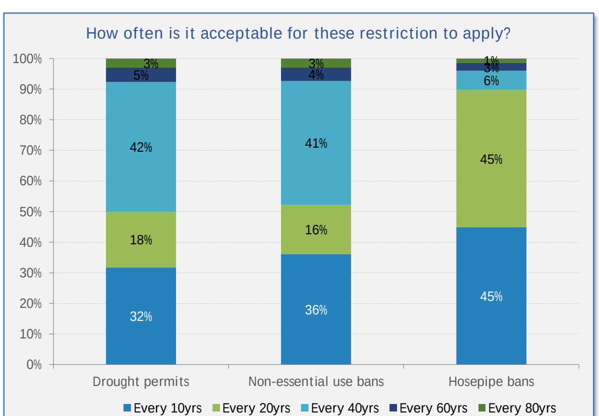
HOUSEHOLD: Acceptable levels of restriction



- 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

BUSINESS: Acceptable levels of restriction



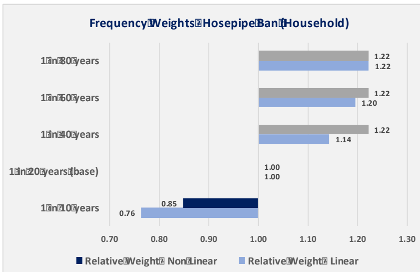
- Similar results to households here
- NEU and Drought Permit should be less frequent than hosepipe bans

Average: 28 years | Average: 28 years | Average: 19 years

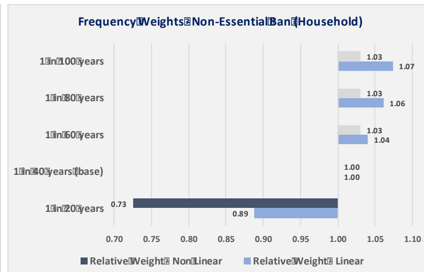
Restrictions

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

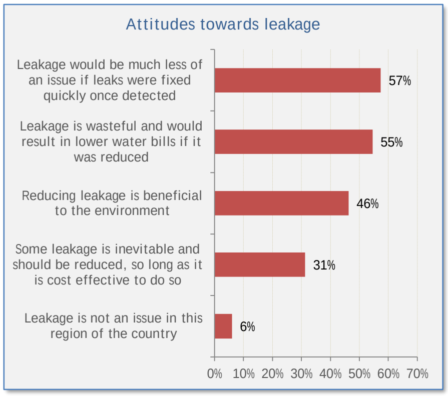
Households are clearly averse to a level of service lower than the current (base) service. There is a preference (estimated weights > 1) for a lower frequency (better service) but this is not strong, i.e. not statistically different to the base levels of service.

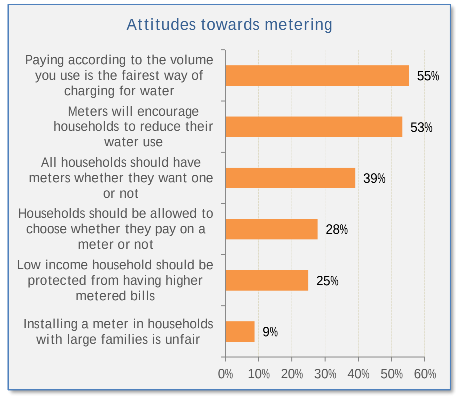
Extending to hosepipe and non essential use

- 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

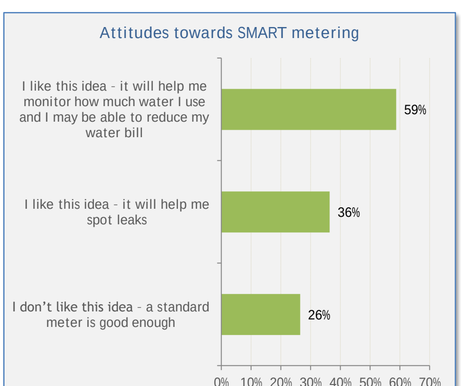
HOUSEHOLD: Attitudes to demand side options…

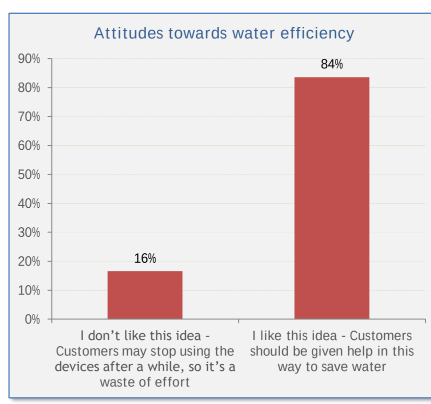




- Strong views on leakage
- Some misunderstanding about the impact of leakage on bills
  - Confirms need to put into the choice tasks to isolate impact of bills
- Recognition that metering is fair and encourages water saving
- But less than half think further metering should be compulsory
- 25% support helping poorer families on meters

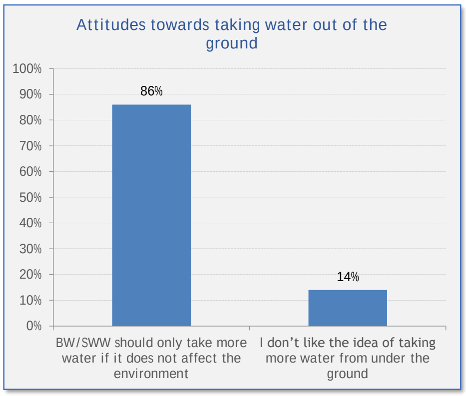
HOUSEHOLD: Attitudes to demand side options…

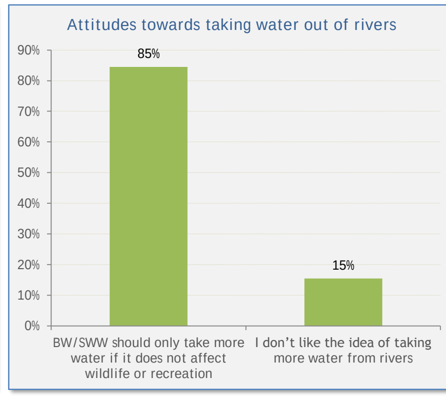




- Moving from dumb meters to smart meters supported by ¾ of respondents
- Need to explore differences between measured and unmeasured
- Well supported
- Few sceptical about benefits

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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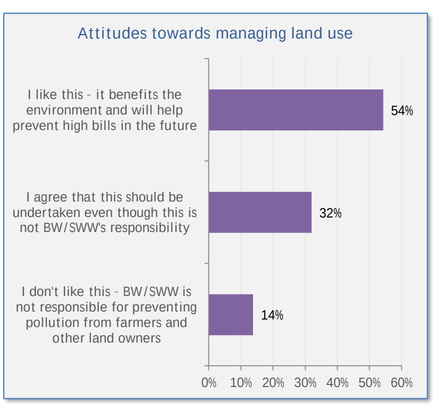
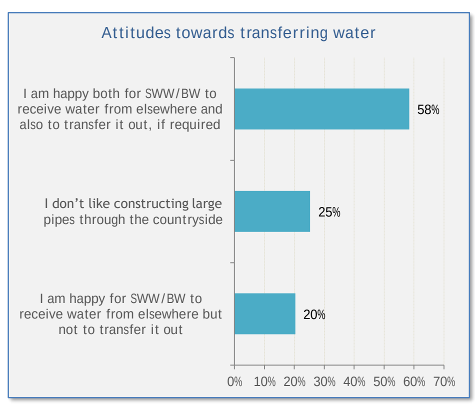
HOUSEHOLD: Attitudes to supply side options…





- 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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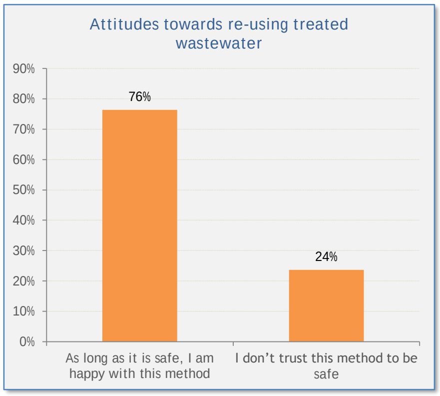
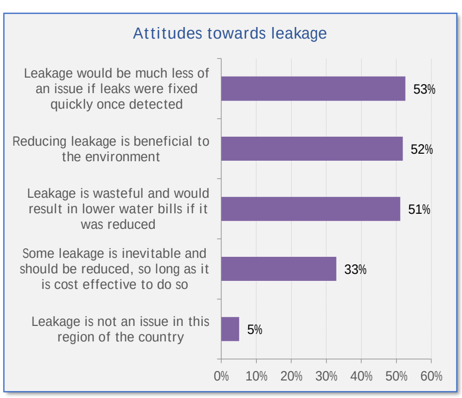
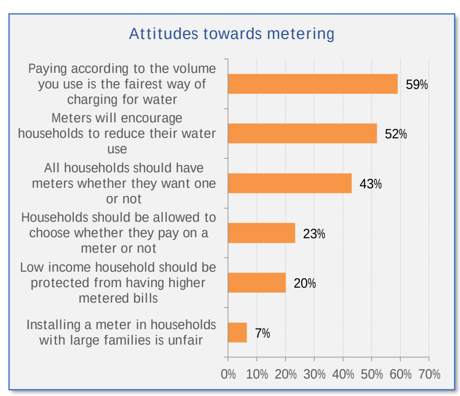
HOUSEHOLD: Attitudes to supply side options…



- Generally people okay with this as long as it is safe
- But still not as popular as demand options

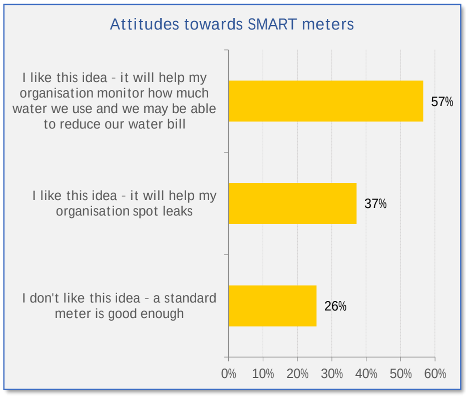
BUSINESS: Attitudes to demand side options…

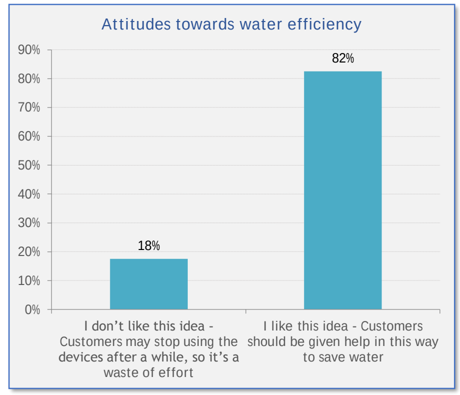




- Strong views on leakage
- Some misunderstanding about the impact of leakage on bills
- Recognition that metering is fair and encourages water saving

BUSINESS: Attitudes to demand side options…



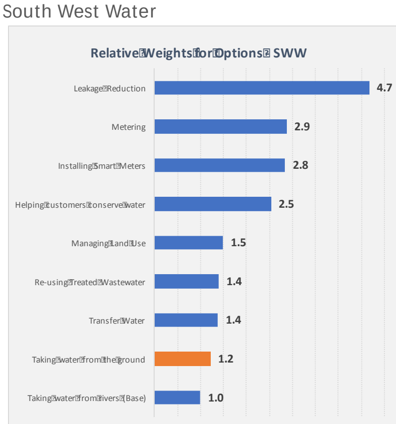


- Businesses would welcome smart meters

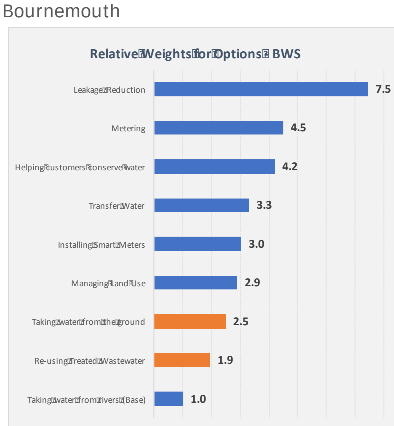
- Well supported
- Few sceptical about benefits

Water Resource Options
Findings - Household Samples

South West Water



Bournemouth



Note: orange denotes options with weights not significantly different to the base option

Water Resource Options - Findings - Business Samples
Note - small separate samples, so need to combine

South West Water

Bournemouth

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

Stage 1

Stage 2 weights

Option	Ml/d
Leakage (20%-16%)	£540,000
(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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A.1.6.2.4 Customer Research

The following information sets out the approaches used on the customer research regarding levels of service.

The following table summarises the customer research on levels of service undertaken with customers. This is followed by further detail on what was undertaken.

Title: Stated Preference - Water Resources second stage study

Objectives: The aim of second stage studies is to support the development of a full set of quantified customer valuation data. This study provides the relative value of water resource options and water restrictions, to link to the anchor values from the main study.

Format	Households (number)	Non households (number)	Vulnerable customers	Future customers	Retailers	Stakeholders	SWW	BW
Quantitative survey	601	274	✓	-	-	-	✓	✓

Key messages – What Matters Most

<u>What we did:</u>

- Stated preference survey to investigate household and non-household customer preferences for:
  - Managing water when it is in short supply during periods of drought, including different types of water use restrictions; and
  - Different options for managing the amount of available water and for providing additional water resources
- We used a stated preference approach to understand the relative value of service impacts on the households and non-households.
- Respondents were presented with choice tasks and asked to select their preferred scenario from two alternatives. The approach was the DCE method as this tested better with customers in the main stage study.

<u>What matters most:</u>

- **Water restrictions**:
  - Customers are not too concerned about lower level restrictions such as hosepipe bans, but are very concerned about more serious restrictions. Drought permits were particularly of concern to customers – and were considered to be more of a concern than hosepipe bans or the business impacts of non essential use bans.
  - There is no appetite to reduce the current level of risk restrictions or drought permits. Customers are happy with the current level of service – hosepipe bans every c. 20 years is considered to be good levels of performance.
- Water resource options:
  - Leakage reduction and metering are the most preferred options for managing water resources
  - Overall demand-side options are preferred to supply-side options. The very clear order of preference is to reduce leakage, encourage metering and support water conservation. Other sources of water are less popular with customers.
  - Options with lower environmental impact and those that use renewable energy are also strongly preferred
  - Linked to the main stage outputs, the value of leakage is similar to the value in PR14.

Impact on our plan *and ways of working:*

The OPM Framework underpins our whole approach to business planning, decision making and delivery. OPMs represent the level of detail against which all expenditures are assessed and business cases are developed.

The OPM framework aligns with our Outcomes framework – in particular we ensure there is a clear mapping from OPMs to performance commitments. We predict and forecast our PC performance by first predicting and forecasting performance at OPM level.

In total we have 150 OPMs – this study has been combined with main stage research in our triangulation process to populate all of the OPMs relating to water resources.

This means we can ensure our WRMP balances what matters most to our customers and delivers maximum value to our customers.

The WRMP has used the values for all restriction types and resource options in a cost-benefit assessment.

Next steps: – The results fed into our valuation triangulation process. These results were given high weight in the process.	

Reference: ICS Consulting and eftec final report *"Water Resources SP Research".* March 2018

eftec economics for the environment

ICS consulting

South West Water

South West Water PR19 Water Resources Research

Report

March 2018

DOCUMENT INFORMATION

Document title	PR19 Water Resources Research
Project	Second Stage Water Resource Survey
Prepared by	ICS Consulting Ltd Pear Tree House, Main Street Little Smeaton, North Yorkshire WF8 3LG www.icsconsulting.co.uk and Economics for the Environment Consultancy Ltd (eftec) 73-75 Mortimer Street London W1W 7SQ www.eftec.co.uk
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Document version	1.0
Version date	March 2018
Circulation to	Sally Mills

Executive Summary

Introduction

This report documents the objectives, approach, analysis and results from the 2017 Water Resources Second Stage research.

This study investigates household and non-household customer preferences for:

- managing water when it is in short supply during periods of drought, including different types of water use restrictions; and
- different options for manging the amount of available water and for providing additional water resources

The research forms a core component of South West Water's customer engagement programme for PR19 and beyond, as summarised in South West Water's PR19 Valuation Strategy.

The results and key findings from the study are inputs to both the Water Resource Management Plan (WRMP19) and PR19 business planning processes.

This component of the valuation strategy provides data on the relative values for the areas highlighted in blue in Figure ES.1. These relative values are then combined with the green-highlighted areas valued in the Main Stage Stated Preference Study to provide £-values for the blue measures.

Figure ES.1: 2nd Stage Water Resources Quantitative Values

Water Quality Failure	Number events mitigated	PCV failures					
	Properties at reduced risk	Boil Water Notice	Do Not Drink Notice	Do Not Use Notice			
Aesthetic Water Quality	Properties at reduced risk	Discolouration - isolated incident	Discolouration - persistent	Taste and smell - isolated incident	Taste and smell - persistent		
DG2 Poor pressure	Nr of properties addressed	DG2 Poor pressure					
Supply interruption - unexpected	Properties at reduced risk	3-6 hours	6 - 12 hours	12 - 24 hours	24-48 hours	2-7 days	7+ days
Supply interruption - planned	Properties at reduced risk	6 - 12 hours	12 - 24 hours				
Security of supply - levels of service	Properties at reduced risk	Temporary Use ban	Non-Essential Use Ban	Drought Permit			
Mains leakage	Ml/d saved	Leakage					
Water conservation	Ml/d saved	Water conserved					
Metering	Number	Meter optants	Smart meter optants				
Water resource options	Ml/d saved	Re-use	Catchment mgt	Transfer	River abstraction	Groundwater abstraction	
Catchment management activity	Number	Farms	Acres				
Water resilience	Properties at risk	By hazard					

Main Stage (Anchor)
2nd Stage Water Resources

Expert peer review of the research by a leading academic in this area, Professor Ken Willis, notes that the research is:

'an improvement on the PR14 research in terms of methodology and analysis'

And concludes that:

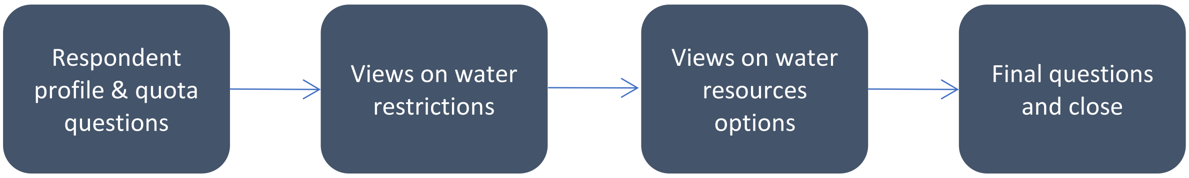
'The PR19 Water Resources Research study by ICS and eftec is a meticulous piece of research. South West Water can have confidence in the results.'

Approach

The research uses a stated preference approach, which is a survey-based method for eliciting customer priorities and preferences for changes in service levels. A total of 601 household customers and 274 non-household (business) customers were interviewed using online survey methods. The two samples are representative of their respective customer bases, with at least 100 households and 100 businesses being drawn from the Bournemouth Water region.

The broad structure of the survey is given in Figure ES.2.

Figure ES.2: Study approach



Customers were asked about the impact of options on themselves followed by the core component of the questionnaire - choice tasks that asked respondents to select their preferred scenario from two alternatives.

The expert peer review endorses this approach, noting:

> *'This is an excellent prelude, getting respondents to identify and think about the impact of water management options, before presenting the respondent with different choice experiment cards with different water resource management options and bill impacts.'*

Design, testing and validation

The questionnaire wording and choice tasks were designed through a comprehensive phase of design and testing that sought to ensure respondent understanding of the survey. This was a notable improvement over previous studies in PR14 and PR09 and the expert peer reviewer notes that:

> *'The PR19 research strategy follows good practice. The design and testing of the questionnaire and choice experiment are exemplary.'*

Comparative data on other company performance as well as on South West Water's were also included to provide an additional perspective for customers.

The survey development was an iterative process, building on South West Water's existing research and involving the Water Future Customer Panel throughout. The survey material was further developed through a series of qualitative testing exercises with household customers (cognitive interviews and hall tests) and then piloted with household customers. The expert peer review notes that:

> *'The qualitative tests ensured the optimal amount of contextual information was provided to customers, that customers understood this information, and the demand management and water resource options. The tests also ensured customers could respond to the choice tasks presented to them.*
>
> *The questionnaire is easy to comprehend. Its language is exceptionally clear.'*

The design and testing process resulted in amendments to the survey structure and improvements in the explanatory material. The findings from the testing process were highly encouraging, with respondent debriefs indicating that the survey was interesting, and it was clear how the results would be informative for South West Water. This provided assurance that the customers would be engaged by the survey and provide considered responses to the choice tasks.

The design, testing and validation of the survey has provided a number of key differentiators in this study over previous research:

- A clear design concept that is visually engaging to customers
- Clear, simple language that customers find interesting - and are not too wordy and lengthy
- A survey that is long enough to get the right information from customers, but is not too long
- A unique understanding of what factors drive customers' decisions - including cost, reliability and environmental impact
- A tested survey that meets the challenges and provides results that South West Water can be confident in

Key findings - restrictions

Varying levels of frequency of three types of restriction were explored with customers - hosepipe bans, non-essential use bans and drought permits.

Figure ES.3: Screenshots from the survey GIF

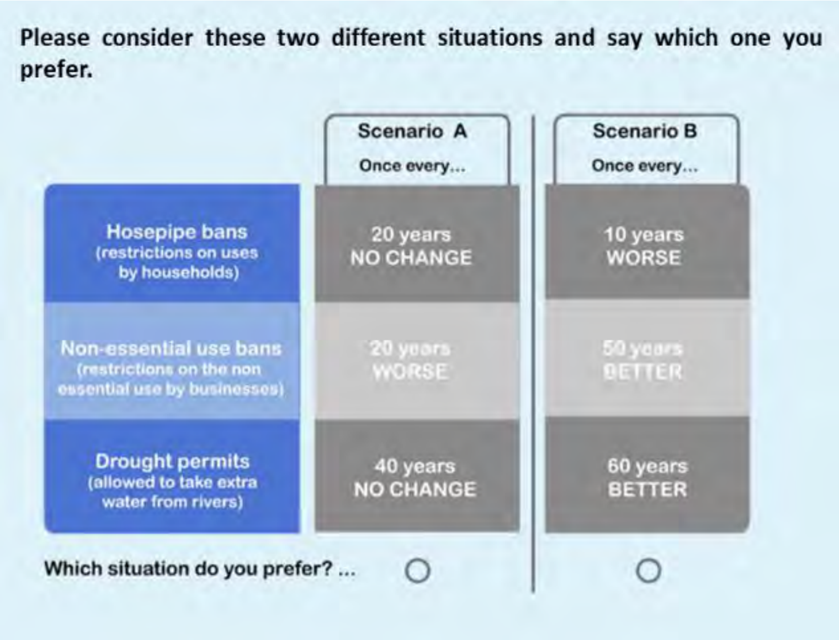
The frequencies investigated for each of the three restriction types are summarised in Table ES.1.

Table ES.1: Changes in levels of restrictions

Restriction	Deterioration	Current Level	Improved +1	Improved +2	Improved +3
Hosepipe ban *(restrictions on uses by households)*	1 in 10 years	1 in 20 years	1 in 40 years	1 in 60 years	1 in 80 years
Non-essential use ban *(restrictions on the non-essential use by businesses)*	1 in 20 years	1 in 40 years	1 in 60 years	1 in 80 years	1 in 100 years
Drought permit *(SWW allowed to take extra water from rivers)*	1 in 20 years	1 in 40 years	1 in 60 years	1 in 80 years	1 in 100 years

Customers were asked about their preferences towards these options and their perceived impact on them before making a series of choices to trade-off different levels of service for each restriction type by selecting one scenario over the other, as shown in Figure ES.4. Their choices provide the basis for understanding priorities for maintaining or improving service levels.

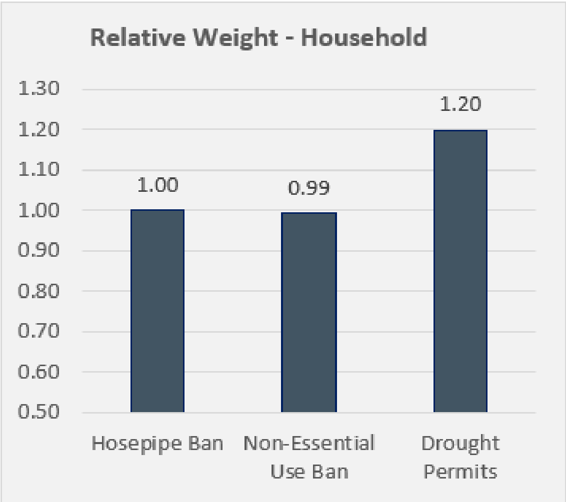
Figure ES.4: Example restrictions choice

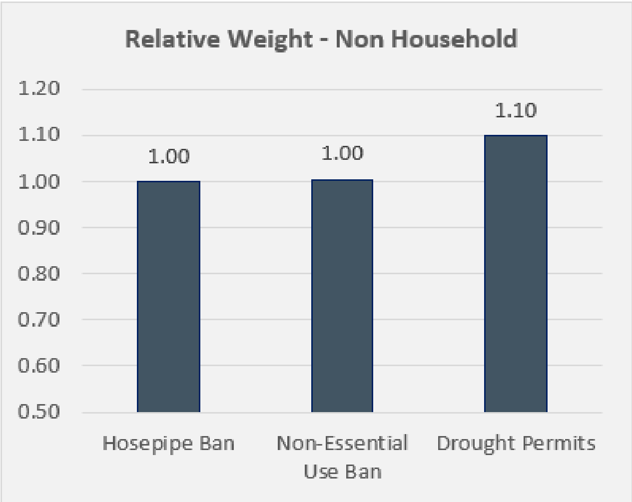


The results show that:

- Customers are not too concerned about lower level restrictions but view drought permits as relatively worse than hosepipe bans and non-essential use bans.
- There is no appetite to reduce the current level of risk of restrictions or drought permits with average minimum acceptable levels below current levels of service.
- The relative weights show that a 1% reduction in risk of a Drought Permit is valued at 1.2 times a 1% reduction in risk of a Hosepipe Ban for households and 1.1 times for non-households as shown in Figure ES.5.

Figure ES.5: Customer preferences for different types of water restrictions





The expert peer review concludes that this analysis:

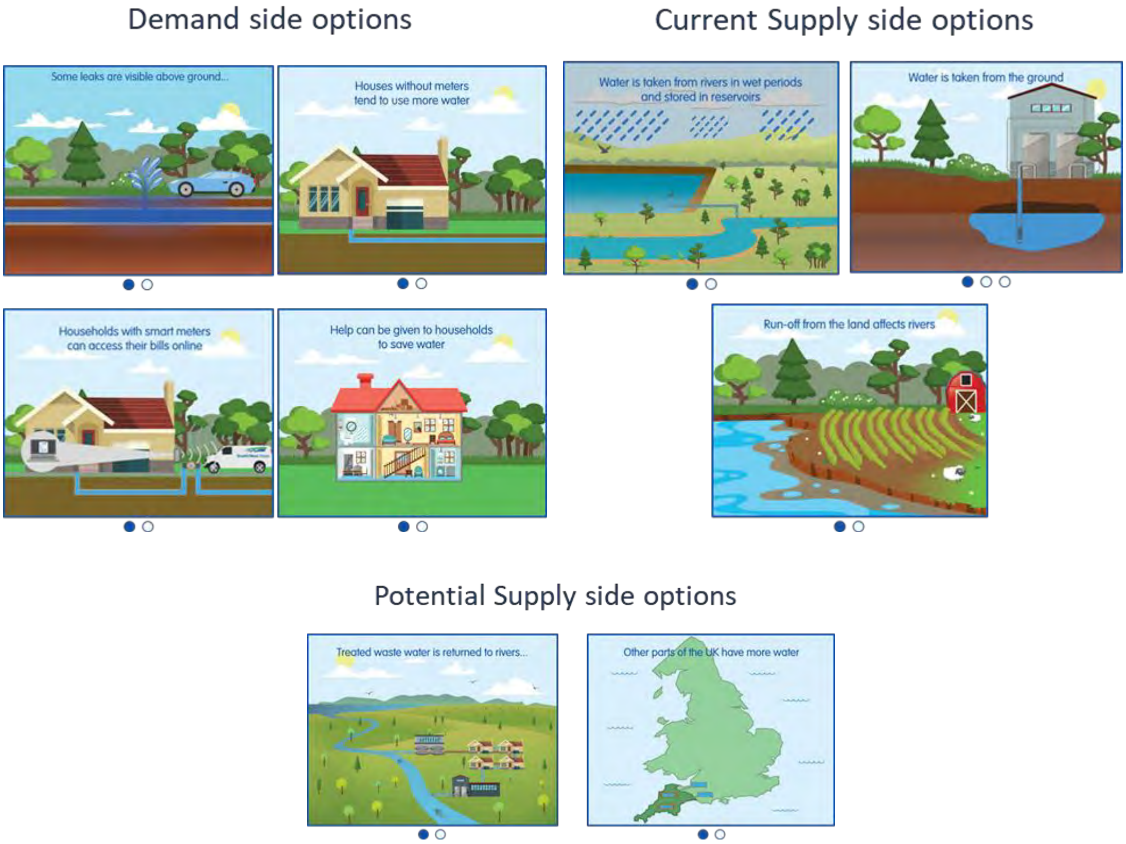
'produces reliable and robust results'.

Key Findings - Options

The following alternative current and potential water resource options were explored with customers:

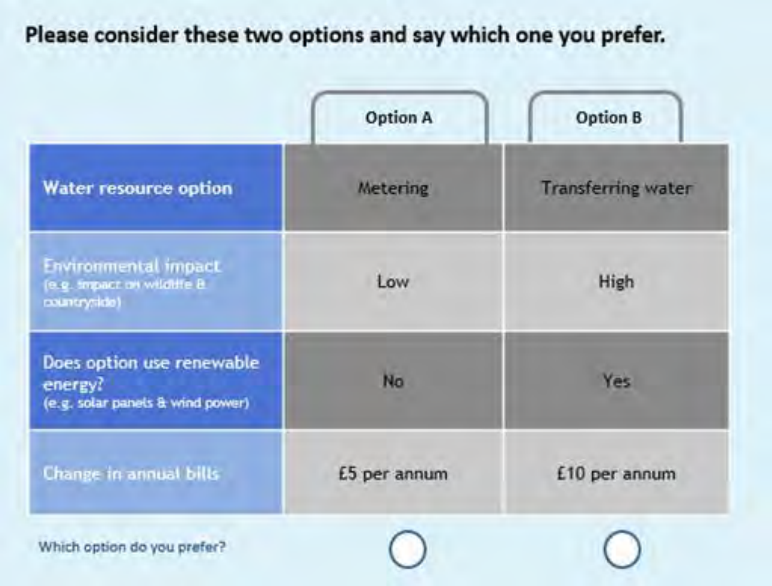
- Demand management options: leakage reduction, further normal metering, smart metering, helping customers save water;
- Current water resource options: take from rivers, take from ground, catchment (land) management; and
- Potential resource options: introducing re-use, introducing water transfers.

Figure ES.6: Screenshots of GIF for options



Customers were asked about their preferences towards these options before making a series of choices to trade-off different options and environmental, energy and bill impacts, as shown in Figure ES.7. Their choices provide the basis for understanding priorities for alternative options.

Figure ES.7: Example options choice



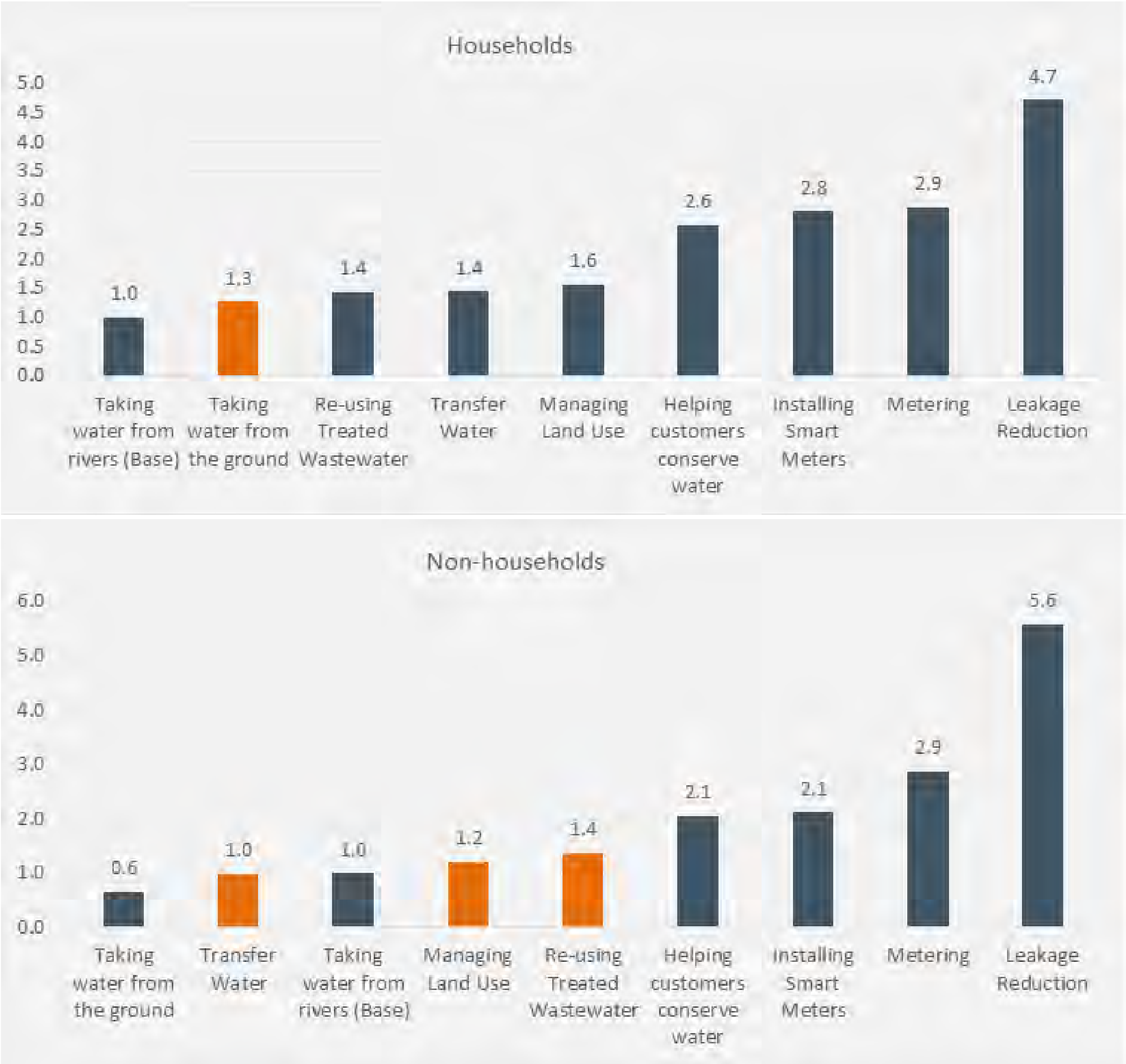
Please consider these two options and say which one you prefer.

	Option A	Option B
Water resource option	Metering	Transferring water
Environmental impact (e.g. impact on wildlife & countryside)	Low	High
Does option use renewable energy? (e.g. solar panels & wind power)	No	Yes
Change in annual bills	£5 per annum	£10 per annum
Which option do you prefer?	○	○

The results show that:

- Leakage reduction and metering are the preferred options in both the South West and Bournemouth regions. Figure ES.8 summarises these results - for example leakage reduction is valued by households at 4.7 times as good as taking water from rivers.
- Overall the demand side options are preferred with a very clear order of preference being leakage, metering/water conservation and then other sources.
- Options with lower environmental impact and those that use renewable energy are also strongly preferred. There was a 40% premium for renewable energy and a negative premium of 70% for options with a high environmental impact.
- These results are consistent across both South West and Bournemouth Water regions and hold across both households and non-households.

Figure ES.8: Customer preferences for different resource options



NB orange bar denotes options with weights that are not significantly different to the base option of taking water from rivers.

Conclusions

The study's main findings are that:

- There is no appetite in either the South West or Bournemouth Water regions to reduce the current level of risk of restrictions or drought permits with average minimum acceptable levels below current levels of service.
- Leakage reduction and metering are the preferred water resource options in both the South West and Bournemouth Water regions. Demand side options are preferred with a very clear order of preference being leakage, metering/water conservation and then other sources.
- Options with lower environmental impact and those that use renewable energy are also strongly preferred.

The study's main findings and results are judged to be robust and 'fit for use' by South West Water in the WRMP19 and PR19 business planning processes. Results from the choice models analysis are consistent with reasonable expectations concerning customer priorities and provide a coherent view of preferences.

Overall, the findings are consistent with respondents providing considered responses and demonstrate a sound understanding of the purpose of the survey and the requirements of the choice tasks on the part of respondents.

Expert peer review of the research by a leading academic in this area, Professor Ken Willis, concludes that:

> *'The PR19 Water Resources Research study by ICS and eftec is a meticulous piece of research. South West Water can have confidence in the results. The PR19 research on water restrictions, and on water resource options, by ICS and eftec is, in my opinion, an improvement on the PR14 research in terms of methodology and analysis.'*

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.1.2 shows screenshots of the interactive water resources video.

Figure A.1.2: Screenshots of interactive water resources video

A.1.6.3.2 Results

Key results are presented in Figure A.1.3. 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.1.4.

Figure A.1.3: EngageOne video results

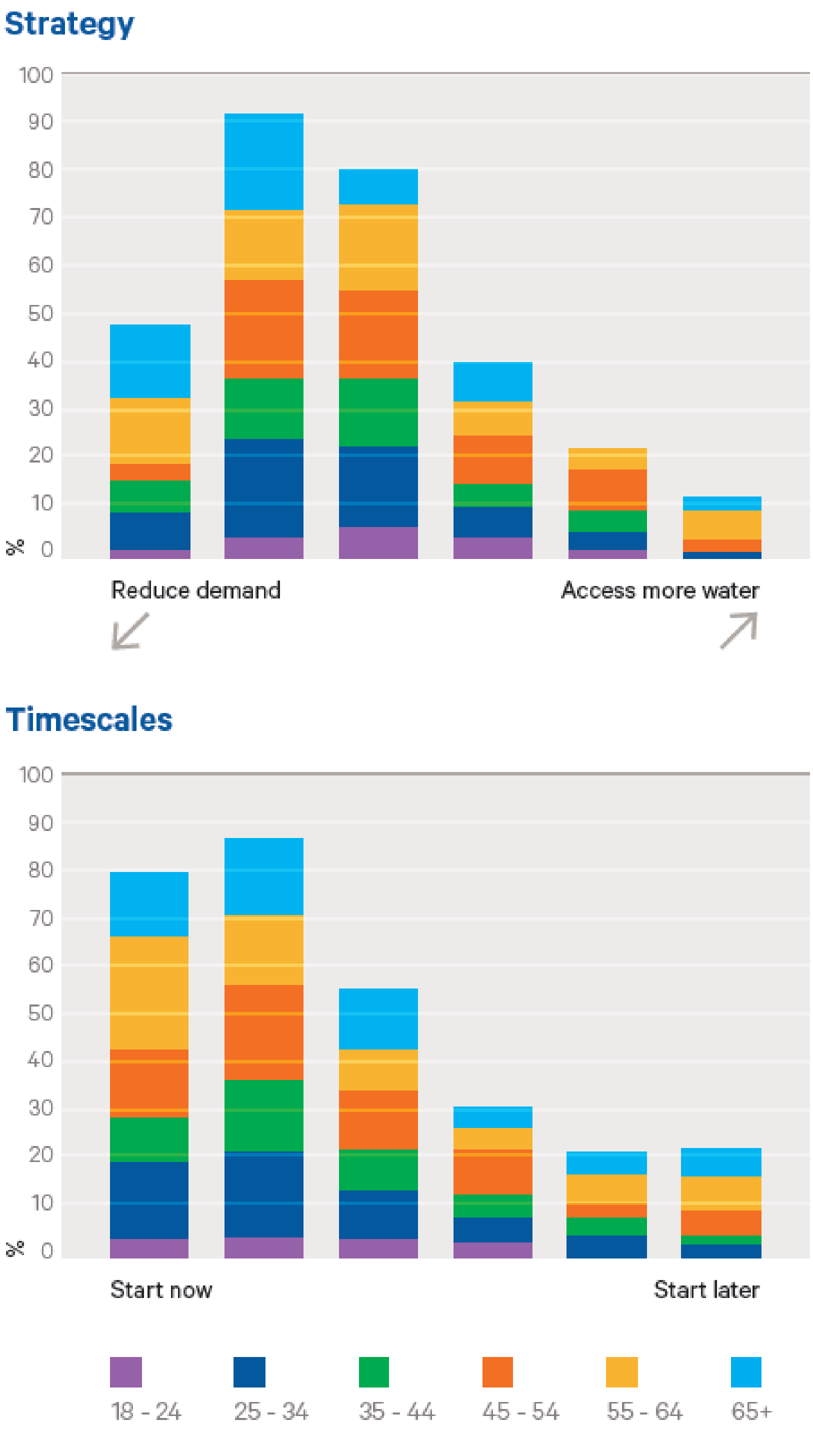


Figure A.1.4: EngageOne video feedback

- 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.

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 West Country Water Resources Group

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.

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.

South West Water

Bournemouth Water

Climate Change Vulnerability Assessment

April 2017

Contents

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.

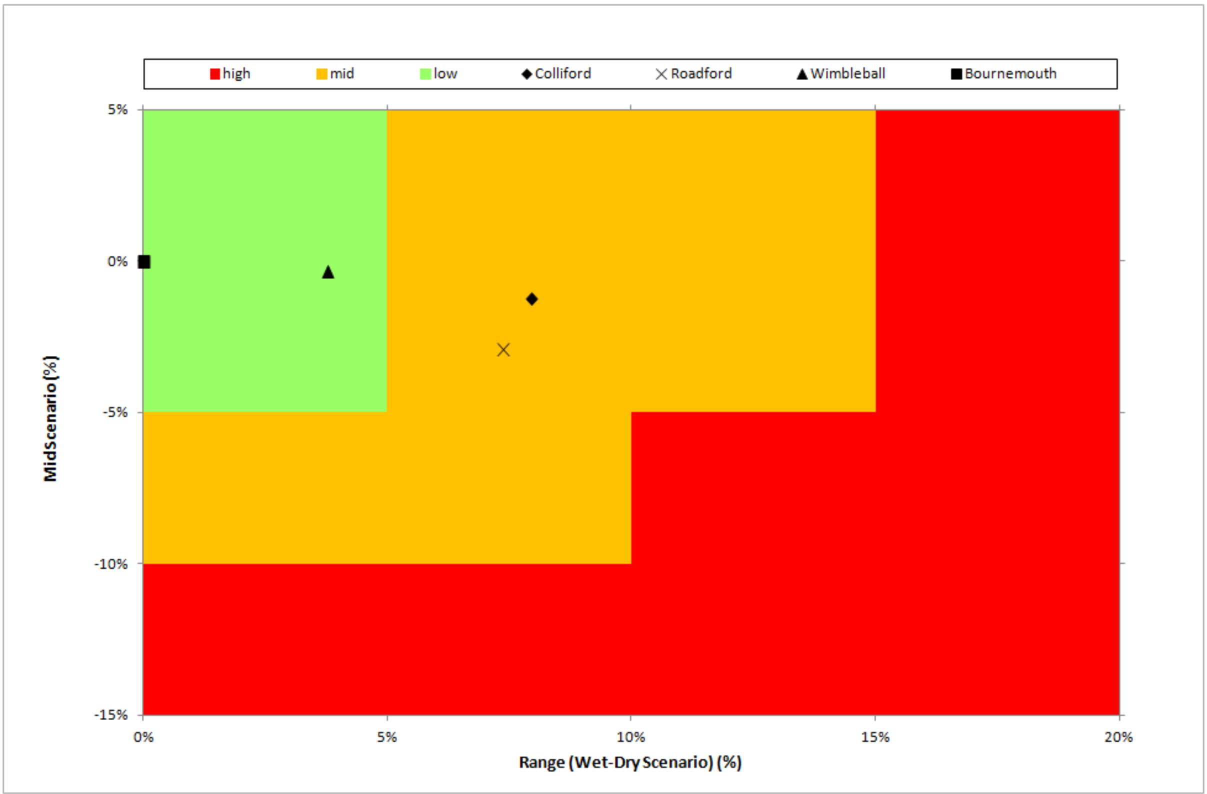


Figure 2.1. Magnitude versus sensitivity plot for the year 2035

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* [3&4]
[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* [3&4]
[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* [3&4]
[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[26].
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	

[26] Environment Agency & Natural Resources Wales (2013) *Water Stressed areas – final classification*. Cat code: LIT 3230

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

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

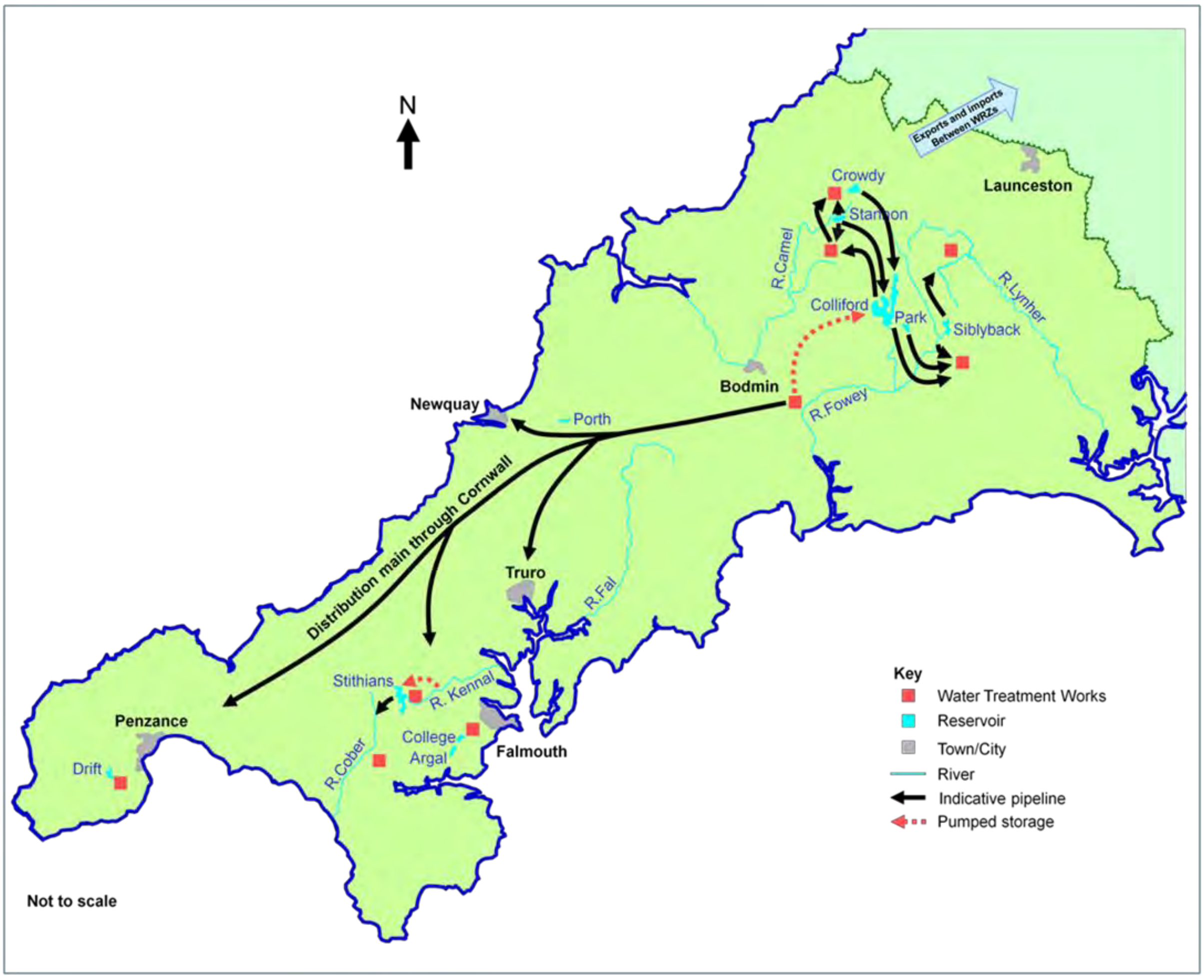


Figure A.1 Key components of the Colliford WRZ

A.2 Roadford Water Resource Zone

Figure A.2 Key components of the Roadford WRZ

A.3 Wimbleball Water Resource Zone

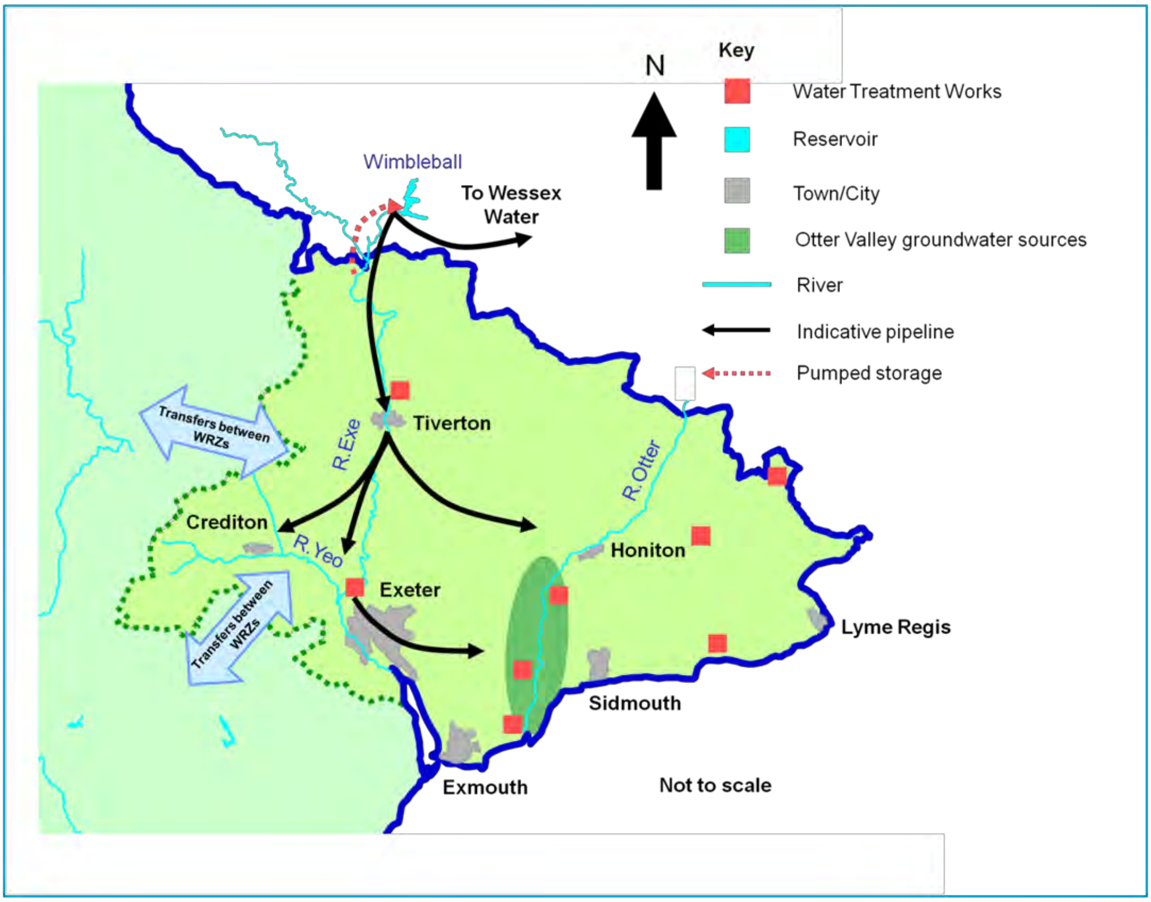


Figure A.3 Key components of the Wimbleball WRZ

A.4 Bournemouth Water Resource Zone

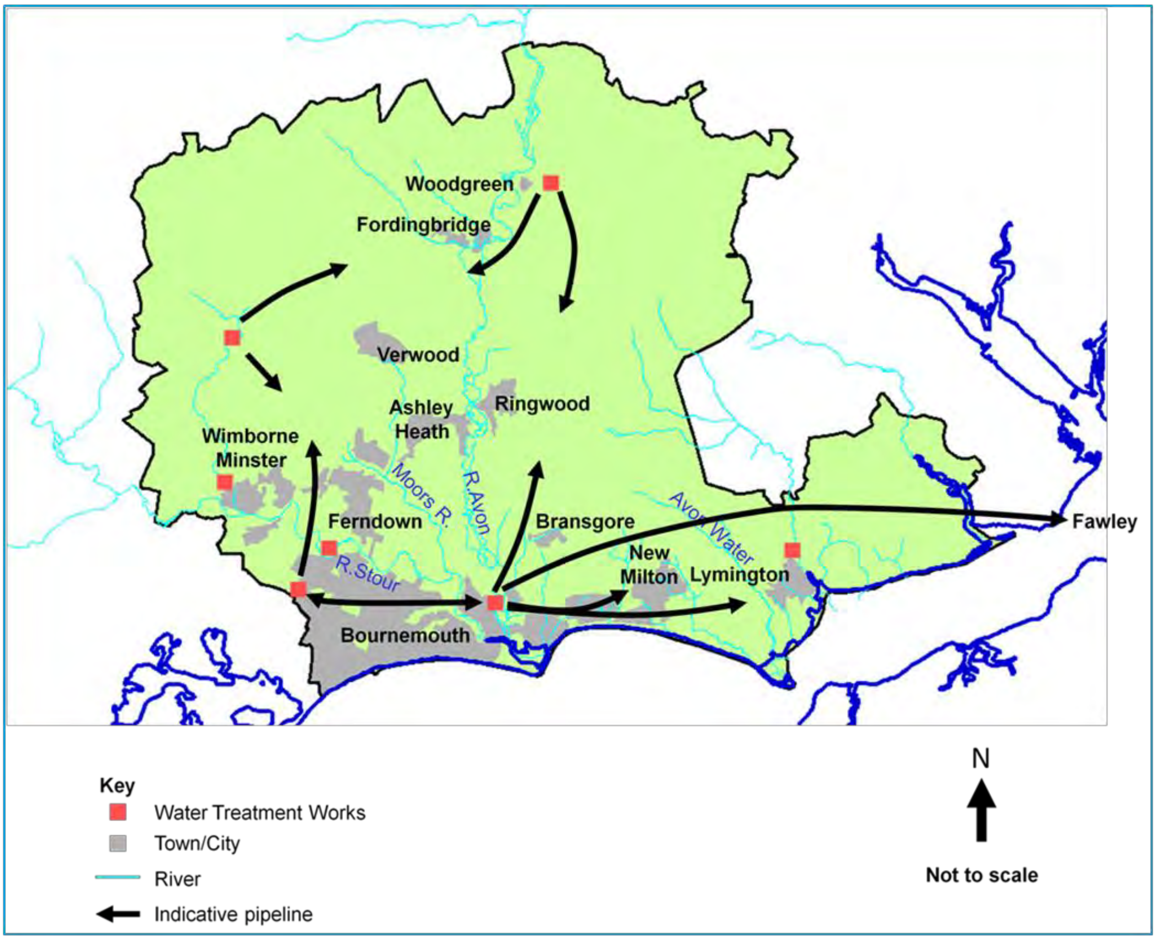


Figure A.4 Key components of the Bournemouth WRZ

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):

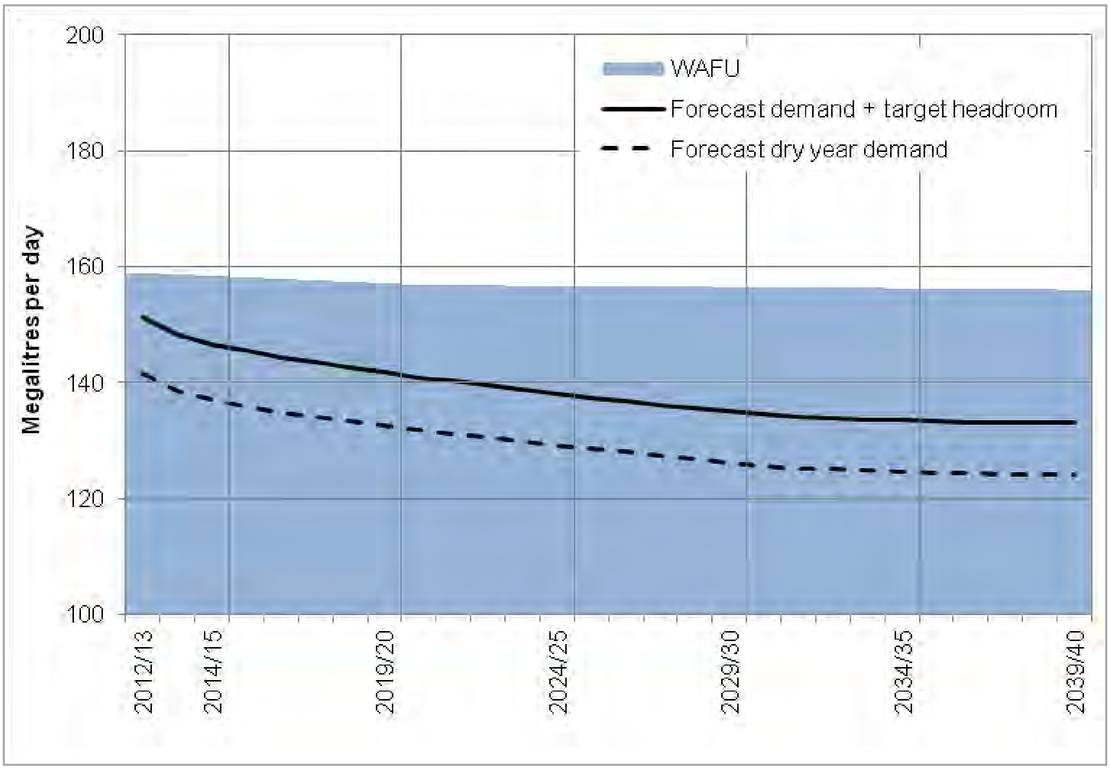


Figure B.1: The baseline supply demand position in the Colliford WRZ

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.

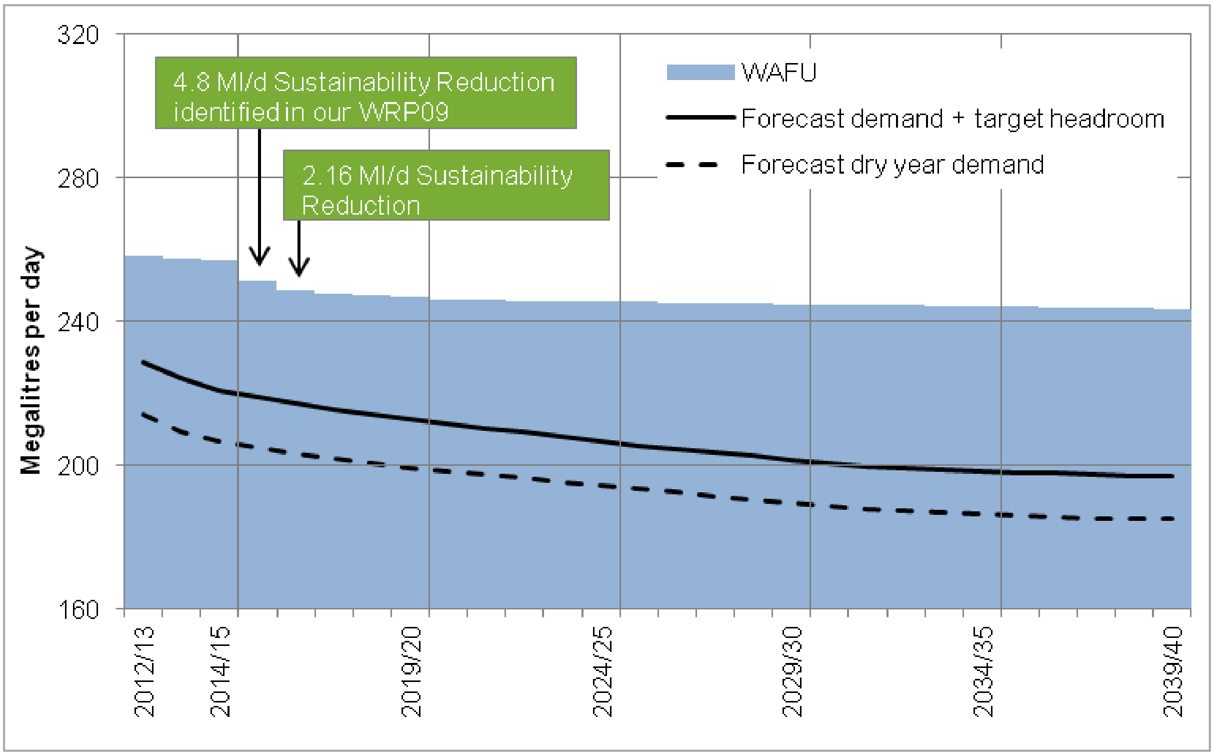


Figure B.2: The baseline supply demand position in the Roadford WRZ

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):

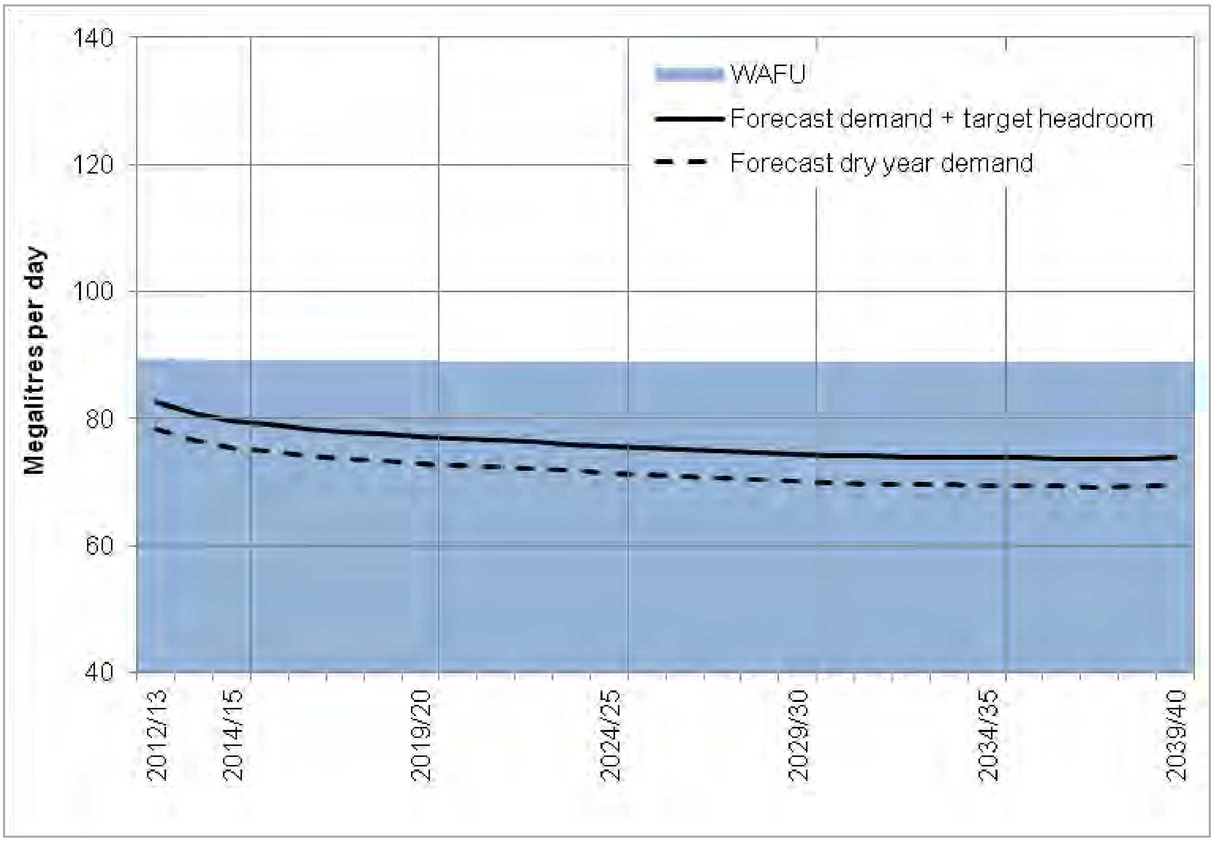


Figure B.3: The baseline supply demand position in the Wimbleball WRZ

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):

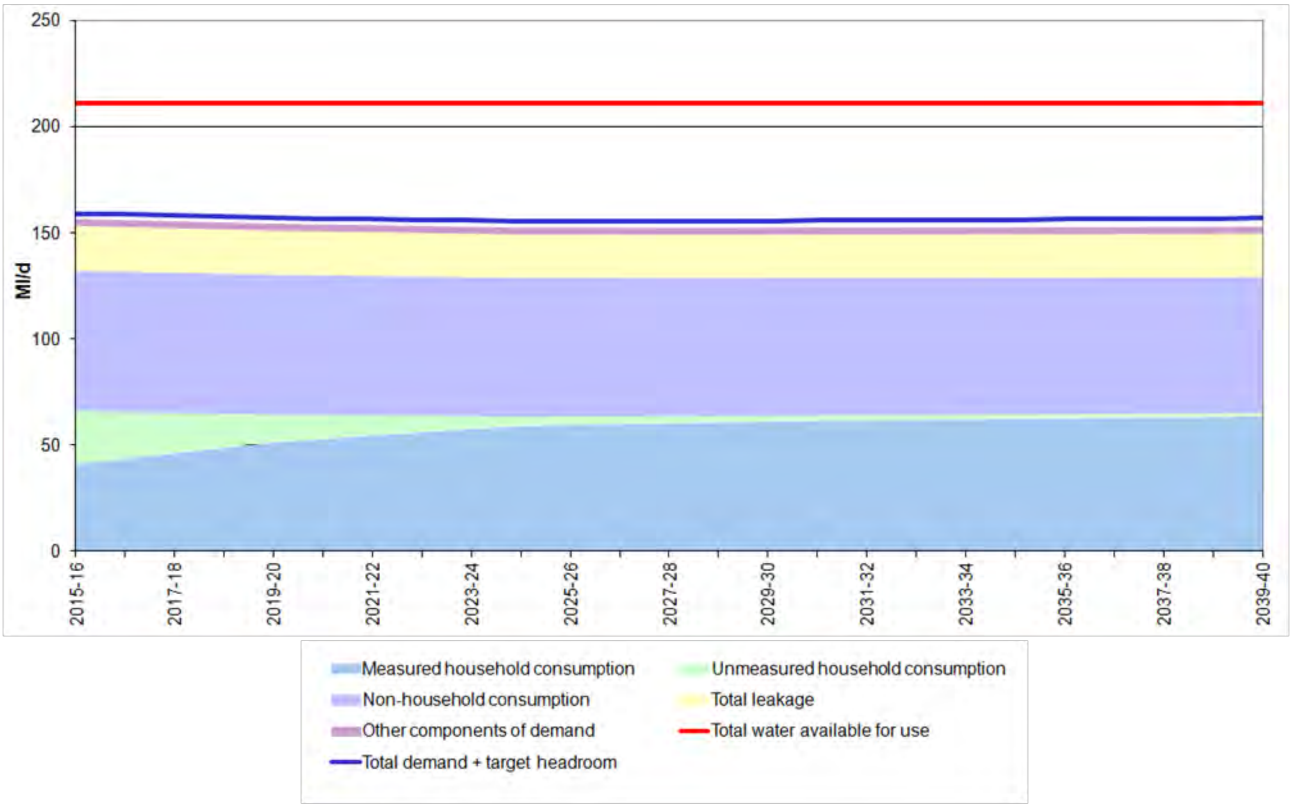


Figure C2. Final Planning Water Supply-Demand Balance for dry year annual average

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)

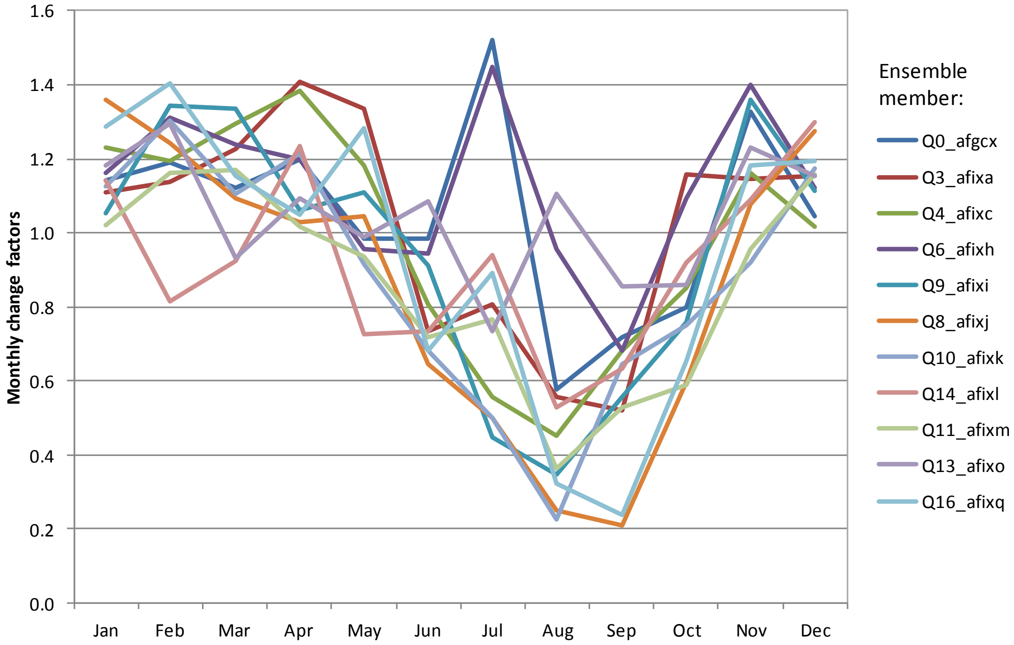


Figure A.2.2: Monthly change factors for Roadford Reservoir (Roadford WRZ)

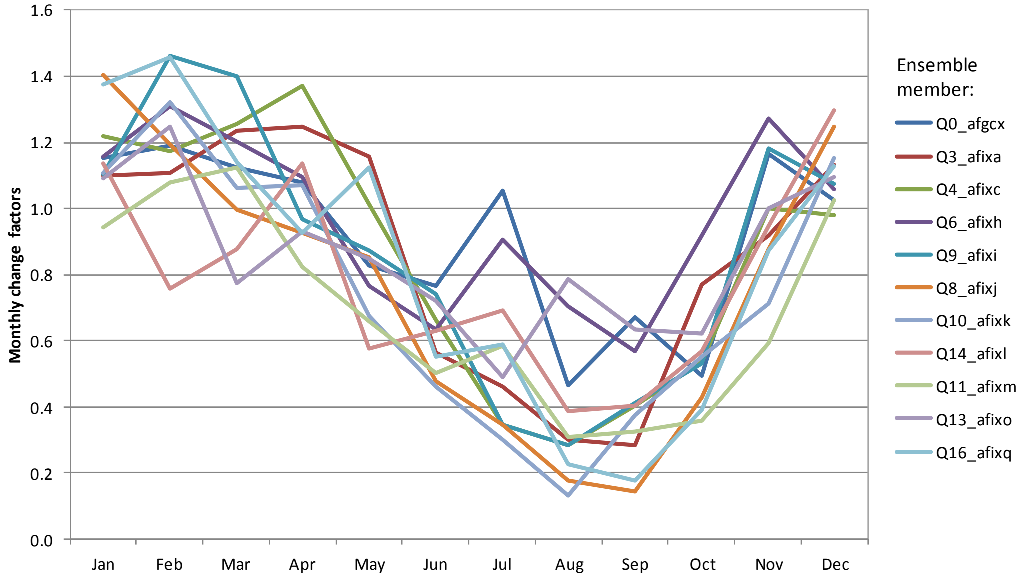


Figure A.2.3: Monthly change factors for Wimbleball Reservoir (Wimbleball WRZ)

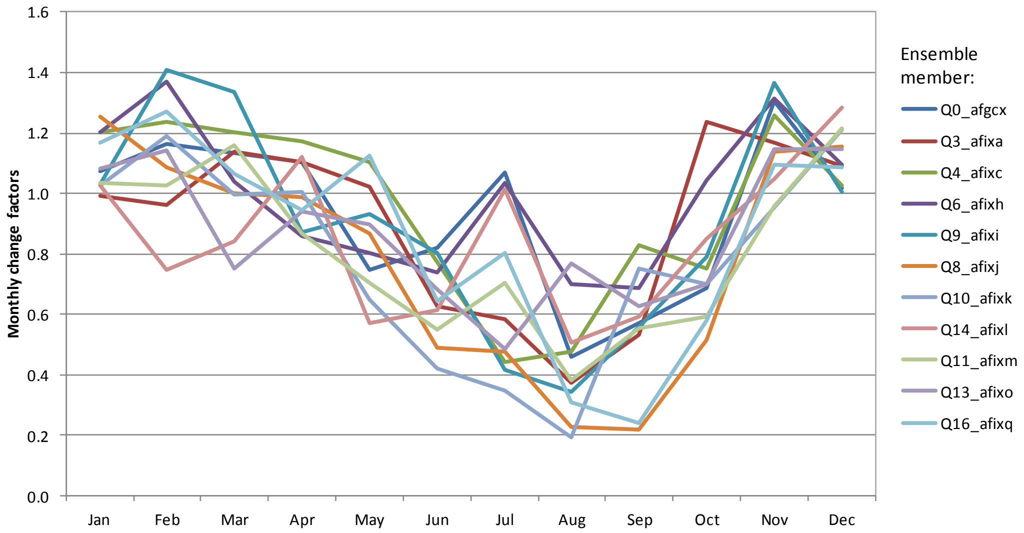
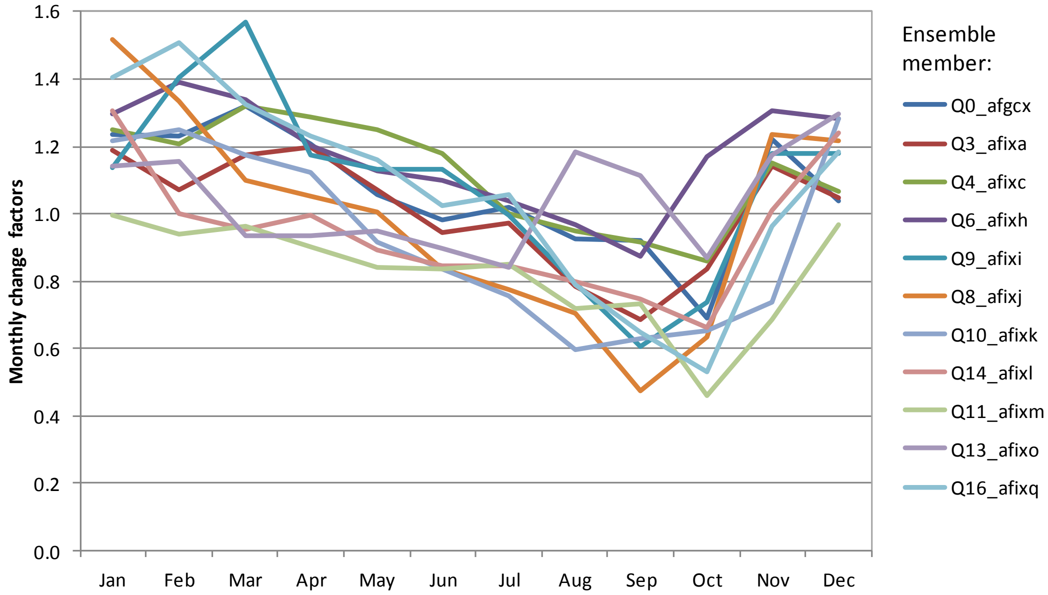


Figure A.2.4: Monthly change factors for Throop Mill (Bournemouth WRZ)



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 latest Environment Agency Water Resources Planning Guideline (2017)[A.2.1] 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 Greensand 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 (located outside the Otter Valley)

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 as they are all constrained by licence.

<u>Current Assessment</u>

For this WRMP we re-commissioned AMEC to review and update where necessary the climate change impact assessments[A.2.2] in line with current guidelines i.e. Environment Agency WRMP19 supplementary information sheet 'Estimating the impacts of climate change on water supply', revised April 2017.

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 Future Flows and Groundwater Levels (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
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 <u>Outage assessment report</u>

SWW commissioned Aecom to undertake the outage assessment for SWW and Bournemouth supply areas. The outage assessment report by Aecom is presented below.

South West Water Draft Water Resources Management Plan 2019

Outage Assessment Report

Final

Project number: 60539035

10 August 2017

Quality information

Prepared by	Checked by	Approved by
Mital Pindoria-Nandha Senior Water Resources and Groundwater Consultant	Neil Mackenzie/ Helen Culshaw	Jane Sladen

Revision History

Revision	Revision date	Details	Authorized	Name	Position
1st draft	July 2017	Draft for client comments			
2nd draft	August 2017	Final version with client comments incorporated			

Distribution List

# Hard Copies	PDF Required	Association / Company Name

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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.

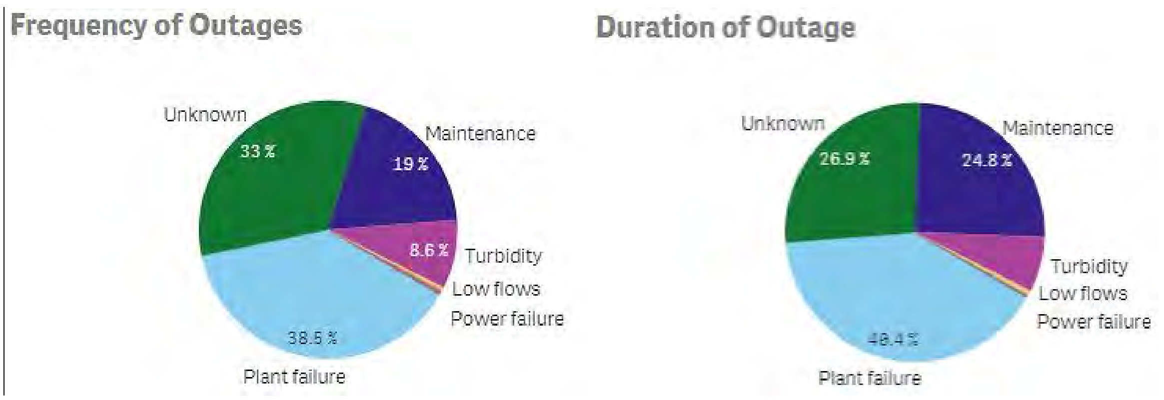
With respect to event magnitudes, all events have been assumed to have an outage magnitude of 100% of the DO. This is likely to be conservative, especially since only 180 out of 475 days of outage (37.9%) resulted in a 100% loss of DO, most of which (149 days) were in the Wimbleball WRZ. Where no outage 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.

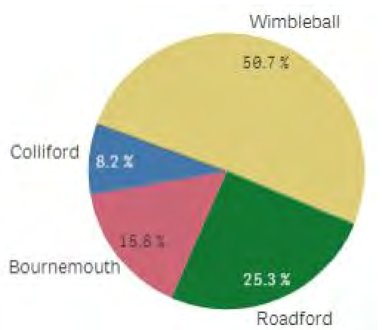
Figure 2-1: Overall frequency and duration of outages across all WRZ's for the period 2012-2016



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.

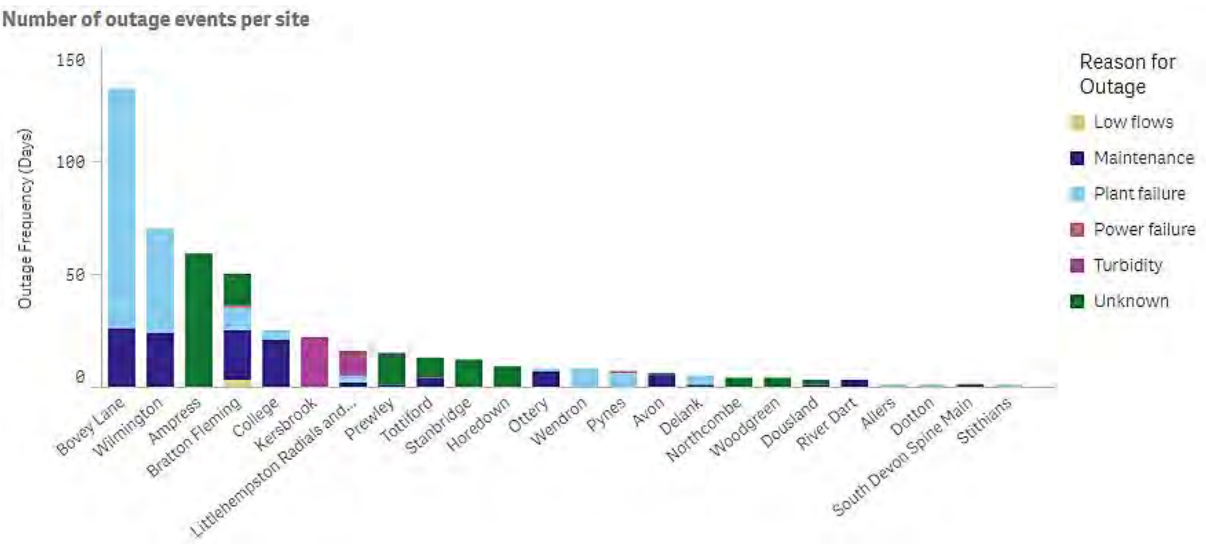
Despite the significant reduction in Wimbleball outage compared to WRMP14 (see Section 3.2), this WRZ still experienced the largest number of outages, which contributed to more than half the outages as shown in Figure 2-2 below. A key reason for this is that this WRZ has a large number of sources and 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

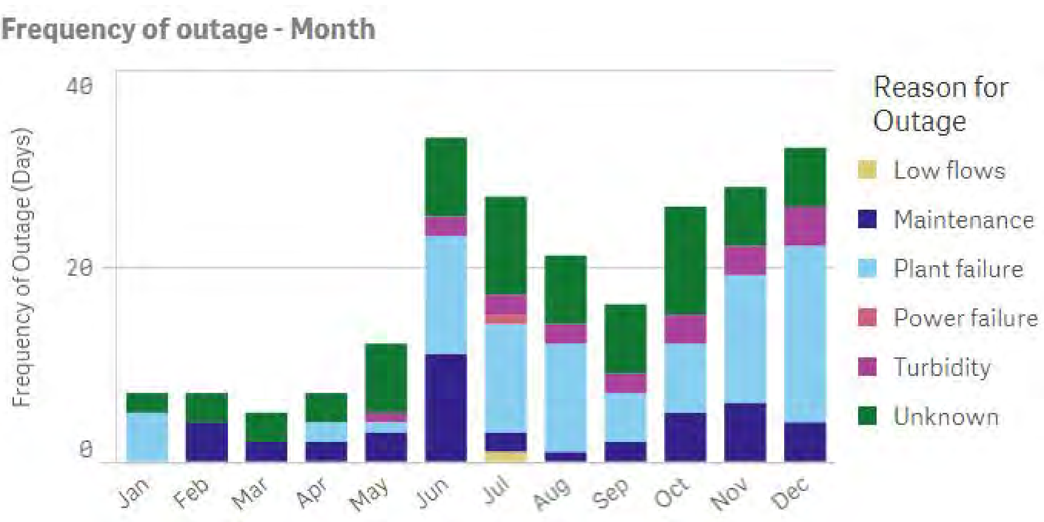
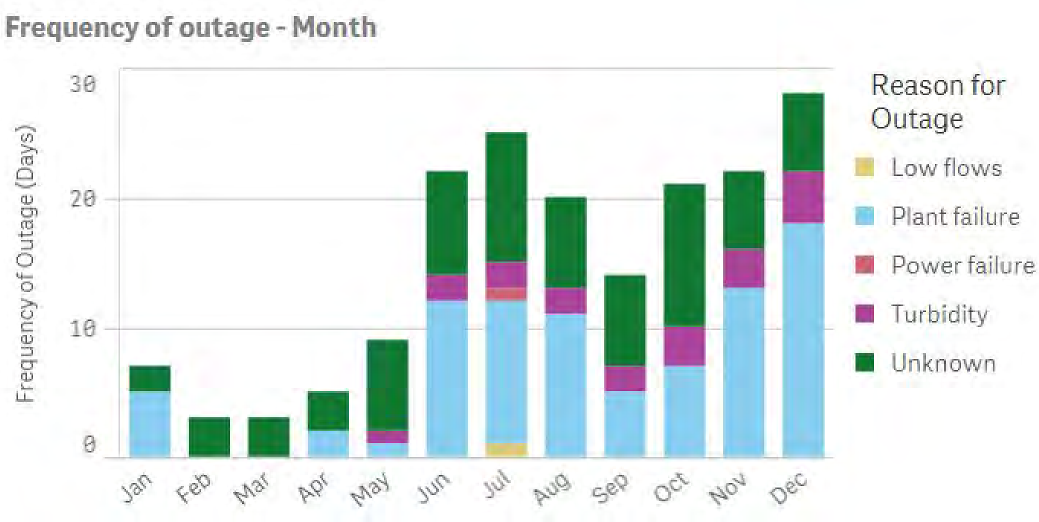


Figure 2-5: Seasonal distribution of legitimate unplanned outages across all WRZ's 2012-2016



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%**

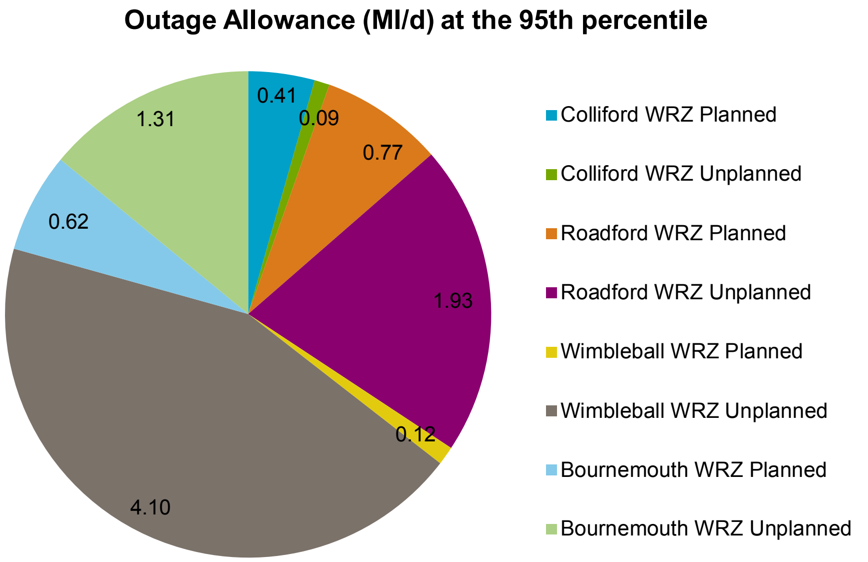
**Outage values to be used in the dWRMP 2019*

*** 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	06/06/2017 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	06/06/2017 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 18.2 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

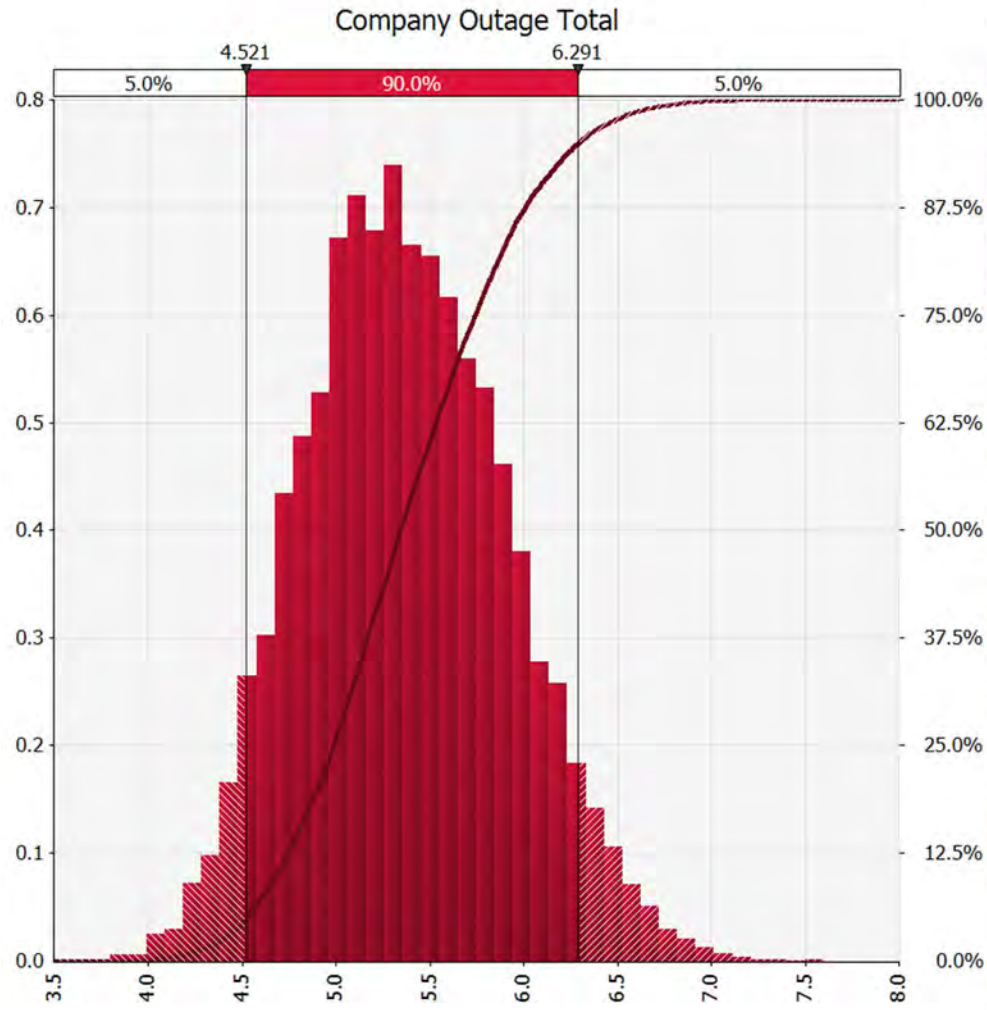
C.3 Sourceworks Outage Allowance (in Ml/d) by Probability – Bournemouth

	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

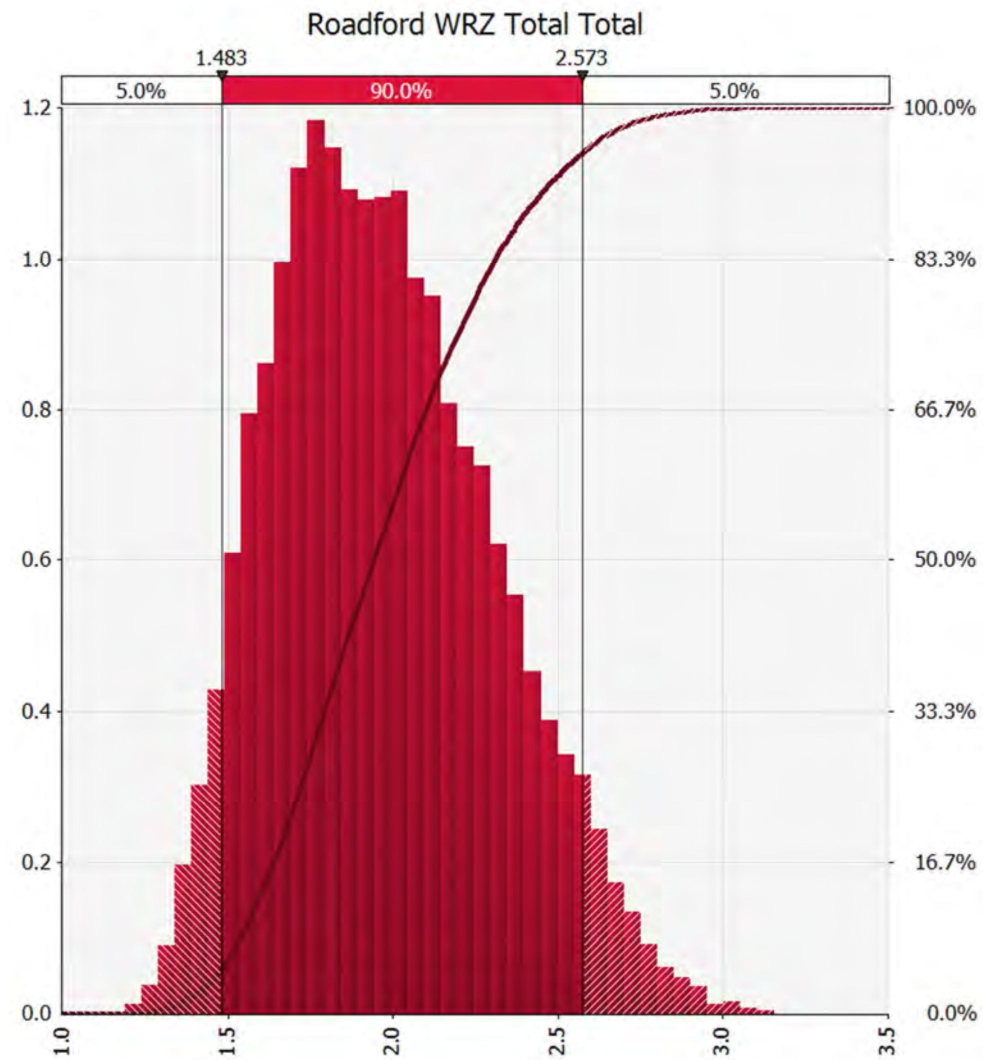
C.4 Sourceworks Outage Allowance (in Ml/d) by Probability – Roadford

	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

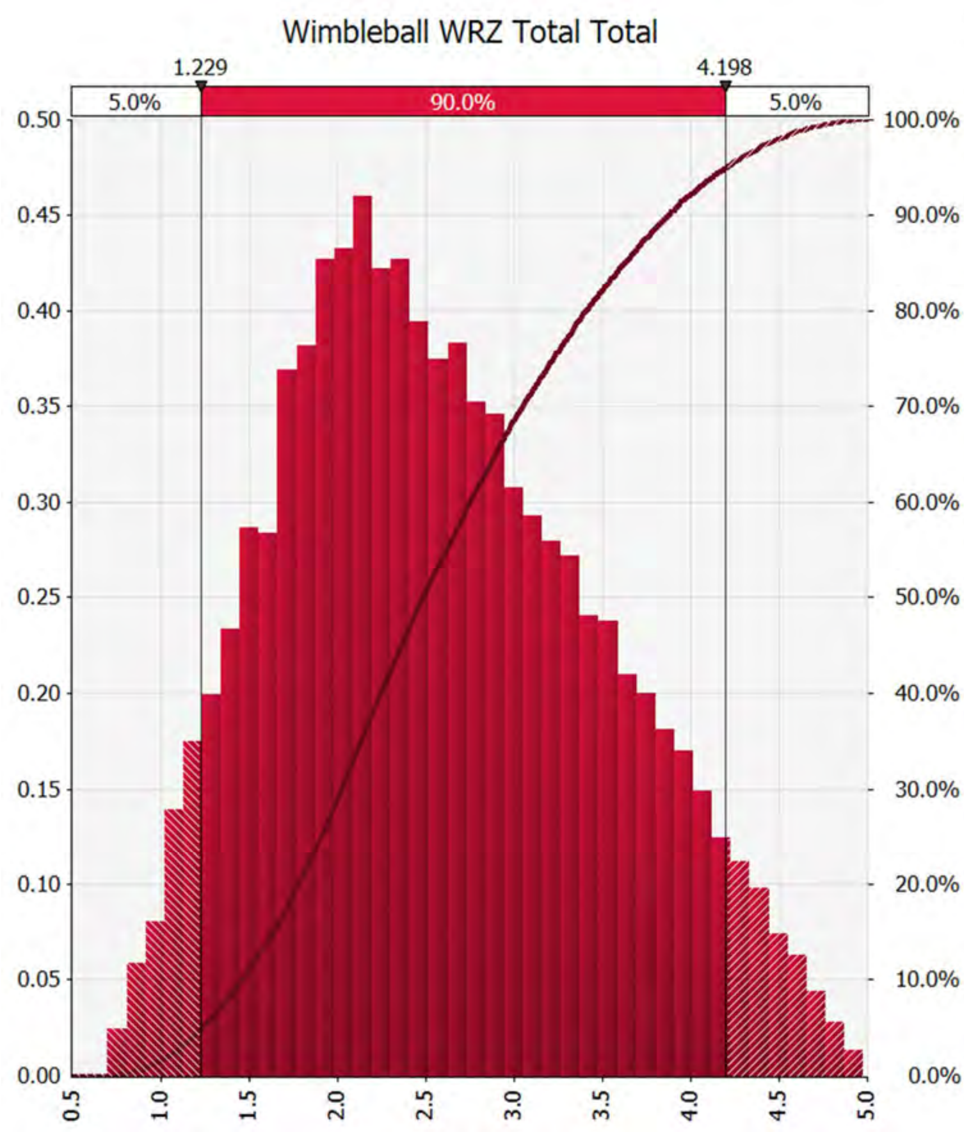
Appendix D - @Risk Graphical Outputs



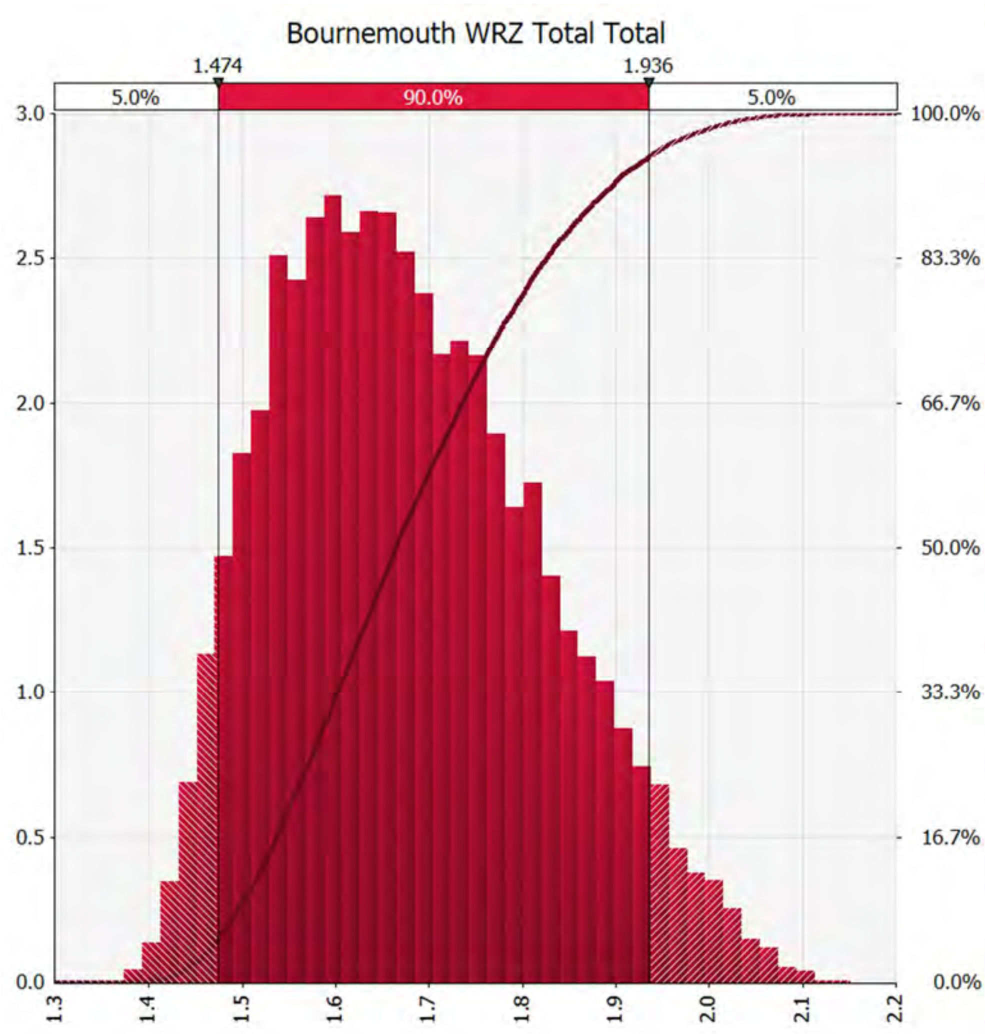
Statistics	
	Company Outa..
Cell	Simulation!F45
Minimum	3.6971
Maximum	7.6002
Mean	5.3697
Mode	5.2940
Median	5.3409
Std Dev	0.5398
Skewness	0.2045
Kurtosis	2.7823
Values	10000
Errors	0
Filtered	0
Left X	4.521
Left P	5.0%
Right X	6.291
Right P	95.0%
Dif. X	1.7704
Dif. P	90.0%
1%	4.2434
5%	4.5211
10%	4.6875
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.

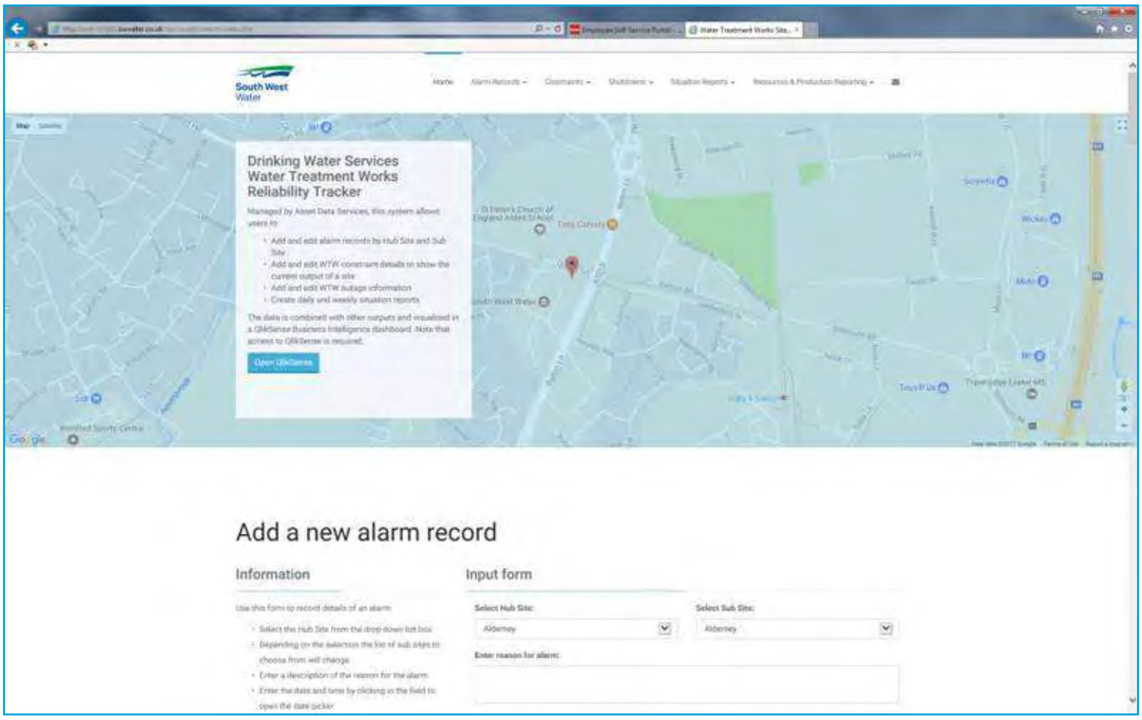
	Stanbridge	12.5
	Woodgreen	12.5
	Alderney	107.9
	Knapp Mill	90.9
	Bournemouth WRZ Total	226.2
	Company Total	**731.7**

A.2.2.2 Water treatment works reliability tracker

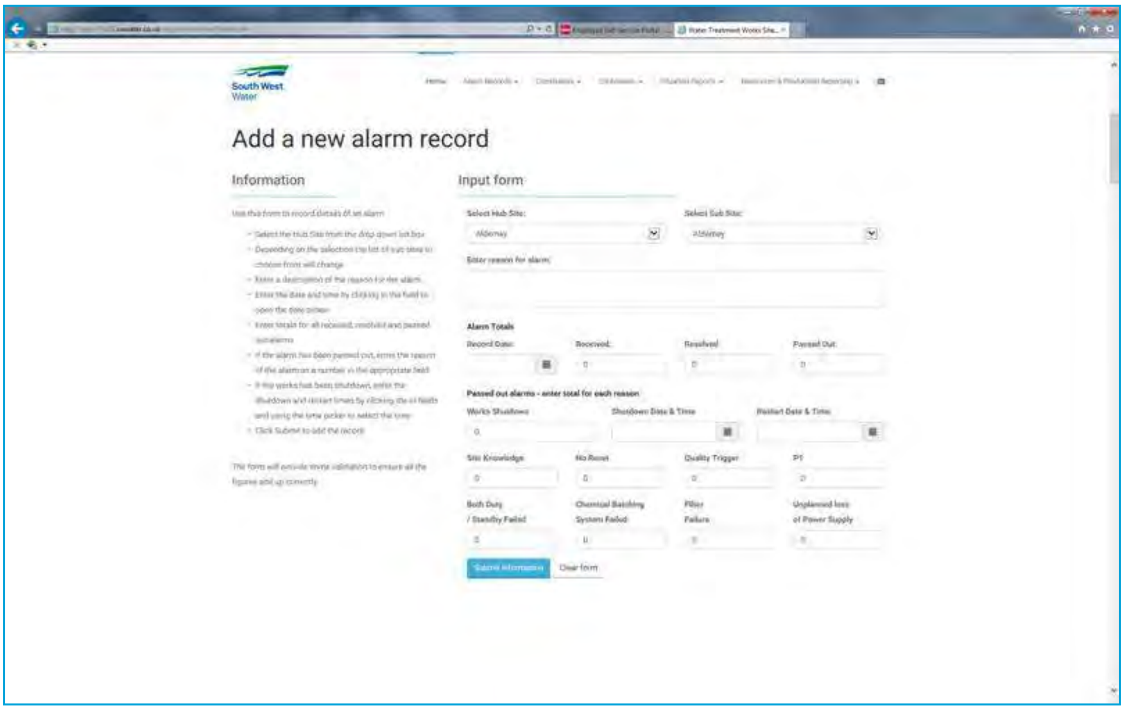
Below are screenshots taken from our new outage information tool which is currently in development. Daily site asset availability information is recorded in the form of alarm records or shutdowns and an assessment is made of the impact on works potential output recorded as a works constraint.

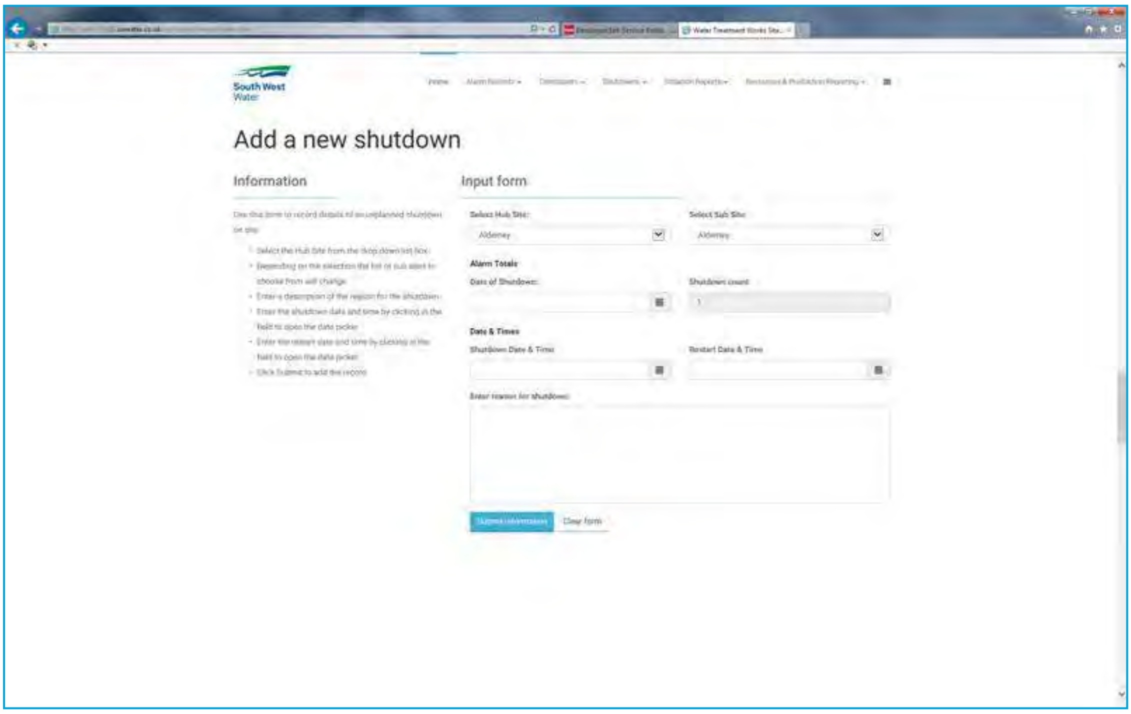
The tool will be extended to include the status of resource assets such as river intakes and boreholes to provide a long term data capture mechanism underpinning an annual outage report which will inform maintenance programmes and investment strategies. In particular, this tool will provide a robust record of the nature of asset interruptions and their consequences which we will integrate into our future WRMP annual reviews.

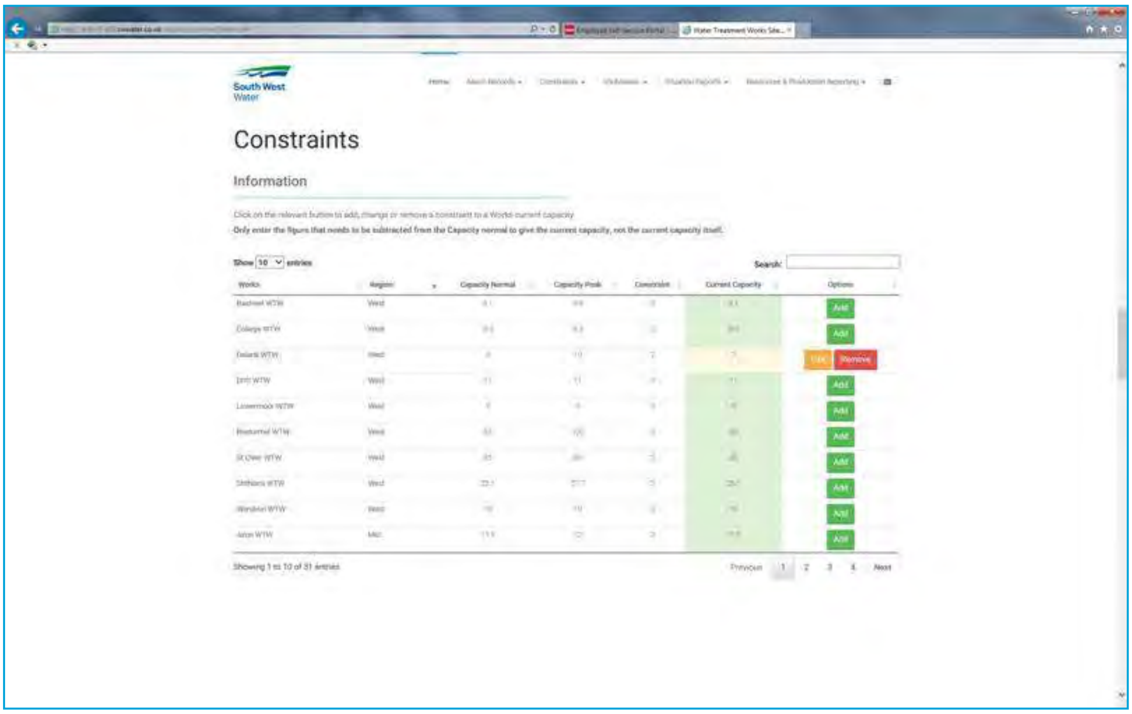
Figure A.2.5: Screenshots of new outage information tool



South West Water Bournemouth Water


South West Water
Add a new alarm record
Information
Input form
Alarm Totals
Passed out alarms - enter total for each reason


South West Water
Add a new shutdown
Information
Input form
Alarm Totals
Date & Times


South West Water
Constraints
Information
Click on the relevant button to add, change or remove a constraint to a Works current capacity
Only enter the figure that needs to be subtracted from the Capacity normal to give the current capacity, not the current capacity itself.
Show 10 entries
Search:
Works
Region
Capacity Normal
Capacity Peak
Constraint
Current Capacity
Options
Add
Remove
Showing 1 to 10 of 31 entries
Previous
1
2
3
4
Next

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.

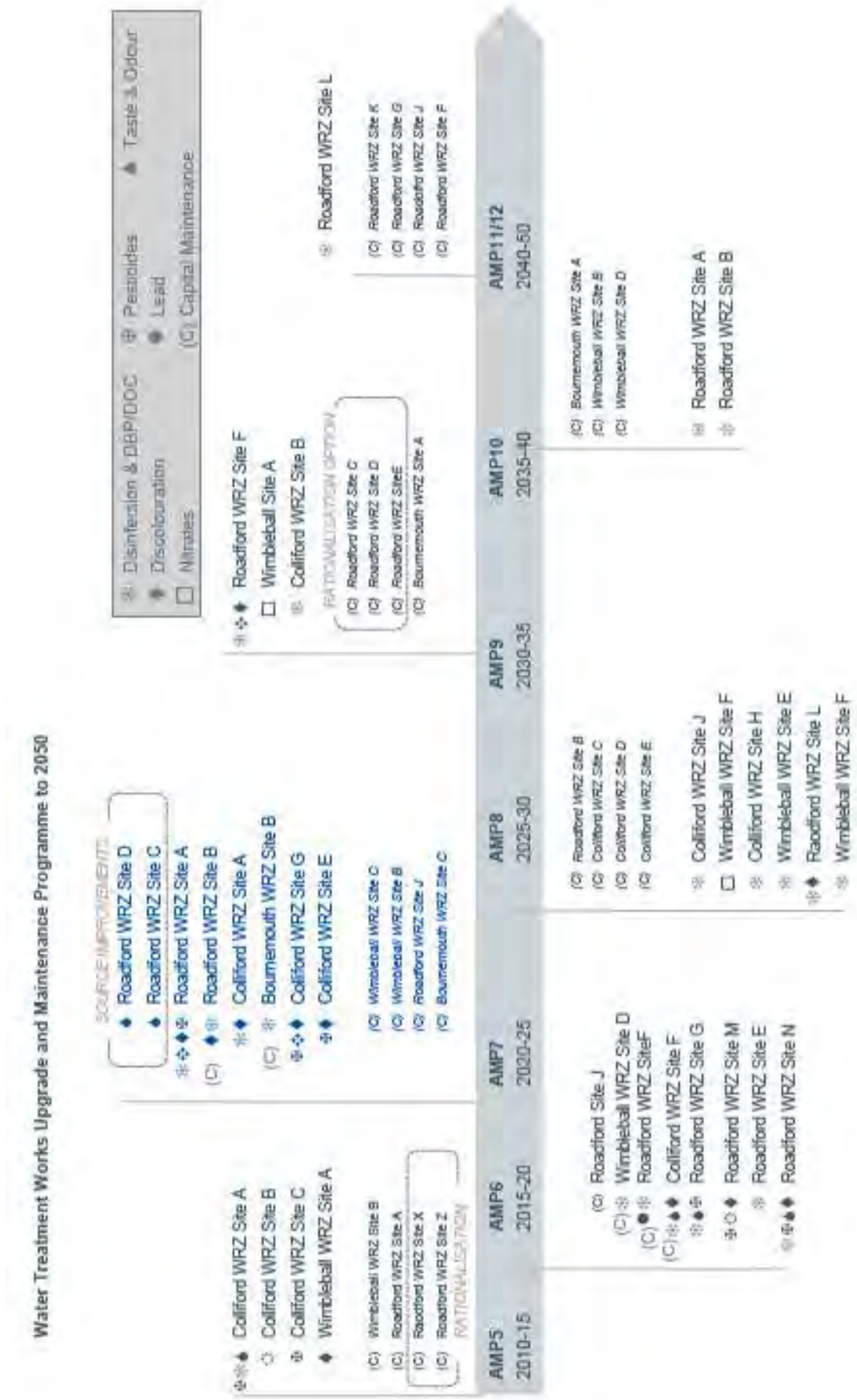
I hope you will appreciate that we are still in the process of developing our PR19 Business Plan, which includes technical assurance of water quality programme. Therefore, we envisage this document evolving as we proceed towards finalising our investment plan.

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

Figure A.2.6: WTW upgrade and maintenance programme to 2050



South West Water
Bournemouth Water

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.

[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*

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
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

Site Name	Water Resources Zone
Lopwell River Intake	Roadford
Wistlandpound Reservoir	Roadford
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 (i.e. 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 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 Background

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 Environment Agency 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 Ofwat guidelines

OFWAT guidelines[A.2.6] explain the approach water companies should take when developing AIM schemes. They define the steps companies should take as:

- 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
- 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

[A.2.6] Ofwat (2016), *Guidelines on the abstraction incentive mechanism.*

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 Environment Agency has requested that SWW enter into discussions with the Environment Agency 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 Environment Agency 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.2.7). 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.

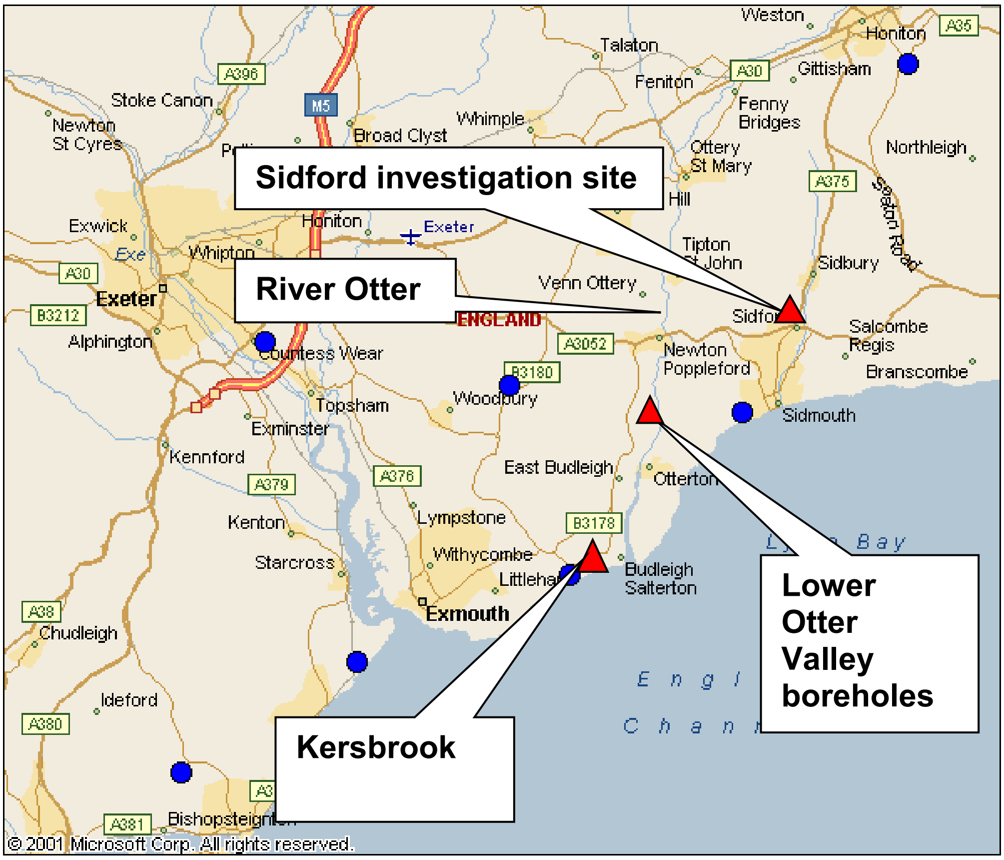
Giving preference to sources within the Otter Valley, which have no, or a lower, impact on river flows

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.2.7). 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.2.7: Key abstraction sites in the Otter Valley linked to a potential AIM scheme



A.2.5.6 Capturing abstraction data at each AIM site

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.

A.2.6 Historical drought drawdowns

We use a behavioural simulation model to test and understand the operation of our system to dry weather events. The charts in Figures A.2.8 to A.2.10 show the predicted response of the strategic reservoirs to a past dry weather event. This shows the drawdown relative to the control curves.

Figure A.2.8: Predicted drawdown response of Colliford Reservoir to historic 1975-1978 dry weather event

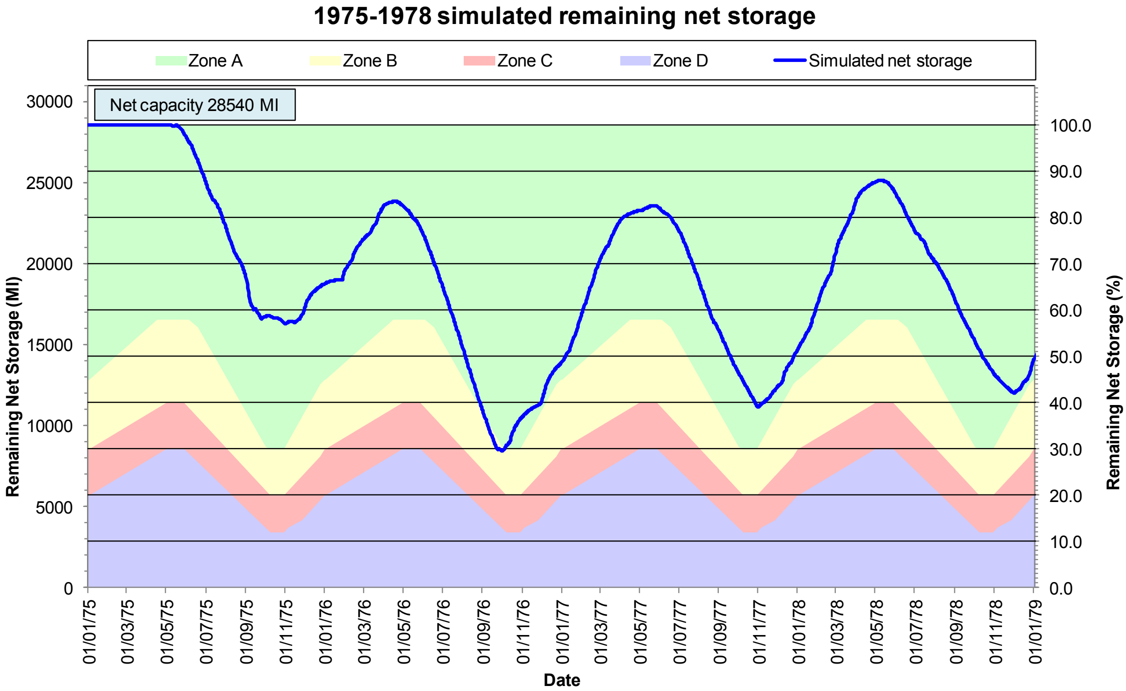


Figure A.2.9: Predicted drawdown response of Roadford Reservoir to historic 1975-1978 dry weather event

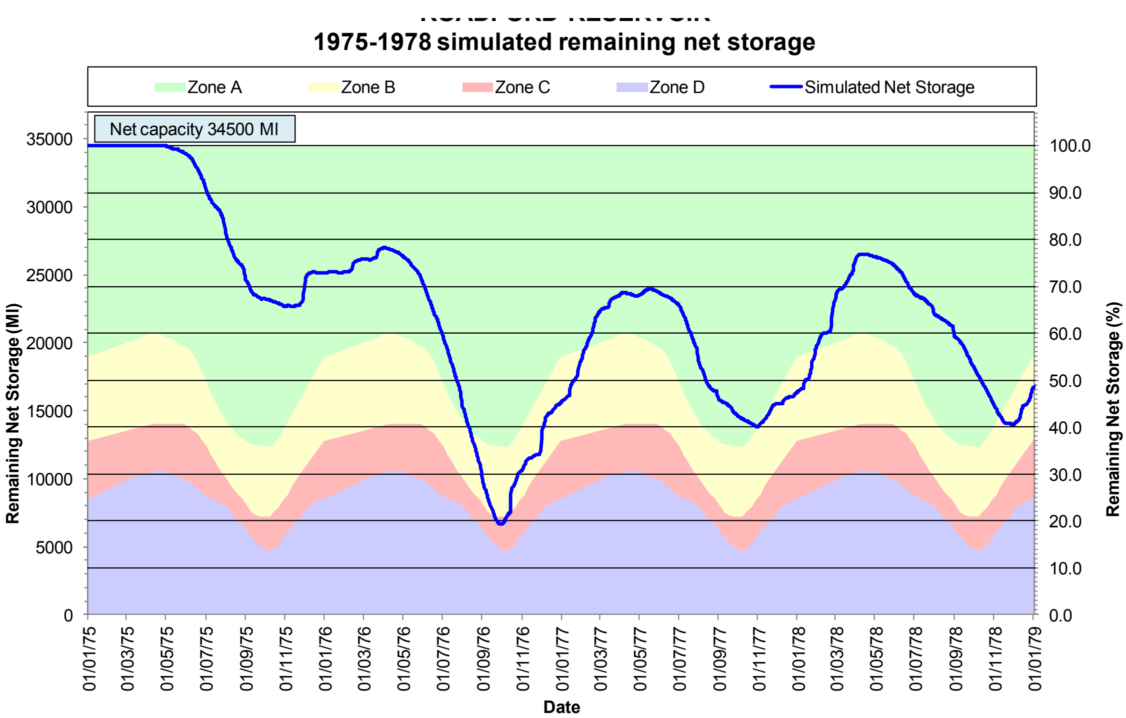
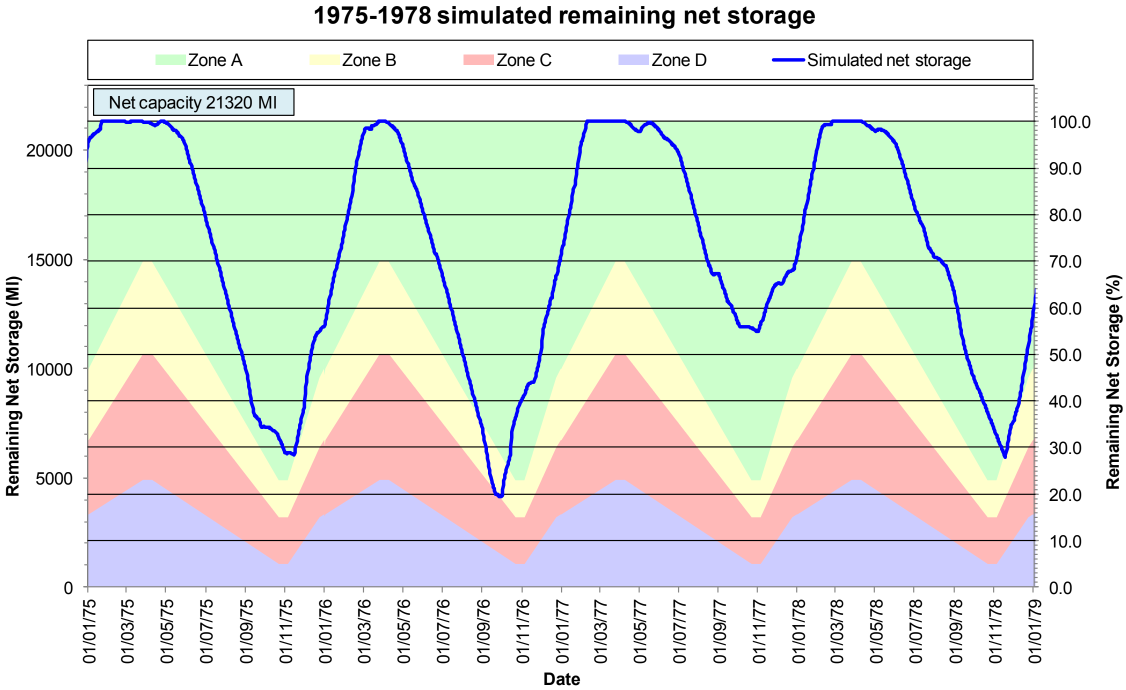


Figure A.2.10: Predicted drawdown response of Wimbleball Reservoir to historic 1975-1978 dry weather event



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

Update of HHCF to AR18 reported figures

FINAL

AR1221

29th June 2018

Report title:	**Update of HHCF to AR18 reported figures**
Report number:	**AR1221**
Date:	**29th June 2018**
Client:	**South West Water**
Author(s):	**Sarah Rogerson, Dene Marshallsay**

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Executive Summary

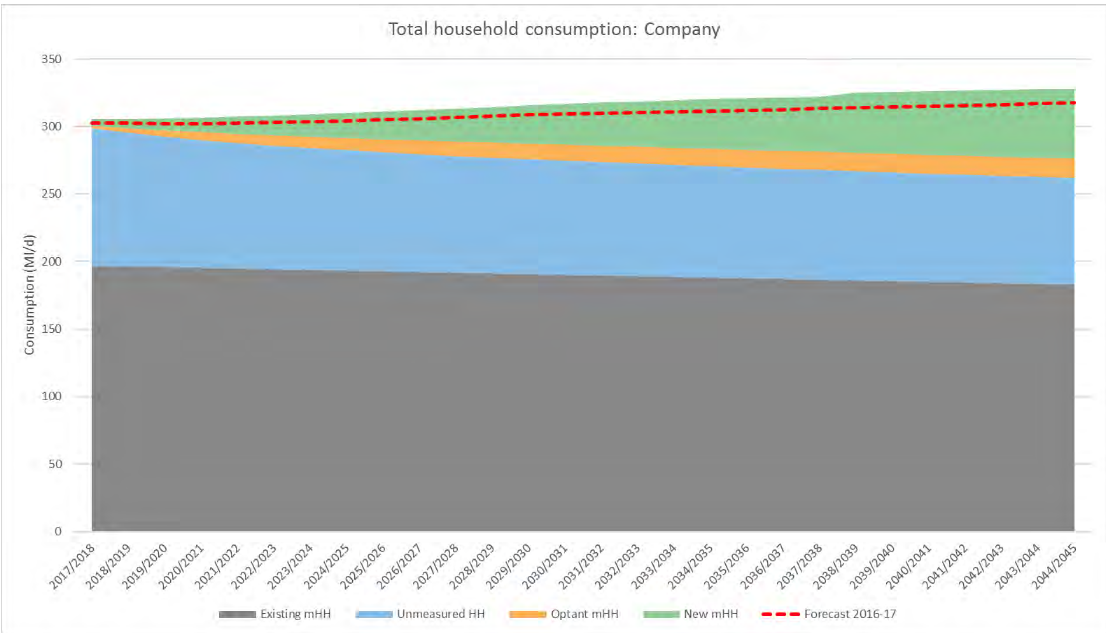
Since the draft submission of the Water Resource Management Plan 2019 (WRMP19), South West Water (SWW) has contracted Artesia Consulting to update the base year to match the figures reported for annual returns AR18, which covers the reporting year from April 2017 to March 2018. The property and population forecasts have also been updated, and these will be included in the AR18 update.

Updating to the latest reported figures causes slight increase in the baseline. This is firstly due to the base year figures deviating away from the previous forecast, and secondly the update to the population and properties have caused the total company consumption for slightly increase.

Total forecast (Ml/d)	2017-18	2044-45
Forecast 2016-17	302.69	317.54
Forecast 2017-18 (without population and property update)	305.21	322.01
Forecast 2017-18 (with population and property update)	305.21	327.94

After an assessment of the potential reasons and implications of the changes between the forecast for 2017-18 and the new reported figures there has been a slight shift upwards in the forecast. Weather data and summer distribution input data (DI) were assessed, and the difference is largely due to interaction between a shift in a few commercial properties to domestic. The reported properties numbers are therefore slightly higher than the previous forecast. Population has been calculated separately, which gives an apparent slight change in occupancy, so that when consumption is divided by the population the reported per capita consumption is slightly higher. The additional properties have been validated by SWW, and no further changes of this manner are expected, therefore the method for using the historic trend in PCC cannot be used to calculate a normal year factor. No normal year factor is applied, and this is validated by assessing the summer DI.

This approach provides South West Water with a resilient forecast, which has considered the changes which were not apparent at the time of the 2016-17 forecast.



		AMP6			AMP7	AMP8	AMP9	AMP10	AMP11
Company Consumption (Ml/d)		2017/2018	2018/2019	2019/2020	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
Total company	AR18 Baseline	305.33	305.63	306.05	309.96	315.78	320.26	325.39	327.94
	AR17 Baseline	302.69	302.31	302.16	304.20	308.64	311.48	314.41	317.44
	% difference	0.87%	1.10%	1.29%	1.89%	2.31%	2.82%	3.49%	3.31%
Company PHC (l/prop/day)		2017/2018	2018/2019	2019/2020	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
Total company	AR18 Baseline	322.17	319.34	316.76	306.75	299.44	292.06	284.97	278.32
	AR17 Baseline	324.01	321.05	318.45	308.86	302.86	296.74	291.03	285.35
	% difference	-0.57%	-0.53%	-0.53%	-0.68%	-1.13%	-1.58%	-2.09%	-2.46%
Company PCC (l/head/day)		2017/2018	2018/2019	2019/2020	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
Total company	AR18 Baseline	144.30	143.27	142.59	139.83	138.31	137.55	134.96	132.97
	AR17 Baseline	142.18	141.27	140.50	137.62	136.14	134.33	132.69	131.13
	% difference	1.49%	1.42%	1.49%	1.61%	1.59%	2.39%	1.71%	1.40%

Contents

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1 Introduction

South West Water (SWW) asked Artesia to forecast total household consumption using the Annual Report value of consumption for 2017/18 as the base year of the forecast.

This forecast update reflects the changes between 2016/17 and 2017/18 of the properties, population and consumption figures reported. Also, the number of new metered properties; optants, new properties, and a movement of certain commercial properties to domestic based on an update of the classification of domestic properties.

As well as the base year reported figures being updated, in addition to this there is an update of the forecast number of properties and population throughout the forecast period to 2044/45.

This forecast assesses and accounts for a step change in the number of properties compared to the previous forecast and how this impacts the total domestic consumption, per household consumption and per capita consumption. Each of these components are inter linked and it is important to capture these changes within the base year in order to provide the most accurate forecast into the future to ensure water resilience by capturing changes which impact demand in the future.

2 Results

This section presents the results of the updated analysis, considering four specific areas:

- The difference in property numbers reported for 2017/18, compared to the previous forecast;
- The difference in population numbers reported for 2017/18, compared to the previous forecast;
- A higher per capita consumption (PCC) for 2017/18 compared to the previous forecast.
- The impact of the updated population and property forecasts.

2.1 Properties versus forecast

There is an increase in the number of new connections in AR18 compared to the previous forecast for 2017/18. Forecast new connections for AR18 were 7,452, actual new connections are 13,558 (a difference of 6,106). In 2017/18 a new tariff type was introduced for newly completed properties that were yet to be occupied. This new tariff type was included in measured household numbers (previously such properties didn't appear in counts), leading to an increase of around 6,000 in the number of reported measured households. This change has been considered and as this method of property assessment will remain consistent with this revision, it is correct to amend the property forecast to include these additional properties.

2.2 Population versus forecast

There is a slight decrease in the population in AR18 compared to the previous forecast for 2017/18. Forecast total residential population was 2,128,926, and the reported AR18 population is 2,115,972 (a difference of 12,953, or 0.6%). The reason for this decrease is due to an update of the ONS population estimates.

The step change seen is to be treated as a re-basing step, and as such the base year figures will be updated, and the previous figures can be discarded. As well as updating the base year figures the forecast has also been updated which should negate this step change from occurring in future years.

2.3 Higher per capita consumption than forecast

Figure 1 and Figure 2 show measured and unmeasured household per capita consumption, as reported by South West Water from 2005-2018. The reported value for 2018 (i.e. AR18) is the blue dot on the right-hand side of each graph.

Figure 1 **Measured household PCC 2003-2018**

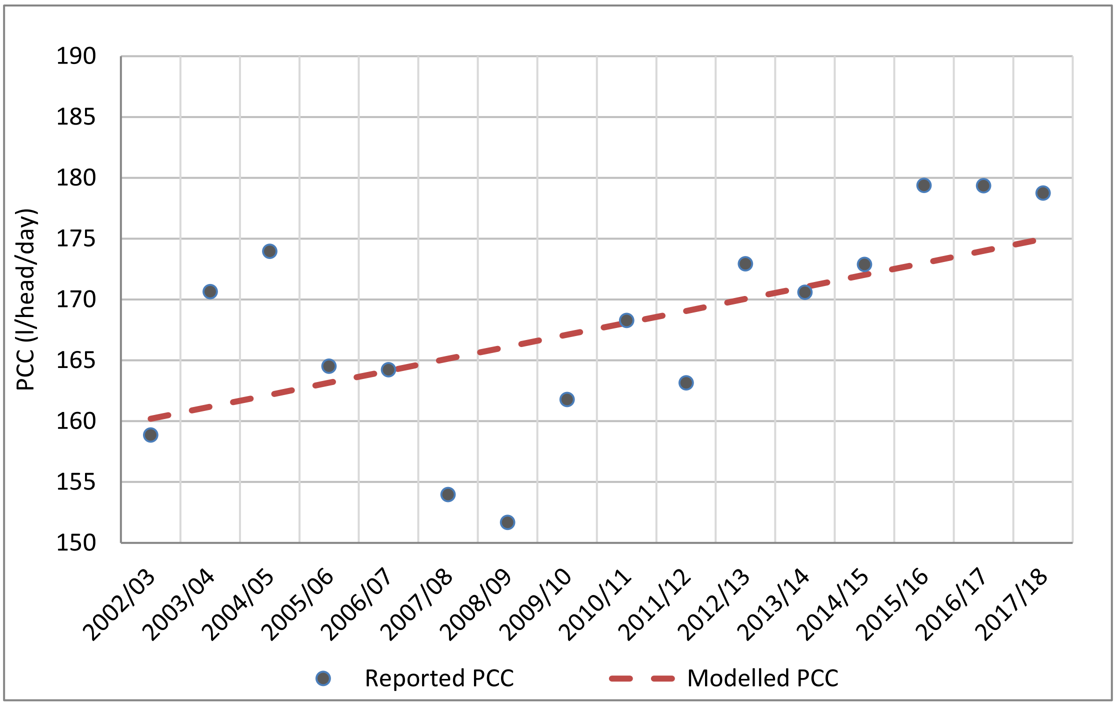

Figure 2 **Unmeasured household PCC 2003-2018**

These plots also show the normal year trend line for measured and unmeasured. In figure 2, the unmeasured PCC appears quite consistent with the historic trend line. However, this is not the case for the measured PCC. The trend line predicts a decreasing mPCC over time. The SWW only points in green must be used to analyse the trend to maintain a consistent dataset. The 2017/18 point deviates from the trend line more significantly than other years, and would indicate that a larger normal year adjustment is needed.

Further analysis was carried out to determine the cause of the deviation away from the trend. It is important to establish this fact to know whether to amend the trend or to treat the change and as a shift.

Firstly, AR18 demand was assessed as to whether it is a dry year, as illustrated in Figure 3.

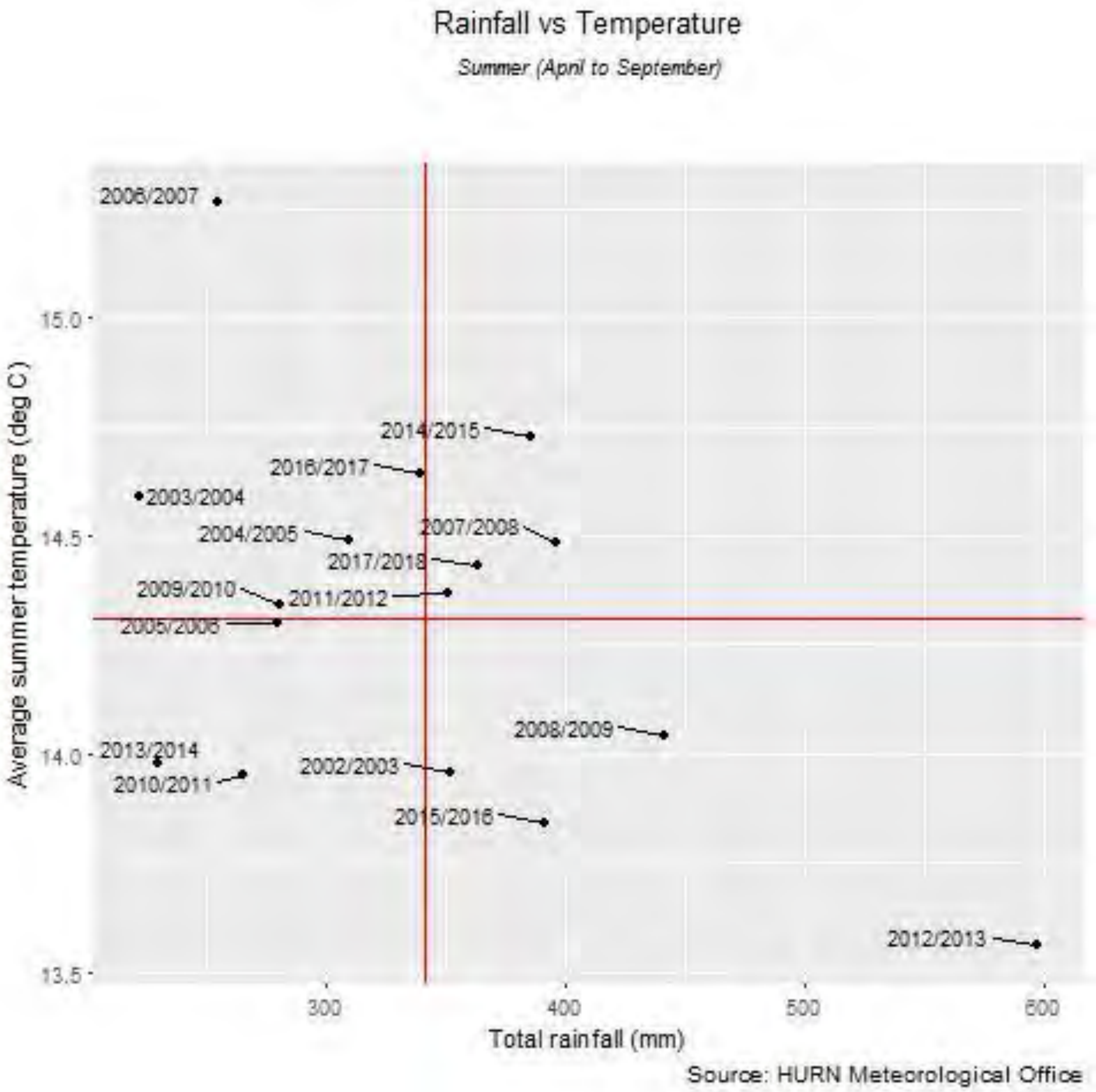

Figure 3: Quadrant analysis of rainfall versus temperature – summer period

Dry year analysis assesses if the weather during the summer had higher than expected temperature and lower than expected rainfall. The summer of 2017 – which impacts the AR18 figure is close to but not within the Dry year quadrant. The rainfall for the summer of 2017 is slightly higher than average rainfall and the mean summer temperature is slightly higher than average. Therefore 2017/18 is not considered a dry year and the relatively high consumption rates reported in AR18 must be being impacted by other factors.

For this reason, the historic weekly DI has been assessed, as illustrated in **Error! Reference source not found.**4.

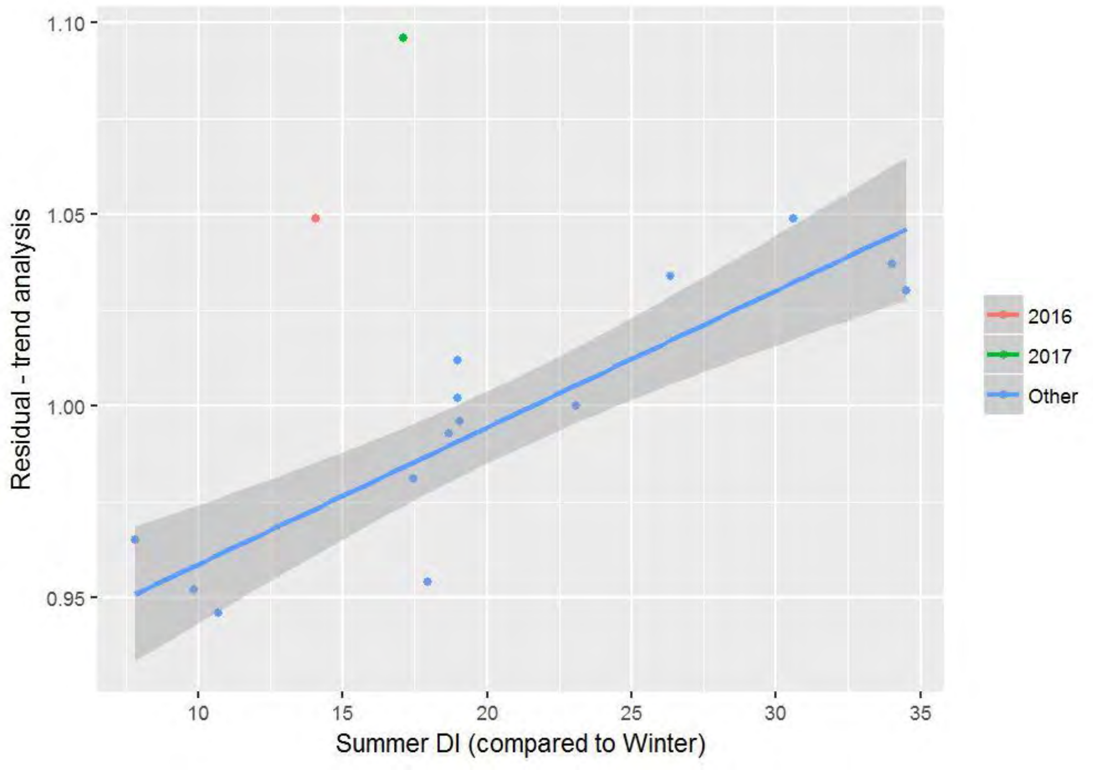

Figure 4 Comparison of summer DI and PCC trend residual

Figure 4 correlates the summer DI and residual around the trend of PCC. The figures displayed on the x-axis are summer DI figures normalised by winter DI, to ensure that residual leakage does have an impact on the summer consumption. The y-axis figures are the residual of the reported figure compared to the trend line, figures greater than 1 indicate that the reported PCC was higher than expected. Both the 2016-17 and 2017-18 are outliers from the previously very tight correlation (0.89). The 2016-17 PCC figure includes the Bournemouth water (BW) consumption, so it is expected that it might deviate. Figure 1 shows that the PCC for 2017-18 is very similar when BW is included or excluded, therefore another factor must be affecting the high PCC figure.

The conclusion from this analysis is that the demand has not shifted, the summer DI appears within a normal range, but the strong correlation between summer demand and PCC is not apparent.

2.4 Impact of updated properties and population

Considering the findings in section 2.3, in that the company summer DI, which is largely demand related, has not increased it appears abnormal that the PCC has increased. Therefore, we shift the focus back to the properties and population. Comparisons are made between the total consumption, per household consumption and per capita consumption. At the same time, we analyse the impact of the updated property and population forecasts.

Table 1 Changes in forecast between 2016-17 and 2017-18

		AMP6			AMP7	AMP8	AMP9	AMP10	AMP11
Company Consumption (Ml/d)		2017/2018	2018/2019	2019/2020	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
Total company	AR18 Baseline	305.33	305.63	306.05	309.96	315.78	320.26	325.39	327.94
	AR17 Baseline	302.69	302.31	302.16	304.20	308.64	311.48	314.41	317.44
	% difference	0.87%	1.10%	1.29%	1.89%	2.31%	2.82%	3.49%	3.31%
Company PHC (l/prop/day)		2017/2018	2018/2019	2019/2020	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
Total company	AR18 Baseline	322.17	319.34	316.76	306.75	299.44	292.06	284.97	278.32
	AR17 Baseline	324.01	321.05	318.45	308.86	302.86	296.74	291.03	285.35
	% difference	-0.57%	-0.53%	-0.53%	-0.68%	-1.13%	-1.58%	-2.09%	-2.46%
Company PCC (l/head/day)		2017/2018	2018/2019	2019/2020	2024/2025	2029/2030	2034/2035	2039/2040	2044/2045
Total company	AR18 Baseline	144.30	143.27	142.59	139.83	138.31	137.55	134.96	132.97
	AR17 Baseline	142.18	141.27	140.50	137.62	136.14	134.33	132.69	131.13
	% difference	1.49%	1.42%	1.49%	1.61%	1.59%	2.39%	1.71%	1.40%

Table 1 shows an increase in total company household consumption (2.64 Ml/d). This is largely driven by the addition 6,106 properties.

The decrease in PHC but increase in PCC is at first surprising, but these can both be explained at least to a degree by the decrease in occupancy. SWW provided PCC figures, property and population figures. Considering PHC is calculated by multiplying PCC by occupancy, if the occupancy is lower than expected then it is not unexpected that the PHC would be lower than expected.

If per household consumption were held flat but the occupancy has decreased (caused by the higher property numbers and lower population numbers) the PCC would be higher. Equally, if the PCC was held flat but the occupancy was reduced then the PHC would decrease.

Regardless of these differences, we are confident that the consumption in 2017-18 was not usually high, and the changes in classification of the commercial properties will not revert. Even if there are some fluctuations in the population and occupancy figures, the base year figure should not be adjusted from the current position.

Since the 2016-17 forecast there has been further work on the property and population forecasts, and these have been input into the forecast. The difference of 2.6 Ml/d in the base year caused by the updates converts to a 4.47 Ml/day increase in the final year of the forecast 2044-45. With the addition of the new property and population forecasts on top of this we get an addition 5.2 Ml/d increase in the final year of the forecast.

Table 1 shows the impacts of both the base year updates and the property and population forecast updates to the household consumption forecast.

In the final year of the forecast, household consumption is now forecast to by 327.94 Ml/d which is 9.67Ml/d higher than the previous forecast. PHC has gone down from 285.35 to 278.32 (l/property/day), and the PCC has increase slightly from 131.13 to 132.97 (l/head/day).

The DYAA household consumption (Ml/d) is shown in Figure 5. The red dotted line indicates the previous forecast so that a direct comparison can be made. The changes in the base year are quite negligible, but over the forecast the updated forecast increases at a slightly higher rate. This is almost entirely driven by the changes in the properties and population in the base year and updated forecasts.

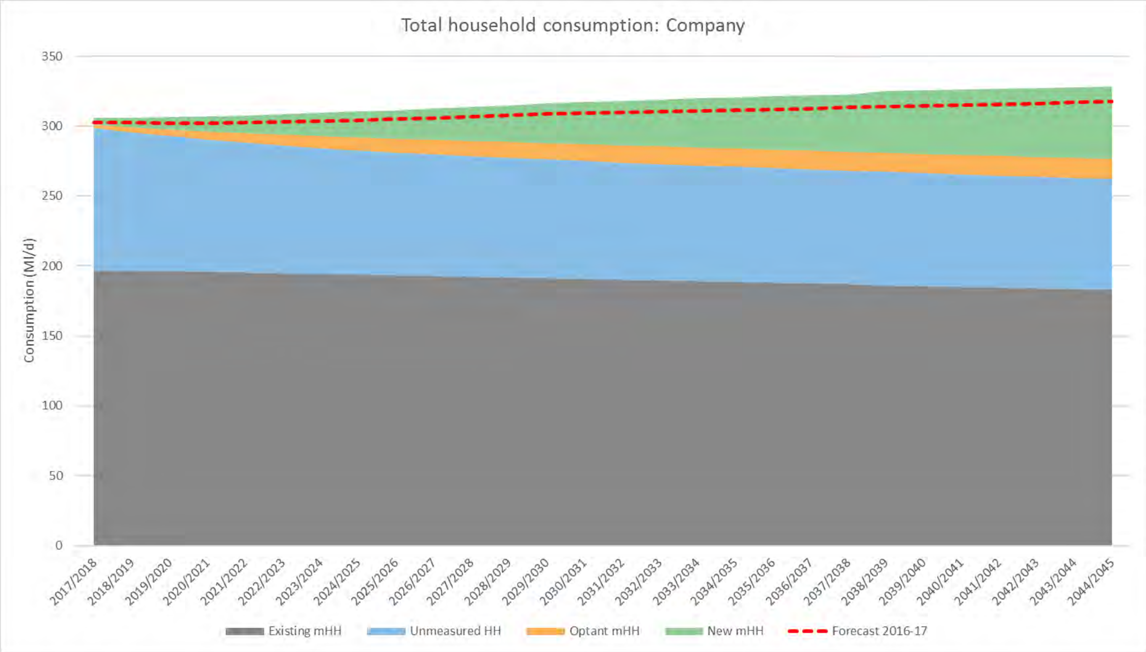

Figure 5 **DYAA Household consumption forecast (Ml/d)**

Whilst there is an increase in the forecast demand, the new base year and the full length of the forecast are well within the uncertainties calculated around the 2016-17 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.

servelec technologies

CONFIDENTIAL

03 July 2018

Non-household demand forecasting

Final report

South West Water

South West Water

J1827\GD004\05

Version: 5

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Revision History

Version	Date	Description
1	28 June 2017	First issue
2	15 September 2017	Final issue for draft Water Resources Management Plan
3	20 November 2017	Redactions for public domain publication
4	29 June 2018	Update to include additional datasets; climate change section added
5	03 July 2018	Update to DYAA graph

Author	Reviewer 1	Reviewer 2	Reviewer 3	Approver
Sorour Shamshiri	Julian Rickard	Alan Cunningham		Alan Cunningham

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 Water Resources Management Plan (WRMP) that is currently in development requires forecasts for the period to 2045.

SWW has asked Servelec Technologies 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 period January 2007 to January 2018
- 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
- 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
- UK Climate Projections data produced in 2009, funded by a number of agencies led by Defra (UKCP09)

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 values between 2% and 4% were added in each year based upon the water balance
- 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 onwards in the Bournemouth region were significantly reduced due to the reassignment of some properties to households.

Values of 3% in the Devon and Cornwall region and 5% in the Bournemouth region were previously estimated for the factors other than MUR. However, recent data suggests that the gap between the estimate obtained from the billing data and the water balance total has narrowed in the Devon and Cornwall region, as shown in Figure 1. The results in subsequent sections for the Devon and Cornwall region exclude this adjustment.

The consumption in the Bournemouth region prior to 2016-17 has been adjusted to reflect the reassignment of properties to households. The results in subsequent sections include the reassignment adjustment, but exclude the previously calculated adjustment.

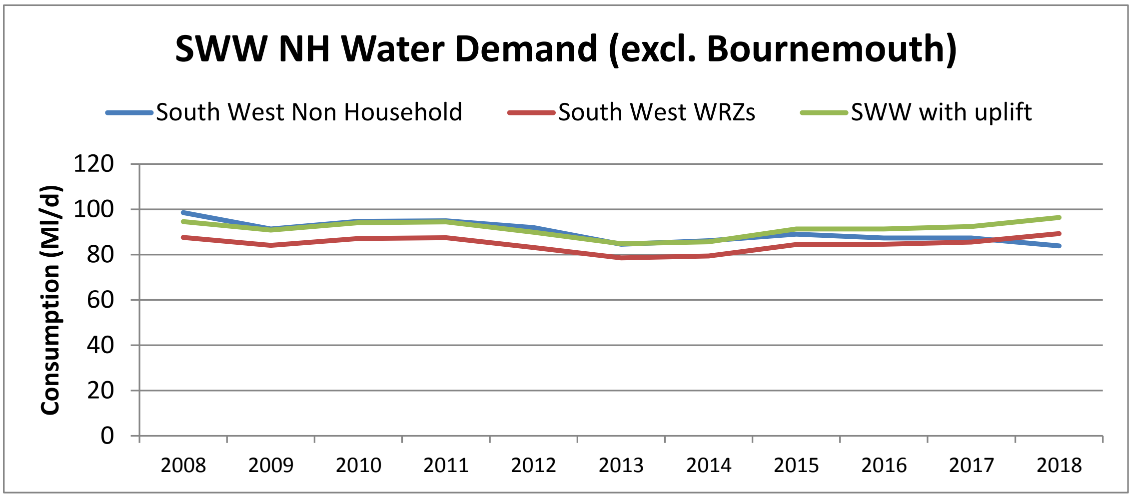


Figure 1: Historical Non-Household Demand in the Devon and Cornwall region

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.

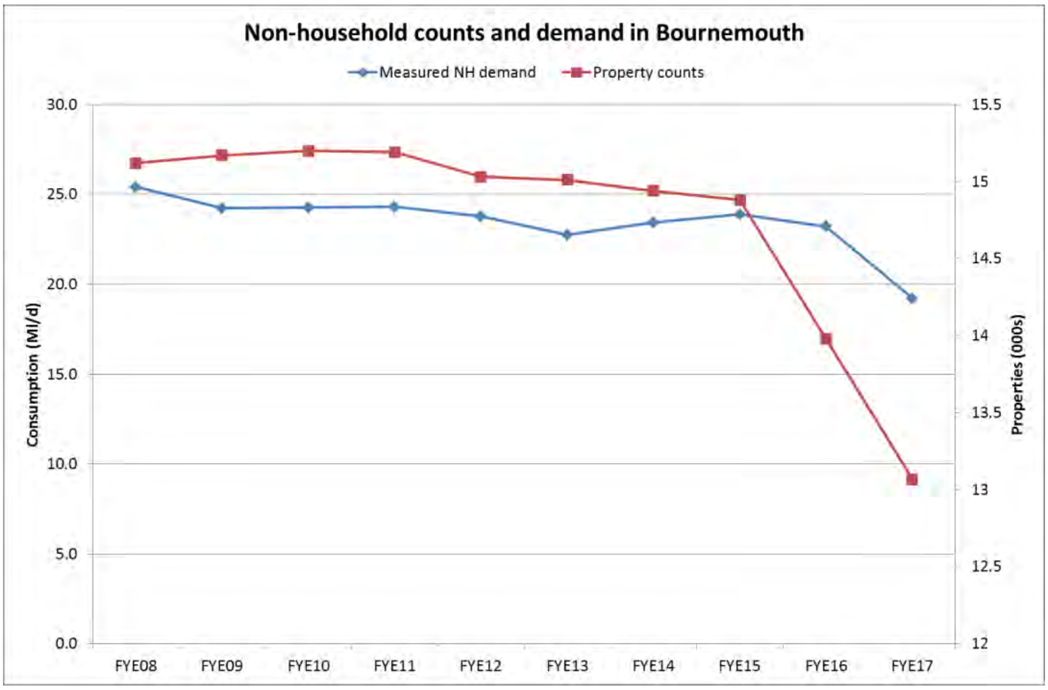


Figure 2: Measured non-household counts and demand in BRM

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.

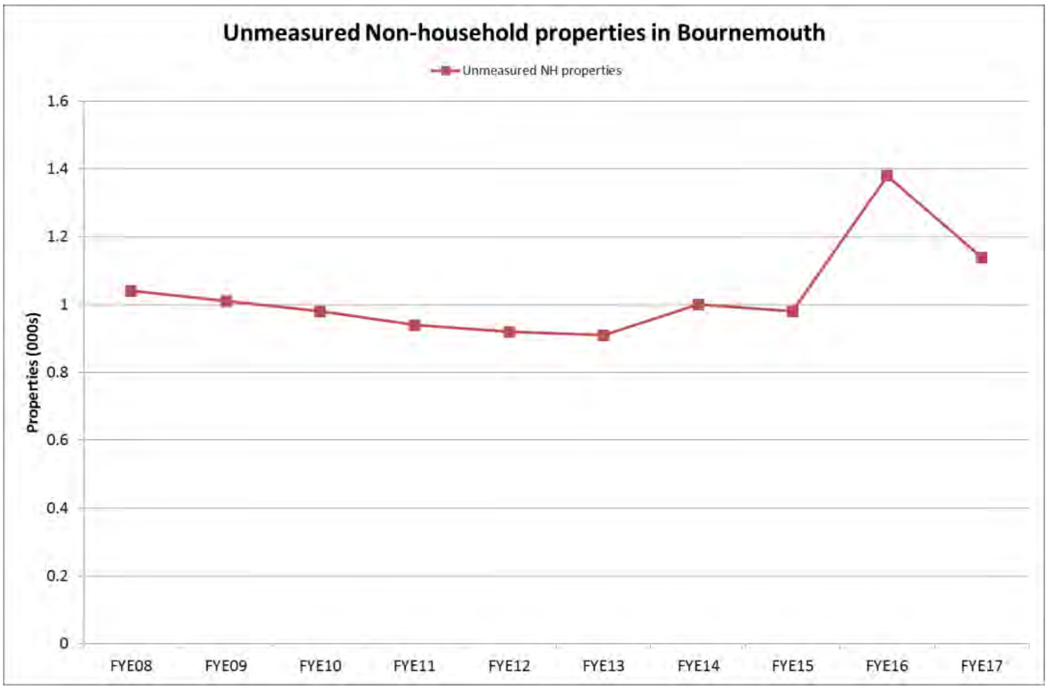


Figure 3: Unmeasured NH counts in BRM

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.

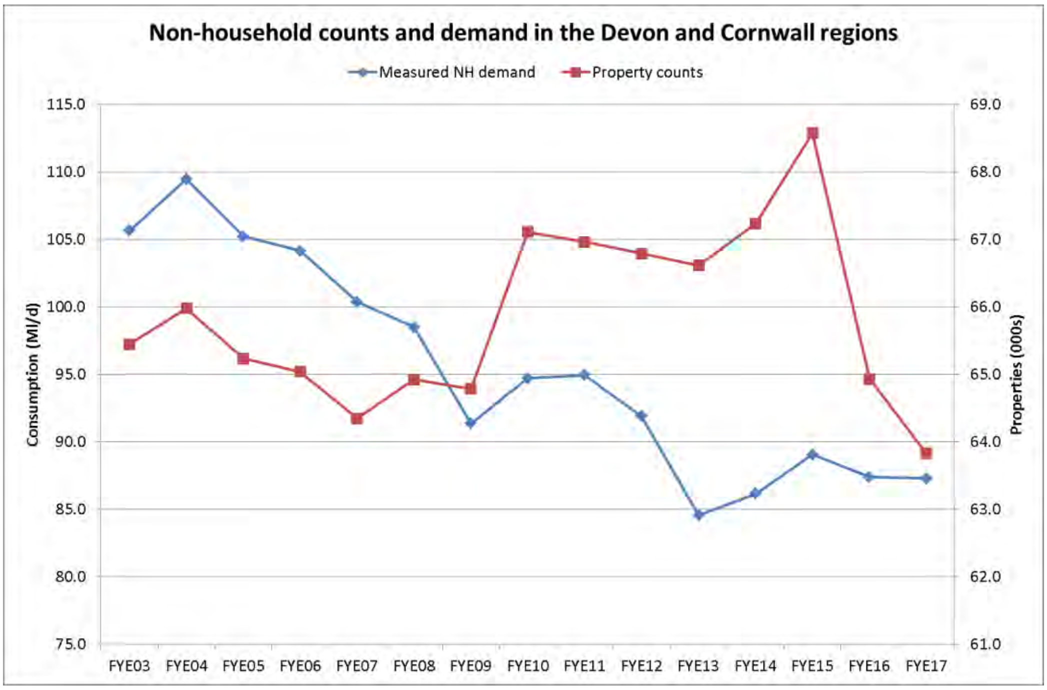


Figure 4: Measured non-household counts and demand in the Devon and Cornwall regions

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 individual 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.

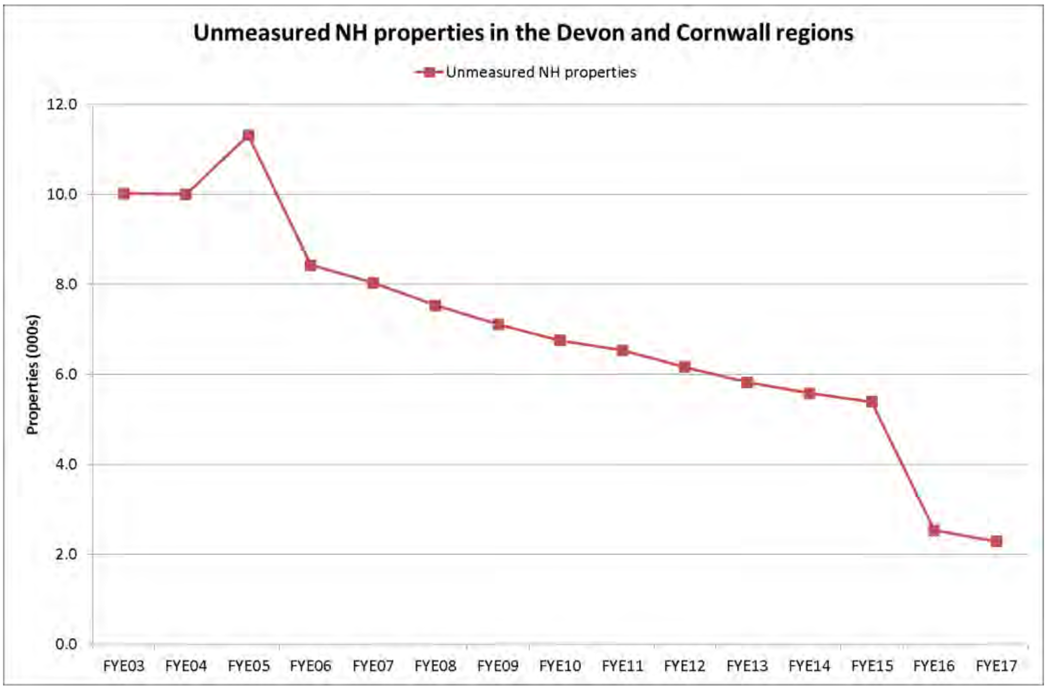


Figure 5: Unmeasured NH counts in the Devon and Cornwall regions

5. Unmeasured non-household demand

Limited information is available regarding unmeasured non-household demand. Recently, many properties were reclassified as households and unmeasured non-household demand for 2017-18 is currently estimated at approximately 2 Ml/d for the Devon and Cornwall region and 1 Ml/d for the Bournemouth region. 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 were to be 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. No such adjustments have been assumed in this analysis.

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 generally 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. Further details for individual RZs are given in the sections below.

6.2.1 Bournemouth

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).

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 represent approximately 7.6% and 7.1% respectively of the total demand in Bournemouth. The proportion has been relatively similar during recent years.

6.2.2 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[1] 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 is currently approximately 4 Ml/d (14% of the total demand in Colliford). This is a notable increase from a proportion of 9% in 2008.

[1] Water Into Supply Zone

6.2.3 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 is currently approximately 3.5 Ml/d (9% of the total demand in Roadford). This is a decrease from a proportion of 13% in 2008.

6.2.4 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.

There is a step change in the Unknown sector within Wimbleball due to a single property in Willand (WIS 610) that starts in 2017. This appears plausible given the presence of a large food processing plant within that area.

The total demand from the top ten highest consumption customers is currently approximately 2.2 Ml/d (13.5% of the total demand in Wimbleball). This is a slight increase from a proportion of 12% in 2008, but a decrease from a proportion of 16% in 2013.

6.3 Treatment of the Unknown sector

The demand from properties without a known sector was individually forecast in each of the resource zones. 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 approximately 4% of the current total demand, 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 will continue. Additional demand management initiatives that may potentially be introduced as part of the WRMP would require an adjustment to the forecasts. No such adjustment has been made in this analysis.

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.

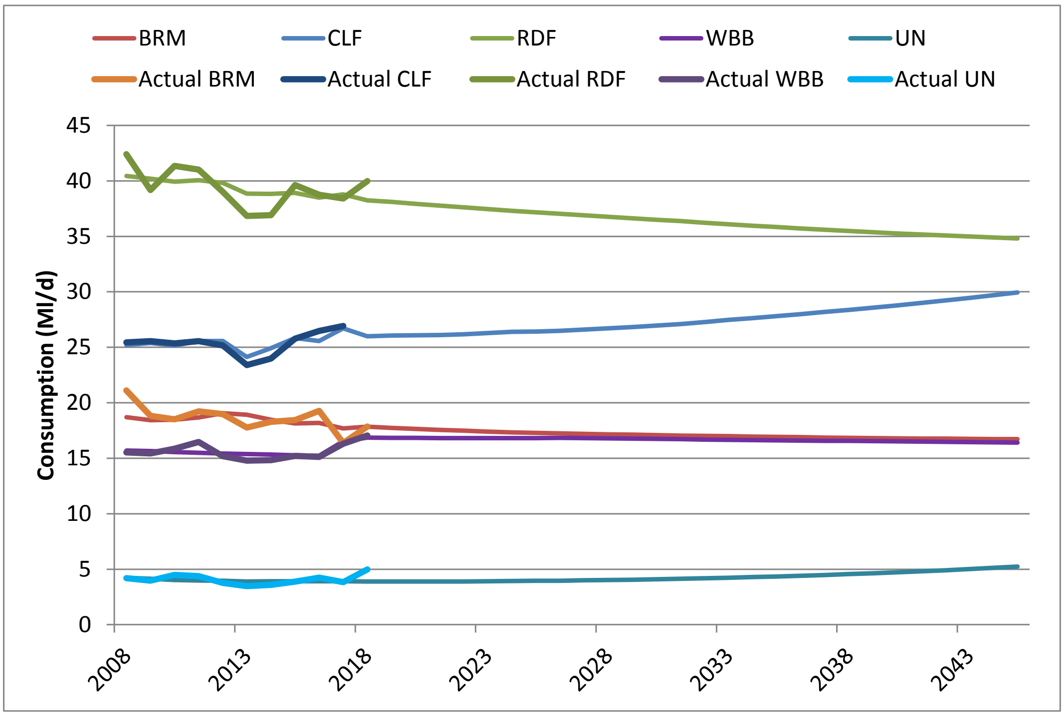


Figure 6: Non-household demand forecast at zonal level

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

[2] The notation FYE08 is used to denote the Financial Year Ending 2008 (i.e. April 2007-March 2008)

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 Appendix A.

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 following trends are observed for the different sectors:

- Service sector (approximately 83% of demand in 2018, excluding the high consumption customer): The average demand from all service sectors is forecast to decrease. Only in the professional and business services sectors (Serv2) is demand forecast to increase. Demand from the remaining service sectors is forecast to decrease
- 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. The alternative model has only been used for comparison of the results as it does not account for trends in individual industries.

7.2 Colliford - CLF

The overall demand in Colliford is forecast to be increasing. The following trends are observed:

- Service sector (approximately 69% of demand in 2018): The overall demand from service sectors is forecast to increase. Of the component sectors, only demand from professional and business services (Serv2) is forecast to reduce.
- Non-service sector: Demand from non-manufacturing sectors including agriculture (NServ1) is forecast to decrease, whereas demand from the remaining non-service sectors is forecast to increase.
- Demand from the unknown sector is forecast to decrease and remain small relative to the other groups.

An alternative model at resource zone level was also used for comparison. The two models show close agreement.

7.3 Roadford - RDF

The overall demand in Roadford is forecast to steadily decrease. The following trends are observed:

- Service sector (approximately 73% of demand in 2018): The overall demand from service sectors is forecast to remain relatively constant. Demand from sectors involving professional services is forecast to remain relatively constant, demand from education and health is forecast to decrease, and demand from the remaining sectors is forecast to increase

- Non-service sector: Demands from the non-service sectors are forecast to decrease, particularly in manufacturing (NServ2)
- Demand from the unknown sector is forecast to decrease.

An alternative model at resource zone level was used for comparison. The alternative model suggests a faster reduction in demand than the current model. However, this is considered to reflect a limitation of the alternative model, which does not separate out the differing trends in service and non-service sectors.

7.4 Wimbleball - WBB

The overall demand in Wimbleball is forecast to remain relatively constant. The following trends are observed:

- Service sector (approximately 66% of demand in 2018): The overall demand from service sectors is forecast to increase. Demand from professional and business services (Serv2) is forecast to decrease, with demand from the remaining service sectors increasing.
- Non-service sector: Demand from the non-service sectors is forecast to decrease
- Demand from the unknown sector is forecast to remain approximately constant at the recently observed level including the additional customer detailed in section 6.2.4.

An alternative model at resource zone level was used for comparison. The alternative model shows a broadly constant level of consumption, with a poor ability to model the recent increase in consumption driven by a single large customer.

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.

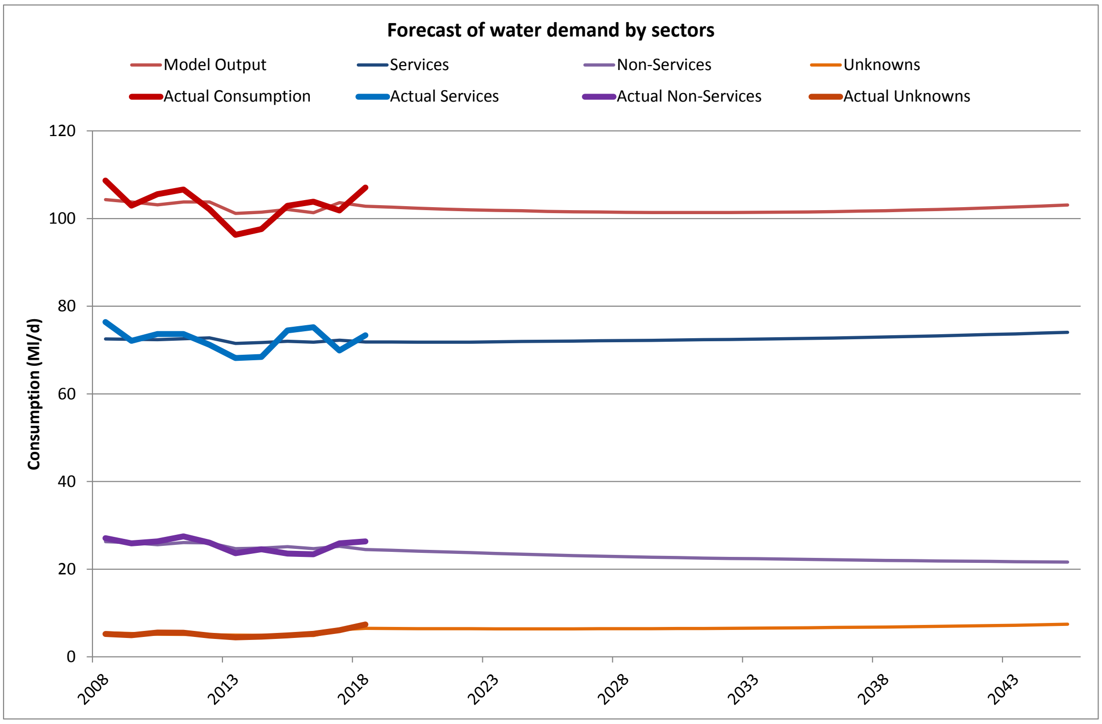


Figure 7: Model forecast for known and unknown sectors (excluding high consuming customer)

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 0.94% in 2019, with an average factor over the forecast period of 0.99%. 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.

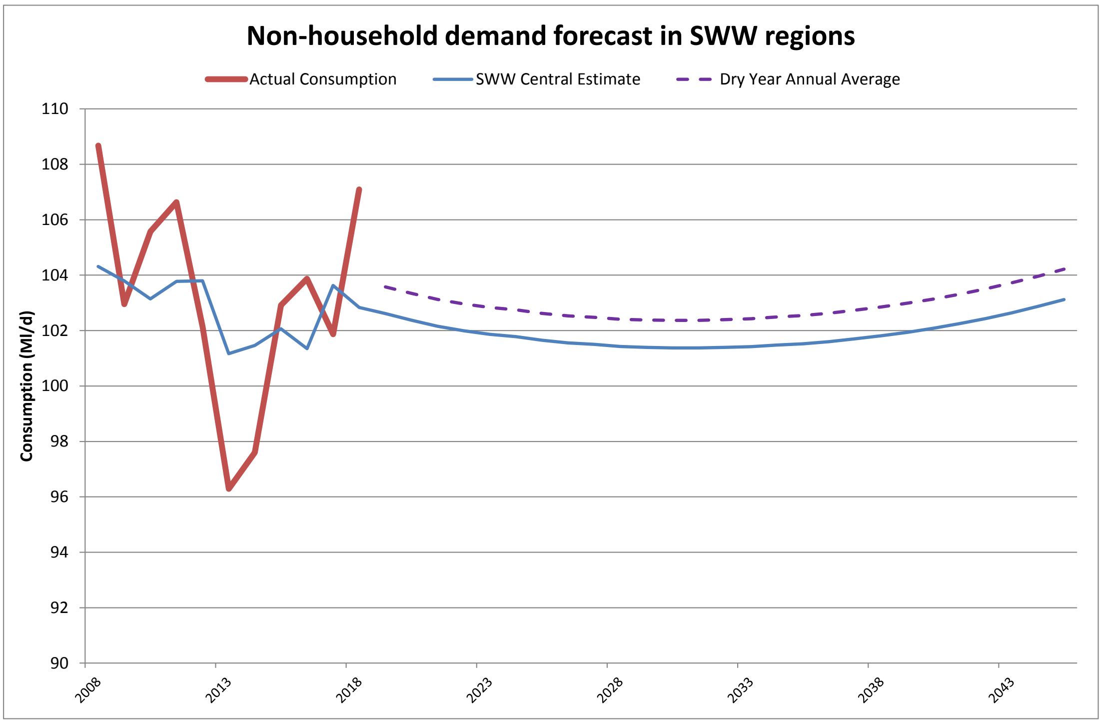


Figure 8: Normal Year and Dry Year Annual Average forecast in the SWW regions

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.

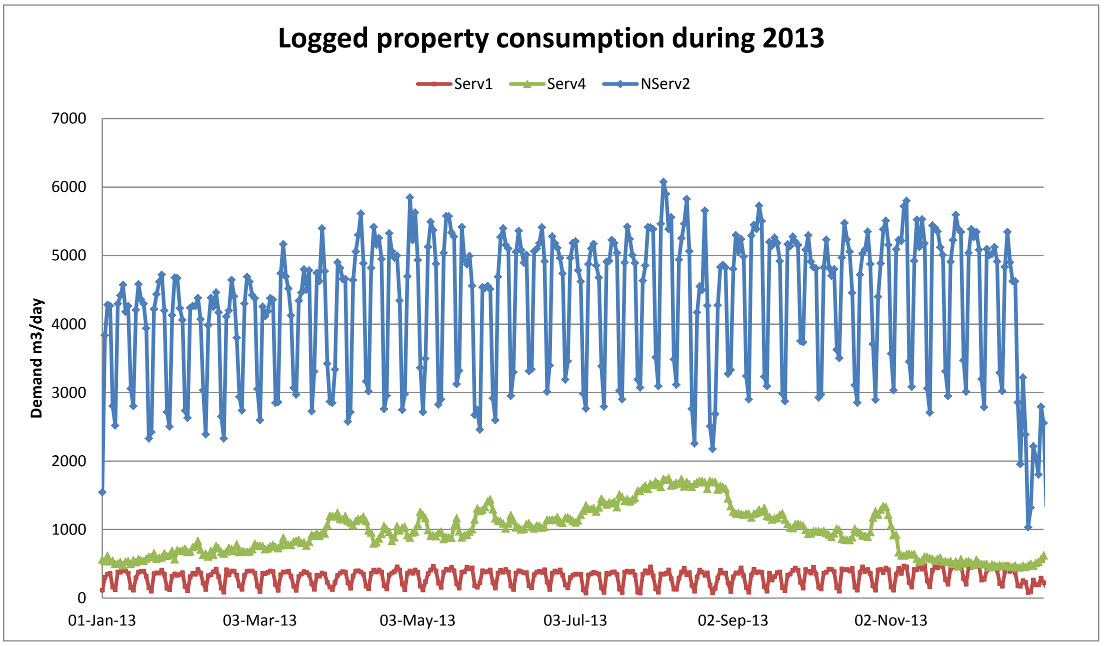


Figure 9: Logged property consumption split by industry sector

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.

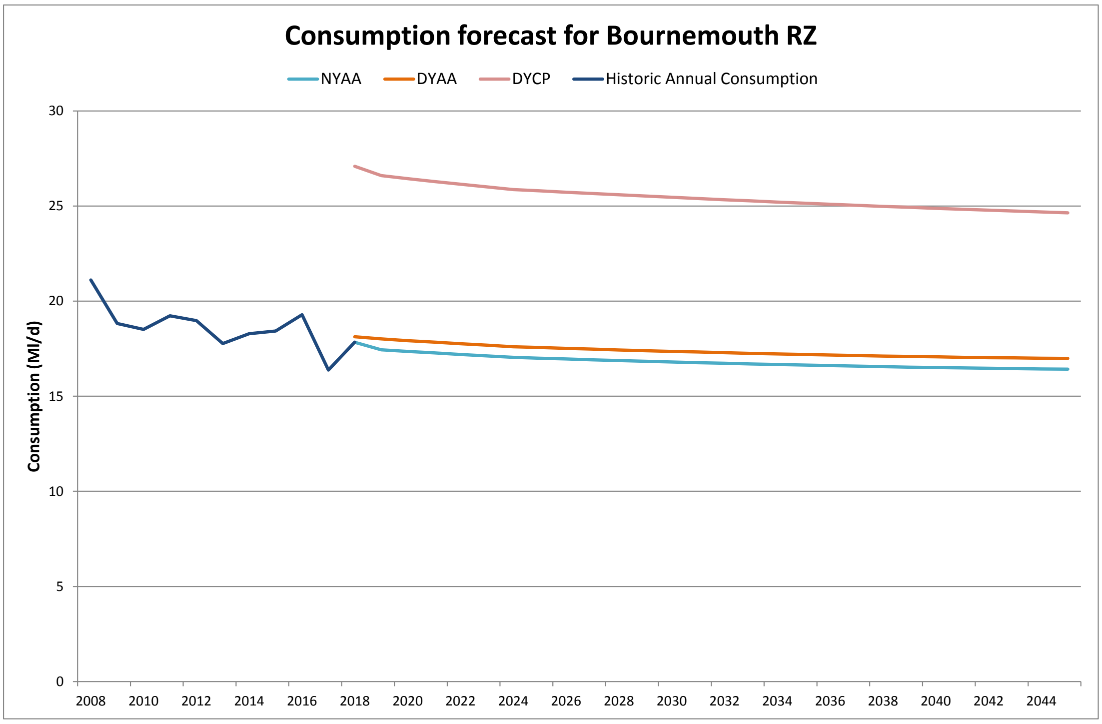


Figure 10: Consumption forecasts for Bournemouth RZ

9. Climate change

9.1 Approach

Data from UKCP09 provides projections of the change in mean precipitation for each of summer and winter for the South West England region. Values are provided for a set of emissions scenarios and the following time periods (relative to a baseline period of 1961-1990):

- 2010-2039 (referred to as 2020s)
- 2040-2069 (referred to as 2050s)
- 2070-2099 (referred to as 2080s)

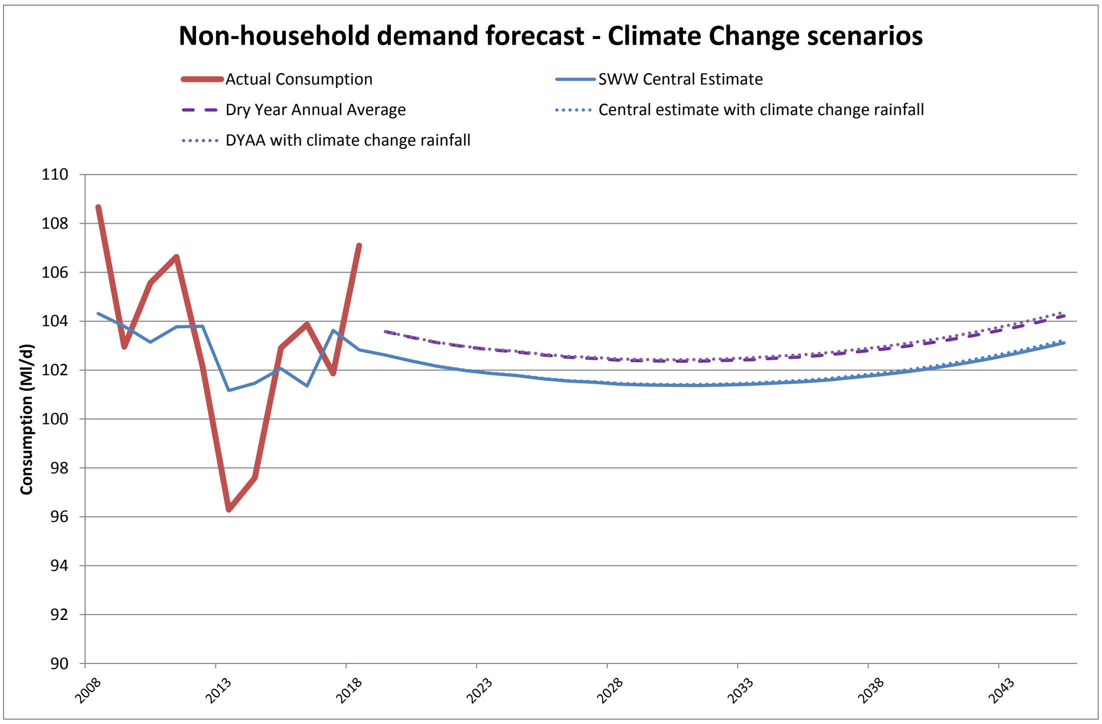
An annual rate of change to use for representing climate change within the demand forecasts has been derived using the difference between the projected 2020s value (approximately equivalent to the start of the WRMP forecast period) and the projected 2050s value (approximately equivalent to the end of the WRMP forecast period). The Medium emissions scenario has been used.

The projection suggests that rainfall in South West England will increase in winter and decrease in summer. It has been considered appropriate to exclude the winter increase from the rainfall input into the demand forecast model rather than allowing this to offset the summer reduction. There are a number of reasons for this:

- Water consumption is more sensitive to rainfall in summer than in winter
- For Dry Year scenarios, the net effect of changes in winter and summer precipitation may not be equal to the sum of the means
- The precipitation variable is the sole weather variable included in the demand forecast model; other climate change impacts such as increased temperatures in both summer and winter would be expected to increase consumption

9.2 Results

The graph below show what happens when the climate change adjustment is applied. The difference is negligible.



10. 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.

10.1 Impact of Open Water retail separation

Since April 2017 non-household customers in England have been able to choose who supplies their water and wastewater retail services. Two of the proposed benefits of the change were 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.

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.

10.2 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.

[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
[6] http://www.watercommission.co.uk/UserFiles/Documents/Grant%20Thornton%20CBA%20report%20December%202010.pdf

10.3 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.

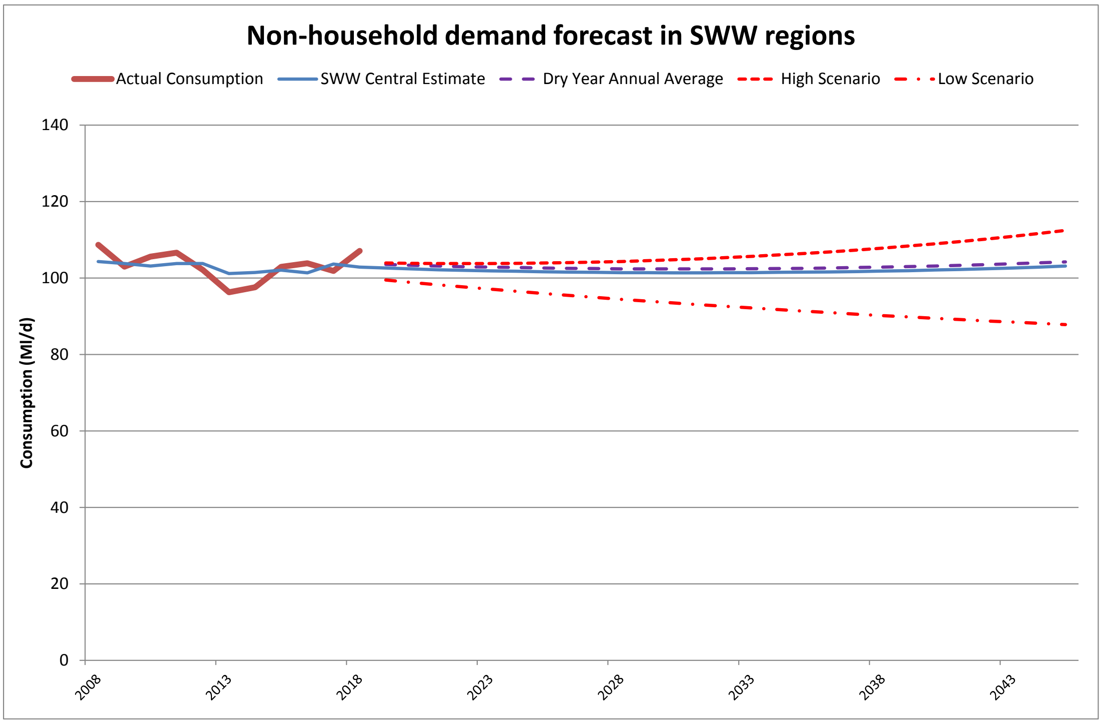


Figure 11: SWW Measured Non-household under high and low scenarios

11. Spreadsheet implementation of 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.

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.

12. 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 in the available 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 remain approximately constant over the forecast period.

[7] Spreadsheet reference J1827_GD003_03, dated 29 June 2018

Appendices

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

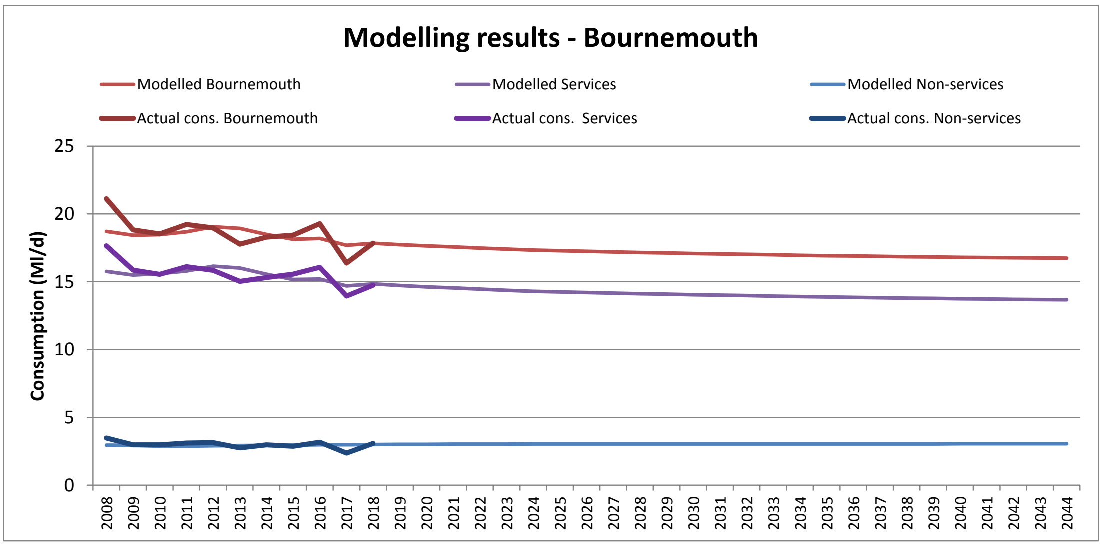


Figure 12: Forecasts of demand by sectors in Bournemouth

A.2. Colliford

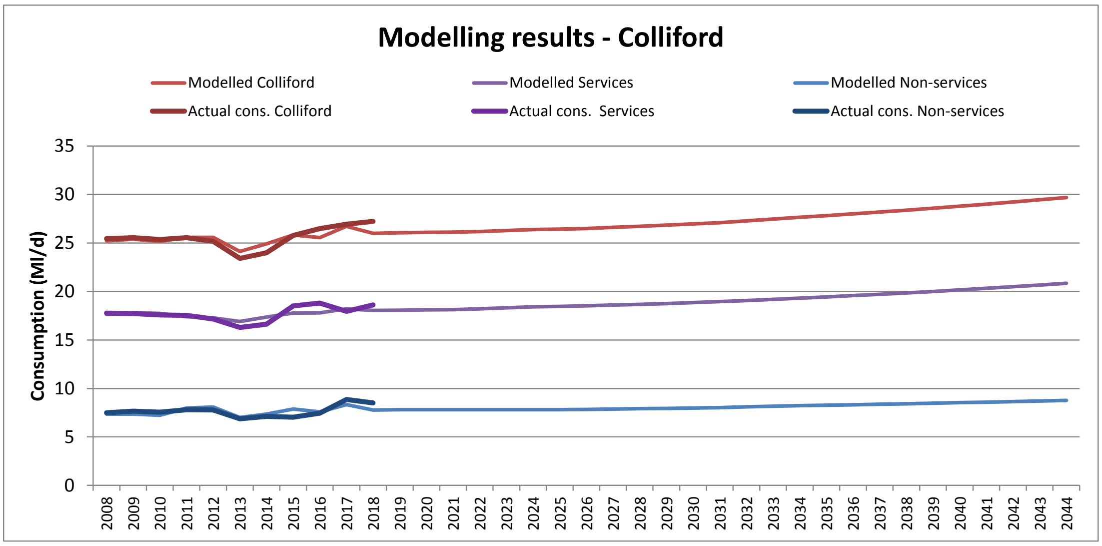


Figure 13: Forecasts of demand by sectors in Colliford

A.3. Roadford

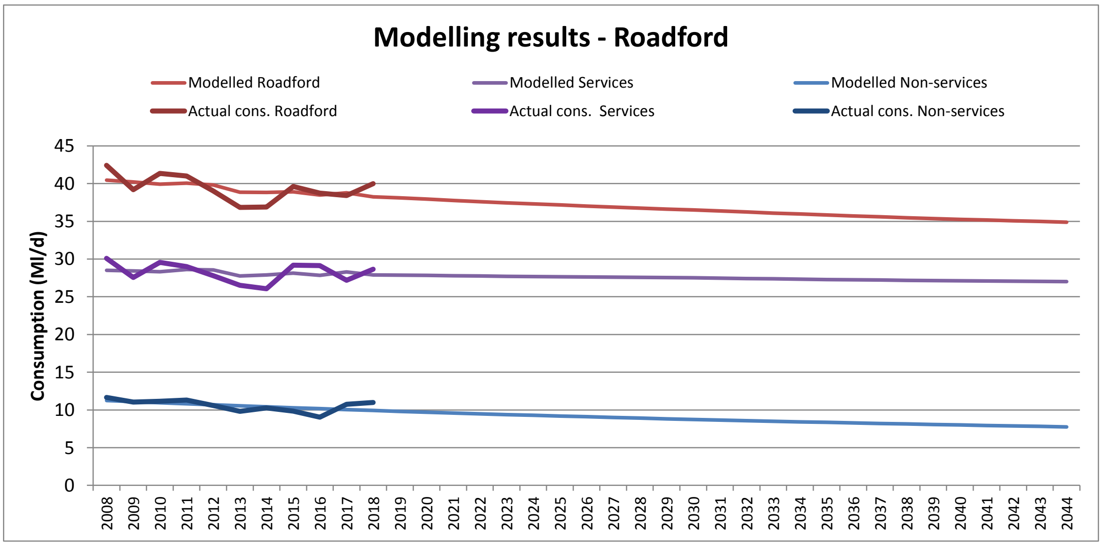


Figure 14: Forecasts of demand by sectors in Roadford

A.4. Wimbleball

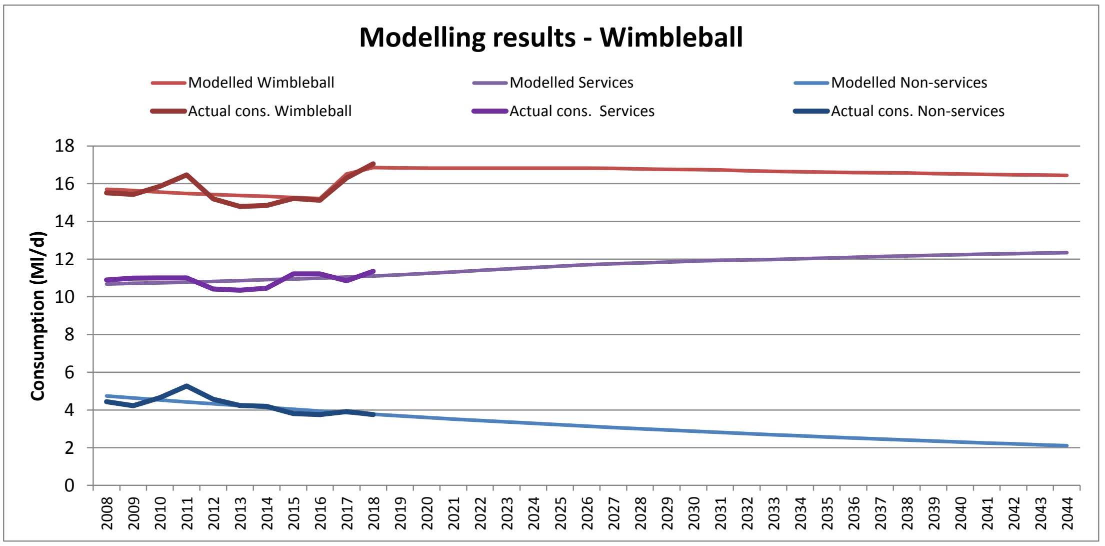


Figure 15: Forecasts of demand by sectors in Wimbleball

A.3.3 Plan for compliance with leakage and PCC consistency reporting

Currently all water companies in England and Wales are working towards reporting leakage and PCC 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.

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 reporting methodologies, and South West Water area and Bournemouth WRZ reporting currently differs in some respects, therefore separate RAG assessments have been completed for each. These RAG assessments are summarised in the tables below. We are targeting full compliance with the guidelines by the end of 2019/20.

Table A.3.3.1: RAG assessment of current compliance with leakage consistency guidance

		South West Water area			Bournemouth WRZ		
		Green	Amber	Red	Green	Amber	Red
1	Coverage	1	0	0	1	0	0
2	Availability	0	0	1	0	0	1
3	Properties	3	2	0	3	2	0
4	Night flow period and analysis	8	1	2	8	1	2
5	Household night use	2	5	0	2	5	0
6	Non-household night use	3	5	0	1	7	0
7	Hour to day conversion	1	0	2	3	0	0
8	Annual distribution leakage	2	0	0	1	1	0
9	Trunk main losses	2	1	0	0	3	0
10	Service reservoir losses	1	2	0	0	3	0
11	Distribution input	4	2	0	2	4	0
12	Measured consumption	5	0	0	2	3	0
13	Unmeasured consumption	4	6	0	4	6	0
14	Company own water use	1	1	1	1	1	1
15	Other water use	2	0	1	3	0	0
16	Water balance and MLE	1	4	0	1	4	0
	Total	**40**	**29**	**7**	**32**	**40**	**4**

[A.3.1] UKWIR, *Consistency of reporting performance measures*, 2017

Table A.3.3.2: RAG assessment of current compliance with PCC consistency guidance

		South West Water area			Bournemouth WRZ		
		Green	Amber	Red	Green	Amber	Red
1	Household population estimates	3	1	0	3	0	0
2	Household property estimates	2	1	0	3	0	0
3	Measured household consumption	3	2	0	1	2	2
4	Unmeasured household consumption	6	2	3	4	2	5
	Total	**14**	**6**	**3**	**11**	**4**	**7**

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

South West Water Bournemouth Water

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.

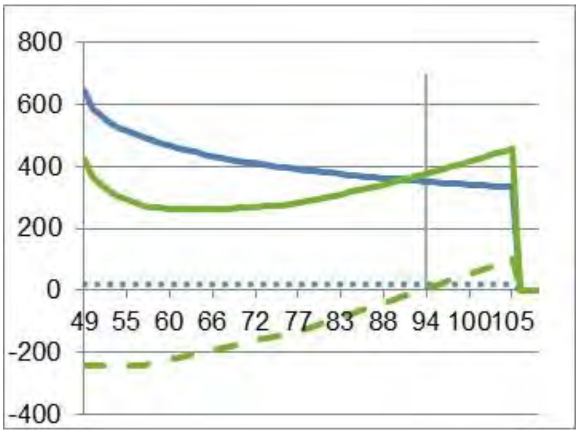
In each chart the maximum leakage level is constrained by the balance of supply and demand. Leakage is not allowed to rise beyond this balance, and so the NPV drops to zero – visible as 'tails' on each series.

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).

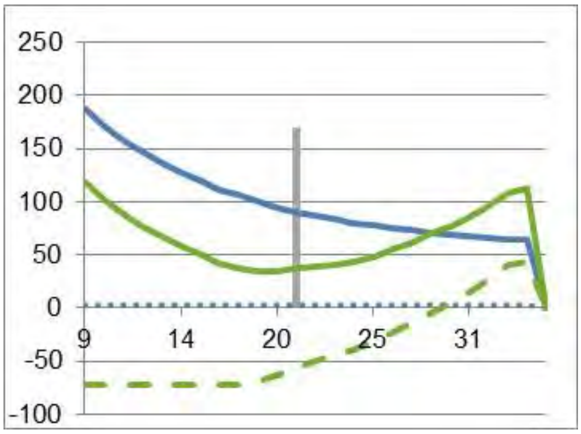
The purpose of this analysis is that it allows the cost of different uncertainties or policy decisions to be assessed. We then used this as part of the data in the multi-criteria assessment to understand what the best value programme is overall.

Figure A.3.5.1 1a (baseline)

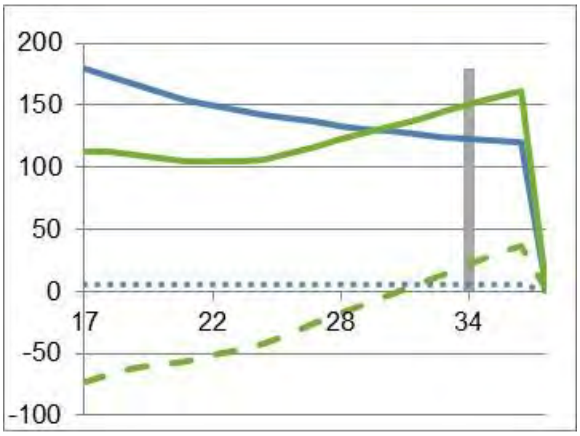
SWW



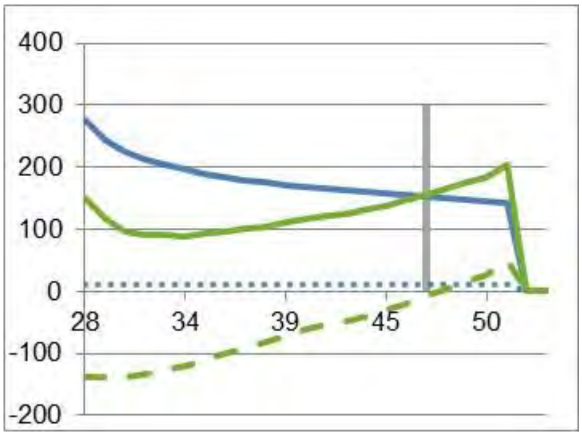
Bournemouth



Colliford



Roadford



Wimbleball

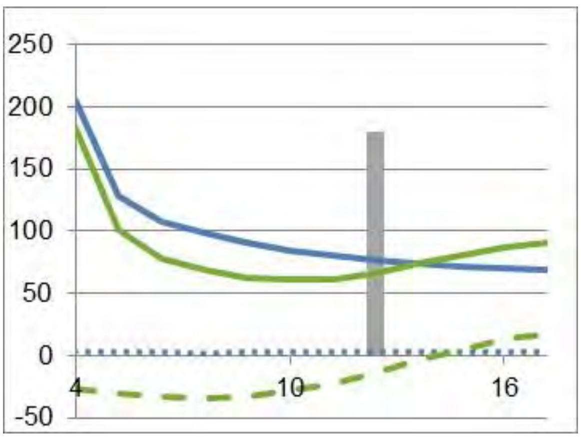
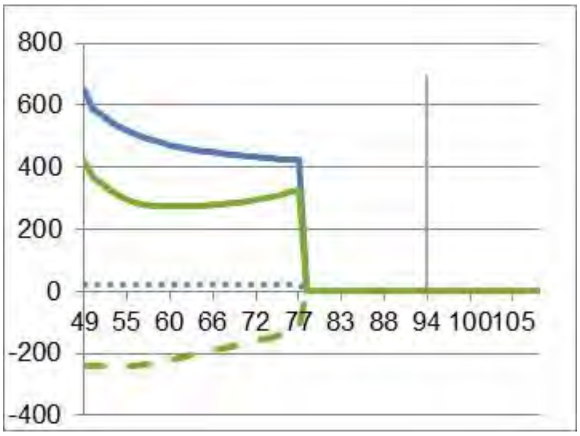
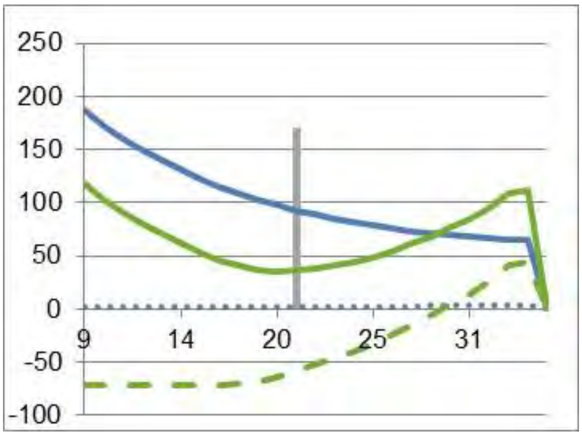


Figure A.3.5.2 3a (plausible droughts PD-1)

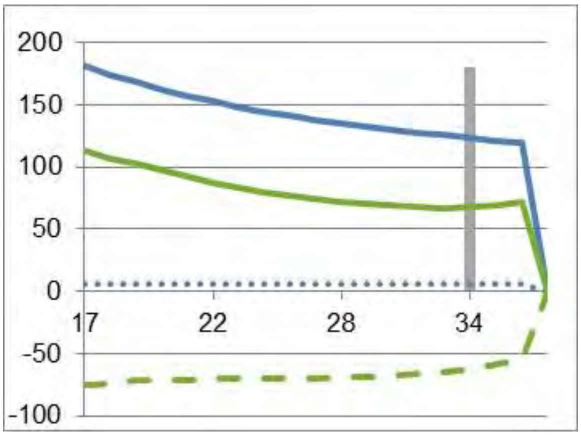
SWW



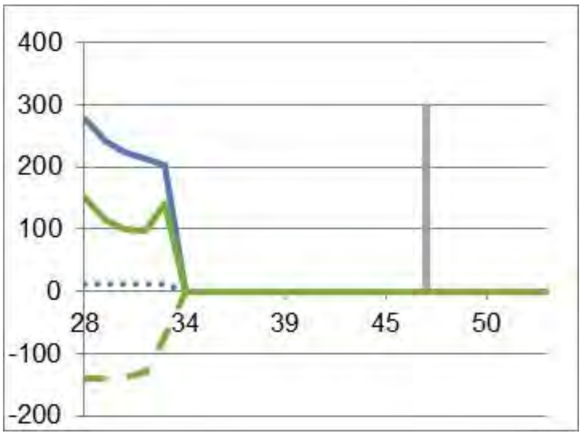
Bournemouth



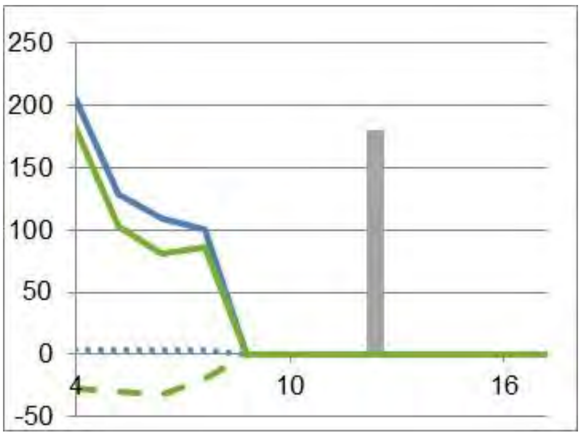
Colliford



Roadford



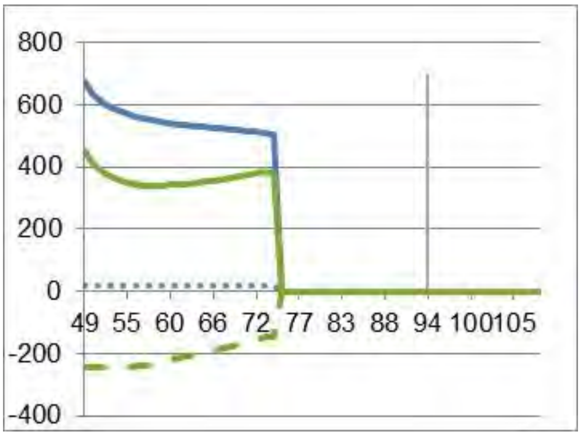
Wimbleball



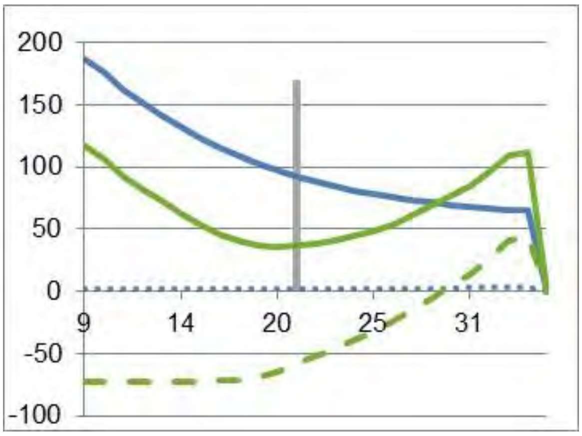
South West Water Bournemouth Water

Figure A.3.5.3 3a (plausible droughts PD-2)

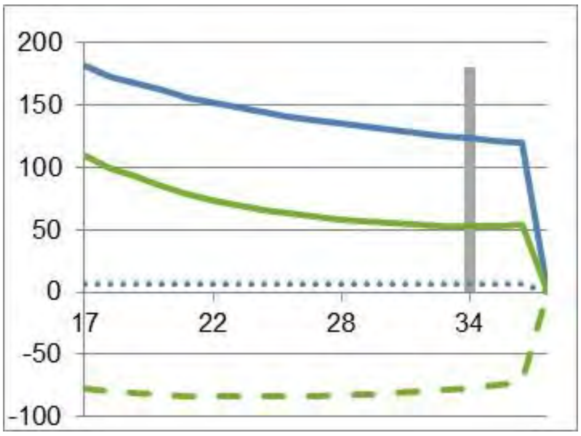
SWW



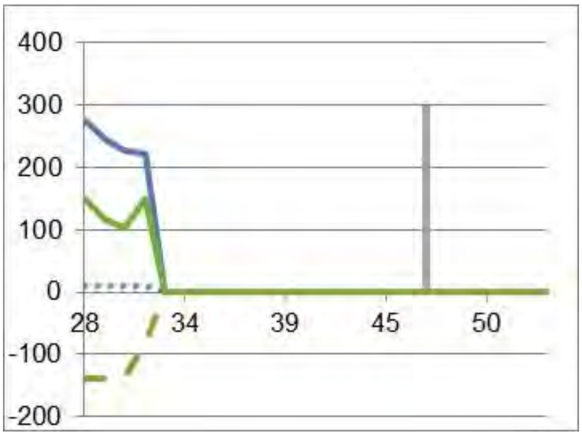
Bournemouth



Colliford



Roadford



Wimbleball

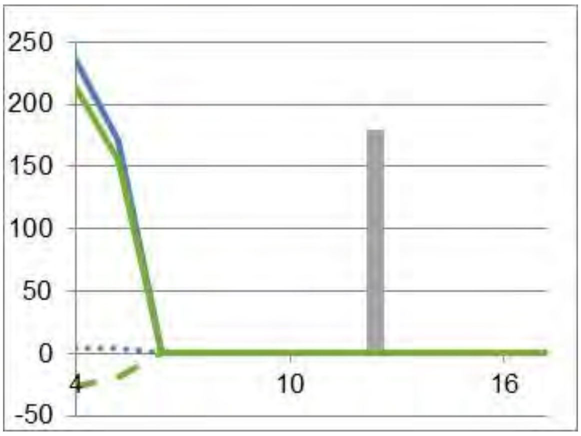
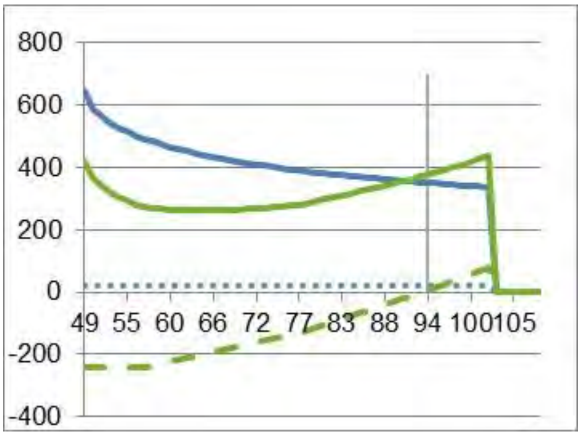
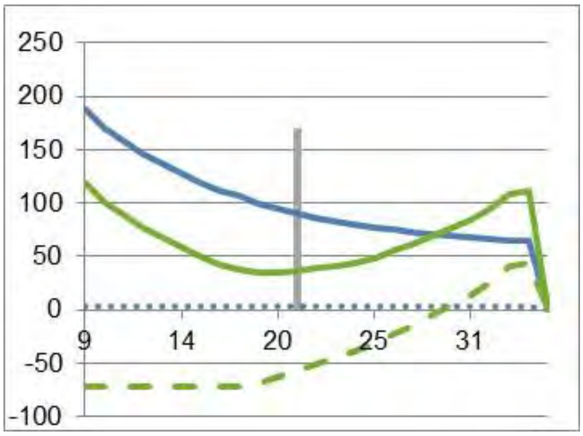


Figure A.3.5.4 3a (plausible droughts PD-3)

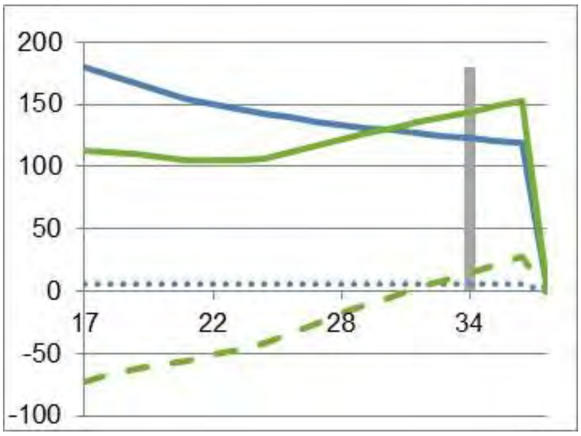
SWW



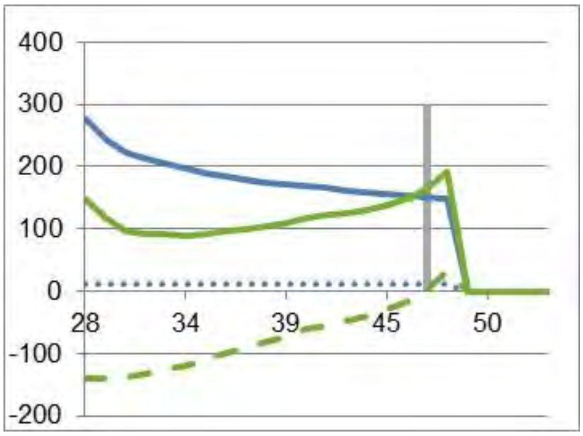
Bournemouth



Colliford



Roadford



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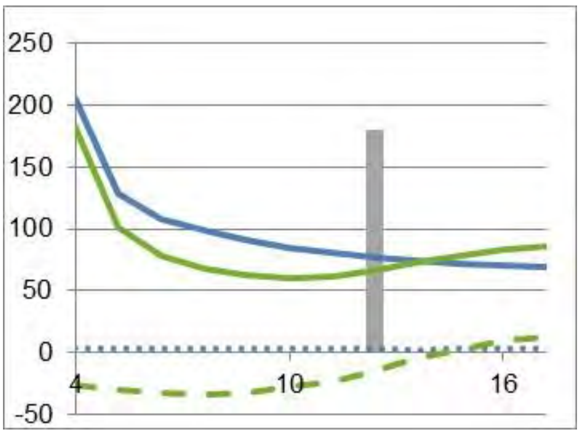
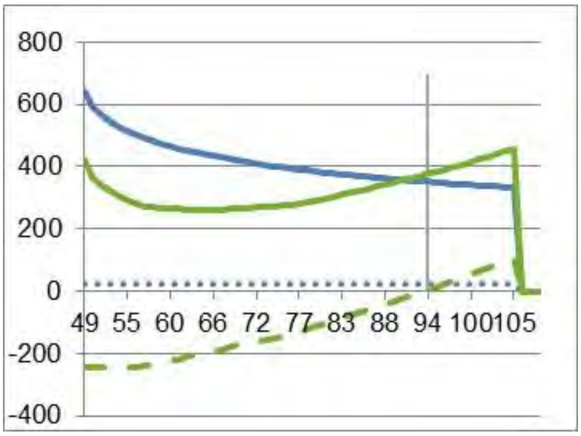
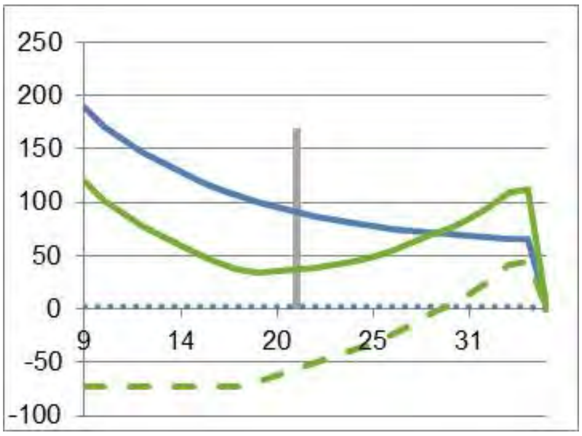


Figure A.3.5.5 3a (plausible droughts PD-4)

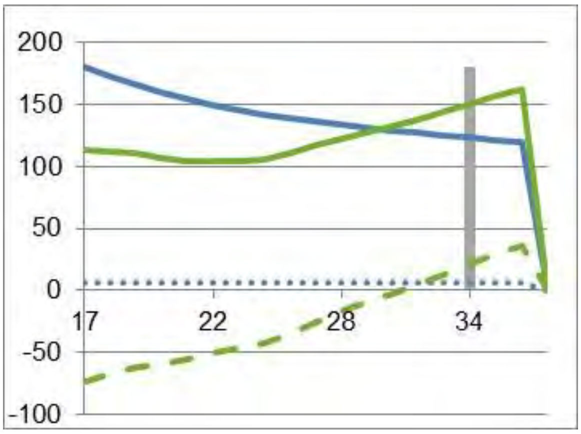
SWW



Bournemouth



Colliford



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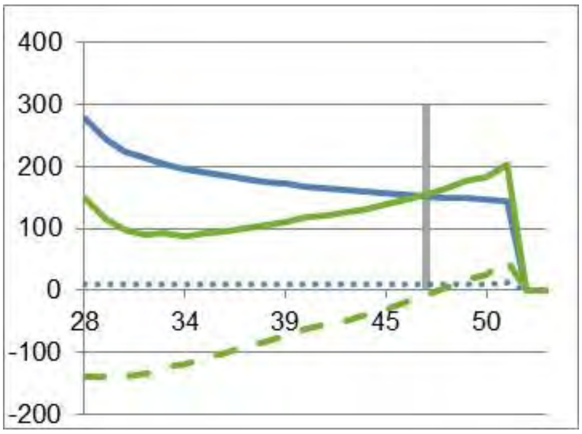

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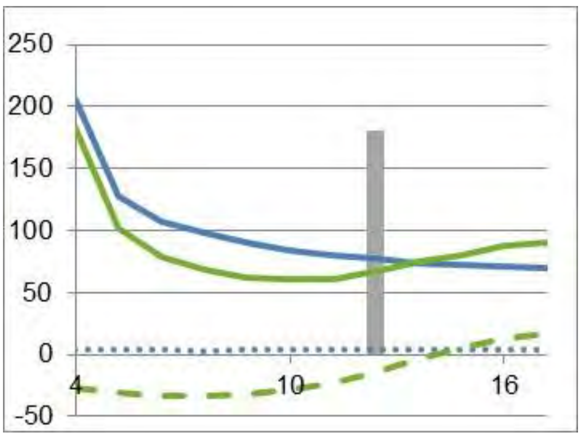
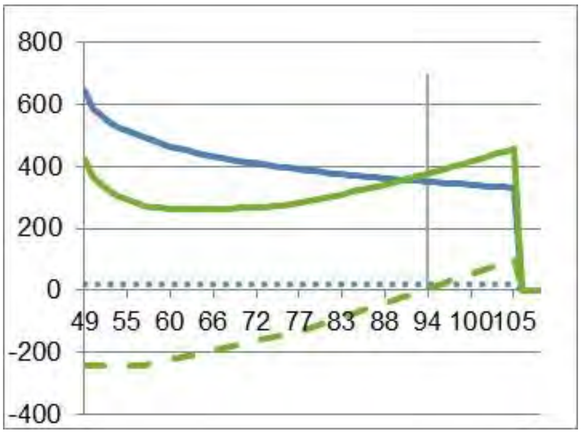


Figure A.3.5.6 3b (1 in 200 year drought)

SWW



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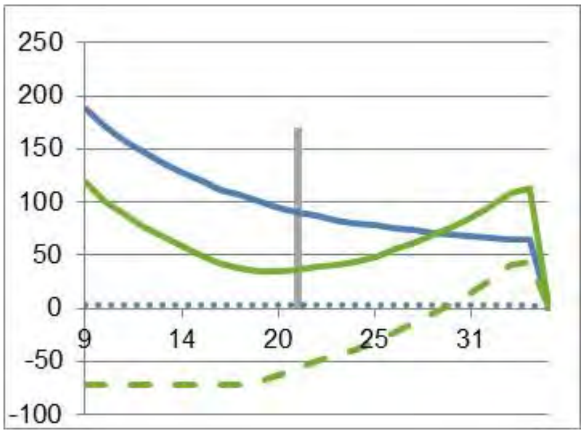

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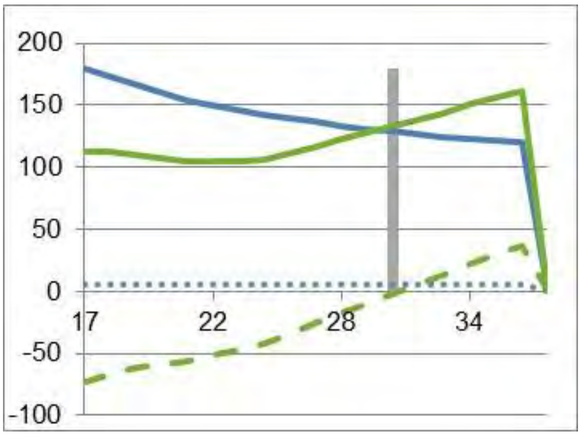

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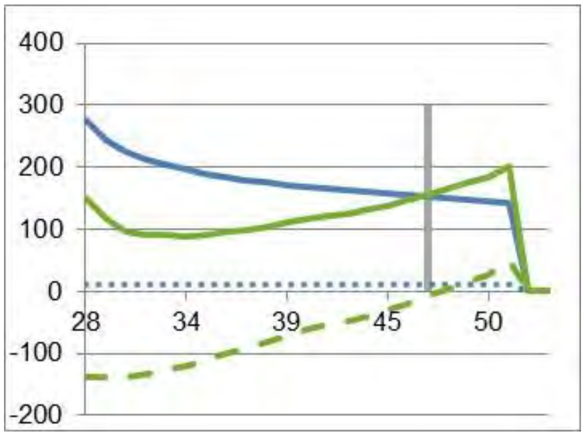

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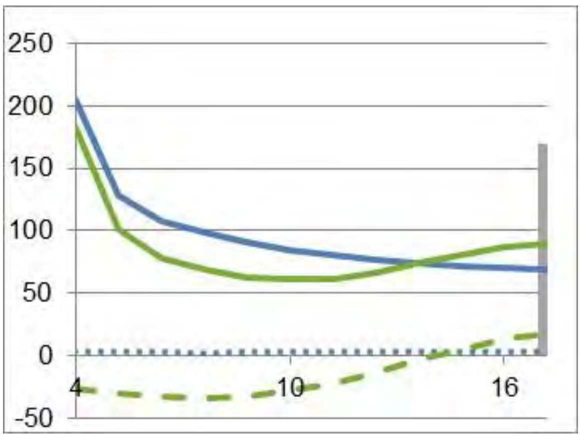
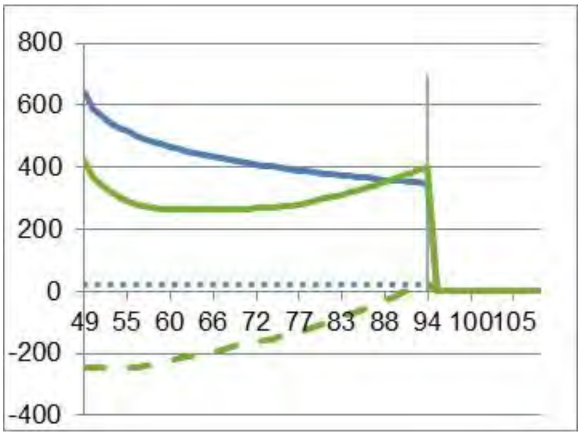


South West Water Bournemouth Water

Figure A.3.5.7 5b (impacts of WINEP3)

SWW



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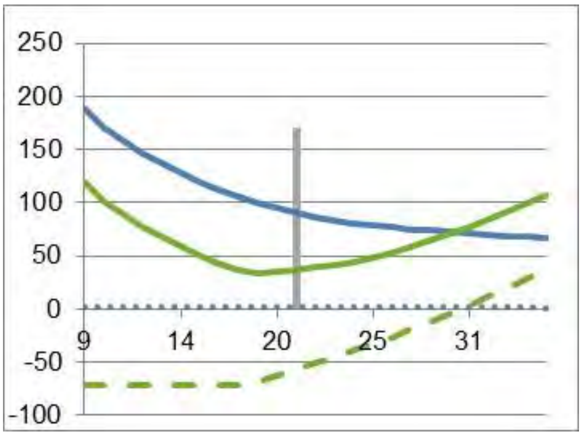

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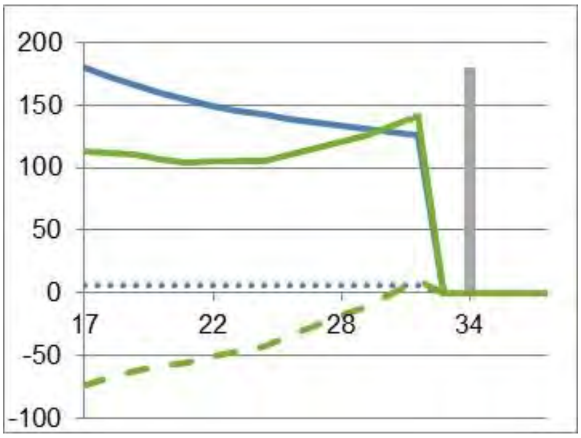

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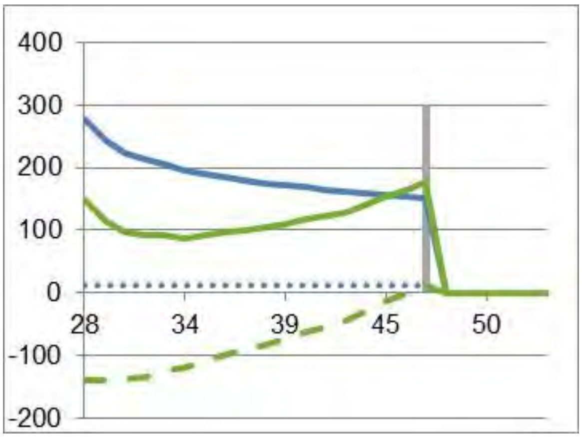

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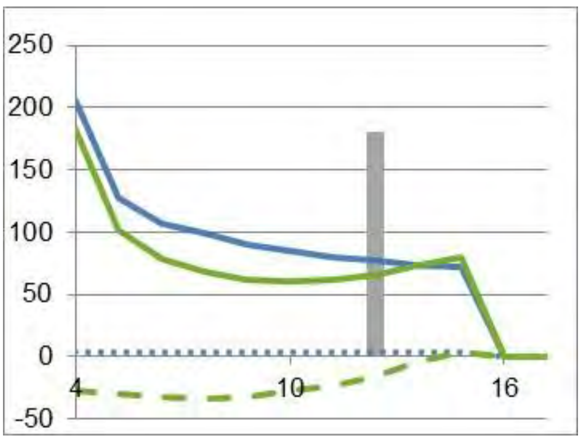
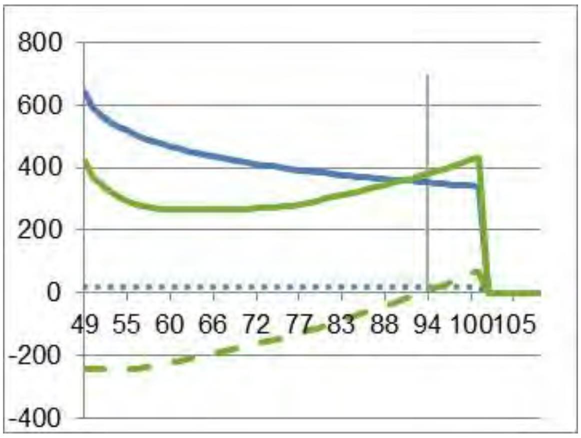


Figure A.3.5.8 6a (leakage consistency)

SWW



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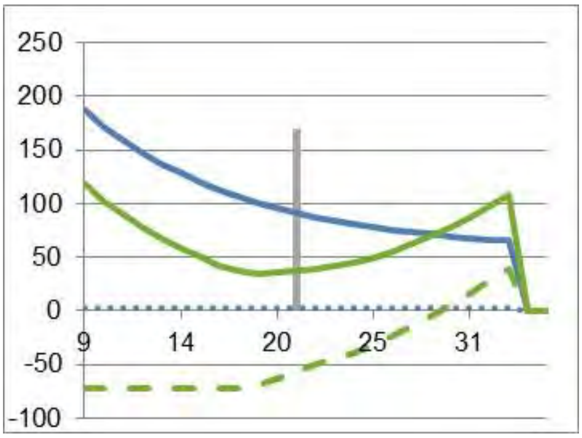

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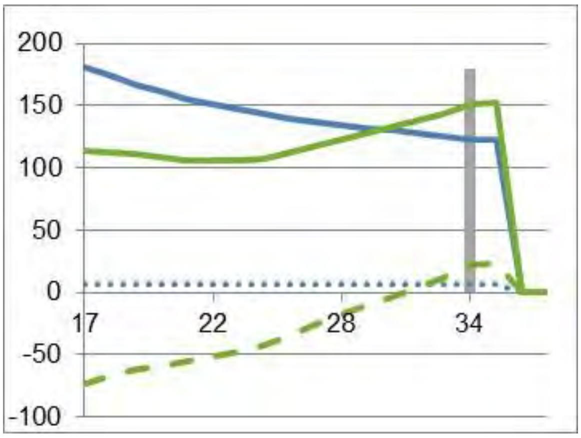

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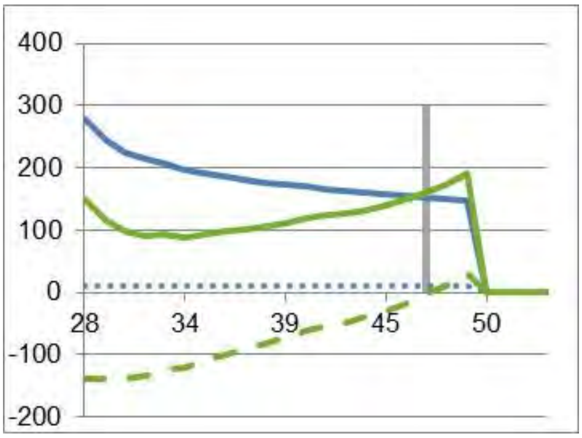

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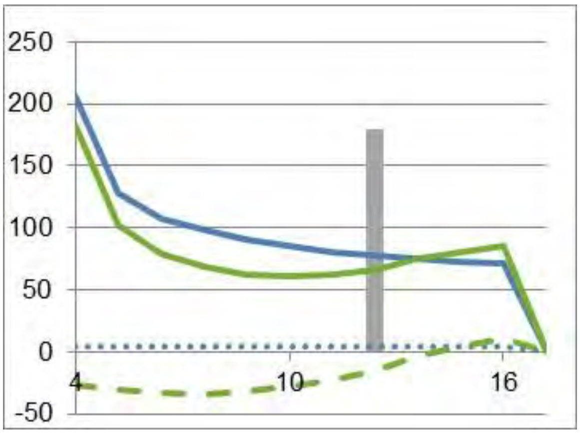
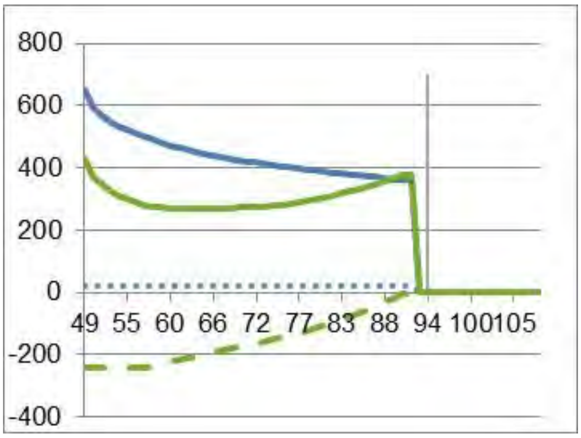


Figure A.3.5.9 7a (household high)

SWW



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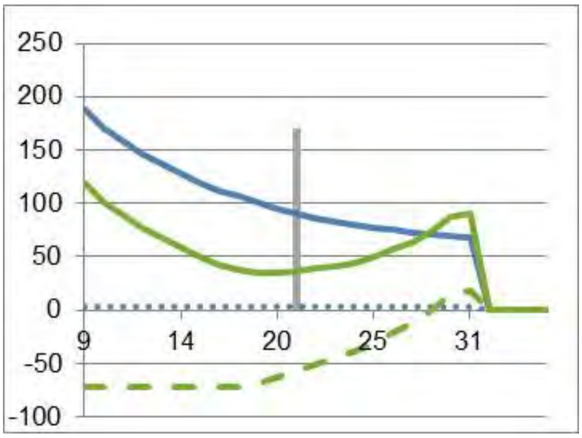

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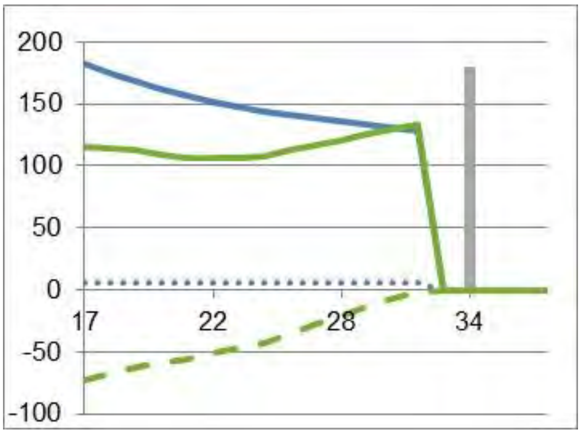

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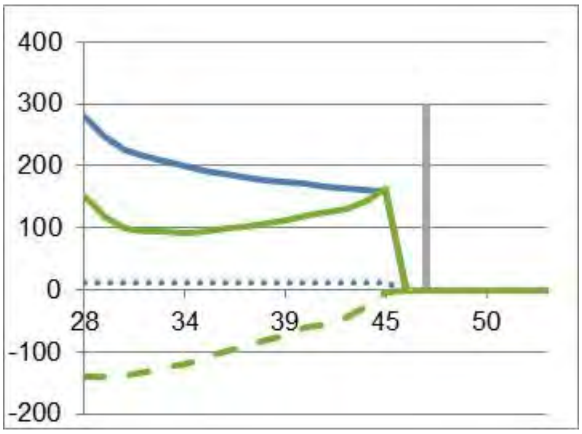

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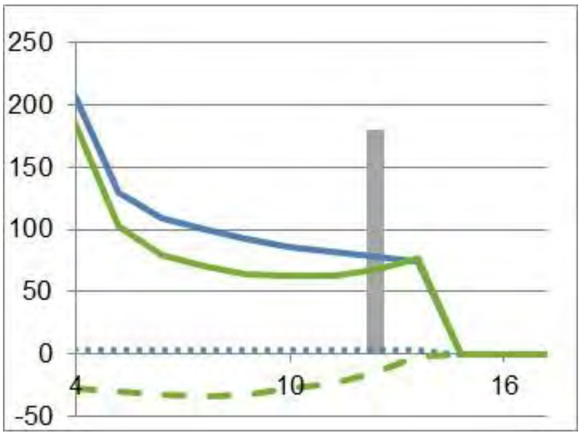
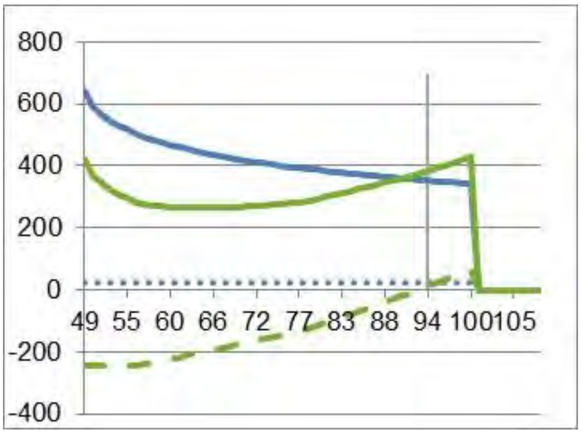


Figure A.3.5.10 7b (non-household high)

SWW



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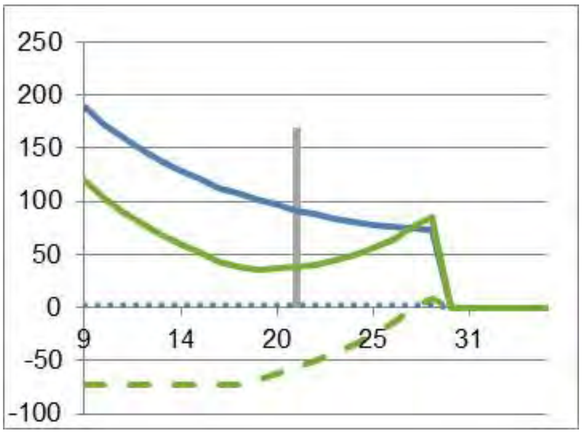

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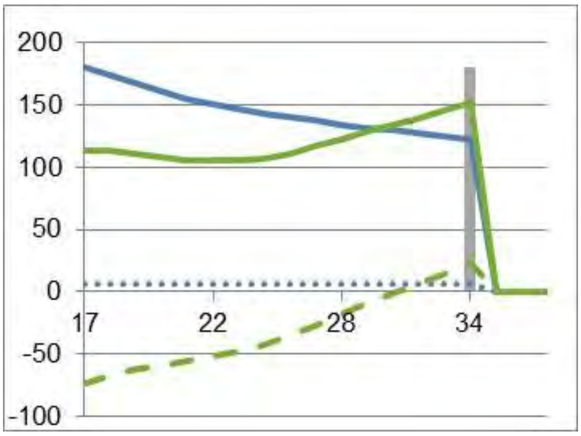

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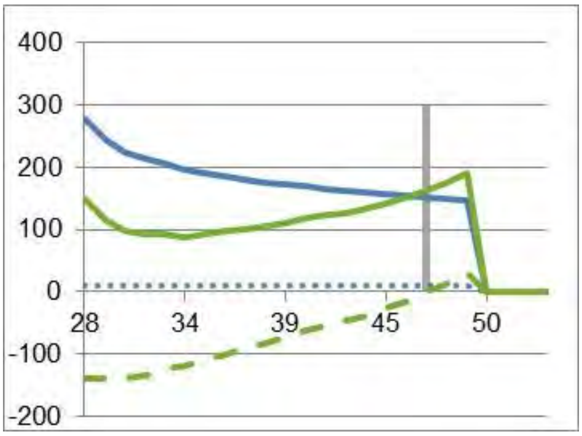

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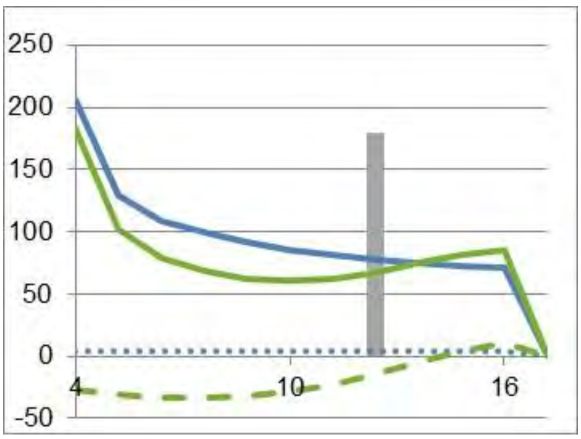
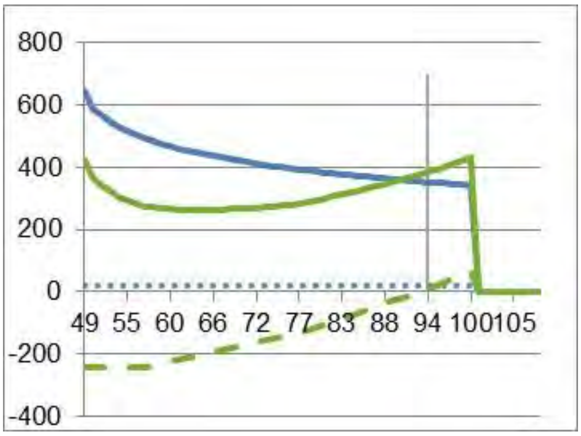


Figure A.3.5.11 7b alternative (non-household high)

SWW



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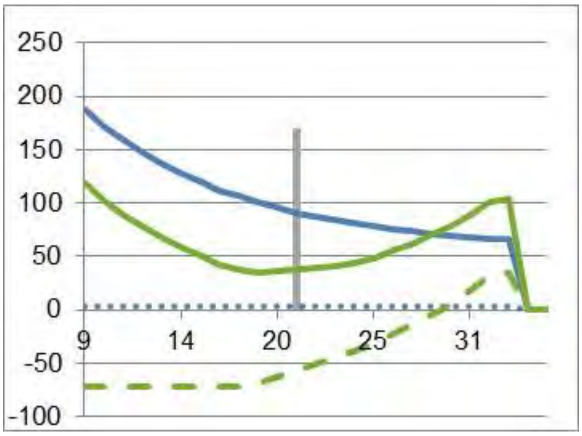

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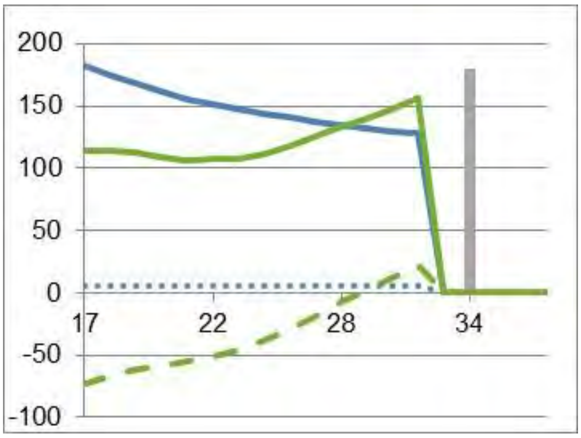

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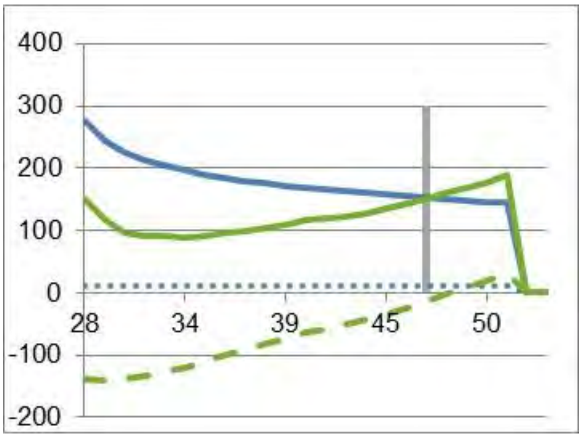

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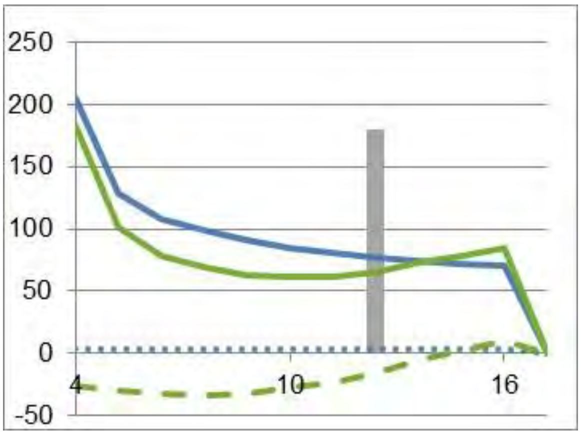

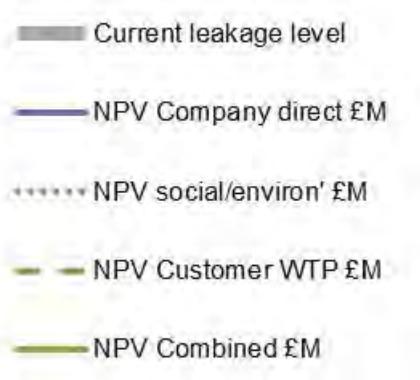

APPENDIX 4

Target headroom

A.4.1 Target headroom methodology and results

SWW commissioned AECOM Ltd to undertake the headroom assessment for SWW and Bournemouth supply areas. This appendix presents the final Headroom Assessment Report by AECOM.

A key change to the assessment carried out for WRMP14 is the risk profile adopted.

For WRMP14 the risk profile chosen used the 85% confidence level at the start of the period, falling to the 70th percentile at the end of the period. In its 2020 direction, Ofwat instructed companies to use the 95% for the first five years of the planning period. We have followed this instruction in our determination of Target Headroom

Additionally, given the heightened focus on water resources resilience, we changed the long-term allowance to 85%. This is considered the right balance so as not to drive unnecessary expenditure whilst reducing the supply demand risk.

The choice of Target Headroom percentile in our Plan does not drive any new investment as the Plan is in surplus. We would expect all companies to have difference volumes for Target Headroom reflecting their circumstances – for example, we have a higher proportion of surface water abstraction than many companies and this carries an inherently more uncertainty than groundwater measurement. Our catchments are also smaller and more flashy thereby creating a difference issue in terms of the accuracy of supply-side data to other companies.

Further details of the differences in Target Headroom are given in the AECOM report – section 4.6.

It should be noted that as part of the finalisation of the WRMP, actual 2016/17 demand data used in the draft Plan and the headroom assessment have been rebased using actual 2017/18 data. In addition, a very minor change has been to made to our Water Available for Use assessment. However, these changes are not sufficient to produce a material change to the results of the headroom assessment carried out and used in our draft Plan.

Headroom Assessment Report

South West Water
Final Water Resources Management Plan 2019

Project Number: 60539035

15th January 2019

Prepared for: South West Water

Quality information

Prepared by	Checked by	Approved by
Mital Pindoria-Nandha Senior Consultant Jenny Rush Principal Hydrogeologist	Stephen Cox Associate	Neil Mackenzie Associate

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			
4	December 2018	Final – with final demand, WAFU and climate change figures	PJS	Jane Sladen	Technical Director
5	January 2019	Final – with outputs from high demand scenario analysis	NM	Neil Mackenzie	Associate

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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 Final WRMP19 (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;
- Determine headroom allowance profiles, by selecting values from the combined headroom uncertainty distributions at appropriate levels of risk across the planning horizon for use in the final WRMP tables; and
- Determine additional headroom allowance profiles using high demand scenarios for sensitivity testing.

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. The high demand analysis is presented in Appendix D.

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 WRMP19, 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 the 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 WRMP19

Factor	WRMP14	WRMP19
	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%.

Factor	WRMP14	WRMP19
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	166.5	8.3	4.2	249.1	12.5	6.4	92.6	4.6	2.4	204.8	10.2	5.2	225.8	11.3	5.8
2016/17	166.3	8.3	4.2	248.5	12.4	6.3	90.5	4.6	2.4	204.8	10.2	5.2	225.8	11.3	5.8
2017/18	166.2	8.3	4.2	247.9	12.4	6.3	90.5	4.6	2.4	204.8	10.2	5.2	225.8	11.3	5.8
2018/19	166.1	8.3	4.2	245.3	12.4	6.3	90.4	4.6	2.4	204.8	10.2	5.2	225.8	11.3	5.8
2019/20	165.9	8.3	4.2	244.7	12.3	6.3	90.4	4.6	2.4	204.8	10.2	5.2	225.8	11.3	5.8
2020/21	165.8	8.3	4.2	244.1	12.3	6.3	90.3	4.6	2.4	204.8	10.2	5.2	225.8	11.3	5.8
2021/22	165.7	8.3	4.2	243.5	12.3	6.3	90.2	4.6	2.4	204.8	10.2	5.2	225.8	11.3	5.8
2022/23	165.5	8.3	4.2	242.9	12.2	6.2	90.2	4.6	2.4	204.8	10.2	5.2	225.8	11.3	5.8
2023/24	165.4	8.3	4.2	242.3	12.2	6.2	90.1	4.6	2.4	204.8	10.2	5.2	225.8	11.3	5.8
2024/25	165.3	8.3	4.2	241.7	12.2	6.2	90.1	4.6	2.3	204.8	10.2	5.2	225.8	11.3	5.8
2025/26	165.1	8.3	4.2	241.2	12.2	6.2	90.0	4.6	2.3	216.2	10.8	5.5	235.8	11.8	6.0
2026/27	165.0	8.2	4.2	240.6	12.1	6.2	89.9	4.6	2.3	216.2	10.8	5.5	235.8	11.8	6.0
2027/28	164.9	8.2	4.2	240.0	12.1	6.2	89.9	4.6	2.3	216.2	10.8	5.5	235.8	11.8	6.0
2028/29	164.7	8.2	4.2	239.4	12.1	6.2	89.8	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2029/30	164.6	8.2	4.2	238.8	12.0	6.1	89.8	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2030/31	164.5	8.2	4.2	238.2	12.0	6.1	89.7	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2031/32	164.4	8.2	4.2	238.0	12.0	6.1	89.7	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2032/33	164.4	8.2	4.2	237.8	12.0	6.1	89.7	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2033/34	164.3	8.2	4.2	237.6	12.0	6.1	89.7	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2034/35	164.3	8.2	4.2	237.4	12.0	6.1	89.6	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2035/36	164.2	8.2	4.2	237.2	12.0	6.1	89.6	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2036/37	164.2	8.2	4.2	237.0	11.9	6.1	89.6	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2037/38	164.1	8.2	4.2	236.8	11.9	6.1	89.6	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2038/39	164.1	8.2	4.2	236.6	11.9	6.1	89.6	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2039/40	164.0	8.2	4.2	236.4	11.9	6.1	89.5	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2040/41	164.0	8.2	4.2	236.2	11.9	6.1	89.5	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2041/42	163.9	8.2	4.2	236.0	11.9	6.1	89.5	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2042/43	163.9	8.2	4.2	235.8	11.9	6.1	89.5	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2043/44	163.9	8.2	4.2	235.5	11.9	6.1	89.5	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9
2044/45	163.8	8.2	4.2	235.3	11.9	6.1	89.4	4.6	2.3	204.0	10.2	5.2	231.4	11.6	5.9

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	166.5	16.6	8.5	249.1	24.9	12.71	92.6	9.3	4.7	204.8	20.5	10.5	225.8	22.6	11.5
2016/17	166.3	16.6	8.5	248.5	24.8	12.71	90.5	9.1	4.6	204.8	20.5	10.5	225.8	22.6	11.5
2017/18	166.2	16.6	8.5	247.9	24.8	12.71	90.5	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.5
2018/19	166.1	16.6	8.5	245.3	24.5	12.71	90.4	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.5
2019/20	165.9	16.6	8.5	244.7	24.5	12.71	90.4	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.5
2020/21	165.8	16.6	8.5	244.1	24.4	12.71	90.3	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.5
2021/22	165.7	16.6	8.5	243.5	24.4	12.71	90.2	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.5
2022/23	165.5	16.6	8.4	242.9	24.3	12.71	90.2	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.5
2023/24	165.4	16.5	8.4	242.3	24.2	12.71	90.1	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.5
2024/25	165.3	16.5	8.4	241.7	24.2	12.71	90.1	9.0	4.6	204.8	20.5	10.5	225.8	22.6	11.5
2025/26	165.1	16.5	8.4	241.2	24.1	12.71	90.0	9.0	4.6	216.2	21.6	11.0	235.8	23.6	12.0
2026/27	165.0	16.5	8.4	240.6	24.1	12.71	89.9	9.0	4.6	216.2	21.6	11.0	235.8	23.6	12.0
2027/28	164.9	16.5	8.4	240.0	24.0	12.71	89.9	9.0	4.6	216.2	21.6	11.0	235.8	23.6	12.0
2028/29	164.7	16.5	8.4	239.4	23.9	12.71	89.8	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2029/30	164.6	16.5	8.4	238.8	23.9	12.71	89.8	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2030/31	164.5	16.4	8.4	238.2	23.8	12.71	89.7	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2031/32	164.4	16.4	8.4	238.0	23.8	12.71	89.7	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2032/33	164.4	16.4	8.4	237.8	23.8	12.71	89.7	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2033/34	164.3	16.4	8.4	237.6	23.8	12.71	89.7	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2034/35	164.3	16.4	8.4	237.4	23.7	12.71	89.6	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2035/36	164.2	16.4	8.4	237.2	23.7	12.71	89.6	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2036/37	164.2	16.4	8.4	237.0	23.7	12.71	89.6	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2037/38	164.1	16.4	8.4	236.8	23.7	12.71	89.6	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2038/39	164.1	16.4	8.4	236.6	23.7	12.71	89.6	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2039/40	164.0	16.4	8.4	236.4	23.6	12.71	89.5	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2040/41	164.0	16.4	8.4	236.2	23.6	12.71	89.5	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2041/42	163.9	16.4	8.4	236.0	23.6	12.71	89.5	9.0	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2042/43	163.9	16.4	8.4	235.8	23.6	12.71	89.5	8.9	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2043/44	163.9	16.4	8.4	235.5	23.6	12.71	89.5	8.9	4.6	204.0	20.4	10.4	231.4	23.1	11.8
2044/45	163.8	16.4	8.4	235.3	23.5	12.71	89.4	8.9	4.6	204.0	20.4	10.4	231.4	23.1	11.8

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	166.5	-0.9	0.6	249.1	-2.1	1.8	92.6	-0.5	0.2
2016/17	166.3	-1.2	0.8	248.5	-2.6	2.3	90.5	-0.6	0.3
2017/18	166.2	-1.4	1.0	247.9	-3.1	2.8	90.5	-0.8	0.3
2018/19	166.1	-1.6	1.1	245.3	-3.6	3.2	90.4	-0.9	0.4
2019/20	165.9	-1.9	1.3	244.7	-4.1	3.7	90.4	-1.0	0.5
2020/21	165.8	-2.1	1.4	244.1	-4.6	4.1	90.3	-1.1	0.5
2021/22	165.7	-2.3	1.6	243.5	-5.1	4.6	90.2	-1.3	0.6
2022/23	165.5	-2.6	1.8	242.9	-5.7	5.1	90.2	-1.4	0.6
2023/24	165.4	-2.8	1.9	242.3	-6.2	5.5	90.1	-1.5	0.7
2024/25	165.3	-3.0	2.1	241.7	-6.7	6.0	90.1	-1.6	0.7
2025/26	165.1	-3.3	2.2	241.2	-7.2	6.4	90.0	-1.8	0.8
2026/27	165.0	-3.5	2.4	240.6	-7.7	6.9	89.9	-1.9	0.9
2027/28	164.9	-3.8	2.6	240.0	-8.2	7.3	89.9	-2.0	0.9
2028/29	164.7	-4.0	2.7	239.4	-8.7	7.8	89.8	-2.2	1.0
2029/30	164.6	-4.2	2.9	238.8	-9.3	8.3	89.8	-2.3	1.0
2030/31	164.5	-4.5	3.0	238.2	-9.8	8.7	89.7	-2.4	1.1
2031/32	164.4	-4.5	3.1	238.0	-10.0	8.9	89.7	-2.5	1.1
2032/33	164.4	-4.6	3.2	237.8	-10.1	9.0	89.7	-2.5	1.1
2033/34	164.3	-4.7	3.2	237.6	-10.3	9.2	89.7	-2.5	1.2
2034/35	164.3	-4.8	3.3	237.4	-10.5	9.4	89.6	-2.6	1.2
2035/36	164.2	-4.9	3.3	237.2	-10.7	9.5	89.6	-2.6	1.2
2036/37	164.2	-4.9	3.4	237.0	-10.8	9.7	89.6	-2.7	1.2
2037/38	164.1	-5.0	3.4	236.8	-11.0	9.8	89.6	-2.7	1.2
2038/39	164.1	-5.1	3.5	236.6	-11.2	10.0	89.6	-2.8	1.2
2039/40	164.0	-5.2	3.5	236.4	-11.4	10.2	89.5	-2.8	1.3
2040/41	164.0	-5.3	3.6	236.2	-11.5	10.3	89.5	-2.8	1.3
2041/42	163.9	-5.3	3.7	236.0	-11.7	10.5	89.5	-2.9	1.3
2042/43	163.9	-5.4	3.7	235.8	-11.9	10.6	89.5	-2.9	1.3
2043/44	163.9	-5.5	3.8	235.5	-12.1	10.8	89.5	-3.0	1.3
2044/45	163.8	-5.6	3.8	235.3	-12.3	10.9	89.4	-3.0	1.4

3.9 S9 New sources

There are no new sources proposed in WRMP19; 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	144.9	3.6	1.8	217.9	5.4	2.8	77.0	1.9	1.0	145.3	3.6	1.9	184.3	4.6	2.4
2016/17	146.7	3.7	1.9	221.1	5.5	2.8	78.5	2.0	1.0	146.2	3.7	1.9	186.2	4.7	2.4
2017/18	150.0	3.7	1.9	226.1	5.7	2.9	80.3	2.0	1.0	149.5	3.7	1.9	188.8	4.7	2.4
2018/19	147.3	3.7	1.9	222.3	5.6	2.8	79.4	2.0	1.0	149.0	3.7	1.9	188.0	4.7	2.4
2019/20	146.7	3.7	1.9	221.5	5.5	2.8	79.2	2.0	1.0	148.5	3.7	1.9	187.5	4.7	2.4
2020/21	146.0	3.6	1.9	221.1	5.5	2.8	79.7	2.0	1.0	148.4	3.7	1.9	187.5	4.7	2.4
2021/22	145.0	3.6	1.8	221.6	5.5	2.8	80.0	2.0	1.0	148.4	3.7	1.9	187.5	4.7	2.4
2022/23	145.0	3.6	1.9	221.0	5.5	2.8	80.4	2.0	1.0	148.4	3.7	1.9	187.6	4.7	2.4
2023/24	144.2	3.6	1.8	221.7	5.5	2.8	80.6	2.0	1.0	148.5	3.7	1.9	187.6	4.7	2.4
2024/25	144.5	3.6	1.8	220.7	5.5	2.8	81.2	2.0	1.0	148.5	3.7	1.9	187.8	4.7	2.4
2025/26	144.2	3.6	1.8	221.0	5.5	2.8	81.5	2.0	1.0	148.6	3.7	1.9	187.9	4.7	2.4
2026/27	144.0	3.6	1.8	222.0	5.5	2.8	81.0	2.0	1.0	148.7	3.7	1.9	188.1	4.7	2.4
2027/28	144.1	3.6	1.8	222.0	5.5	2.8	81.4	2.0	1.0	148.8	3.7	1.9	188.3	4.7	2.4
2028/29	144.4	3.6	1.8	222.0	5.5	2.8	81.6	2.0	1.0	149.0	3.7	1.9	188.6	4.7	2.4
2029/30	144.2	3.6	1.8	222.5	5.6	2.8	81.9	2.0	1.0	149.1	3.7	1.9	188.8	4.7	2.4
2030/31	144.2	3.6	1.8	222.8	5.6	2.8	82.1	2.1	1.0	149.2	3.7	1.9	189.0	4.7	2.4
2031/32	144.7	3.6	1.8	222.9	5.6	2.8	81.9	2.0	1.0	149.3	3.7	1.9	189.2	4.7	2.4
2032/33	145.3	3.6	1.9	222.6	5.6	2.8	82.0	2.1	1.0	149.4	3.7	1.9	189.3	4.7	2.4
2033/34	146.0	3.7	1.9	222.2	5.6	2.8	82.1	2.1	1.0	149.4	3.7	1.9	189.5	4.7	2.4
2034/35	146.2	3.7	1.9	222.3	5.6	2.8	82.2	2.1	1.0	149.5	3.7	1.9	189.6	4.7	2.4
2035/36	146.0	3.6	1.9	222.7	5.6	2.8	82.4	2.1	1.1	149.6	3.7	1.9	189.8	4.7	2.4
2036/37	146.4	3.7	1.9	222.8	5.6	2.8	82.2	2.1	1.0	149.6	3.7	1.9	189.9	4.7	2.4
2037/38	146.6	3.7	1.9	223.1	5.6	2.8	82.0	2.1	1.0	149.7	3.7	1.9	190.0	4.7	2.4
2038/39	147.0	3.7	1.9	223.1	5.6	2.8	81.9	2.0	1.0	149.7	3.7	1.9	190.1	4.8	2.4
2039/40	147.2	3.7	1.9	223.0	5.6	2.8	82.0	2.1	1.0	149.8	3.7	1.9	190.2	4.8	2.4
2040/41	147.7	3.7	1.9	222.8	5.6	2.8	82.2	2.1	1.0	149.8	3.7	1.9	190.3	4.8	2.4
2041/42	147.8	3.7	1.9	222.9	5.6	2.8	82.3	2.1	1.0	149.9	3.7	1.9	190.4	4.8	2.4
2042/43	148.4	3.7	1.9	222.5	5.6	2.8	82.5	2.1	1.1	150.0	3.7	1.9	190.5	4.8	2.4
2043/44	149.0	3.7	1.9	222.1	5.6	2.8	82.6	2.1	1.1	150.0	3.8	1.9	190.7	4.8	2.4
2044/45	149.2	3.7	1.9	221.9	5.5	2.8	83.1	2.1	1.1	150.1	3.8	1.9	190.8	4.8	2.4

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	144.9	0.0	0.0	217.9	0.0	0.0	77.0	0.0	0.0	145.3	0.0	0.0	184.3	0.0	0.0
2016/17	146.7	-0.8	0.8	221.1	-1.1	1.1	78.5	-0.4	0.4	146.2	-0.8	0.8	186.2	-1.0	1.0
2017/18	150.0	-1.5	1.5	226.1	-2.3	2.3	80.3	-0.9	0.9	149.5	-1.6	1.6	188.8	-2.0	2.0
2018/19	147.3	-2.3	2.3	222.3	-3.4	3.4	79.4	-1.3	1.3	149.0	-2.3	2.3	188.0	-3.0	3.0
2019/20	146.7	-3.1	3.1	221.5	-4.6	4.6	79.2	-1.7	1.7	148.5	-3.1	3.1	187.5	-3.9	3.9
2020/21	146.0	-3.9	3.9	221.1	-5.7	5.7	79.7	-2.1	2.1	148.4	-3.9	3.9	187.5	-4.9	4.9
2021/22	145.0	-4.6	4.6	221.6	-6.9	6.9	80.0	-2.6	2.6	148.4	-4.7	4.7	187.5	-5.9	5.9
2022/23	145.0	-5.4	5.4	221.0	-8.0	8.0	80.4	-3.0	3.0	148.4	-5.4	5.4	187.6	-6.9	6.9
2023/24	144.2	-6.2	6.2	221.7	-9.2	9.2	80.6	-3.4	3.4	148.5	-6.2	6.2	187.6	-7.9	7.9
2024/25	144.5	-6.9	6.9	220.7	-10.3	10.3	81.2	-3.9	3.9	148.5	-7.0	7.0	187.8	-8.9	8.9
2025/26	144.2	-7.7	7.7	221.0	-11.5	11.5	81.5	-4.3	4.3	148.6	-7.8	7.8	187.9	-9.9	9.9
2026/27	144.0	-8.5	8.5	222.0	-12.6	12.6	81.0	-4.7	4.7	148.7	-8.5	8.5	188.1	-10.9	10.9
2027/28	144.1	-9.3	9.3	222.0	-13.8	13.8	81.4	-5.2	5.2	148.8	-9.3	9.3	188.3	-11.8	11.8
2028/29	144.4	-10.0	10.0	222.0	-14.9	14.9	81.6	-5.6	5.6	149.0	-10.1	10.1	188.6	-12.8	12.8
2029/30	144.2	-10.8	10.8	222.5	-16.1	16.1	81.9	-6.0	6.0	149.1	-10.9	10.9	188.8	-13.8	13.8
2030/31	144.2	-11.6	11.6	222.8	-17.2	17.2	82.1	-6.4	6.4	149.2	-11.6	11.6	189.0	-14.8	14.8
2031/32	144.7	-12.3	12.3	222.9	-18.4	18.4	81.9	-6.9	6.9	149.3	-12.4	12.4	189.2	-15.8	15.8
2032/33	145.3	-13.1	13.1	222.6	-19.5	19.5	82.0	-7.3	7.3	149.4	-13.2	13.2	189.3	-16.8	16.8
2033/34	146.0	-13.9	13.9	222.2	-20.7	20.7	82.1	-7.7	7.7	149.4	-14.0	14.0	189.5	-17.8	17.8
2034/35	146.2	-14.7	14.7	222.3	-21.8	21.8	82.2	-8.2	8.2	149.5	-14.8	14.8	189.6	-18.7	18.7
2035/36	146.0	-15.4	15.4	222.7	-23.0	23.0	82.4	-8.6	8.6	149.6	-15.5	15.5	189.8	-19.7	19.7
2036/37	146.4	-16.2	16.2	222.8	-24.1	24.1	82.2	-9.0	9.0	149.6	-16.3	16.3	189.9	-20.7	20.7
2037/38	146.6	-17.0	17.0	223.1	-25.2	25.2	82.0	-9.5	9.5	149.7	-17.1	17.1	190.0	-21.7	21.7
2038/39	147.0	-17.7	17.7	223.1	-26.4	26.4	81.9	-9.9	9.9	149.7	-17.9	17.9	190.1	-22.7	22.7
2039/40	147.2	-18.5	18.5	223.0	-27.5	27.5	82.0	-10.3	10.3	149.8	-18.6	18.6	190.2	-23.7	23.7
2040/41	147.7	-19.3	19.3	222.8	-28.7	28.7	82.2	-10.7	10.7	149.8	-19.4	19.4	190.3	-24.7	24.7
2041/42	147.8	-20.1	20.1	222.9	-29.8	29.8	82.3	-11.2	11.2	149.9	-20.2	20.2	190.4	-25.7	25.7
2042/43	148.4	-20.8	20.8	222.5	-31.0	31.0	82.5	-11.6	11.6	150.0	-21.0	21.0	190.5	-26.6	26.6
2043/44	149.0	-21.6	21.6	222.1	-32.1	32.1	82.6	-12.0	12.0	150.0	-21.7	21.7	190.7	-27.6	27.6
2044/45	149.2	-22.4	22.4	221.9	-33.3	33.3	83.1	-12.5	12.5	150.1	-22.5	22.5	190.8	-28.6	28.6

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	144.9	0.0	0.0	217.9	0.0	0.0	77.0	0.0	0.0	145.3	0.0	0.0	184.3	0.0	0.0
2016/17	146.7	0.0	0.0	221.1	0.0	0.0	78.5	0.0	0.0	146.2	0.0	0.0	186.2	0.0	0.0
2017/18	150.0	0.0	0.0	226.1	0.0	0.0	80.3	0.0	0.0	149.5	0.0	0.0	188.8	0.0	0.0
2018/19	147.3	0.0	0.0	222.3	0.0	0.0	79.4	0.0	0.0	149.0	0.0	0.0	188.0	0.0	0.0
2019/20	146.7	0.0	0.0	221.5	0.0	0.0	79.2	0.0	0.0	148.5	0.0	0.0	187.5	0.0	0.0
2020/21	146.0	0.0	0.0	221.1	-0.1	0.1	79.7	0.0	0.0	148.4	0.0	0.0	187.5	0.0	0.0
2021/22	145.0	0.0	0.0	221.6	-0.1	0.1	80.0	0.0	0.0	148.4	0.0	0.0	187.5	0.0	0.0
2022/23	145.0	-0.1	0.1	221.0	-0.1	0.1	80.4	0.0	0.0	148.4	0.0	0.0	187.6	0.0	0.0
2023/24	144.2	-0.1	0.1	221.7	-0.1	0.1	80.6	0.0	0.0	148.5	0.0	0.0	187.6	-0.1	0.1
2024/25	144.5	-0.1	0.1	220.7	-0.1	0.1	81.2	0.0	0.0	148.5	-0.1	0.1	187.8	-0.1	0.1
2025/26	144.2	-0.1	0.1	221.0	-0.1	0.1	81.5	0.0	0.0	148.6	-0.1	0.1	187.9	-0.1	0.1
2026/27	144.0	-0.1	0.1	222.0	-0.1	0.1	81.0	0.0	0.0	148.7	-0.1	0.1	188.1	-0.1	0.1
2027/28	144.1	-0.1	0.1	222.0	-0.1	0.1	81.4	0.0	0.0	148.8	-0.1	0.1	188.3	-0.1	0.1
2028/29	144.4	-0.1	0.1	222.0	-0.1	0.1	81.6	-0.1	0.1	149.0	-0.1	0.1	188.6	-0.1	0.1
2029/30	144.2	-0.1	0.1	222.5	-0.2	0.2	81.9	-0.1	0.1	149.1	-0.1	0.1	188.8	-0.1	0.1
2030/31	144.2	-0.1	0.1	222.8	-0.2	0.2	82.1	-0.1	0.1	149.2	-0.1	0.1	189.0	-0.1	0.1
2031/32	144.7	-0.1	0.1	222.9	-0.2	0.2	81.9	-0.1	0.1	149.3	-0.1	0.1	189.2	-0.1	0.1
2032/33	145.3	-0.1	0.1	222.6	-0.2	0.2	82.0	-0.1	0.1	149.4	-0.1	0.1	189.3	-0.1	0.1
2033/34	146.0	-0.1	0.1	222.2	-0.2	0.2	82.1	-0.1	0.1	149.4	-0.1	0.1	189.5	-0.1	0.1
2034/35	146.2	-0.1	0.1	222.3	-0.2	0.2	82.2	-0.1	0.1	149.5	-0.1	0.1	189.6	-0.1	0.1
2035/36	146.0	-0.1	0.1	222.7	-0.2	0.2	82.4	-0.1	0.1	149.6	-0.1	0.1	189.8	-0.1	0.1
2036/37	146.4	-0.2	0.2	222.8	-0.2	0.2	82.2	-0.1	0.1	149.6	-0.1	0.1	189.9	-0.1	0.1
2037/38	146.6	-0.2	0.2	223.1	-0.2	0.2	82.0	-0.1	0.1	149.7	-0.1	0.1	190.0	-0.2	0.2
2038/39	147.0	-0.2	0.2	223.1	-0.3	0.3	81.9	-0.1	0.1	149.7	-0.1	0.1	190.1	-0.2	0.2
2039/40	147.2	-0.2	0.2	223.0	-0.3	0.3	82.0	-0.1	0.1	149.8	-0.1	0.1	190.2	-0.2	0.2
2040/41	147.7	-0.2	0.2	222.8	-0.3	0.3	82.2	-0.1	0.1	149.8	-0.1	0.1	190.3	-0.2	0.2
2041/42	147.8	-0.2	0.2	222.9	-0.3	0.3	82.3	-0.1	0.1	149.9	-0.1	0.1	190.4	-0.2	0.2
2042/43	148.4	-0.2	0.2	222.5	-0.3	0.3	82.5	-0.1	0.1	150.0	-0.2	0.2	190.5	-0.2	0.2
2043/44	149.0	-0.2	0.2	222.1	-0.3	0.3	82.6	-0.1	0.1	150.0	-0.2	0.2	190.7	-0.2	0.2
2044/45	149.2	-0.2	0.2	221.9	-0.3	0.3	83.1	-0.1	0.1	150.1	-0.2	0.2	190.8	-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	144.9	0.25	0.19
Roadford	217.9	0.37	0.28
Wimbleball	77.0	0.13	0.10
Bournemouth	145.3	0.25	0.19
Total	**585.1**	**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	144.9	0.0	0.0	217.9	0.0	0.0	77.0	0.0	0.0	145.3	0.0	0.0	184.3	0.0	0.0
2016/17	146.7	0.0	0.0	221.1	0.0	0.0	78.5	0.0	0.0	146.2	0.0	0.0	186.2	0.0	0.0
2017/18	150.0	0.0	0.0	226.1	-0.1	0.1	80.3	0.0	0.0	149.5	0.0	0.0	188.8	0.0	0.0
2018/19	147.3	-0.1	0.1	222.3	-0.1	0.1	79.4	0.0	0.0	149.0	-0.1	0.1	188.0	-0.1	0.1
2019/20	146.7	-0.1	0.1	221.5	-0.1	0.1	79.2	0.0	0.0	148.5	-0.1	0.1	187.5	-0.1	0.1
2020/21	146.0	-0.1	0.1	221.1	-0.1	0.1	79.7	0.0	0.0	148.4	-0.1	0.1	187.5	-0.1	0.1
2021/22	145.0	-0.1	0.1	221.6	-0.2	0.2	80.0	-0.1	0.1	148.4	-0.1	0.1	187.5	-0.1	0.1
2022/23	145.0	-0.1	0.1	221.0	-0.2	0.2	80.4	-0.1	0.1	148.4	-0.1	0.1	187.6	-0.1	0.1
2023/24	144.2	-0.1	0.1	221.7	-0.2	0.2	80.6	-0.1	0.1	148.5	-0.1	0.1	187.6	-0.1	0.1
2024/25	144.5	-0.2	0.2	220.7	-0.3	0.3	81.2	-0.1	0.1	148.5	-0.2	0.2	187.8	-0.2	0.2
2025/26	144.2	-0.2	0.2	221.0	-0.3	0.3	81.5	-0.1	0.1	148.6	-0.2	0.2	187.9	-0.2	0.2
2026/27	144.0	-0.2	0.2	222.0	-0.3	0.3	81.0	-0.1	0.1	148.7	-0.2	0.2	188.1	-0.2	0.2
2027/28	144.1	-0.2	0.2	222.0	-0.3	0.3	81.4	-0.1	0.1	148.8	-0.2	0.2	188.3	-0.2	0.2
2028/29	144.4	-0.2	0.2	222.0	-0.4	0.4	81.6	-0.1	0.1	149.0	-0.2	0.2	188.6	-0.2	0.2
2029/30	144.2	-0.3	0.3	222.5	-0.4	0.4	81.9	-0.1	0.1	149.1	-0.3	0.3	188.8	-0.3	0.3
2030/31	144.2	-0.3	0.3	222.8	-0.4	0.4	82.1	-0.1	0.1	149.2	-0.3	0.3	189.0	-0.3	0.3
2031/32	144.7	-0.3	0.3	222.9	-0.4	0.4	81.9	-0.2	0.2	149.3	-0.3	0.3	189.2	-0.3	0.3
2032/33	145.3	-0.3	0.3	222.6	-0.5	0.5	82.0	-0.2	0.2	149.4	-0.3	0.3	189.3	-0.3	0.3
2033/34	146.0	-0.3	0.3	222.2	-0.5	0.5	82.1	-0.2	0.2	149.4	-0.3	0.3	189.5	-0.3	0.3
2034/35	146.2	-0.4	0.4	222.3	-0.5	0.5	82.2	-0.2	0.2	149.5	-0.4	0.4	189.6	-0.4	0.4
2035/36	146.0	-0.4	0.4	222.7	-0.6	0.6	82.4	-0.2	0.2	149.6	-0.4	0.4	189.8	-0.4	0.4
2036/37	146.4	-0.4	0.4	222.8	-0.6	0.6	82.2	-0.2	0.2	149.6	-0.4	0.4	189.9	-0.4	0.4
2037/38	146.6	-0.4	0.4	223.1	-0.6	0.6	82.0	-0.2	0.2	149.7	-0.4	0.4	190.0	-0.4	0.4
2038/39	147.0	-0.4	0.4	223.1	-0.6	0.6	81.9	-0.2	0.2	149.7	-0.4	0.4	190.1	-0.4	0.4
2039/40	147.2	-0.4	0.4	223.0	-0.7	0.7	82.0	-0.2	0.2	149.8	-0.4	0.4	190.2	-0.4	0.4
2040/41	147.7	-0.5	0.5	222.8	-0.7	0.7	82.2	-0.2	0.2	149.8	-0.5	0.5	190.3	-0.5	0.5
2041/42	147.8	-0.5	0.5	222.9	-0.7	0.7	82.3	-0.3	0.3	149.9	-0.5	0.5	190.4	-0.5	0.5
2042/43	148.4	-0.5	0.5	222.5	-0.8	0.8	82.5	-0.3	0.3	150.0	-0.5	0.5	190.5	-0.5	0.5
2043/44	149.0	-0.5	0.5	222.1	-0.8	0.8	82.6	-0.3	0.3	150.0	-0.5	0.5	190.7	-0.5	0.5
2044/45	149.2	-0.5	0.5	221.9	-0.8	0.8	83.1	-0.3	0.3	150.1	-0.5	0.5	190.8	-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 are 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)	0.96	2.67	4.57	6.52	8.57	10.97	**13.68**	16.91	21.61
Roadford WRZ (Ml/d)	2.36	4.88	7.62	10.20	13.01	16.38	**20.38**	25.26	32.05
Wimbleball WRZ (Ml/d)	0.38	1.32	2.33	3.37	4.46	5.65	**7.10**	8.99	11.68
Bournemouth WRZ DYAA (Ml/d)	1.84	3.73	5.84	7.97	10.52	13.15	**15.92**	19.20	24.54
Bournemouth WRZ DYCP (Ml/d)	2.29	4.51	6.87	9.32	12.12	15.27	**18.36**	22.70	29.11

* *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.

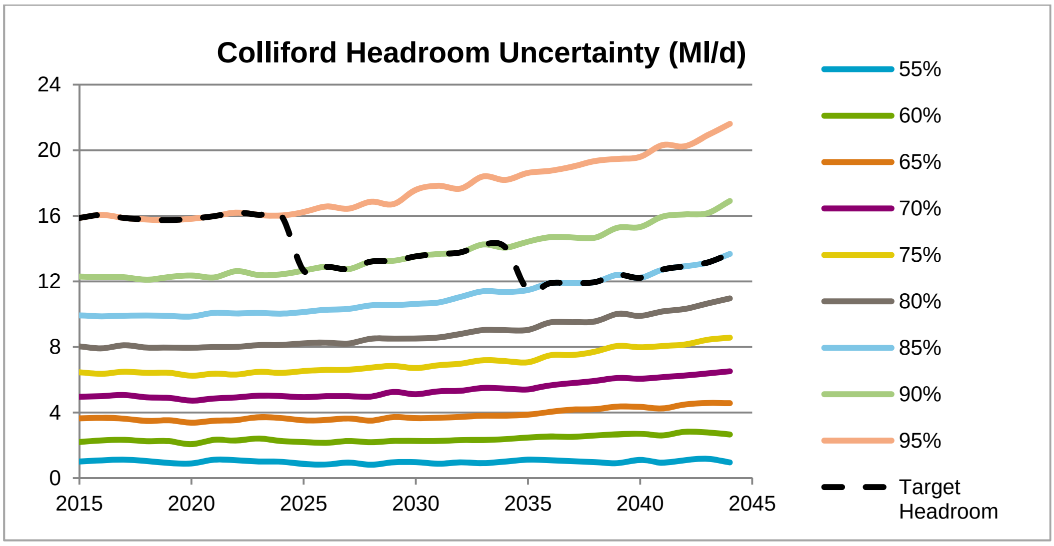
For WRMP14 the risk profile chosen was the 85th percentile at the start of the planning period, falling to the 70th by the end of the planning period. In its 2020 Direction, OFWAT has instructed companies to use 95% uncertainty (or equivalent for complex methods) for the first five years of the planning 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.

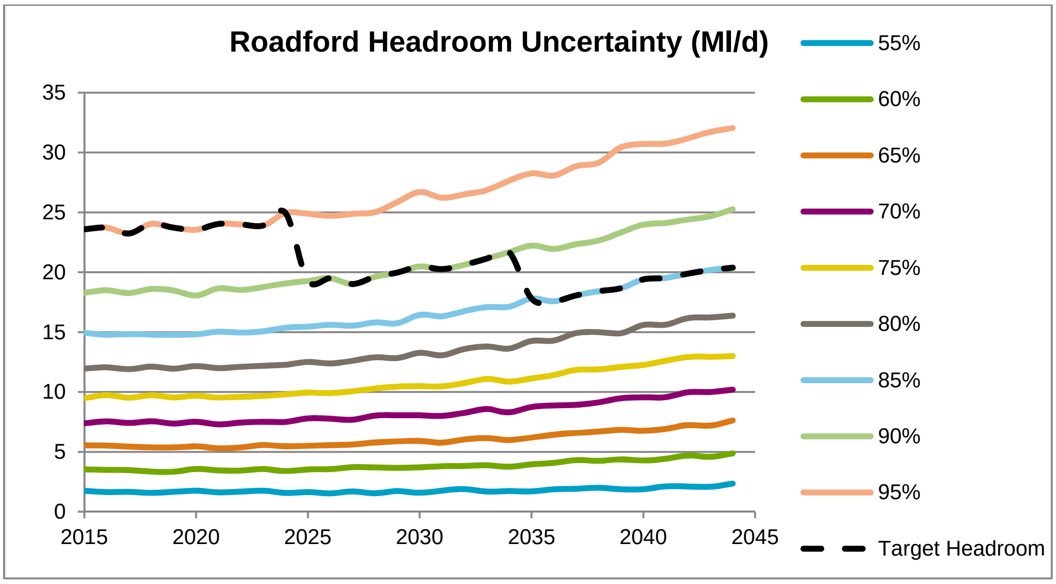
Table 4-2 WRMP19 Target headroom risk profile

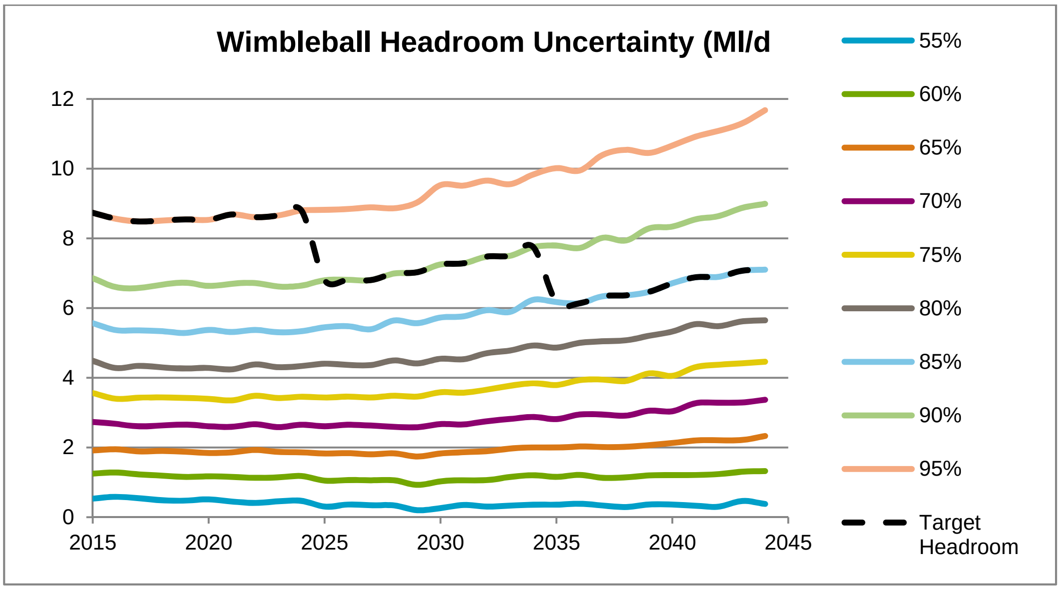
Component	2020/21 - 2024/25	2025/26 - 2029/30	2030/31 - 2034/35	2035/36 - 2039/40	2040/41 – 2044/45
Risk of variation (reduced surplus/ increased deficit) in the supply-demand balance	5%	10%	10%	15%	15%
Headroom distribution probability	95%	90%	90%	85%	85%

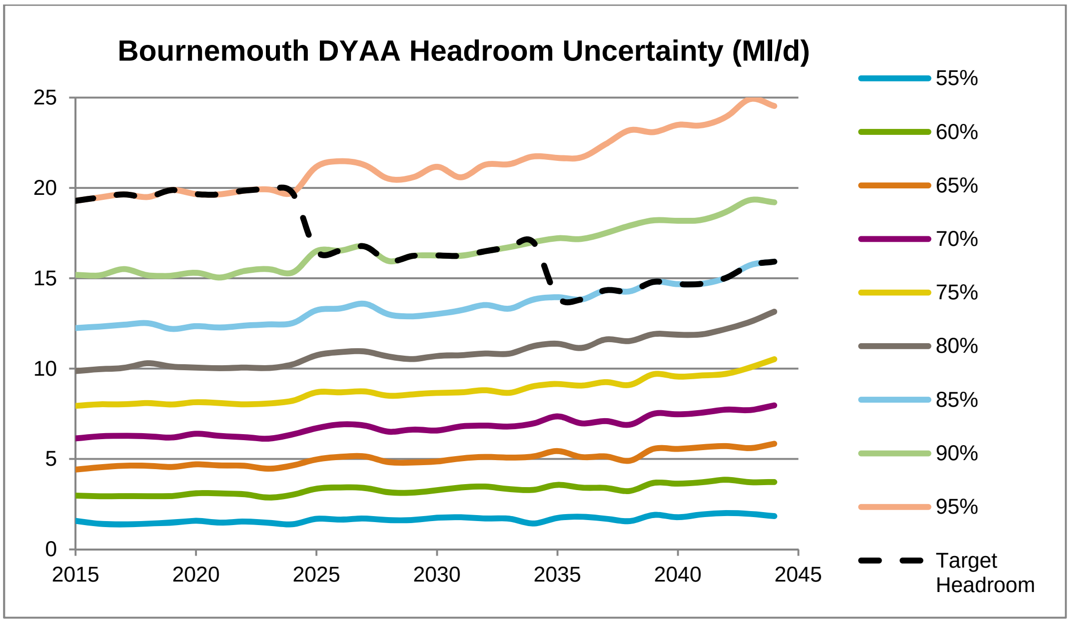
Figure 4-1 below summarises how the headroom uncertainty varies over time in each WRZ as well as the target headroom based on the acceptable level of risk over the planning period. Generally, the uncertainty increases with time; however, the glide path approach means that the headroom allowance is actually 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).

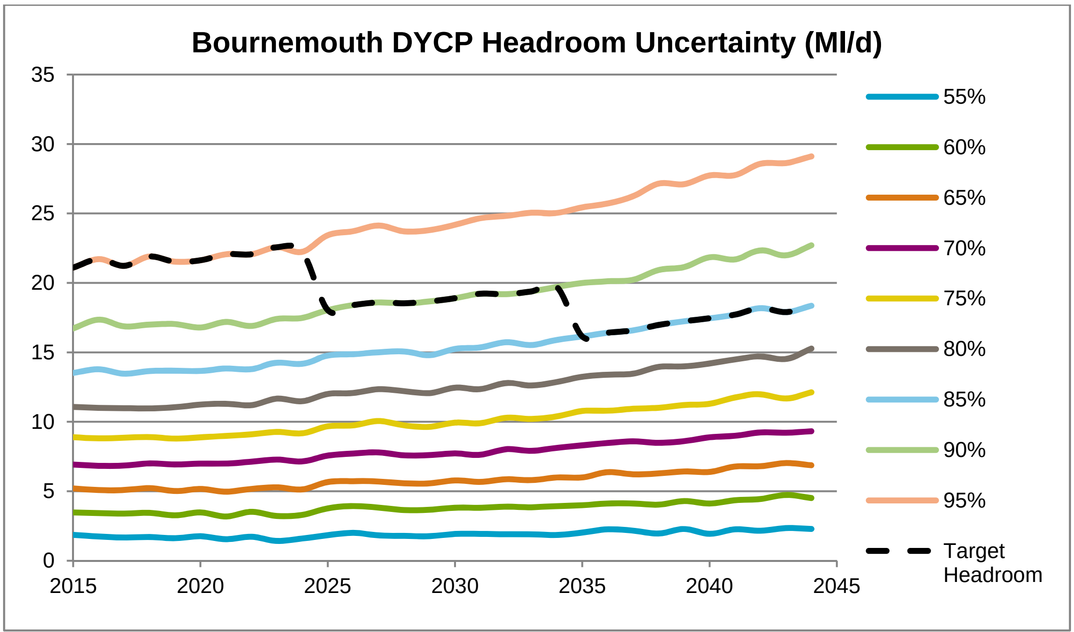
Figure 4-1: Target headroom risk profile







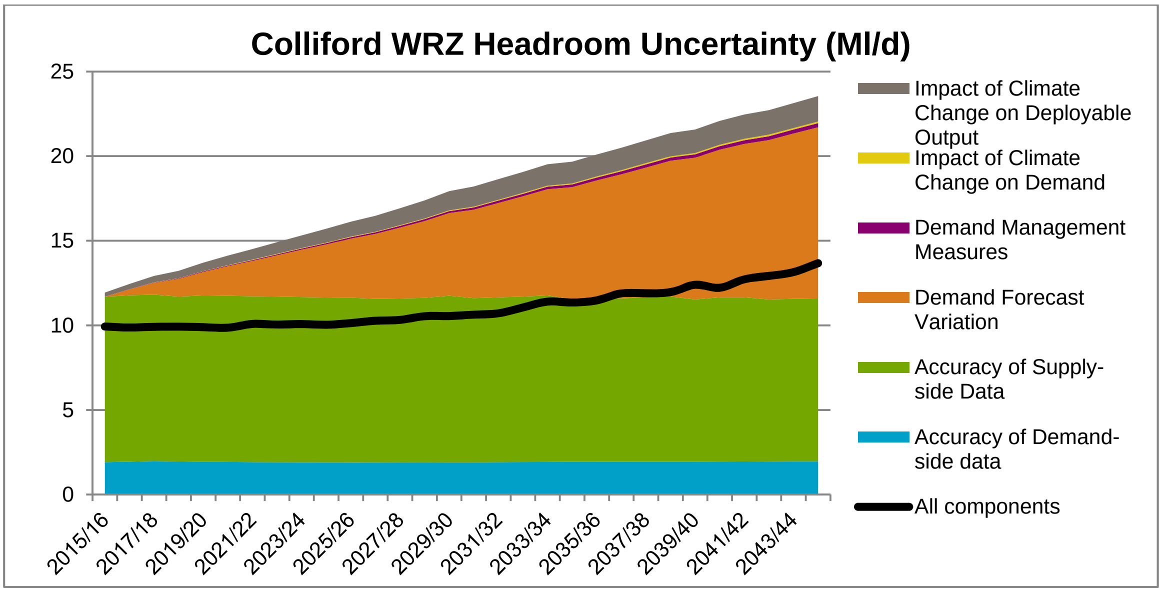


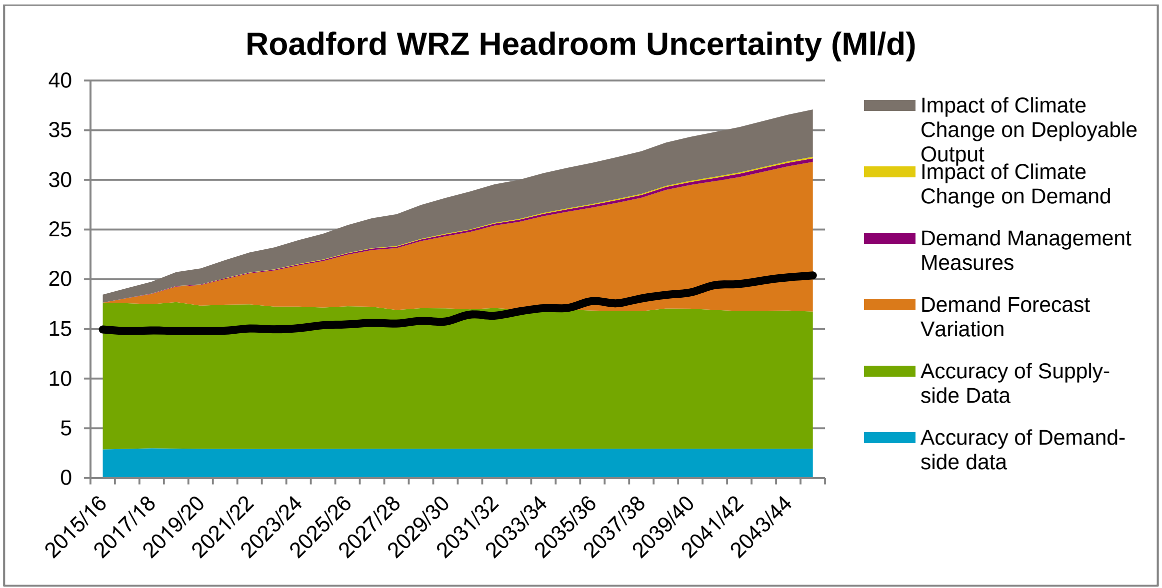


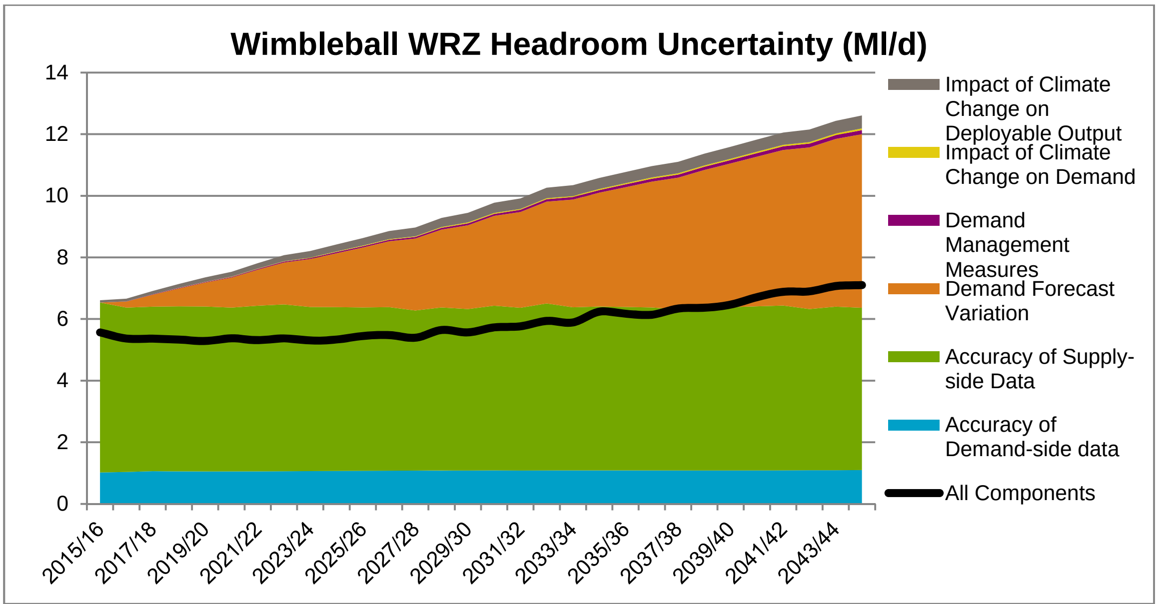
4.3 Headroom by uncertainty factor

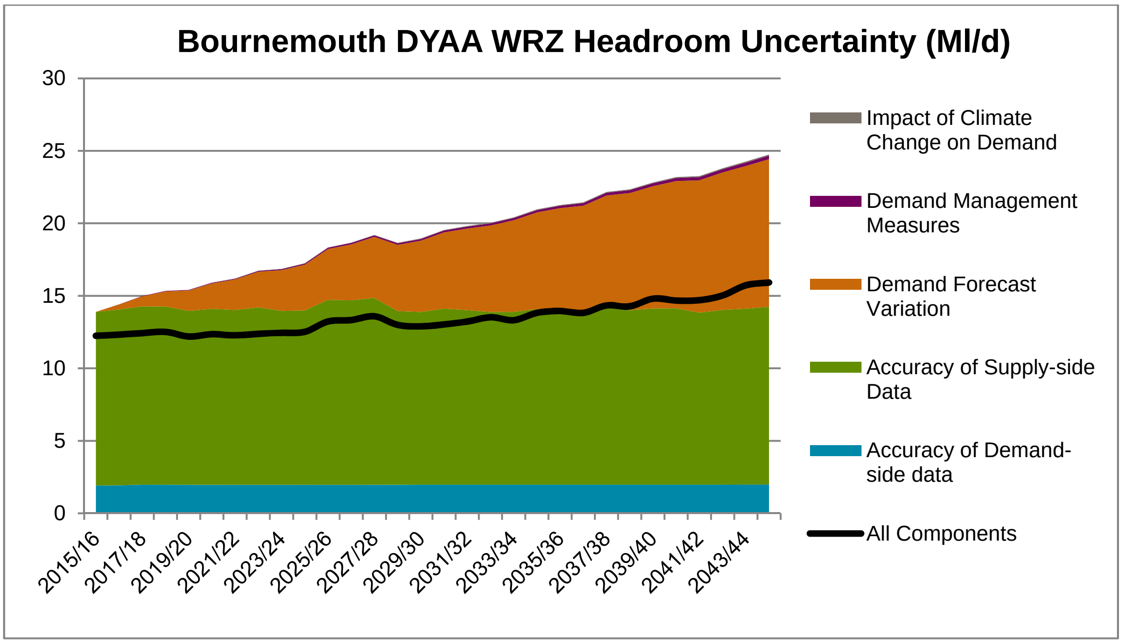
The relative contribution of the different components of the target headroom assessment is shown in Figure 4-2 below. It should be noted that the sum of the different categories does not match the target headroom. This is because the sum of the individual categories does not provide a statistically correct 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 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.

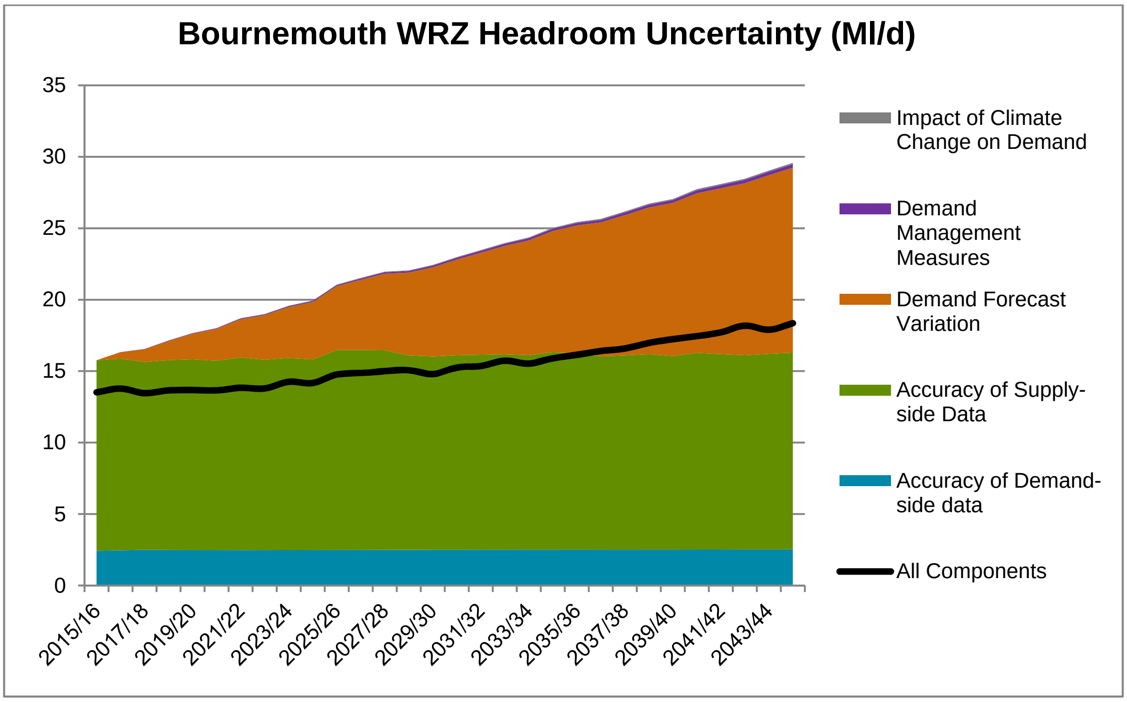
Figure 4-2: Relative contribution of the different categories to the target headroom at the 85th percentile







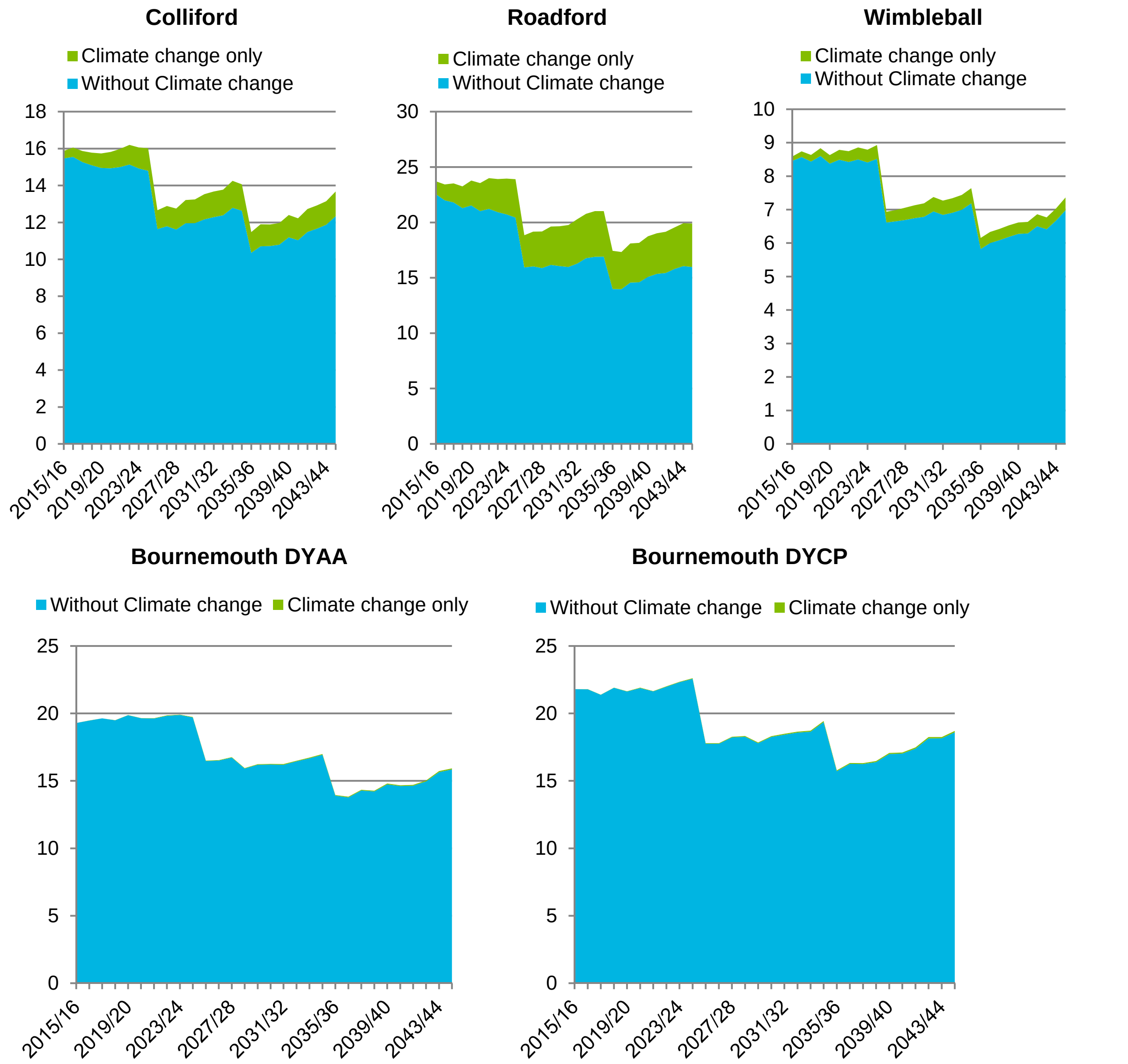




4.4 Impact of climate change on the target headroom

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 WRMP19 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 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.

The headroom allowance for Bournemouth WRZ is significantly higher than in WRMP14. This is mainly because the WRMP14 assessment for Bournemouth did not consider 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 WRMP19	
	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	15.87	13.68
Roadford	23.72	21.52	23.59	20.38
Wimbleball	6.66	7.50	8.73	7.10
Bournemouth (DYAA)*	2.4	3.9	19.29	15.92
Bournemouth (DYCP)*	2.8	5.5	21.10	18.36

Overall the headroom allowance at the start of the planning period is similar to the WRMP14 allowance for Colliford, Roadford and 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 WRMP19

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 WRMP19	End of planning period WRMP19
Colliford	4.6	33.1	2.6	9.8
Roadford	3.9	28.7	5.0	19.2
Wimbleball	4.2	31.5	1.5	5.4
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 WRMP19 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.

Appendix A @Risk Spreadsheet Outputs

A.1 Colliford Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.17	1.01	2.20	3.65	4.96	6.46	8.04	9.93	12.29	15.87
2016/17	-0.11	1.08	2.30	3.67	5.01	6.36	7.92	9.87	12.26	16.06
2017/18	-0.16	1.12	2.34	3.63	5.07	6.49	8.10	9.91	12.26	15.87
2018/19	-0.18	1.05	2.25	3.49	4.93	6.42	7.97	9.92	12.10	15.78
2019/20	-0.18	0.91	2.26	3.53	4.89	6.43	7.97	9.90	12.27	15.74
2020/21	-0.34	0.90	2.07	3.38	4.73	6.25	7.95	9.86	12.37	15.82
2021/22	-0.11	1.12	2.34	3.50	4.86	6.37	7.99	10.08	12.24	15.98
2022/23	-0.13	1.10	2.30	3.54	4.93	6.32	8.01	10.05	12.63	16.20
2023/24	-0.33	1.02	2.42	3.72	5.03	6.49	8.12	10.08	12.39	16.06
2024/25	-0.25	1.01	2.26	3.67	5.01	6.42	8.12	10.03	12.43	16.02
2025/26	-0.34	0.86	2.20	3.53	4.94	6.53	8.22	10.13	12.66	16.23
2026/27	-0.49	0.84	2.16	3.55	5.00	6.60	8.27	10.27	12.89	16.57
2027/28	-0.32	0.95	2.26	3.64	5.00	6.61	8.21	10.32	12.75	16.44
2028/29	-0.52	0.82	2.19	3.51	4.98	6.74	8.51	10.54	13.21	16.86
2029/30	-0.34	0.97	2.27	3.73	5.26	6.84	8.51	10.55	13.25	16.71
2030/31	-0.34	0.98	2.27	3.66	5.12	6.71	8.52	10.63	13.53	17.58
2031/32	-0.61	0.88	2.27	3.69	5.29	6.88	8.58	10.71	13.67	17.84
2032/33	-0.38	0.96	2.32	3.73	5.33	6.98	8.80	11.06	13.77	17.66
2033/34	-0.54	0.91	2.33	3.81	5.50	7.19	9.03	11.40	14.25	18.40
2034/35	-0.42	1.01	2.37	3.81	5.46	7.14	9.03	11.35	14.07	18.19
2035/36	-0.35	1.13	2.48	3.87	5.41	7.07	9.04	11.48	14.43	18.62
2036/37	-0.37	1.09	2.54	4.04	5.67	7.49	9.50	11.90	14.70	18.75
2037/38	-0.51	1.03	2.51	4.18	5.79	7.51	9.52	11.89	14.68	19.01
2038/39	-0.59	0.97	2.61	4.21	5.94	7.72	9.56	11.96	14.67	19.35
2039/40	-0.65	0.91	2.66	4.37	6.11	8.07	10.02	12.40	15.28	19.47
2040/41	-0.44	1.11	2.71	4.35	6.06	7.98	9.90	12.22	15.32	19.60
2041/42	-0.63	0.94	2.61	4.25	6.16	8.06	10.17	12.72	15.95	20.32
2042/43	-0.50	1.10	2.83	4.49	6.26	8.15	10.32	12.92	16.09	20.24
2043/44	-0.60	1.18	2.79	4.59	6.39	8.44	10.65	13.15	16.16	20.91
2044/45	-0.74	0.96	2.67	4.57	6.52	8.57	10.97	13.68	16.91	21.61

A.2 Roadford Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.06	1.75	3.54	5.56	7.39	9.49	11.96	14.94	18.29	23.59
2016/17	-0.25	1.64	3.50	5.52	7.55	9.74	12.06	14.78	18.50	23.72
2017/18	-0.08	1.66	3.48	5.44	7.42	9.53	11.91	14.84	18.27	23.24
2018/19	-0.22	1.58	3.35	5.37	7.56	9.73	12.12	14.79	18.60	24.05
2019/20	-0.17	1.66	3.35	5.37	7.37	9.55	11.95	14.78	18.47	23.72
2020/21	-0.08	1.76	3.58	5.47	7.52	9.69	12.17	14.82	18.06	23.55
2021/22	-0.25	1.62	3.45	5.30	7.30	9.53	12.00	15.04	18.65	24.04
2022/23	-0.23	1.68	3.45	5.38	7.45	9.60	12.11	14.96	18.53	24.00
2023/24	-0.16	1.76	3.57	5.58	7.51	9.67	12.19	15.07	18.76	23.90
2024/25	-0.35	1.58	3.40	5.47	7.50	9.79	12.27	15.37	19.08	24.95
2025/26	-0.42	1.64	3.54	5.51	7.80	9.96	12.51	15.46	19.27	24.89
2026/27	-0.32	1.54	3.56	5.56	7.77	9.90	12.38	15.61	19.50	24.71
2027/28	-0.27	1.70	3.72	5.62	7.69	10.07	12.61	15.54	19.02	24.88
2028/29	-0.34	1.55	3.71	5.79	8.03	10.30	12.90	15.81	19.62	25.02
2029/30	-0.27	1.73	3.67	5.87	8.07	10.46	12.84	15.75	19.98	25.86
2030/31	-0.33	1.58	3.71	5.92	8.06	10.49	13.27	16.44	20.48	26.70
2031/32	-0.32	1.78	3.80	5.77	8.01	10.47	13.07	16.32	20.26	26.22
2032/33	-0.08	1.89	3.84	6.04	8.26	10.75	13.59	16.76	20.63	26.51
2033/34	-0.35	1.69	3.88	6.16	8.58	11.10	13.80	17.09	21.14	26.86
2034/35	-0.29	1.73	3.76	5.98	8.30	10.87	13.63	17.12	21.68	27.65
2035/36	-0.48	1.70	3.96	6.20	8.75	11.13	14.27	17.80	22.22	28.26
2036/37	-0.30	1.88	4.09	6.45	8.88	11.42	14.30	17.58	21.95	28.08
2037/38	-0.24	1.92	4.32	6.57	8.93	11.85	14.92	18.07	22.35	28.86
2038/39	-0.42	2.00	4.25	6.70	9.14	11.89	15.00	18.42	22.65	29.14
2039/40	-0.37	1.88	4.38	6.84	9.48	12.10	14.91	18.67	23.32	30.43
2040/41	-0.50	1.88	4.28	6.76	9.56	12.26	15.60	19.41	23.98	30.72
2041/42	-0.42	2.12	4.43	6.92	9.57	12.61	15.62	19.52	24.12	30.74
2042/43	-0.53	2.12	4.70	7.24	9.98	12.93	16.17	19.89	24.40	31.19
2043/44	-0.47	2.08	4.59	7.20	10.00	12.93	16.23	20.19	24.68	31.72
2044/45	-0.28	2.36	4.88	7.62	10.20	13.01	16.38	20.38	25.26	32.05

A.3 Wimbleball Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.11	0.53	1.25	1.91	2.73	3.56	4.48	5.57	6.86	8.73
2016/17	-0.14	0.58	1.28	1.95	2.68	3.40	4.28	5.37	6.60	8.56
2017/18	-0.11	0.54	1.23	1.88	2.61	3.43	4.34	5.36	6.58	8.48
2018/19	-0.22	0.48	1.19	1.90	2.63	3.44	4.30	5.33	6.67	8.51
2019/20	-0.17	0.48	1.15	1.88	2.66	3.42	4.27	5.29	6.73	8.55
2020/21	-0.19	0.51	1.17	1.84	2.61	3.40	4.28	5.37	6.63	8.53
2021/22	-0.24	0.45	1.16	1.86	2.59	3.35	4.24	5.31	6.70	8.69
2022/23	-0.27	0.41	1.13	1.93	2.67	3.48	4.38	5.37	6.72	8.61
2023/24	-0.22	0.45	1.14	1.87	2.58	3.42	4.30	5.30	6.62	8.66
2024/25	-0.25	0.47	1.18	1.86	2.65	3.45	4.34	5.33	6.64	8.80
2025/26	-0.35	0.30	1.05	1.83	2.61	3.43	4.40	5.45	6.80	8.82
2026/27	-0.37	0.36	1.06	1.84	2.65	3.46	4.37	5.48	6.81	8.84
2027/28	-0.33	0.34	1.06	1.80	2.63	3.43	4.36	5.39	6.80	8.89
2028/29	-0.37	0.34	1.06	1.83	2.59	3.48	4.50	5.64	6.99	8.86
2029/30	-0.47	0.20	0.93	1.74	2.58	3.46	4.41	5.57	7.03	9.03
2030/31	-0.47	0.26	1.02	1.83	2.67	3.58	4.54	5.73	7.25	9.53
2031/32	-0.39	0.35	1.06	1.86	2.66	3.57	4.53	5.76	7.29	9.52
2032/33	-0.44	0.30	1.06	1.89	2.75	3.66	4.71	5.94	7.48	9.66
2033/34	-0.51	0.33	1.15	1.96	2.82	3.77	4.78	5.89	7.50	9.55
2034/35	-0.48	0.36	1.20	2.00	2.87	3.84	4.92	6.24	7.75	9.83
2035/36	-0.41	0.36	1.16	2.00	2.81	3.79	4.86	6.17	7.79	10.02
2036/37	-0.39	0.38	1.21	2.03	2.94	3.93	5.00	6.14	7.72	9.95
2037/38	-0.52	0.33	1.13	2.01	2.94	3.95	5.05	6.34	8.02	10.40
2038/39	-0.55	0.29	1.14	2.01	2.91	3.91	5.07	6.37	7.94	10.54
2039/40	-0.49	0.36	1.20	2.07	3.05	4.13	5.21	6.47	8.29	10.45
2040/41	-0.52	0.36	1.21	2.12	3.04	4.05	5.32	6.71	8.34	10.66
2041/42	-0.54	0.33	1.21	2.20	3.27	4.30	5.54	6.88	8.55	10.92
2042/43	-0.59	0.30	1.23	2.21	3.28	4.38	5.48	6.90	8.64	11.09
2043/44	-0.44	0.46	1.31	2.21	3.29	4.42	5.62	7.07	8.87	11.30
2044/45	-0.52	0.38	1.32	2.33	3.37	4.46	5.65	7.10	8.99	11.68

A.4 Bournemouth DYAA Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	0.10	1.57	2.97	4.42	6.14	7.94	9.86	12.25	15.19	19.29
2016/17	-0.08	1.41	2.94	4.54	6.26	8.03	9.97	12.33	15.17	19.48
2017/18	-0.15	1.38	2.94	4.63	6.29	8.03	10.04	12.43	15.51	19.64
2018/19	-0.06	1.43	2.94	4.62	6.26	8.09	10.30	12.52	15.17	19.50
2019/20	0.03	1.48	2.95	4.56	6.19	8.02	10.11	12.20	15.16	19.89
2020/21	-0.11	1.58	3.10	4.70	6.40	8.14	10.06	12.35	15.31	19.66
2021/22	0.00	1.48	3.09	4.64	6.28	8.09	10.02	12.27	15.04	19.64
2022/23	0.04	1.54	3.05	4.63	6.21	8.02	10.06	12.38	15.40	19.85
2023/24	0.06	1.47	2.87	4.46	6.12	8.08	10.04	12.45	15.51	19.92
2024/25	-0.15	1.39	3.02	4.64	6.36	8.22	10.23	12.52	15.32	19.73
2025/26	0.12	1.69	3.36	4.98	6.70	8.69	10.74	13.23	16.50	21.18
2026/27	0.06	1.65	3.43	5.12	6.91	8.69	10.92	13.33	16.53	21.48
2027/28	-0.03	1.71	3.40	5.14	6.85	8.74	10.95	13.59	16.76	21.27
2028/29	-0.02	1.62	3.16	4.82	6.51	8.50	10.67	13.00	15.95	20.50
2029/30	-0.03	1.63	3.14	4.81	6.63	8.58	10.53	12.90	16.24	20.59
2030/31	0.23	1.75	3.27	4.86	6.58	8.66	10.70	13.03	16.27	21.17
2031/32	0.16	1.77	3.43	5.03	6.80	8.69	10.74	13.23	16.25	20.59
2032/33	-0.04	1.71	3.47	5.12	6.85	8.81	10.84	13.52	16.50	21.29
2033/34	0.02	1.70	3.33	5.08	6.80	8.66	10.83	13.32	16.72	21.32
2034/35	-0.13	1.43	3.29	5.14	6.96	9.03	11.25	13.82	16.99	21.75
2035/36	0.10	1.74	3.57	5.44	7.36	9.15	11.38	13.95	17.22	21.67
2036/37	0.23	1.81	3.42	5.11	6.97	9.06	11.14	13.83	17.17	21.69
2037/38	-0.04	1.70	3.40	5.14	7.10	9.25	11.62	14.34	17.50	22.42
2038/39	-0.12	1.56	3.23	4.91	6.90	9.10	11.53	14.28	17.91	23.19
2039/40	0.04	1.90	3.68	5.57	7.51	9.70	11.91	14.80	18.21	23.09
2040/41	0.08	1.78	3.63	5.56	7.47	9.56	11.88	14.68	18.18	23.49
2041/42	0.14	1.93	3.71	5.65	7.56	9.62	11.90	14.70	18.24	23.47
2042/43	0.15	2.01	3.85	5.72	7.73	9.71	12.20	15.02	18.67	23.93
2043/44	-0.01	1.96	3.72	5.60	7.71	10.07	12.59	15.73	19.33	24.92
2044/45	-0.21	1.84	3.73	5.84	7.97	10.52	13.15	15.92	19.20	24.54

A.5 Bournemouth DYCP Headroom Allowance by Probability

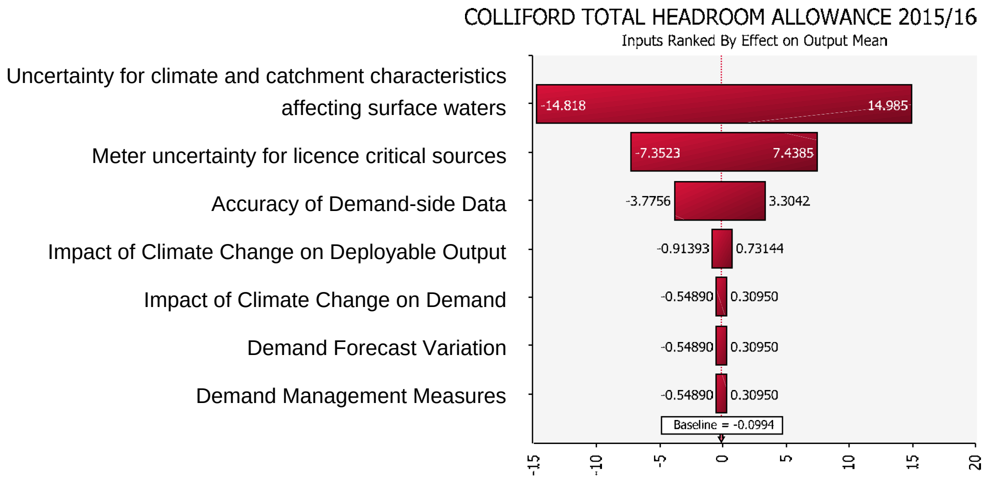
	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	0.07	1.86	3.48	5.20	6.92	8.89	11.07	13.52	16.72	21.10
2016/17	0.06	1.74	3.42	5.09	6.83	8.80	11.01	13.78	17.35	21.71
2017/18	0.09	1.67	3.40	5.09	6.85	8.85	10.98	13.46	16.87	21.23
2018/19	0.03	1.71	3.44	5.23	7.00	8.90	10.96	13.66	17.00	21.90
2019/20	0.02	1.62	3.27	5.01	6.93	8.79	11.05	13.68	17.04	21.53
2020/21	0.05	1.76	3.47	5.16	6.99	8.88	11.24	13.66	16.79	21.63
2021/22	-0.10	1.55	3.18	4.97	6.99	8.98	11.30	13.83	17.19	22.06
2022/23	0.06	1.72	3.52	5.17	7.13	9.10	11.20	13.79	16.90	22.06
2023/24	-0.22	1.42	3.22	5.28	7.28	9.27	11.67	14.26	17.41	22.57
2024/25	-0.16	1.60	3.30	5.13	7.15	9.17	11.48	14.17	17.48	22.24
2025/26	0.06	1.84	3.77	5.66	7.56	9.67	12.00	14.77	18.04	23.43
2026/27	0.11	2.01	3.94	5.73	7.72	9.74	12.07	14.87	18.40	23.72
2027/28	-0.11	1.82	3.82	5.70	7.79	10.06	12.35	15.00	18.59	24.13
2028/29	-0.06	1.79	3.65	5.57	7.58	9.74	12.21	15.06	18.53	23.71
2029/30	0.03	1.76	3.67	5.57	7.60	9.64	12.07	14.80	18.66	23.80
2030/31	-0.02	1.92	3.81	5.78	7.72	9.94	12.46	15.25	18.90	24.18
2031/32	-0.02	1.93	3.81	5.67	7.63	9.90	12.35	15.36	19.22	24.65
2032/33	0.05	1.90	3.89	5.86	8.03	10.29	12.79	15.73	19.18	24.82
2033/34	0.07	1.90	3.84	5.80	7.91	10.21	12.61	15.53	19.39	25.05
2034/35	-0.04	1.85	3.94	5.99	8.12	10.39	12.87	15.90	19.71	25.03
2035/36	0.16	2.02	3.99	5.99	8.31	10.78	13.24	16.14	19.99	25.44
2036/37	0.24	2.26	4.11	6.38	8.47	10.79	13.39	16.41	20.12	25.71
2037/38	0.19	2.16	4.12	6.22	8.59	10.94	13.47	16.58	20.23	26.24
2038/39	-0.10	1.96	4.04	6.28	8.48	11.01	13.95	16.97	20.93	27.15
2039/40	0.29	2.28	4.29	6.43	8.60	11.21	13.99	17.23	21.14	27.11
2040/41	-0.04	1.93	4.12	6.39	8.89	11.30	14.20	17.45	21.84	27.74
2041/42	-0.14	2.26	4.35	6.78	8.99	11.75	14.49	17.71	21.69	27.76
2042/43	-0.03	2.16	4.44	6.80	9.23	11.98	14.70	18.18	22.35	28.58
2043/44	0.07	2.35	4.73	7.03	9.21	11.67	14.52	17.90	21.98	28.63
2044/45	0.09	2.29	4.51	6.87	9.32	12.12	15.27	18.36	22.70	29.11

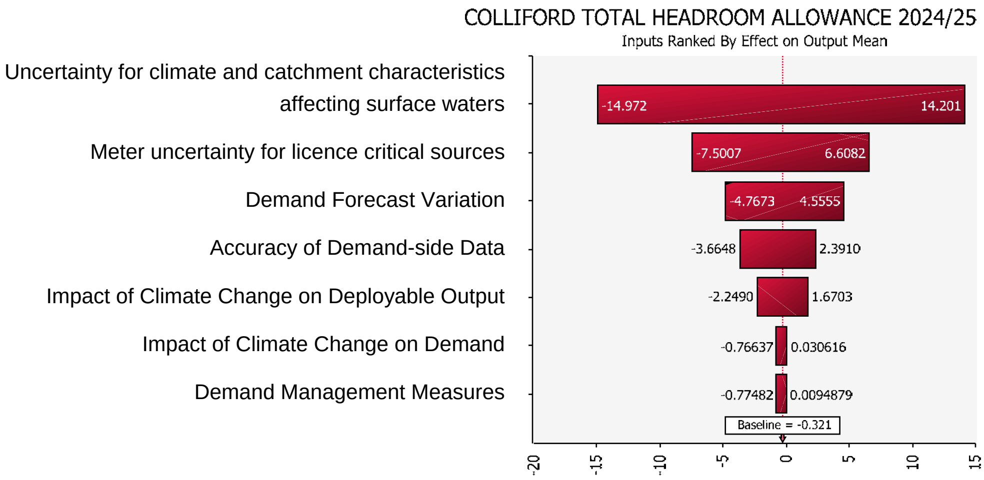
Appendix B Target headroom with and without climate change

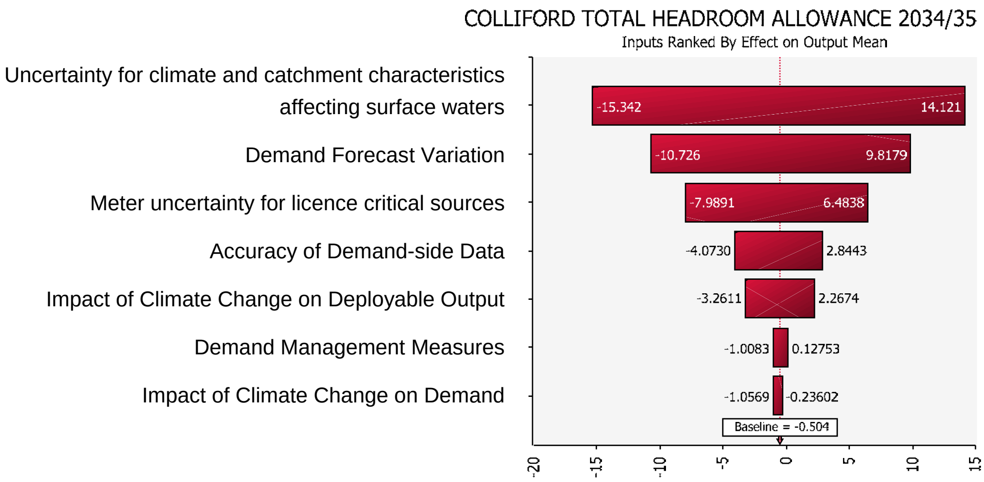
		Colliford			Roadford			Wimbleball			Bournemouth DYAA			Bournemouth DYCP		
Percentile	Year	Without Climate change	Climate change only	*Total check*	Without Climate change	Climate change only	*Total check*	Without Climate change	Climate change only	*Total check*	Without Climate change	Climate change only	*Total check*	Without Climate change	Climate change only	*Total check*
95TH PERC	2015/16	15.47	0.41	*15.87*	22.42	1.17	*23.59*	8.60	0.13	*8.73*	19.29	0.00	*19.29*	21.10	0.00	*21.10*
95TH PERC	2016/17	15.55	0.51	*16.06*	22.27	1.46	*23.72*	8.39	0.17	*8.56*	19.47	0.00	*19.48*	21.71	0.00	*21.71*
95TH PERC	2017/18	15.27	0.60	*15.87*	21.57	1.68	*23.24*	8.29	0.20	*8.48*	19.63	0.01	*19.64*	21.22	0.01	*21.23*
95TH PERC	2018/19	15.09	0.69	*15.78*	22.04	2.01	*24.05*	8.28	0.23	*8.51*	19.49	0.01	*19.50*	21.88	0.01	*21.90*
95TH PERC	2019/20	14.95	0.78	*15.74*	21.48	2.24	*23.72*	8.28	0.27	*8.55*	19.87	0.02	*19.89*	21.51	0.02	*21.53*
95TH PERC	2020/21	14.94	0.88	*15.82*	21.09	2.46	*23.55*	8.24	0.29	*8.53*	19.64	0.02	*19.66*	21.60	0.02	*21.63*
95TH PERC	2021/22	15.00	0.98	*15.98*	21.27	2.77	*24.04*	8.36	0.33	*8.69*	19.62	0.02	*19.64*	22.03	0.03	*22.06*
95TH PERC	2022/23	15.13	1.06	*16.20*	20.99	3.01	*24.00*	8.26	0.35	*8.61*	19.83	0.03	*19.85*	22.03	0.03	*22.06*
95TH PERC	2023/24	14.92	1.14	*16.06*	20.64	3.26	*23.90*	8.28	0.38	*8.66*	19.89	0.03	*19.92*	22.53	0.04	*22.57*
95TH PERC	2024/25	14.80	1.22	*16.02*	21.33	3.62	*24.95*	8.37	0.43	*8.80*	19.70	0.03	*19.73*	22.19	0.04	*22.24*
90TH PERC	2025/26	11.64	1.02	*12.66*	16.29	2.98	*19.27*	6.48	0.32	*6.80*	16.47	0.03	*16.50*	18.01	0.04	*18.04*
90TH PERC	2026/27	11.79	1.10	*12.89*	16.35	3.16	*19.50*	6.47	0.34	*6.81*	16.50	0.03	*16.53*	18.36	0.04	*18.40*
90TH PERC	2027/28	11.62	1.14	*12.75*	15.80	3.22	*19.02*	6.45	0.36	*6.80*	16.72	0.04	*16.76*	18.55	0.05	*18.59*
90TH PERC	2028/29	11.96	1.25	*13.21*	16.16	3.46	*19.62*	6.61	0.38	*6.99*	15.91	0.04	*15.95*	18.48	0.05	*18.53*
90TH PERC	2029/30	11.96	1.29	*13.25*	16.30	3.68	*19.98*	6.62	0.41	*7.03*	16.20	0.04	*16.24*	18.61	0.06	*18.66*
90TH PERC	2030/31	12.17	1.36	*13.53*	16.57	3.92	*20.48*	6.81	0.44	*7.25*	16.22	0.05	*16.27*	18.84	0.06	*18.90*
90TH PERC	2031/32	12.29	1.39	*13.67*	16.37	3.89	*20.26*	6.86	0.43	*7.29*	16.20	0.05	*16.25*	19.16	0.06	*19.22*
90TH PERC	2032/33	12.39	1.38	*13.77*	16.64	3.98	*20.63*	7.03	0.45	*7.48*	16.45	0.05	*16.50*	19.12	0.06	*19.18*
90TH PERC	2033/34	12.79	1.46	*14.25*	17.06	4.08	*21.14*	7.06	0.44	*7.50*	16.67	0.05	*16.72*	19.31	0.07	*19.39*
90TH PERC	2034/35	12.64	1.43	*14.07*	17.48	4.20	*21.68*	7.28	0.47	*7.75*	16.94	0.06	*16.99*	19.64	0.07	*19.71*
85TH PERC	2035/36	10.35	1.12	*11.48*	14.38	3.42	*17.80*	5.85	0.33	*6.17*	13.90	0.05	*13.95*	16.08	0.06	*16.14*
85TH PERC	2036/37	10.70	1.19	*11.90*	14.22	3.35	*17.58*	5.82	0.32	*6.14*	13.78	0.05	*13.83*	16.35	0.07	*16.41*
85TH PERC	2037/38	10.73	1.17	*11.89*	14.54	3.52	*18.07*	6.00	0.33	*6.34*	14.28	0.06	*14.34*	16.51	0.07	*16.58*
85TH PERC	2038/39	10.79	1.17	*11.96*	14.93	3.49	*18.42*	6.03	0.34	*6.37*	14.22	0.06	*14.28*	16.90	0.07	*16.97*
85TH PERC	2039/40	11.20	1.20	*12.40*	15.05	3.62	*18.67*	6.13	0.34	*6.47*	14.74	0.06	*14.80*	17.16	0.08	*17.23*
85TH PERC	2040/41	11.04	1.19	*12.22*	15.67	3.74	*19.41*	6.36	0.35	*6.71*	14.61	0.06	*14.68*	17.37	0.08	*17.45*
85TH PERC	2041/42	11.49	1.24	*12.72*	15.82	3.70	*19.52*	6.53	0.36	*6.88*	14.64	0.06	*14.70*	17.63	0.08	*17.71*
85TH PERC	2042/43	11.67	1.25	*12.92*	16.14	3.74	*19.89*	6.54	0.36	*6.90*	14.96	0.07	*15.02*	18.10	0.09	*18.18*
85TH PERC	2043/44	11.88	1.27	*13.15*	16.38	3.81	*20.19*	6.70	0.37	*7.07*	15.65	0.07	*15.73*	17.81	0.09	*17.90*
85TH PERC	2044/45	12.34	1.34	*13.68*	16.48	3.90	*20.38*	6.72	0.38	*7.10*	15.85	0.07	*15.92*	18.26	0.09	*18.36*

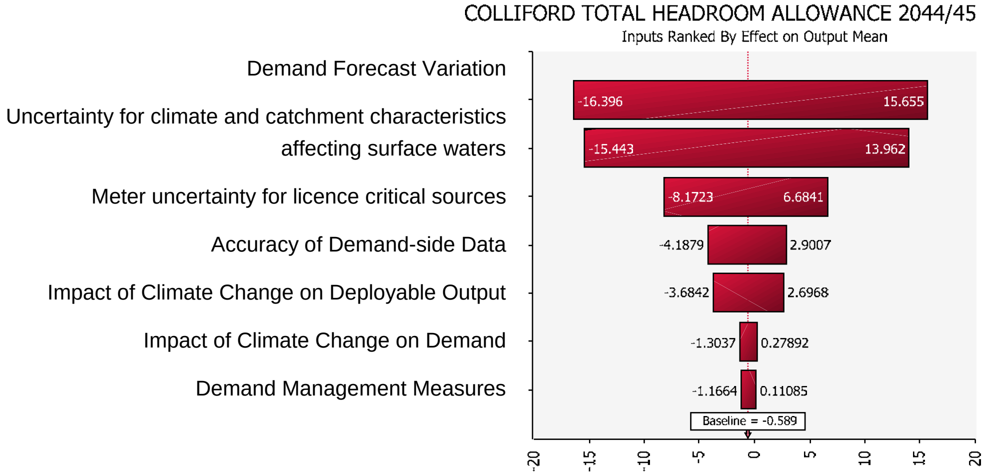
Appendix C @Risk Graphical Outputs

C.1 Colliford

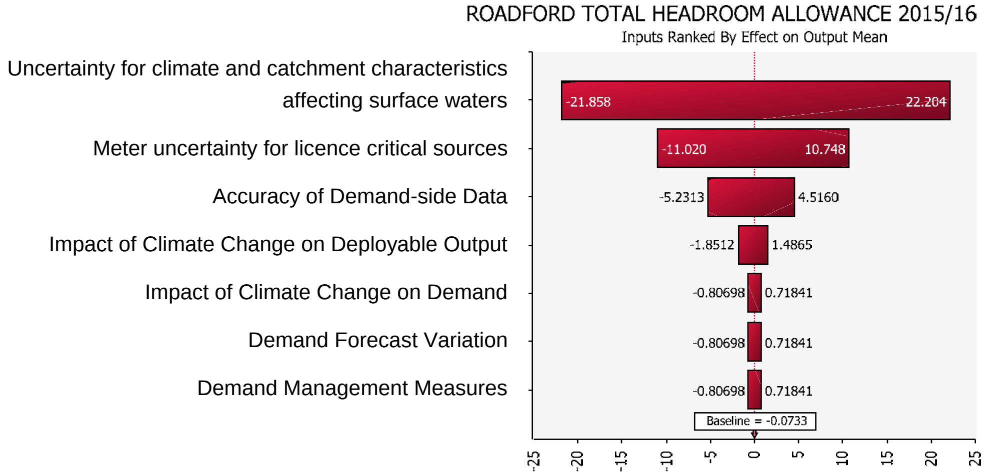







COLLIFORD TOTAL HEADROOM ALLOWANCE 2044/45
Inputs Ranked By Effect on Output Mean
Demand Forecast Variation
Uncertainty for climate and catchment characteristics affecting surface waters
Meter uncertainty for licence critical sources
Accuracy of Demand-side Data
Impact of Climate Change on Deployable Output
Impact of Climate Change on Demand
Demand Management Measures
-16.396
15.655
-15.443
13.962
-8.1723
6.6841
-4.1879
2.9007
-3.6842
2.6968
-1.3037
0.27892
-1.1664
0.11085
Baseline = -0.589
-20
-15
-10
-5
0
5
10
15
20

C.2 Roadford


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
Impact of Climate Change on Demand
Demand Forecast Variation
Demand Management Measures
-21.858
22.204
-11.020
10.748
-5.2313
4.5160
-1.8512
1.4865
-0.80698
0.71841
-0.80698
0.71841
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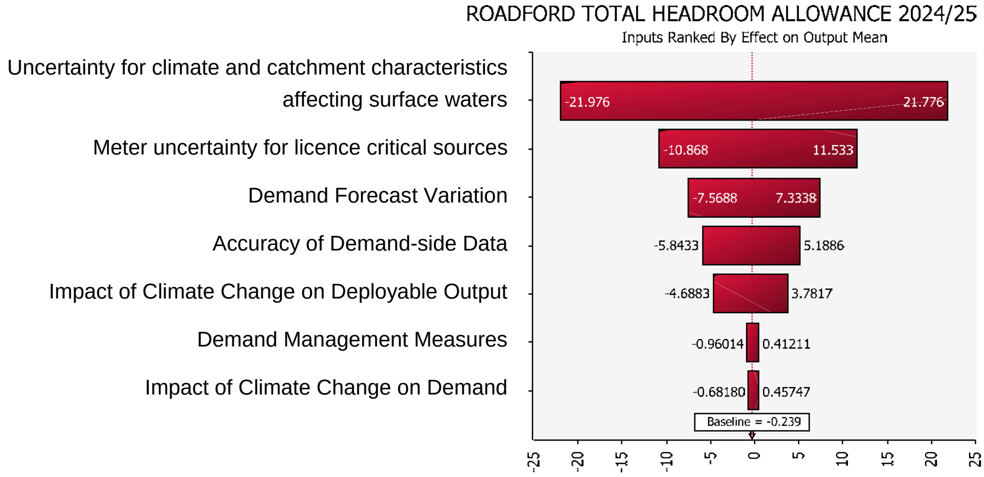
Baseline = -0.0733
-25
-20
-15
-10
-5
0
5
10
15
20
25


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
Demand Management Measures
Impact of Climate Change on Demand
-21.976
21.776
-10.868
11.533
-7.5688
7.3338
-5.8433
5.1886
-4.6883
3.7817
-0.96014
0.41211
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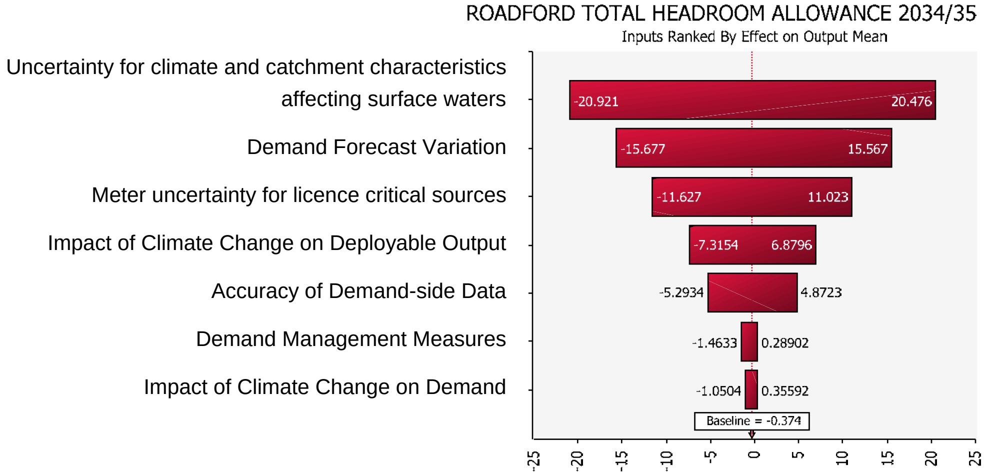
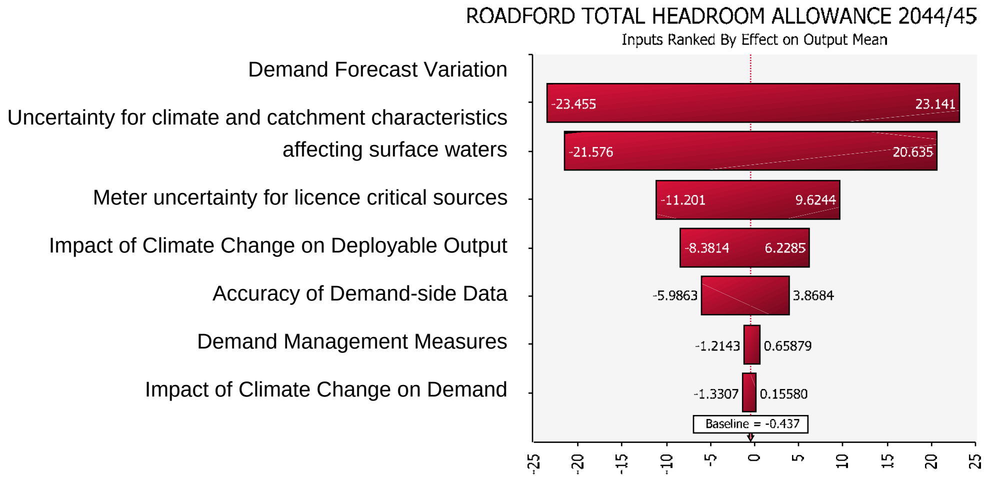
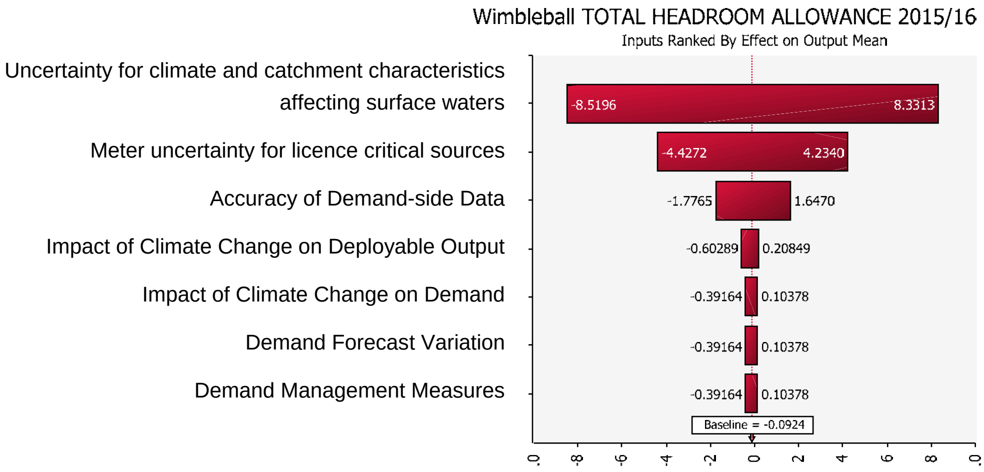
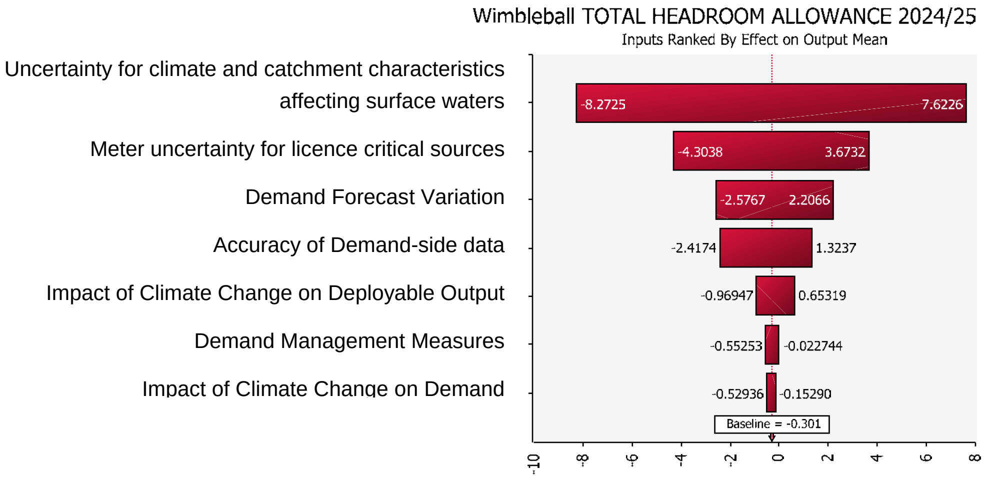
-20
-15
-10
-5
0
5
10
15
20
25

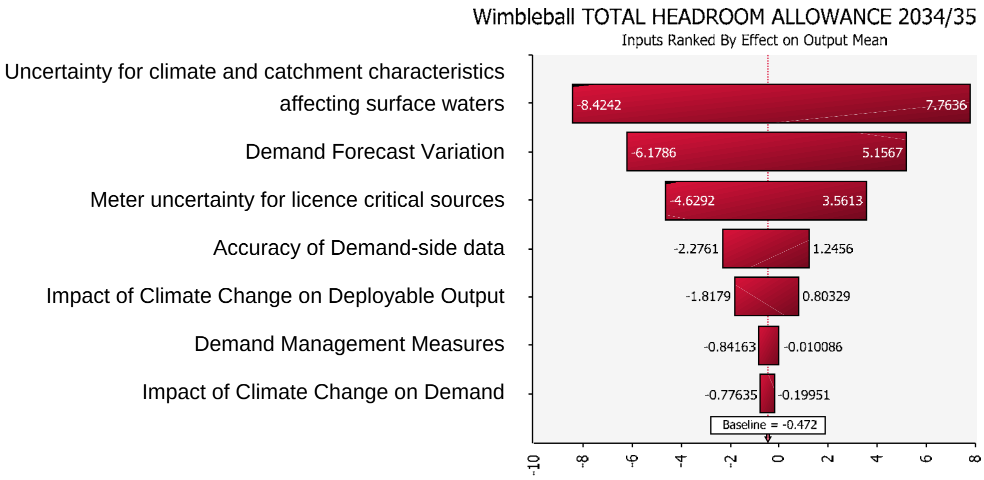


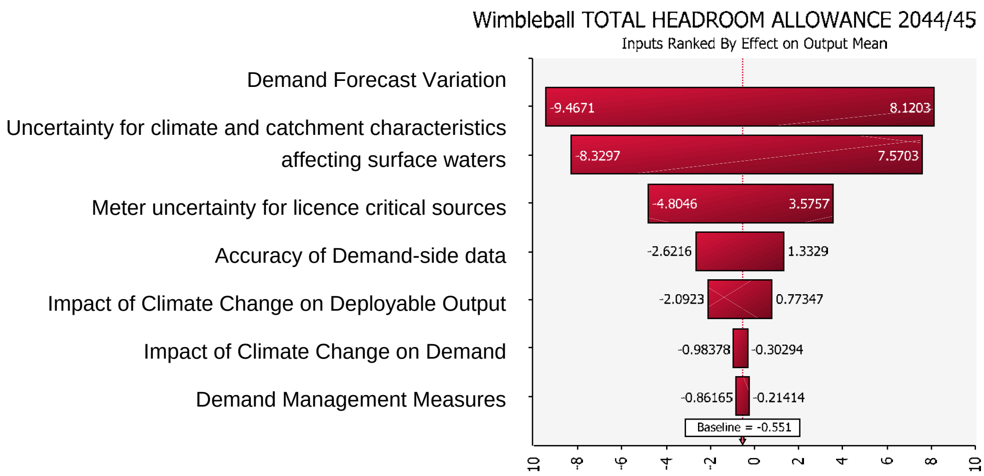


C.3 Wimbleball

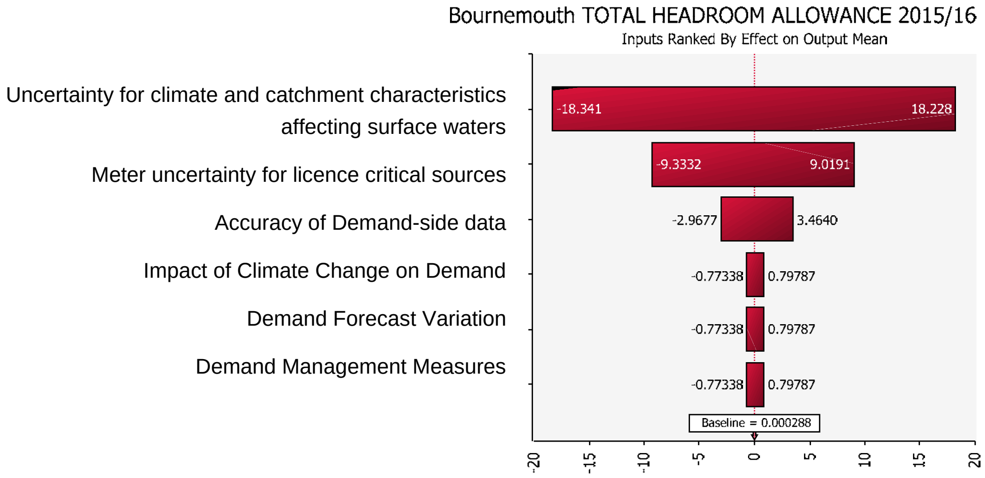


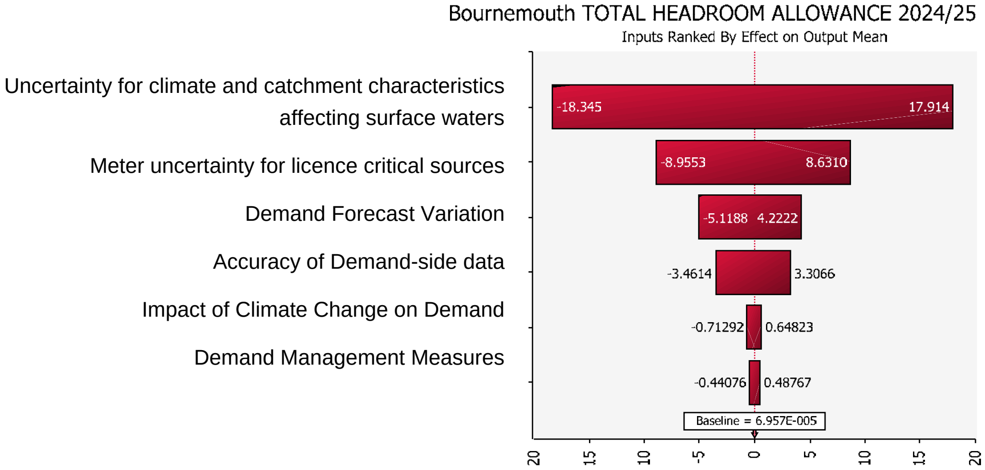

Wimbleball TOTAL HEADROOM ALLOWANCE 2024/25
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
Meter uncertainty for licence critical sources
Demand Forecast Variation
Accuracy of Demand-side data
Impact of Climate Change on Deployable Output
Demand Management Measures
Impact of Climate Change on Demand
-8.2725
7.6226
-4.3038
3.6732
-2.5767
2.2066
-2.4174
1.3237
-0.96947
0.65319
-0.55253
-0.022744
-0.52936
-0.15290
Baseline = -0.301
-10 -8 -6 -4 -2 0 2 4 6 8

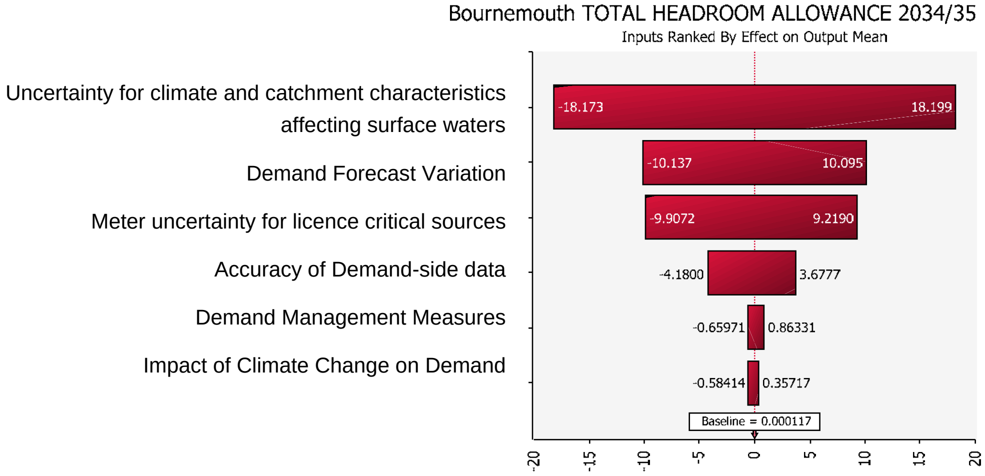

Wimbleball TOTAL HEADROOM ALLOWANCE 2034/35
Inputs Ranked By Effect on Output Mean
Uncertainty for climate and catchment characteristics affecting surface waters
Demand Forecast Variation
Meter uncertainty for licence critical sources
Accuracy of Demand-side data
Impact of Climate Change on Deployable Output
Demand Management Measures
Impact of Climate Change on Demand
-8.4242
7.7636
-6.1786
5.1567
-4.6292
3.5613
-2.2761
1.2456
-1.8179
0.80329
-0.84163
-0.010086
-0.77635
-0.19951
Baseline = -0.472
-10 -8 -6 -4 -2 0 2 4 6 8

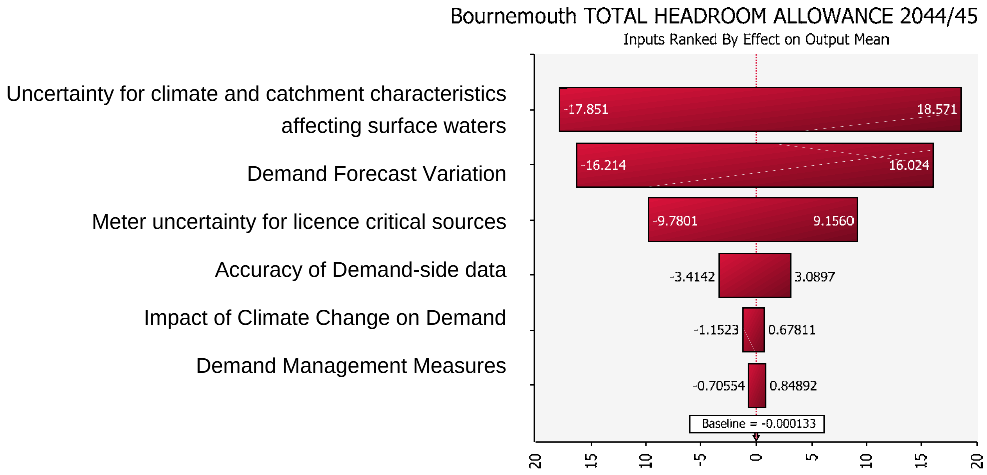

Wimbleball TOTAL HEADROOM ALLOWANCE 2044/45
Inputs Ranked By Effect on Output Mean
Demand Forecast Variation
Uncertainty for climate and catchment characteristics affecting surface waters
Meter uncertainty for licence critical sources
Accuracy of Demand-side data
Impact of Climate Change on Deployable Output
Impact of Climate Change on Demand
Demand Management Measures
-9.4671
8.1203
-8.3297
7.5703
-4.8046
3.5757
-2.6216
1.3329
-2.0923
0.77347
-0.98378
-0.30294
-0.86165
-0.21414
Baseline = -0.551
-10 -8 -6 -4 -2 0 2 4 6 8 10

C.4 Bournemouth DYAA

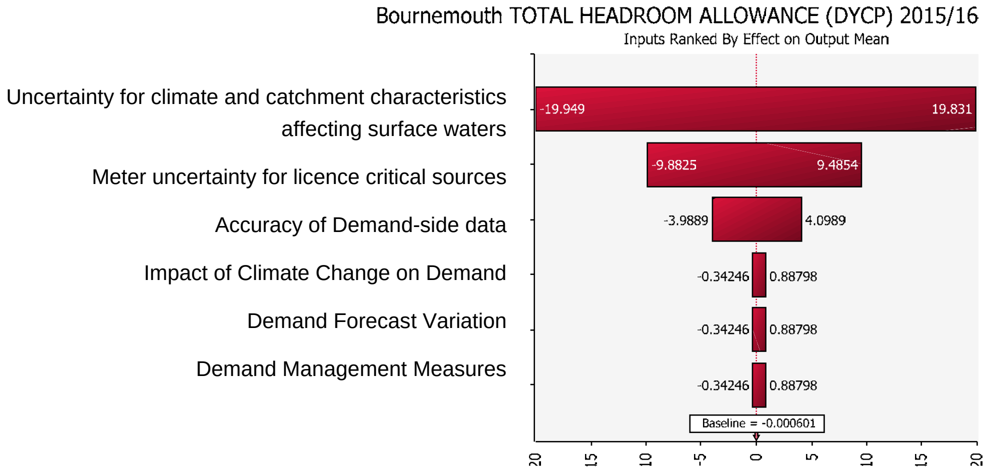


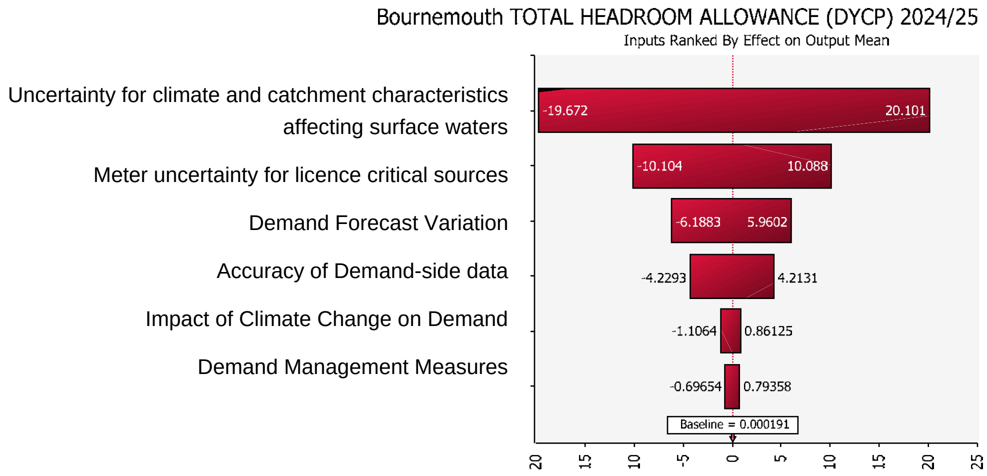


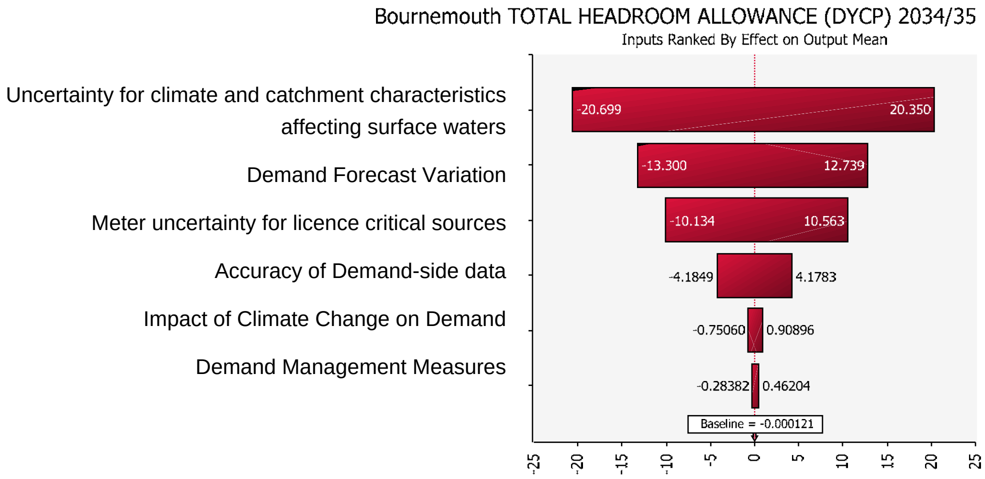


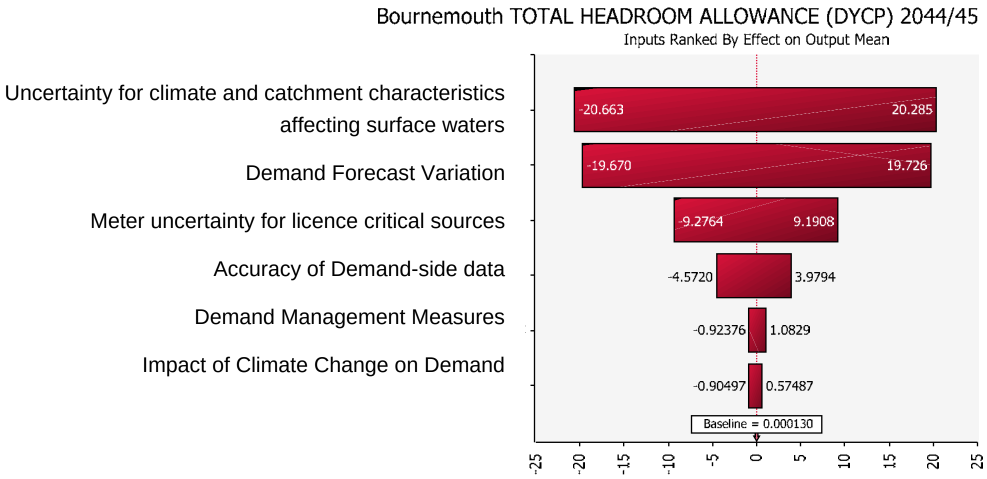


C.5 Bournemouth DYCP






Bournemouth TOTAL HEADROOM ALLOWANCE (DYCP) 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
Impact of Climate Change on Demand
Demand Management Measures
-20.699
20.350
-13.300
12.739
-10.134
10.563
-4.1849
4.1783
-0.75060
0.90896
-0.28382
0.46204
Baseline = -0.000121
-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
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
-20.663
20.285
-19.670
19.726
-9.2764
9.1908
-4.5720
3.9794
-0.92376
1.0829
-0.90497
0.57487
Baseline = 0.000130
-25
-20
-15
-10
-5
0
5
10
15
20
25

Appendix D High Demand Scenario Analysis

D.1 Introduction

For the WRMP14, additional analysis was undertaken to determine headroom allowance profiles using high demand scenarios for sensitivity testing. These scenarios were based on high household demand and high non-household demand, estimates of which were at the higher end of the plausible range of forecast demand. This analysis has also been undertaken for the WRMP19, the results of which are reported in this appendix.

D.2 Factor D2 and demand forecast variation

For the high demand scenario analysis, a triangular distribution has been used to express the probability distribution, using the high demand forecast as the central or most likely value, the baseline demand forecast as the minimum value, and 25% of the difference between the baseline and the high demand forecasts added to the high demand forecast as the maximum value. This approach is consistent with the high demand scenario analysis undertaken for WRMP14. The values used are shown in Table D-1 and Table D-2.

Table D-1: D2 high household demand headroom uncertainty probability distribution summary data

	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	146.3	-1.5	0.4	220.1	-2.2	0.5	77.8	-0.8	0.2	146.5	-1.1	0.3	185.9	-1.6	0.4
2016/17	148.1	-1.5	0.4	223.3	-2.2	0.5	79.3	-0.8	0.2	147.5	-1.2	0.3	188.0	-1.8	0.4
2017/18	152.2	-2.2	0.6	229.4	-3.3	0.8	81.5	-1.2	0.3	151.3	-1.8	0.4	191.4	-2.6	0.6
2018/19	150.1	-2.9	0.7	226.5	-4.3	1.1	81.0	-1.6	0.4	151.3	-2.4	0.6	191.4	-3.4	0.8
2019/20	150.3	-3.6	0.9	226.8	-5.3	1.3	81.2	-2.0	0.5	151.4	-2.9	0.7	191.7	-4.2	1.1
2020/21	150.2	-4.2	1.1	227.5	-6.4	1.6	82.2	-2.4	0.6	152.0	-3.5	0.9	192.5	-5.1	1.3
2021/22	149.8	-4.8	1.2	228.9	-7.3	1.8	82.8	-2.8	0.7	152.5	-4.0	1.0	193.3	-5.8	1.4
2022/23	150.1	-5.1	1.3	228.7	-7.7	1.9	83.3	-3.0	0.7	152.7	-4.3	1.1	193.7	-6.1	1.5
2023/24	149.5	-5.4	1.3	229.9	-8.2	2.1	83.7	-3.2	0.8	153.0	-4.6	1.1	194.2	-6.5	1.6
2024/25	150.1	-5.6	1.4	229.4	-8.6	2.2	84.5	-3.3	0.8	153.3	-4.8	1.2	194.6	-6.9	1.7
2025/26	150.1	-5.9	1.5	230.2	-9.2	2.3	85.0	-3.6	0.9	153.7	-5.1	1.3	195.2	-7.3	1.8
2026/27	150.1	-6.2	1.5	231.6	-9.6	2.4	84.8	-3.7	0.9	154.0	-5.3	1.3	195.7	-7.6	1.9
2027/28	150.6	-6.5	1.6	232.0	-10.0	2.5	85.3	-3.9	1.0	154.4	-5.6	1.4	196.3	-8.0	2.0
2028/29	151.1	-6.6	1.7	232.3	-10.3	2.6	85.6	-4.0	1.0	154.7	-5.7	1.4	196.8	-8.2	2.1
2029/30	151.2	-6.9	1.7	233.3	-10.8	2.7	86.1	-4.2	1.1	155.1	-6.0	1.5	197.5	-8.6	2.2
2030/31	151.3	-7.1	1.8	233.9	-11.1	2.8	86.5	-4.4	1.1	155.4	-6.2	1.5	197.9	-8.9	2.2
2031/32	152.1	-7.4	1.8	234.3	-11.5	2.9	86.4	-4.5	1.1	155.7	-6.4	1.6	198.3	-9.2	2.3
2032/33	152.8	-7.5	1.9	234.3	-11.7	2.9	86.5	-4.6	1.1	155.9	-6.5	1.6	198.7	-9.4	2.3
2033/34	153.8	-7.7	1.9	234.2	-12.0	3.0	86.8	-4.7	1.2	156.1	-6.7	1.7	199.1	-9.6	2.4
2034/35	154.1	-7.9	2.0	234.6	-12.3	3.1	87.1	-4.8	1.2	156.4	-6.9	1.7	199.5	-9.9	2.5
2035/36	154.0	-8.1	2.0	235.1	-12.5	3.1	87.3	-4.9	1.2	156.5	-7.0	1.7	199.8	-10.0	2.5
2036/37	154.8	-8.3	2.1	235.7	-12.9	3.2	87.3	-5.1	1.3	156.8	-7.2	1.8	200.3	-10.4	2.6
2037/38	155.1	-8.6	2.1	236.3	-13.2	3.3	87.2	-5.2	1.3	157.1	-7.4	1.8	200.7	-10.7	2.7
2038/39	155.6	-8.6	2.2	236.4	-13.3	3.3	87.2	-5.3	1.3	157.2	-7.5	1.9	200.9	-10.8	2.7
2039/40	156.0	-8.8	2.2	236.5	-13.5	3.4	87.4	-5.4	1.3	157.4	-7.6	1.9	201.1	-10.9	2.7
2040/41	156.8	-9.1	2.3	236.7	-13.9	3.5	87.7	-5.5	1.4	157.7	-7.8	2.0	201.6	-11.3	2.8
2041/42	157.0	-9.2	2.3	237.1	-14.2	3.5	87.9	-5.6	1.4	157.9	-8.0	2.0	202.0	-11.5	2.9
2042/43	157.7	-9.3	2.3	236.8	-14.3	3.6	88.2	-5.7	1.4	158.0	-8.1	2.0	202.2	-11.7	2.9
2043/44	158.4	-9.5	2.4	236.6	-14.5	3.6	88.4	-5.8	1.4	158.2	-8.2	2.0	202.5	-11.8	3.0
2044/45	158.9	-9.7	2.4	236.7	-14.9	3.7	89.0	-5.9	1.5	158.5	-8.4	2.1	203.0	-12.2	3.0

Table D-2: D2 high non-household demand headroom uncertainty probability distribution summary

	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	146.1	-1.2	0.3	218.6	-0.7	0.2	77.1	-0.1	0.0	146.0	-0.7	0.2	184.6	-0.4	0.1
2016/17	148.0	-1.3	0.3	221.8	-0.7	0.2	78.6	-0.1	0.0	146.9	-0.7	0.2	186.6	-0.4	0.1
2017/18	151.3	-1.3	0.3	226.8	-0.7	0.2	80.3	-0.1	0.0	150.2	-0.7	0.2	189.2	-0.4	0.1
2018/19	148.6	-1.3	0.3	222.9	-0.7	0.2	79.5	-0.1	0.0	149.7	-0.7	0.2	188.4	-0.4	0.1
2019/20	148.2	-1.5	0.4	222.2	-0.7	0.2	79.2	0.0	0.0	149.3	-0.8	0.2	187.8	-0.4	0.1
2020/21	147.6	-1.6	0.4	221.8	-0.7	0.2	79.8	0.0	0.0	149.3	-0.9	0.2	187.8	-0.4	0.1
2021/22	146.7	-1.7	0.4	222.3	-0.7	0.2	80.0	0.0	0.0	149.4	-1.0	0.2	187.9	-0.4	0.1
2022/23	146.9	-1.9	0.5	221.7	-0.7	0.2	80.4	0.0	0.0	149.5	-1.0	0.3	187.9	-0.3	0.1
2023/24	146.1	-1.9	0.5	222.4	-0.8	0.2	80.6	0.0	0.0	149.6	-1.1	0.3	188.0	-0.3	0.1
2024/25	146.7	-2.2	0.5	221.5	-0.8	0.2	81.2	0.0	0.0	149.7	-1.2	0.3	188.1	-0.3	0.1
2025/26	146.6	-2.4	0.6	221.8	-0.8	0.2	81.5	0.0	0.0	149.9	-1.3	0.3	188.3	-0.3	0.1
2026/27	146.5	-2.5	0.6	222.8	-0.8	0.2	81.0	0.0	0.0	150.1	-1.3	0.3	188.5	-0.3	0.1
2027/28	146.9	-2.8	0.7	222.8	-0.9	0.2	81.4	0.0	0.0	150.3	-1.4	0.4	188.7	-0.3	0.1
2028/29	147.4	-3.0	0.7	222.9	-0.9	0.2	81.6	0.0	0.0	150.5	-1.5	0.4	188.9	-0.3	0.1
2029/30	147.4	-3.2	0.8	223.5	-0.9	0.2	81.9	0.0	0.0	150.7	-1.6	0.4	189.2	-0.3	0.1
2030/31	147.5	-3.3	0.8	223.8	-1.0	0.2	82.1	0.0	0.0	150.9	-1.7	0.4	189.3	-0.3	0.1
2031/32	148.2	-3.5	0.9	223.9	-1.1	0.3	81.9	0.0	0.0	151.1	-1.8	0.5	189.5	-0.3	0.1
2032/33	149.0	-3.7	0.9	223.8	-1.1	0.3	82.0	-0.1	0.0	151.3	-1.9	0.5	189.7	-0.3	0.1
2033/34	149.9	-3.9	1.0	223.5	-1.2	0.3	82.2	-0.1	0.0	151.5	-2.1	0.5	189.8	-0.3	0.1
2034/35	150.3	-4.1	1.0	223.6	-1.3	0.3	82.4	-0.1	0.0	151.7	-2.2	0.6	190.0	-0.3	0.1
2035/36	150.3	-4.3	1.1	224.1	-1.4	0.3	82.6	-0.2	0.0	151.9	-2.3	0.6	190.1	-0.3	0.1
2036/37	151.1	-4.7	1.2	224.2	-1.5	0.4	82.4	-0.2	0.1	152.1	-2.5	0.6	190.2	-0.3	0.1
2037/38	151.5	-4.9	1.2	224.6	-1.5	0.4	82.3	-0.2	0.1	152.3	-2.6	0.7	190.3	-0.3	0.1
2038/39	152.2	-5.2	1.3	224.8	-1.6	0.4	82.2	-0.3	0.1	152.5	-2.8	0.7	190.4	-0.3	0.1
2039/40	152.7	-5.5	1.4	224.8	-1.7	0.4	82.4	-0.3	0.1	152.8	-3.0	0.7	190.5	-0.3	0.1
2040/41	153.5	-5.8	1.4	224.6	-1.8	0.5	82.6	-0.4	0.1	153.0	-3.2	0.8	190.6	-0.3	0.1
2041/42	153.9	-6.1	1.5	224.8	-1.9	0.5	82.8	-0.4	0.1	153.3	-3.4	0.8	190.8	-0.3	0.1
2042/43	154.9	-6.5	1.6	224.5	-2.0	0.5	83.0	-0.5	0.1	153.5	-3.6	0.9	190.9	-0.3	0.1
2043/44	155.8	-6.8	1.7	224.2	-2.1	0.5	83.2	-0.6	0.1	153.8	-3.8	0.9	191.0	-0.3	0.1
2044/45	156.3	-7.1	1.8	224.1	-2.2	0.6	83.7	-0.6	0.2	154.1	-4.0	1.0	191.1	-0.3	0.1

D.3 Results of high demand scenario analysis

The results of the additional analysis undertaken using high demand scenarios are summarised in Tables D-3 and D-4 below. The full outputs from the @RISK spreadsheets are contained in Sections D-4 to D-13.

The headroom allowance values calculated using the high household demand forecast are lower than the WRMP19 target headroom allowance values throughout the planning period, as would be expected. The 95% probability values from the high household demand scenario are similar to the 85% probability values from the WRMP19 target headroom allowance values. While the headroom allowance values calculated using the high non-household demand forecast are higher than those calculated using the high household demand forecast, the values are less similar to those of the WRMP19 target headroom allowance.

Table D-3: Results of high household demand scenario analysis (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)	-1.76	-0.42	0.85	2.25	3.76	5.50	**7.34**	9.83	13.67
Roadford WRZ (Ml/d)	-2.31	-0.47	1.61	3.97	6.21	8.55	**11.54**	14.99	20.40
Wimbleball WRZ (Ml/d)	-1.39	-0.64	0.10	0.87	1.66	2.60	**3.60**	4.97	7.11
Bournemouth WRZ DYAA (Ml/d)	-0.56	0.94	2.53	4.24	6.00	7.95	**10.36**	13.31	17.87
Bournemouth WRZ DYCP (Ml/d)	-1.25	0.51	2.28	4.35	6.35	8.57	**11.21**	14.60	19.48

** Risk Percentile to be used at the end of the planning period*

Table D-4: Results of high non-household demand scenario analysis (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)	-1.08	0.11	1.39	2.72	4.15	5.87	**7.91**	10.31	13.87
Roadford WRZ (Ml/d)	0.74	2.55	4.37	6.50	8.68	11.14	**13.82**	17.67	23.23
Wimbleball WRZ (Ml/d)	-0.01	0.63	1.30	2.04	2.90	3.83	**4.81**	6.01	7.79
Bournemouth WRZ DYAA (Ml/d)	0.38	1.95	3.48	5.15	7.01	8.98	**11.36**	13.88	18.24
Bournemouth WRZ DYCP (Ml/d)	1.54	3.37	5.21	6.95	8.99	11.18	**13.68**	16.76	21.62

** Risk Percentile to be used at the end of the planning period*

The full outputs from the @RISK spreadsheets are contained in Sections D-4 to D-13 below.

D.4 High Household Demand - Colliford Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.46	0.80	2.01	3.26	4.59	6.03	7.69	9.62	11.95	15.50
2016/17	-0.43	0.83	2.12	3.31	4.65	6.07	7.65	9.44	11.75	15.35
2017/18	-0.79	0.48	1.89	3.15	4.47	5.93	7.52	9.45	11.81	15.23
2018/19	-0.81	0.28	1.46	2.77	4.20	5.73	7.24	9.12	11.57	15.20
2019/20	-0.97	0.26	1.62	2.78	4.08	5.60	7.11	8.96	11.24	14.94
2020/21	-1.25	-0.04	1.19	2.51	3.81	5.31	6.86	8.79	11.39	14.86
2021/22	-1.45	-0.24	0.95	2.14	3.62	5.14	6.85	8.72	10.96	14.62
2022/23	-1.65	-0.39	0.87	2.16	3.62	5.24	6.93	8.68	11.07	14.67
2023/24	-1.57	-0.26	1.07	2.40	3.71	5.08	6.68	8.47	10.76	14.20
2024/25	-1.73	-0.52	0.74	2.09	3.48	4.98	6.70	8.63	10.95	14.24
2025/26	-1.83	-0.64	0.62	1.93	3.32	4.72	6.31	8.42	10.68	14.24
2026/27	-1.92	-0.67	0.67	2.02	3.37	4.84	6.41	8.15	10.47	14.00
2027/28	-2.03	-0.72	0.55	1.80	3.21	4.62	6.31	8.13	10.59	14.32
2028/29	-2.19	-0.94	0.38	1.68	3.04	4.49	6.21	8.17	10.66	14.25
2029/30	-2.16	-0.83	0.37	1.60	2.96	4.47	6.13	8.02	10.52	14.25
2030/31	-2.27	-1.01	0.26	1.57	2.95	4.38	6.13	8.12	10.51	14.12
2031/32	-2.32	-1.04	0.16	1.52	2.91	4.32	5.89	7.89	10.35	14.01
2032/33	-2.36	-1.09	0.17	1.46	2.85	4.32	6.01	8.10	10.54	13.84
2033/34	-2.45	-1.20	0.09	1.35	2.79	4.22	5.72	7.75	10.16	13.91
2034/35	-2.40	-1.13	0.19	1.34	2.77	4.25	5.83	7.82	10.36	13.74
2035/36	-2.53	-1.35	0.01	1.39	2.79	4.31	5.98	7.85	10.29	13.63
2036/37	-2.58	-1.33	-0.06	1.19	2.66	4.26	5.78	7.67	10.12	13.79
2037/38	-2.64	-1.39	-0.22	1.11	2.48	4.02	5.82	7.67	10.22	13.70
2038/39	-2.76	-1.48	-0.10	1.24	2.68	4.19	5.85	7.74	10.24	13.82
2039/40	-2.77	-1.49	-0.21	1.16	2.63	4.15	5.78	7.69	10.18	13.80
2040/41	-2.82	-1.61	-0.31	0.94	2.41	3.92	5.63	7.60	10.11	13.53
2041/42	-2.80	-1.44	-0.13	1.09	2.48	3.96	5.62	7.65	10.08	13.61
2042/43	-2.89	-1.70	-0.34	0.98	2.46	3.95	5.58	7.54	10.05	13.59
2043/44	-2.95	-1.66	-0.33	0.98	2.33	3.79	5.44	7.49	9.90	13.60
2044/45	-3.10	-1.76	-0.42	0.85	2.25	3.76	5.50	7.34	9.83	13.67

D.5 High Non-Household Demand - Colliford Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.41	0.76	2.00	3.27	4.64	6.10	7.76	9.53	12.00	15.42
2016/17	-0.47	0.78	2.05	3.33	4.63	6.12	7.71	9.59	12.01	15.67
2017/18	-0.50	0.75	2.08	3.34	4.69	6.01	7.63	9.48	11.85	15.36
2018/19	-0.45	0.78	1.93	3.24	4.55	6.00	7.59	9.49	11.81	15.48
2019/20	-0.52	0.65	1.92	3.20	4.46	5.85	7.44	9.43	11.80	15.42
2020/21	-0.61	0.52	1.80	3.08	4.35	5.95	7.53	9.49	11.80	15.55
2021/22	-0.71	0.51	1.84	3.05	4.43	5.93	7.61	9.42	11.70	15.25
2022/23	-0.94	0.35	1.69	2.94	4.39	5.87	7.56	9.41	11.70	15.24
2023/24	-0.91	0.27	1.54	2.93	4.30	5.73	7.33	9.19	11.49	15.02
2024/25	-0.88	0.37	1.49	2.87	4.14	5.58	7.31	9.26	11.53	14.96
2025/26	-0.94	0.32	1.58	2.87	4.20	5.55	7.16	9.19	11.44	14.77
2026/27	-1.06	0.20	1.41	2.73	4.06	5.54	7.21	9.21	11.59	14.95
2027/28	-1.09	0.18	1.42	2.64	3.98	5.48	7.10	8.95	11.41	14.86
2028/29	-1.20	0.00	1.22	2.58	3.90	5.28	6.89	8.85	11.34	14.94
2029/30	-1.21	-0.12	1.15	2.46	3.77	5.24	6.87	8.86	11.17	14.57
2030/31	-1.32	-0.17	1.10	2.47	3.86	5.39	6.91	8.87	11.19	14.73
2031/32	-1.28	-0.10	1.02	2.32	3.64	5.20	6.81	8.70	11.00	14.65
2032/33	-1.41	-0.18	1.00	2.34	3.73	5.21	6.88	8.72	11.19	14.69
2033/34	-1.48	-0.24	1.04	2.22	3.59	5.17	6.66	8.56	10.91	14.71
2034/35	-1.55	-0.28	0.96	2.21	3.56	5.08	6.68	8.60	10.80	14.60
2035/36	-1.57	-0.37	0.92	2.16	3.54	5.02	6.80	8.61	10.93	14.61
2036/37	-1.76	-0.50	0.82	2.15	3.60	4.98	6.54	8.49	10.81	14.51
2037/38	-1.74	-0.47	0.81	2.10	3.39	4.92	6.59	8.41	10.73	14.44
2038/39	-1.76	-0.55	0.67	2.02	3.30	4.89	6.45	8.39	10.54	14.15
2039/40	-1.99	-0.74	0.52	1.90	3.24	4.76	6.39	8.21	10.57	14.23
2040/41	-1.95	-0.78	0.50	1.77	3.10	4.60	6.24	8.12	10.53	13.97
2041/42	-1.95	-0.75	0.46	1.67	3.08	4.43	6.12	8.08	10.48	13.98
2042/43	-2.13	-0.88	0.42	1.71	3.03	4.45	6.10	8.10	10.60	14.16
2043/44	-2.27	-1.04	0.19	1.50	2.90	4.49	6.10	8.08	10.33	13.68
2044/45	-2.36	-1.08	0.11	1.39	2.72	4.15	5.87	7.91	10.31	13.87

D.6 High Household Demand - Roadford Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.71	1.02	2.92	4.83	6.91	9.14	11.53	14.36	17.88	23.65
2016/17	-0.49	1.33	3.21	5.06	6.94	9.01	11.29	14.27	17.95	23.34
2017/18	-1.18	0.71	2.70	4.62	6.68	8.91	11.23	13.99	17.48	23.05
2018/19	-1.21	0.60	2.43	4.33	6.35	8.46	10.97	13.73	17.14	22.65
2019/20	-1.34	0.47	2.35	4.36	6.33	8.29	10.67	13.26	16.91	22.18
2020/21	-1.71	-0.01	1.82	3.64	5.78	7.84	10.39	13.27	16.60	22.59
2021/22	-2.06	-0.31	1.60	3.52	5.63	7.88	10.24	13.32	16.64	21.81
2022/23	-2.04	-0.24	1.61	3.47	5.38	7.59	9.98	12.78	16.29	21.46
2023/24	-2.45	-0.59	1.22	3.18	5.06	7.41	9.98	12.85	16.37	21.67
2024/25	-2.57	-0.65	1.18	3.30	5.25	7.35	9.81	12.69	16.34	21.75
2025/26	-2.50	-0.59	1.15	3.13	5.07	7.00	9.41	12.22	15.77	21.04
2026/27	-2.61	-0.91	0.99	2.89	4.93	7.12	9.44	12.39	15.79	21.31
2027/28	-2.88	-1.08	0.67	2.60	4.71	6.88	9.44	12.49	16.24	21.70
2028/29	-2.86	-0.97	0.85	2.88	4.93	7.21	9.58	12.39	15.97	21.31
2029/30	-2.83	-0.99	0.79	2.63	4.69	6.72	8.96	11.90	15.88	20.95
2030/31	-3.17	-1.25	0.63	2.60	4.57	6.76	9.23	12.05	15.76	20.82
2031/32	-3.18	-1.28	0.52	2.53	4.40	6.70	9.23	12.17	15.68	20.94
2032/33	-3.23	-1.35	0.61	2.69	4.58	6.78	9.02	11.86	15.44	20.82
2033/34	-3.17	-1.35	0.42	2.53	4.49	6.57	9.03	11.88	15.52	20.81
2034/35	-3.56	-1.70	0.20	2.31	4.40	6.67	9.17	12.06	15.63	20.73
2035/36	-3.62	-1.69	0.21	2.12	4.19	6.51	8.93	11.77	15.53	21.19
2036/37	-3.64	-1.62	0.18	2.32	4.45	6.68	9.03	12.07	15.80	20.97
2037/38	-3.53	-1.67	0.19	2.33	4.29	6.39	8.72	11.60	15.30	20.58
2038/39	-3.54	-1.77	0.11	2.00	4.21	6.55	9.04	11.86	15.37	20.57
2039/40	-3.69	-1.86	0.04	2.05	4.14	6.33	8.87	11.87	15.61	20.80
2040/41	-3.71	-1.91	0.04	2.01	4.00	6.26	8.69	11.55	15.17	20.47
2041/42	-3.99	-1.96	-0.03	1.84	3.88	6.23	8.63	11.58	15.28	20.91
2042/43	-3.96	-2.05	0.10	2.02	3.95	6.12	8.72	11.38	15.38	21.00
2043/44	-3.87	-2.00	-0.13	1.78	3.84	6.09	8.71	11.59	15.21	20.82
2044/45	-4.24	-2.31	-0.47	1.61	3.97	6.21	8.55	11.54	14.99	20.40

D.7 High Non-Household Demand - Roadford Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.38	1.47	3.38	5.35	7.21	9.40	11.85	14.85	18.50	23.93
2016/17	-0.17	1.73	3.47	5.40	7.26	9.56	11.89	14.65	18.36	23.38
2017/18	-0.36	1.43	3.37	5.34	7.43	9.62	11.82	14.63	18.27	23.48
2018/19	-0.30	1.40	3.19	5.15	7.11	9.43	11.82	14.67	18.02	23.46
2019/20	-0.38	1.45	3.33	5.12	7.15	9.42	11.76	14.59	18.03	23.21
2020/21	-0.30	1.48	3.29	5.12	7.11	9.20	11.63	14.39	18.00	23.64
2021/22	-0.21	1.60	3.33	5.19	7.13	9.16	11.53	14.28	17.80	23.22
2022/23	-0.42	1.37	3.19	5.08	7.12	9.27	11.62	14.46	17.91	23.25
2023/24	-0.50	1.33	3.18	5.02	7.13	9.36	11.69	14.57	18.15	23.39
2024/25	-0.15	1.57	3.24	5.19	7.06	9.06	11.30	13.97	17.65	23.19
2025/26	-0.34	1.57	3.31	5.24	7.14	9.15	11.44	14.42	17.94	22.98
2026/27	-0.49	1.33	3.06	5.04	6.95	9.11	11.53	14.40	18.04	23.12
2027/28	-0.52	1.28	3.15	5.17	7.13	9.33	11.70	14.38	17.64	23.25
2028/29	-0.54	1.36	3.11	4.94	6.89	9.21	11.38	14.28	17.88	22.85
2029/30	-0.56	1.14	3.08	5.00	6.93	9.15	11.59	14.38	17.66	22.96
2030/31	-0.70	1.05	2.87	4.78	6.73	8.95	11.43	14.46	17.88	23.17
2031/32	-0.75	1.10	2.95	5.01	6.99	9.10	11.48	14.23	17.54	23.06
2032/33	-0.59	1.08	2.97	4.93	6.86	8.92	11.32	14.17	17.61	22.88
2033/34	-0.60	1.35	3.13	4.95	7.06	9.14	11.52	14.57	17.93	23.27
2034/35	-0.69	1.23	3.10	4.99	6.86	9.00	11.41	14.07	17.52	23.09
2035/36	-0.74	0.95	2.70	4.53	6.74	8.94	11.33	14.20	17.74	23.17
2036/37	-0.57	1.22	3.10	4.96	6.89	8.98	11.39	14.34	17.98	23.07
2037/38	-0.88	0.97	2.80	4.66	6.76	8.90	11.25	14.28	17.88	23.02
2038/39	-1.05	0.74	2.77	4.68	6.69	9.14	11.90	14.51	18.19	23.24
2039/40	-0.88	0.88	2.61	4.55	6.69	8.98	11.38	14.01	17.61	22.91
2040/41	-0.77	0.96	2.81	4.71	6.72	8.94	11.35	14.07	17.71	23.21
2041/42	-0.92	0.85	2.72	4.65	6.72	8.80	11.27	13.90	17.38	22.63
2042/43	-1.04	0.91	2.92	4.86	6.72	8.87	11.40	14.30	17.89	23.36
2043/44	-1.05	0.82	2.63	4.57	6.60	8.90	11.36	14.18	17.58	22.84
2044/45	-0.94	0.74	2.55	4.37	6.50	8.68	11.14	13.82	17.67	23.23

D.8 High Household Demand - Wimbleball Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.23	0.42	1.05	1.76	2.51	3.31	4.17	5.28	6.67	8.62
2016/17	-0.32	0.34	1.03	1.75	2.47	3.26	4.16	5.18	6.50	8.51
2017/18	-0.45	0.21	0.88	1.59	2.31	3.14	3.95	5.02	6.25	8.14
2018/19	-0.58	0.08	0.74	1.42	2.16	3.00	3.89	4.93	6.19	8.13
2019/20	-0.70	-0.01	0.69	1.38	2.09	2.86	3.72	4.86	6.13	8.01
2020/21	-0.82	-0.14	0.55	1.27	2.00	2.84	3.72	4.72	5.99	7.94
2021/22	-0.98	-0.36	0.32	1.01	1.78	2.65	3.53	4.48	5.84	7.84
2022/23	-0.96	-0.34	0.36	1.06	1.78	2.58	3.47	4.55	5.83	7.81
2023/24	-1.07	-0.44	0.21	0.91	1.72	2.54	3.48	4.47	5.77	7.73
2024/25	-1.16	-0.43	0.25	0.94	1.69	2.50	3.39	4.39	5.61	7.61
2025/26	-1.24	-0.58	0.13	0.90	1.70	2.49	3.37	4.34	5.66	7.48
2026/27	-1.27	-0.59	0.10	0.77	1.52	2.38	3.28	4.36	5.67	7.61
2027/28	-1.35	-0.70	-0.06	0.68	1.46	2.23	3.15	4.23	5.47	7.58
2028/29	-1.41	-0.75	-0.03	0.70	1.46	2.33	3.18	4.19	5.41	7.47
2029/30	-1.49	-0.85	-0.18	0.57	1.35	2.17	3.09	4.12	5.40	7.42
2030/31	-1.46	-0.80	-0.09	0.58	1.32	2.10	3.00	4.09	5.36	7.35
2031/32	-1.58	-0.87	-0.13	0.57	1.30	2.10	3.01	4.06	5.33	7.31
2032/33	-1.65	-0.99	-0.28	0.43	1.22	2.05	3.04	4.15	5.49	7.24
2033/34	-1.67	-0.91	-0.18	0.56	1.28	2.05	2.95	4.01	5.30	7.47
2034/35	-1.67	-0.97	-0.28	0.45	1.22	2.03	2.93	3.99	5.34	7.29
2035/36	-1.73	-1.04	-0.30	0.43	1.17	2.00	2.84	3.92	5.29	7.18
2036/37	-1.75	-1.08	-0.37	0.37	1.10	1.93	2.92	3.94	5.28	7.23
2037/38	-1.80	-1.10	-0.36	0.38	1.15	1.96	2.84	3.88	5.21	7.16
2038/39	-1.89	-1.15	-0.44	0.27	1.04	1.86	2.76	3.85	5.30	7.28
2039/40	-1.80	-1.16	-0.49	0.26	1.07	1.88	2.84	3.84	5.17	7.05
2040/41	-1.86	-1.12	-0.40	0.33	1.08	1.95	2.84	3.84	5.19	7.08
2041/42	-1.99	-1.24	-0.56	0.17	1.02	1.83	2.72	3.77	5.17	7.19
2042/43	-1.96	-1.26	-0.58	0.17	0.96	1.82	2.73	3.86	5.11	7.07
2043/44	-1.97	-1.29	-0.60	0.09	0.81	1.66	2.65	3.68	5.05	7.04
2044/45	-2.08	-1.39	-0.64	0.10	0.87	1.66	2.60	3.60	4.97	7.11

D.9 High Non-Household Demand - Wimbleball Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.14	0.57	1.23	1.91	2.71	3.55	4.42	5.49	6.80	8.82
2016/17	-0.13	0.55	1.21	1.91	2.62	3.45	4.34	5.39	6.58	8.54
2017/18	-0.15	0.52	1.22	1.92	2.64	3.46	4.32	5.31	6.62	8.54
2018/19	-0.20	0.53	1.19	1.92	2.58	3.36	4.20	5.22	6.52	8.53
2019/20	-0.26	0.41	1.12	1.82	2.52	3.29	4.16	5.16	6.62	8.53
2020/21	-0.19	0.47	1.13	1.86	2.59	3.37	4.25	5.24	6.56	8.45
2021/22	-0.25	0.42	1.10	1.83	2.55	3.37	4.20	5.24	6.49	8.41
2022/23	-0.25	0.38	1.08	1.77	2.50	3.30	4.19	5.21	6.49	8.51
2023/24	-0.27	0.40	1.07	1.80	2.54	3.34	4.21	5.21	6.41	8.27
2024/25	-0.29	0.36	1.00	1.74	2.48	3.24	4.12	5.15	6.46	8.47
2025/26	-0.32	0.31	0.99	1.70	2.42	3.21	4.14	5.19	6.49	8.37
2026/27	-0.38	0.33	0.99	1.68	2.42	3.17	4.09	5.14	6.49	8.29
2027/28	-0.41	0.23	0.92	1.66	2.45	3.23	4.13	5.15	6.36	8.39
2028/29	-0.39	0.30	0.97	1.67	2.38	3.15	4.06	5.12	6.30	8.35
2029/30	-0.38	0.24	0.90	1.62	2.37	3.15	4.00	4.97	6.40	8.28
2030/31	-0.39	0.24	0.88	1.59	2.28	3.08	3.97	4.96	6.24	8.17
2031/32	-0.44	0.24	0.94	1.59	2.29	3.11	3.94	4.98	6.29	8.12
2032/33	-0.42	0.20	0.86	1.57	2.27	3.11	4.06	5.12	6.27	8.12
2033/34	-0.52	0.21	0.90	1.59	2.28	3.05	3.97	5.03	6.26	8.11
2034/35	-0.54	0.14	0.81	1.55	2.25	3.03	3.87	4.90	6.23	8.07
2035/36	-0.55	0.14	0.84	1.53	2.24	3.03	3.91	5.02	6.28	8.27
2036/37	-0.60	0.12	0.83	1.49	2.26	3.06	3.97	5.02	6.34	8.16
2037/38	-0.57	0.11	0.79	1.51	2.22	3.04	3.91	4.92	6.23	8.04
2038/39	-0.60	0.05	0.72	1.40	2.20	3.01	3.86	4.88	6.23	8.08
2039/40	-0.60	0.11	0.79	1.50	2.25	3.04	3.84	4.88	6.18	8.10
2040/41	-0.67	-0.03	0.71	1.42	2.17	3.00	3.89	4.88	6.20	8.07
2041/42	-0.71	-0.06	0.60	1.38	2.13	2.85	3.74	4.76	6.18	8.19
2042/43	-0.65	0.01	0.66	1.34	2.09	2.92	3.79	4.76	6.08	8.01
2043/44	-0.78	-0.11	0.56	1.29	2.12	2.93	3.87	4.96	6.28	8.18
2044/45	-0.70	-0.01	0.63	1.30	2.04	2.90	3.83	4.81	6.01	7.79

D.10 High Household Demand – Bournemouth DYAA Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.40	1.03	2.56	4.23	5.96	7.78	9.80	12.12	15.21	19.10
2016/17	-0.21	1.24	2.72	4.14	5.80	7.69	9.59	11.86	14.78	19.21
2017/18	-0.32	1.07	2.62	4.28	5.88	7.64	9.75	11.95	14.85	19.31
2018/19	-0.52	1.11	2.56	4.13	5.69	7.50	9.45	11.75	14.60	19.17
2019/20	-0.82	0.66	2.19	3.74	5.44	7.26	9.29	11.58	14.36	18.90
2020/21	-0.95	0.57	2.14	3.68	5.39	7.21	9.13	11.60	14.54	18.79
2021/22	-1.08	0.40	1.90	3.45	5.15	6.96	8.95	11.37	14.43	18.79
2022/23	-1.09	0.37	1.86	3.41	5.17	6.95	8.98	11.27	13.89	18.19
2023/24	-1.18	0.30	1.89	3.48	5.12	6.85	8.90	11.14	14.14	18.77
2024/25	-1.16	0.29	1.67	3.25	4.92	6.69	8.87	11.25	14.24	18.76
2025/26	-1.11	0.36	1.92	3.58	5.35	7.19	9.30	11.67	14.64	19.55
2026/27	-1.28	0.28	1.77	3.38	5.16	7.11	9.27	11.71	14.85	19.51
2027/28	-1.56	0.16	1.87	3.43	5.26	7.11	9.10	11.71	14.69	19.07
2028/29	-1.54	0.00	1.64	3.25	4.95	6.71	8.67	10.88	13.71	17.86
2029/30	-1.54	-0.06	1.42	2.99	4.74	6.54	8.57	10.84	13.68	18.11
2030/31	-1.49	0.03	1.59	3.23	4.77	6.43	8.52	10.85	13.57	17.82
2031/32	-1.56	-0.06	1.38	2.95	4.65	6.61	8.54	10.85	13.77	18.04
2032/33	-1.55	0.02	1.48	2.90	4.59	6.44	8.43	10.83	13.72	17.93
2033/34	-1.62	-0.16	1.44	2.96	4.72	6.43	8.44	10.71	13.69	17.66
2034/35	-1.90	-0.34	1.18	2.77	4.48	6.40	8.29	10.71	13.71	18.00
2035/36	-1.61	-0.13	1.39	2.95	4.52	6.27	8.20	10.57	13.65	17.94
2036/37	-1.81	-0.38	1.18	2.71	4.44	6.28	8.30	10.65	13.60	17.92
2037/38	-1.94	-0.35	1.12	2.72	4.50	6.28	8.24	10.56	13.65	18.18
2038/39	-2.08	-0.44	1.24	2.77	4.52	6.28	8.18	10.52	13.50	17.85
2039/40	-1.90	-0.38	1.29	2.85	4.46	6.11	8.20	10.55	13.38	17.75
2040/41	-1.92	-0.49	1.17	2.80	4.41	6.22	8.26	10.57	13.49	17.64
2041/42	-1.97	-0.48	1.02	2.53	4.18	5.88	7.94	10.45	13.46	17.90
2042/43	-1.93	-0.50	0.99	2.61	4.26	6.15	8.07	10.42	13.48	17.77
2043/44	-1.92	-0.54	0.88	2.38	4.19	5.86	7.94	10.52	13.62	17.66
2044/45	-2.07	-0.56	0.94	2.53	4.24	6.00	7.95	10.36	13.31	17.87

D.11 High Non-Household Demand – Bournemouth DYAA Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.29	1.19	2.77	4.36	5.99	7.82	9.77	12.31	14.92	19.23
2016/17	-0.12	1.30	2.82	4.32	5.92	7.68	9.64	11.95	14.84	19.12
2017/18	-0.13	1.37	2.93	4.43	6.04	7.63	9.62	11.83	14.87	19.44
2018/19	-0.24	1.12	2.72	4.36	6.02	7.78	9.81	12.09	14.86	19.31
2019/20	-0.14	1.35	2.92	4.51	6.05	7.92	9.83	12.05	14.90	19.36
2020/21	-0.16	1.37	2.81	4.35	6.06	7.72	9.86	12.08	14.99	19.54
2021/22	-0.23	1.30	2.69	4.23	6.01	7.69	9.63	11.84	14.87	19.52
2022/23	-0.23	1.26	2.81	4.22	5.84	7.56	9.44	11.90	14.82	19.22
2023/24	-0.27	1.16	2.72	4.23	5.85	7.67	9.60	11.86	14.88	19.04
2024/25	-0.30	1.21	2.80	4.42	6.01	7.70	9.65	11.91	14.86	19.40
2025/26	-0.33	1.29	2.86	4.49	6.24	8.13	10.19	12.70	15.75	20.32
2026/27	-0.31	1.33	2.85	4.52	6.27	8.18	10.14	12.63	15.64	19.95
2027/28	-0.43	1.13	2.80	4.47	6.26	8.11	10.19	12.52	15.74	20.27
2028/29	-0.28	1.12	2.70	4.20	5.77	7.49	9.31	11.45	14.55	19.24
2029/30	-0.50	0.99	2.51	4.10	5.86	7.67	9.48	11.68	14.29	18.75
2030/31	-0.47	1.06	2.48	4.07	5.55	7.42	9.45	11.78	14.89	19.27
2031/32	-0.49	0.98	2.46	4.13	5.84	7.57	9.48	11.67	14.56	18.97
2032/33	-0.56	0.88	2.49	4.13	5.76	7.56	9.45	11.79	14.84	19.36
2033/34	-0.50	0.98	2.45	4.08	5.71	7.42	9.43	11.64	14.71	18.67
2034/35	-0.55	0.89	2.48	3.97	5.72	7.32	9.52	11.71	14.43	18.64
2035/36	-0.40	1.01	2.57	4.06	5.67	7.32	9.29	11.72	14.60	18.75
2036/37	-0.67	0.76	2.43	4.00	5.66	7.34	9.34	11.64	14.28	18.53
2037/38	-0.79	0.75	2.36	3.92	5.61	7.49	9.52	11.75	14.54	18.71
2038/39	-0.78	0.73	2.25	3.85	5.61	7.42	9.35	11.74	14.48	18.76
2039/40	-0.77	0.65	2.29	3.84	5.42	7.31	9.31	11.59	14.58	19.08
2040/41	-0.76	0.69	2.19	3.83	5.56	7.33	9.21	11.44	14.30	18.52
2041/42	-0.76	0.77	2.33	3.82	5.38	7.11	9.09	11.25	14.24	18.61
2042/43	-0.91	0.62	2.13	3.63	5.34	7.27	9.16	11.52	14.34	18.64
2043/44	-0.77	0.69	2.23	3.76	5.27	7.01	9.03	11.24	14.17	18.34
2044/45	-1.03	0.38	1.95	3.48	5.15	7.01	8.98	11.36	13.88	18.24

D.12 High Household Demand – Bournemouth DYCP Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.25	1.40	3.02	4.71	6.52	8.53	10.50	13.17	16.27	21.08
2016/17	-0.56	1.14	2.91	4.57	6.33	8.36	10.69	13.27	16.36	21.12
2017/18	-0.69	1.03	2.63	4.48	6.14	8.11	10.52	13.22	16.51	21.21
2018/19	-0.80	0.93	2.52	4.23	5.96	7.84	10.08	12.64	15.98	20.86
2019/20	-1.06	0.56	2.29	4.05	5.86	7.82	9.88	12.47	15.82	20.60
2020/21	-1.31	0.41	2.15	3.85	5.59	7.71	10.00	12.44	15.85	20.60
2021/22	-1.41	0.24	1.91	3.79	5.55	7.45	9.55	12.15	15.47	20.41
2022/23	-1.44	0.23	1.89	3.60	5.50	7.43	9.71	12.25	15.40	20.30
2023/24	-1.63	0.05	1.81	3.51	5.23	7.27	9.52	12.21	15.40	20.23
2024/25	-1.84	-0.15	1.44	3.19	5.12	7.11	9.43	12.00	15.31	20.27
2025/26	-1.87	-0.12	1.54	3.33	5.23	7.37	9.65	12.21	15.77	21.07
2026/27	-1.91	-0.06	1.73	3.54	5.49	7.68	9.83	12.45	15.97	20.86
2027/28	-2.03	-0.38	1.44	3.22	5.06	7.17	9.56	12.10	15.48	20.85
2028/29	-2.14	-0.50	1.22	3.05	4.96	7.01	9.50	12.28	15.48	20.45
2029/30	-2.05	-0.29	1.29	3.23	5.08	7.08	9.16	11.84	15.34	20.18
2030/31	-2.36	-0.64	1.18	2.96	4.76	6.90	9.41	12.04	15.47	20.41
2031/32	-2.20	-0.45	1.27	2.93	4.73	6.74	8.99	11.71	15.19	20.06
2032/33	-2.18	-0.55	1.15	2.87	4.74	6.83	9.13	12.03	15.37	20.06
2033/34	-2.37	-0.63	1.20	2.94	4.74	6.85	8.96	11.70	15.01	20.23
2034/35	-2.40	-0.72	1.03	2.93	4.85	6.77	9.05	11.57	15.12	19.81
2035/36	-2.57	-0.93	0.83	2.58	4.57	6.71	9.08	11.83	15.11	20.02
2036/37	-2.52	-0.85	0.99	2.70	4.59	6.53	8.72	11.51	14.91	19.58
2037/38	-2.53	-0.83	0.87	2.63	4.55	6.70	8.98	11.69	14.91	19.99
2038/39	-2.65	-0.96	0.80	2.67	4.49	6.49	8.79	11.44	14.82	20.20
2039/40	-2.88	-1.09	0.70	2.63	4.54	6.74	8.94	11.49	14.74	19.75
2040/41	-2.83	-1.09	0.64	2.54	4.50	6.37	8.75	11.43	14.87	19.67
2041/42	-2.91	-1.25	0.50	2.28	4.19	6.14	8.46	11.22	14.65	19.83
2042/43	-2.90	-1.22	0.57	2.36	4.32	6.41	8.70	11.21	14.41	19.70
2043/44	-2.98	-1.23	0.51	2.25	4.31	6.32	8.65	11.28	14.62	19.60
2044/45	-3.02	-1.25	0.51	2.28	4.35	6.35	8.57	11.21	14.60	19.48

D.13 High Non-Household Demand - Bournemouth DYCP Headroom Allowance by Probability

	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
2015/16	-0.09	1.47	3.12	4.79	6.66	8.50	10.75	13.27	16.57	21.43
2016/17	-0.15	1.42	3.08	4.81	6.57	8.62	10.71	13.28	16.37	21.32
2017/18	0.00	1.52	3.19	4.97	6.61	8.56	10.65	13.40	16.74	21.43
2018/19	-0.17	1.64	3.15	4.91	6.80	8.72	10.95	13.48	16.62	21.36
2019/20	-0.10	1.55	3.25	4.86	6.78	8.82	11.01	13.64	16.78	21.35
2020/21	-0.13	1.56	3.19	5.00	6.86	8.72	11.13	13.66	16.92	21.66
2021/22	-0.14	1.59	3.20	5.03	7.02	9.09	11.20	13.60	16.59	21.14
2022/23	-0.16	1.54	3.27	5.04	6.78	8.61	10.88	13.43	16.65	21.46
2023/24	-0.23	1.44	3.20	4.83	6.71	8.69	10.89	13.39	16.75	21.41
2024/25	-0.21	1.47	3.17	4.90	6.80	8.62	10.86	13.40	16.67	21.77
2025/26	-0.21	1.47	3.34	5.24	7.13	9.24	11.48	14.00	17.47	22.52
2026/27	-0.01	1.84	3.43	5.17	7.19	9.12	11.34	14.11	17.36	21.94
2027/28	-0.13	1.60	3.35	5.11	7.11	9.18	11.38	14.26	17.59	22.48
2028/29	-0.09	1.67	3.35	5.11	7.01	8.94	11.08	13.79	17.08	21.92
2029/30	-0.05	1.64	3.29	5.03	6.89	8.85	11.06	13.76	16.93	21.92
2030/31	-0.04	1.68	3.33	5.20	7.05	9.02	11.18	13.78	17.17	21.87
2031/32	0.01	1.55	3.31	5.00	6.75	8.84	10.98	13.58	16.86	21.97
2032/33	-0.10	1.56	3.32	5.17	7.02	9.03	11.29	13.88	17.11	22.20
2033/34	-0.13	1.66	3.46	5.21	7.11	9.03	11.24	14.16	17.41	21.66
2034/35	-0.14	1.45	3.09	4.97	6.79	8.94	11.19	13.70	17.05	21.70
2035/36	-0.02	1.80	3.52	5.29	7.07	9.12	11.24	14.12	17.35	21.93
2036/37	-0.03	1.64	3.33	5.01	6.89	8.87	11.05	13.72	17.05	21.96
2037/38	-0.18	1.55	3.25	5.06	6.96	8.95	11.16	13.86	17.56	22.37
2038/39	-0.15	1.62	3.33	5.17	6.94	8.90	11.21	13.88	17.05	21.65
2039/40	-0.18	1.43	3.21	5.04	7.09	9.18	11.42	13.88	17.35	21.93
2040/41	0.00	1.62	3.36	5.02	6.82	9.03	11.27	13.91	17.34	22.14
2041/42	0.08	1.66	3.31	5.07	7.00	8.95	11.16	13.57	16.87	21.94
2042/43	-0.04	1.58	3.28	5.07	6.87	8.92	11.10	13.67	17.29	22.25
2043/44	-0.20	1.46	3.26	5.04	6.99	8.99	11.49	13.98	17.06	22.11
2044/45	0.02	1.54	3.37	5.21	6.95	8.99	11.18	13.68	16.76	21.62

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)
2017/18	166.20	165.20
2018/19	166.06	162.17
2019/20	165.93	161.29
2020/21	165.79	160.22
2021/22	165.66	158.90
2022/23	165.53	158.67
2023/24	165.39	157.46
2024/25	165.26	157.51
2025/26	165.12	156.84
2026/27	164.99	156.53
2027/28	164.86	156.52
2028/29	164.72	156.76
2029/30	164.59	156.42
2030/31	164.45	156.25
2031/32	164.41	156.65
2032/33	164.36	157.16
2033/34	164.32	157.76
2034/35	164.27	157.78
2035/36	164.22	157.45
2036/37	164.18	158.32
2037/38	164.13	158.48
2038/39	164.08	158.96
2039/40	164.04	159.65
2040/41	163.99	159.94
2041/42	163.95	160.60
2042/43	163.90	161.38
2043/44	163.85	162.18
2044/45	163.81	162.91

Table A.5.2: Roadford WRZ

Financial year	WAFU (Ml/d)	Baseline demand + target headroom (Ml/d)
2017/18	248.88	248.83
2018/19	246.29	244.55
2019/20	245.70	243.36
2020/21	245.11	242.55
2021/22	244.52	242.57
2022/23	243.93	241.52
2023/24	243.34	241.81
2024/25	242.75	240.45
2025/26	242.16	240.25
2026/27	241.57	241.11
2027/28	240.98	240.95
2028/29	240.38	240.80
2029/30	239.79	241.22
2030/31	239.20	241.32
2031/32	239.00	241.25
2032/33	238.79	240.85
2033/34	238.59	240.33
2034/35	238.39	240.28
2035/36	238.18	240.48
2036/37	237.98	240.37
2037/38	237.77	241.15
2038/39	237.57	241.54
2039/40	237.37	241.72
2040/41	237.16	242.23
2041/42	236.96	242.42
2042/43	236.75	242.39
2043/44	236.55	242.32
2044/45	236.34	242.26

Table A.5.3: Wimbleball WRZ

Financial year	WAFU (Ml/d)	Baseline demand + target headroom (Ml/d)
2017/18	90.47	88.62
2018/19	90.41	87.55
2019/20	90.35	87.11
2020/21	90.29	87.53
2021/22	90.24	87.59
2022/23	90.18	87.74
2023/24	90.12	87.76
2024/25	90.06	88.17
2025/26	90.01	88.27
2026/27	89.95	87.78
2027/28	89.89	88.03
2028/29	89.83	88.21
2029/30	89.78	88.46
2030/31	89.72	88.61
2031/32	89.70	88.38
2032/33	89.68	88.39
2033/34	89.66	88.47
2034/35	89.64	88.57
2035/36	89.62	88.73
2036/37	89.60	88.48
2037/38	89.58	88.52
2038/39	89.56	88.40
2039/40	89.54	88.68
2040/41	89.52	89.04
2041/42	89.50	89.38
2042/43	89.48	89.57
2043/44	89.46	89.90
2044/45	89.44	90.40

Table A.5.4: Bournemouth WRZ - DYAA

Financial year	WAFU (Ml/d)	Baseline demand + target headroom (Ml/d)
2017/18	204.84	168.26
2018/19	204.84	167.45
2019/20	204.84	166.66
2020/21	204.84	166.37
2021/22	204.84	166.06
2022/23	204.84	165.78
2023/24	204.84	165.52
2024/25	204.84	165.30
2025/26	216.15	165.10
2026/27	216.15	164.95
2027/28	216.15	164.81
2028/29	204.02	164.70
2029/30	204.02	164.59
2030/31	204.02	164.42
2031/32	204.02	164.25
2032/33	204.02	164.07
2033/34	204.02	163.90
2034/35	204.02	163.72
2035/36	204.02	163.53
2036/37	204.02	163.46
2037/38	204.02	164.02
2038/39	204.02	164.01
2039/40	204.02	164.59
2040/41	204.02	164.52
2041/42	204.02	164.60
2042/43	204.02	164.98
2043/44	204.02	165.76
2044/45	204.02	166.01

Table A.5.5: Bournemouth WRZ - DYCP

Financial year	WAFU (Ml/d)	Baseline demand + target headroom (Ml/d)
2017/18	225.77	209.32
2018/19	225.77	208.20
2019/20	225.77	207.39
2020/21	225.77	207.10
2021/22	225.77	206.78
2022/23	225.77	206.51
2023/24	225.77	206.27
2024/25	225.77	206.10
2025/26	235.77	205.95
2026/27	235.77	205.96
2027/28	235.77	205.99
2028/29	231.44	206.04
2029/30	231.44	206.11
2030/31	231.44	206.08
2031/32	231.44	206.05
2032/33	231.44	206.02
2033/34	231.44	205.99
2034/35	231.44	205.95
2035/36	231.44	205.88
2036/37	231.44	206.27
2037/38	231.44	206.55
2038/39	231.44	207.05
2039/40	231.44	207.42
2040/41	231.44	207.75
2041/42	231.44	208.13
2042/43	231.44	208.71
2043/44	231.44	208.55
2044/45	231.44	209.13

APPENDIX 6

Future Options

A.6.1 Different types of water management options

Tables 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]. Tables A.6.1 to A.6.5 also show schemes we have considered further in our unconstrained set of options.

The different types of options were divided into the following categories:

(i) Interconnection with neighbouring water companies and water trading

(ii) Customer side management options (reducing demand)

(iii) Customer side management options (metering)

(iv) Distribution side management options (predominantly managing leakage)

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

(vi) Resource management options (increasing supply)

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

Table A.6.2: Types of customer side management options (reducing demand and metering)

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)		✓

South West Water Bournemouth Water

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 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	✓
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)		✓

Option	Scheme type	Scheme sub-categories/sub-components	Considered
	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		✓
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 Indicative costs of potential options for interconnection with neighbouring water companies

An indicative Average Incremental Cost (AIC) was calculated for each of the above options. The costs are shown in Table A.6.6 below.

Table A.6.6: 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.6.2] Atkins (2017). '*South West Water Bulk Supply Options Study Phase 2 Report*'
[A.6.3] *Ibid.* A.6.2

South West Water
Bournemouth Water

A.6.2.1.2 Conclusions from indicative cost calculations

Gunnislake and Northbridge bulk supply options

The Gunnislake options G3 and G4 (up to 15 Ml/d) are the most expensive of the options considered within this study due to the longest transfer lengths, with indicative AIC values of 234-243p/m^3 for G3 and G4 respectively.

For the combined Gunnislake and Northbridge options GN1 and GN2 the cost effectiveness of these schemes increases due to the increase in transfer volume from up to 15 Ml/d to up to 20 Ml/d, with indicative AIC values of 184-193p/m^3 for options GN1 and GN2 respectively.

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 (16 Ml/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 with neighbouring water companies

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 WTW 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 WRZ bulk supply 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 on to 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."*

However, following more detailed consideration, Southern Water has confirmed that the 20 Ml/d transfer from our Bournemouth WRZ has been selected for their plan, with a start date of 2027. The cost of this scheme is included in their plan, and no costs appear in our WRMP. The size of the scheme means it meets the Direct Procurement for Customers threshold and could also be delivered through a 3rd party market provider.

A.6.3 Customer side management options (reducing the demand for water)

Unconstrained, rejected/infeasible and feasible customer side management options (reducing the demand for water) are given in Section 6.2.3.

A.6.3.1 <u>Feasible options descriptions</u>

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. As part of this scheme we will consider opportunities to offer combined energy and water retrofitting.

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.

Five 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.6.7: 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)	1.916	7,300	0	97	15
CU20b	Retrofit (unmetered)	0.518	1,489	0	71	-12
CU20c	Retrofit (metered+leaky loos fix)	2.853	7,300	0	62	-20
CU20d	Retrofit (unmetered+leaky loos fix)	0.889	1,489	0	38	-44
CU20e	Retrofit (metered+leaky loos fix, 1500 properties per annum)	0.550	331	0	34	-48

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

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 reported a 15 l/property/day saving for a similar housing association trial

- Essex and Suffolk Water achieved savings of 21 l/property/day through home audits
- Severn Trent believe a 27 l/property/d saving is possible through social housing audits following trials they undertook

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 Severn Trent trial.

We have assumed that 32,000 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 12.6 years.

Table A.6.8: 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	2.493	1,114	0	4	-79

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 1.8%.

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.6.3.1, 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, with a half-life of 12.6 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.6.9 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	0.309	369	0	16	-66

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'[A.6.4]. 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.

[A.6.4] Ministry of Housing, Communities & Local Government (2015, amended 2016), *Building Regulations 2010 Part G: Sanitation, hot water safety and water efficiency*

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.6.10: Summary of reduced infrastructure charge option

Ref.	Description	Maximum demand saving (Ml/d)	Capex (£k)	Opex (£k/yr)	AISC exc. WTP (p/m³)	AISC inc. WTP (p/m³)
CU54	Reduced infrastructure charge	2.154	22,036	0	148	66

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

Scheme run with 4 communities per resource zone over the 5 years starting in 2020/21, 1 community per resource zone after.

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 most 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 13.9 years.

Table A.6.11: 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)
CU60	Community incentives	3.398	2,545	0	2	-81

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

Starting in 2020/21.

Assumptions

The primary case study to support this comes from South East Water's work with Advizzo, which saw an average saving of 1.8%. 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.6.12: 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	5.099	50	40	-6	-88

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.6.13: 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	40	-4
CU65b	Buckland	Roadford	0.065	88	1.2	12	-32
CU65c	Brokenbury	Roadford	0.521	104	1.6	-5	-49
CU65d	Camborne	Colliford	0.337	144	1.2	-2	-46
CU65e	Camelshead	Roadford	0.275	91	1.2	-3	-47
CU65f	Cornborough	Roadford	0.043	80	1.0	19	-25
CU65g	Countess Wear	Wimbleball	0.154	200	2.4	11	-33
CU65h	Ernesettle	Roadford	0.909	112	1.6	-6	-50
CU65i	Marsh Mills	Roadford	0.186	104	2.0	1	-43
CU65j	Plymouth Central	Roadford	0.570	72	1.6	-6	-50
CU65k	Radford	Roadford	0.443	80	1.2	-5	-49

CU66: Non-household retailer water efficiency

Description

We have had initial discussions with retailers regarding potential collaborative water efficiency options. Suggestions include cost sharing of non-household water use audits that meet specified requirements. Audits would most likely be undertaken by third-parties.

Timing

Starting in 2020/21.

Assumptions

Thames Water found that savings of 24% in a hotels and catering cohort, while Pennon Water services have undertaken case studies in which savings of around 15% were identified.

Around 750 properties would be targeted each year, with an assumed uptake rate of 10%. A savings decay rate of 12.6 years has been assumed.

Table A.6.14: 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)
CU66	Non-household retailer water efficiency	0.616	1,050	0	17	-65

A.6.3.2 Summary of feasible options and associated costs

A summary of all the customer side options described above and associated costs are shown in Table A.6.15 below

Table A.6.15: Summary of feasible customer side options (reducing the demand for water) with costs

Ref.	Description	Maximum demand saving (Ml/d)	Capex (£k)	Opex (£k/yr)	AISC exc. WTP (p/m³)	AISC inc. WTP (p/m³)
CU20a	Retrofit (metered)	1.916	7,300	0	91	15
CU20b	Retrofit (unmetered)	0.518	1,489	0	65	-12
CU20c	Retrofit (metered+leaky loos fix)	2.853	7,300	0	57	-20
CU20d	Retrofit (unmetered+leaky loos fix)	0.889	1,489	0	32	-44
CU20e	Retrofit (metered+leaky loos fix, 1500 properties per annum)	0.550	331	0		-48
CU21	Social housing retrofit	2.493	1,114	0	32	-79
CU26	Holiday home rental water efficiency	0.309	369	0	46	-66
CU54	Reduced infrastructure charge	2.154	22,036	0	182	66
CU60	Community incentives	3.398	2,545	0	7	-81
CU62	Social norms feedback on bills	5.099	50	40	-5	-88
CU65a	WWTW final effluent re-use (Ashford)	0.026	80	1.2	73	-4
CU65b	WWTW final effluent re-use (Buckland)	0.065	88	1.2	31	-32
CU65c	WWTW final effluent re-use (Brokenbury)	0.521	104	1.6	5	-49
CU65d	WWTW final effluent re-use (Camborne)	0.337	144	1.2	9	-46
CU65e	WWTW final effluent re-use (Camelshead)	0.275	91	1.2	7	-47
CU65f	WWTW final effluent re-use (Cornborough)	0.043	80	1.0	42	-25
CU65g	WWTW final effluent re-use (Countess Wear)	0.154	200	2.4	29	-33
CU65h	WWTW final effluent re-use (Ernesettle)	0.909	112	1.6	3	-50
CU65i	WWTW final effluent re-use (Marsh Mills)	0.186	104	2.0	14	-43
CU65j	WWTW final effluent re-use (Plymouth Central)	0.570	72	1.6	3	-50
CU65k	WWTW final effluent re-use (Radford)	0.443	80	1.2	4	-49
CU66	Non-household retailer water efficiency	0.616	1,050	0	-5	-65

A.6.4 Managing leakage

Table A.6.16 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.6.16: Feasible leakage reduction options

Ref No	Option name	WRZ	Description
LC Inno'	Innovation Colliford WRZ	C	Schemes supporting ALC
LC1	Step 1 Colliford WRZ	C	Reduction of leakage from 32.8 to 31.7 Ml/d
LC2	Step 2 Colliford WRZ	C	Reduction of leakage from 31.7 to 30.6 Ml/d
LC3	Step 3 Colliford WRZ	C	Reduction of leakage from 30.6 to 29.5 Ml/d
LC4	Step 4 Colliford WRZ	C	Reduction of leakage from 29.5 to 28.3 Ml/d
LC5	Step 5 Colliford WRZ	C	Reduction of leakage from 28.3 to 27.2 Ml/d
LC6	Step 6 Colliford WRZ	C	Reduction of leakage from 27.2 to 26.1 Ml/d
LC7	Step 7 Colliford WRZ	C	Reduction of leakage from 26.1 to 25.0 Ml/d
LC8	Step 8 Colliford WRZ	C	Reduction of leakage from 25.0 to 23.9 Ml/d
LC9	Step 9 Colliford WRZ	C	Reduction of leakage from 23.9 to 22.7 Ml/d
LC10	Step 10 Colliford WRZ	C	Reduction of leakage from 22.7 to 21.6 Ml/d
LR Inno'	Innovation Roadford WRZ	R	Schemes supporting ALC
LR1	Step 1 Roadford WRZ	R	Reduction of leakage from 46.3 to 45.1 Ml/d
LR2	Step 2 Roadford WRZ	R	Reduction of leakage from 45.1 to 44.0 Ml/d
LR3	Step 3 Roadford WRZ	R	Reduction of leakage from 44.0 to 42.9 Ml/d
LR4	Step 4 Roadford WRZ	R	Reduction of leakage from 42.9 to 41.8 Ml/d
LR5	Step 5 Roadford WRZ	R	Reduction of leakage from 41.8 to 40.7 Ml/d
LR6	Step 6 Roadford WRZ	R	Reduction of leakage from 40.7 to 39.5 Ml/d
LR7	Step 7 Roadford WRZ	R	Reduction of leakage from 39.5 to 38.4 Ml/d
LR8	Step 8 Roadford WRZ	R	Reduction of leakage from 38.4 to 37.3 Ml/d
LR9	Step 9 Roadford WRZ	R	Reduction of leakage from 37.3 to 36.2 Ml/d
LR10	Step 10 Roadford WRZ	R	Reduction of leakage from 36.2 to 35.1 Ml/d
LW Inno'	Innovation Wimbleball WRZ	W	Schemes supporting ALC
LW1	Step 1 Wimbleball WRZ	W	Reduction of leakage from 11.6 to 10.5 Ml/d
LW2	Step 2 Wimbleball WRZ	W	Reduction of leakage from 10.5 to 9.4 Ml/d

Ref No	Option name	WRZ	Description
LW3	Step 3 Wimbleball WRZ	W	Reduction of leakage from 9.4 to 8.3 Ml/d
LW4	Step 4 Wimbleball WRZ	W	Reduction of leakage from 8.3 to 7.2 Ml/d
LB Inno'	Innovation Bournemouth WRZ	B	Schemes supporting ALC
LB1	Step 1 Bournemouth WRZ	B	Reduction of leakage from 20.9 to 19.8 Ml/d
LB2	Step 2 Bournemouth WRZ	B	Reduction of leakage from 19.8 to 18.7 Ml/d
LB3	Step 3 Bournemouth WRZ	B	Reduction of leakage from 18.7 to 17.6 Ml/d
LB4	Step 4 Bournemouth WRZ	B	Reduction of leakage from 17.6 to 16.5 Ml/d
WFP C	WRMP Final Plan (ALC + Innovations) Colliford	C	15% reduction in Colliford WRZ by 2025
WFP R	WRMP Final Plan (ALC + Innovations) Roadford	R	15% reduction in Roadford WRZ by 2025
WFP W	WRMP Final Plan (ALC + Innovations) Wimbleball	W	15% reduction in Wimbleball WRZ by 2025
WFP BW	WRMP Final Plan (ALC + Innovations)	B	15% reduction in Bournemouth WRZ by 2025

A.6.5 Metering

A.6.5.1 Unconstrained list and screening of metering options

A list of rejected / infeasible metering options is given in Section 6.

A.6.6 Options to increase the supply of water within our WRZs

A.6.6.1 Unconstrained list and screening of supply side management options at company level

Tables A.6.17 (distribution expansion and production side management options) and A.6.18 (resource management options) are colour coded to show the outcome of the options screening described in Section 6.1 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.

Options shaded green have been developed further at a WRZ level in A.6.6.2.

Table A.6.17: 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.6.18: 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 increased yields	SWW currently uses, and will continue to use, sophisticated conjunctive management.

Option	Scheme type	Scheme sub-categories/sub-components
	(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

Section 6.2.6.4 provides 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.6.6.2.5.

A.6.6.2.2 Roadford WRZ

Section 6.2.6.4 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.6.6.2.5.

A.6.6.2.3 Wimbleball WRZ

Section 6.2.6.4 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.6.6.2.5.

A.6.6.2.4 Bournemouth WRZ

Section 6.2.6.4 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.6.6.2.5.

A.6.6.2.5 Options descriptions

In Section 6 of the main report, Table 6.27 summarises the feasible options identified, 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

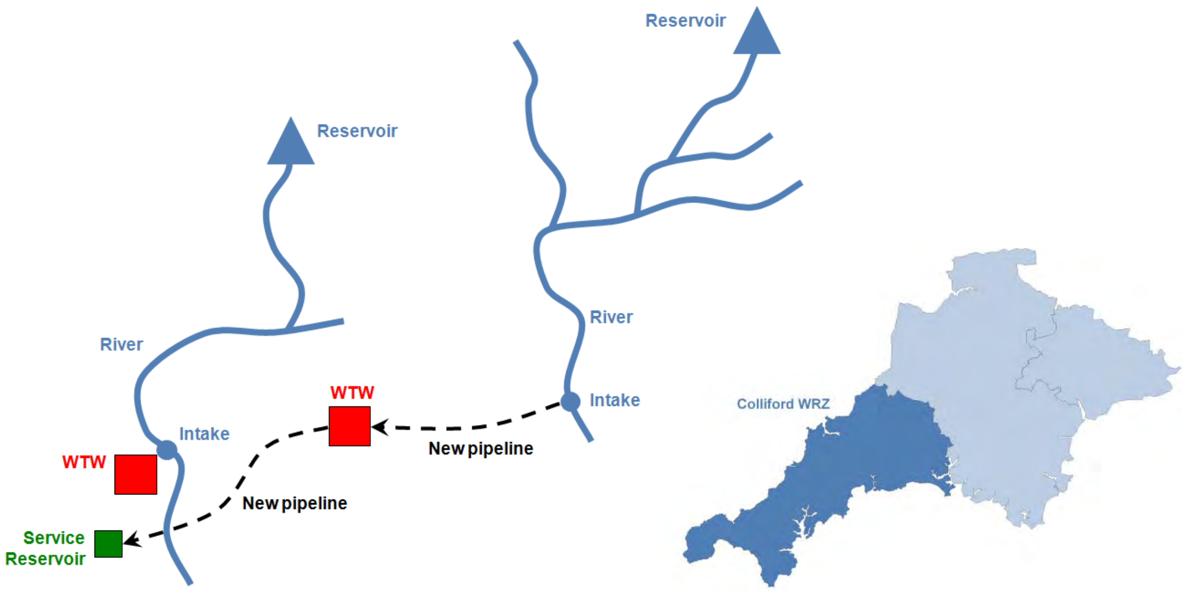
The key used for tables measuring the social and environmental impacts of each option is as follows:

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 600 mm 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 Short term	 Med term	 Long term	Commentary (including cumulative effects and potential mitigation measures)
				Gunnislake is within 5 km 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. • 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

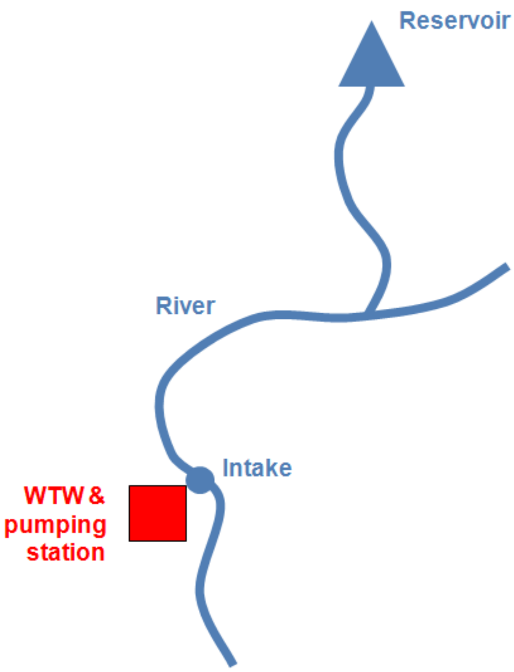
Description of the option

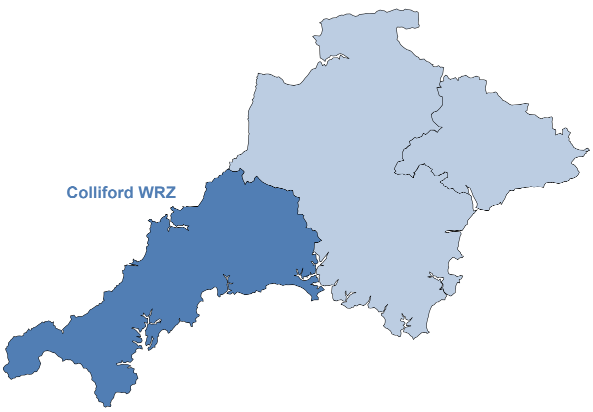
This option would take Restormel WTW up to its maximum licensed abstraction and enable more effective use to be made of the Colliford/River Fowey Resources system.

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

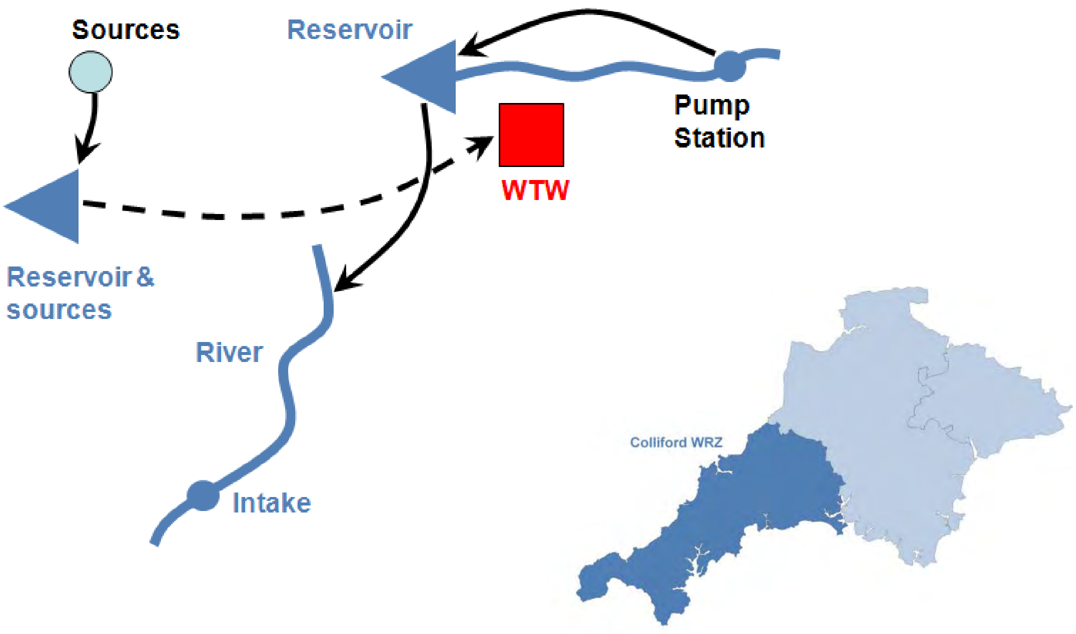
Option type: Production management
Indicative benefit: 3 Ml/d
Implementation: 2 years

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 6.6 km 400 mm 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 4 km 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 1 km 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.

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	?/-	0	0	The proposed abstractions are within 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 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

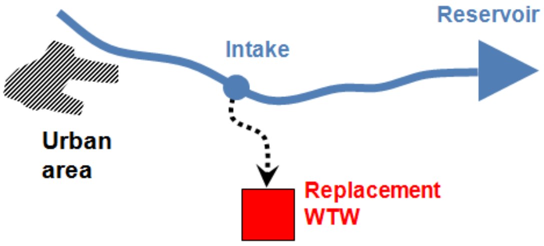
Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Reintroduce abstractions at Boswyn and Cargenwyn for treatment at Stithians WTW	3	17,780	4,340	1,600	0	250	6,190	33	35

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 biodiversity, key habitats and species	0	++	++	This option involves the clean-up of the polluted Porth catchment (pollution from 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.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
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. 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 clean-up 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.

Summary
• 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.6.5] 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 abstraction 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.

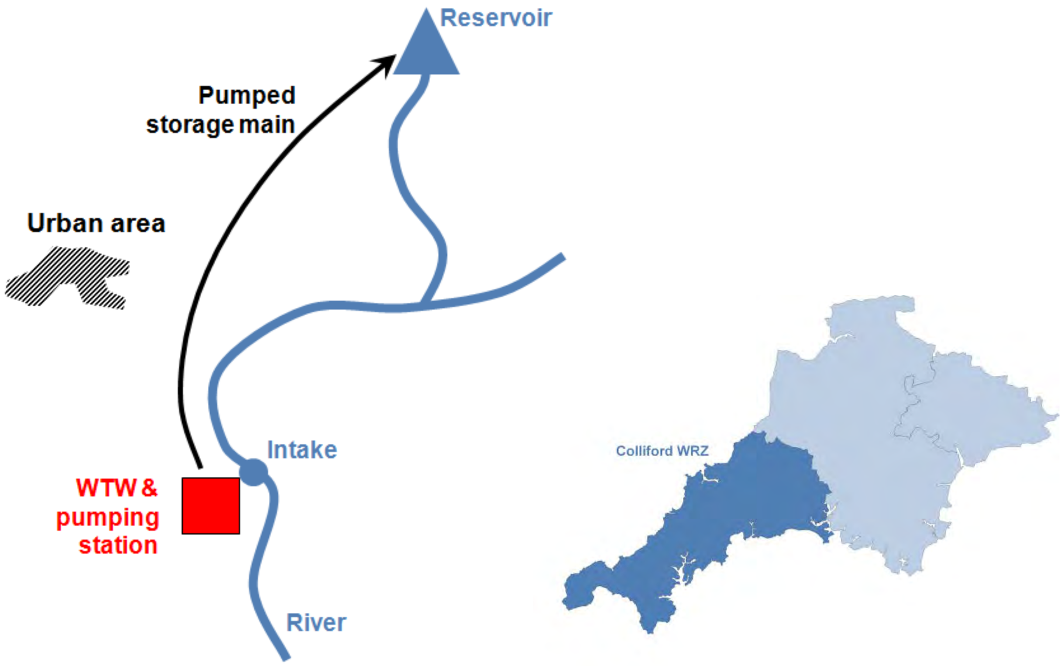
It is stressed that this option is exploratory at this stage, representing a potential opportunity for water resource development to support Colliford Reservoir. Significantly more work would be required in support of any formal application, including an environmental impact assessment (EIA) for any 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.6.5] Solomon, D. Sambrook, H. & Toms, S. (2007), *Restormel abstraction and winter run salmon on the River Fowey, South West Water/Environment Agency, June 2007*

- 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.

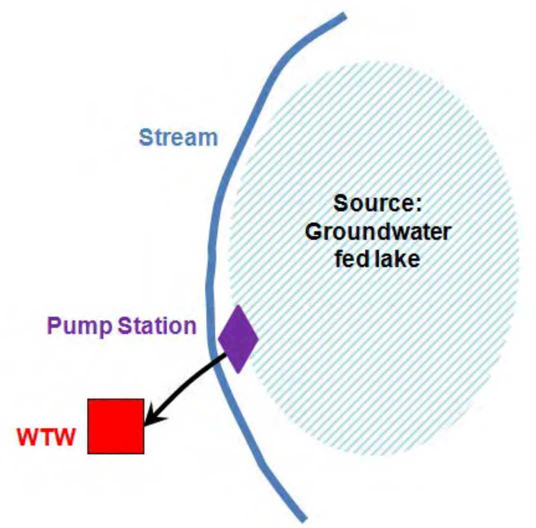
Summary	
Positive	• This option proposes to increase the Deployable Output of the Colliford Scheme through abstraction of higher flows whilst protecting low flows. • This option has the potential to manage water resources in an environmentally sensitive and sustainable manner and therefore help the region 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 an increase in the peak licence up to a maximum of 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.

The Environment Agency has stated that the waterbody which includes Stannon Lake “is on the list of waterbodies perceived to be at high risk of deterioration if used to its current licence maximum”. Given this, and to confirm our proposals would have no significant environmental impact, it will be necessary to undertake testing, environmental monitoring and analysis of the hydrological consequences of drawing down the lake.

The current Stannon licence (renewed November 2016) includes a requirement to undertake a programme of investigation into the nature and characteristics of any potential hydraulic linkage between the Stannon Stream and the Stannon Lake. This will be best informed by the completion of an abstraction test under low flow conditions during a period of limited rainfall when the lake is close to, or already drawn down below, top water level. However, operational use of the source in recent years has demonstrated that the current daily abstraction limit of 4 Ml/d is unlikely to result in a drawdown of the lake to its permitted maximum of 3m below top water level.

We are therefore proposing a period of investigation permitting a higher level of abstraction to draw down the lake. Following prolonged dry weather conditions in early summer 2018, and with lower than average rainfall predictions for the following months, SWW submitted an application for consent to carry out higher rate abstraction testing on the 2nd July 2018. A temporary increase in maximum pumping rate from 4 Ml/d to 6 Ml/d for a six month period was proposed starting 1st July 2018. This would have enabled Stannon Lake to be drawn down closer to its maximum permitted level of 3 m below top water level so that the environmental impact of such a reduction in the lake level could be fully evaluated. To date, permission has not been granted for such a test but we continue to enter into discussions with the Agency on how best to comply with the testing requirement within the current licence.

A revised conceptual model of the catchment hydrology is currently being developed by our consultants, ESI Ltd. The data from the proposed test would inform the development of the conceptual model and support hydrological modelling, which will be used to predict any impact from lake levels being lowered closer to the permitted maximum.

Should the abstraction testing be granted and subsequent analysis of hydrological data prove favourable with no increase in risk of deterioration in the downstream catchment, we would then wish to apply to increase the peak daily rate that can be abstracted, whilst constraining total abstraction to the existing annual volumetric limit averaged over a rolling multi-year period.

As previously stated, this approach is similar to that agreed for the Park Lake abstraction licence (renewed January 2018), which is believed to be a broadly comparable hydrological system. This has allowed us to benefit from extra water for operational purposes at certain times of the year whilst ensuring that the environment is safeguarded over the long term.

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. Continued hydrological monitoring.
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 environment and the groundwater resource	+	+	+	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 environment.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				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 to be costed if it is identified as being a potential solution to a possible future developing supply demand concern in this WRZ.

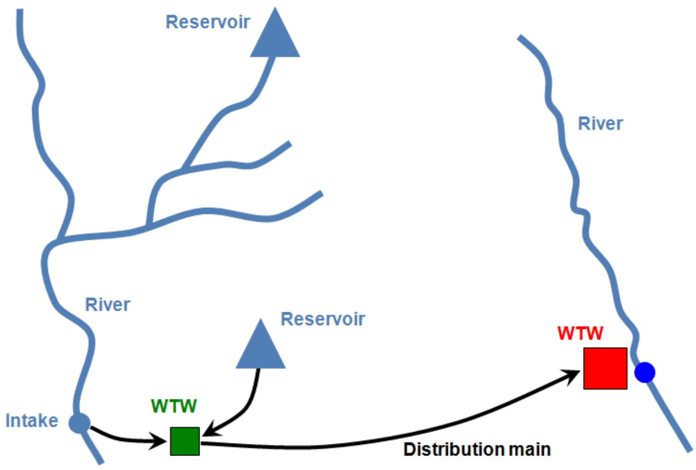
R1: Duplication of distribution main through South Devon and Littlehempston WTW capacity increase to 100Ml/d

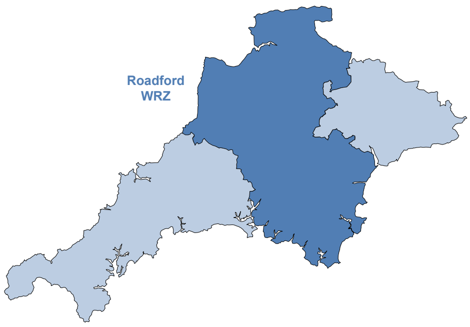
Option type: Distribution/production management
Indicative benefit: 16 Ml/d
Implementation: 3 years

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 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 innovative 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 anticipated. Littlehempston No ecological designated sites within approximately 5 km.

Criteria	What is the predicted temporal effect Short term	Med term	Long term	Commentary (including cumulative effects and potential mitigation measures)
				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 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

Criteria	What is the predicted temporal effect Short term	Med term	Long term	Commentary (including cumulative effects and potential mitigation measures)
				landscape in the short term. Littlehempston South Devon AONB is approximately 5 km 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.
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

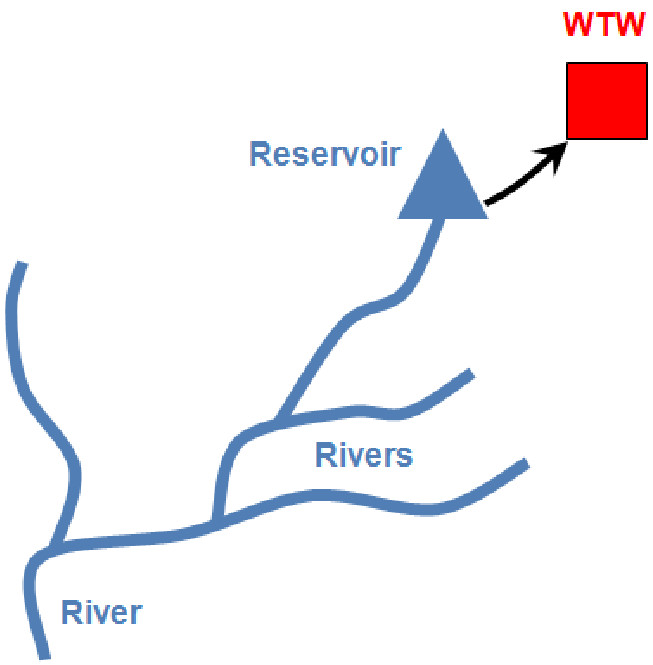
Option type: Distribution/production management
Indicative benefit: 10 Ml/d
Implementation: 2 years

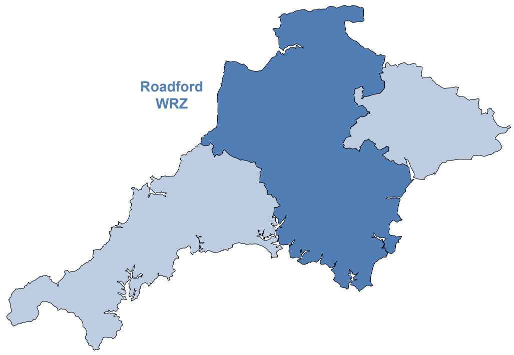
Description of the option

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 to climate change	+/-	+/-	+/-	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. Increasing the capacity of the WTW is likely to lead to the consumption of more

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				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

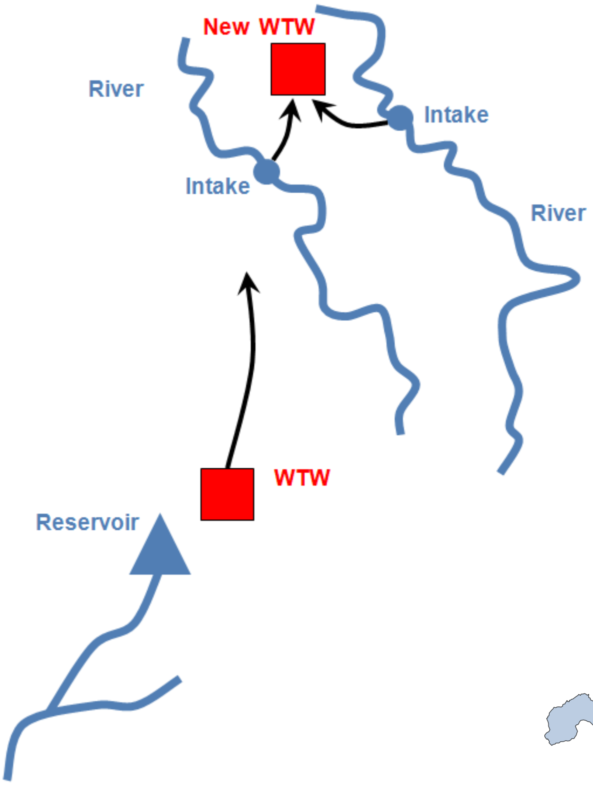
R3: River Taw and / or Torridge abstractions

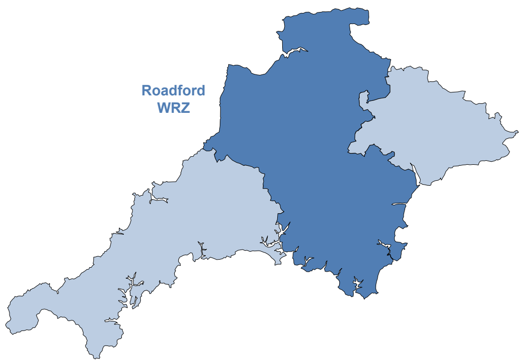
Option type: Resource scheme
Indicative benefit: 14 Ml/d
Implementation: 3 years

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

South West Water Bournemouth Water

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/Thrushel pipeline and the existing main from Roadford to Northcombe WTW.

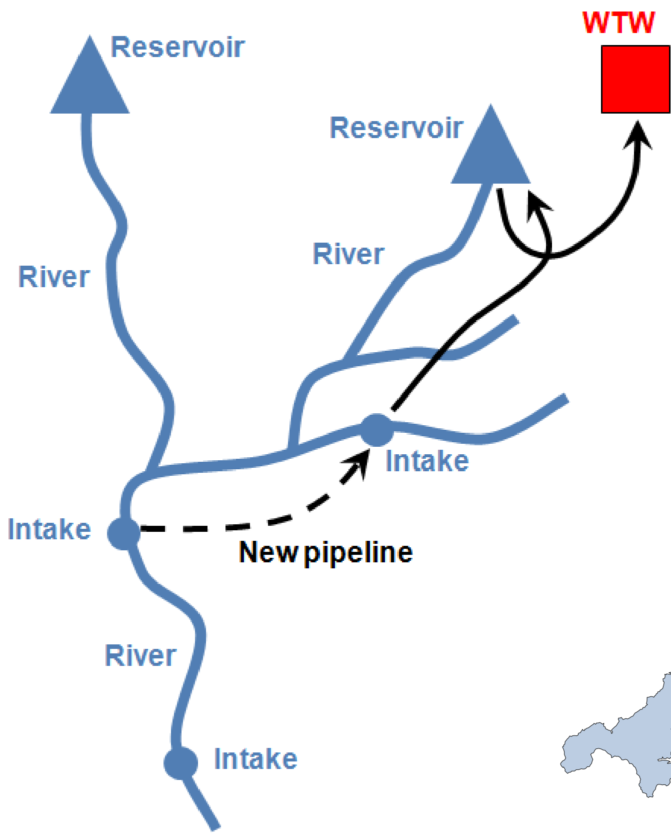
Two phases of the scheme are under consideration:

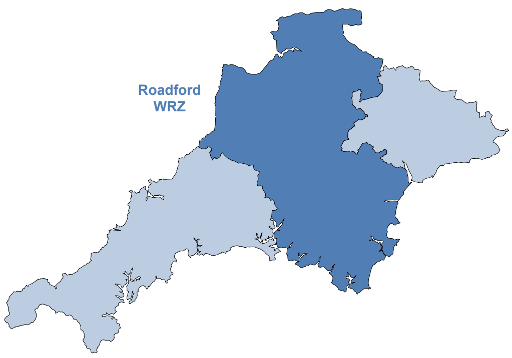
Phase 1: Will enable water from the River Lyd/Tamar to be **only** transferred to Northcombe WTW - rather than to Northcombe WTW and/or Roadford Reservoir. This will result in the benefit of the scheme being limited as although abstractions from Roadford will be minimised, no additional water will be 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 2 km 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

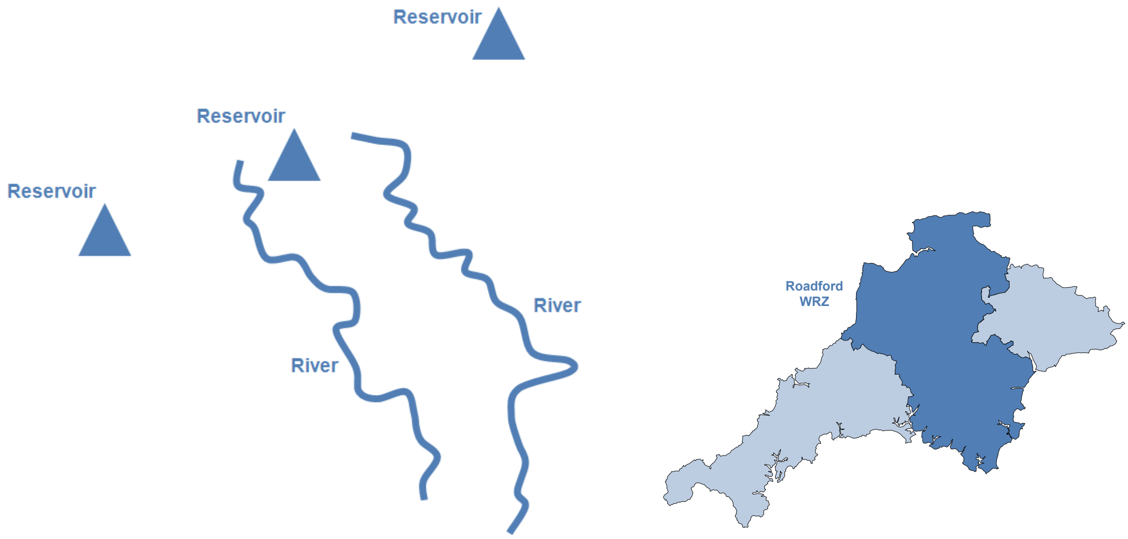
Option name	Indicative WAFU (Ml/d)	NPV of WAFU (Ml)	CAPEX NPV £000)	OPEX NPV (£000)	NPV of OPEX savings (£000)	Social and env. NPV (£000)	Total NPV (£000)	AIC (p/m3)	AISC (p/m3)
Roadford / Northcombe pumped storage from Gatherley (River Tamar)	14	33,100	3,900	730	0	520	5,150	14	16

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 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.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				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 to be costed if it is identified as being a potential solution to a possible future developing supply demand concern in this WRZ.

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

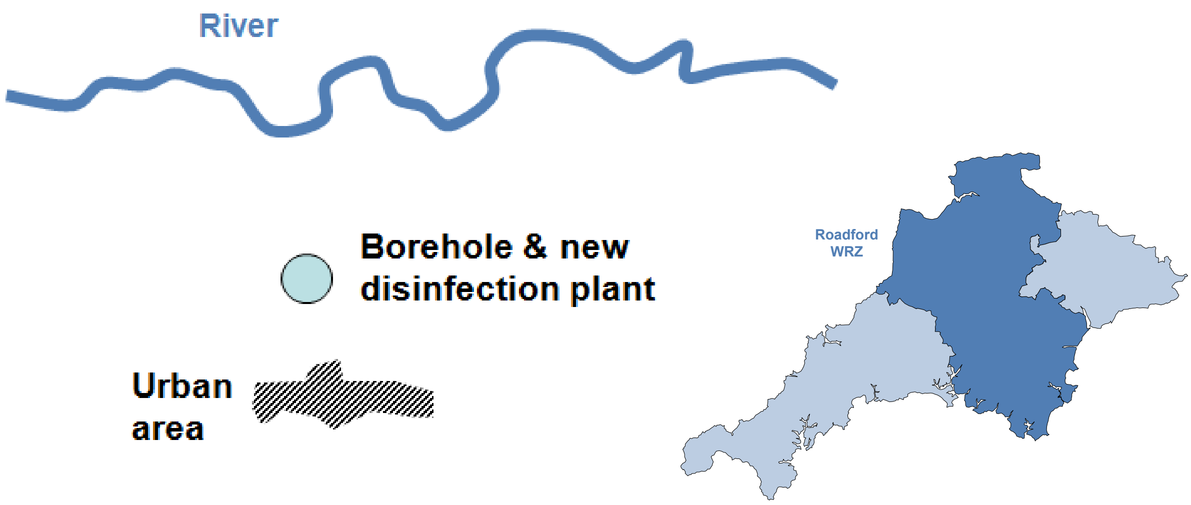
The disused pumping station and WTW at Uton has an abstraction licence for 0.9 Ml/d as an annual average. The original source (now backfilled) was replaced with a new borehole but never commissioned.

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 SWW 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. Viability of connecting to the existing treated water mains system will have to be checked. The transferral of abstraction licences may not be agreed by the EA.

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 have short-term 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	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	
resource				
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.
Negative	• The construction works for the new treatment plant, equipping 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

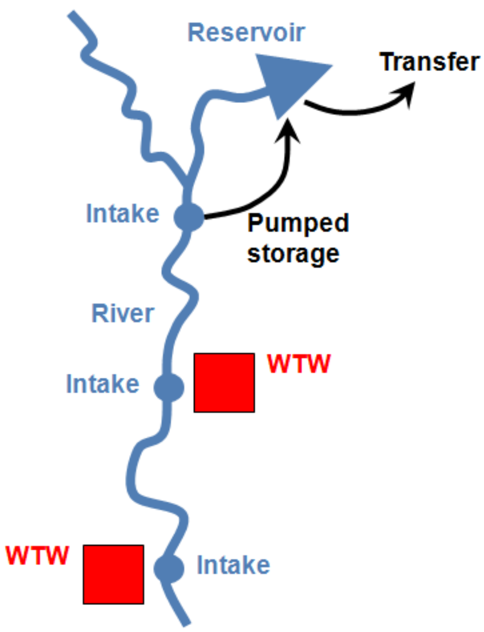
Description of the option

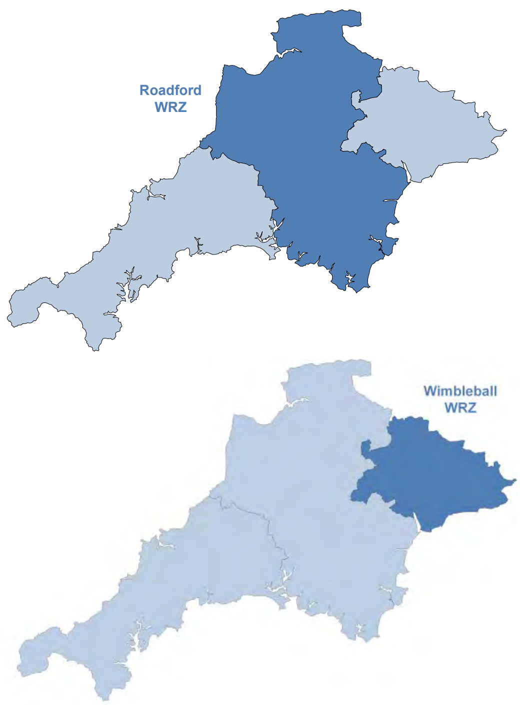
This option will increase the maximum capacity of Pynes WTW up to its licensed maximum of 67 Ml/d thereby improving the Company's ability to utilise the yield of the River Exe/Wimbleball resources system.

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:

- Seventh filtration stream
- Washwater capacity increased by 125 m^3
- Generator to power filter gallery
- Alum pump capable of dosing to 125 ppm
- Third 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.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				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, 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	?/+/-	+	+	This option would help ensure the continuity of clean drinking water supply.

Criteria	What is the predicted temporal effect: Short term	Med term	Long term	Commentary (including cumulative effects and potential mitigation measures)
health				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. • 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.

At this stage, it is envisaged that Brampford Speke and Stoke Canon boreholes could be used seasonally to either:

a) Partially replace potential releases to the River Exe from Wimbleball Reservoir in the autumn when natural river flows are low and in so doing preserving reservoir storage. This operation would reduce pumped storage requirements to augment reservoir storage over the subsequent winter, minimising energy use and carbon emissions
b) Partially replace potential releases in the spring and preserve storage in the reservoir, thereby providing improved resilience against extreme droughts

Two options exist to utilise the boreholes

1) Pumping the water directly to the river intake location via a new raw water main
2) Using the existing discharge points into the river locally, with the water being abstracted from the river at the river intake location

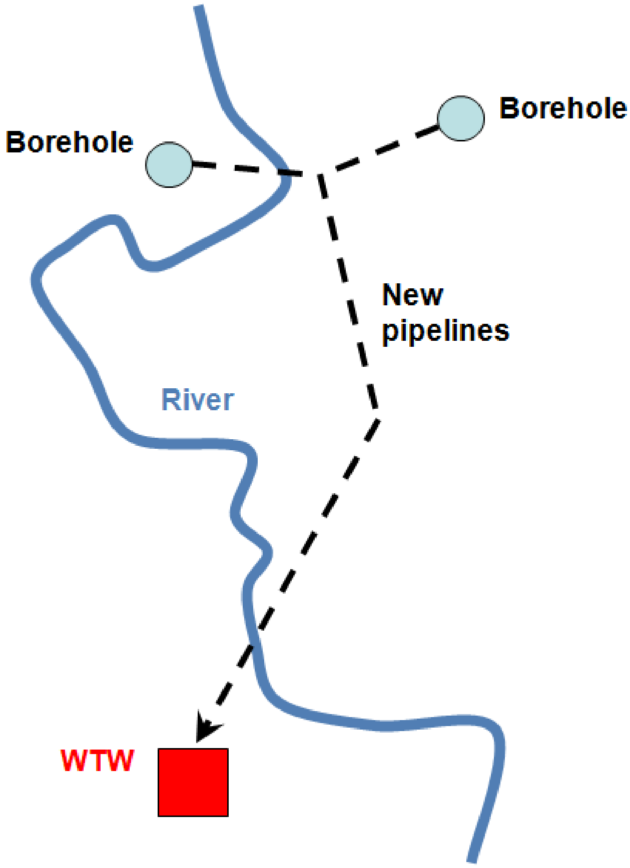
A greater understanding of the benefits from operating these boreholes will be identified through detailed water resources modelling of the conjunctive use of these sources in the Wimbleball WRZ.

The works required include:

- Replacement headworks, pumps and motor control centres at each site

In order to pump directly 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 within the vicinity of two SSSIs. Stoke Canon borehole is within approximately 2 km 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 (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

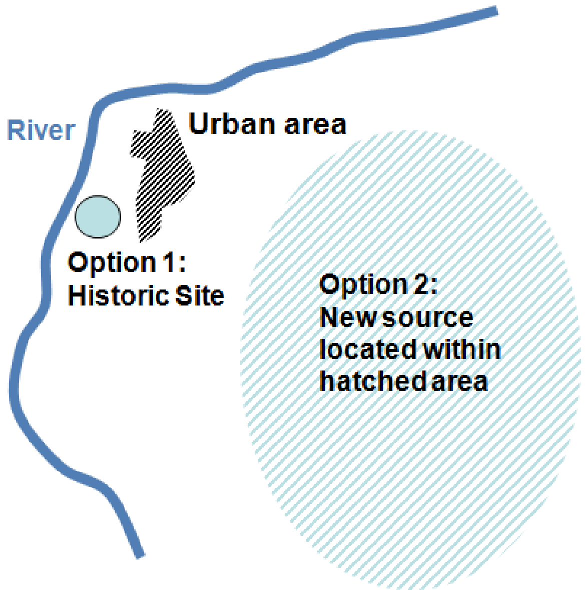
Option type: Resource scheme
Indicative benefit: 2 Ml/d
Implementation: 18 months

Description of the option

Construction of a new groundwater source in East Devon with new treatment plant and connections to the existing network.

The establishment of a new groundwater source in East Devon could be located at Sidford or another location outside the Otter Valley subject to viability assessments.

The construction and testing of the trial borehole at Sidford in 2017 confirmed the availability of water for supply but also identified high levels of manganese and iron. We are therefore continuing to investigate potential options to improve the water quality at this source.



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.

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 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 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

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

BW1: Re-introduce Wimborne

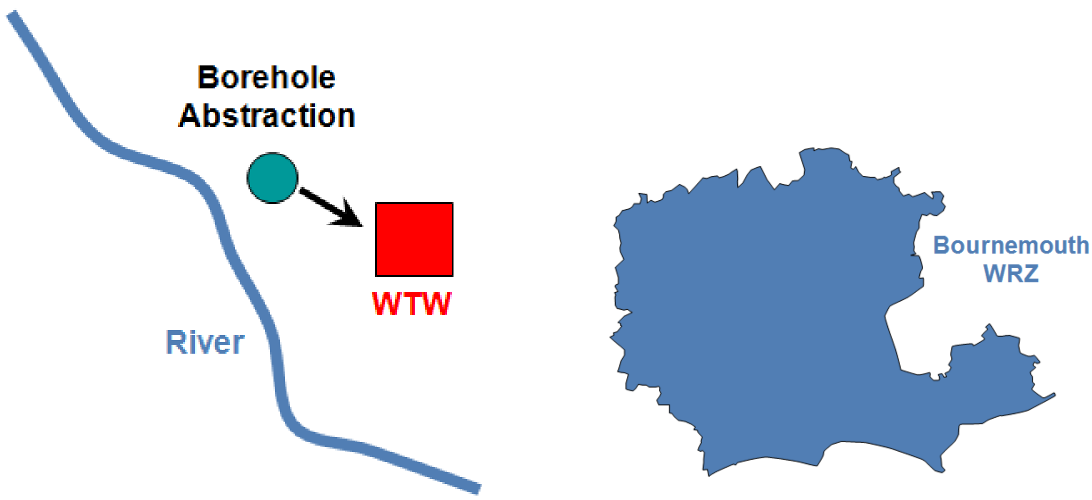
Option type: Production
Indicative benefit: 4.1 Ml/d
Implementation: 2 years

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 investments at the Bournemouth WTWs included in the proposed PR19 programme

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 activities 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.

Criteria	What is the predicted temporal effect			Commentary (including cumulative effects and potential mitigation measures)
	Short term	Med term	Long term	
				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	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

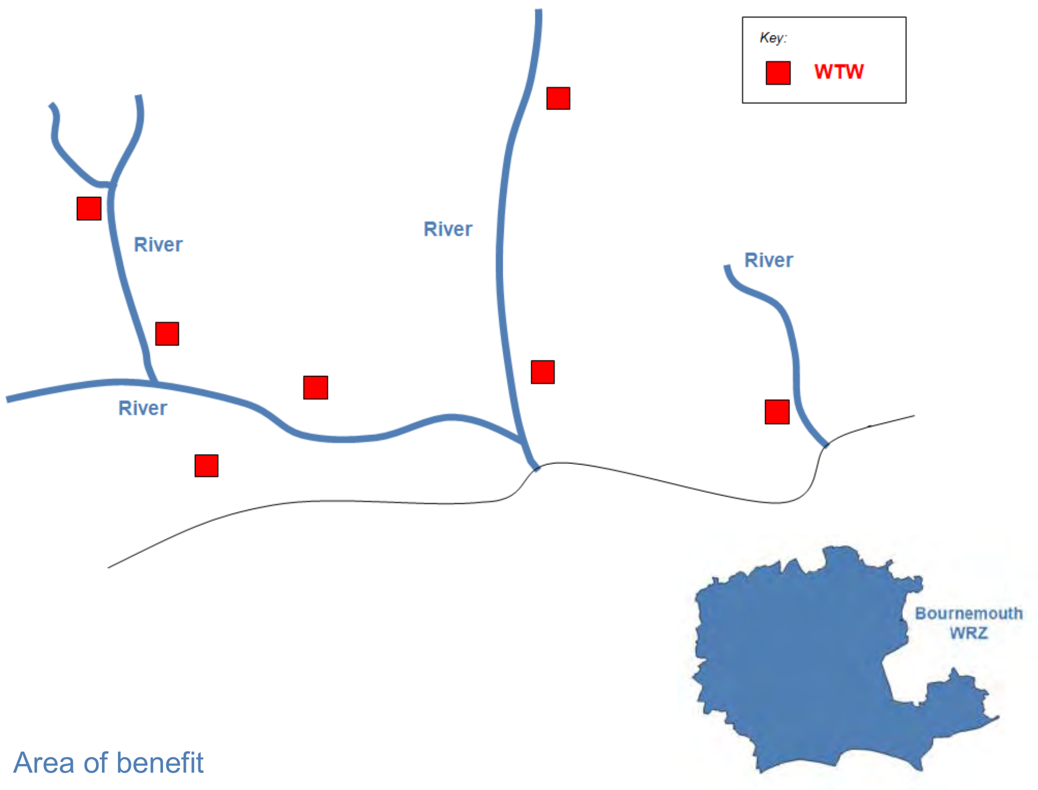
Option to be costed if it is identified as being a potential solution to a possible future developing supply demand concern in this WRZ.

BW2: 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.

Uncertainty of benefits

Currently unknown, further work is required when specific schemes have been identified.

Flexibility of option

Currently unknown, further work is required when specific schemes have been identified.

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.

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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 to be costed if it is identified as being a potential solution to a possible future developing supply demand concern in this WRZ.

A.6.6.3 Direct Procurement for Customers

DPC has the potential to benefit customers by providing an option for delivering the largest and most expensive new assets at lower cost, and allows scope for greater innovation, allowing new providers to bring new ideas.

We instructed KPMG to undertake an independent assessment for the opportunities for DPC in our Plan. The following sets out the work undertaken.

A.6.6.3.1 Our approach

We followed a structured and transparent approach to assessing options for DPC. Figure A.6.1 summarises our overall methodology.

Figure A.6.1: Methodology used for assessing options for DPC

	Eligibility Assessment		Value for Money Assessment	
	Sort schemes by value	Technical suitability	Qualitative assessment of value for money	Quantitative assessment of value for money
Objective	Identify the number of schemes and their size against Ofwat's threshold.	Consider and asses technical suitability for project base don Ofwat guidance published as part of PR19 methodology	Identify schemes that could provide scope for customer value for money using a qualitative assessment.	Identify schemes that could provide scope for customer value for money using a quantitative CBA.
Test	Compile a list of projects and programmes by present value for further consideration. The present value of each scheme will be derived using: • Development costs, initial capex, renewal capex, opex, financing costs (TBD depending on Ofwat's final methodology). • The social discount rate. • Life-span over the proposed concession period (25 years TBD).	• Consider specific operational and technical considerations of the asset within the wider context of South West Water's network including: - Interactions with the network. - Asset and operational failures. - Contributions to supply capacity and ability to specific outputs. - Stakeholder interactions and statutory obligations.	• Each scheme will be qualitatively assessed against key criteria, to assess the value for money and hence suitability for undertaking the scheme via DPC. • Each scheme will receive a 'pass' / 'neutral' / 'fail' qualitative test against a range of criteria. • The criteria are selected to ensure projects which pass the qualitative tests will increase the value for money of the customers. • The criteria and summary of the qualitative assessment is below.	• To determine if a scheme will have greater scope for customer value for money if undertaken via DPC, schemes will undergo a CBA using two scenarios. • Scenario A: will be a scheme carried out by a third party provider under DPC arrangements. • Scenario B: will assume the scheme is carried out by SWW under the PR19 framework. • A number of assumptions are considered under both scenarios. • A value for money assessment provides the impact on the costs to customers of completing the schemes under different approaches (scenario A&B).
Outcome	• Schemes that are within close proximity to the Ofwat threshold, are technically suitable and could provide scope for customer value for money when considered under the qualitative assessment, will undergo a quantitative assessment for customer value for money in step 2.			• Schemes that are shown to provide value customer value for money through a DPC delivery route will be considered for approval in accordance with the PR19 business planning governance structure.

Within this process the assessment included the relevant analysis against the 5 case areas set out in the Ofwat methodology:

- Strategic
- Economic
- Commercial
- Finance
- Management

A.6.6.3.2 Eligible process

As part of the eligibility process, to test the suitability of assets in a clear and transparent manner a common assessment template was used. Table A.6.19 sets out an example of how the asset suitability was assessed.

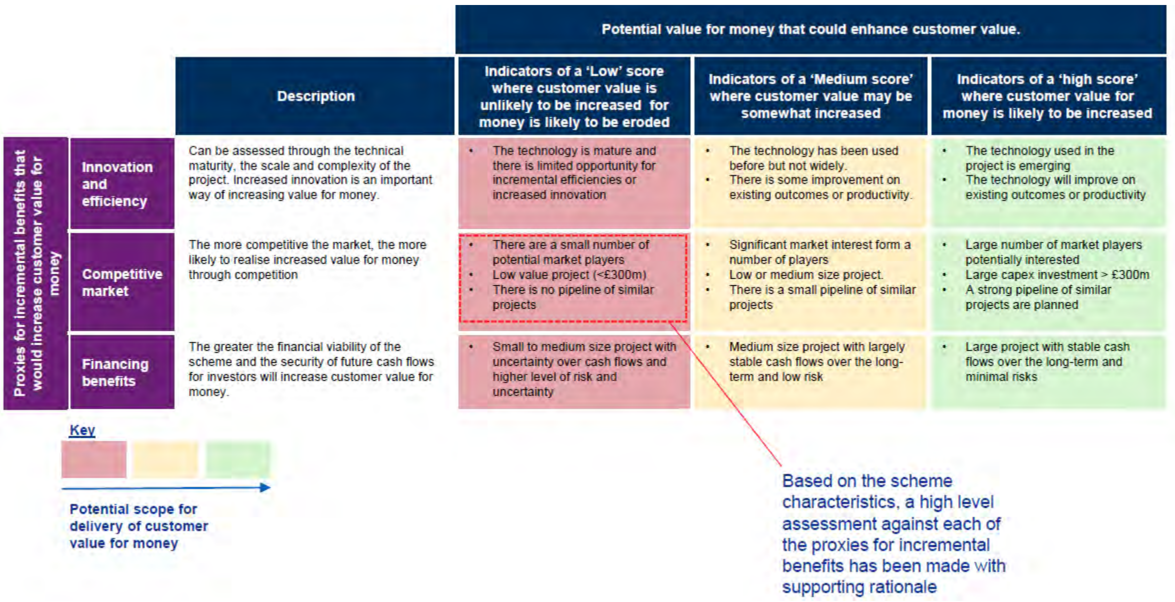
Table A.6.19: Template used for assessment of asset suitability

Key criteria/considerations	Assessment of specific projects technical characteristics and risks against key criteria	Overall assessments
Stakeholder interactions and statutory obligations: *Number of regulators (e.g. DWI, EA, Ofwat) , frequency of monitoring involvement, Regulatory enforcement*	Assessment of project schemes against key considerations and criteria	
Interoperability considerations: *Number type and nature of interfaces with wider network Actively manged or passive assets, separate physical location, economies of scope and scale*		
Output type and stability: *Day to day supply source, resilience asset, volatility of output , alternative sources*		
Asset and operational service failures *Simple well understood assets or complex assets where limited precedents exist, limited impact of failure on customers, mature supply chain*		

A.6.6.3.3 Value for money process

As part of the value for money qualitative process, to give consistency in assessment, a separate common assessment template was used. Figure A.6.2 sets out an example of how value for money was assessed.

Figure A.6.2: Approach for qualitative assessment of value for money



For the quantitative assessment, a similar common approach was adopted. This compared the NPV of the different delivery routes as set out in Figure A.6.3.

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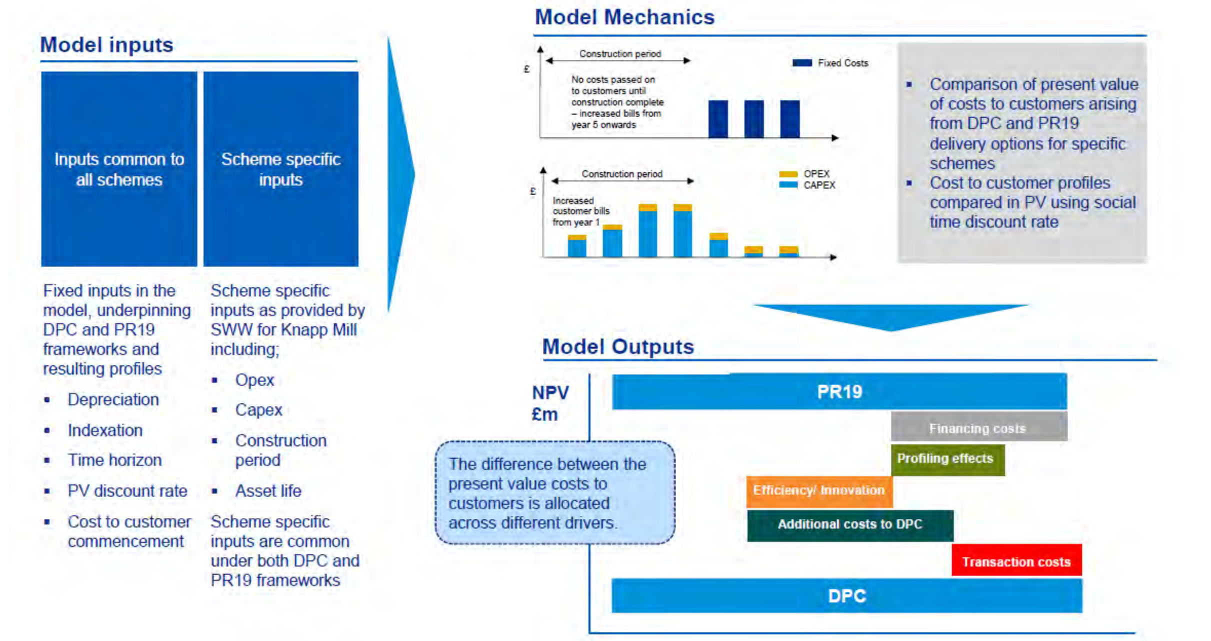
Figure A.6.3: Approach for quantitative assessment of NPV



A.6.6.4 Additional considerations built into the assessment

The project size threshold set by Ofwat is £100m whole-life totex. We set out some additional clarity on this interpretation as part of our considerations to enable the schemes to be evaluated. These were:

A.6.6.4.1 Scope of costs

Potential costs could include:

- Project development costs
- Financing costs
- Initial capital expenditure and renewal capital expenditure
- Operating costs associated with operations and maintenance activities including allocated overheads

We assumed the following costs in the size test analysis:

- Totex by definition excludes financing costs and therefore we have only considered all capital and operating costs associated with the scheme
- Project development costs are not included as it is assumed these would be incurred by Southern Water and the project would only be tendered post development and planning consents

A.6.6.4.2 Duration of costs

Periods that expenditure is considered over:

- Business plan life (5 years)
- Asset life
- Typical concession period (e.g. 25 years)
- Costs have been discounted at the social time preference rate of 3.5% (real)

For the purpose of analysis, we have assumed a 28 year period. This includes a three-year construction period and a 25 year operations and maintenance concession period.

This aligns with typical concession periods for PFI /PPP contracts and which would include the full scope of costs being considered for competitive procurement. 25 years is likely to be the upper end of the time range for which financing could be secured against the project.

A.6.6.4.3 Cost of Treatment

Whole-life costs could be based on:

- Real or nominal costs
- Discounted or undiscounted rates

For the purpose of analysis, we have assumed a discount rate of 3.5% in line with the social time preference.

Costs are in real terms in a 2017/18 price base.

Consistent assumptions were used on discount rates, efficiencies assumed and pass back of costs to customers in all the analysis to allow them to be compared equally.

1. Schemes assessed

Within our Plan, the study identified two large schemes for a DPC assessment. Key details are given in Table A.6.20. The sites were assessed for the Plan as individual projects but also as a combined project. There are no other large schemes in the Plan.

Table A.6.20: Two large schemes identified for a DPC assessment

Scheme	Description	Cost	Asset life	Construction period
WTW A	A new WTW to safeguard water supply and meet DWI water quality requirements. Based on membrane technology.	Initial estimated build cost is £69.4m, annual operating costs are estimated at £1.4m per annum.	60 years for civils, 25 years for M&E and 10 years for ICA.	3 years, planned to commence in 2021.
WTW B	A new WTW to safeguard water supply and meet DWI water quality requirements. Based on membrane technology.	Initial estimated build cost is c.£63.9m annual operating costs are estimated at c.£1m per annum.	60 years for civils, 25 years for M&E and 10 years for ICA.	3 years, planned to commence in 2023.

The timeline for the schemes is as follows. In both cases expenditure occurs in AMP7, but in the case of WTW B the works does not complete until AMP8. The WTW A site serves a large non-household demand. This requires a constant volume of water to maintain processes and outputs. This is delivered via a pipeline direct from the WTW to the plant.

In addition, we are also in discussion with Southern Water on a potential treated water transfer from Bournemouth WRZ to their operations in Hampshire. This is discussed at the end of this appendix.

2. Results of the DPC assessment – WTW A

The overall results for the WTW A assessment are set out below. The results show that the scheme meets some of the criteria for a DPC scheme, however some of the features of the project significantly reduce its suitability for DPC. Specifically, the need to meet the DWI timescale for site improvements on water quality by 2025 and the impact of the site on local resilience and supply to the non-household demand are not suitable for the DPC route.

Eligibility Assessment

<u>Value</u>

The whole life totex for WTW A on a discounted basis is £84.6m over the contract period (21 years) and £115.9m over the full asset life on a discounted basis. WTW A is over the £100m threshold under every scenario apart from discounted over the concession period when it is marginally below the threshold. The most literal interpretation of Ofwat's methodology is totex over the whole life of the asset undiscounted which for WTW A is significantly above the threshold. Therefore, the project is considered to be sufficiently above the threshold and therefore requires further assessment and evaluation to determine the eligibility of the project for DPC delivery.

Technical suitability

The WTW A project exhibits some characteristics that may make it more suitable for DPC and some characteristics that may make it less suitable for DPC when assessed against Ofwat's technical guidance. Whilst the project could be considered largely discrete, with relatively well understood and manageable interfaces, the impacts of service failure associated with non-household demand and the wider supply network are significant. Given SWW will retain its statutory obligations and contractual obligations associated with serving the non-household demand, transfer of these risks to a DPC is likely to create risks which would impact on costs to customers.

The summary of the technical suitability is given below.

Table A.6.21: WTW A - assessment of asset suitability for DPC

Key criteria/considerations	Overall assessments
Stakeholder interactions and statutory obligations: *Number of regulators (e.g. DWI, EA, Ofwat) , frequency of monitoring involvement, Regulatory enforcement*	Characteristics somewhat less suitable for DPC
Interoperability considerations: *Number type and nature of interfaces with wider network Actively manged or passive assets, separate physical location, economies of scope and scale*	Characteristics somewhat more suitable for DPC
Output type and stability: *Day to day supply source, resilience asset, volatility of output , alternative sources*	Characteristics somewhat more suitable for DPC
Asset and operational service failures *Simple well understood assets or complex assets where limited precedents exist, limited impact of failure on customers, mature supply chain*	Characteristics somewhat less suitable for DPC

Value for money assessment

Qualitative

There may be some incremental benefits associated with delivery of WTW A under a DPC route. However, there is also likely to be some off-setting incremental costs which could erode their benefits and reduce customer value for money.

High costs of failure are likely to increase risks and costs under a DPC delivery route for this site. There is some interest from the supply chain but the relative size and complexity of the scheme may reduce competitive tension over time as the project develops and potentially larger projects emerge over AMP7.

<u>Quantitative</u>

The quantitative analysis suggests that delivery of WTW A under a DPC model would not create value for customers. The base case shows PR19 delivers greater value for money than a DPC delivery model.

Sensitivity analysis suggests that more aggressive efficiency assumptions associated with DPC delivery could provide some customer value for money against a conventional delivery approach. However, achieving this level of efficiency is likely to be challenging given the expenditure profile, SWW's existing experience with plants of this nature and the efficiency challenge Ofwat may place on companies under the PR19 framework. It would also need to be offset against any risks bidders may price.

The DWI requires SWW to replace WTW A and remove the associated risks to water quality by 31st March 2025. The delivery of WTW A under a DPC route may impact the delivery timeline given the immaturity of the DPC market and this would delay benefits to customers, however, this has not been quantified.

Table A.6.22 shows the comparison of the costs. Two additional sensitivity scenarios under DPC were undertaken to stress test the analysis.

Table A.6.22: WTW A - cost comparison for DPC

	2022 NPV Customer Value for Money (£m)		
Scenarios	**PR19**	**DPC**	**Difference**
Base case	92.5	99.1	(6.6)
Lower cost of financing (Scenario A)		98.2	(5.7)
Increased efficiencies (Scenario B)		90.5	2

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3. Results of the DPC assessment – WTW B

The overall results for WTW B assessment are set out below. The results show that the scheme meets some of the criteria for a DPC scheme, however some of the features of the project significantly reduce its suitability for DPC. Specifically, the site is a key resilience element of the supply in the Bournemouth WRZ area and the technology required to meet future drinking water quality requirements is not compatible with the DPC delivery route.

Eligibility assessment

Value

The whole life totex for WTW B is £98.2m over the contract period (21 years) on a discounted basis is marginally below the £100m threshold. WTW B is above the threshold over the full asset life on a discounted basis £127.6m. On an undiscounted basis it is £113.9 over the contract period and £261.4m over the whole life of the asset. Therefore, on balance WTW B lies substantially close to and above the £100m totex threshold to warrant further examination on suitability for delivery under a DPC model.

Technical suitability

The WTW B project exhibits characteristics that are likely to make it more suitable for DPC. Some aspects of the scheme are likely to create additional risks. For example, WTW B serves a significant proportion of the Bournemouth supply region and asset failure could result in SWW breaching its licence obligations and SWW is likely to require contractual penalties to incentivise compliance but these could increase contractual costs. In addition, membrane technology is largely untested in the UK and this could attract more scrutiny from the DWI and increase monitoring and compliance costs.

The summary of the technical suitability is given in Table A.6.23.

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Table A.6.23: WTW B - assessment of asset suitability for DPC

Key criteria/considerations	Overall assessments
Stakeholder interactions and statutory obligations: *Number of regulators (e.g. DWI, EA, Ofwat) , frequency of monitoring involvement, Regulatory enforcement*	Characteristics somewhat more suitable for DPC
Interoperability considerations: *Number type and nature of interfaces with wider network Actively manged or passive assets, separate physical location, economies of scope and scale*	Characteristics somewhat more suitable for DPC
Output type and stability: *Day to day supply source, resilience asset, volatility of output , alternative sources*	Characteristics somewhat more suitable for DPC
Asset and operational service failures *Simple well understood assets or complex assets where limited precedents exist, limited impact of failure on customers, mature supply chain*	Characteristics somewhat less suitable for DPC

Value for Money Assessment

Qualitative

There may be some benefits associated with delivery of WTW B under a DPC route due to its emerging technology and the level of discreteness of the asset which reduces interoperability issues and costs this could create. However, the small scale of the asset, the associated uncertainties with the scheme and SWW's experience with membrane technology erode the potential benefits it could deliver.

The supply chain has shown some interest but the low capital expenditure and complexity of the scheme may reduce competitive tension especially as potentially larger projects emerge over AMP7.

Quantitative

The quantitative analysis suggests that delivery of WTW B under a DPC model would not create value for customers. Sensitivity analysis suggests that more aggressive efficiency assumptions could deliver greater value for money under DPC. Achieving this level of efficiency is likely to be challenging given the expenditure profile and SWW's existing experience with plants of this nature.

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Table A.6.24: WTW B - cost comparison for DPC

	PV Customer Value for Money (£m)		
Scenarios	**PR19**	**DPC**	**Difference**
Base case	96.1	101.1	(5)
Lower cost of financing (Scenario A)		100.3	(4.2)
Increased efficiencies (Scenario B)		90.8	5.2

4. Combined WTW A and WTW B delivery

The assessment undertaken concluded that whilst there could be some economies of scale as a result of procuring the projects under one contract, there is likely to be additional complexity associated with this approach which is likely to offset some of the potential benefits.

- The projects are located on different sites and will be delivered at different times and there are some constraints on the level of synergy that could be realised by bundling the plants under a single procurement
- The timing of WTW A construction (expected to start in 2021/22 in order to meet the DWI's delivery expectations of 2024/25) is earlier than WTW B and including WTW B in the procurement for WTW A, creates additional risk of delay in delivery of WTW A and placing customers at greater risk or a quality or reliability issue
- Combined, WTW A and WTW B would supply approximately 80% of Bournemouth WRZ's population and ceding this much control to a single third party creates a risk and reduces flexibility where a long-term contract is established
- Customers in the Bournemouth WRZ, which was recently acquired by SWW, may be concerned that SWW was allowing third parties to own and operate its water supply assets and which could erode customers' trust.

A value for money analysis combining WTW A and WTW B under a single project finance model shows limited improved value for customers but still compares unfavourably to the price control framework.

Table A.6.25: Combined WTW A and WTW B - cost comparison for DPC

	PV Customer Value for Money (£m)		
Scenarios	**PR19**	**DPC**	**Difference**
Base case	185.9	195.8	(9.9)
Lower cost of financing (Scenario A)		190.2	(4.2)
Increased efficiencies (Scenario B)		178.1	7.9

Overall findings by the Ofwat 5 Case Model Structure

Table A.6.26 presents the results of the analysis against the Ofwat 5 case model structure.

Table A.6.26: Overall findings by the Ofwat 5 case model structure

Case	*Results and findings based on assessment of ATW*
Strategic	▪ ATW was built in 1903 and is well in excess of its expected asset life (60 years) and still uses slow sand filter process technology which is recognised as an outdated and insufficient to ensure consistent high quality drinking water commensurate with current regulatory expectations. The plant is on the DWI's aged asset process register and is also subject to ongoing statutory notices based on concerns over the condition, design and configuration of the current assets and robustness of the treatment process to provide an effective barrier against all water quality risks. Increased operating costs are also being experienced as the performance of the plants continues to deteriorate. ▪ ATW serves 50% of Bournemouth's population which equates to approximately 240k people. ▪ The DWI's ongoing interest and monitoring of ATW also creates additional risks for South West Water around this project and which creates more risk under a DPC model than delivery under a conventional model. ▪ SWW's decision to adopt membrane technology at its newly constructed plant, Mayflower (the only plant of this type in the UK), could result in greater synergies with other membrane plants through experience and knowledge already acquired. ▪ As a strategic water treatment works, supplying approximately 50% of Bournemouth Water's population, SWW consider ATW to be core business. However, given the potential for DPC to offer improved customer value for money, further examination of the project has been undertaken to ascertain whether it is likely to be beneficial for customers.
Economic	**Options considered:** ▪ Options to replace process technology at ATW using conventional or membrane process treatment technologies or re-location to a new site have been considered alongside the cost benefit analysis of the different options. SWW has selected to replace the existing works with membrane process treatment similar to that adopted for the Mayflower Water Treatment Works currently under construction and which is the first of its kind in the UK. **Size Test:** • The total cost of the project over the assumed construction and concession period (21 years) is £98.2m on a discounted basis and marginally below the proposed threshold set by Ofwat of £100m (£113.9m totex undiscounted).). In addition, the initial capital expenditure is only £64m. Additionally, the total cost of the project over the entire asset life (60 years) including construction (3 years) is £127.6m on a discounted basis and £261.4m on an undiscounted basis. • Given the proximity to the £100m threshold, further analysis has been completed to determine if the project is technically eligible and whether there is potential scope to offer value for money for customers through a DPC delivery route.

Case	Results and findings based on assessment of ATW
Economic (Cont'd)	**Technical assessment:** Based on the key project characteristics as considered against Ofwat's technical guidance, the ATW scheme could be considered 'discrete' and somewhat suitable for DPC from a technical perspective. There are challenges that could reduce the suitability of this project for DPC although these are considered to be largely manageable through contractual arrangements. There are some important considerations that may impact on suitability: • Co-location on the new asset on an existing SWW operational site has the potential to cause construction overruns to programme and target costs which are likely to be priced by a bidder. • There is limited resilience to support a period of sustained outage which could have a significant impact on customers in the Bournemouth Water area and could impact on SWW's licence and key performance commitments. ATW serves a population of c.240k, 50% of the Bournemouth water supply area.. ▪ Membrane technology is relatively untested in the UK and this may create additional scrutiny from the DWI, especially where a third party is responsible for operational delivery and which could require increased monitoring and compliance costs **Qualitative vfm:** • The analysis suggests that there may be some benefits associated with delivery of ATW under a DPC route, largely driven by the use of emerging process technology. • The relatively low value of the project and SWW's experience with membrane technology already is considered to reduce the likely benefits that could be realised for customers through DPC delivery. **Quantitative vfm:** • The quantitative vfm analysis suggests that delivery of ATW under a DPC model may not create value for customers. The cost to customers for delivery of ATW under a conventional price control model is £96.1m on an NPV basis (at the start of construction) compared with £101.1m under a DPC model. • This is dependent on the discount rates used, the level of assumed efficiencies under each delivery route, the residual value at the end of the concession period and the assumption that additional costs to SWW would be passed on to customers. A range of sensitivities are provided in the analysis. • At this stage no specific risks to DPC have been priced into the vfm analysis such as construction overrun or delay. **Tender model** ▪ A 'late' tender model has been adopted based on consideration of project risks and feedback from market sounding. ▪ In addition, separating responsibility for operations and construction risks impacting negatively on whole life costs where there are no incentives to build assets for low cost operations over the long-term.

Case	Results and findings based on assessment of ATW
Commercial	• Feedback from market sounding and research on the potential DPC market suggests WTW A may not be of significant size to be attractive to investors and realise benefits through a DPC model given the relatively low initial capital investment value of the scheme. • Some of the DPC contractual features set out by Ofwat as part of the final methodology may create challenges for bidders or could result in higher costs for customers compared with the current model.
Finance	• The value for money modelling on the base case suggests a higher bill impact of 3.2% over the contract period under a DPC model versus 2.4% under a conventional delivery model suggesting DPC delivery would increase customers' bills by a greater amount. • The DPC asset is likely to be considered as a financing lease under IFRS16 and would need to be recognised as a liability on SWW's balance sheet and which could have implications for credit metrics. • Given the size of the investment in the context of SWW's RCV and investment programme and its ability to access capital, there is unlikely to be a financial case for delivery of ATW under a DPC model.
Management	• SWW's Board will consider the best procurement strategy and approach for the project and which may include delivery under the existing alliance model or a separate procurement given the relative size of this project. The H5O alliance is currently being competitively tendered for the next 5+5 years. • SWW and the existing alliance has experience and capabilities gained through the development, construction and planned operations of WTW A. • Additional costs associated with the capabilities required to run and manage a PPP style procurement process would increase costs associated and have been included in the VFM analysis.

Future assessments - Bournemouth WRZ to Southern Water transfer

We have been working on a potential treated water transfer to Southern Water from Bournemouth WRZ. Our Draft WRMP identified this as an option with a potential earliest delivery date of 2025 to 2030. In their Draft WRMP, Southern Water identified this scheme as being needed in the 2035-2040 period.

Work since the Draft WRMP suggests that Southern Water scheme may be selected earlier in the Southern Water programme than their original estimate.

Three different transfer schemes have been costed, all have a total capital cost in excess of £100m. As such we consider they are of sufficient size to warrant future consideration as a DPC scheme.

In addition, this transfer scheme could form part of future competitive process for water transfers in 2019 recommended by the National Infrastructure Commission in the report “Preparing for a Drier Future”.

In light of the size of the project, the need for confirmation of the scheme in the Southern Water Final Determination, and the forthcoming competitive process on transfers, we have not included the costs for this scheme within our Plan. Instead we consider this could form part of the new market process.

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.

Compared to the Draft WRMP, the Final Plan included the following additional scenarios:

- National Infrastructure Commission scenario of 50% leakage reduction by 2045
- Stretching PCC reductions to 100, 86 and 62l/per/day by 2045
- Best and worst-case scenario for environmental needs
- The impact on the cost of the programme of a 15% leakage reduction by 2025 using a revised leakage delivery programme
- An additional analysis was undertaken assessing a range of different risks in the Otter Valley catchment.

We also included additional analysis on wider resilience.

As for our Draft Plan, as the baseline forecasts show our WRZs are in surplus for the planning period or for the short-term, 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. However, following feedback on our Draft Plan and as part of our overall Business Plan commitments we will be looking to install new meters on all unmeasured properties. As such, we did not model different metering scenarios for this plan.

Feedback on the Draft WRMP was that customers and stakeholders would like to see more water efficiency in our Final Plan. We therefore included additional scenarios showing the impact of different future outcomes on customer water use. With the 15% leakage reduction by 2025 a key feedback point from the Draft Plan consultation, there is not strict supply-demand driver for water efficiency. As shown in Section 8, the level of water efficiency in the Final Plan was therefore based on a range of broader factors and not cost alone.

Unless stated otherwise the costs of leakage reduction are based on the same costs in the Draft Plan. Additional analysis is given on our Final Plan leakage costs and comparisons to the Draft Plan are given.

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. This shows the curve for current leakage costs. The sensitivity to future leakage costs in our Final Plan is in Scenario 6. 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. The SELL curves show a ‘cost-beneficial’ leakage range of c55-70Ml/d for SWW WRZs and 16-19Ml/d for BW. This is consistent with the findings in the Draft Plan and for both assessments based on current leakage costs and the Final Plan costs.

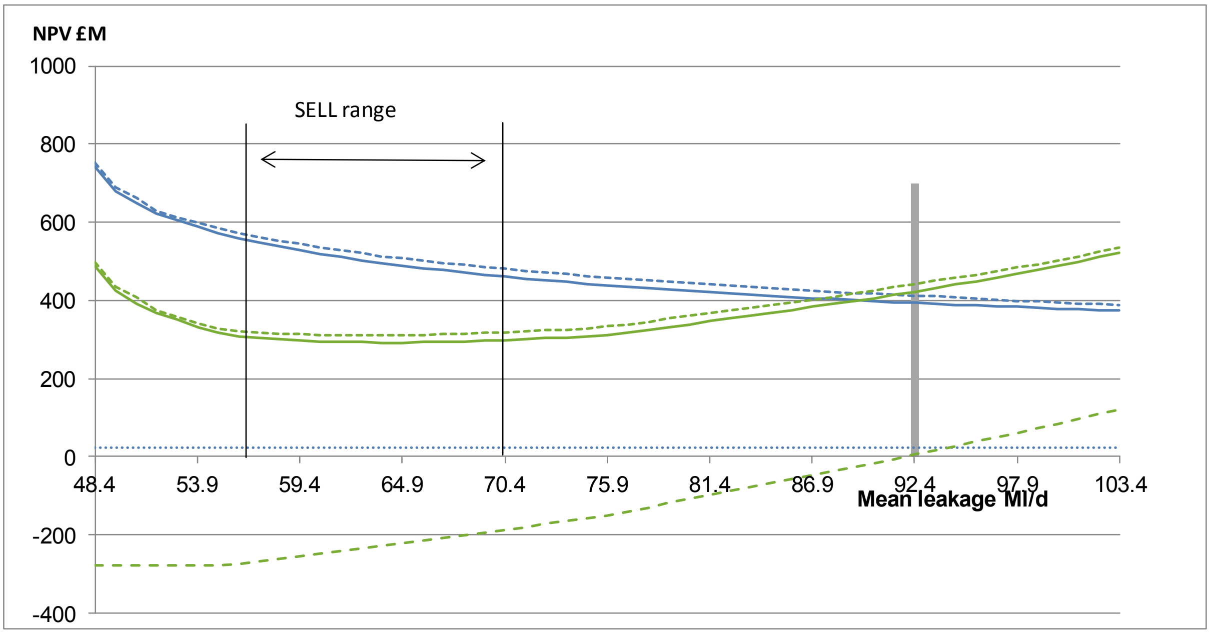
Table A.7.1: Willingness to Pay data

Leakage Level	Leakage level (SWW)	Leakage level (BW)	Willingness to Pay [£k/Ml/d]
>20% of DI	>84 *(92.4)*	>27 *(29.7)*	540
20% to 16% of DI	84 to 69 *(92.4-75.9)*	27 to 23 *(29.7-25.3)*	540
16% to 12% of DI	69 to 51 *(75.9-57.2)*	23 to 17 *(25.3-18.7)*	360
<12% of DI	<51 *(57.2)*	<17 *(18.7)*	0

Figures in italics are for leakage totals using the new reporting methodology.

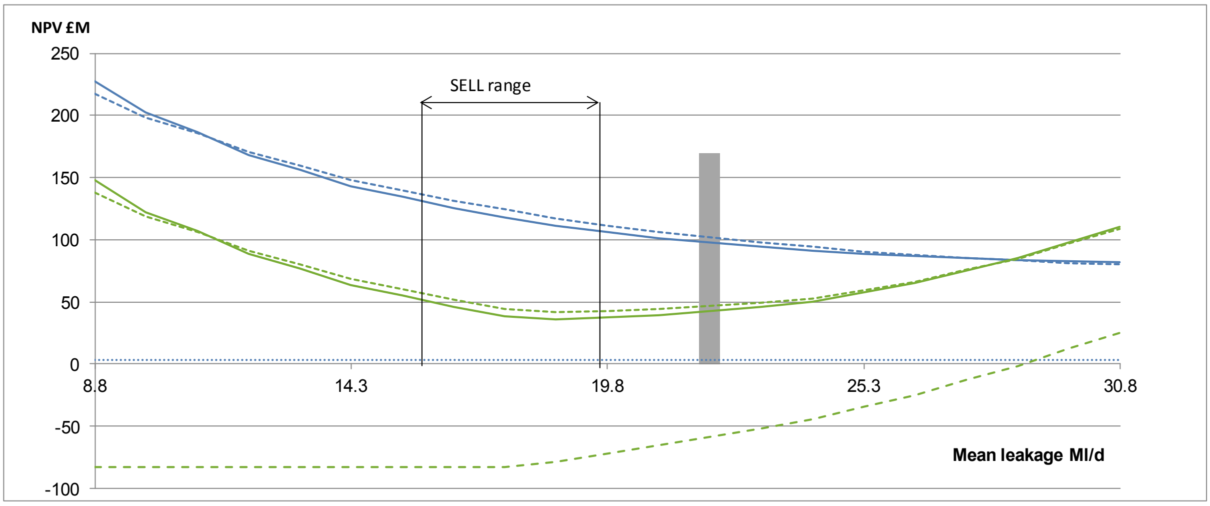
Figure A.7.1: Impact of customer Willingness to Pay on leakage costs

a) SWW supply area



SELL Range: 55-70 Ml/d

b) BW supply area



SELL range: 16-19 Ml/d

Current (2019/20) | Company - Draft | Company - Innovations
Soc & Env | Cust WTP | NPV tot - Draft
NPV tot - Innovations

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.

Following feedback on the Draft WRMP, further details on how the system responds to different drought types is given in Section A.7.13.

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)

[A.7.1] South West Water (2017), *Drought Plan*, October 2018.

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

** These scenarios give rise to an additional supply demand deficit*

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

Note: The drought return period is based on historic records; not the 1 in 200 year drought in say 2050. This is because the impact of climate change on our supply capability is already included in Target Headroom.

South West Water Bournemouth Water

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.
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.

Note: The drought return period is based on historic records; not the 1 in 200 year drought in say 2050. This is because the impact of climate change on our supply capability is already included in Target Headroom.

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, as per the Draft Plan. In the case of Roadford, PD-3 also places the WRZ 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	Deficit [Ml/d]	Additional cost of mitigation	
			Leakage [£m NPV]	New water resources [£m NPV]
Roadford	PD-1	23.9	>£100m	30.7 to 76.9[A.7.2]
	PD-2	25.9	>£100m	30.7 to 76.9[A.7.3]
	PD-3	9.9	>£40m	3.2[A.7.4]
Wimbleball	PD-1	8.7	>£50m	11.8[A.7.5]
	PD-2	10.7	>£50m	>11.8[A.7.6]

Note: Deficit is the maximum deficit over the planning period. Leakage cost is the NPV assuming the full deficit is resolved from the start of the planning period taken from Figure 7.4 and 7.6. The cost is the additional cost of mitigation and is relative to the both the current costs or the Final Plan cost curves.

For the Roadford WRZ the cost of mitigation of plausible droughts is high. This is consistent with the findings in the Draft Plan. Mitigation would be upwards of £30m using resource schemes, but could be as high as £100m if mitigated through leakage reduction. The high cost of leakage reduction is because it would require reducing leakage by approximately 50% in the most extreme scenarios.

In Wimbleball WRZ, resource development is a lower cost option than meeting the deficit by leakage reduction. This is consistent with the findings from the Draft Plan. However, to meet the scale of the reduction at least three schemes would be needed – this compares to at least two in the Draft Plan. As with Roadford, for either leakage reduction or new water resource options the additional cost of mitigation is high.

[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 W1+W2+W3
[A.7.6] Option W1+W2+W3

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 consistent with current policy to see long-term reductions in leakage and the NIC recommendation for a 50% reduction in leakage long-term
2. New water resource options have the lowest level of support from customers
3. 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.

In forming our Final 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. This includes the understanding of the feasibility of a pumped storage scheme for Roadford Reservoir.

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. The volumes are consistent with the Draft Plan.

Two programmes 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.

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.7.7]
4b	Demand only plan	0.5-1	1.7	3.5
	Roadford			
4a	Resource only plan	<0.5	9.8	3.1[A.7.8]
4b	Demand only plan	<0.5	1.9	3.7
	Wimbleball			
4a	Resource only plan	<0.5	4.5	4.2[A.7.9]
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.

<u>PCC reduction 100, 86 and 62l/p/d</u>

In response to the feedback from customers and stakeholders to see more leakage reduction and the National Infrastructure Commission report ‘Preparing for a Drier Future’, for the Final Plan we undertook additional scenarios for long-term per capita consumption reductions.

We used three scenarios:

Scenario 4c – reduce PCC to 100l/p/d by 2045

Scenario 4d – reduce PCC to 86l/p/d by 2045

Scenario 4c – reduce PCC to 62 l/p/d by 2045

In all cases we do not have sufficient information to cost the reductions. We also do not have the information to assess the uncertainty of the options. However, the scenarios show that such reductions would result in a surplus in 2045 in the order of the following:

[A.7.7] Re-use Rialton Intake/Porth
[A.7.8] Northcombe WTW output increased to 60Ml/d
[A.7.9] Brampford Speke boreholes

Colliford = 16.5 to 40.2 Ml/d

Roadford = 17 to 53 Ml/d

Wimbleball = 9 to 23 Ml/d

Bournemouth (no SRN transfer) = 42 to 72 Ml/d (critical period ONLY)

Bournemouth (with SRN transfer) = 22 to 52 Ml/d (critical period ONLY)

The results show that such large-scale reductions in PCC give rise to supply demand benefits. Our Final Plan therefore includes work to develop how such reductions could be achieved.

However, such reductions need to be considered in relation to our Drought Plan. As part of our actions in our drought we would look to see customers reduce less water, but if the underlying demand for water has already been reduced the options available in a drought will therefore be curtailed.

We will need to look at this interaction in more detail for future plans.

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. The Final Plan assumption following discussion with Southern Water and their Plan is for the transfer to be planned for 2027.

Further details on the transfer are given in Sections 6 and 7. The results showed that with the proposed investment in the new WTW in the BW WRZ, the zone can accommodate a 20Ml/d transfer to Southern Water and meet all stress tests with the exception of a higher household demand forecast. The proposed 15% reduction in leakage and the longer-term reductions however, offset the shortfall under that stress test. This suggests that subject to the environmental assessment of the transfer and whether it passes the 'no deterioration' test the volume predicted in the Draft Plan should be sustainable and reliable for transfer to Southern Water. Further work on this transfer will be undertaken as part of the West Country Water Resource Group to feed into the next round of WRMPs. This is consistent with the findings in the Draft Plan.

A.7.7 Environment and markets – environmental needs (Scenario 5b and c)

For the Final Plan we updated the assessment of best and worst-case scenarios for potential environmental needs in the region. This has been built from information in the Final Water Industry National Environment Programme (WINEP3) information, which was received post the submission of the Draft WRMP.

There are several schemes listed in WINEP3 as requiring implementation, investigations and/or options appraisals. These are listed in Table A.7.8, together with the scoped cost submitted in the Business Plan for undertaking the investigations, adaptive management trials and identification of mitigation measures.

Table A.7.8: WINEP3 water resource schemes / WFD activities

Scheme name	Driver code (primary)	Driver code (secondary)	Measure type	Completion date	WISER category (S, S+)	Cost (scoped) (£)
Burrator – Adaptive management trials	NERC_INV1	WFD_INV_ WRHMWB	Adaptive Management	31/03/25	S	125,000
College & Argal – Identify mitigation measures	WFD_INV_ WRHMWB		Investigation and Options Appraisal	31/03/22	S	10,000
Fernworthy – Fishbank release	WFD_IMP_ WRHMWB		Fish Passage	22/12/24	S	10,000
KTT - Adaptive management trials	NERC_INV1		Adaptive Management	31/03/22	S	75,000
Otter catchment options appraisal	WFDGW_IN V_GWR		Options Appraisal	31/03/22	S	8,000
rCSMG investigation / options appraisal – Camel catchment	HD_INV		Investigation and Options Appraisal	31/03/22	S	30,000
Stithians / Kennal - Identify mitigation measures	WFD_INV_ WRHMWB		Investigation and Options Appraisal	31/03/22	S	20,000
Venford - Identify mitigation measures	WFD_INV_ WRHMWB		Investigation and Options Appraisal	31/03/22	S	10,000
Wilsworthy Brook investigation / options appraisal	NERC_INV1		Investigation and Options Appraisal	31/03/22	S	35,000
Wistlandpound - Identify mitigation measures	WFD_INV_ WRHMWB		Investigation and Options Appraisal	31/03/22	S	10,000

Scheme name	Driver code (primary)	Driver code (secondary)	Measure type	Completion date	WISER category (S, S+)	Cost (scoped) (£)
Burrator – Investigation into flow regime requirements	NERC_INV1	WFD_INV_WRHMWB	Investigation and Options Appraisal	31/03/22	S	17,000
Devonport Leat – Ecological survey / identify mitigation measures	WFD_INV_WRHMWB		Investigation and Options Appraisal	31/03/22	S	10,000
Wimborne	WFD_NDINV_WRFlow		Investigation and Options Appraisal	31/03/22	S	15,000
Boswyn Shaft	WFD_NDINV_WRFlow		Investigation	31/03/22	S	Combined cost 40,000
Boswyn Stream	WFD_NDINV_WRFlow		Investigation	31/03/22	S	
Carwynen	WFD_NDINV_WRFlow		Investigation	31/03/22	S	
Cargenwyn	WFD_NDINV_WRFlow		Investigation	31/03/22	S	
Rialton/Porth	WFD_NDINV_WRFlow		Investigation	31/03/22	S	
Slade	WFD_NDINV_WRFlow		Investigation	31/03/22	S	
Gammaton	WFD_NDINV_WRFlow		Investigation	31/03/22	S	
Uton	WFD_NDINV_WRFlow		Investigation	31/03/22	S	
Coleford	WFD_NDINV_WRFlow		Investigation	31/03/22	S	
Knowle	WFD_NDINV_WRFlow		Investigation	31/03/22	S	
Stoke Canon	WFD_NDINV_WRFlow		Investigation	31/03/22	S	
Brampford Speke	WFD_NDINV_WRFlow		Investigation	31/03/22	S	

Potential impacts on WAFU of these schemes

Estimated potential impacts on WAFU of these WINEP3 schemes are summarised by scheme in Table A.7.9 and by WRZ in Table A.7.10. A summary of our assumptions on WAFU impacts for each scheme is given below, by WRZ.

For this Final Plan we updated the analysis for a 'best' and 'worst' case scenario. For the best case we have assumed 50% of the possible losses from the worst case. This may be a pessimistic assessment, but allows a position against which to test the sensitivity of the WRZs against future environmental needs.

It is important to note that even if there is no reduction in WAFU from a WINEP scheme that results in less water being available for supply, there will be a loss in resilience because the conjunctive use system will become less flexible. Also, where reductions are applied to sources that supply a local WTW (which is the case for most of the sources listed in Table A.7.8), more abstraction from other sources will be needed to make up for the loss of water available from the local source. This is likely to result in increased pumping and hence increased carbon costs.

Table A.7.9: Potential impacts on WAFU of WINEP3 schemes

WRZ	Scheme name	Location affected	Potential impact on WAFU (Ml/d)		Assumptions
			Likely worst case	Best case	
Colliford	College and Argal - identify mitigation measures	College and Argal Reservoirs	-3.0	-1.5	Assume PF increased to Q95
Colliford	rCSMG investigation/ options appraisal - Camel catchment	Crowdy Reservoir, De Lank intake, Stannon Lake	-4.0	-2.0	Assume PF increased to Q95 and abstraction restricted to 10% of natural flow
Colliford	Stithians / Kennal - identify mitgation measures	Stithians Reservoir, Kennal Vale intake	-4.0	-2.0	Assume Stithians CF increased to Q95. Assume Kennal Vale PF increased to Q95
Colliford	Boswyn Shaft	Boswyn Shaft	0.0	0.0	These sources are currently disused, so they do not contribute to WAFU. Any potential future reductions in licensed quantities would reduce the benefit of bringing these sources back into use.
Colliford	Boswyn Stream	Boswyn Stream	0.0	0.0	
Colliford	Cargenwyn	Cargenwyn Reservoir	0.0	0.0	
Colliford	Carwynen	Carwynen Stream at Botetoe Bridge	0.0	0.0	
Colliford	Rialton / Porth	R Porth at Rialton & Porth Reservoir	0.0	0.0	

WRZ	Scheme name	Location affected	Potential impact on WAFU (Ml/d)		Assumptions
			Likely worst case	Best case	
Roadford	Burrator - investigation into flow regime requirements	Burrator Reservoir	-12.0	-6.0	Assume PF increased to Q95
Roadford	Burrator - adaptive management trials	Burrator Reservoir	0.0	0.0	Assume adaptive management involves changing use of existing discretionary fisheries bank volume, so no impact on WAFU
Roadford	Devonport Leat – Ecological survey / identify mitigation measures	Devonport Leat	0.0	0.0	PFs at intakes are already Q70, so assume no impact on WAFU
Roadford	Fernworthy - fishbank release	Fernworthy Reservoir	0.0	0.0	If the options appraisal undertaken in AMP6 indicates that a fisheries bank would be cost beneficial, assume this would be discretionary, so no impact on WAFU
Roadford	KTT - adaptive management trials	KTT Reservoirs	-1.0	-0.5	Trials may indicate that CF should be increased to > Q95, so a small impact on WAFU has been assumed If trials indicate that a new fisheries bank would be beneficial, assume this would be discretionary, so no impact on WAFU
Roadford	Venford - identify mitigation measures	Venford Reservoir	0.0	0.0	Current CF is already > Q95 and no known concerns at this site, so assume no changes to licence required
Roadford	Wilsworthy Brook investigation/ options appraisal	Wilsworthy Leat	0.0	0.0	HEP abstraction, not for water supply, so no impact on WAFU

WRZ	Scheme name	Location affected	Potential impact on WAFU (Ml/d)		Assumptions
			Likely worst case	Best case	
Roadford	Wistlandpound - identify mitigation measures	Wistlandpound Reservoir	-1.0	-0.5	Assume PF increased to Q95
Roadford	Coleford	Coleford borehole	0.0	0.0	These sources are currently disused, so they do not contribute to WAFU. Any potential future reductions in licensed quantities would reduce the benefit of bringing these sources back into use.
Roadford	Gammaton	Gammaton Reservoirs	0.0	0.0	
Roadford	Knowle	Knowle borehole	0.0	0.0	
Roadford	Slade	Slade Reservoirs	0.0	0.0	
Roadford	Uton	Uton borehole	0.0	0.0	
Wimbleball	Otter catchment options appraisal	Otter Valley boreholes	-6.0	-3.0	See Section 7.6 and Appendix 7.14
Wimbleball	Brampford Speke	Brampford Speke borehole	0.0	0.0	These sources are currently disused, so they do not contribute to WAFU. Any potential future reductions in licensed quantities would reduce the benefit of bringing these sources back into use.
Wimbleball	Stoke Canon	Stoke Canon borehole	0.0	0.0	
Bournemouth	Wimborne	Wimborne groundwater	0.0	0.0	These sources are currently disused, so they do not contribute to WAFU. Any potential future reductions in licensed quantities would reduce the benefit of bringing these sources back into use.

Colliford WRZ

At the WRZ WAFU demand, there is spare water in Colliford Reservoir. However, we cannot make use of this spare water because of infrastructure constraints (maximum WTW output during peak period, water mains peak capacities) and licence constraints (Restormel annual licence limit).

A summary of potential changes to licence conditions under WINEP3 for each scheme is given below, together with our assumptions on how such changes could impact on WAFU.

College and Argal – identify mitigation measures

The estimated impact on WAFU is based on the assumption that a compensation flow is introduced at the Q95 flow at College Reservoir. Other mitigation measures may also be appropriate, such as habitat improvements, but such measures would not impact on WAFU.

rCSMG investigation / options appraisal – Camel catchment

Abstractions from De Lank River and Crowdy Reservoir are supported by abstractions from Stannon Lake and Colliford Reservoir. The amount of available water from these supporting sources is constrained by the Stannon Lake daily abstraction limit and the capacity of the raw water main from Colliford Reservoir to De Lank WTW.

If, as a result of the options appraisal, the prescribed flow at De Lank intake is increased to the Q95 flow, this would reduce the available abstraction from this source during the peak demand period, requiring more water to be abstracted from the supporting sources. Because of the constraints on the supporting abstractions, there would be an impact on WAFU approximately equivalent to the increase in prescribed flow. This is the estimated impact included in Table A.7.9.

If, in addition to a potential increase in De Lank prescribed flow, the amount of water that can be abstracted at De Lank is reduced to the Natural England cCSMG flow targets, this will put further pressure on the supporting sources. Currently there is spare water in Colliford Reservoir at the WRZ WAFU level of demand. Outside of the peak demand period there is sufficient spare capacity on the raw water main to enable transfers water from Colliford Reservoir into the De Lank supply area to support abstraction at De Lank. Hence, there is unlikely to be any significant impact on WAFU provided that this Colliford water is not needed elsewhere as a result of other licence reductions. However, if other WINEP3 schemes in Colliford WRZ also result in reductions in water available at other sources, the spare Colliford Reservoir water would also be needed to offset reductions in water available at these other sources. Depending on the scale of such reductions, WAFU could be impacted and the impact could be significant.

Stithians / Kennal – identify mitigation measures

The estimated impact on WAFU is based on the assumption that the Stithians Reservoir compensation flow and Kennal Vale prescribed flow might be increased to the Q95 flow. Other mitigation measures may also be appropriate, such as habitat improvements, but such measures would not impact on WAFU. Changes to any other licence conditions (such as the percentage of prescribed flow excess at Kennal Vale that can be abstracted) could also impact on WAFU, but at present we have assumed that there will be no such changes. The likely impact on WAFU is less than the difference between the current and potential increased compensation flow and prescribed flow to a Q95 flow.

Boswyn Shaft, Boswyn Stream, Cargenwyn Reservoirs, Carwynen Stream, Porth Reservoir and the River Porth at Rialton

These are all currently disused, so they do not contribute to the WRZ WAFU. If investigations show that reductions need to be made to the current licensed quantities and/or increases in prescribed / compensation flows are required, this would potentially reduce the benefit of bringing these sources back into use. However, as reintroduction of some or all of these sources is not included in the Final WRMP19 final strategy, there will be no impact on WRZ WAFU.

Roadford WRZ

The WAFU constraint in Roadford WRZ is resource availability. A reduction in the licence limits at any source will result in a loss of WAFU, because there is no spare water to support reductions in local abstractions.

A summary narrative is provided below for each WINEP3 scheme, summarising our assumptions regarding the estimated potential WAFU impacts of each scheme.

Burrator – investigation into flow regime requirements

The estimated impact on WAFU is based on the assumption that the compensation flow is increased to the Q95 flow.

Burrator – adaptive management trials

There is currently a discretionary fisheries bank at Burrator Reservoir and the Environment Agency decides it is to be used each year, depending on prevailing flow conditions. As this is a discretionary fisheries bank, releases are only made if there is no risk to public water supply. Hence, there is no impact on WAFU. It is understood that the fisheries bank would not be made compulsory and hence the potential impact on WAFU has been assumed to be zero.

Devonport Leat – ecological survey / identify mitigation measures

Devonport Leat is a man-made open stone channel that transfers abstracted water from the headwaters of the River Dart to Burrator Reservoir and Dousland WTW. The leat has been in use for over 200 years and over that time an ecological regime has developed in the leat. The current abstraction licences include both prescribed flows at the intakes to the leat and sweetening flow requirements in the leat to protect the leat ecology. The prescribed flows are currently set to around Q70. We have therefore assumed that no increase in prescribed flows will be required. Hence, we have assumed that there will be no impact on WAFU of this scheme.

Fernworthy - fishbank release

During AMP6 a fisheries bank options appraisal is being undertaken. This will identify whether the introduction of fisheries bank releases would be cost beneficial and the volume of any such fisheries bank. The outcome of this appraisal will inform this WINEP3 scheme. It is not possible at this stage to give any indication of the likely scale of the fisheries bank or how it would be used. We have assumed that, like Burrator Reservoir, it will be a discretionary fisheries bank and hence would only be used when there is no risk to water supply, in which case there would be no impact on WAFU.

KTT – adaptive management trials

The KTT resource system consists of three reservoirs: Kennick, Tottiford and Trenchford. Kennick Reservoir flows into Tottiford Reservoir, which in turn flows into Trenchford Reservoir. Under the National Environment Programme (NEP) in AMP6, a compensation release was introduced at Trenchford Reservoir. This was set to the Q95 flow. AMP6 monitoring and adaptive management trials under the WINEP3 scheme in AMP7 may indicate that the compensation flow should be increased, so a small impact on WAFU has been assumed.

These adaptive management trials may also indicate that fisheries releases may be cost beneficial. If this is the case, we have assumed that the fisheries bank would be discretionary and releases would only be made if there is no risk to public water supply, in which case there would be no impact on WAFU.

Venford – identify mitigation measures

The current compensation flow is greater than the Q95 flow and there are no known concerns at this site, therefore we have assumed that there will be no changes to the abstraction licence and hence no impact on WAFU.

Wilsworthy Brook investigation / options appraisal

This is a source of water for an HEP scheme, not water supply. Hence, any changes to this site will not impact on WAFU.

Wistlandpound – identify mitigation measures

We have assumed that the compensation flow is increased to the Q95 flow.

Coleford, Gammaton, Knowle, Slade, Uton

These are all currently disused, so they do not contribute to the WRZ WAFU. If investigations show that reductions need to be made to the current licensed quantities and/or increases in prescribed / compensation flows are required, this would potentially reduce the benefit of bringing these sources back into use. However, as reintroduction of some or all of these sources is not included in the final strategy, there will be no impact on WRZ WAFU.

Wimbleball WRZ

At the WRZ WAFU demand, there is spare water in Wimbleball Reservoir. However, WAFU cannot be increased to make use of this spare water, because of infrastructure constraints (maximum WTW output during peak period, water mains peak capacities).

A summary narrative is provided below for each WINEP3 scheme, summarising our assumptions regarding the estimated potential WAFU impacts of each scheme.

<u>Otter Valley catchment options appraisal</u>

See Section 7.6 and Appendix A.7.14 for more details.

<u>Brampford Speke, Stoke Canon</u>

These are both currently disused, so they do not contribute to the WRZ WAFU. If investigations show that reductions need to be made to the current licensed quantities and/or increases in prescribed / compensation flows are required, this would potentially reduce the benefit of bringing these sources back into use. However, as reintroduction of some or all of these sources is not included in the final strategy, there will be no impact on WRZ WAFU.

Bournemouth WRZ

<u>Wimborne groundwater source</u>

The only WINEP3 scheme in Bournemouth WRZ that could result in a reduction in water available is for the Wimborne groundwater source. However, this source is currently disused, so does not contribute to the WRZ WAFU. If investigations show that reductions need to be made to the current licensed quantities and/or other conditions on the licence that could reduce the amount of water available for supply, this could reduce the benefit of bringing this source back into use. However, as reintroduction of this source is not included in the final strategy, there will be no impact on WRZ WAFU.

Table A.7.10: Potential impacts on WAFU of WINEP3 schemes by WRZ

WRZ	Potential Impact on WAFU (Ml/d)	
	Worst Case	Best Case
Colliford	-11.0	-5.5
Roadford	-14.0	-7.0
Wimbleball	-6.0	-3.0
Bournemouth	0.0	0.0
Company	-31.0	-15.5

The costs of mitigating these options with leakage reduction are presented in Table A.7.11. 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.

The results for this Final Plan confirm those from the Draft Plan that the supply demand position is sensitive to losses in the licensed volumes of water available to supply.

Table A.7.11: Scenario 5b and 5c results

WRZ	Programme costs to mitigate risk		
	Baseline plan (£m NPV)	Scenario 5b – best case (£m NPV)	Scenario 5c – worst case (£m NPV)
Colliford	135	136	137
Roadford	162	176	190+
Wimbleball	77	82	111
Bournemouth	97	97	97

Note: Total NPV used. Private and environmental and social costs. All programmes based on current leakage costs to allow like for like comparison with the Draft Plan and the relative impact of environmental needs. The difference in cost between the baseline and the scenarios will be the same if using the Final Plan costs, since the leakage cost curve is shifted for the final plan.

A.7.8 Data – leakage consistency and PR19 draft methodology (Scenario 6a)

This scenario tested the plan against two data changes.

Leakage consistency (Scenario 6a)

This scenario is not used in the Final Plan, as all data is based on the new leakage consistency methodology.

PR19 Methodology (Scenario 6b)

This scenario implemented a 15% reduction in leakage in each WRZ by 2025 to test the impact of the PR19 methodology for leakage targets. It is unchanged from our Draft Plan, is based on current leakage costs and based on existing leakage reporting methodologies.

Table A.7.12 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 as such the 15% reduction in leakage increases 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 bill increases early in the programme that are not driven by a supply-demand need.

15% leakage reduction (final costs) (Scenario 6c)

Feedback on the Draft Plan was support for a 15% leakage reduction by 2025. There was also additional feedback on further detail on the costs of leakage reduction and the activity to deliver leakage savings.

This scenario examined a 15% reduction in leakage by 2025, but based on the Final Plan demand forecasts and PR19 Business Plan costs. The demand forecasts are based on the new leakage consistency approach and the costs are built from a breakdown of activity based on a ranked cost-benefit ratio. Further details of the costs are given in Section 8.

Table A.7.12 shows the leakage reductions embedded in the demand forecast and the expected cost of the reduction.

As for scenario 6b, this reduction increases the supply-demand surplus to 2025, but the costs of the programme are lower than the Draft Plan. This is due to the additional optimisation undertaken on the leakage activities.

NIC Recommendation (Scenario 6d)

This scenario included a 50% leakage reduction by 2045 in line with the NIC recommendation in the report ‘Preparing for a Drier Future’.

This gives additional surplus in each Resource Zone, however the costs of the programme are uncertain. By way of comparison we have estimated the costs based on our leakage cost curves. The scale of the reduction means the costs are indicative only the leakage cost curves do not extend to such a low level of leakage with reliable cost estimates.

Table A.7.12: Scenario 6 results

Ref	Description	Estimated bill impact in 2025 (£/prop)	Total Leakage reduction by 2025 (Ml/d)	Additional cost to baseline plan (£m NPV)	Customer WTP (£m/Ml/d)	Customer WTP (£m NPV)
	Colliford					
6a	Leakage consistency	-	-	-	-	-
6b	PR19 draft methodology	2-3	4.5	10.6	0.54	26.5
6c	15% leakage reduction (final costs)	-	4.7	3.0**	0.54	28.9
6d	NIC Recommendation*	-	16-17	50+	-	-
	Roadford					
6a	Leakage consistency	-	-	-	-	-
6b	PR19 methodology	2-3	6.3	22.1	0.54	36.8
6c	15% leakage reduction (final costs)	-	7.1	8.9**	0.54	44.6
6d	NIC Recommendation*	-	~25	>100m	-	-
	Wimbleball					
6a	Leakage consistency	-	-	-	-	-
6b	PR19 methodology	3-4	1.7	10.0	0.54	10.3
6c	15% leakage reduction (final costs)	-	1.5	0.9**	0.54	9.1
6d	NIC Recommendation*	-	7-8	>40	-	-
	Bournemouth					
6a	Leakage consistency	-	-	-	-	-
6b	PR19 methodology	3-4	2.9	12.7	0.36	11.2
6c	15% leakage reduction (final costs)	-	2.8	9.2**	0.36	8.5
6d	NIC Recommendation*	-	10-11	>50	-	-

** The costs for the programme are indicative only, as they fall outside where we have reliable data.*
*** Comparison of is to current costs.*

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.7.13. The scenarios are consistent with those used in the Draft Plan.

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.7.10], 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, gross value added (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 7.13: 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

The Draft Plan highlighted that the WRZs with the exception of Bournemouth had some sensitivity to higher household demands. This continues in the Final Plan however, the sensitivity is higher as the starting demand is higher. As per the Draft Plan there is limited sensitivity to higher non-household demands, but not until the end of the planning period. Overall the supply-demand graphs show Roadford supply-demand balance is the most sensitive to higher demand. The costs of mitigating the high household scenario (7a) are shown in Table A.7.14 below.

[A.7.10] UKWIR, *"WRMP19 methods: Population, household property and occupancy forecasting"*, Ref 15/WR/02/8, 2015

Table A.7.14: 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	2.4	<3.0	0.54	<4.5
7b	Higher non-household demand	0	0.4	~0	0.54	~0
	Roadford					
7a	Higher household demand	0	12.9	~30	0.54	>60
7b	Higher non-household demand	0	2.6	<3.0	0.54	0
	Wimbleball					
7a	Higher household demand	0	3.2	<6	0.54	<7
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 based on current costs.

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.7.15.

The results for each WRZ are given in Table A.7.16 to A.7.19.

Table A.7.15: 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		

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Table A.7.15: 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	

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Table A.7.16: 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	No supply-demand deficit to solve. No investment needed. Current leakage costs.	129	6	0
2	Customer WTP	-	Leakage reduced to 19 to 22 Ml/d from current level	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	1 in 200 year drought	L	No leakage reduction, no new investment	129	6	0
4a	Water resource only plan	M	Resource schemes to offset c1.7 Ml/d	136	6	
4b	Demand only plan	M	Leakage reduction to offset 1.7 Ml/d	132	6	0.5-1
4c	PCC@100 l/p/d	L	PCC reduced to 100 l/p/d by 2045	-*	-	-
4d	PCC@86 l/p/d	L	PCC reduced to 86 l/p/d by 2045	-*	-	-
4e	PCC@62 l/p/d	R	PCC reduced to 62 l/p/d by 2045	-*	-	-
5a	Southern transfer (BW only)		N/A	-	-	-
5b	Environmental needs (Best case)	M	Best case environmental needs forecast	130	6	0
5c	Environmental needs (worst case)	L	Worst case environmental needs forecast	131	6	0
6a	Leakage consistency	H	N/A	-	-	-
6b	PR19 Methodology	-	Reduces leakage by 15%. Uses current costs and leakage reporting methodology	139	6	2-3
6c	15% leakage reduction (final costs)	H	Reduces leakage by 15% based on forecast costs and new leakage methodology	133	6	0
6d	NIC recommendation	R	Reduces leakage by 50% by 2045	179	12	-
7a	Household demand - high forecast	L	Reduce leakage to offset deficit of c2.4 Ml/d at end of the period	132	6	0
7b	Non-household demand - high forecast	L	Reduce leakage to offset deficit of 0.4 Ml/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. * Cost data not available for this level of demand reduction.*

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	1 in 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**
4c	PCC@100 l/p/d	L	1	3	1	3	2	1	1	2	3	3	2	3	**25**
4d	PCC@86 l/p/d	L	1	3	1	3	2	1	1	1	3	3	2	3	**24**
4e	PCC@62 l/p/d	R	1	3	1	3	2	1	1	1	3	3	2	3	**24**
5a	Southern transfer (BW only)		-	-	-	-	-	-	-	-	-	-	-	-	**-**
5b	Environmental needs (best case)	M	3	3	3	4	3	1	1	3	2	1	1	3	**30**
5c	Environmental needs (worst case)	L	3	3	3	4	3	1	1	3	1	2	1	3	28
6a	Leakage consistency	H	-	-	-	-	-	-	-	-	-	-	-	-	**-**
6b	PR19 Methodology	-	2	3	1	2	3	1	1	3	3	2	1	3	**25**
6c	15% leakage reduction (final costs)	H	3	3	3	2	3	1	1	3	3	2	1	3	**28**
6d	NIC recommendation	L	1	1	1	2	3	1	1	1	3	3	1	3	**21**
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	3	3	3	3	2	1	2	1	**28**

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 - 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	Leakage reduction from AMP8 onwards. Max at 8Ml/d by end of planning period.	153	11	0
2	Customer WTP	-	Leakage reduced to 30-33Ml/d	204 to 221	11.6 to 11.6	6-10
3a	Plausible Droughts	R	Leakage reduction between 7 to 26 Ml/d depending on scenario	163 to 251	11-20	3 -10
3b	1 in 200 year drought	L	No leakage reduction, no new investment	153	11	0
4a	Water resource only plan	M	Resource schemes to offset c1.9 Ml/d	156	11	<0.5
4b	Demand only plan	M	Leakage reduction to offset 1.9 Ml/d	155	11	0-0.5
4c	PCC@100 l/p/d	L	PCC reduced to 100 l/p/d by 2045	-*	-	-
4d	PCC@86 l/p/d	L	PCC reduced to 86 l/p/d by 2045	-*	-	-
4e	PCC@62 l/p/d	R	PCC reduced to 62 l/p/d by 2045	-*	-	-
5a	Southern transfer (BW only)			-	-	-
5b	Environmental needs (best case)	M	8 Ml/d leakage reduction, starting in AMP8	165	11	0
5c	Environmental needs (worst case)	L	15 Ml/d leakage reduction, starting in AMP8	180+	11+	
6a	Leakage consistency	H	N/A	-	-	-
6b	PR19 Methodology	-	Reduces leakage by 15%. Uses current costs and leakage reporting methodology	173	12	2-3
6c	15% leakage reduction (final costs)	H	Reduces leakage by 15% based on forecast costs and new leakage methodology	162	11	-
6d	NIC recommendation	L	Reduces leakage by 50% by 2045	262	20	-
7a	Household demand - high forecast	L	Reduce leakage to offset growth (c4.8 Ml/d)	155	11	0
7b	Non-household demand - high forecast	L	Reduce leakage to offset demand growth (0 Ml/d)	154	11	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. * Cost data not available for this level of demand reduction.*

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	1	3	1	2	3	1	1	1	3	2	1	3	**22**
3b	1 in 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**
4c	PCC@100 l/p/d	L	1	3	1	3	2	1	1	2	3	3	2	3	**25**
4d	PCC@86 l/p/d	L	1	3	1	3	2	1	1	1	3	3	2	3	**24**
4e	PCC@62 l/p/d	R	1	3	1	3	2	1	1	1	3	3	2	3	**24**
5a	Southern transfer (BW only)				-	-	-	-	-	-	-	-	-	-	**0**
5b	Environmental needs (best case)	M	2	3	2	4	3	1	1	3	2	1	1	3	**26**
5c	Environmental needs (worst case)	L	1	3	1	4	3	1	1	1	3	2	1	3	**24**
6a	Leakage consistency	H	-	-	-	-	-	-	-	-	-	-	-	-	**-**
6b	PR19 Methodology	H	1	3	1	2	3	1	1	3	3	2	1	3	**24**
6c	15% leakage reduction (final costs)	H	3	3	3	2	3	1	1	3	3	2	1	3	**28**
6d	NIC recommendation	L	1	1	1	2	3	1	1	1	3	3	1	3	**21**
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**

Likelihood: R = Remote (<2%), L = low (2-20%); M = Medium (20 – 65%); H = high (85-90%); VH = very high (>90%)

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Table A.7.18: 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	Small deficit at end of period. No material impact on programme cost	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 10Ml/d depending on scenario	73.4 to 126.2	4-8	0-13
3b	1 in 200 year drought	L	No leakage reduction, no new investment	73	4	0
4a	Water resource only plan	M	Resource schemes to offset c0.5 Ml/d	77	4	<0.5
4b	Demand only plan	M	Leakage reduction to offset 0.5 Ml/d	76	4	0.5-1
4c	PCC@100 l/p/d	L	PCC reduced to 100 l/p/d by 2045	-*	-	-
4d	PCC@86 l/p/d	L	PCC reduced to 86 l/p/d by 2045	-*	-	-
4e	PCC@62 l/p/d	R	PCC reduced to 62 l/p/d by 2045	-*	-	-
5a	Southern transfer (BW only)			-	-	-
5b	Environmental needs (best case)	M	4 Ml/d leakage reduction at the end of the planning period	78	4	1
5c	Environmental needs (worst case)	L	6.7 Ml/d leakage reduction at the end of the planning period	103	8	>3
6a	Leakage consistency	H	N/A	-	-	-
6b	PR19 Methodology	-	Reduces leakage by 15%. Uses current costs and leakage reporting methodology	83	4	3-4
6c	15% leakage reduction (final costs)	H	Reduces leakage by 15% based on forecast costs and new leakage methodology	74	4	-
6d	NIC recommendation	L	Reduces leakage by 50% by 2045	126	8	-
7a	Household demand - high forecast	L	Reduce leakage to offset growth (c0.5 Ml/d) at the end of the period	73	4	0
7b	Non-household demand - high forecast	L	Reduce leakage to offset demand growth (0 Ml/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 rounded to nearest significant figure. * Cost data not available for this level of demand reduction.*

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	1 in 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**
4c	PCC@100 l/p/d	L	1	3	1	3	2	1	1	2	3	3	2	3	**25**
4d	PCC@86 l/p/d	L	1	3	1	3	2	1	1	1	3	3	2	3	**24**
4e	PCC@62 l/p/d	R	1	3	1	3	2	1	1	1	3	3	2	3	**24**
5a	Southern transfer (BW only)				-	-	-	-	-	-	-	-	-	-	**-**
5b	Environmental needs (best case)	M	2	3	2	2	3	2	2	3	2	1	1	1	**24**
5c	Environmental needs (worst case)	L	1	1	1	2	3	1	1	1	3	3	1	2	**20**
6a	Leakage consistency	H			-	-	-	-	-	-	-	-	-	-	**-**
6b	PR19 Methodology	-	1	3	1	2	3	2	2	3	3	2	1	3	**26**
6c	15% leakage reduction (final costs)	H	3	3	3	2	3	1	1	3	3	2	1	3	**28**
6d	NIC Recommendation	L	1	1	1	2	3	1	1	1	3	3	1	3	**21**
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**

Likelihood: R = Remote (<2%), L = low (2-20%); M = Medium (20 – 65%); H = high (85-90%); VH = very high (>90%)

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Table A.7.19: 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 2.5 Ml/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	1 in 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 1.39 Ml/d (data as WTP)	102	3	2-3
4c	PCC@100 l/p/d	L	PCC reduced to 100 l/p/d by 2045	-*	-	-
4d	PCC@86 l/p/d	L	PCC reduced to 86 l/p/d by 2045	-*	-	-
4e	PCC@62 l/p/d	R	PCC reduced to 62 l/p/d by 2045	-*	-	-
5a	Southern transfer (BW only)		In Final Programme. Cost borne by SRN customers.	94	3	0
5b	Environmental needs (best case)	M	No impact. Same as baseline plan.	94	3	0
5c	Environmental needs (worst case)	L	No impact. Same as baseline plan.	94	3	0
6a	Leakage consistency	H	N/A	-	-	-
6b	PR19 Methodology	-	Reduces leakage by 15%. Uses current costs and leakage reporting methodology	107	3	3-4
6c	15% leakage reduction (final costs)	H	Reduces leakage by 15% based on forecast costs and new leakage methodology	103	3	0
6d	NIC recommendation	L	Reduces leakage by 50% by 2045	153	6	-
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 rounded to nearest significant figure. * Cost data not available for this level of demand reduction.*

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	1 in 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**
4c	PCC@100 l/p/d	L	1	3	1	3	2	1	1	2	3	3	2	3	**25**
4d	PCC@86 l/p/d	L	1	3	1	3	2	1	1	1	3	3	2	3	**24**
4e	PCC@62 l/p/d	R	1	3	1	3	2	1	1	1	3	3	2	3	**24**
5a	Southern transfer (BW only)		3	3	3	1	3	1	2	1	3	3	2	3	**28**
5b	Environmental needs (best case)	M	3	3	3	1	0	3	3	3	2	1	1	1	**24**
5c	Environmental needs (worst case)	L	3	3	3	1	0	3	3	3	2	1	1	1	**24**
6a	Leakage consistency														
6b	PR19 Methodology	-	1	3	1	2	3	2	1	3	3	2	1	3	**25**
6c	15% leakage reduction (final costs)	H	2	3	1	2	3	2	1	3	3	2	1	3	**26**
6d	NIC recommendation	L	1	1	1	2	3	1	1	1	3	3	1	3	**21**
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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A.7.11 Plausible droughts methodology

The plausible drought scenarios are summarised in Table A.7.20 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.7.20: 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

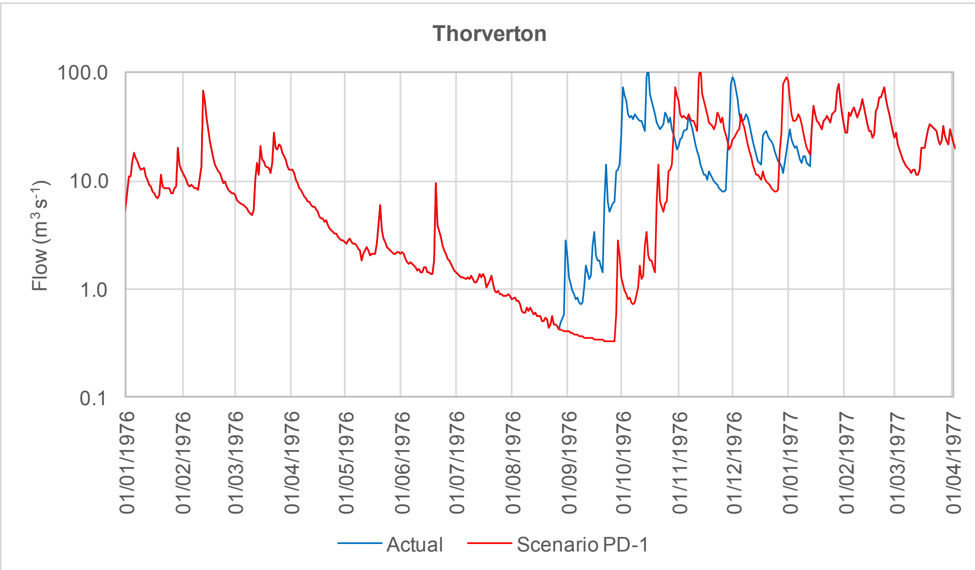


Figure A.7.3: Scenario PD-2: actual 1975-76 drought extended into October

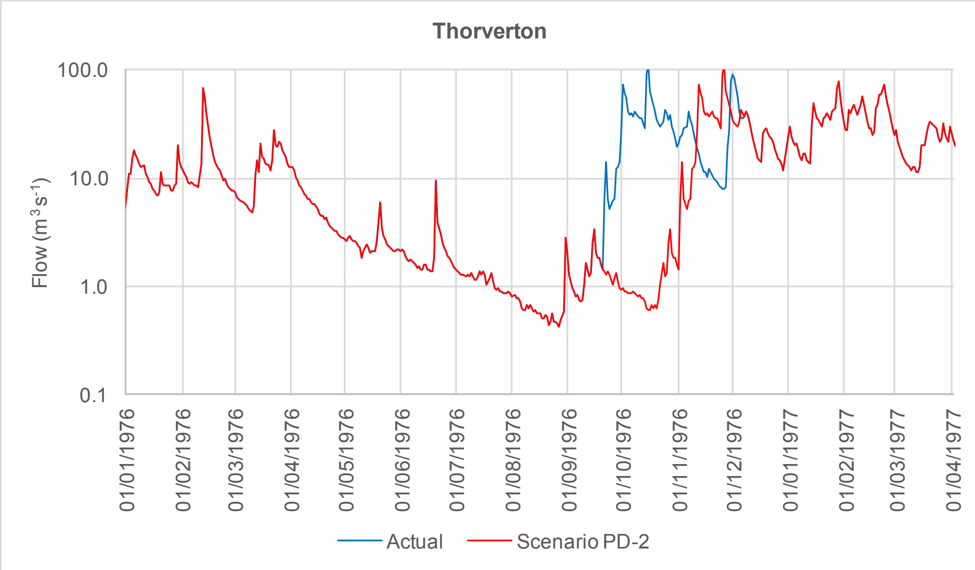


Figure A.7.4: Scenario PD-3: 10% less flow 1 November 1975 – 31 March 1976

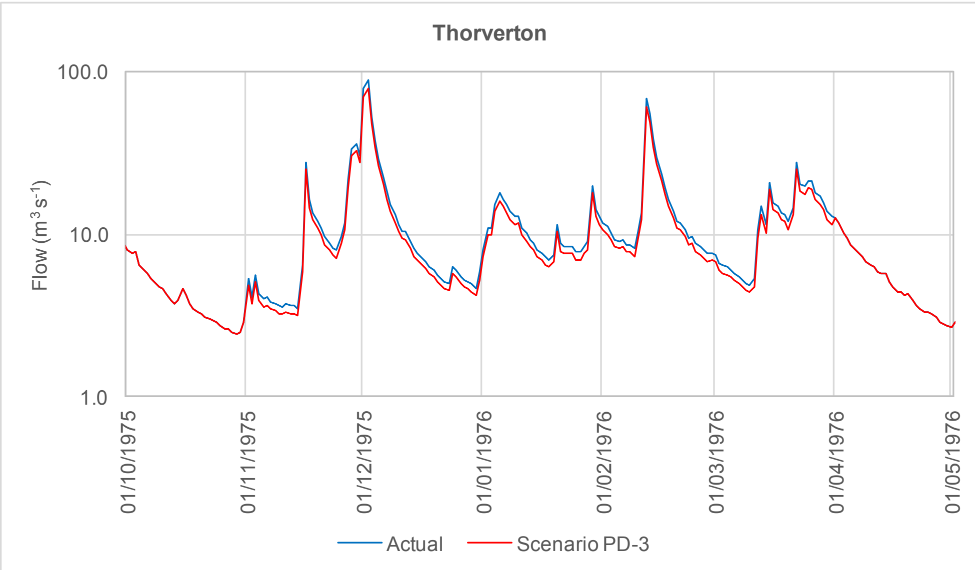


Figure A.7.5: Scenario PD-4: Swap 1977 and 1978 flows (to give three consecutive dry years)

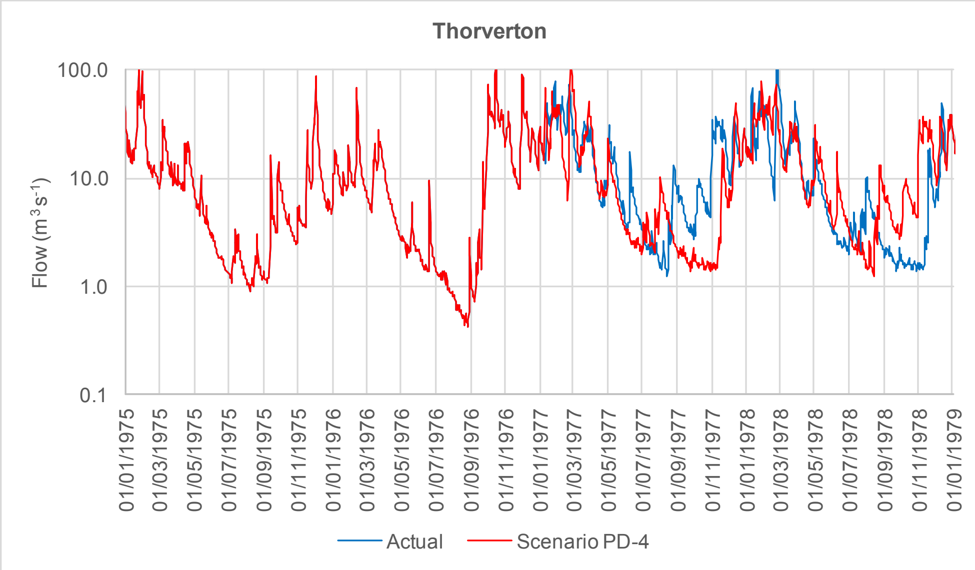
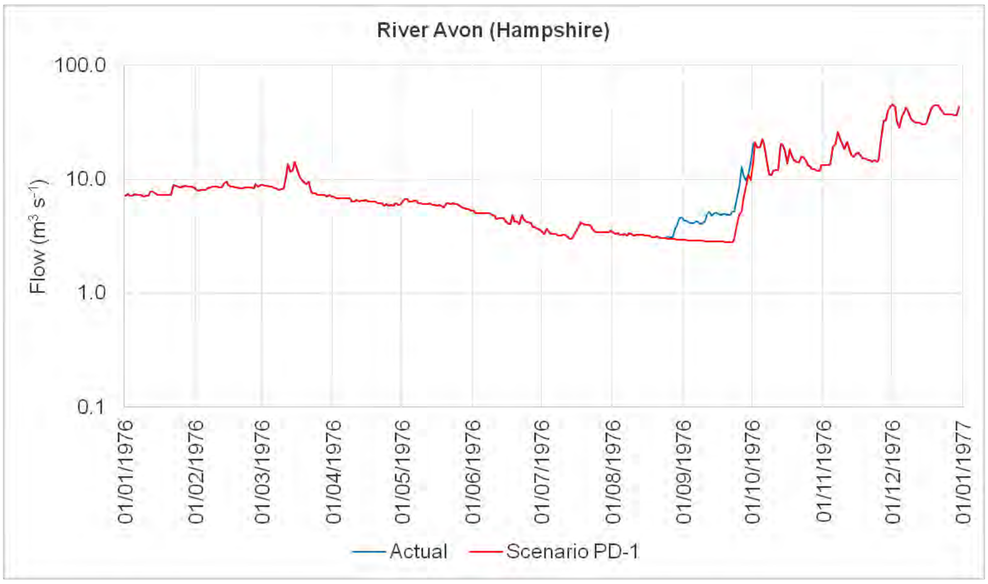


Figure A.7.6: Scenario PD-1: actual 1975-76 drought extended into September



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

This section contains the Executive Summary from the Met Office report *Severe Drought Analysis for Water Resource Management Plan and Drought Plan*. This analysis was undertaken to provide estimates of return periods for historic droughts 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.

A.7.13 Additional information on droughts

A.7.13.1 SWW supply area

Our three WRZs in the SWW supply area are all conjunctive use systems. Each WRZ contains a mixture of types of local sources (impounding reservoirs, rivers, groundwater sources and/or groundwater fed lakes) supported by a large strategic reservoir. Each WRZ is named after its strategic reservoir.

See Section 1.2 for overviews of these WRZs and their sources.

Colliford, Roadford and Wimbleball reservoirs are our three largest impounding reservoirs. The net capacity of these three reservoirs accounts for 75% of the total net capacity of all of our impounding reservoirs and groundwater fed lakes. Colliford and Roadford reservoirs are multi-season reservoirs. Whilst they have large net capacities, they do not refill every year and in the past have taken up to 5 years or more to refill (e.g. Colliford Reservoir 2000 – 2007). If operated without its winter pumped storage scheme, Wimbleball Reservoir would be multi-season, however the winter pumped storage scheme is of sufficient size to enable this reservoir to refill each year.

Our local impounding reservoirs are small with large catchment areas relative to the reservoir capacity. Most are located on Bodmin Moor, Dartmoor or Exmoor, where annual rainfall tends to be between 1500mm and 1900mm. These areas have low groundwater capacity, resulting in a rapid response of our local reservoirs and river sources to rainfall events. Some of these reservoirs have been known to increase in storage by 30% - 40% or more in a few days. Conversely, whilst Roadford and Colliford strategic reservoirs have large surface areas and are located in areas with high annual rainfall, they are situated in upland locations and hence each has a small catchment relative to their reservoir capacity. Their refill response to rainfall therefore tends to be much slower unless extremely wet weather is experienced (such as in spring and summer 2012). There is a small pumped storage scheme for Colliford Reservoir, which aids refill, but is not sufficient to refill the reservoir in a single winter period. Roadford Reservoir does not have a pumped storage scheme. Wimbleball Reservoir is situated on Exmoor and its storage shows a fairly quick response to heavy rainfall. We have a supporting winter pumped storage scheme for Wimbleball Reservoir, effectively increasing the catchment area and enabling much quicker refill, effectively changing this multi-season reservoir into a single-season reservoir.

The main groundwater area is in Wimbleball WRZ, in East Devon. Groundwater contributes around one third of total supplies in this WRZ, with the majority of abstraction coming from the underlying sandstone aquifer within the Otter Valley. The Otter Valley sources make a key contribution to meeting demand in the far east of the SWW supply area.

Colliford WRZ geology is not conducive to large groundwater schemes. However, we have acquired two groundwater fed lakes on Bodmin Moor which provide valuable support for both local sources and the strategic Colliford Reservoir. In Roadford WRZ a small proportion of total supply comes from groundwater sources in South Devon. These sources support surface water supplies in the Teignbridge, Torbay and South Hams areas.

A.7.13.2 Testing how our water supply systems respond to drought[A.7.11]

We use a behavioural model to simulate the operation of our water supply system. The model has been developed in the Miser network optimisation software environment. The model consists of a network of nodes and links which represent our supply system's rivers, impounding reservoirs, groundwater fed reservoirs, groundwater sources, raw water mains, WTWs, key potable distribution infrastructure (including key service reservoirs, distribution pumping stations and potable mains) and our Water Into Supply (WIS) demand zones.

Model settings and inputs include:

- Abstraction licence constraints (including abstraction limits, prescribed flows and compensation flows)
- Reservoir operational curves and associated abstraction profiles
- Naturalised river flows and reservoir inflows
- Groundwater yield profiles
- Maximum flow constraints on raw and potable mains
- WTW constraints (including minimum and maximum capacities)
- WIS zone demands

Reservoir operational curves are produced using optimisation models created for each reservoir and associated river abstractions, including winter pumped storage abstractions. We use these models to produce operational curves and drought zone curves following the methodology described in the Handbook of Source Yields [A.7.12].

We produce naturalised river flows and reservoir inflows following the methodology described in the Handbook of Source Yields [A.7.13].

Groundwater yield profiles are produced following the methodology described in the Handbook of Source Yields [A.7.14]. Most of our groundwater sources are licence constrained. For those sources that

[A.7.11] Ref: EA Representation on Draft WRMP, item 2.10
[A.7.12] UKWIR (2014), *Handbook of Source Yields* (14/WR/27/7)
[A.7.13] *Ibid A.7.12*
[A.7.14] *Ibid A.7.11*

show some sensitivity to hydrological constraints, we undertake rainfall runoff modelling to assess the potential impacts on source availability in severe droughts and under climate change. From this modelling, we produce groundwater yield profiles, which are then input into the WRZ conjunctive use model.

In order to investigate how our sources operate in conjunction with each other under a range of scenarios, we can determine the WAFU for each WRZ under a range of different inputs, by varying the following inputs:

- Naturalised river flows (e.g. historic flows, climate change adjusted historic flows, plausible drought scenario flows)
- Groundwater yield profiles
- Demand (e.g. historic actual demand, current dry year demand, forecast dry year demand, WAFU demand)
- Licence variations
- Drought options (supply and demand side)
- Potential new supply options

In order to explore how our systems operate under different flow conditions, we can use the system model in different ways, for example:

1. A "long run" simulation, whereby we run the model on a daily timestep for the full period of the historic record, starting on the first day in the year with all reservoirs full. This enables us to analyse how the preceding year's flows will influence the current year and also illustrates which reservoirs are single season and which are multi-season. Long run simulations identify the historic periods when WRZ minimum storage is lowest and hence the resilience of our conjunctive supply systems to different types of historic droughts. Long run simulation charts for our three strategic reservoirs during drought conditions are shown in Section A.2.6 and our Drought Plan
2. A simulation with a daily timestep for a shorter period than the full historic record. These simulations run much more rapidly than the "long run" simulations. Once the historic periods which have the most impact on our systems have been identified from the long run simulation analyses, we then undertake more detailed analysis of specific drought periods, such as our design drought (1975-76), using shorter time period simulations
3. A "flow iterations" simulation, whereby we run the model from a specific start date within the year to the end of the current year, or to the end of the following year, with initial conditions set to the current actual conditions. The model simulates the performance of our supply systems to the end of the simulation period for given demand profiles and with historic river flows, to simulate

experiencing a repeat of historic flow conditions. An example of how we use this type of simulation is when assessing the likelihood of needing to operate our winter pumped storage schemes.

The outcome of the modelling is an understanding of how all our sources respond to drought conditions, both individually and conjunctively. That response is also built into our Deployable Output figures for our long-term planning since this is based on the long-term simulation.

A.7.13.3 Resilience to different types of drought

Single season droughts

As noted above, we use our behavioural model to understand how single sources respond to different types of drought.

Modelling the WRZ systems with forecast dry year demand and historic flow records shows that our reservoirs are resilient to all of the single season droughts in the historic record. The single season reservoirs all refill or nearly refill after these single season droughts.

For a single season drought, by definition the preceding and following years are normal or wetter than normal and hence storage in our strategic reservoirs would not be of concern.

In principle our local reservoirs (i.e. all reservoirs except Colliford, Roadford and Wimbleball) could potentially be vulnerable to single season droughts more severe than those in our historic record. However, if such a drought were to occur, due to the conjunctive nature of our WRZs we can reduce abstraction from these local reservoirs and increase abstraction from our strategic reservoirs if necessary, to meet demand and maintain resilience. This was part of the rationale for the need for the strategic reservoirs in their conception in the 1970s.

Hence, our WRZs are able to meet demand in a single season drought, even those more severe than in the historic record. For example, 2018 had one of, if not the, driest and warmest May – July period on record, but without the need for any demand restrictions to be imposed.

Multi-season droughts

Our smaller reservoirs are resilient to multi-season droughts, because they refill or nearly refill each year and because we can reduce abstraction from these reservoirs and increase abstraction from our strategic sources if necessary.

However, our strategic reservoirs may be vulnerable to certain types of multi season droughts more severe than those in the historic record, depending on the extent of increased impact on reservoir drawdown from the smaller reservoirs and on how dry the intervening refill periods are.

For example, after an initial single season drought, if the following winter is not sufficiently wet these reservoirs may not refill sufficiently to provide resilience to another dry spring / summer period.

A multi-season drought may vary in onset, severity and duration. In the historic record, the most severe and prolonged drawdowns for our strategic reservoirs are for the period containing the 1975-76 drought. For Colliford and Roadford reservoirs the drawdown period is from 1975 to 1980. For Wimbleball Reservoir, because of the large winter pumped storage scheme, the reservoir refills every year in the historic record simulation, including 1975 and 1976.

A.7.13.4 Selection of plausible drought types[A.7.15]

Types of plausible droughts chosen and why they are representative

The 1975-76 multi season drought gives the most severe historic impact on our strategic reservoir storages. It is the historic drought that determines our WAFU in all three WRZs and hence is our design drought.

For the reasons outlined above, when considering selecting the types of more severe droughts that our WRZs may be vulnerable to, they would need to be of a similar nature to the 1975-76 drought and be more severe in order to potentially be an issue.

A stochastic model for drought synthesis in the South West does not exist. We have therefore tested the resilience of our WRZs against variations on the historic 1975/76 drought building on what we know stresses the system. The types of droughts more severe than the historic 1975/76 drought that our WRZs may not be resilient to are:

a) A longer duration drought
b) A drier winter in the middle of the drought
c) A dry year following the 1975/76 drought

They test different temporal distributions, drought durations and higher rainfall deficits compared to the 1975/76 drought[A.7.16].

[A.7.15] Reference Environment Agency representation, issue 2.8, 2.9
[A.7.16] Reference EA Representation on Draft WRMP, item 2.12

A longer duration drought

Whilst our WRZs are designed to meet our levels of service for the 1975/76 drought, they may not be resilient to a more severe drought similar to 1975/76 that remains dry for longer. We have therefore produced plausible drought scenarios to test this type of extended drought.

Towards the end of the historic 1975/76 drought, after a long dry period the first significant rainfall event was at the end of August 1976. The start of September was dry, followed by a few days of reasonable rainfall from 10th September onwards, changing to more persistent rain towards the end of September and into October.

Plausible drought PD-1 extends the historic drought by 30 days from the end of August 1976 (i.e. removing the end of August and early to mid September historic rainfall). PD-2 extends the drought by 30 days from mid September 1976 (i.e. removing the mid September to mid October historic rainfall). For both of these scenarios, a period of 30 days of zero rainfall was inserted into the historic record, with the actual historic rainfall being shifted back by 30 days. For example, in the PD-1 scenario the rainfall that occurred historically from the end of August to mid September 1976 now occurs from the end of September to mid October, thus extending the historic drought.

This therefore tests the resilience of the system to a longer dry period and the extent to which the strategic reservoirs are able to continue to support the smaller reservoirs.

A drier winter in the middle of the drought

As the strategic reservoirs are multi-season, they may not be resilient to a drought where the winter is drier, because they do not refill as much before the second dry spring and summer. We tested this by reducing winter 1975/76 flows by 10% initially, to see how much impact on resilience this sort of more severe drought might have in each of our WRZs in the following years.

Plausible drought PD-3 is based on 1975/76 flows, but with the winter 1975 flows reduced by 10%.

In their representation on the Draft WRMP, the Environment Agency queried whether our PD-3 drought (a 10% reduction in flow during winter 1975/76) complies with the WRMP guidelines. The guidelines state that companies should consider:

> *"a more challenging, but still plausible, scenario than the worst drought on record (what constitutes more challenging*

> *will depend on the resource zone but should include higher rainfall deficit, longer duration or a combination of both)"* [A.7.17].

Our PD-3 plausible drought is an example of "a more challenging, but still plausible, scenario than the worst drought on record" of the type "higher rainfall deficit". Hence our PD-3 plausible drought scenario is an example of the type described in the WRMP guidelines. Importantly, it is not scaling of a drought, but creation of a different drought sequence and testing the long-term response of the system to a different type of drought not seen in the historic record.

We selected the PD-3 type drought, because our systems have the potential to be vulnerable to this type of drought, whereby the lower winter rainfall could reduce strategic reservoir refill. This could result in lack of resilience if these reservoirs do not sufficiently refill to meet demand in the second year of the drought.

It is important to note that this is not the only type of more challenging, plausible drought that we have considered. This type of drought has been considered in the context of other types of drought, namely droughts of longer duration (PD-1 and PD-2) and a dry year following the historic drought (PD-4). We have therefore considered a range of different types of drought, which is consistent with the WRMP guidelines.

A dry year following the 1975/76 drought

Our WRZs could be vulnerable to a multi season drought similar to the 1975/76 historic drought, if the historic drought had been followed by another dry year. This is because it would put additional stress on the strategic reservoirs to support the smaller reservoirs over the summer months.

Plausible drought DP-4 is an example of this type of drought, whereby the historic 1978 dry year follows immediately after the 1975/76 drought, i.e. removing the historically wetter 1977 year.

As Roadford and Colliford can take many years to refill from a dry period, this scenario tests if the system can sustain the demand required of it in the long-term.

A.7.13.5. Return period analysis

To understand risk, it is necessary to estimate return periods for our historic design drought and our plausible drought scenarios. We commissioned the Met Office to calculate return periods for our design drought, other historic droughts and also for the plausible droughts.

[A.7.17] Environment Agency and Natural Resources Wales (2017), *Water resources planning guideline – April 2017*

The Executive Summary of the Met Office report is included within the Final WRMP. The full report has been shared with the Environment Agency after the submission of our Draft WRMP. This includes a description of the different methods used to calculate return periods.

Valuing the return period

Because of the nature and rarity of drought events and the limitations of data, it is not possible to provide a single year value for a return period, specifically a 1 in 200 year event. Furthermore, a 1 in 200 year event could have different characteristics (e.g. short and severe vs. long but less severe) and therefore is not a specific type of drought.

The Met Office instead produced returns periods for each of the different droughts and these were presented as a range e.g. 1 in 175 – 225 years. Because of the nature of the analysis method used, the return period range given represents the range of best estimates, i.e. each return period within this range is equally likely. In reviewing severity we chose the mid-point of the range. We consider this is a reasonable and practical approach and does not unduly bias the results with regard to assessing severity. One could equally choose the lower or upper estimates, but this could equally bias the result by excluding the higher and lower return periods respectively. Where the return period was higher than 1 in 200 years, it was therefore taken that a drought of that type, but with a lower return period would have a lower effect than modelled.

Should further guidance be set on what the approach should be nationally for defining a 1 in 200 year drought, we will look to include this in our future plans.

A.7.13.6 Testing resilience to plausible droughts and to the reference 1 in 200 year drought[A.7.18]

Method

Our system's resilience to droughts more severe than in the historic record was tested by undertaking the following process. Items 1 to 4 are covered in the preceding sections.

1. Review each WRZ to confirm the types of drought that both the individual sources and the conjunctive use WRZ system are vulnerable and resilient to
2. Identify a suite of plausible droughts that will test the WRZ to a representative range of different types of droughts that are more severe than those in the historic record

[A.7.18] Reference, EA Representation on Draft WRMP, item 2.11

3. Produce rainfall, flow sequences and groundwater yield profiles that represent these plausible droughts
4. Commission the Met Office to estimate rainfall return periods for the plausible droughts
5. For each WRZ, investigate the impact of each plausible drought on our supply system using the Company's behavioural model, to determine WAFU for each plausible drought
6. Produce supply demand forecast from the above analysis to determine how resilient each WRZ is to these more severe plausible droughts
7. Use the results from the plausible droughts analysis to determine the resilience of each WRZ to the reference 1 in 200 year drought
8. Consider whether further analysis of different types of plausible droughts is required in order to confirm the conclusions made in steps 6 and 7 above.

Plausible droughts analysis results

Table A.7.21 shows the impact on WAFU relative to the baseline WAFU for Colliford, Roadford and Wimbleball WRZs to the plausible droughts.

Table A.7.21: Impact on WAFU relative to the baseline WAFU

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

*Note: * these scenarios give rise to a supply demand deficit*

A longer duration drought (PD-1, PD-2)

For the PD-1 and PD-2 droughts, as would be expected with an extension to the historic drought, the extended drought period results in more water being required from our strategic reservoirs to support the local reservoir and river abstractions for the dry period following the end of the historic drought. Depending on the WAFU constraint, this extra support may or may not result in loss of resilience.

Colliford WRZ

Colliford WRZ WAFU is infrastructure and licence constrained. There is spare water in Colliford Reservoir and this is sufficient to enable resilience to the PD-1 and PD-2 plausible droughts.

Roadford WRZ

Roadford WRZ WAFU is constrained by water available and infrastructure, hence extending the drought results in loss of WAFU.

Wimbleball WRZ

Wimbleball WRZ WAFU is infrastructure constrained. There is enough spare water in Wimbleball if the drought were to be extended by 2 – 3 weeks, but not enough to prevent a loss in WAFU from an extended drought similar to the PD-1 and PD-2 plausible droughts.

Table A.7.22 shows return periods for the PD-1 and PD-2 droughts, using the EVA-F method (details on the methods used to estimate return periods are provided in the Executive Summary of the Met Office report, a copy of which is included).

Table A.7.22: Return periods for PD-1 and PD-2 plausible droughts for the EVA-F method

WRZ	Plausible drought PD-1		Plausible drought PD-2	
	Return period band (years)	% chance in any given year	Return period band (years)	% chance in any given year
Colliford	> 10,000	< 0.01	1,100 – 5,000	0.09 – 0.02
Roadford	1,500 – 4,000	0.07 – 0.03	400 - 430	0.25 – 0.23
Wimbleball	1,250 – 2,500	0.08 – 0.04	525 - 675	0.19 – 0.15

It is important to note that PD-1 and PD-2 are droughts with different characteristics. This is reflected in the different return periods. As the strategic reservoirs are prone to multi-season droughts, there is therefore not a simple one to one relationship between return period and impact on WAFU. The nature of PD-2 ‘stresses’ the system more than PD-1, even though the latter has a higher return period. This illustrates why we consider our approach for assessing the different types of drought is important, because it gives more information on what types of drought the system is sensitive to. A simple plot of rainfall or runoff return period vs. storage level on its own does not reveal the full understanding of system risk in the South West.

A drier winter in the middle of the drought (PD-3)

Analysis of our PD-3 plausible drought shows that Colliford and Wimbleball WRZs are all resilient to this type of plausible drought, whereby the winter in the middle of the drought experiences 10% lower flows than in the historic drought. However, Roadford WRZ shows an impact on WAFU of 3 Ml/day, which would give rise to a supply demand deficit in the short term but not in the longer term, due to the forecast demand reductions.

For all WRZs, the PD-3 plausible drought is estimated to be in the range 1 in 500 to 1 in 1500 or rarer (using the EVA-F method to estimate the return periods), depending on the WRZ. Hence, Colliford, Roadford and Wimbleball WRZs are all resilient to a 1 in 200 year drought of this type.

A drought of this type, if sufficiently severe, could give rise to a supply demand deficit in all three WRZs, but such a drought would be rarer than the modelled PD-3 plausible drought.

A dry year following the 1975/76 drought (PD-4)

Analysis of our PD-4 plausible drought (a dry year following the 1975/76 drought) shows that WAFU is not impacted. Because autumn 1976 was very wet, all of our local reservoirs refill, as does Wimbleball Reservoir (with the help of the winter pumped storage scheme there). Colliford and Roadford reservoirs do not refill, however they do refill sufficiently to be resilient to the following dry summer and autumn. The EVA-F method for estimating return periods was not undertaken for PD-4, however the return periods from the Tabony Tables for the PD-4 droughts in these three WRZs indicate that this specific plausible drought was not extreme, being between 1 in 7 and 1 in 16 years depending on the WRZ. This is likely to be because of the wet autumn in 1976.

A.7.13.7 Resilience to the reference 1 in 200 year drought

Table A.7.23: 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

Colliford WRZ

Colliford WRZ is resilient to all of the plausible droughts modelled, including PD-1 and PD-2. Hence, Colliford WRZ is resilient to a 1 in 200 year drought.

Roadord WRZ

Roadord WRZ is resilient to the 1 in 200 year drought, because the historic 1975/76, which as the most impact on the WRZ, is around a 1 in 200 year drought.

Wimbleball WRZ

The historic design drought for Wimbleball WRZ has a return period estimated at around 1 in 110 to 125 years. The WAFU constraints are infrastructure and WTW capacity; there is spare water in Wimbleball Reservoir and this would be sufficient to meet demand by making supply releases for a further 2 – 3 weeks to support abstraction from the River Exe.

Our plausible drought modelling shows that under the plausible droughts PD-1 and PD-2 there would be a WAFU loss sufficient to cause a supply demand deficit in this WRZ. However, these droughts have estimated return periods of 1 in 1,250 – 2,500 years and 1 in 525 – 675 years respectively.

Since submitting the Draft WRMP, we have carried out further plausible droughts analysis for Wimbleball WRZ to better understand its resilience to droughts of varying severity and of the type that this WRZ is most vulnerable to (i.e. an extended multi-season drought).

We commissioned the Met Office to provide return periods for various extensions to the historic design drought, to identify droughts of around the 1 in 200 year return period. These are:

- No rainfall from 28 August 1976 for 7, 14, 21 and 28 days, then the same historic rainfall thereafter
- No rainfall from 1 September 1976 for 7, 14, 21 and 28 days, then the same historic rainfall thereafter

The return periods are shown in the following table and will be included in the Final WRMP in the updated Executive Summary to the Met Office report.

Table A.7.24: Return periods for additional Wimbleball WRZ plausible drought scenarios

Plausible drought	Return period band (years)
7 days no rain beginning 28 August 1976	175 - 180
14 days no rain beginning 28 August 1976	220 - 230
21 days no rain beginning 28 August 1976	330 - 370
28 days no rain beginning 28 August 1976	700 - 990
7 days no rain beginning 1 September 1976	110 - 125
14 days no rain beginning 1 September 1976	190 - 200
21 days no rain beginning 1 September 1976	360 - 410
28 days no rain beginning 1 September 1976	850 – 1,200

Our modelling results show that Wimbleball WRZ is resilient to all of these additional plausible drought scenarios.

However, analysis of the rainfall and flow for the 7 and 14 day plausible droughts shows that these plausible drought scenarios do not extend the historic design drought, but make it more severe in the last month of the drought.

The 21 and 28 day plausible droughts do extend the historic drought, requiring releases from Wimbleball Reservoir to the end of September / early October 1976, which uses the reservoir storage that was spare under the historic design drought. Hence, for the type of drought that Wimbleball Reservoir is most vulnerable to, the WRZ is resilient to a drought at least as severe as a 1 in 330 – 370 year drought and is therefore resilient to the reference 1 in 200 year drought.

A.7.13.8 Bournemouth WRZ

Water supply in our Bournemouth WRZ is predominantly derived from two river systems and associated groundwater sources, with no impounding reservoirs. Each of the sources in the Bournemouth WRZ are constrained either by licence or infrastructure, not by hydrology/resource availability. There is a current surplus of supply against demand.

The extensive Chalk aquifer and significant baseflow component in the main rivers results in a relatively stable hydrological regime that is not subject to significant rapid fluctuations, like those typical of systems where surface water runoff predominates. This means that higher flows are maintained for longer during extended dry periods, typically during the summer. The principal surface water abstractions are relatively far down in the catchment and therefore also benefit from the additional resilience from the combined effect of the upstream catchment runoff.

In contrast to the SWW WRZs, the Bournemouth system is comparatively simple since it does not have the mix of single and supporting multi-season reservoirs.

A.7.13.9 Testing how the Bournemouth WRZ system responds to drought[A.7.19]

Bournemouth WRZ surface water sources

To test our drought performance, we use a water resource spreadsheet model to assess the potential impact of a number of plausible drought scenarios, developed from analysis of observed historic and simulated (hindcast) river flows, on water availability and with respect to current licence constraints and known future licence changes.

Bournemouth WRZ groundwater Sources

The majority of our groundwater abstraction in the Bournemouth WRZ is from the Chalk and in close proximity to the River's Avon and Stour. All of these sources are licence or infrastructure constrained.

Groundwater yield profiles are produced following the methodology described in the Handbook of Source Yields[A.7.20]. All of our Bournemouth WRZ groundwater sources are licence constrained.

Impact of climate change

AMEC Foster Wheeler re-assessed the potential impact of climate change on the Bournemouth WRZ sources to take into account hydrological data from the last five years and in the light of the current Environment Agency's (2017) Water Resources Planning Guideline[A.7.21]. For further details refer to the response to A.2.1.3 and the full report provided in Section A.2.1.

The main conclusions of this review are as follows:

- The impact of climate change on DO from all these sources is considered insignificant.
- In our Bournemouth WRZ groundwater abstractions, groundwater level change factors for the West Woodyates Manor observation borehole have shown they remain licence constrained.
- Scaling to the end of the planning period does not result in any additional climate change impact for Bournemouth WRZ.

A.7.13.10 Resilience to different types of drought

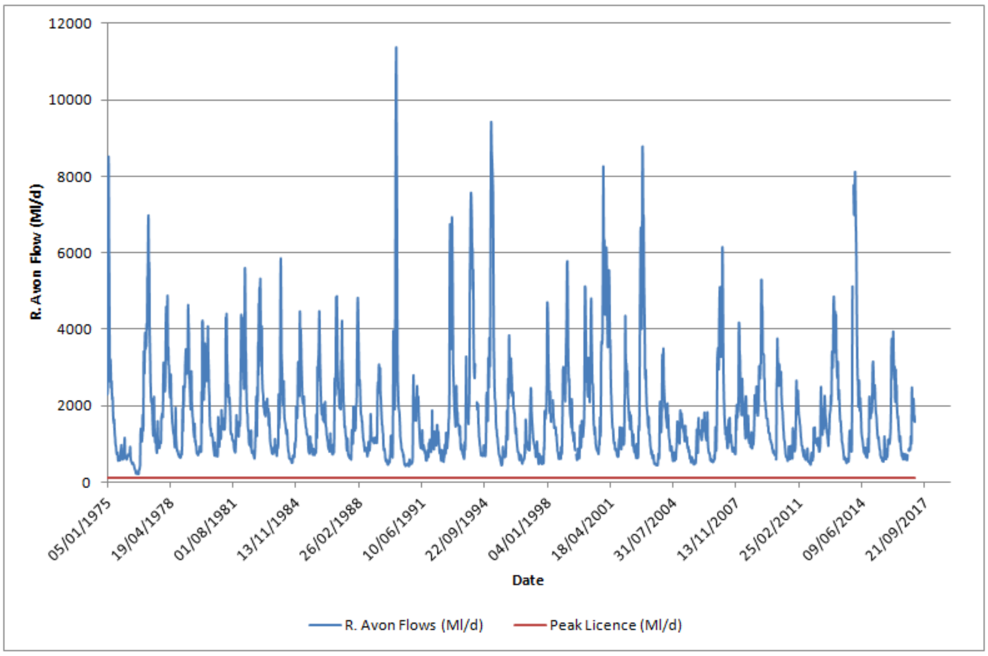
[A.7.19] Reference, EA Representation on Draft WRMP, item 2.10
[A.7.20] *Ibid A.7.11*
[A.7.21] Environment Agency and Natural Resources Wales (2017), *Water resources planning guideline – April 2017*

Single season droughts

The Bournemouth WRZ is resilient to single season droughts, because of the significant groundwater storage and associated positive impact in sustaining the base flow component of the main river sources in the Bournemouth WRZ.

This means that even in historic drought conditions, the river flow is in excess of the maximum daily licence flow. This means that in the historic record it is constrained by licence, not water availability.

Figure A.7.7: River Avon Historic Flows cf. Peak Licence



Multi season droughts

Due to the location of the sources in this WRZ and the significant base flow component in the key rivers sources, it is multi-season droughts that this WRZ may be vulnerable to, because they would lead to a long-term derogation in baseflow.

The 1975-76 multi-season drought had the most severe impact on the groundwater storage and river flows and is therefore the historic drought that determines our WAFU in Bournemouth WRZ. Extensions of this drought would therefore need to be understood in order to assess the impact on supply resilience.

A.7.13.11 Selection of plausible drought types[A.7.22]

Types chosen and why they are representative

When considering the types of more severe droughts that Bournemouth WRZ may be vulnerable to, our analysis of our supply systems against historic droughts shows that the drought would need to be of a similar nature to 1975-76 to be a potential issue.

This is seen in the previous analysis at WRMP14. Observed daily average flow data from 1975 on the River Avon and from 1973 for the River Stour at Throop Mill were hind cast back to 1883 based on a correlation analysis with the River Thames at Kingston.

The analysis of the hindcast flow sequences for the River Avon and River Stour indicate that the hydrological yield would be defined by a single point in 1934. However, hydrological analysis of the historic observed data for the Avon and the Stour indicates that the 1975/76 drought could be considered at least as extreme an event.

As a result of the records prior to 1975 being derived by hind cast methods, 1975/76 remains the most severe event on record and is very similar in severity to 1934. Thus the 1975/76 drought remains the primary, reliable benchmark on which the assessment of plausible droughts has been based.

Due to the multi-season vulnerability of the WRZ, we used similar plausible drought types to the SWW supply area WRZs to test the sensitivity of the system. They test different temporal distributions, drought durations and higher rainfall deficits compared to the 1975/76 drought[A.7.23].

A7.13.12 Return period analysis

We commissioned the Met Office[A.7.24] to assign return periods to the plausible droughts for the Bournemouth WRZ. The results indicate some plausible droughts having return periods in excess of 1,000 years depending on plausible drought and location.

A summary of the return periods assigned to each plausible drought for the Bournemouth WRZ is presented in Table A.7.25 below.

[A.7.22] Reference Environment Agency representation, issue 2.8, 2.9
[A.7.23] Reference, EA Representation on Draft WRMP, item 2.12
[A.7.24] Met Office (2017), *Severe Drought Analysis for Water Resources Management Plan and Drought Plan – v3.0.*

Table A.7.25: Summary of initial results for Bournemouth WRZ

Scenario Ref(s)	Scenario description(s)	Results	Return period (years) EVA	*For reference: Return period (years) Tabony*	Likelihood in 5 year period
PD-1 and PD-2	PD-1: remove early to mid September historic rainfall PD-2: remove late September and early-mid October historic heavy rainfall	Predicted minimum river flow is above the flow required to abstract the maximum licensed volume for all river sources. No impact on WAFU.	PD-1: 5,000 - >10,000 PD-2: 850 – 1,200	*PD-1: >>1000* *PD-2: 450 – 1800*	PD-1: Exceptionally unlikely <0.1% PD-2: Exceptionally unlikely (0.4% to 0.58%)
PD-3	Flows during the period 1 Nov 1975 to 31 Mar 1976 reduced by 10%	Predicted minimum winter 1975-76 river flow is above the flow required to abstract the maximum licensed volume for all river sources. No impact on WAFU.	350 – 550	*500 – 2000*	Highly Unlikely (0.9% to 1.4%)
PD-4	1977 and 1978 records swapped around, i.e. to give a dry year following the 1975/76 drought	Predicted minimum river flow is above the flow required to abstract the maximum licensed volume for all river sources. No impact on WAFU.	-	*6 – 24*	-

Note: Return periods for PD4 were not analysed by the Met office as the impact of PD-4 was less severe than those of PD1-PD3.

The plausible droughts considered in this analysis do not impact on WAFU or the supply demand balance. The results show the Bournemouth WRZ is currently resilient to historic and more extreme droughts with higher return periods.

For example, under the PD-1 scenario, flows at WTW A on the River Avon are predicted to fall to 2.8 $m^3 s^{-1}$ (241.9 Ml/day), so there would still be enough flow to abstract the combined maximum licensed abstraction for the River Avon of 1.8 $m^3 s^{-1}$ (154.5 Ml/day), comprising 1.1 $m^3 s^{-1}$ (90.9 Ml/day) at WTW A and 0.7 $m^3 s^{-1}$ (63.6 Ml/day) at Matchams WTW. Similar results were obtained for the remaining plausible drought scenarios. The WRZ is therefore deemed resilient to the types of plausible droughts considered and abstraction can occur within the licensed conditions. This is consistent with the assessment of the supply demand balance which shows there is a surplus of supply over demand.

A7.13.13 Summary

The sections above describe our approach and analysis for testing the resilience of our supply system to more extreme droughts.

From our understanding of how the sources we operate respond to droughts, we developed a range of plausible droughts to evaluate the vulnerability of the supply system.

The configuration of the supply systems and the nature of the hydrology, means it is the multi-season droughts that pose the greatest risk to supply resilience. In the SWW supply area, the simulation modelling shows that the strategic reservoirs can support single season droughts, however a subsequent dry period leaves the WRZ more vulnerable to future dry periods. In the Bournemouth WRZ it is also the long-term drought that poses the greatest vulnerability, as it would cause a derogation of the long-term baseflows. However, the likelihood of the drought of that nature is currently assessed as very low.

The analysis shows that we do have some sensitivity in some areas to more extreme droughts in the future. Whilst the likelihood of one occurring in any one year is relatively low, over the planning period there because a more material risk.

Our Draft Plan recognised this risk and included work on leakage reduction and demand management as early risk mitigation measures.

However, the complexity of the future problem also highlighted the need to further develop the drought severity analysis; for example no stochastic drought sequence data exists for the SWW Company region that is suitable for modelling. We also highlighted the need to develop understanding of possible future resource options as a contingency should they be needed. In doing so, we consider our Draft Plan and our Final Plan make appropriate and measured responses to potential risks from future more extreme droughts.

A.7.14 Otter Valley Risk Assessment

A.7.14.1 Background

The Otter Valley groundwater sources are facing a specific range of risks, which have potential implications for one sub-area within the broader Wimbleball WRZ. Consequently, we have assessed these separately from the wider scenario testing described earlier.

The Environment Agency has assessed the Lower River Otter catchment as having Poor Ecological Status under the Water Framework Directive (WFD)[A.7.25]. Whilst the River Otter is non-compliant under the WFD due to poor water quality, groundwater abstraction from the underlying aquifer is believed to contribute to the poor status.

SWW currently operates 21 boreholes in the Otter Sandstone aquifer of the Otter Valley in East Devon, sub-divided into six groups (Wellfields K, C, G, H, D & O shown in Figure A.7.8). These sources are licensed to abstract up to 13,580 Ml per year in total (13,579,935 m^3/a). Whilst there are a number of other abstractors, including Wessex Water, the South West Water abstractions account for c. 30% of the total licensed resource in the Wimbleball WRZ.

[A.7.25] (Environment Agency, December 2015), *South West River Basin District River Basin Management Plan*

Figure A.7.8: Otter Valley Wellfields location map

The SWW resources in the Otter Valley are of critical importance to meeting the demand for potable water in the East Devon area of the Wimbleball WRZ. The groundwater sources are operated in conjunction with the surface water abstractions from the Exe catchment to meet temporal and spatial variations in demand across the whole WRZ. However, capacity to transfer water from the Exe system in to the Otter Valley is limited.

As part of this assessment we have identified the following potential risks to water availability in the Otter Valley:

1. WINEP3 licence reductions
2. Potential saline Intrusion & the longer term impact of climate change
3. Deterioration of borehole performance due to asset age
4. Temporary outages which result from river flooding events
5. Deterioration in nitrates concentration and other key water quality parameters

An integrated approach is required to assess the combined impact of all the identified risks to abstraction in the Otter Valley, along with any broader implications for the overall level of resilience of the Wimbleball WRZ. We are therefore assessing a range of options including improved intra-zonal connectivity and the development of alternative sources within the Otter catchment or in other local catchments. One innovative option being implemented is an Abstraction Incentive Mechanism (AIM) scheme. This has the objective of partially offsetting any reductions in abstraction capacity with water from sources which have less environmental impact.

A.7.14.2 Abstraction licence quantities and deployable output

Table A.7.26 lists the Otter Valley abstraction licences compared to actual abstractions during 2017/18.

Table A.7.26: Licenced abstractions in the Otter Valley:

Licence Ref.	Wellfield Ref	Average licensed daily abstraction (Ml/d)	Average daily abstraction FY 17/18 (Ml/d)	Licensed annual abstraction (m^3/a)	Actual annual abstraction FY 17/18 (m^3/a)
14/45/001/0425	K	2.18	1.09	795.56	396.19
14/45/01/0478	C	2.59	2.13	945.34	776.22
14/45/001/0426	G	4.36	3.14	1,591.12	1,145.13
14/45/001/0505	G	2.49	0.93	909.20	340.38
SW/045/0001/014/R01	G	2.00	1.36	730.00	496.06
SW/045/0001/008/R01	G	1.69	0.66	617.22	241.08
14/45/001/0518	H	4.70	4.31	1,716.00	1,573.31
SW/045/001/016/R01	D	7.15	7.14	2,609.75	2,604.14
14/45/001/0520	D	1.19	1.19	434.75	434.26
SW/045/0001/017/R01	O	3.50 2.33	2.75 1.75	1,277.50 853.00	1,004.36 639.78
Total:		***31.85***		***12,479.44***	***9,650.90***

Notes:

1. *Average licenced daily abstraction based on Licenced annual abstraction averaged over the year (i.e. divided by 365 days)*
2. *Peak daily abstractions based on period 01/01/2017 to 30/09/2018*
3. *Average daily and actual annual abstraction based on period 01/04/2017 to 31/03/2018*
4. *A number of licences are subject to further sub-daily, monthly &/or seasonal constraints*
5. *Additional requirements:*
    a. *Licence Ref. 14/45/001/0520 (Wellfield D) includes a requirement to provide river support under specific flow conditions*
    b. *Licence Ref. 14/45/01/0478 (Wellfield C) includes a prescribed flow constraint*
6. *Licences SW/045/0001/008/R01, 14/45/001/0505 & SW/045/0001/014/R01, relating to Wellfield G, have an aggregate maximum abstraction amount of 4.19 Ml/a.*

Between January 2017 and September 2018 we used approximately 77% of the total water available for abstraction in the Otter Valley. Approximately 48% of the water abstracted during this period came from Wellfields D and O. This period coincides with the impact of the most recent licence changes at a number of Wellfield D sources, including the operation of a stream support scheme, which took effect in January 2017. It also includes a period of very high outputs associated with the significant demand generated by the freeze/burst event in March 2018 and the extended dry weather period in summer 2018.

Drought yield deployable outputs (DO) for the Otter Valley sources have been re-assessed and updated using data to September 2018 (see Table A.7.27).

Table A.7.27: Deployable Outputs (DO's) for the Otter Valley sources during Peak week

Licence Ref.	Wellfield Ref	Peak DO (Ml/d)	Constraint
C14/45/001/0425	K	1.2	Source
14/45/01/0478* [&] **	C	0	Licence
14/45/001/0426	G	6.3	Licence
14/45/001/0505	G		
SW/045/0001/014/R01	G		
SW/045/0001/008/R01	G		
14/45/001/0518	H	4.7	Licence
SW/045/001/016/R01*	D	9.5	Licence
14/45/001/0520*	D	2.5	Licence
SW/045/0001/017/R01	O	5.6	Licence
	Total	***29.8***	

** Monthly variations*
*** Assumes Licence 14/45/01/0478 (Wellfield C) not available due to low flow constraint.*

These represent the minimum reliable outputs available from these sources under low groundwater conditions during a drought. Higher rates of abstraction may be possible under different hydrological conditions.

A.7.14.3 Climate change and extended drought scenarios

Review of the Wellfield D licences in 2017 led to a reduction in unused Fully Licensed headroom and the addition of low flow triggered stream support from two boreholes, one each in Wellfields D and G. This has resulted in increased dependence on the Wellfield O borehole sources and shifted abstraction pressures closer to the sea. As all of the other Otter Valley sources are considered licence constrained (exc. Wellfield K), re-analysis of the predictions from this EA modelling work for 'severe drought' purposes has therefore focused on the saline intrusion risks at Wellfield O.

The saline intrusion risk at Wellfield O is, in theory, increasing as a result of reduced recharge and sea level rise associated with climate change. This represents a long-term risk with relatively slow onset and limited immediate consequence, within the current planning period to 2045. However, given the criticality of the Wellfield O sources and the inherent uncertainty in the rate of change, we will continue to progress the development of robust monitoring and mitigation options.

The Wellfield O groundwater sources contribute approximately 18% of the Otter Valley total licenced volume, making them critical to meeting local demand in East Devon. They are also geographically important in reducing the impact of abstraction on low flows in the Lower Otter and ensuring compliance with the Environment Agency's Environmental Flow Indicator thresholds. In terms of the wider water resource situation, they typically contribute approximately 6% of total water available for supply in the Wimbleball WRZ.

WRMP14

The WRMP14 South West Water climate change analysis for the Otter Valley Sandstone boreholes used the recommended Future Flows and Groundwater Levels GR2 spreadsheet to predict pumped groundwater level change. These level changes were very small in this high storage sandstone aquifer, mostly resulting in negligible impacts. They were confirmed by running perturbed rainfall and potential evapo-transpiration (PET) recharge sequences through the Otter Valley Groundwater (GW) model. This showed that only the Wellfield O sources are at risk of being impacted by climate change, otherwise all of the licences except Wellfield K remain licence constrained.

WRMP19

The assessment undertaken for this plan (WRMP19) has been updated to include the outputs from an Environment Agency project completed in 2014, which used the Otter Valley Groundwater Model to investigate the implications of climate change and associated sea level rise on the Otter Valley sources.

This project involved:

- Running the 11 UKCP09-based Future Flow climate sequences 1950 to 2098, plus the associated median estimate of rising sea level
- Modelling each of the standard scenarios – Natural, Recent Actual and Fully Licensed
- Various options for 'Smarter GW Management' being considered as part of Abstraction Reform modelling

- Analysis of river flow impacts and saline intrusion risks for Wellfield O, including the extreme AfixM scenario 2097 drought event.

The UKCP09 Future Flows climate modelling using the Otter Valley GW model considered 11 'equally likely' future climate scenarios. The AfixM scenario resulted in the most severe impact, including an 'extreme but plausible' drought in 2097, which is beyond that experienced in the historical record. The 2097 autumn drought flow on the River Otter is the lowest in the whole 1950 to 2098 simulation and results in autumn simulated natural river flows of just under 40 Ml/d at Otterton. This is much more severe than the actual 1976 drought used in this Plan for drought planning purposes which resulted in simulated river flows of 71 Ml/d at Otterton. It is also extreme when compared to the 'extended 1976 (dry September)' approach used for surface flow analysis in each of SWW's WRZ's. The return period estimated for the 'extended 1976 (dry September)' scenario has been assessed as falling in the range 500 to 2000 years[A.7.26] which, despite the large range, indicates that the return period of the AfixM 2097 drought scenario is significantly greater than we are currently required to plan for.

The abstraction licences for Wellfield O were not modified in 2017. DO reductions for Wellfield O were calculated for each of the 11 Future Flows climate scenarios by factoring up the maximum Recent Actual (RA) saline inflows over the 2070-2098 period to Fully Licensed, based on the FL/RA simulated inflow ratio available for the AfixM scenario. Inland encroachment from the sea during the 2097 AfixM drought event was modelled using an average sea level increase of ~0.6 m, approximating to that currently predicted to occur in 2080. The Fully Licensed (FL) model scenario indicates that, unless action is taken to switch Wellfield O off during such a combined drought / high sea level scenario, saline intrusion risks to DO could be significant (ranging from 0.3 to 0.9 Ml/d).

Any reduction in DO from Wellfield O would either require imports from elsewhere in the network or the development of an alternative 'satellite' source, which could be used conjunctively with Wellfield O to provide occasional drought relief.

AMEC (now Wood) recommended that any further climate change-related DO analysis for WRMP19 should be undertaken once the new guidance from the UKWIR project and the associated UKCP18 new datasets become available. The UKCP18 climatological data was published in late November 2018 and the derivation of an associated range of potential hydrological responses requires significant additional evaluation and analysis. It has not been possible to complete this within the timescales for delivery of this WRMP. However, an evaluation of the impact of the

[A.7.26] *South West Water Bournemouth Water Drought Plan October 2018*

UKCIP18 datasets will be carried out prior to 2020 and will be included in future WRMP reviews.

The Wimbleball WRZ is predominantly a surface water system and our conjunctive use models are therefore driven mainly by historic river flow and reservoir inflow sequences. In order to model climate change impacts on WAFU for Wimbleball WRZ as a whole, it is necessary to incorporate the groundwater DO estimates into our conjunctive use models.

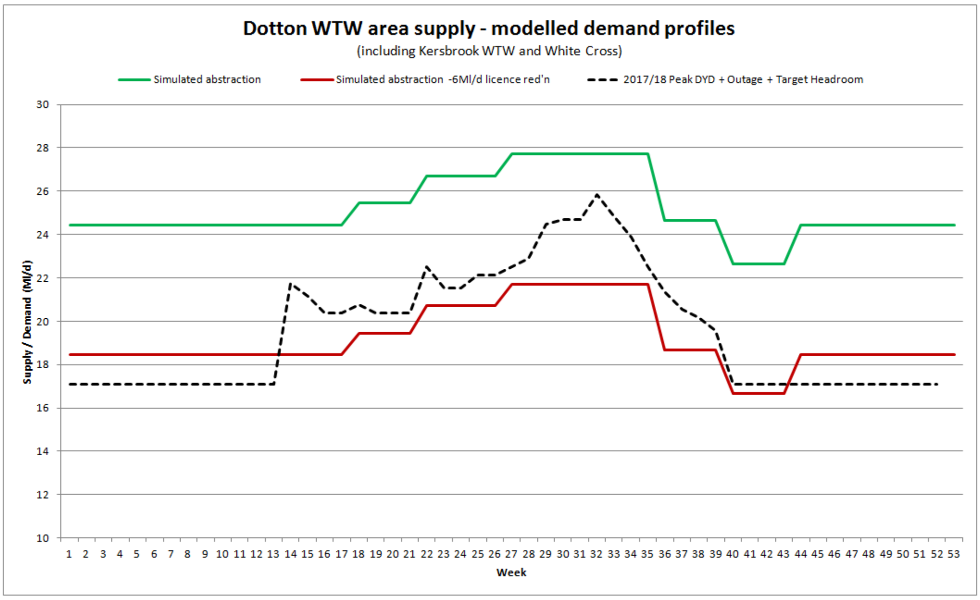
The 11 UKCP09 Future Flows climate data scenarios were used to generate monthly climate change factors for precipitation and PET to carry out rainfall-runoff modelling using the Otter Valley GW model. These groundwater yield profiles were then input into our conjunctive use models in order to model climate change impacts on WAFU for each WRZ. 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.

A.7.14.4 Water Resource Modelling

A water resources model is utilised by SWW for water resources planning purposes. The existing Wimbleball baseline model has been re-run to include updates to the supply demand balance and provide further insight of the current constraints in the network.

Figure A.7.9 shows output from the model for the specific sub-zones of the Wimbleball WRZ supplied by Dotton WTW and its supporting satellite WTW at Kersbrook. The peak demand profile (black line), reflecting the Dry Year Demand plus outage plus target headroom, is shown in relation to the peak licensed abstraction (green line). Currently, the peak demand in such a year is predicted to be approximately 26 Ml/d, resulting in a small surplus of 2 Ml/d. The red line shows the impact of a potential 6 Ml/d WINEP3 reduction on the licensed abstraction at Wellfield D to meet the Environment Agency Environmental Flow Indicator (EFI) threshold. This results in a deficit of 4.2 Ml/d, clearly demonstrating that the system might be unable to meet the peak demand without further significant investment.

Figure A.7.9: Dotton WTW area supply demand balance



N.B.: Pynes supplementary flow limited to 4.2 Ml/d.

The 2 Ml/d of spare capacity above target headroom represents additional resilience of only 7.7%.

A.7.14.5 Risk Assessment

The key potential risks to Water Available For Use (WAFU) in the Otter Valley are identified below and subsequently described in more detail:

1. WINEP reductions (implications from time limited licence changes in 2025)
2. Saline Intrusion:
    a. Natural embankment breach
    b. Lower Otter Restoration Project (LORP)
    c. Climate change / extended drought impacts
3. Borehole asset age & performance
4. Flooding outages (affecting Wellfield D)
5. Nitrates and water quality in general

The potential 'permanent loss of water available' are summarised in Table A.7.28 below.

Table A.7.28: Potential permanent loss of water available associated with different risks to supply

Ref	Risk	Description	Potential permanent loss (Ml/d)
1.	WINEP reductions	Potential reduction in abstraction as a result of reassessment of all Otter Valley licences in 2025	6
2.	Saline Intrusion:	Saline intrusion risk to Wellfield O boreholes as a result of: a. Natural breach of earth embankments b. Lower Otter Restoration Project c. Climate Change (sea level rise & lower GW levels)	Limited TBC (EA) 2.5 - 3.1 *[1]
3.	Borehole asset condition	Risk of poor performance or failure due to borehole asset condition	2.2 *[2]
4.	Flooding outages	Short term outages at two boreholes due to floodplain inundation from the River Otter	Short term
5.	Nitrates / WQ	Risk to supply from nitrate peaks and/or other parameters	Short term

*[1] *Range of losses based on 11 'equally likely' climate change scenarios.*
*[2] *Estimated impact of single borehole failure (based on average licensed abstraction for all supply boreholes)*

Further description and consideration of each risk is provided in the sections below:

<u>WINEP3 reductions</u>

Through the Water Industry National Environment Programme, currently in its third iteration (WINEP3), the Environment Agency has provided water companies with information on actions that they need to complete to contribute towards meeting environmental obligations. The latest release includes information on measures, which could impact on deployable output (DO).

In the Otter Valley, two key groundwater abstraction licences (SW/045/0001/016/R01 & 14/45/001/0520) covering six boreholes in Wellfield D, were renewed in 2017. The licences are due to be renewed again in 2025 following discussions to identify options for minimising their environmental impact. Although these specific licences will be the focus for any potential licence reductions, the EA have confirmed that they wish to assess the impact from all the Otter Valley licences and hence it may be agreed that reductions at other licences may prove more acceptable from a water supply perspective, as well as leading to a better environmental outcome.

The licenced abstractions for the Wellfield D boreholes (ref. SW/045/001/016/R01) were previously subject to licence reductions in 2017/18, as outlined in Table A.7.29 below:

Table A.7.29: Recent licence abstraction reductions in Wellfield D

Date	Reduction Type	From (Ml/a)	To (Ml/a)	Reduction (Ml/a)
14/03/2017	Annual	3,915	2,883.5	1,031.5
26/05/2018	Annual	2,883.5	2,609.75	273.75
Total reduction				**1,305.25**

Two licences in Wellfield G (SW/045/0001/008/R01 and SW/045/0001/014/R01) are also due for renewal in 2025. A further licence (ref. 14/45/001/0426) is due to revert to the previous licence conditions at the same time, in theory resulting in the cessation of the Wellfield G stream support borehole.

Groundwater modelling has been used extensively to identify the impact of abstraction on river flows. Current analysis shows that at Dotton Gauging Station, Q95 flows are compliant with the Environment Agency EFI threshold. The Q95 used to determine the EFI compliance on the Lower Otter at Otterton is currently failing to achieve the EFI by approximately 6 Ml/d. This equates to approximately 7% of the 95th percentile flow at Dotton GS (Q95 = 0.967 m3/s). It is therefore assumed that there is a potential for 6Ml/d permanent loss from the existing licences, not accounting for the implementation of proposed mitigation measures. During the scenario testing described earlier in this section, it was assumed that a less extreme 3 Ml/d licence reduction may be required, as we are currently discussing other options for mitigating the impact of abstraction (such as the AIM scheme).

Saline Intrusion

- Natural embankment breach

The tidal extent of the Lower Otter is partially constrained by a number of earth embankments constructed within the estuary / Otter floodplain downstream of East Budleigh. There is a concern that failure of these embankments may lead to more extensive or more prolonged saline intrusion up the Otter Valley towards the Wellfield O boreholes.

Recent modelling undertaken by ESI[A.7.27] and ABPmer[A.7.28] to assess the potential impact of the LORP indicates that the impact of embankment failure in the Otter estuary downstream of White Bridge would have little if any impact on the Wellfield O boreholes. The risk of saline penetration into the aquifer between White Bridge and the Budleigh Aqueduct is also reported to be minimal due to the limited areal extent and short period of inundation.

On the assumption that the breached section of embankment would be reconstructed relatively quickly (i.e. within weeks), the limited duration would significantly reduce the potential impact of any breach.

It is therefore assumed that although the impact could be up to the full 7.0 Ml/d available from Wellfield O the risk would be limited to a short-term impact (therefore simply a short term outage), provided the breach is reconstructed in a matter of weeks and occurs during a period when it is feasible to switch to alternative sources or import more water from within the broader Wimbleball WRZ.

- Lower Otter Restoration Project (LORP)

The proposed Lower Otter Restoration Project, will result in increased tidal encroachment into the Otter Estuary and Lower Otter Valley, with the potential to negatively impact the water quality of the Wellfield O borehole sources. The Wellfield O boreholes are locally significant in terms of water supply, particularly in light of the ongoing pressure to reduce the impact of the up-catchment Wellfield D boreholes on the lower River Otter.

The Environment Agency commissioned ESI Stantec to undertake an assessment of the saline intrusion risk to the Otter Sandstone[A.7.27]. This was further supplemented by ABPmer modelling on the saline extent in the River Otter[A.7.28]. The work was further summarised in the “Salinity Modelling - Summary Report” released in preliminary draft form by CH2M in late March 2019 for initial review and comment.

The saline intrusion risk assessment work identified that the primary risk relates to the extent of the saline intrusion up the River Otter, with the mechanism of downward water penetration within the wider inundated floodplain area considered to be of much lower significance. The ABPmer modelling suggests that there is little, if any, risk of the saline limit encroaching further up the main River Otter than is currently observed. However, the LORP scheme would increase both the extent and duration of tidal inundation on the Otter floodplain immediately adjacent to this stretch of the river.

[A.7.27] ESI/Stantec (2018), *Technical Note: Otter Sandstone saline intrusion risk assessment: Phase 1A modelling*
[A.7.28] ABPmer (September 2018), *Lower Otter Restoration Project Modelling*

The modelling also “demonstrates the concept and feasibility of a ‘ratcheting’ effect, whereby successive tidal cycles could lead to the progressive salinisation of the underlying groundwater body”. This was identified to be most likely to occur along a specific reach of the Otter from immediately downstream of the Wellfield O sources to a point approximately 340m upstream of White Bridge.

The conclusions of the initial reports were confirmed in the Summary Report (draft March 2019), which states that ‘the combination of surface water saline modelling and the 1D groundwater modelling demonstrate that risks to the PWS sources at Otterton are minimal’.

However, there remains significant uncertainty around the potential for increased risk of saline intrusion, as a result of LORP.

Any increase in tidal extent, which increases the frequency of inundation and prolongs the saline loading on the Otter floodplain adjacent to the river, has the potential to result in increased leakage of saline water into the aquifer. If significant, this could lead to reductions in abstraction with the potential for the long term viability of the Wellfield O sources to be put at risk. The Wellfield O sources currently contribute 5.8 Ml/d average daily abstraction and 7.0 Ml/d peak daily abstraction, which is an important contribution to the water resources available for East Devon.

SWW and the Environment Agency currently undertake monitoring to identify the potential for ingress of saline water into the aquifer primarily from the coast to the east of the Wellfield O sources. Any significant increase in the salinity of the groundwater would require a reduction in the abstraction from the Wellfield O boreholes to achieve a reduction in the hydraulic gradient towards the sources and limit the risk of further saline intrusion. The current monitoring programme is primarily targeted at identifying saline intrusion from the coast to the east towards the most easterly borehole in Wellfield O. However, any potential increase in risk from the Otter estuary to the west would be most likely to impact the most westerly borehole in Wellfield O initially.

In line with the recommendation of the ‘Salinity Modelling - Summary Report’ that ‘an enhanced monitoring strategy should be implemented both pre and post scheme’, we will work with the Environment Agency to extend the existing early warning system to ensure robust baseline monitoring and as a means of monitoring any potential future impacts of the LORP scheme. Ideally such a system would be based on one or more existing boreholes (e.g. EA Obs. BH4 and/or South West Water OBH S12), but may also require the drilling of additional monitoring points.

- Climate change impacts

As previously stated, the UKCP09 Future Flows climate modelling using the Otter Valley GW model considered 11 'equally likely' future climate scenarios. The AfixM scenario resulted in the most severe impact, including an 'extreme but plausible' drought in 2097, which is beyond that experienced in the historical record. Inland encroachment from the sea during the 2097 AfixM drought event was modelled using an average sea level increase of ~0.6 m higher than today, approximating to that predicted to occur in 2080. The Fully Licensed (FL) model scenario indicates that, unless action is taken to switch Wellfield O off during such a combined drought / high sea level scenario, saline intrusion risks to DO could be significant (ranging from 0.3 to 0.9 Ml/d).

Any reduction in DO from Wellfield O would either require imports from elsewhere in the network or the development of an alternative 'satellite' source, which could be used conjunctively with Wellfield O to provide occasional drought relief.

The work undertaken to date by ESI and ABPmer does not include any assessment of the potential increase in future risk due to climate change, as a result of the LORP being implemented. It is possible that, whilst there is no significant increase in current risk, the future risk as a result of LORP including climate change may increase e.g. due to an increased extent and prolonged duration of inundation at an earlier point in the future than would occur under a 'no LORP' scenario.

Re-drilling boreholes

The performance of a number of the existing public supply boreholes in the Otter Valley are restricted by water quantity and quality constraints, as a result of asset age. We have therefore made an allowance in our water resource management planning for re-drilling of one or more sources.

Wellfield D flooding outages

Two boreholes in Wellfield D are subject to periodic short term outages due to floodplain inundation from the River Otter. Estimates of these values are included in our general outage estimates. We currently mitigate for these losses through the operation of another Wellfield D borehole and are currently investigating the potential to further reduce the impact of these outages by implementing changes to the operational approach at a number of sources in the affected wellfield. Further mitigation for any significant future increase in frequency due to climate change is likely to require the establishment of a new borehole located outside of the Otter floodplain.

Nitrates / WQ deterioration

Nitrate levels in the Otter Valley groundwater body are variable with some borehole water being relatively close to, or above, the standard for public water supply. We ensure nitrate levels in the final treated water leaving Dotton WTW are compliant through a combination of nitrate stripping and multi-source blending. Nitrate stripping is applied to three boreholes with excessive nitrate (one in Wellfield D and two in Wellfield C). The treated water is then blended with that from the other Dotton WTW sources, which possess low nitrate concentrations before going to supply. The relative contribution from each borehole source can be varied to aid the management of total nitrate in the water going to supply.

Some boreholes appear to be showing an upward trend in nitrate. If there were to be further increases in nitrate, this might lead to the requirement to use water from alternative sources or explore additional treatment options. We are currently taking the following measures to minimise this risk:

- The 'River Otter & Cofton Cross DrWPAs Catchment – Ongoing Capital Maintenance Scheme (UST)' is being delivered under PR19 Catchment Management Planning – Upstream Thinking 3. The project aims to deliver measures which address the specific water quality issues through a combination of integrated farm management plans and active interventions delivered through a partnership approach with local landowners and stakeholders.

- We are working with Exeter University to develop a better understanding of the source receptor pathway with the aim of reducing the amount of nitrate entering the groundwater system in the medium to long term through the implementation of suitable catchment management interventions. Exeter University are currently conducting detailed field study and investigation work to establish the rate of nitrate input and loading under current land use practices.

A.7.14.6 Discussion of mitigation options

Improvement of existing resources

- Wellfield K

We are planning to progress with the drilling of a 'new' borehole at Wellfield K in 2019. This will allow us to make greater use of the water available under the existing licence and fully implement an Abstraction Incentive Mechanism (AIM) scheme.

- Wellfield G

Within our PR19 Business Plan we are proposing the development of a new borehole to replace an existing Wellfield G source, which has suffered from reduced yield in recent years. A new borehole would allow us to make greater use of the water available on the current licence. The new borehole would be located in the same general location and, if successful, be operated in preference to the existing source.

Development of new resources

- Potential new Wellfield S

Testing of an existing trial borehole at potential new Wellfield S, outside the Otter Valley, suggests that the development of a supply borehole in this location would be likely to produce a reasonable yield (up to 1 Ml/d). However, this would require the installation of a manganese treatment plant to ensure that manganese levels remained below the relevant standards. Investigations into the development of a new Wellfield S have highlighted both the lead in time and potential challenges of identifying and developing a new source to support the Otter Valley.

- Alternative new source(s)

We are continuing to review the potential for developing one or more additional sources in future. To offset any potential reduction in the licensed abstraction at Wellfield D these would either have to be located outside of the Otter Valley or at an alternative location within the Otter Valley, which does not result in a negative environmental impact, particularly a reduction in flows in the Lower Otter.

Improved intra-zonal connectivity

There is an existing transfer of water between Pynes WTW in the Exe catchment and Dotton WTW in the Otter Valley. The current capacity of this link has been assessed as 4.2 Ml/d. In order for additional water to be made available, duplication of the existing pipeline link would be necessary and the treatment capacity at Pynes WTW would need to be increased. This pipeline improvement scheme would require significant additional capital investment. The current high level cost estimate for undertaking the upgrade to Pynes WTW and increasing the capacity of the Pynes to Dotton link is £10.5M.

The pipeline improvement scheme would have a capital cost and increase operational running costs. There would also be other significant costs and environmental implications:

Financial costs:

- Upgrade to Pynes WTW estimated at £3.8M

- New Pipeline between Pynes and Dotton WTW's estimated at £6.7M
- Additional production and pumping costs of approximately £10k/Ml/Year
- Additional Wimbleball pump storage costs of roughly £100 per Ml - based on a 1975/76 event, it is estimated that additional pump storage would be in the region of 1,700 Ml/a.

Environmental costs:

Environmental implications of the required 18 km of pipeline being laid would result from:

- 12 km through Exeter and along the A3052 road
- 6 km through East Devon AONB and Woodbury Common SSSI
- Significant CO_2 generated by additional pumping

Revised operational approach

We are looking to implement a number of local operational improvements to enable the management/control of the sources to be optimised to a greater degree than is currently possible. This will include greater automation of the source management code alongside better visibility and improved functionality of key system settings. This in turn will result in greater adaptability in meeting the changing water resources situation, whilst still fulfilling the licence requirements.

Demand management

Future demand management options, which include customer side management options, managing leakage and metering, are considered further in Sections A.6.3 to A.6.5 of WRMP Appendix 6.

AIM scheme

We are in the process of developing an AIM scheme in the Otter Valley of East Devon. The River Otter is currently assessed as having Poor Ecological Status, in part due to the hydrological impact of local groundwater abstractions. Low flows (Q95) in the river are non-compliant Band 1. The proposed AIM scheme will reduce abstraction at Wellfield D by offsetting with increased abstraction at Wellfield K, or from an alternative source.

The scheme will require an increase in abstraction capacity at Wellfield K, which is scheduled to be available by the end of 2018/19, or an alternative source of supply. Because of the nature of the aquifer system and its hydrological interaction with the river, the scheme, if triggered, will need to operate for an extended period (12 months) in order to fully benefit the River Otter.

The proposal is for the identification of a groundwater trigger level on a set date (site and level to be agreed following further groundwater modelling, currently set at 99.8mAOD, set date of 31st April), which would initiate the scheme. The target will be to achieve an average abstraction at Wellfield D over the course of 12 months which is equal to 1 Ml/d below its current licence allowance (7.15 Ml/d down to 6.15 Ml/d).

Catchment based approaches

As part of our catchment based approach we are progressing discussions with Wessex Water as to how best we can jointly manage water resources in adjacent WIS zones and/or shared catchments through catchment specific initiatives.

We are also supporting broader research projects, such as the 'FEVOW' (France-England Value of Water) project, which is being delivered under the Interreg VA France (Channel) England Programme.

A.7.14.7 Assessment of risks to DO in the Otter Valley

The potential impact of the identified risks on DO in the Otter Valley are summarised in Table A.7.30 below:

Table A.7.30: Potential impact of risks on DO in the Otter Valley

Risk	Likelihood	Consequence	Initial Risk	Mitigation measures	Likelihood	Consequence	Residual Risk
1. WINEP reductions / TLL	H	H	H	Pursue alternatives to permanent licence reductions in the form of smart abstraction protocols and AIM scheme. Ensure sufficient short, mid and long-term resilience in the OV WR sub-zone.	H	M	M/H
2. Saline Intrusion							
a. Natural breach	L	M	M	Assess the current risk status and review the potential for increased risk in future e.g. as a result of LORP and climate change. Ensure sufficient short, mid and long-term resilience in the OV WR sub-zone.	L	M	L/M
b. LORP	L	M	M	Review the current risk status and the potential for increased risk in future e.g. as a result of LORP and	L	M	L/M

Risk		Likelihood	Consequence	Initial Risk	Mitigation measures	Likelihood	Consequence	Residual Risk
					climate change. Ensure sufficient short, mid and long-term resilience in the OV WR sub-zone.			
c.	Climate change	H*	H	H	Review the current risk status and the potential for increased risk in future, including the potential impact of LORP. Review the current risk status and the potential for increased risk in future. Ensure sufficient short, mid and long-term resilience in the OV WR sub-zone.	H	M	M/H
3.	Borehole asset failure	M	M	M	Review the current risk status and the potential for increased risk in future. Ensure sufficient short, mid and long-term resilience in the OV WR sub-zone	L	M	L
4.	Flooding outages	H	M	M/H	Review the current risk status and the potential for increased risk in future due to climate change. Ensure sufficient short, mid and long-term resilience in the OV WR sub-zone	H	L	M
5.	Nitrates / water quality	M	M	M	Review the current risk status and the potential change in future risk status due to changes in land management practices, climate, etc. Ensure sufficient short, mid and long-term resilience in the OV WR sub-zone.	M	M	M

** Overall risk (Likelihood and Consequence) continue to increase with time.*

A.7.14.8 Conclusions – overall level of resilience and potential enhancements

The previous sections outline the current water resource position in the Otter Valley in the context of the wider Wimbleball WRZ, together with the main risks to supply and potential mitigation measures.

The overall water resource position is that current supply, including the transfer of water via Pynes WTW, is able to meet predicted peak demand, but with only a very limited surplus of circa 2 Ml/d above target headroom.

Given the local reliance on the Otter Valley sources and the limited surplus available to meet peak demand, it is desirable that we retain existing water available to maintain adequate confidence in local security of supply. In practice this means being able to abstract sufficient water at critical times of high demand from a variety of sources. However, whilst we would not be overly reliant on any one source, the importance of certain sources cannot be understated. In particular, it is important that we have the ability to abstract at current levels from Wellfields D and O during periods of peak demand.

To further protect resilience we are considering a number of innovative licence changes, which would continue to allow us to meet peak demand, whilst reducing the overall long term impact of abstraction from key groundwater sources by reducing abstraction at other times of the year. This includes the implementation of the Otter Valley AIM scheme, which will result in a small but significant reduction in the hydrological impact of the abstraction at Wellfield D.

The multiple risks to water resource supply in the Otter Valley and in the broader Wimbleball WRZ will require a range of mitigation measures, some addressing specific risks while others have wider benefits.

There are a number of specific threats to the sources in the Lower Otter Valley, especially in relation to the potential for saline intrusion affecting the Wellfield O borehole sources. Saline intrusion risks include short duration threats, such as embankment breach, which can be managed through operational measures (e.g. changing sources) provided there is sufficient resilience in the system. In the longer term, the risk of saline intrusion due to climate change induced sea level rise has been shown, by groundwater modelling, to increase significantly in the second half of this century.

The initial assessment of the impact of the Lower Otter Restoration Project on saline intrusion, commissioned by the Environment Agency, suggests a limited increased risk of saline intrusion, as a result of implementing the scheme. However, the work completed to date makes no assessment of the potential future increase in risk to the Wellfield O borehole sources following implementation of the scheme under a range of future climate change scenarios.

There are also significant challenges and costs associated with the development of new sources and/or importing water from outside the Otter Valley sub-zone. Ongoing work to identify suitable alternative sources, either in the Otter Valley or elsewhere in East Devon, suggests that, whilst it may be possible to gain 1 Ml/d of additional water per source, water quality constraints remain a significant issue. The cost of developing infrastructure to enable the transfer of additional water from outside the Otter Valley is significant, with high level estimates of over £10m for the capital works alone. There are also significant socio-environmental impacts associated with implementing this solution.

Future demand management measures will also remain important, including the proposed 15% reduction in leakage, a range of customer side management options and extended metering.

Once mitigation measures have been implemented, there will still be critical residual risks in terms of potential WINEP reductions and climate change. Any agreed WINEP reductions will come into effect in 2025 and we are continuing to investigate options to offset the impact of these. Climate change is a significant risk in the long term, with the likelihood of significant consequences increasing with time. This therefore requires an ongoing adaptive approach to mitigation.

Maintaining and developing a high degree of resilience will be critical to our ability to ensure we meet existing and future customer demands. Given the current small surplus within the Otter Valley and the relatively limited availability of water in the wider Wimbleball WRZ, any reduction in the current peak licence abstractions would increase the risk to supply. However, addressing this through infrastructure changes, including importing extra water and/or developing new sources, would be a high cost response, with additional carbon footprint, whilst the environmental benefit is currently unproven.

Therefore, in order to progress towards meeting the Environment Agency environmental targets on the Lower Otter, this Plan takes the following approach:

1. Demand reduction measures (including 15% leakage reduction)
2. Innovative/smarter abstraction management approaches (including the AIM scheme)
3. Further review of the environmental benefit of increasing flows in the Lower Otter.

Given the additional risks facing the Otter Valley abstractions, the current additional 2 Ml/d available above target headroom represents a minimum additional buffer to ensure resilience of supply. However, a reduction in supply capability in 2025 to fully meet the current estimate of environmental need would result in sufficient supply demand deficit to require major investment in infrastructure.

We will be working on an options appraisal with the EA to confirm the best approach, which will be agreed by 2022, leading to an investment case which will be included in PR24.

A.7.15 Wider resilience

Resilience has been defined as “the ability to cope with, and recover from, disruption, and anticipate trends and variability in order to maintain services for people and protect the natural environment, now and in future.” (Resilience Task and Finish Group, 2015).

We tested our Plan against non-drought resilience factors. The most important of these are: impact of cold weather events, impact of flooding, Bournemouth WRZ and wider resilience issues (e.g. cyber).

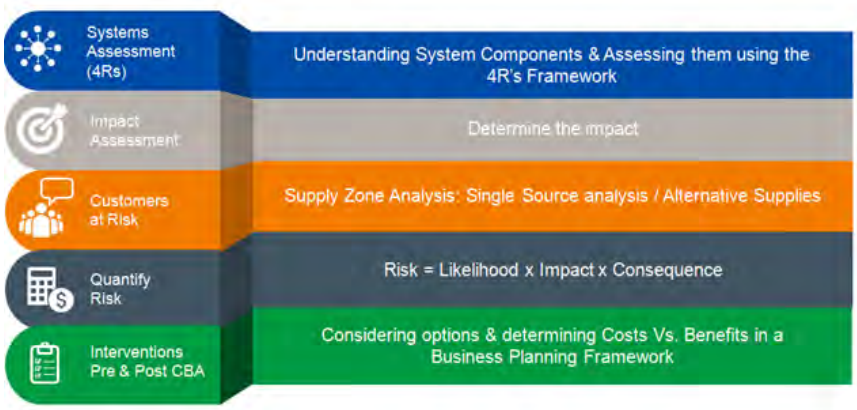
These are set out below, together with a short summary of how we measure resilience across our assets.

Further details of our overall approach to resilience can be found on our website (https://www.southwestwater.co.uk/get-into-water/resilience/)

A.7.15.1 Resilience assessment

Our overall approach to resilience is set out below. Our process follows that set out in the UKWIR best practice approach as in Figure A.7.10.

Figure A.7.10: UKWIR best practice approach to resilience



The first principle of resilience planning calls for an 'all-hazards' identification of risk to enable companies to generate a holistic view of potential threats to service. An all-hazards register has been developed to record the best available evidence of the full range of foreseeable hazards, both natural (e.g. storms and flooding) and man-made (e.g. pollution events and cyber-attack), with the potential to adversely impact service.

The hazard register includes:

- hazard title and reference code
- the 'reasonable worst-case scenario'
- potential impacts, in days loss of service, on system components
- the annualised probability of occurrence (inverse of 'return period')
- the impact geography – 'single site' (e.g. major fire) or 'whole region' (e.g. fuel crisis)

- the systems at which the hazard is applicable (e.g. coastal hazards would not be applicable inland)
- additional commentary on the assessment of the Hazard.

The individual hazards and scenarios were initially compiled from:

- Keeping the Country Running: Natural Hazards and Infrastructure (Cabinet Office, 2011)
- National Risk Register of Civil Emergencies (Cabinet Office, 2012)
- White Paper on Resilience - outcome focused regulation (Ofwat, May 2012)
- RG06 Resilience – Making a Business Case for PR14: Development of Common Strategic Approach to Resilience (UKWIR, February 2013).

We have also considered other hazards, which could present a risk to service for customers and the environment, identified in discussion with operational staff, external consultants and our LRF partners.

A.7.15.2 4Rs assessment

For our sites we then identify the risk against the 4Rs of resilience – resistance, reliability, redundancy, response. An example is given below in Table A.7.31.

This data is then used to identify remedial actions. These solutions are then assessed in terms of their cost and benefit to determine the right level of investment at the right location.

The process ensures that we understand the level of resilience at our sites. For PR19 this has been used to identify specific remedial actions – see following sections.

Table A.7.31: 4Rs assessment example

Component	Impact	Resistance	Reliability	Redundancy	Response Recovery	Resilience Score (%)	Assessment Date
Water Resource	Resource	Low	Moderate	Very Low	Low	40.8	29/08/2017
Intake	Comms/Control	Low	Moderate	Low	Very Low	40.8	29/08/2017
	Physical Asset	High	High	Very Low	Low	72.6	29/08/2017
	Power Supply	Moderate	Low	Moderate	Moderate	60.1	29/08/2017
	Staff Avail/Access	Low	Moderate	Very Low	Low	40.8	29/08/2017
Raw Transfer	Physical Asset	Moderate	Moderate	Very Low	Moderate	57.7	29/08/2017
Treatment	Comms/Control	Low	Moderate	Low	Very Low	40.8	29/08/2017
	Physical Asset	Low	Moderate	Very Low	Moderate	50.0	29/08/2017
	Power Supply	Moderate	Low	Moderate	Moderate	60.1	29/08/2017
	Staff Avail/Access	Low	Moderate	Very Low	Low	40.8	29/08/2017
	Suppliers	Moderate	Low	Very Low	Low	40.8	29/08/2017
High Level Pumping	Comms/Control	Low	Moderate	Low	Very Low	40.8	29/08/2017
	Physical Asset	Very Low	Moderate	Low	Moderate	50.0	29/08/2017
	Power Supply	Moderate	Low	Moderate	Moderate	60.1	29/08/2017
	Staff Avail/Access	Low	Moderate	Very Low	Low	40.8	29/08/2017
Treated Transmission	Physical Asset	Moderate	Moderate	Low	Moderate	60.1	29/08/2017
	Staff Avail/Access	Low	Moderate	Low	Low	44.1	29/08/2017
	Treated Water Quality	Moderate	Moderate	Low	Moderate	60.1	29/08/2017
Strategic Storage	Comms/Control	Low	Moderate	Low	Very Low	40.8	29/08/2017
	Physical Asset	Moderate	High	High	Moderate	85.0	29/08/2017
	Staff Avail/Access	Low	Moderate	Low	Low	44.1	29/08/2017
	Treated Water Quality	Moderate	High	High	Moderate	85.0	29/08/2017

A.7.15.3 Cold weather events/summer 2018

With high tourist demand in our region, we have extensive experience of meeting peak demands for water.

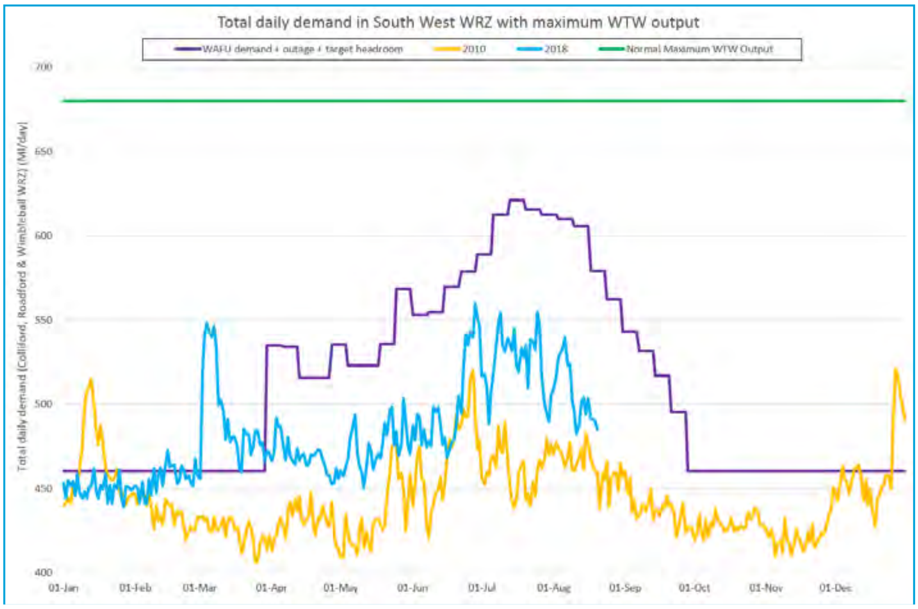
Cold weather events can cause increases in demand, due to an increased outbreak of leaks. We have compared the demand profiles from the most recent extreme cold weather event in 2018 to our demand forecasts.

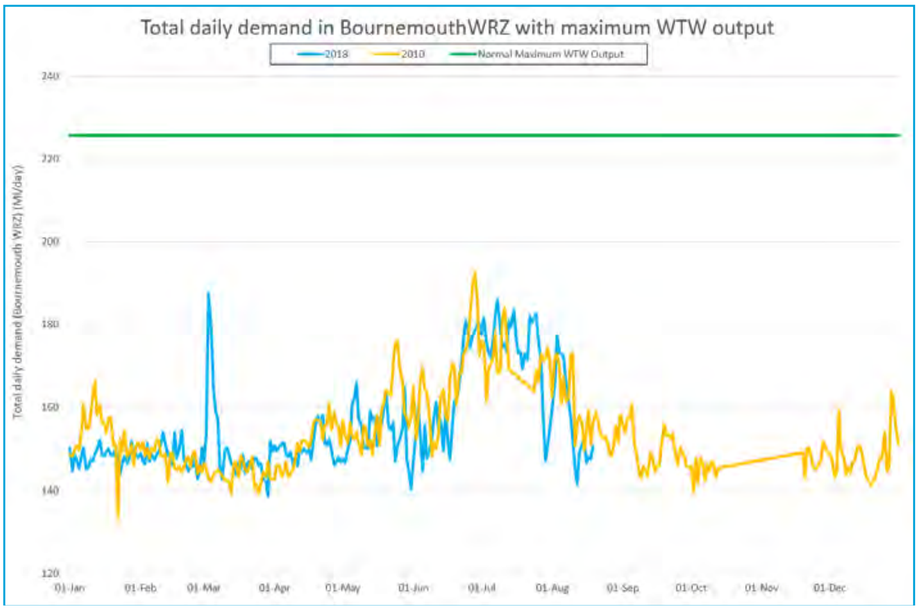
The graph below shows that the actual demand experienced during extreme weather events is lower than the peak demand we experience and plan for in the summer. From a water resources perspective, this means the cold weather events demand is within the assumptions we use in our planning. It is also well within our overall treatment capacity. It is worth noting that a winter demand can spike in SWW in any week and that can be above the demand forecast that we use for water resource planning. As this demand is short term, it is drawn from storage in the system. This therefore does not affect the assumptions for the water

resource models, as it is the annual average demand that is the constraining factor for water resources planning.
We are therefore satisfied that the WRMP accounts for the demand that can be experienced in the extreme cold weather in SWW and BW supply areas.

The graph in Figure A.7.11 also shows the high demand experienced from the very hot and dry summer of 2018. This shows the demand experienced is within the envelope we plan for within our water resources modelling and also within our total water treatment works capacity.

Figure A.7.11: Daily demand and WTW output 2018





However, the cold weather events in 2018 highlighted some local, short-term interruptions to supply issues, accentuated by the lack of access due to the weather. Since then we have:

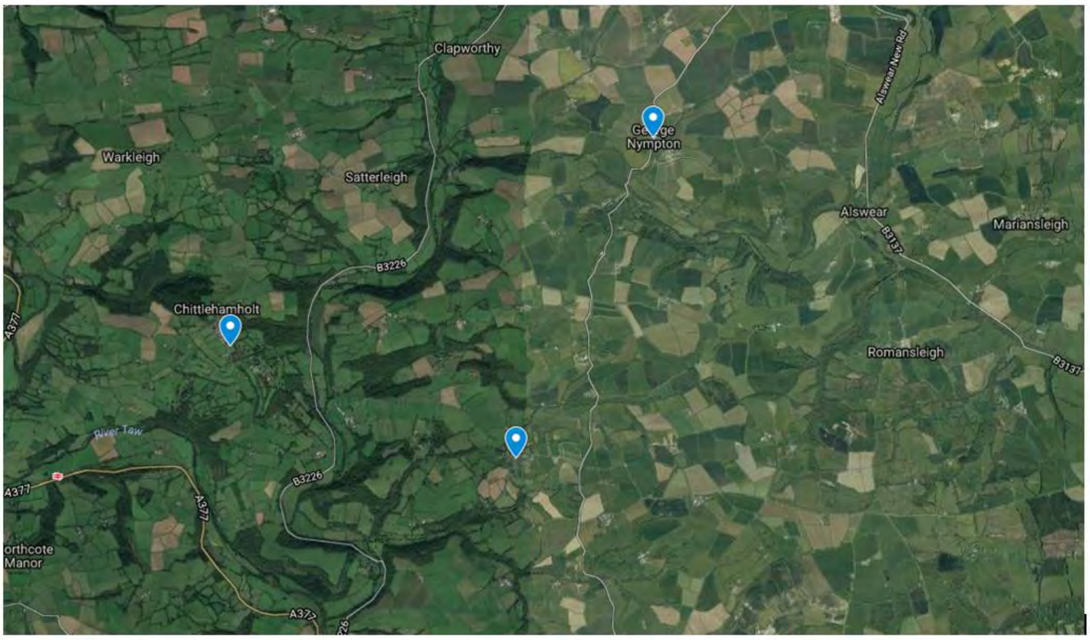
- Invested in a number of tactical network inter-connectivity schemes which will allow us greater flexibility in moving water around our network and optimising outputs from our production sites e.g. from Northcombe
- Increased the number of network connection points in rural areas to enable rapid connection of mobile tankers or temporary booster pump installations
- Invested in multi-use vehicles to speed up the resolution of the impact supply interruptions

The freeze/thaw also highlighted the challenge of alternative water supplies in poorly connected rural areas. We have since updated our alternative water supply arrangements to reflect the rural system and deployment off all service reservoirs and learning from the event - this also gives locations for agriculture to be able to access alternative supplies. The screen shot below give an example of where we pre-plan Alternative Water Supplies in the event of future supply failures.

Figure A.7.12: Examples of Alternative Water Supply locations

312D14 MEWP 2 - Parking Area outside The Grove Inn, Kings Nympton. EX37 9ST

Bratton Fleming WTW – 312D14 DMA – MEWP Locations



A.7.15.4 Flooding

We undertake a flood risk assessment every five years. This examines the overall risk to the site and takes into account the impact on supply reliability. We have already invested in flood protection – most notably at Pynes WTW that has protection to 1 in 200 years already. We also have temporary deployable flood protection for our sites. Flood investment during AMP5 delivered protection to 175,452 properties. The total investment was £1.9m or £11 per property protected.

Our approach is to screen all our non-infra, surface works, assets GIS NGR's by drawing a 100m circle around the location and listing the site if it overlaps the flood outline.

This identified the following:

120 sites were identified including:

- 22 impounding reservoirs
- 3 intakes
- 69 water pumping stations
- 20 clean water tanks and WTWs most referring to the same geographic location
- 2 service reservoirs

Detailed assessments on each are undertaken and solutions identified and recorded. Within this, we located eight WTWs that supply greater than 25,000 populations potentially at risk and therefore of particular interest from a water resources management plan perspective due to their size. Three sites benefit from the deployment of our existing temporary flood barrier treatment, and one site is due for replacement.

Our PR19 plan has then included £2.570m to improve flood defences at four treatment works to mitigate 1:1000 year floods.

In the interests of security, site maps and site details are not provided in this WRMP.

A.7.15.6 Drinking water quality

Providing resilience to drinking water pollutants is vital to the resilience of the WRMPs.

- We have a 25 year drinking water quality plan as required by the DWI. This sets out the plan for safeguarding supplies at all WTW.
- We operate catchment management to mitigate raw water quality risks

Details of the catchment management plan are given in Section 6.9.

Both of the above actions help to safeguard rural supplies. For example, catchment management on Roadford, Tamar and Wistlandpound collectively help safeguard supplies in rural North Devon by reducing the risk of raw water deterioration.

A.7.15.7 Bournemouth WRZ

Bournemouth WRZ is supplied by two principal water treatment works. These are old slow sand filter works.

To improve resilience to raw water quality events, both of the principal works are planned for replacement starting in AMP7.

This provides specific resilience for our WRMP in Bournemouth WRZ.

We are in the process of installing a dual supply to the Wimborne area, reducing the risk of unplanned interruptions and securing supplies for a significant number of properties. The scheme will also readily enable maintenance to be undertaken of the existing main, which will have additional benefits of reducing discolouration events in the area.

The new main will enable Wimborne to have a dual resilient feed from both of our Stanbridge and WTW B sources.

A.7.15.5 Wider resilience

The water resource system is part of a wider, integrated network. The performance of this effects the service customers received. Elements of our wider resilience work in our business plan that are relevant to the security of water resources are:

- PLC and cyber resilience - £0.973m to replace old, obsolete control equipment to facilitate delivery of enhanced cyber protection of OT systems
- electrical resilience - £0.484m to provide enhanced protection of electrical and control equipment
- contingency planning - £0.736m to improve the systemization of our contingency planning in line with enhanced automation and control of our network to better support operation via our central Control Centre
- inter zonal transfers - £3.040m to provide resupply options to zones with a high proportion of single source customers
- critical crossings - £0.901m to provide alternative supply routes for a number of trunk mains which cross major roads, rail or rivers
- control and automation - £1.200m to increase our control of the network and hence our ability to respond quickly to potential events.

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 reduction of 8% by 2025, water efficiency and STW re-use	138	6	>1
8	Final Plan	M	Leakage reduction of 15% by 2025 SWW, water efficiency and STW re-use	129	6	0

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**
8	Final Plan	M	3	3	3	4	4	2	2	3	3	2	2	2	**33**

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 reduction of 8% by 2025, water efficiency and STW re-use	164	12	0.5-1
8	Final Plan	M	Leakage reduction of 15% by 2025 SWW, water efficiency and STW re-use	153	11	0

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**
8	Final Plan	M	3	3	3	4	4	2	2	3	3	2	2	2	**33**

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 reduction of 8% by 2025, water efficiency and STW re-use	77	4	0.5-1
8	Final Plan	M	Leakage reduction of 15% by 2025 SWW, water efficiency and STW re-use	73	4	0

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**
8	Final Plan	M	3	3	3	4	4	2	2	3	3	2	2	2	**33**

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	Leakage reduction of 8% by 2025, water efficiency	104	3	1-1.5
8	Final Plan	M	Leakage reduction of 15% by 2025 SWW, water efficiency	94	3	0

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**
8	Final Plan	M	3	3	3	4	4	2	2	3	3	2	2	2	**33**

A.8.3 Reduce leakage and the future demand for water

A.8.3.1 Leakage target in 2025

The Draft WRMP had an 8% reduction in leakage by 2025. This was based on a balance on the trade-off between cost, affordability, resilience, deliverability and the initial customer research.

This trade off in the Draft Plan is shown in Tables A.8.5 and A.8.6.

Feedback on the Draft Plan from customers and stakeholders was for more leakage reduction in the period to 2025.

Our Final Plan therefore includes a 15% reduction in leakage from 2020 to 2025. This has been based on the three year rolling average Ofwat methodology and the Draft Determination targets received. The underlying annual average reduction to achieve this is a 17% reduction.

In delivering this target, we have set out the specifics of our leakage reduction programme. This is given in Section 8. This includes data on the range of expected leakage costs and leakage levels expected.

The underlying trade-off shown in Tables A.8.5 and A.8.6 still occur in the Final Plan, but the additional leakage reduction was chosen based on the feedback received on the Draft.

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.

Table A.8.5: Draft WRMP: 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: Draft WRMP: 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.

South West Water Bournemouth Water

Table A.8.7 shows the comparison of leakage reduction in the Final Plan. The results show that The Final Plan has a considerably higher rate of leakage reduction in the short term. This is consistent with feedback from the Draft WRMP where customers and stakeholders would prefer our Plan to act early ahead of future risks. The Plan is open to achieving larger leakage reductions, long term if external policy targets are set.

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 (all)	116.2	95.9	20.3	89.3	1.7

Note:
1) leakage values are reporting in line with the new leakage methodology. They therefore should not be compared like for like with the Draft WRMP values.
2) the 15% leakage reduction is based on the Ofwat Draft Determination leakage targets converted into annual average totals. Actual targets and performance will be measured in line with the PR19 Final Determination. See end of this Appendix.

For consistency with the Business Plan we will report on performance on the leakage reduction each year on our WRMP Annual Review. In doing so, we will report performance consistent with our PR19 Final Determination. This will keep the reporting of targets consistent between different publications. For transparency, the approach at the time of publication, as written in our Draft Determination, is reproduced below.

1.1.3 Leakage

Purpose: This PC is designed to incentivise companies to reduce leakage.

Benefits: The benefits of reduced leakage are improved water resources supply/demand balance and increased water supply network resilience.

The company has committed to reduce average annual leakage by 15.8% from 2019-20 to 2024-25. This is a different figure in the table below as the performance commitment is measured on a three-year average to smooth annual variations due to weather.

Performance commitment definition and parameters

Unique Reference	PR19SWB_PC C2
Detailed definition of performance measure	The total level of leakage is defined in the Final reporting guidance for PR19 – Leakage, published on the 27th March 2018: https://www.ofwat.gov.uk/publication/reporting-guidance-leakage/ It is calculated as a three-year average and reported in absolute values expressed in megalitres per day (Ml/d) and as percentage reduction from baseline. The definitive service levels are those expressed in the percentage reduction from baseline.
Additional detail on measurement units	Total leakage is defined as the sum of distribution system leakage, including service reservoir losses and trunk main leakage plus customer supply pipe leakage. Baseline total leakage is calculated as a three-year average of annual values for 2017-18, 2018-19 and 2019-20 and expressed in megalitres per day (Ml/d). Three-year average values are calculated from annual average values for the reporting year and two preceding years and expressed in megalitres per day (Ml/d).
Specific exclusions:	As defined in the reporting guidance.
Reporting and assurance:	This measure is reported in absolute terms and also the percentage change from 2019-20 baseline.
Measurement unit and decimal places	Percentage reduction from 2019-20 baseline, reported to one decimal place. The volumetric levels resulting from the application of the percentage reduction in megalitres per day (Ml/d) reported to one decimal place.
Measurement timing	Reporting year
Incentive form	Revenue
Incentive type	Outperformance and underperformance payments

PR19 draft determinations: South West Water – Outcomes draft determination appendix

Unique Reference	PR19SWB_PC C2
Timing of underperformance and outperformance payments	In-period
Price control allocation	100% water network plus
Frequency of reporting	Annually
Any other relevant information	Performance commitment levels are set as both percentage reduction from 2019-20 forecast baseline and absolute values expressed in megalitres per day (Ml/d). Performance commitment levels expressed as percentage reduction are to be re-applied to 2019-20 actual baseline following the final data being available to recalculate the performance commitment levels re-presented in megalitres per day (Ml/d). Incentive payments relate to performance changes expressed in megalitres per day (Ml/d).
Links to relevant external documents	None

Performance commitment levels

		Company forecast	Committed performance level				
	Unit	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Performance commitment level – percentage reduction	%	0.0	3.0	6.0	9.0	12.0	15.0
Performance commitment level – absolute value	Ml/d	119.5	115.9	112.3	108.7	105.1	101.5

Source: https://www.ofwat.gov.uk/publication/pr19-draft-determinations-south-west-water-outcomes-performance-commitment-appendix/

A.8.3.2 Delivering the leakage reduction

Section 8 sets out in detail the activities we propose to undertake to deliver our leakage reduction plan.

A.8.3.2.1 Customer supply pipe leakage

We estimate that approximately 80% of leakage is from our distribution network and 20% from customer supply pipe leakage.

The programme set out in Section 8 and in WRMP19 Table 6 details our expected savings from customer supply pipe leakage.

This includes the roll out of additional Automatic Meter Read meters to replace existing dumb meters.

A.8.3.2.2 Pressure management

This is included in our Final Plan. Section 8 sets out the proposed savings. The impact of these activities is included in the costs of each step of leakage reduction included in WRMP Table 5 for each WRZ.

A.8.3.3 Reduce our own demand for water

Our Final Plan includes actions to reduce our own demand for water. Table A.8.8 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.8.8: Proposed Water Re-use and Efficiency Schemes at STWs

Site names	WRZ
Brokenbury	Roadford
Camborne	Colliford
Ernesettle	Roadford
Plymouth Central	Roadford
Radford	Roadford

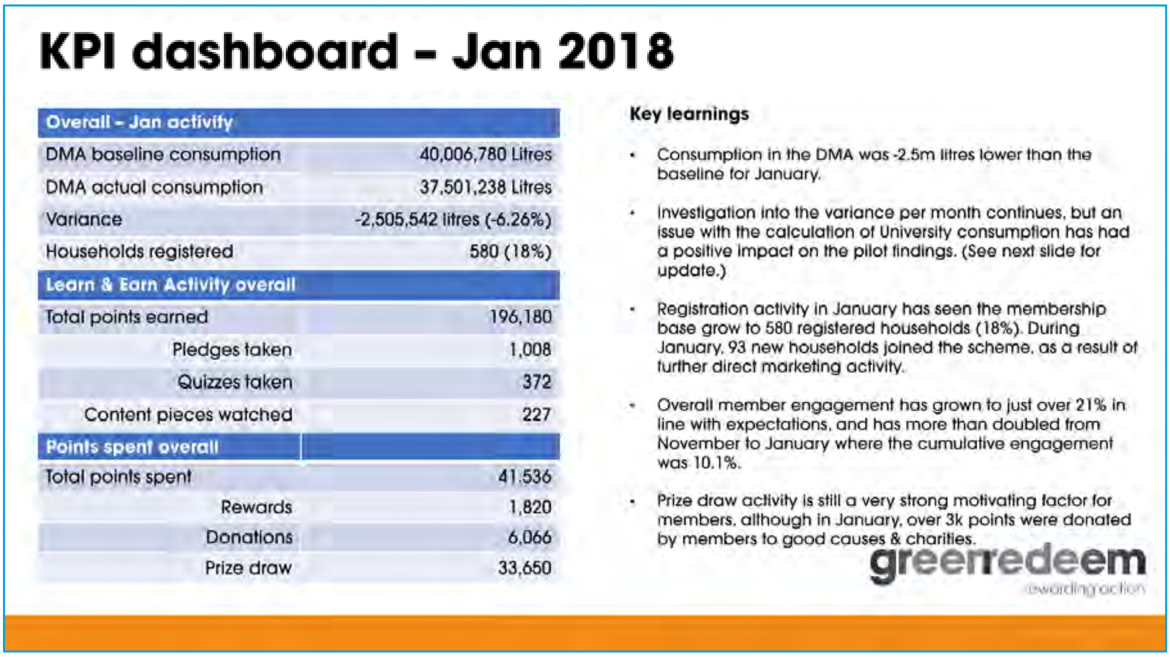
A.8.3.4 Measuring water efficiency benefits

The overall success of our water efficiency programme will be seen in the annual PCC totals. However, per capita consumption can vary year on year due to a range of exogenous factors, such as if it has been a wet or dry year, but also economic factors such as bill value.

For each of our water efficiency programmes we will be monitoring usage to quantify what the reductions in water use are. Factors we will monitor include changes in consumption of measured households, customer engagement, uptake rates, and feedback. These factors will be analysed to identify both the impacts of the programme, as well as potential improvements that can be used to increase the effectiveness of future activity. We will include this information in the annual reviews of our WRMP.

Figure A.8.1 below shows an example of the type of monitoring we will undertake, this being a dashboard on the performance of our current GreenRedeem programme.

Figure A.8.1: Example dashboard for our GreenRedeem programme



KPI dashboard - Jan 2018

Overall - Jan activity	
DMA baseline consumption	40,006,780 Litres
DMA actual consumption	37,501,238 Litres
Variance	-2,505,542 litres (-6.26%)
Households registered	580 (18%)
Learn & Earn Activity overall	
Total points earned	196,180
Pledges taken	1,008
Quizzes taken	372
Content pieces watched	227
Points spent overall	
Total points spent	41,536
Rewards	1,820
Donations	6,066
Prize draw	33,650

Key learnings

- Consumption in the DMA was -2.5m litres lower than the baseline for January.
- Investigation into the variance per month continues, but an issue with the calculation of University consumption has had a positive impact on the pilot findings. (See next slide for update.)
- Registration activity in January has seen the membership base grow to 580 registered households (18%). During January, 93 new households joined the scheme, as a result of further direct marketing activity.
- Overall member engagement has grown to just over 21% in line with expectations, and has more than doubled from November to January where the cumulative engagement was 10.1%.
- Prize draw activity is still a very strong motivating factor for members, although in January, over 3k points were donated by members to good causes & charities.

For consistency with the Business Plan we will report on performance on the PCC reduction each year on our WRMP Annual Review. In doing so, we will report performance consistent with our PR19 Final Determination. This will keep the reporting of targets consistent between different publications. For transparency, the approach at the time of publication, as written in our Draft Determination, is reproduced below.

1.1.4 Per capita consumption

Purpose: This PC is designed to incentivise companies to help customers reduce their consumption.

Benefits: The benefit of reduced per capita consumption (PCC) is to improve long term water resources supply/demand balance.

Performance commitment definition and parameters

Unique Reference	PR19SWB_PC C3
Detailed definition of performance measure	Per capita consumption is defined in the Final reporting guidance for PR19 – Per Capita Consumption, published on the 27th March 2018: https://www.ofwat.gov.uk/publication/reporting-guidance-per-capita-consumption/ It is reported as a three-year average and reported in absolute values expressed in litres/person/day (l/p/d) and as percentage reduction from baseline. The definitive service levels are those expressed in the percentage reduction from baseline.
Additional detail on measurement units	Per capita consumption is defined as the sum of measured household consumption and unmeasured household consumption divided by the total household population. Three-year average values are calculated from annual average values for the reporting year and two preceding years and expressed in litres/person/day (l/p/d).
Specific exclusions:	As defined in the reporting guidance.
Reporting and assurance:	This measure is reported in absolute terms and percentage reduction from 2019-20 baseline.
Measurement unit and decimal places	Percentage reduction from 2019-20 baseline, reported to one decimal place. The volumetric levels resulting from the application of the percentage reduction in litres/person/day (l/p/d) reported to one decimal place.
Measurement timing	Reporting year
Incentive form	RCV adjustment
Incentive type	Outperformance and underperformance payments
Timing of underperformance and outperformance payments	End of period
Price control allocation	100% water network plus

Unique Reference	PR19SWB_PC C3
Frequency of reporting	Annually
Any other relevant information	Performance commitment levels are set as both percentage reduction from 2019-20 forecast baseline and absolute values expressed in litres/person/day (l/p/d). Performance commitment levels expressed as percentage reduction are to be re-applied to 2019-20 actual baseline following final data being available to recalculate the performance commitment levels re-presented in litres/person/day (l/p/d). Incentive payments relate to performance changes expressed in litres/person/day (l/p/d).
Links to relevant external documents	None

Performance commitment levels

		Company forecast	Committed performance level				
	Unit	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Performance commitment level – percentage reduction	%	0.0	1.1	2.3	3.6	5.0	6.2
Performance commitment level – absolute value	Litres/person/day	137.2	135.7	134.1	132.2	130.4	128.7

Source: https://www.ofwat.gov.uk/publication/pr19-draft-determinations-south-west-water-outcomes-performance-commitment-appendix/

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.8.9 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

South West Water Bournemouth Water

work will not only support our future WRMPs, but also the work for our future Drought Plans.

In the case of the Roadford pumped storage feasibility study, following feedback on our Draft WRMP, this will include a natural capital assessment of such a solution.

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.8.9 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 the 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.

Following feedback from our Draft WRMP, we have also included additional work to investigate the opportunity for an Abstraction Incentive Scheme in the Bournemouth WRZ. We have also updated our plan to include specific delivery of the new Regional Water Resource Plans that fit part of the new National Water Resource Framework under development by the Environment Agency.

Table A.8.9: 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

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.

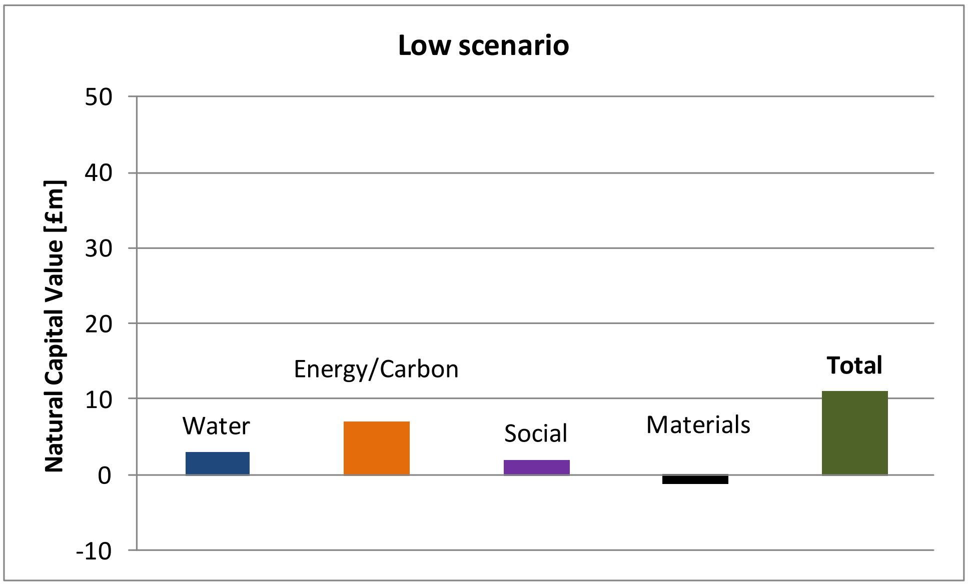
To complement our multi-criteria assessment we also undertook a high level assessment of the impact of our plan on natural capital. We are already playing a lead role in the Defra PIONEER projects and have worked with stakeholders in the development of a natural capital assessment for the North Devon area.

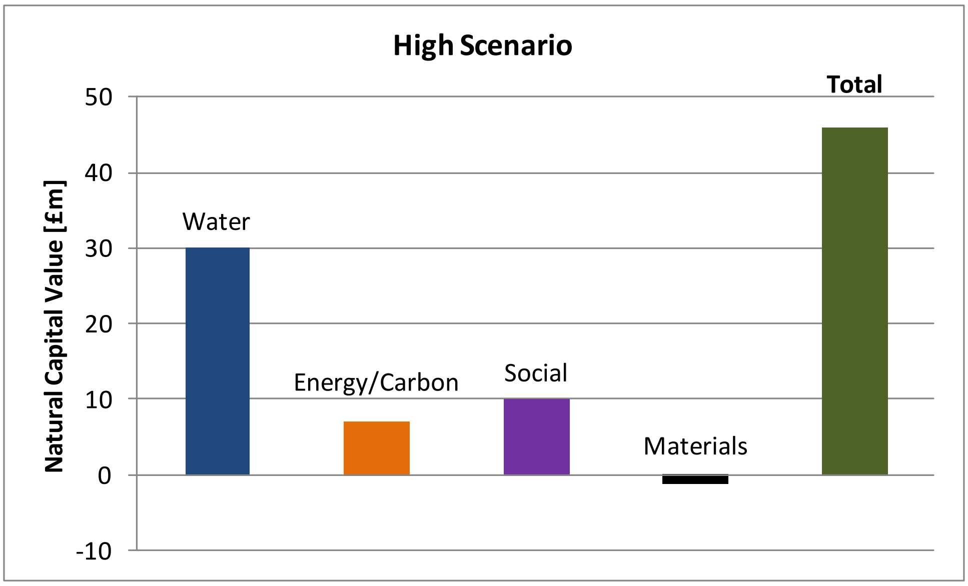
The calculation of Natural Capital is new for our Water Resources Management Plan and an area we plan to develop in the future. The results of the analysis are shown in Figure A.8.2 and show:

- 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 included additional 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. The assessment below is based on the data from the Draft Plan. Whilst our Final Plan includes more leakage reduction in the short term and additional water efficiency, we have not chosen to update the Natural Capital assessment. This is because it does not affect the decision in the Final Plan. However, the higher water savings mean that the natural capital impact is more beneficial than the Draft Plan and would be closer to the Upper Estimate of the calculated benefit.

Figure A.8.2: Summary of natural capital assessment





A.8.6.1 What is natural capital?

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.8.10: 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 the level of leakage, and a series of water efficiency measures aimed at reducing average household consumption across our whole operational area.

In total, these two measures result in the water savings set out in Table A.8.11 below:

Table A.8.11: 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 (16)	13 (19)	17 (21)	20 (24)	24 (27)
Water saved from water efficiency measures	2 (13)	2 (14)	3 (14)	3 (15)	3 (15)
Total water saved	**11 (29)**	**15 (33)**	**19 (35)**	**23 (39)**	**27 (42)**

Note: the savings included in the calculation are from our Draft Plan. The Final Plan figures are given in brackets. Although there are additional savings in the Final Plan, these were not used. This is because the natural capital assessment does not affect the decision in the Final Plan. The additional water savings mean the benefit will be larger and towards the upper estimate calculated at the Draft Plan.

[A.8.2] EU Commission (2016) *'Mapping and Assessment of Ecosystems and their Services'*

Table A.8.12 sets out which natural capital asset categories are likely to be affected.

Table A.8.12: 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.8.13: 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:

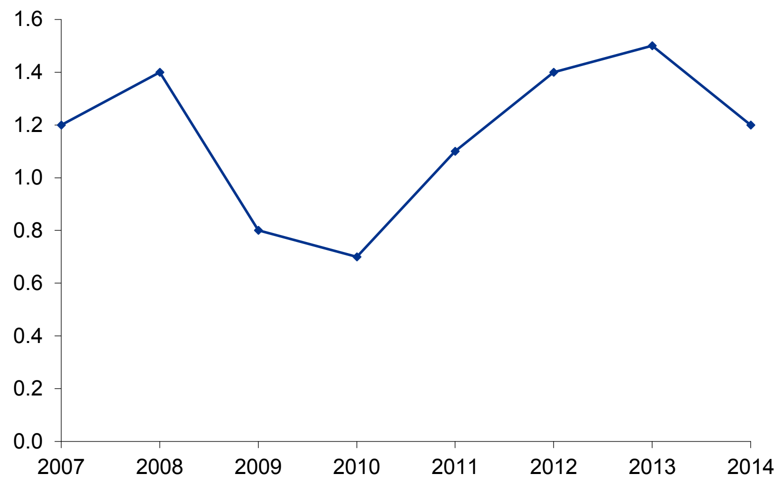
- A simplistic pro-rata of the ONS's national assessment.
- A high-level assessment of the additional economic costs to South West Water should the water not be available.
- Based on the company's draft WRMP, an assessment of the next least cost way of providing an equivalent amount of water into the 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.8.3 below shows the ONS's recent valuations.

Figure A.8.3: 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 A.8.3, 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.

<u>Approach 3 – alternative supply options</u>

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 tCO2e per Ml. Therefore, the draft WRMP results in a reduction of carbon of approximately 40 million tCO2e 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 CO2e (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.8.14 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.8.14: 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. The Final Plan has more water savings included than the Draft Plan and therefore the natural capital benefit will be closer to the upper end of the benefit range (£46m) calculated for the Draft Plan.

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 has been estimated here.

Further impacts on biodiversity and the 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.8.6.6 Natural capital impacts of catchment management

As part of our overall programme to manage supply resilience and improve the environment, our PR19 programme includes a large catchment management programme. This is principally driven to mitigate raw water quality risks however it will have indirect benefits for water quantity.

We have undertaken an additional analysis of the natural capital impacts of this programme of work.

Our proposed programme has a net overall benefit of £40M NPV. This is presented below at a total and at a catchment level.

Table A.8.15: Catchment management – total natural capital assessment

Ecosystem services' flow	Interventions leading to the benefit	Description of cumulative benefits	Net Present Value (2020-2045)	Qualitative assessment of uncertainty
Water quantity Flood risk reduction Low flow management	Various	Some measures are planned across the business cases to reduce the risk of flooding and manage low flows.	↑↑↑↑↑↑↑↑↑↑↑↑	high
Water quality Recreational values	Various	Interventions are planned to improve the water quality across the business cases and increase the ecological condition. Improvements in the quality of river courses can be relevant to increase the recreational value of the area.	£10,635,092 (general)	medium
			£53,124 ↑↑↑↑↑↑↑ (fishing) [a]	
Recreation In other habitats (i.e. woodlands, peatlands, etc.)	Woodland creation	Woodland creation will likely have a small effect on increased number of visits. Information on recreational impacts is hypothetical.	£5,527	medium
	Woodland management	Changes in woodland management can have some positive effects on increased number of visits. Information on recreational impacts is hypothetical.	£7,664 ↑	medium
Carbon sequestration	Woodland creation	Planting new trees is likely to have positive impacts on carbon sequestration.	£466,871	medium
	Woodland management changes	Changes in woodland management will mainly have positive effects on carbon sequestration, even though in specific cases no impact is expected.	↑↑↑↑↑↑↑↑↑↑ →→→→	medium
	Peatland restoration	Restoring degraded peatlands will have a positive effect on carbon sequestration	£4,627,307	High
	Wet (Culm) grassland	Interventions of wet grassland restoration or creation are anticipated to have positive effects on carbon sequestration.	£778,957	medium
	Agricultural land management	Changing land cover types from more intensive to less intensive use will have a positive effect on carbon sequestration.	£158,015	medium
	Soil management	Soil management interventions across catchments are mostly aimed at building soil health and reducing soil compaction (through soil aeration), which will have a positive impact on carbon sequestration.	↑↑↑↑↑↑↑↑↑↑↑↑↑	low-medium
	New farm buildings	Interventions of new farm buildings or smaller projects of roofing, guttering or yard concreting will have negative consequences for carbon sequestration.	-£11,246	medium-high
	Other land use change	Mixed interventions of wetland restoration, pond creation, hedgerows restoration/creation, etc. will have generally positive consequences for carbon sequestration.	↑↑↑↑↑↑↑ →→	medium

Ecosystem services' flow	Interventions leading to the benefit	Description of cumulative benefits	Net Present Value (2020-2045)	Qualitative assessment of uncertainty
Health Physical and mental health benefits of volunteering	Various	Volunteering boosts physical and mental health, especially in the case of frequent volunteers (engaging in volunteering activities once a week or at least once a month).	£2,903,652	low-medium
Biodiversity Direct impacts and indirect impacts	Various	Biodiversity is expected to be improved by creating more habitat for species, supporting pollinators and controlling invasive species.	↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑	high
Cultural heritage	Various	In specific catchments, some interventions are expected to have effects on cultural heritage	↑↑↑↑↑	High
Food production	Agricultural land management	Changing land cover types and/or stocking density, from more intensive to less intensive agriculture and farming, will have a negative effect on food production and farmers' gross margins.	-£289,457	medium
Soil condition	Soil management	Interventions of better soil management will generate private savings for farmers in terms of decreased costs on nutrients and decreased costs associated to soil erosion (including less operational costs and avoided yield loss)	£20,619,114	low

Table A.8.16: Catchment Management – Catchment Natural Capital Assessment

Catchment	Value (£)
Argal & College	402,275
Exmoor Mires	1,155,594
Exe	6,116,193
Drift	1,569,733
Dart	3,934,950
Cober	428,335
Barnstaple Yeo	243,471
Burrator	4,713,286
Fernworthy	26,414
Fowey	4,040,303
Headwaters of Exe	3,170,881
Otter	2,542,856
Roadford	402,261
Stithians	71,128
Tamar	11,675,126
Wistlandpound	24,247
TOTAL	**£40,517,053**

A.8.7 Performance Assessment

Our plan makes reductions in both leakage and per capita consumption. Tables A.8.17 and A.8.18 show the targets in our Final Plan relative to data from other companies.[A.8.10] This shows that our Plan will maintain Upper Quartile performance on both leakage and per capita consumption.

Table A.8.17: Performance Assessment (Leakage)

Company	Leakage (l/prop/d)		Leakage (m^3/km)	
	17/18 (actual)	24/25	17/18 (actual)	24/25
Anglian	83	75	4.8	4.3
Northumbrian	113	94	8.0	6.6
Southern	80	70	6.4	5.6
Severn Trent	123	102	9.4	7.8
South West Water (Draft Determination)	115	94	6.2	5.1
Thames Water	182	150	22.1	18.2
Welsh Water	121	102	6.3	5.3
Wessex	110	94	5.7	4.8
United Utilities	137	125	10.8	9.9
Yorkshire	130	77	9.5	5.6
Affinity Water	115	96	10.4	8.7
South Staffs inc. Cambridge	122	97	11.9	9.5
Bristol Water	87	68	6.8	5.3
Portsmouth Water	103	82	9.9	7.9
Sutton and East Surrey	83	72	6.9	6.0
South East Water	87	78	6.0	5.4
Upper Quartile	**88**	**77**	**6.3**	**5.3**
Average	**112**	**92**	**8.8**	**7.3**
Final Plan				
SWW	115	94	6.2	5.1
Overall Performance	**Av**	**Av**	**UQ**	**UQ**

Note: 24/25 figure based on 17/18 total less reduction included in Table APP1 of the Water Company PR19 Business Plans. These figures may differ from those in the WRMP tables, since the Ofwat reporting format is different. Figures for other companies may also change due to their respective Draft Determinations, which were not available at the time of writing.

[A.8.10] Based on data from APP1 from the PR19 Business Plan

Table A.8.18: Performance Commitment Assessment (PCC)

Company	PCC 24/25 (3 yr rolling average) (l/p/d)	PCC (24/25) – dry year [l/p/d]	PCC (24/25) – normal year (l/p/d)
ANH	131		
DWR	139		
NES	136		
SVT	128		
SWT (Draft Determination)	129	133	127
SRN	120		
TMS	136		
UU	139		
WSX	128		
YKY	119		
AFF	133		
BRI	135		
POR	135		
SES	136		
SEW	140		
SSC	128		
Upper Quartile	**129**		
Final Plan (SWW+BW)	**129**		
Overall Performance	**UQ**		

Note: Data from Table APP1 of the Water Company PR19 Business Plans. These figures may differ from those in the WRMP tables, since the Ofwat reporting format is different.

A.8.8 WINEP programme

The following table lists the final WINEP3 water resource activities for AMP7. This includes investigations into existing sources e.g. Coleford.

Table A.8.19: WINEP3 water resource / WFD activities

Scheme, Business case and status WISER category [S, S+]	COST (scoped)	Scheme Name/Name of Investigation/Site Name/License name	Driver Code (Primary)	Driver Code (Secondary)	Driver Code (Tertiary)	Measure Type	Completion Date (DD/MM/YY)
		Water resources business case					
S		BURRATOR - INVESTIGATION INTO FLOW REGIME REQUIREMENTS	NERC_INV1	WFD_INV_W RHMWB		Investigation and Options Appraisal	31/03/22
S		WILSWORTHY BROOK INVESTIGATION/OPTIONS APPRAISAL	NERC_INV1			Investigation and Options Appraisal	31/03/22
S		BURRATOR - ADAPTIVE MANAGEMENT TRIALS	NERC_INV1	WFD_INV_W RHMWB		Adaptive Management	31/03/22
S		KTT - ADAPTIVE MANAGEMENT TRIALS	NERC_INV1			Adaptive Management	31/03/22
S		rCSMG INVESTIGATION/OPTIONS APPRAISAL - CAMEL CATCHMENT	HD_INV			Investigation and Options Appraisal	31/03/22
S		OTTER CATCHMENT OPTIONS APPRAISAL	WFDGW_INV _GWR			Options Appraisal	31/03/22
S		COLLEGE & ARGAL - IDENTIFY MITIGATION MEASURES	WFD_INV_W RHMWB			Investigation and Options Appraisal	31/03/22
S		STITHIANS/KENNAL - Identify Mitigation Measures	WFD_INV_W RHMWB			Investigation and Options Appraisal	31/03/22
S		WISTLANDPOUND - IDENTIFY MITIGATION MEASURES	WFD_INV_W RHMWB			Investigation and Options Appraisal	31/03/22
S		VENFORD - IDENTIFY MITIGATION MEASURES	WFD_INV_W RHMWB			Investigation and Options Appraisal	31/03/22
S		DEVONPORT LEAT - ECOLOGICAL SURVEY / ID MITIGATION MEASURES	WFD_INV_W RHMWB			Investigation and Options Appraisal	31/03/22
S		FERNWORTHY - FISHBANK RELEASE	WFD_IMP_W RHMWB			Fish Passage	22/12/24
S		Boswyn Shaft	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Boswyn Stream	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Carwynen	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Cargenwyn	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Rialton/Porth	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Slade	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Gammaton	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Uton	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Coleford	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Knowle	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Stoke Canon	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Brampford Speke	WFD_NDINV_ WRFlow			Investigation	31/03/22
S		Wimborne (Walford Bridge)	WFD_NDINV_ WRFlow			Investigation and Options Appraisal	31/03/22

A.8.9 West Country Water Resources Group

In 2017 we were a founding member of the West Country Water Resources Group that seeks to undertake regional water resource planning to identify optimum solutions for the region and, in particular, explore new trading opportunities. Potential new or revised transfers include transfers to:

- Southern Water: to partially address their deficits due to sustainability reductions.
- Bristol Water: for improved resilience.

We've already embraced an opportunity to enhance our resilience through a cross-border transfer arrangement in our Bournemouth WRZ. The arrangement provides resilience benefits to Wessex Water and ourselves by maximising the use of existing assets.

Our work in the next period, as part of the West Country Water Resources Group, will see us continue the regional analysis of water resources planning and exploration of cross-sector solutions, including new trading opportunities, and region wide optimisation, to develop a regional plan, that will inform the development of our WRMP for 2024. This work will also include widening the group membership to non-water company sectors and helping the publication of information to promote future water markets.

In light of the representations on our Draft Plan and the broader developments of national and regional plans, we consider the group plays an important role in delivering:

- A better understanding of the broader future demand for water outside of public water supply
- Understanding the role of regulation in helping to balance the competing needs of the demand for water and the environment
- Revealing information on the availability of water to promote market opportunities
- Development of regional resilience and conjunctive use optimisation across the respective companies
- Further development of regional transfers (including to Southern Water)
- Shared understanding and development of water efficiency
- Better understanding of future droughts and drought frequency.

APPENDIX 9

Assurance and water company checklist

A.9.1 Introduction

Three stages of assurance were undertaken in the development of this Final 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 for our Draft Plan 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 water company checklist and senior manager review was updated for the Final Plan. The Third Party assurance was used in the Draft Plan used to help understand areas that we could or should develop on as a business for future WRMPs. As the feedback on the Draft Plan was largely focussed on the ambition for more leakage reduction and water efficiency, the third party assurance was not repeated for the Final Plan as there was no material change in either our process or the strategy for the Plan.

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 A.9.1 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.

We included in our Final Plan all the key recommendations and comments on our Draft Plan consultation. Full details of which are included in the Statement of Response.

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)
		Jun 18	Draft WRMP consultation feedback and proposed recommendations
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
		May-Jun-July 18	Draft WRMP consultation feedback and proposed recommendations for Final 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
		Jul 18	Run through of consultation responses and SWW changes for the Final 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
	EA, Ofwat	Mar 18	Draft WRMP consultation feedback
Risk Committee	SWW Directors	April 17	Deep dive into Water Resources and Resilience
		Jan 18	Deep dive into Water Resources risk
Board		Monthly	Draft WRMP progress update
		Nov 17	Draft WRMP Final sign off
		July 18	Statement of Response/Final WRMP changes Sign Off
		July/Aug 18	PR19 Business Plan sign off – includes WRMP supply and demand forecasts and performance commitments
PR19 Steering Group	Chief Exec, SWW Managing Director and Executive team	Monthly (Jan 17 to Nov 17)	Draft WRMP update – progress, risks, issues.

Governance	Attendance	Date	Purpose
		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
		June 18	Draft WRMP consultation feedback and recommended actions for Final Plan
SWW Executive Management Team	SWW Directors	Monthly	Progress review
		Sept 17	Results of scenario analysis and key decision areas
		June 18	Draft WRMP consultation feedback and recommended actions for Final Plan
Sponsoring Director	SWW Director	Weekly	WRMP update – progress, risks, issues.

A.9.2 Water company checklist Final Plan

A.9.1.1 Contents

We EA used the water company checklist to review the content of our Final 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.	Final 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. Final Plan includes additional information on droughts that effect our system which is also included in our Final Drought Plan.
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	A7.13	Y	PR19 Business Plan includes expenditure for flooding risk. Additional details on the wider resilience are included in the final 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. For the Final Plan this included new best and worst cases.

2.2 Early engagement with regulators, customers and interested parties

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment

No.	Action or approach	WRPG ref.	Final 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
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.	Final 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	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 Business Plan, not our Water Resources Management Plan.

	approach accordingly.				
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.	Final 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.	Final 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.

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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.	Final 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	Final Plan published in Jan 18.
20	You have redacted sensitive information prior to publication.	S2.6, Page 6		N/A	No redactions needed.
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.	Final 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 held a consultation for 12 weeks. Given the low complexity of our Plan and the lack of new water resource schemes, we think this was appropriate.

2.8 Publish a statement of response

No.	Action or approach	WRPG ref.	Final 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	Statement of Response Published on time on 4th Sept
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	Exec summary, page 5, S7, S8	Y	All responses considered. See published Statement of Response.
26	You have set out any changes due to other factors during the consultation period (for example, external influences).	S2.8, Page 7	S2,S3,S4, S5,S6	N/A	We updated all our supply and demand forecasts for the Final Plan
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	Throughout docs but mainly S7 and S8	Y	See Statement of Response. Details of all changes included.
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	Yes. All parties received written confirmation of the Statement of Response publication on 4th Sept 18.
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	Yes. Our Business Plan used our Final Demand and Supply forecasts. This included the Drought Resilience metric.

2.9 Send your draft final plan

No.	Action or approach	WRPG ref.	Final 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	Statement of Response submitted on 4th Sept. Key changes to Draft Plan text were included. We did not submit a Final Draft Plan as the key text changes were included with the Statement of Response. In addition the feedback on the Draft Plan was on more leakage reduction and water efficiency and therefore was consistent with our overall water resource strategy.
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	S2.9, Page 7	S7, A7	Y	We undertook additional sensitivity analyses on leakage reduction, pcc reduction and on the risks in the Otter Valley.

	have fully checked all changes.				
32	You have completed and submitted the WRMP tables alongside the final WRMP.	S2.9, Page 7	Tables	Y	Yes. This includes updated Table 10.

2.10 Publish your final plan

No.	Action or approach	WRPG ref.	Final 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	No directions received.
34	You have notified any party that responded to the consultation as you publish the final plan.	S2.10, Page 7		N/A	Yes.

2.11 Revise and review your final plan

No.	Action or approach	WRPG ref.	Final 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	This is part of our existing annual reporting requirements.
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	We will do this as needed.

Section 3 – Technical methods

3.1 Developing your plan

No.	Action or approach	WRPG ref.	Final 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.

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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
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. For the Final Plan we included additional uncertainties to look at policy that came out after the Draft Plan e.g. National Infrastructure 'Preparing for a Drier Future'
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, S7	Y	The Final Plan shows some small deficits occurring in the medium to long-term – particularly in Roadford. Feedback on the Draft Plan for a 15% leakage reduction, offsets the supply risk. No other options were therefore considered. However, for this and other WRZs, our Final Plan includes a range of studies into possible future options outside of leakage and water efficiency.
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	S3.1, Page 10	S8, A8	Y	Our Plan will reduce the demand for water than would otherwise occur. Overall the plan is water neutral (i.e. demand is lower by 2045 than in 17/18)

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
	Environmental Assessment (SEA).				
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. The Final Plan has a higher natural capital benefit than the draft.
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	For the Final Plan we included new sensitivities on sustainability reductions.
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	Yes. The Final Plan however, shows that without intervention we face a higher risk of a supply-demand deficit from future more extreme droughts. This confirms that our Draft Strategy to reduce demand but also examine other options remains valid to hedge the possible future risk.
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	The Final Plan builds in the consultation feedback on the Draft Plan.
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	S3.1, Page 10	S8, A8	Y	Our decision making process included an assessment of the flexibility of our Plan

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
	development of the 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.	Final 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	
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.	Final 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	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. The Final Plan shows that with the future potential risks this confirms a key area of our water resource strategy to develop.

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
	planning problem (including scale and complexity) as well as related issues, risks and uncertainties.				Our Plan suggests that future problem characterisation will 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.	Final 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	For the Final Plan we have included additional information on the types of droughts that effect the resilience of our supply system

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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.	Final 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	
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	The Final Plan includes additional information on the make-up of activity on the leakage reduction we propose to deliver by 2025.

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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	We have updated all our baseline forecasts for the Final Plan. These are based on the new leakage consistency reporting approach.
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.
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	Following feedback on our Draft Plan we have focussed on leakage reduction and water efficiency measures for our near-term plan.
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	S.5, Page 12	S8, A8	Y	Yes. WRMP tables show the reductions in demand we propose to offset any supply demand balance risk.

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
	statutory duties.				
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.	Final 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 measures.	S3.6, Page 13	S8.5	Y	We have given estimates of the impact on service levels. For the Final Plan we have given an annual minimum profile.
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	

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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	The costs of meeting our level of service is given in the baseline scenario for each water resource zone.

Section 4 – Developing your supply forecast

4.1 How to develop your supply forecast

No.	Action or approach	WRPG ref.	Final 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
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	

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No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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	S4.2, Page 15	S2 & S5	Y	

No.	Action or approach	WRPG ref.	Draft WRMP ref.	Prop inc. (Y, N or n/a)	Comment
	losses related to abstraction or treatments.				
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.	Final 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	
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	S7, A7	Y	We have included additional detail on the Otter Valley licences in our Final Plan
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 WINEP 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	S4.3, Page 16	S2.2	Y	

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
	documented your choice of method and supporting techniques.				
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.	Final 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 scenario assessment
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 scenario 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	

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No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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	To date all investigations and deliverable are complete in progress.
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.	Final 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 plan we are examined the risk on INNS in our existing supply system and the measures we should undertake to mitigate any risk. The INNS mitigation programme is included in our PR19 Plan.
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.	Final 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. We used updated sensitivities in our Final Plan to show the potential impacts.
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	

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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.	Final 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	Following feedback on the Draft Plan we have included additional activity to develop an AIM scheme in the Bournemouth Water Zone.
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	
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.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Climate Change

No.	Action or approach	WRPG ref.	Final 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.	Final 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	For our Final Plan we have included a treated Water Transfer to Bournemouth at 20Mld from 2027. This scheme is being developed as part of the West Country Water Resources group ready for WRMP24.
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	S4.9, Page 18	Tables	Y	

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
	reduce quantities).				
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.	Final 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 –our Final Plan includes the upgrading of the WTWs in Bournemouth to allow the release of water for a transfer to Southern Water.
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. The new WTW at Bournemouth reduce process water losses and these savings have been included in our forecasts.
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. For our Final Plan we included additional information on our catchment management programme.

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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.	Final 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 have already started our annual new outage calculation, completing the first assessment in 17/18. This used the 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, particularly in cases of a supply-demand balance deficit.	S4.11, Page 20	S2.6, p2.22 A2.2.2, pA.2.65	Y	

4.12 Water available for use

No.	Action or approach	WRPG ref.	Final 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.	Final 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 Note – the Final WRMP demand forecast use the new leakage consistency reporting methodology. Leakage numbers are therefore not directly comparable to the Draft Plan.
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	
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.	Final 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.	Final 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	
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	

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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.
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.	Final 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	

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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.	Final 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	

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
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.	Final 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	S3	Y	Our demand forecasts for the final plan are based on the new leakage consistency 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		N/A	
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		N/A	
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	For the Final Plan we have included the impact of 15% leakage reduction by 2025 as well as 50% by 2050. Our data does not allow an accurate assessment of the cost or deliverability of a 50% leakage reduction in the long-term. This reinforces our proposed strategy and the development of our economic model to allow such policy decisions to be quantified

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No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Comment
					for future plans.
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	S8	Y	In our Final Plan we set out the activities we will undertake and their expected benefit to meet the 15% leakage reduction target.
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. Our Final Plan strategy however states we will plan on this level or the government policy level.
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, S8	Y	

5.7 Other components of demand

No.	Action or approach	WRPG ref.	Final 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.	Final 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	

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
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 Business Plan.

5.9 Impacts of climate change

No.	Action or approach	WRPG ref.	Final 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.	Final 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.

No.	Action or approach	WRPG ref.	Final WRMP ref.	Prop inc. (Y, N or n/a)	Any issue identified
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.	Final 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	

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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.	Final 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.	Final 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.

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.	Final 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.	Final 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, S8	Y	For the Final Plan we undertook additional work on leakage optimisation. Details of the proposed delivery plan are given in Section 8.
	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.	Final 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.	Final 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.	Final 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 given
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	S7, S8	Y	The transfer to Southern Water is contingent on the successful delivery of a new WTW in Bournemouth
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.	Final 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 environmental and social costs in the Tables. Non-monetised impacts of our Plan are 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.	Final 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.	Final 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.	Final 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	S7	Y	None proposed, but see Appendix 7 for sensitivity analysis on the River Otter.
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.	Final 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.	Final 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.	Final 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	S7, A7	Y	See sensitivity test on the River Otter and environmental needs scenarios
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.

For the Final Plan the analysis confirmed the sensitivity to higher than expected demands. To address this activities in the Plan on water efficiency and testing the resilience of drought sources were brought forward into the 2018 and 2019 work programme. This included the testing of the Roadford Pumped storage scheme as part of the longer term assessment of its feasibility as a future option.

A.9.4 CH2M

Third Party assurance was undertaken on our Draft Plan. This used the same EA checklist as outlined above.

No materials exceptions were found, but some observations were made. These are given below. The consultation feedback on the Draft Plan did not materially change the strategy and therefore the assurance undertaken and the findings remain valid for the Final Plan. In addition assurance was undertaken as part of the PR19 Business Plan submission on the demand and supply forecasts. A separate assurance for the Final WRMP was therefore not undertaken as this would duplicate the assurance.

Overall, the assurance on our Draft Plan (and relevant parts of the PR19 Business Plan) 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 the Draft 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.

<u>Supply</u>

- 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.

<u>Demand</u>

- 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*

Term	Description
Granular Activated Carbon (GAC)	An adsorbent filtration media used to remove trace organic 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.

Term	Description
Micro-component analysis	The process of deriving estimates of present or future consumption based on expected changes in the individual 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.

Term	Description
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
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.

Term	Description
Sourceworks	All assets used between and including the point of abstraction and the point at which water is first fit for purpose. These include: • 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.

Term	Description
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 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*.

Term	Description
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.
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 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*

APPENDIX 12

Isles of Scilly

Executive Summary

Defra and the Council for the Isles of Scilly, along with Tresco Estate and the Duchy of Cornwall are working to put water and wastewater services on the Isles of Scilly onto a sustainable footing. This will help ensure they can meet the challenge of protecting public health, supporting the local tourist economy, and safeguarding the environment now and in the future. This involves putting appropriate legislation in place but also ensuring the correct technical skills and level of investment are provided on a sustainable basis. A water company operating on a similar basis to the rest of the mainland of the UK is their preferred option to deliver this.

South West Water was the only company that expressed an interest in taking on the responsibility of delivering water and wastewater services on the Isles of Scilly as requested by Government. Since that time South West Water have been undertaking a due diligence exercise in partnership with the working group members before preparing this business plan for submission to Defra and the working group.

This business plan submission represents South West Water's view of the operational and investment needs which will be required to support the necessary improvements in water and wastewater services on the islands. Defra are seeking a provider to develop a solution that will enable service provision on the islands to meet all of the required service standards including 100% regulatory compliance by 2025 or 2030 in the context of Tresco. Investment in the islands will need to be made in the context of concerns around any potential increase in bills for both South West Water customers and the customers of the Isles of Scilly.

As part of the due diligence assessments for the operation of services on the islands, the following activities have been undertaken:

- Review of over 500 documents, maps, operational procedures, photos and asset performance data from the Council of the Isles of Scilly, Tresco Estate, the Duchy of Cornwall as well as documents from Defra, Environment Agency (EA) and the Drinking Water Inspectorate (DWI).
- Independent online survey of over 300 South West Water customers to determine the customer acceptability and "willingness to pay" support for investment in the Isles of Scilly. The survey has been reviewed by key stakeholders including the Council of the Isles of Scilly, Defra and Ofwat.
- A technical site visit was undertaken in October 2016, consisting of South West Water staff from our asset management, wastewater, drinking water and from engineering teams. The technical site visit included visits to many of the assets on the islands and was used to verify the information placed within a data room and to clarify high risk areas. Visits to a number of the drinking water sites included DWI staff who had been directly involved in advising the current delivery of services on the islands.
- A further visit of South West Water Directors was undertaken in December 2016, which included meetings with the Council of the Isles of Scilly, Duchy of Cornwall and Tresco Estate.
- Regulatory meetings have been held with the DWI and EA to agree improvement needs and how regulatory compliance will be assessed on the islands.
- Discussions with Ofwat are ongoing to explore how the necessary investments can be funded and treated within the Water Industry price control period and future price reviews.
- A technical audit review has been undertaken by SMC consultants to review and assure the investment costs contained within this plan in order to satisfy Ofwat's rigorous cost base assessment processes.
- South West Water have engaged consultants and contractors to visit the islands to carry out technical investigations and surveys, which are being used to inform the investment and operational strategies for the Isles of Scilly.
- The Draft business plan document was submitted to the working party in July 2017.
- Ministerial support to proceed with incorporating the Isles of Scilly into our operational area was received in February 2018.

4

The customer survey demonstrated that our customers, regard the Isles of Scilly as part of south west region. This business plan submission also reaffirms the outcomes we have developed for our customers during the PR19 price review.

We have developed our investment plan to deliver these outcomes by 2025 for four Islands and 2030 for Tresco, such that it will enjoy the same levels of service, drinking water compliance and environmental performance that customers on the mainland receive. Our investment plans have identified a need for £53m to be invested up to 2030, with £0.5m identified up to 2020, and a further £36m identified in 2020-2025.

We have engaged with both the DWI and the EA in confirming the regulatory mechanisms which would support the delivery of this investment programme.

We have also engaged with Ofwat with regard to developing the regulatory incentives and funding mechanisms which would support the transfer of assets and services to South West Water. Whilst these conversations are ongoing, we recognise that the identification of appropriate funding mechanisms is sufficiently advanced to enable this submission to progress to the next stage.

Following this due diligence review, the South West Water and Pennon Boards have carefully reviewed the proposals for the operation and investments required for the Isles of Scilly and have considered whether South West Water should consent to undertake the provision of water and wastewater services on the islands.

The Board has agreed (subject to final/review agreement and further conversations with Ofwat) that South West Water would be prepared to deliver the water and wastewater services on the islands and has supported the development of this business plan to deliver the services on all five islands commencing 1st October 2019.

We recognise that there are a number of challenges in meeting this timetable, in particular both the legislative changes and licence amendments required by this date. To reduce the costing uncertainty in our plan we have engaged consultants, who have visited the islands on our behalf, conducted surveys and investigations and engaged with consultants and contractors who have previously delivered solutions on the islands. This has all raised confidence in our planned investment and in the costing approach taken. We will continue to plan and resource to deliver against the 1st October 2019 date, but recognise this may well change as a result of uncertainties within the programme around Defra priorities linked to Brexit. We are seeking advice from Defra on the appropriate timetable to consider in our forward planning, reflecting these programme risks.

A key element of this programme will be ongoing engagement with Isles of Scilly customers with regard to the changes that could occur. We recognise that it would be inappropriate for South West Water to contact Isles of Scilly customers on this issue until the key decisions, legislative changes, final agreement and licence amendments have been undertaken. We would also recommend that the Council of the Isles of Scilly, The Duchy of Cornwall and Tresco Estate alongside Defra, the DWI and the EA lead on these communications throughout 2018-19. South West Water will support this communication programme, but do not believe that we should lead this until the appropriate appointments are complete in order to avoid any conflict of interest concerns.

APPENDIX 13

Defra directions

A.13.1 Introduction

This Appendix sets out information in relation to the Defra Directions. Where relevant the corresponding text in other sections of this Plan are given.

A.13.2 Response to Defra directions

2.—(1) A water undertaker must prepare a water resources management plan for a period of at least 25 years commencing on 1st April 2020.

The Plan is for a 25 year planning period ending in 2044/45.

3. In accordance with section 37A(3)(d), a water undertaker must include in its water resources management plan a description of the following matters—

(a) the appraisal methodologies which it used in choosing the measures which it has identified in accordance with section 37A(3)(b) and its reasons for choosing those measures;

The appraisal methodology is given in Section 7 and 8 and Appendix 7 and 8. These sections also set out the reasons for choosing these measures.

(b) for the first 25 years of the planning period, its estimate of the average annual risk, expressed as a percentage, that it may need to impose prohibitions or restrictions on its customers in relation to the use of water under each of the following—

(i) section 76;

(ii) section 74(2)(b) of the Water Resources Act 1991(b); and

(iii) section 75 of the Water Resources Act 1991,

and how it expects the annual risk that it may need to impose prohibitions or restrictions on its customers under each of those provisions to change over the course of the planning period as a result of the measures which it has identified in accordance with section 37A(3)(b);

Table A.13.1 sets out the annual risk of the imposition of restrictions over the planning period. The assumptions are given below.

Table A.13.1: Annual risk of imposition of restrictions over the planning period

Drought action	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Publicity, appeals for restraint and water conservation measures	0	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Temporary Use Bans (TUBs)[1.1]	0	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Supply-side Drought Orders or Drought Permits[1.2]	0	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Demand-side Drought Orders[1.3]	0	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Emergency Drought Orders – partial supply, rota cuts or standpipes[1.4]	0	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%

Drought action	28/29	29/30	30/31	31/32	32/33	33/34	34/35	35/36	36/37	37/38	38/39
Publicity, appeals for restraint and water conservation measures	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Temporary Use Bans (TUBs)	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Supply-side Drought Orders or Drought Permits	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Demand-side Drought Orders	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Emergency Drought Orders – partial supply, rota cuts or standpipes	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%

[1.1] Formerly termed hosepipe bans. Return period calculated based on historic droughts.
[1.2] 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.
[1.3] 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.
[1.4] 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.

Drought action	39/40	40/41	41/42	42/43	43/44	44/45
Publicity, appeals for restraint and water conservation measures	10%	10%	10%	10%	10%	10%
Temporary Use Bans (TUBs)	5%	5%	5%	5%	5%	5%
Supply-side Drought Orders or Drought Permits	5%	5%	5%	5%	5%	5%
Demand-side Drought Orders	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Emergency Drought Orders – partial supply, rota cuts or standpipes	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%

(c) the assumptions it has made to determine the estimates of risks under sub-paragraph (b), including but not limited to drought severity;

We have interpreted risk as the minimum service level customers can expect from our Plan. As our WRZs are forecast to be in surplus, minimum risk is given as our planned service level to customers. We do not expect any change over the planning period. The risk is expressed as the equivalent annual probability of that demand restriction occurring.

The underlying assumptions in this risk are included in the derivations of all the elements in the Plan: see sections on demand, supply, outage, headroom and the Final Plan and summarised below Table A.13.2. Within this our design drought that underpins the service levels is 1975/76.

Note: As we forecast a supply demand surplus, actual service levels may be higher in a year than our planned level. Our actual services levels in 2016/17 are presented below for information. We have not forecast this in our Plan for two reasons:

- The risk of restrictions can be caused by either a supply risk or a demand risk so it is unclear in setting out the risk of restrictions, which risk to refer to
- We do not have a probability distribution for supply and demand each year of our forecast

Table A.13.2: Actual levels of service 2016/17

	Level of service used within strategic water resources planning	Current Levels Of Service			
		Colliford WRZ	Roadford WRZ	Wimbleball WRZ	Bournemouth WRZ
Publicity, appeals for restraint and water conservation measures	1 in 10 years	> 1 in 10 years	> 1 in 10 years	> 1 in 10 years	> 1 in 10 years
Temporary Use Bans (TUBs)[5]	1 in 20 years	> 1 in 40 - 135 years*	>1 in 175 - 220 years	>1 in 110 – 125 years	> 1 in 130 -150 years
Supply-side Drought Orders or Drought Permits[6]	1 in 20 years	> 1 in 40 - 135 years* (a)	>1 in 175 - 220 years (a)	>1 in 110 – 125 years (a)	> 1 in 130 -150 years (a)
Demand-side Drought Orders[7]	1 in 40 years	> 1 in 40 - 135 years* (a)	> 1 in 175 - 220 years (a)	> 1 in 110 – 125 years (a)	> 1 in 130 -150 years (a)
Emergency Drought Orders – partial supply, rota cuts or standpipes[8]	>> 1 in 200 years (a)	>> 1 in 200 years (a)	>> 1 in 200 years (a)	>> 1 in 200 years (a)	>> 1 in 200 years (a)

**Analysis and modelling of our more severe plausible droughts has shown that this is likely to be in the region of 1 in 200 or more severe*

(a) Should the area experience a drought requiring these actions, the drought would be more extreme than the most severe historical drought on record (1975/76)

The following method was used to calculate the probability of restrictions occurring.

1. For each year the supply-demand balance was calculated. This was calculated as WAFU + Target Headroom – Forecast Distribution Input. This was repeated for each Resource Zone.

2. The WAFU figure used is based on the Deployable Output for the Zone. This DO is based on meeting at least the company levels of service:

   - Media campaigns 1 in 10 years (10% p.a. equivalent)
   - Temporary Use Bans 1 in 20 years (5% p.a.)
   - Supply side drought order or permits 1 in 20 years (5% p.a.)
   - Demand Side drought orders 1 in 40 years (2.5% p.a.)
   - Emergency Drought orders >1 in 200 years (0.5% p.a.)

[5] Formerly termed hosepipe bans. Return period calculated based on our historic design drought (1975/76), being at least 1 in 40 years in our SWW supply area WRZs and at least 1 in 100 years in BW supply area.
[6] 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.
[7] Formerly termed bans on non-essential use. All resource zones do not currently enter Zone D 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] 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.

3. Where there is a supply-demand surplus, the probability of restrictions in any one year is taken as the being the probability at least equal to that from the service levels. This is because the DO figure that is used in the calculation is based on restrictions occurring at an equivalent average rate of the modelled period. As the zones are in surplus, therefore one can expect the probability of restrictions to be at least equal to this in terms of frequency of occurrence. E.g. when in supply-demand surplus one can expect the probability of Temporary Use Bans to be at least 1 in 20 years, on average as supply exceeds demand.

4. All Zones are forecast to be in surplus for the planning period and so this method was used for all Zones.

As all Zones are forecast to be in surplus, this method will underestimate the level of resilience i.e. the surplus means that the Zones should be able to deliver better service levels than quoted and in turn have a lower annual likelihood of restrictions in any one year. In our method we did not seek to factor in this additional benefit, as it is not clear in the Directions whether the risk of restrictions is to be measured against supply return periods, demand return periods or combined effects or whether this should include or exclude the uncertainty allowance already included in Target Headroom. In our method we have therefore instead kept the calculation consistent with the long-term levels of service built into our supply forecasts as the minimum we can achieve.

In terms of relative drought severity, this impact is included in calculating the service levels, through the analysis that is built on our Deployable Output. This is calculated against historic droughts, the most severe of these in the available record is 1975/76 or 1995/96 with a return period as follows: (see SWW Drought Plan 2018, Section 4.2):

Colliford	1 in 40 to 135 (1 in 65 to 200 for 1995)
Roadford	1 in 175 to 220
Wimbleball	1 in 110 to 125
Bournemouth	1 in 130 to 150

The modelling of Deployable Output shows that the demand forecast in the WRMP can be sustained in these droughts without the need for emergency drought orders or drought permits and can meet the company levels of service against these droughts. It is important to note that the likelihood of demand restrictions is not equal to the return period of the drought in SWW Zones as the largest reservoirs provide multi-season support for extreme droughts. This is why the supply capability (via Deployable Output) is calculated from simulation over the available data record to obtain a long-term view of the level of demand the system can sustain in line with the company levels of service.

(d) the emissions of greenhouse gases which are likely to arise as a result of each measure which it has identified in accordance with section 37A(3)(b), unless that information has been reported and published elsewhere and the water resources management plan states where that information is available;

We have no water resource schemes in our Plan. The greenhouse gas emissions from the combined effect of our water efficiency and leakage activities in our Plan are given in Table A.13.3. The emissions are given by:

Volumes of water saved per initiative [Ml/d] x GHG [kt CO_2e/ Ml/d]

A value of 0.097 kt CO_2e GHG emissions per Ml/d water supplied was used for 17/18 based on actual performance in that year. (57 kt CO_2e for 587Ml/d Ml/d across the SWW and BW supply areas). In line with our GHG reduction programme the rate was then reduced by 15% by 2025 and to 90% of 2009 levels by 2050. This is why the GHG savings decrease over time. Savings are based on normal year demand forecasts.

Table A.13.3: Greenhouse gas emissions from the combined effect of our water efficiency and leakage activities

		17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
GHG rate	[ktCO2e/Ml/d]	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.083	0.070	0.067	0.065	0.062
Leakage programme	[ktCO2e]	0.0	0.63	0.69	0.83	1.07	1.30	1.51	1.71	1.49	1.47	1.44	1.41
Metering programme	[ktCO2e]	0.0	0.00	0.00	0.52	0.68	0.83	0.96	1.06	0.95	0.92	0.89	0.86
Demand management programme	[ktCO2e]	0.0	0.04	0.07	0.10	0.13	0.16	0.18	0.20	0.19	0.19	0.19	0.19
Total GHG Saving	[ktCO2e]	**0**	**0.67**	**0.76**	**1.45**	**1.88**	**2.28**	**2.65**	**2.97**	**2.62**	**2.57**	**2.52**	**2.46**

		29/30	30/31	31/32	32/33	33/34	34/35	35/36	36/37	37/38	38/39	39/40
GHG rate	[ktCO2e/Ml/d]	0.059	0.057	0.054	0.051	0.049	0.046	0.043	0.041	0.038	0.035	0.033
Leakage programme	[ktCO2e]	1.38	1.35	1.31	1.27	1.23	1.18	1.14	1.09	1.04	0.98	0.92
Metering programme	[ktCO2e]	0.83	0.80	0.76	0.73	0.70	0.66	0.63	0.59	0.56	0.52	0.48
Demand management programme	[ktCO2e]	0.19	0.19	0.18	0.18	0.17	0.16	0.16	0.15	0.14	0.13	0.12
Total GHG Saving	[ktCO2e]	**2.40**	**2.33**	**2.26**	**2.18**	**2.10**	**2.01**	**1.92**	**1.83**	**1.74**	**1.64**	**1.53**

		40/41	41/42	42/43	43/44	44/45
GHG rate	[ktCO2e/Ml/d]	0.030	0.027	0.025	0.022	0.019
Leakage programme	[ktCO2e]	0.86	0.80	0.73	0.67	0.60
Metering programme	[ktCO2e]	0.45	0.41	0.37	0.33	0.29
Demand management programme	[ktCO2e]	0.11	0.11	0.10	0.09	0.08
Total GHG Saving	[ktCO2e]	**1.42**	**1.31**	**1.20**	**1.08**	**0.96**

(e) the assumptions it has made as part of the supply and demand forecasts contained in the water resources management plan in respect of —
the implications of climate change, including in relation to the impact on supply and demand of each measure which it has identified in accordance with section 37A(3)(b);

Demand

The impact of climate change on our demand forecasts is in Section 3 of our Plan and Appendix A.3.1.

An allowance for the climate change impact on demand is included in our Target Headroom – see Section 4.

No additional allowance is included in the Plan for the impact of climate change for leakage or water efficiency. This is because the Plan is based on hitting a specific target and is not measured on the delivery of schemes.

With regard to metering no specific change is included however the underlying impact of climate change on demand is already included in the demand forecast.

Supply schemes

The impact of climate change on our deployable output is set out in Appendix A.2.1.

The impact of climate change on supply-side schemes is included in the scheme assessments – see Appendix A.6.6.3.2

No supply schemes are included in our Plan and therefore no climate change impact is included.

With regard to the Bournemouth WRZ to Southern Water transfers, as this is a fixed contractual volume no allowance is included for climate change.

household demand in its area, including in relation to population and housing numbers, except where it does not supply, and will continue not to supply, water to domestic premises; and

This is set out in Sections 3 and 4 and the stress tests in Section 7. Detailed forecast of the final population and housing numbers are in included in the relevant WRMP tables.

non-household demand in its area, except where it does not supply, and will continue not to supply, water to non-domestic premises or to an acquiring licensee;

This is set out in Sections 3 and 4 and the stress tests in Section 7. Detailed forecasts of the final population and housing numbers are in included in the relevant WRMP tables.

(f) its intended programme for the implementation of domestic metering and its estimate of the cost of that programme, including the costs of installation and operation of meters;

The overall cost of our metering programme is set out in Section 3.2.3 and in Section 8. This is also given in Table A.13.4 below. These are the total costs over the 25 years of the Plan in 2017/18 prices (note: these are not an NPV). We have no metering on change of occupancy or compulsory metering in the programme. Selectives are included within the optant programme.

Table A.13.4: Overall cost of our metering programme

	Total installs	Total capex £m	Total Opex £m
Replacements	790,686	126.3	0.45*
New connections	203,228	8.6	5.6
Other installs	73,120	25.8	3.4

*includes only the change to Opex and excludes New connections and other install (optants)

(g) its estimate of the number of premises which will become subject to domestic metering during the planning period as a result of—
- **(i) optant metering;**
- **(ii) change of occupancy metering;**
- **(iii) new build metering;**
- **(iv) compulsory metering; or**
- **(v) selective metering,**

and its estimate of the impact on demand for water in its area of any increase in the number of premises subject to domestic metering;

South West Water Bournemouth Water

See (f).

The impact of the increase in the number of premises subject to domestic metering is shown in Table A.13.5. Figures are the cumulative impact from 2017/18.

Table A.13.5: Impact of the increase in the number of premises subject to domestic metering

	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28
Metering programme (Ml/d)	0.000	0.424	0.800	1.112	1.458	1.824	2.143	2.420	2.665	2.826	2.959

	28/29	29/30	30/31	31/32	32/33	33/34	34/35	35/36	36/37	37/38	38/39
Metering programme (Ml/d)	3.079	3.188	3.282	3.367	3.443	3.512	3.573	3.628	3.676	3.719	3.757

	39/40	40/41	41/42	42/43	43/44	44/45
Metering programme (Ml/d)	3.790	3.818	3.843	3.863	3.880	3.894

(h) its assessment of the cost-effectiveness of domestic metering as a mechanism for reducing demand for water by comparison with other measures which it might take to meet its obligations under Part III of the Act;

Table A.13.6 shows the relative costs and benefits of metering vs. other options. This excludes compulsory metering as we cannot undertake this in our area.

A range of different physical meter installations occurs for optants. These have different costs and benefits. For clarity a comparison of cost is given for each. All these activities are within the underlying mix of meter types included in our optant/selective forecast. The costs assume an 18 year asset life for meters.

These options are also included in WRMP Table 5.

Table A.13.6: Relative costs and benefits of metering vs. other options

	Capex [NPV£k]	Opex [NPV £k]	Volume [NPV]	AIC [p/m3]
Optants and Metering plan (Roadford)				
Optant (existing policy) standard meter RF	9701	1097	8813	123
Optant (existing policy) AMR RF	10180	1097	8813	128
Metering plan - standard meter RF*	10116	1129	4800	234
Metering plan RF*	10613	1129	4800	245
* Metering plan options are additional to the optant policy, not alternatives to it				
Leakage				
Current policy (Roadford LR1)	123	3193	11663	28
Current policy (Roadford LR7)†	246	6013	11663	54
Final Plan (Roadford LR1 - 15% productivity improvement)	105	2714	11663	24
Final Plan (Roadford LR7 - 15% productivity improvement)	209	5110	11663	46
†equal to the marginal cost at 15% leakage reduction				
STW Water efficiency				
Range of sites (Roadford)	-	-	-	-6 - 40
Water efficiency measures				
Retrofit and advice service (CU20e)	457	-85	1066	34.9
Social housing (CU21)	714	-486	6073	3.7
Tourism (CU26)	157	-52	652	16
Community efficiency schemes (CU60)	570	-467	5833	1.8
Social norms (CU62)	23	-1175	20332	-5.7
Non-household retail water efficiency (CU66)	521	-166	2079	17.1

(i) its intended programme to manage and reduce leakage, including anticipated leakage levels and how those levels have been determined; and

We intend to reduce leakage by 15% between 2020 and 2025.

We plan to continue to reduce leakage in the longer term. By 2044/45 we plan to reduce leakage by c25% from current levels.

The short-term level is determined from feedback from the Draft WRMP and consultation with customers and stakeholders.

The long-term level is determined by the customer willingness to pay.

(j) if leakage levels are expected to increase at any time during the planning period, why any increase is expected.

No increase is expected.

TABLES

Available on request