Technical Note

Project:	WRMP24 Headroom Review
Subject:	A shared piece of work for Severn Trent, Dwr Cymru Welsh and South Staffordshire Water Companies. Following a briefing and workshop discussion, this technical note aims to propose a sensible and appropriate approach to Headroom for WRMP24.
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Document history

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1.1	Final draft following review meeting 28 March	DH	HC	BP	HC	14 April '22

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Contents

Main report Tables and Figures (not including appendices)

1. Background

Water resources planning is continually evolving to incorporate new data sets derived from new approaches to hydrological simulation, the incorporation of new (to the water resource sector) analytical methods to assess uncertainties and risk, and new regulatory and customer expectations. Changes are reflected in new regulatory guidance (for example EA/Ofwat Water Resource Planning Guideline (WRPG)) and the requirements of the EA national framework for water resources and corresponding Welsh Legislation. There have been many areas of development in water resources since WRMP19 that are now being applied and implemented in preparation for the next industry cycle of Water Resources Management Plans (WRMP24).

The requirement to plan for a 1 in 500-year hydrological design event includes an implicit assumption that WRMP24s will include greater degrees of resilience that were allowed for in previous WRMPs. By taking a more risk averse starting position for supply-side estimates based on more extreme hydrological events, this has important implications for the selection of appropriate values of Target Headroom that avoids double counting of components of uncertainty that have already been allowed for in other parts of the supply demand balance.

This Headroom Review has been commissioned by three Water Companies within the Water Resources West regional resilience planning group – Severn Trent Water (STW), Dwr Cymru Welsh Water (DCWW) and South Staffordshire Water (SSW). This Technical Note is the output of a review of headroom in the context ongoing and some completed technical work for WRMP24 and for the ‘emerging’ regional plan. The aim of this review is to determine an appropriate approach to take for WRMP24 that avoids double counting with other areas of the supply demand balance but that ensures that appropriate levels of risk are allowed for in each year of the planning period.

The review considered risk and uncertainty in the supply-demand balance and consisted of a desk study, pre-workshop briefing, and a focused collaborative workshop held during Winter and Spring of 2021/22.

It is assumed that readers of this Technical Note already have a basic understanding of the use of headroom in UK water resource planning, though some background material has been included to set the context. Current guidance on the approach to headroom does not yet take account of other elements of water resource planning (for example UKWIR’s WRMP 2019 methods for Risk-based Planning and for Decision Making). This Technical Note sets out a practical and pragmatic approach to the selection of appropriate values of Target Headroom in WRMP24. This Technical Note includes the following sections:

> **Section 2** Introduces this Technical Note by framing the background, drivers and aims of this project.
>
> **Section 3** sets out role of Headroom in UK water resource planning- how it has evolved, why it is an important planning factor for water resources, and how WRMP24 is different from WRMP19 in the approach taken to risk and uncertainty.
>
> **Section 4** summarise the ranges of issues and questions that need to be allowed for in order to set appropriate values for Target Headroom throughout the whole WRMP24 planning period.
>
> **Section 5** details practical recommendations for moving from WRMP19 to WRMP24 – presenting a common framework for selecting appropriate Target Headroom profiles for WRMP24 by following a nine-step approach that articulates the logic behind the glidepaths chosen and the justification and reasoning behind the choices made.

It is recommended that this Technical Note is shared and discussed with regulators for their comments as part of WRMP24 pre-consultation. Looking forward to WRMP29, the recommendation is for a review and update to Headroom guidance.

2. Introduction

"Target Headroom is the minimum buffer that a prudent water company should allow between supply and demand to cater for specified uncertainties (except for those due to outages) in the overall supply demand balance"

Water Companies are required to consider and assess the uncertainty of supply and demand forecast and option values as a part of developing their statutory five-yearly Water Resource Management Plans (WRMP). Accounting for and including an allowance for risk within the long-term water resources planning process is an important way of ensuring a reliable future water supply.

Headroom is reported as an annual allowance defined by its size (in Ml/d) at the start of the planning period and the glidepath the profile takes over the life of the plan. It is vital that target headroom is not estimated to be too large as it may drive unnecessary expenditure, whilst a value of Target Headroom that is too small may expose a Water Resource Zone (WRZ) and hence company to an unacceptable risk of not being able to meet customers' demand for water and hence not being able to meet the company's planned levels of service.

There have been several significant changes to how Water Companies plan water resources since the last round of WRMPs were published in 2019. For instance,

- new analytical techniques now mean that long-term water resource planning can be based on stochastically generated timeseries rather than historic records,
- new estimates of impacts of climate change on hydrological data sets are now available,
- water companies are taking a more collaborative regional approach to planning,
- regulators are asking water companies to use 'Plan-based' property numbers in the central demand forecast despite Local Authority housing plans repeatedly over forecasting future housing numbers,
- regulators are asking water companies to develop more resilient plans than previously to reduce the risk of supply failures from increasingly severe drought events, and
- the modelling approach used for decision-making has evolved so that it can be adaptive to different plausible versions of what the future might look like.

As a result of these changes, the building blocks that are used to develop the WRMP24 preferred plan are grounded in a more risk averse starting position. Risk that has historically been accounted for in Target Headroom is now averted and buffered against in several other parts of the plan. The approach to Headroom needs to evolve to address these changes to avoid double-counting of risk.

The specific aims of this project were:

- To undertake an independent review of Headroom in the context of the planned approaches for WRMP24 and in light of the new data sets (e.g., stochastic inflows, the 'Scottish method' of calculating DO, UKCP18 climate change data) to determine an appropriate approach to take for WRMP24 that avoids double counting with other areas of the Plan.

- To comment on how risk and uncertainty should be translated into an appropriate planning factor to avoid running the risk of needing supply side options to overcome deficits caused by large uncertainty. Specifically:

  - Recommendations for how headroom components 'S6: Accuracy of supply side data' and 'S8: Impact of climate change on DO' should be most appropriately represented in overall headroom uncertainty modelling.

  - Recommendations for how to explain to a non-technical audience how the combined uncertainty assessment around the supply-side headroom components relates to a performance commitment of extreme drought measures of no more than once every 500 years.

- Recommendations for how to translate the target headroom risk percentile to an understanding of confidence in achieving the 1 in 500-year drought resilience standard.

- Make recommendations on how target headroom should be applied to baseline and final plan supply demand balances.

- Provide a short technical note that can be used to communicate these issues with regulators, stakeholder, and a non-technical audience

3. The role of Headroom and what has changed

3.1. Defining Headroom

The concept of headroom was introduced to UK water resource planning in 1998. Since then, the overall concept has remained largely unchanged although the assumptions and methods used to express headroom in volumetric terms have been revised as to take account of changes in data availability, technical methodologies relating to uncertainty and risk, analytical methods, and computing power.

Whilst the analytical approaches have changed the basic definition and concept of headroom has remained the same, namely:

> *Target Headroom is the minimum buffer that a prudent water company should allow between supply and demand to cater for specified uncertainties (except for those due to outages) in the overall supply demand balance"*

As well as looking at risk and uncertainty in demand and supply forecasts, each water company is required to ensure that uncertainties and risks are properly accounted for in assessing what demand management and water resource options are required to deliver its stated levels of service.

The evolution of Headroom

The original methodology (UWKIR 1998) was a simple method of scoring sources of uncertainty in supply and demand in a resource zone and converting the total score to Target Headroom by means of a conversion chart. The method (in terms of the scoring range for each element of uncertainty and the conversion chart) was calibrated to give results that were roughly in line with the then industry planning allowances of between 5% and 10 % of Water Available for Use (WAFU).

The updated method (UWKIR 2002) used the same supply and demand headroom components but offered a significant improvement through probabilistic assessment using Monte Carlo techniques to express headroom uncertainty as a probability distribution. Key challenges were to describe appropriate and justifiable probability distributions for each of the headroom components and to select an appropriate glidepath over the whole planning period from which the appropriate value of Target Headroom was taken.

Over time, some of the original headroom components were explicitly ruled out of the analysis by the contemporary WRPG and it was generally expected that Target Headroom would remain within 5% to 10% range of WAFU. Some of the components have been subdivided.

It is worth noting that when looking ahead to WRMP19 the UKWIR 2012 WR27 series of reports stated that a comprehensive decision-making framework would mean that "…the need for modelling headroom uncertainty is avoided as all sources of uncertainty are assigned directly to either supply or demand profile. The system reliability is then simply estimated from the corresponding probability of a supply demand imbalance".

Methodologies for this type of analysis were described in the two UWKIR WRMP19 Methods reports, but these were not widely adopted for the WRMP19 submissions.

Key reference documents

Key water resource headroom reports include:

- A Practical Method for Converting Uncertainty into Headroom. UKWIR/Environment Agency Report no. 98/WR/13/1, 1998;
- An Improved Methodology for Assessing Headroom, WR-13. UKWIR Report 02/WR/13/2, 2002;
- Uncertainty & Risk in Supply/Demand Forecasting, CL/09. UKWIR Report 03/CL/09/1, 2003;
- Water Resource Planning Tools 2012, WR27. UKWIR Report 12/WR/27/6, 2012;
- WRMP2019 Methods – Risk Based Planning. UKWIR Report 16/WR/02/11, 2016; and
- WRMP 2019 Methods - Decision Making Process: Guidance. UKWIR 16/WR/02/10, 2016.

These reports are referred to in successive updates of the Environment Agency Water Resource Planning Guideline (WRPG).

3.2. Balancing risk and complying with regulatory requirements

Correctly accounting for risk and uncertainty is an important way for water companies to balance the ability to ensure a secure and reliable water supply for customers without incurring unnecessary expenditure on surplus infrastructure. Through the Target Headroom allowance, risk and uncertainty should be translated into an appropriate water resources planning factor.

If Target Headroom is too large it may result in needing supply side options to overcome deficits caused by large uncertainty. If Target Headroom is too small, it could mean companies are unable to meet their planned level of service.

As well as ensuring the correct balance of risk within the WRMP, there is also a regulatory requirement set out in the Water Resources Planning Guideline (WRPG) to report annual values of Target Headroom for baseline and final plan in the Water Resources Planning (WRP) Tables.

3.3. Why WRMP24 Headroom is different compared with WRMP19.

There have been several significant changes to how Water Companies plan water resources since the last round of WRMPs were published in 2019.

As a result of these changes, the building blocks that are used to develop the WRMP24 preferred plan are grounded in a more risk averse starting position. The consequence of all these developments in planning from WRMP19 moving to WRMP24 is that risk that has historically been accounted for in headroom uncertainty is now averted and buffered against explicitly in several other parts of the supply/demand balance components on which a plan is based.

Longer hydrological data sets are now available

The availability of stochastically generated hydrological timeseries now means that analysis of the exposure of a water resource system to extreme drought events is no longer limited to observed historic records. The application of stochastically generated droughts is referred to explicitly in WRPG (Section 5.3 'What to cover in your deployable output assessment').

All three water companies, for example, have adopted the 'Scottish method' of modelling deployable output for dWRMP24. This has meant moving from using a 97-year historic flow record to using 19,400 years' worth of stochastic weather data for hydrological simulations.

DCWW report the move to stochastic data sets as improving their understanding of the hydrology of their sources, especially where they previously had relatively short lengths of historical records.

System response, and how the supply system would best be operated during these previously unexperienced severe events remains unproven. Until these events are experienced, their impacts are assumed. The remaining uncertainty depends on how conservative these assumptions are, and if a Company suspects there are operational decisions and actions that could be taken during these extreme events to mitigate the impact.

Regulatory requirement to allow for more extreme drought events means that WRMPs should be more resilient

For WRMP24 regulatory guidance (see Supplementary guidance ‘Planning to be resilient to a 1 in 500 drought (England)’ and ‘Stochastics’) now requires companies to prepare plans that are resilient to a 1 in 500-year drought return period (compared to 1 in 100-year for WRMP19). This has led to a reduction in deployable output (DO) values for many sources. There is no logical reason to add more uncertainty because you are planning for more severe droughts.

The only reason this would lead to an increase in uncertainty is if the modelling of the 1-in-500-year drought events highlighted a problem that was not already evident or that for some reason the water resource zone is much more vulnerable than previously had appeared to be the case.

Using a different approach (the ‘Scottish method’) coupled with stochastic data sets, Severn Trent Water now reports DO based on avoidance of emergency drought measures occurring more frequently than once every 500 years. As a result, the assessment of supply-side risk has fundamentally changed since WRMP19 which was based on an assessment of not experiencing TUBs more frequently than once every 33 years. This is a much more risk averse starting position for the baseline supply forecast.

The 1 in 500-year approach already allows for precipitation uncertainty and high temperatures in the simulation of extreme drought scenarios. This explains why climate change accounts for a smaller increase in uncertainty in WRMP24 when compared with WRMP19.

Climate change data sets have been updated

The modelling of climate change impact scenarios in WRMP19 showed climate change was the dominant area of long-term uncertainty, reflected in the impact on headroom. WRMP19 climate change uncertainty estimation (based on UKCP09) for Water Resources West (WRW) excluded more extreme, drier scenarios.

Assumed climate change impacts are much lower in WRMP24, because the headroom risk profiles are already representative and reflective of extreme climate scenarios in the 1 in 500-year approach that has been used to calculate the supply-side components of the supply/demand balance. The resulting risk to the supply/demand balance from supply-side uncertainty is therefore lower than was the case for WRMP19 and the supply-side component of headroom uncertainty should be adjusted accordingly. This leaves the uncertainty around data measurement, the estimates of demand, leakage and DI, and the uncertain growth, population, and housing.

The modelled assessment of climate change impacts has also been updated to utilise UK Climate Projects 2018 (UKCP18) outputs. Modelled impacts include a range of potential climate scenarios using UKCP18 RCM outputs and probabilistic model outputs and using them to inform understanding of potential impacts of climate change on long-term supply uncertainty. dWRMP24 headroom analysis shows climate change uncertainty accounts for a much smaller component of overall headroom analysis than WRMP19. It is suspected that this is due to new baseline deployable output (DO) being constrained by extreme drought scenarios rather than TUB frequency, so the implied effect of climate change appears to have a smaller marginal impact on deployable output. Hence this changes the understanding of appropriate risk and target headroom for dWRMP24.

dWRMP24 headroom analysis carried out by Severn Trent so far shows that climate change uncertainty now accounts for a much smaller component of overall headroom than was the case at WRMP19. They suspect that this is due to the new baseline deployable output now being constrained by extreme drought scenarios rather than TUB frequency, and so the implied effect of climate change appears to have a smaller marginal impact on deployable output. This in turn changes the understanding of the appropriate level of risk and thus target headroom to plan for in the new WRMP.

Water companies are taking a more collaborative regional approach to planning

By collaborating for the regional plan to meet the requirements of the national framework for water resource, there is greater sharing and discussion of approaches and assumptions between water companies. This regional approach leads to an increased confidence through knowledge sharing, cross-comparisons of approaches used in past WRMPs, and shared understanding of the design criteria and hence risks to both donor company and receiving company of inter-company transfers.

WRPG requires water companies to use ‘Plan-based’ property numbers in the central demand forecast despite Local Authority housing plans repeatedly over forecasting future housing numbers.

A recurring theme raised by stakeholders during consultation on the ‘emerging’ regional plans has been that population and housing forecasts used by water companies as required in WRPG have tended to overestimate what actual outturn growth has been. Some stakeholders have therefore concluded that forecasts of future demand are too high and therefore the requirement for future water resources has been overestimated.

Water companies are required by WRPG (Section 6.3 ‘Forecast population, properties and occupancy’) to “…base your forecast population and property figures on local plans published by the local council or unitary authority”. So these can be considered as “plan-based” forecasts which are likely to be an upper, rather than a central forecast. The shape and range of the probability distribution to be assigned to this element of the demand-side headroom component needs to take this into account.

New developments in decision-making (such as Real Options Analysis and Adaptive Planning) are now accepted as legitimate approaches for water resource planning in England & Wales. can be adaptive to different plausible versions of what the future might look like.

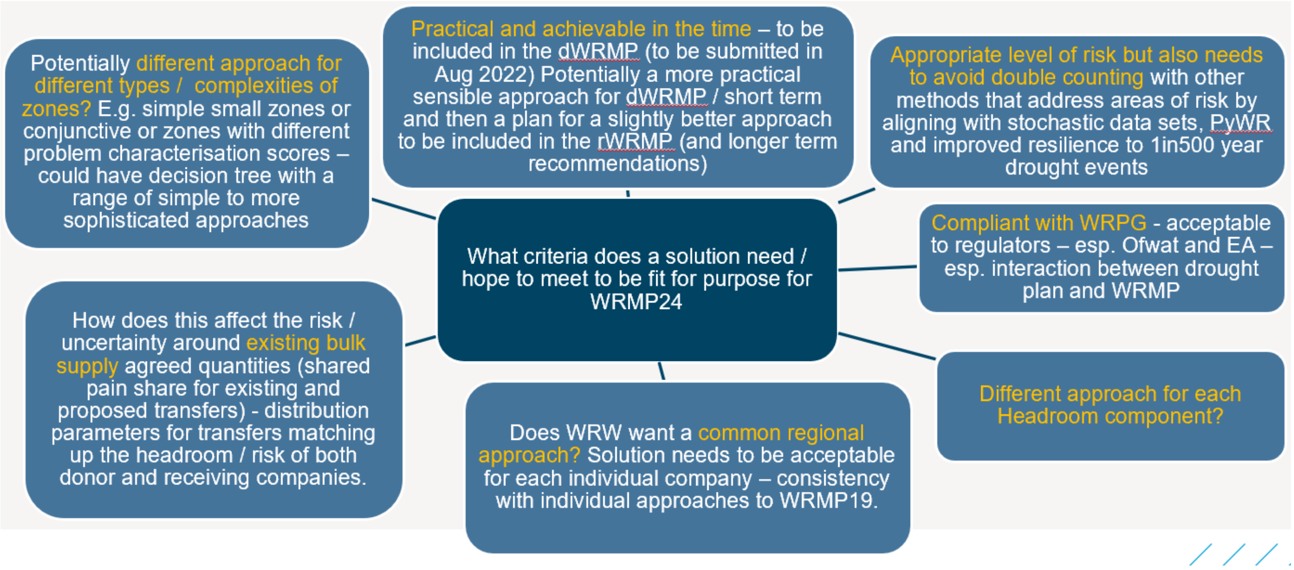
Adaptive planning is now required by WRPG, though its practical application to WRMPs is still at an early stage. The acceptance of adaptive planning as a legitimate tool for WRMPs now means that the plan can be flexible in that it considers different plausible versions of what the future might look like.

This issue of how the conventional approach to headroom uncertainty and Target Headroom fits into the concept of adaptive planning has yet to be addressed in a detailed review and update of methodology and its acceptance by water companies and regulators alike. Although the risk around the accuracy of specific planning components remains, there is less risk over the period of the plan as a consequence of adapting to different variations of the future. This may mean more uptake of the concept of Integrated Risk modelling that was introduced in UKWIR’s WRMP 2019 Methods but this will require further discussion with and acceptance by regulators.

A pragmatic approach to calculating Target Headroom, that allows for an appropriate level of risk, but that does not double count is therefore required for WRMP19, before a more comprehensive review and change to methodologies and regulatory guidance is required.

4. Characterising appropriate Headroom for WRMP24

After concluding the WRMP19 approach to Headroom is no longer appropriate, the next step was to look forward constructively to see what attributes WRMP24 Headroom should have and how it will be characterised, before then looking at the practical steps need to achieve this.



A common regional framework respecting the differing characteristics of individual Water Resource Zones

In response to a challenge by regulators, as part of this review, it was considered whether the member water companies of WRW should agree a common approach to modelling headroom uncertainty and consistent percentiles and glidepath for Target Headroom, or whether variations in approach between water companies and between water resource zones (WRZ) of each company are legitimate. Whilst it would be more straightforward for all WRZs to use the same assumptions within a consistent approach to headroom, this is not appropriate because it does not recognise the reality that there is a wide variety amongst the zones in the region (and sometimes within each water company) that have differing risk characterisations, supply/demand balance surplus or deficit, and hydraulic connectivity, and which experience different challenges and uncertainties. An illustration of the different sizes and locations of the WRZs that make up WRW is shown in Figure 4-1.

Operational system performance is also an important consideration. This includes identifying how a system might perform under extreme events, and the size and predictability of possible impacts on reservoir storage. Each zone has different issues that affect supply, demand, and operations.

Headroom component S6 was chosen as an example to illustrate this point. Talking through a selection of the individual WRZs across the WRW region, there was a clear wide-ranging variety of issues affecting uncertainty in supply including storage, system connectivity, and accuracy.

It was agreed that, rather than a completely harmonised regional approach, a common framework is appropriate where different assumptions should be allowed for to take account of different types of zones and regions.

Figure 10. Map showing the location of water company water resource zones within Water Resources West

Company	Zone	Summary of additional likely resource needs after WRMP19 final plans (Ml/d)		
		2020	2035	2050
Dŵr Cymru Welsh Water	Alwen Dee	-	-	-
	Hereford	-	-	-
	Pilleth	-	-	-
	Ross on Wye	-	-	-
	SEWCUS	-	-	-
	Vowchuch	-	-	-
	Whitbourne	-	-	-
Severn Trent Water	Bishops Castle	-	-	-
	Kinsall	-	-	-
	Mardy	4	-	-
	Ruyton	-	-	-
	Whitchurch and Wem	-	-	-
	Chester	-	-	-
	Stafford	-	-	-
	Forest and Stroud	-	-	-
	Wolverhampton	-	-	-
	Shelton	-	-	-
	North Staffs	-	-	-
	Strategic Grid	8	-	3
South Staffs Water	South Staffs	-	-	-
United Utilities	Barepot	-	-	-
	UU Strategic	-	-	-
	Carlisle	-	-	-
	North Eden	-	-	-
	Total	13	-	3

Table 3. Summary of likely resource needs for all the water resource zones for public water supply in WRW's region after the implementation of WRMP19 preferred plans and under a 1 in 500 resilience standard. Key: "-" represents sufficient water available in the baseline.

Figure 4-1 - Diversity within the region equates to a variety of risk characterisations and uncertainties - Source: WRW Initial Resource Position March 2020

5. Practical recommendations for moving from WRMP19 to WRMP24 - a common framework for picking WRMP24 Headroom profiles

This section presents a common framework for selecting appropriate Target Headroom profiles for WRMP24 by following a nine-step pragmatic approach that articulates the logic behind the glidepaths chosen and the justification and reasoning behind the choices made.

Step 1
- Review WRMP19 headroom as a reference position to start from
- Annex A of this technical note shows WRMP19 Headroom as a proportion of Distribution Input (DI)

Step 2
- Check there is a good fit when comparing stochastic data sets against historic records to discount any introduced bias.

Step 3
- Familiarise yourself yourself with the regulatory Guidance for the adaptive planning approach proposed for WRMP24 and,
- Look at the Headroom Components recommended for inclusion by the WRPG and used for WRMP19

Step 4
- Consider the key Components that characterise each WRZ in your Supply Area
- Use this charaterisation to consider if the dominant areas of risk have changed since WRMP19 and if the percentage should be increased or decreased as a result.

Step 5
- Selecting Componant Glidepaths
- Use the Table in this section to consider if the risk for each component will decease, be consistent or increase over the life of the plan to determine the glidepath.

Step 6
- Look for any positive Headroom in the initial years of the plan resulting from the adoption of Plan based property forecasts and correct these by capping the component at zero.

Step 7
- Consider an additional standalone component to account for the short to medium term uncertainty associated with water use changes during the pandemic.

Step 8
- Sense check the size and glidepath of your draft Headroom against what it was for WRMP19.
- Any increases in particular need to be well justified against the background of Steps 4 and 5.

Step 9
- Components covered by scenarios need to be removed.
- This step relates to all components covered by all scenarios – not just the scenario being tested

5.1. Step 1 - Referencing WRMP19 headroom as a proportion of DI as a starting reference position to adapt

Annex A at the end of this Technical Note shows WRMP19 Headroom as a proportion of DI for each Company. This should be used as a starting reference position.

As the WRMP24 takes a more risk averse position that WRMP19 (discussed in section 3.3 of this Technical Note), Target Headroom is expected to be less in WRMP24 than in WRMP19.

5.2. Step 2 - Sense checking new data sets against historic data sets

The process of moving from historic to stochastic data should provide more confidence and a better understanding of source reliability and reduce risk as a result.

Please sense check historical and stochastic data sets against each other to ensure there is a good fit between the data sets and ensure that the change in approach is not introducing a bias.

Figure 5-1 was shared by Severn Trent during the Headroom review workshop as an example of Step 2. The stochastic data used is a good fit to actual historical data. This provides a good level of confidence that the move from historic to stochastic data for WRMP24 has not introduced any additional uncertainty or bias into the data. In fact, it should have done the opposite, by providing a better understanding of how resources and systems will perform under more severe return periods than historically recorded. This good fit of historic to stochastic data sets was verbally reported in the workshop as a common finding across all of the three participating companies.

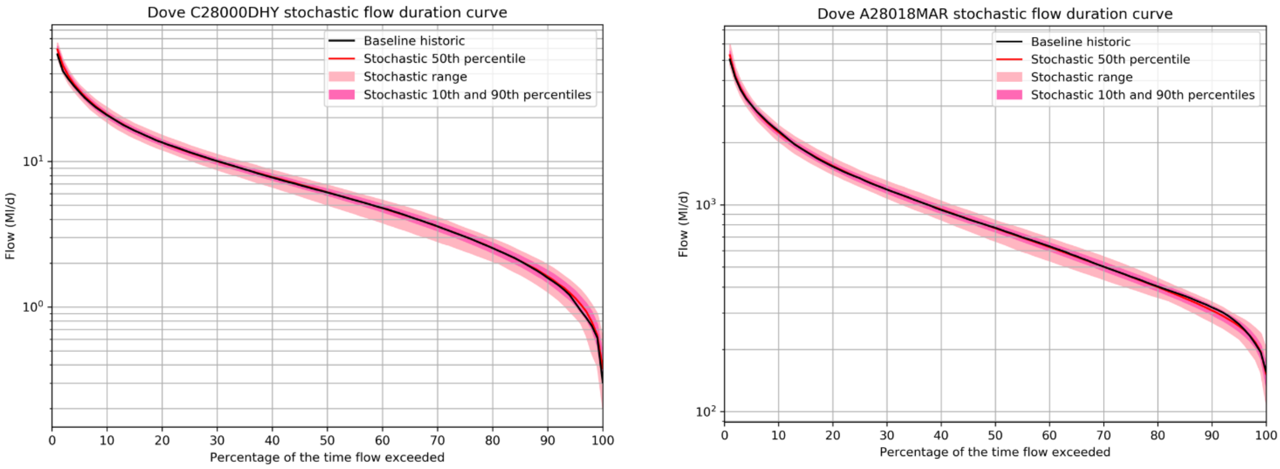


Figure 5-1 - Stochastic in-flow data compared to historical records. Sense check of impact of data vs. impact modelling approach. (Source: shared at the Headroom review workshop by Severn Trent Water)

5.3. Step 3 - Components

To select which components of Headroom are appropriate, see Table 5-1 below. This table shows which components are recommended for inclusion by the WRPG, which were used last WRMP, and the recommendation of which are applicable from this review.

Table 5-1 - Supply and demand side components

		2002 UKWIR Guidance Components	WRMP19 WRPG	WRMP24 WRPG	Recommended for assessment	Comments
Supply Related	S1	**Vulnerable surface water licences**	X	X	X	WRPG for both WRMP19 and WRMP24 advise against including components S1, S2 and S3. Associated uncertainty should be dealt with by scenario planning rather than Headroom.
	S2	**Vulnerable groundwater licences**	X	X	X	
	S3	**Time-limited licences**	X	X	X	
	S4	**Bulk imports**	X	X	X	If companies are planning to the same degree of resilience and use the same method and data, all uncertainty should be captured within S6. Therefore, the use of S4 is not needed as it would add extra uncertainty, causing excessive risk aversion.
	S5	**Gradual pollution of sources causing a reduction in abstraction**	✓	✓	✓	STW and SSW have included S5 component in WRMP19. DCWW have not historically used this as they have a very small reliance on groundwater sources. The appropriate percentage differs based on the characteristics of the WRZ. This is for gradual pollution events (one-off events are covered in Outage).
	S6	**Accuracy of supply-side data**	✓	✓	✓	All three companies included this component, and it should be assessed for WRMP24.
	S8	**Uncertainty of impact of climate change on source yields**	✓	✓	✓	This component should be included but is likely to be a less significant contributor to WRMP24 Headroom than it was for WRMP19 due to the
	S9	**Uncertain output from new resource developments**	X	✓	X	This uncertainty is better dealt with through scenario planning than Headroom – *see explanatory note after table*
Demand Related	D1	**Accuracy of sub-component data**	✓	✓	✓	All three companies included this component, and it should be assessed for WRMP24. Uncertainties include – the reliability of meter readings, the number of optants, the number of new property connections and population numbers. WRPG requires plan-based housing scenarios to be in the core scenario. This housing forecast is likely to be an overestimate of the numbers of houses ultimately built which can result in the perverse modelling outcome of positive headroom numbers.
	D2	**Demand forecast variation**	✓	✓	✓	This component should be used. Uncertainties include changes in household demand, measured non-household consumption depending on market trends and economic growth, and the assumptions used to normalise a 'dry year' and 'peak' forecast.
	D3	**Uncertainty of impact of climate change on demand**	✓	✓	✓	All three companies included this component, and it should be assessed for WRMP24.
	D4	**Uncertain outcome from demand management measures**	X	✓	X	This component should be explicitly explored using scenario analysis. Uncertainties that could be considered include the actual pcc demand of new built properties, and reliance on government water efficiency labelling to reduce water use – *see explanatory note after table.*

5.3.1. Implications of Adaptive Planning to Components

The relevant section of the WRPG is included as Appendix B to this Technical Note. It is also useful to note the 2016 UKWIR report of WRMP Methods: Risk-based Planning (final v17) that advises the Headroom approach relevant for the adaptive planning approach proposed. The scenario-based method proposed by WRW is highlighted below in yellow in Table 5-2.

The use of adaptive planning scenarios has two main impacts on the Target Headroom components:

1) 'Double Counting' of components needs to be avoided for those components of headroom uncertainty that are already taken account of through the adaptive planning scenarios. This is described in Section 5.9 of this technical note.
2) The use of an uncertainty allowance for new schemes and demand management measures is not necessarily appropriate under an adaptive planning framework, provided the framework is able to identify replacement options that can be implemented in a timely fashion if the preferred options cannot be delivered within the assumed timescales due to external factors beyond the company's control. Generally speaking, the uncertainties associated with new schemes can be large, because of the risks to timely and successful progression of a scheme that can arise during processes such as consultation, planning and environmental authorisation. implementation and commissioning. Delays and/or constraints may arise because of changes to environmental requirements or changes/application of governmental policies. Adaptive plans can therefore seek to provide backup in the case that such constraints or policies affect the delivery of the schemes as planned. If alternative backup schemes are included in an adaptive plan then it may be inappropriate to also include a Target Headroom allowance as well.

Welsh legislation and regulatory guidance must be complied with for water resources zones partially or wholly in Wales.

Table 5-2 - Source: 2016 UKWIR, WRMP 2019 Methods, risk-based planning (version Final v17)

Table 11 Summary Overview of the Integration Methods

Integration Method	General Description	How is Uncertainty Included?	Constraints and requirements
Basic Target Headroom Method	As per the 'conventional' WRMP: deterministic supply/demand balance with separate outage and Target Headroom allowance.	**Target Headroom** generated for all years of the planning period	Only provides a single supply/demand forecast, so is not compatible with the **Real Options** DMT. Alternative future 'scenarios' are only used for sensitivity testing.
Scenario based method	Similar to 'conventional' methods, but generates multiple scenarios of supply and demand. Outage is included as a deterministic allowance (unless risk based outage is being used, in which case different outage scenarios can be used).	**Target Headroom**, but uses the **base year value** throughout the period, as future supply and demand forecast scenarios are incorporated into the DMT.	Compatible with the **Real Options** DMT, and can be used as the basis of sensitivity analyses, if required.
Probabilistic method	Uses integrated risk modelling to produce a risk based probability plot of the potential supply/demand balance that could occur in each year of the planning horizon. Outage is included as a deterministic allowance.	**Uncertainty** is combined with inter-annual **variability** in supply and demand to generate a combined risk based supply/demand output	This can be used in any aggregated DMT, but is complex to implement.
Basic Sampling Method	Supply side flow/level timeseries, plus demands are simply sampled from the base data for inclusion into the DMT, with some screening/sampling of the supply side inputs (if required). Outage can be applied in a number of ways.	Added as a simple **percentage uplift** to the demands within the DMT, based on Target Headroom	May not be suitable in situations where there are a large number of scenarios or iterations that need to be run (e.g. for a Multi-Criteria Search DMT).
Complex Sampling Method	Input flow/level timeseries and demands are stratified, and specialist tools are used to reduce the number of samples that are required for the DMT, whilst maintaining an understanding of the relative probability of each input data set. Outage can be applied in a number of ways.	Can still use **Target Headroom**, but can also incorporate uncertainty by creating alternative inputs, and incorporating this into the sampling strategy.	Can be very complex to develop and implement the required specialist tools.

5.4. Step 4: Evaluating the Base Year Percentile to Use for Target Headroom

The components of headroom analysis initially used for WRMP19 were sub-divided into supply-side and demand-side components with uncertainties assigned to each component. The importance of each component influences the choice of glidepath, and therefore the risk profile approach taken for WRMP19: these have been reviewed for WRMP24.

Further discussion surrounding the non-linearity around percentiles was explored. A 5% change in glidepath has larger impacts at the tails than nearer the mid-point (50%) of a distribution. This suggests that choosing a high percentile (say above 85% or 90%) of headroom uncertainty might not take proper account of the sensitivity of the tail of the distribution unless there is a particular issue identified in one of the headroom components – see Step 4.1 below. Otherwise, the choice of a high (and more conservative) percentile could be unnecessarily risk averse and thus lead to larger infrastructure provision.

Based on the discussion, it was determined that the first stage to determining the glidepath that is suitable for each WRZ is to evaluate the base year uncertainty that should be adopted. The *range* of uncertainty in the components is described by the Probability Density Function (PDF) output from the Monte Carlo simulation used to determine headroom uncertainty. When determining the percentile to use to select the appropriate value of Target Headroom, the percentile chosen should reflect the risk that a water company is willing to take in that WRZ. As risk is usually expressed through probability * consequence, it logically follows that the chosen percentile for Target Headroom should be reflective of the consequences that might be expected from 'getting it wrong'. In this case, if in a given WRZ there is a lack of warning or threshold effects that mean the headroom uncertainty components could cause the supply/demand situation to deteriorate quickly or cause impacts that are difficult to control operationally, then it is reasonable to expect a higher percentile for Target Headroom to be adopted for the base year.

A simple two-step process is therefore proposed to guide the selection of the base year percentile to use:

Step 4-1: Review which components contribute most to the Target Headroom PDF 'plume' in the base year using standard tools (e.g. @Risk tornado plots). Determine which of these are the largest (top 2).

Step 4-2: Evaluate the risk position for the top two components based on Table 5-3 below. This will indicate whether a more or less risk averse position should be taken, indicating what the selected base year percentile should be. Established practice means that base year Target Headroom is usually within the range 75th percentile (very low risk) to 95% (very high risk). The following bullet points can can:

- Very low percentiles (75% end of the range) should only be used if there are no WRZ attributes on the supply side that imply a higher risk (see Table 5.3) *and* the base year demand is very stable and predictable in terms of inter-annual behaviour, with a low dry year factor.
- Mid range percentiles (80% - 90%) should be used in those cases where there is some volatility on the supply side (e.g. reservoir systems where records are relatively short, with some 'flashiness' or more reliable hydrologically constrained run-of river or groundwater level systems) and/or where there is some volatility in inter-annual demand and/or dry year factors. Values towards 90% should be used where there are either uncertainties in both components, or where there are notable uncertainties on *either* the supply or demand side.
- Very high percentiles (towards 95%) should only really be adopted if the headroom uncertainty PDF is dominated (75%+) by components with high-risk attributes, which will probably mean that both S6 and D1 exhibit higher risk as described in Table 5.3.

Table 5-3 - Choosing the appropriate percentages for each Headroom Component of your WRZ

2002 UKWIR Guidance Components			WRMP24	Attributes that indicate a more risk averse position should be taken (Logic for higher percentile)	Attributes that indicate a less risk averse position should be taken (Logic for lower percentile)
Supply Related	S1	Vulnerable surface water licences	X	Components S1, S2, S3 and S4 not included in Headroom assessment	
	S2	Vulnerable groundwater licences	X		
	S3	Time-limited licences	X		
	S4	Bulk imports	X		
	S5	Gradual pollution of sources causing a reduction in abstraction	✓	Unlikely to apply to the baseline - but could apply to WRZs where there are a significant number of sources where there is a large amount of uncertainty in the fluctuation of contaminants or pollution risks that means this risk is both applied and uncertain in the base year.	Unlikely to be a dominant component in headroom uncertainty for low base year risk sources.
	S6	Accuracy of supply-side data	✓	It should be noted that in most cases the move to 1 in 500-year drought resilience should not act to increase the impact of supply side uncertainty on overall Target Headroom. This is because although the uncertainties increase, they are acting further down the 'tail' of the annual variability in the supply/demand balance. This tends to reduce the risk impact of a given level of uncertainty, effectively because of taking a more risk adverse position through the adoption of the 1 in 500-year standard (this is an indirect result of the Central Limit Theorem nature of joint probability functions). The assessment of Target Headroom risks should therefore be based on the nature of the WRZ as it relates to any severe drought and does not need to take into account the additional uncertainties caused by evaluation at the 1 in 500-year level. For WRZs where S6 is the dominant component of uncertainty, or where the LoS is heavily dependent on surface water storage, the following attributes indicate a higher risk and hence recommended higher percentile allowance: • Storage systems behave unpredictably and have major 'threshold' tipping points in relation to different drought types (e.g. control curves are optimised against one type of drought, but fail and result in large DO changes if other types of drought patterns occur). • 'Flashy' storage systems that have a short recession. • Storage systems that have a relatively large saving from TUBs/NEUBs, which varies considerably depending on the timing of introduction (this will generally occur in flashy systems). WRZs that are groundwater or run-of-river dominated will tend to have a higher risk profile, particularly where the benefits of TUBs and NEUBs have a large proportional impact. In addition, the following attributes are high risk: • Aquifer types where there is rapid drought recession that creates a large change in WRZ level DO, or aquifer types where the actual performance/reliability under drought is uncertain (e.g. Chalk and other karstic limestone). • Rivers where there is uncertainty or limited understanding of baseflows, particularly where catchment transposition has been used to estimate flow response.	For WRZs where S6 is the dominant component of uncertainty or where the LoS is heavily dependent on surface water storage, the following attributes indicate a lower risk and hence recommended lower percentile allowance: • Larger, more predictable storage systems where control curves work well with no obvious 'tipping points' across a range of droughts. • Systems where there is operational flexibility to share amongst reservoirs that are spatially distant or have notably different drought responses. WRZs that are groundwater or run-of-river dominated will only be lower risk where the benefits of TUBs and NEUBs is relatively limited (i.e., they are not dependent on summer critical conditions) and they contain: • Predictable, reliable aquifers with a high degree of storage and long recession times, where DAPWLs tend to be well understood and behaviour under severe drought conditions is likely to be no different that behaviour experienced during the operational record (e.g. some types of sandstones). • Predictable, well understood and modelled run-of-river sources, most likely with a significant baseflow component.

2002 UKWIR Guidance Components			WRMP24	Attributes that indicate a more risk averse position should be taken (Logic for higher percentile)	Attributes that indicate a less risk averse position should be taken (Logic for lower percentile)
	S8	Uncertainty of impact of climate change on source yields	✓	The uncertainty in climate change is reflected in the distribution of the input profile. A higher risk position in the baseline is only warranted if there is evidence that moving to a higher level of resilience does not reduce the risk from climate change, *and* the PDF for climate change is strongly skewed (e.g. the range increases notably above the 75th percentile of the inputs) – this indicates there is a 'threshold' effect for drier climate ensembles that might not be captured if lower base year percentiles have been used.	Lower percentiles should be considered if there is evidence that climate change is proportionally less risky as drought severity increases – in that case much of the risk is being accounted for by the resilience enhancements being proposed in the WRPG.
	S9	Uncertain output from new resource developments	✓	In most cases this component will not affect the choice of base year percentile.	In most cases this component will not affect the choice of base year percentile.
Demand Related	D1	Accuracy of sub-component data	✓	Where there is a large variability in the dry year or critical period factors that have been assigned to a WRZ and it is likely that this will have changed from the last measured event (e.g., due to changes in metering percentages or demographics) then a higher risk position should be adopted.	Where most of the variability is well understood and the variability between dry year and normal year demand is predictable and appears stable over time, then a lower risk position may be adopted.
Demand Related	D2	Demand forecast variation	✓	In most cases this component will not affect the choice of base year percentile.	In most cases this component will not affect the choice of base year percentile.
Demand Related	D3	Uncertainty of impact of climate change on demand	✓	In most cases this component will not affect the choice of base year percentile.	In most cases this component will not affect the choice of base year percentile.
Demand Related	D4	Uncertain outcome from demand management measures	✓	In most cases this component will not affect the choice of base year percentile.	In most cases this component will not affect the choice of base year percentile.

5.5. Step 5: Evaluation of Glidepaths

Glidepaths differ from base year Target Headroom, as they effectively reflect the willingness/ability of a company to take a higher risk over time. In situations where companies can monitor the risk, and where the investments that may be required to address those future risks can be deferred, then companies are able to act on that monitoring, and so risk allowances can be reduced. Future percentiles will tend to reduce over time in comparison to the base year for exactly this reason – there is time to monitor and adapt to the uncertainties over time. Although Target Headroom may increase in absolute DI terms, that is because uncertainty is increasing over time because of uncertainty about different possible futures or scenarios, at a rate that is greater than a company's willingness to accept greater risk (as expressed through the percentiles that are used).

This means that a 'common' regional glidepath is not appropriate, as the situation around monitoring and investment will vary between WRZs. It is apparent that the choice of glidepath will tend to reflect the mix of the components that make up headroom uncertainty over the whole planning period and hence that represent forecast future uncertainties and the ability to monitor and adjust as those uncertainties crystallise. Theoretically it should reflect the ability to adapt investment as well, but because this is covered by the adaptive planning approach described in Section 5.6, this is not proposed as part of the initial selection of the glidepath.

The suggested approach to determining how the glidepath should change from the baseline is therefore simply based on the proportion of the future uncertainty that is driven by the different components of forecast uncertainty, as described in Table 5-4 below. As with the baseline assessment, the contribution of the different components to uncertainty in the year 2050 can be generated through 'tornado' plots or similar forms of analysis.

Table 5-4 - Choosing the appropriate glidepath profile for your WRZ

Type of Glidepath	Rationale for Selection
Near constant (i.e., maintain percentiles close to or even at the base year)	Target Headroom at 2050 is dominated (>75%) by the following types of forecast components: S5 - where there is a large degree of inter-annual variability in the pollutant concentrations, and the trends are very uncertain, but could be adverse. S8 – all climate change will tend to be uncertain and difficult to monitor, so dominance in S8 implies a need for a more risk adverse glidepath D2 - where changes are rapid in the near term D3 – as above for S8 (although past UKWIR research indicates it is unlikely that D3 will be a significant component) D4 - where there is a rapid rollout or sudden change in risk/ambition
Slowly reducing (i.e., percentiles drop, but stay within a few percentage points of the base year)	Forecast headroom uncertainty components are mixed, without being dominated by either type of component. In this case the Target Headroom as an absolute percentage of DI should fall within the range of marginally increasing over time (<25% increase over the baseline) to remaining broadly flat.
More quickly reducing (i.e., percentiles drop well below the base year by 2050)	Target Headroom at 2050 is dominated (>75%) by base year components and/or future related components that can be readily monitored and adapted to: S5 - where there are sources at risk, but this is evidenced through trends that are reasonably clear/quantifiable without large inter-annual variability. D2 - unless there is very rapid near-term change D4 - provided the risk grows reasonably consistently over time in response to a gradual rollout

> In this case it is reasonable for the absolute Target Headroom allowance to stay constant over time. It may reduce, but only in circumstances where some of the base year risks are likely to be resolved (e.g. the WRZ becomes connected to another WRZ so that the overall hydrological system spreads the risk between the zones and hence the uncertainty allowance reduces, or there is a high uncertainty around demand in the base year that is addressed by demand management strategies).

This selection depends to a certain extent on the level of risk that has been selected by the base year. In particular any absolute reduction in the volume of Target Headroom should relate (in qualitative terms) to an identified change in the risk/uncertainty for the WRZ. Otherwise, it is logically difficult to justify a reduction from the base year Target Headroom (in absolute terms).

5.6. Step 6: Addressing positive headroom modelling outputs

Several companies report positive headroom figures generated because of modelling Climate Change data and Plan-based property numbers. These positive figures are a consequence of the model running conflicting conditions, but the result is illogical. The WRPG requires that Plan-based demand forecasts form the central estimate of demand. If a positively skewed headroom uncertainty is used, then this effectively means that the WRMP does not assume that Plan-based forecasts are the central estimate. Similarly, a positive value of climate change implies that the central forecast is planning for future conditions that are more benign that the median.

It would be counter intuitive to increase headroom (and accompanying investment requirement) due to initial forecast components being considered more conservative than the most likely case.

Because of this, it is recommended for companies to overwrite positive headroom numbers for the sub-component with a zero in those cases where a positive value of Target Headroom is being generated by the S8 or D2 components at the percentile of headroom uncertainty that is being used for the glidepath. This should be tested at the *input* stage (i.e. is the input positive at the chosen percentile).

5.7. Step 7: Accounting for uncertainty around changing demand patterns during the pandemic.

COVID-19 has had a multitude of impacts, and water resources is no exception due to protocols requiring increased water demand, and changes to working requirements altering distribution. The question for COVID-19's impact surrounds the demand and distribution in WRZ is how this might change over time in the short-term, or will the trends be more permanent, thus, providing another area of uncertainty to be accounted for.

Water UK commissioned Frontier Economics, with support from Atkins and the Behavioural Insights Team, to study and document the impacts experienced as a result of covid-19 upon 17 water companies in England and Wales[1].

The University of Manchester in conjunction with Artesia Consulting have published their examination of changes in demand for water due to covid. As well as an increase in household water use (away from workspaces, educational organisations, and public spaces) they also observed a change in the timings of when water was used over the typical day[2]. One observation was increased household water consumption but noted that caution is needed from drawing assumptions from data collected over such a short timescale as the April-July of 2020.

[1] Economic Impacts of covid-19 on the water sector, Frontier Economics and Atkins, December 2020 (available on the Water UK Website)

[2] Collaborative Study: The impact of COVID-19 on water consumption during February to October 2020 – Final report, May 2021, Artesia Consulting (Available on the Artesia website)

Where the best place to represent this uncertainty within the water resources planning process was discussed, in particular whether it is most appropriately represented in headroom or whether it is more appropriate for scenario analysis.

Uncertainty associated with water use changes due to the pandemic could plausibly be a factor for the next 5 to 10 years while demand forecasting methods adapt to the 'new-normal'. This factor should be visible and explicit. A consensus was that it could appropriately be a new additional Headroom component but one that should not be included in Monte Carlo analyses.

There is an additional political consideration with the Welsh Assembly actively encouraging the continuing of home working to reduce pre-pandemic commuting and traffic emissions.

It was decided that the uncertainty surrounding a **new** pandemic is not essential to be accounted for at the moment.

5.8. Step 8: Review against WRMP19

Sense check the size and glidepath of your draft Target Headroom against what it was for WRMP19, to identify and clearly report the main components leading to differences proposed for WRMP24. For transparency, it is recommended that companies include a commentary with a summary table that shows side by side for comparison the WRMP19 and WRMP24 assumptions of the type of distribution with parameters for each component, together with a table that shows for each year of the planning period the percentile of headroom uncertainty used for Target Headroom thus illustrating the shape of the glidepath used for each WRMP.

Table 5-5 shows the different types of probability distribution and the parameters needed for each and a possible template to record the review is given in Table 5-6.

Table 5-5 - Parameters required for each probability distribution

Distribution type	A	B	C	D
Triangular	Minimum estimate	Best estimate	Maximum estimate	
Normal	Mean	Maximum estimate	Standard deviation	
Lognormal	Mean	Maximum estimate	Standard deviation	
Exponential	Rate			
Custom/Discrete	Value 1	Value 2	Probability 1	Probability 2

Table 5-6 - Example template for Step 8 Review against WRMP19

	2002 UKWIR Guidance Components		WRPM	Type of distribution	Parameters of distribution				Comments
				Triangular Normal Lognormal Exponential Custom/ discrete	A	B	C	D	
Supply Related	S1	Vulnerable surface water licences							Assumed not required for WRMP24
	S2	Vulnerable groundwater licences							
	S3	Time-limited licences							
	S4	Bulk imports							
	S5	Gradual pollution of sources causing a reduction in abstraction	**WRMP19**						
			WRMP24						
	S6	Accuracy of supply-side data	**WRMP19**						
			WRMP24						
	S8	Uncertainty of impact of climate change on source yields	**WRMP19**						
			WRMP24						
	S9	Uncertain output from new resource developments	**WRMP19**						
			WRMP24						
Demand Related	D1	Accuracy of sub-component data	**WRMP19**						
			WRMP24						
	D2	Demand forecast variation	**WRMP19**						
			WRMP24						
	D3	Uncertainty of impact of climate change on demand	**WRMP19**						
			WRMP24						
	D4	Uncertain outcome from demand management measures	**WRMP19**						
			WRMP24						

This will clearly and systematically show the components that have changed and can then form the basis of a narrative around the reasons for changes. Any increases in Headroom need to be well justified against the background of Steps 4 and 5.

5.9. Step 9: Generating Scenario Uncertainties

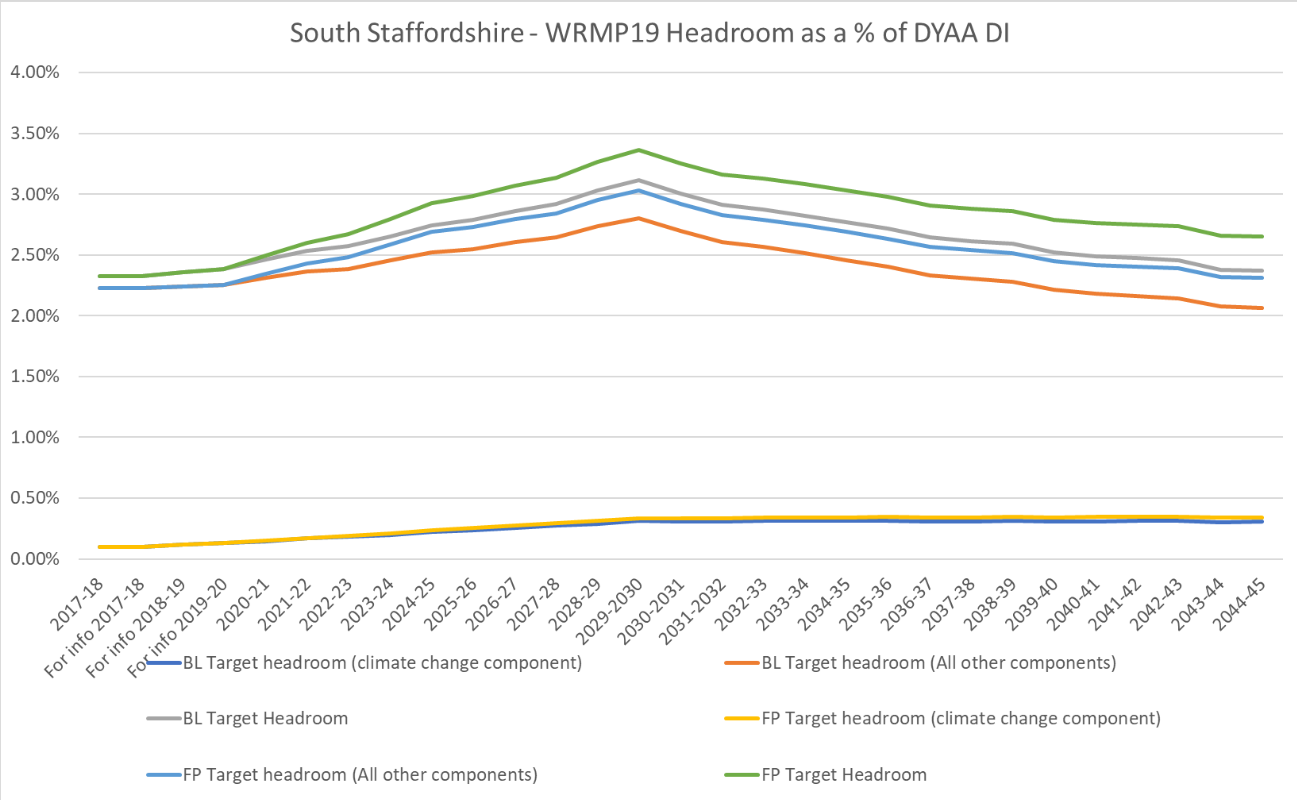
Components covered by forecast scenarios need to be removed so they are not double counted within the adaptive planning process.

This Step relates to all components covered by all scenarios – not just the scenario being tested.

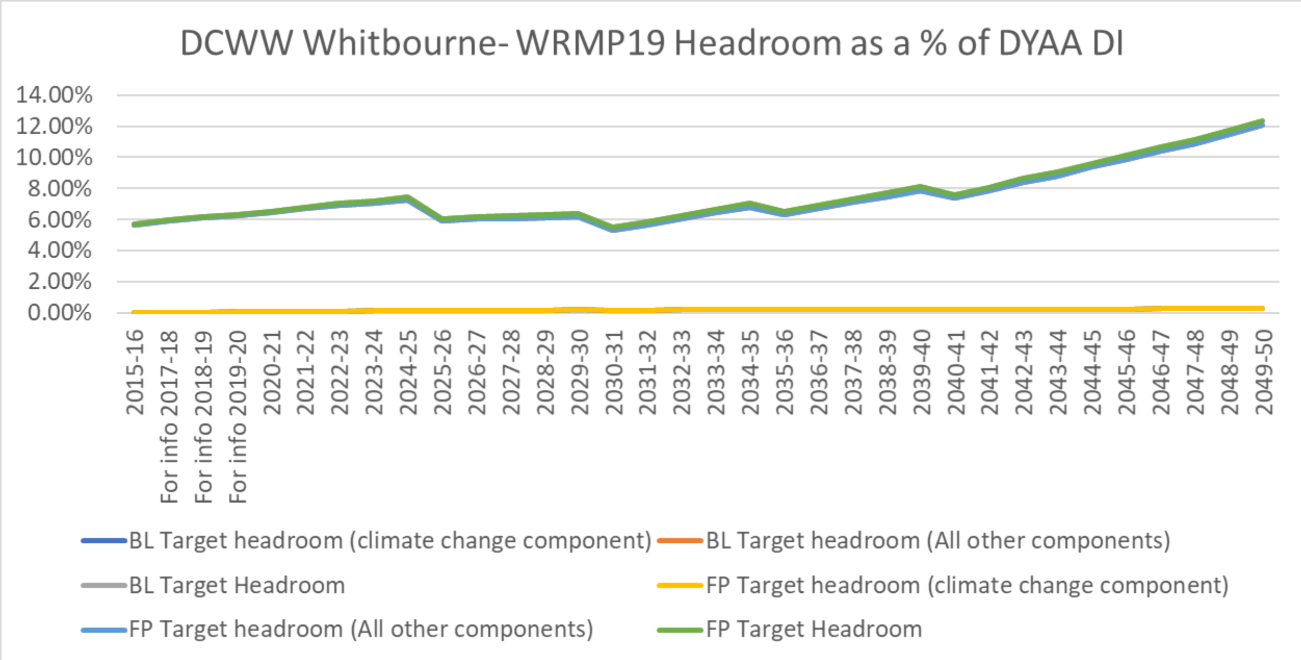
The adaptive planning core-scenario reflects on uncertainty around the planning process, including headroom forecasts. Therefore, companies' need a core scenario, headroom analysis (glidepath and justification) and base year components at that scenario to include a base throughout the year for the core scenarios. These scenarios don't need include all future uncertainty, just base year values, as guidance should include these as future supply and demand forecast scenarios are incorporated into decision making processes for headroom approaches (as suggested in Table 5-2).

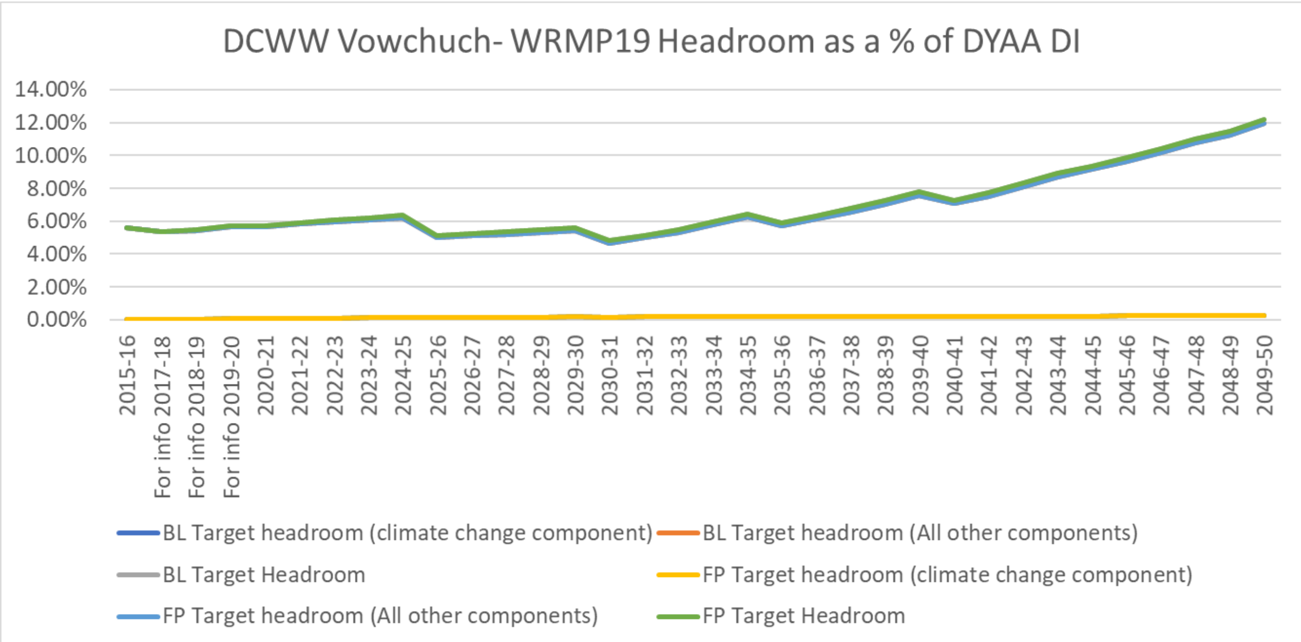
Appendix A: WRMP19 Headroom as a proportion of DYAA Distribution Input (DI)

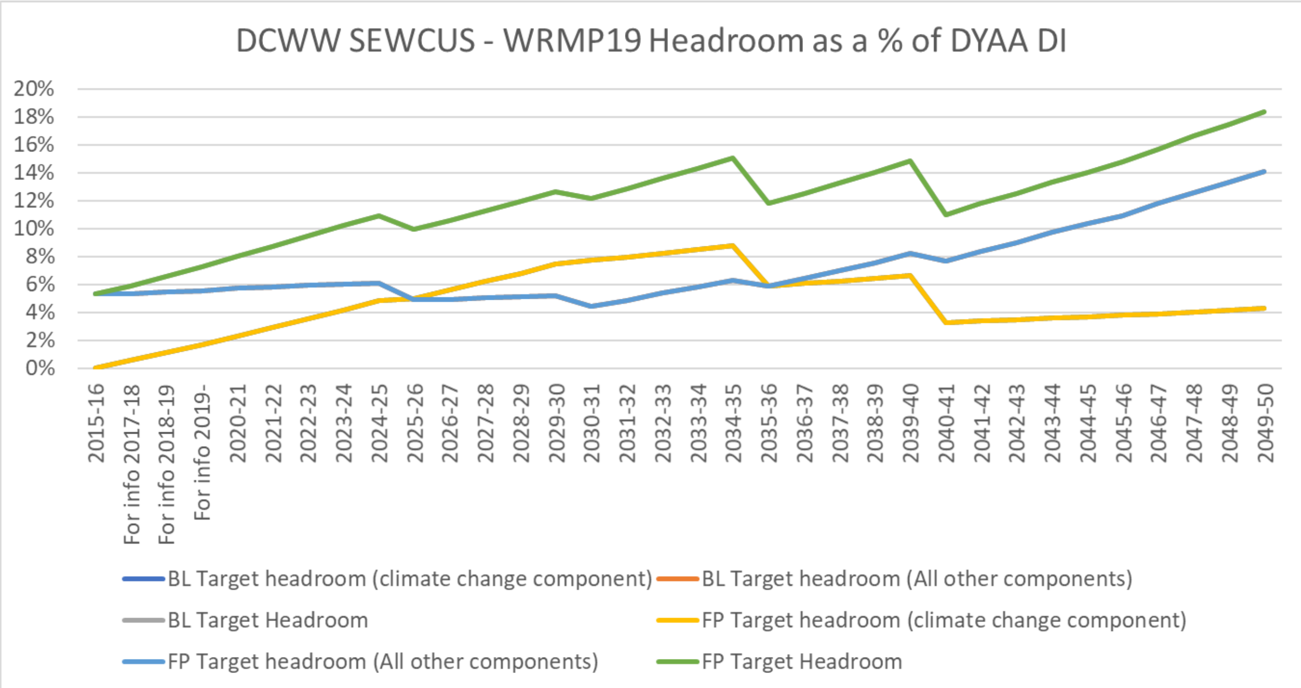
A1: South Staffordshire Water



A2: Dwr Cymru Welsh Water






DCWW SEWCUS - WRMP19 Headroom as a % of DYAA DI
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2015-16
For info 2017-18
For info 2018-19
For info 2019-
2020-21
2021-22
2022-23
2023-24
2024-25
2025-26
2026-27
2027-28
2028-29
2029-30
2030-31
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2040-41
2041-42
2042-43
2043-44
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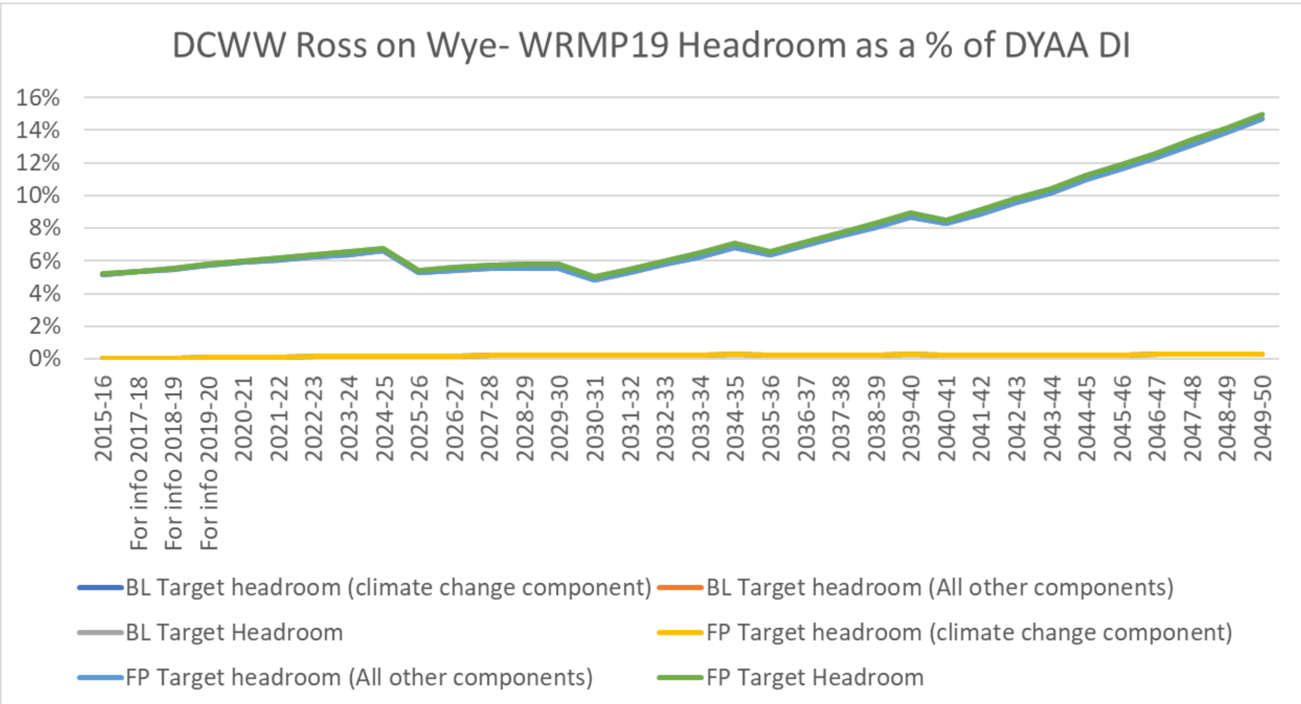
BL Target headroom (climate change component)
BL Target headroom (All other components)
BL Target Headroom
FP Target headroom (climate change component)
FP Target headroom (All other components)
FP Target Headroom


DCWW Ross on Wye- WRMP19 Headroom as a % of DYAA DI
16%
14%
12%
10%
8%
6%
4%
2%
0%
2015-16
For info 2017-18
For info 2018-19
For info 2019-20
2020-21
2021-22
2022-23
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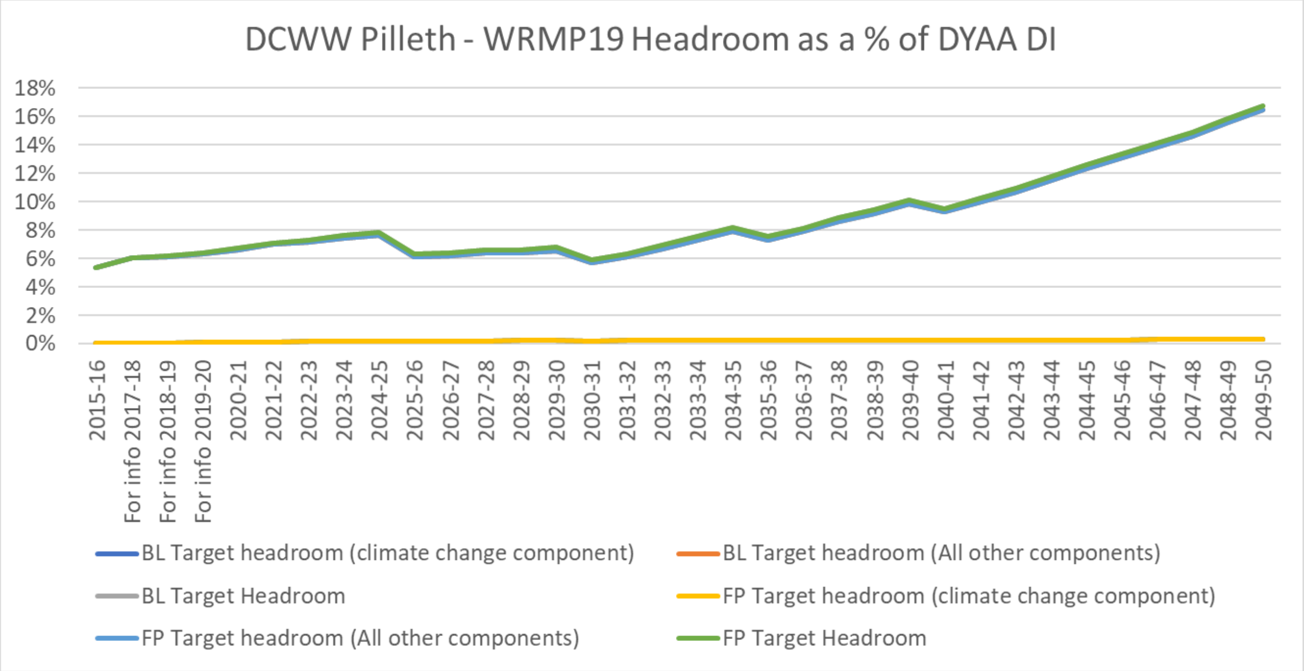
BL Target headroom (climate change component)
BL Target headroom (All other components)
BL Target Headroom
FP Target headroom (climate change component)
FP Target headroom (All other components)
FP Target Headroom


DCWW Pilleth - WRMP19 Headroom as a % of DYAA DI
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2015-16
For info 2017-18
For info 2018-19
For info 2019-20
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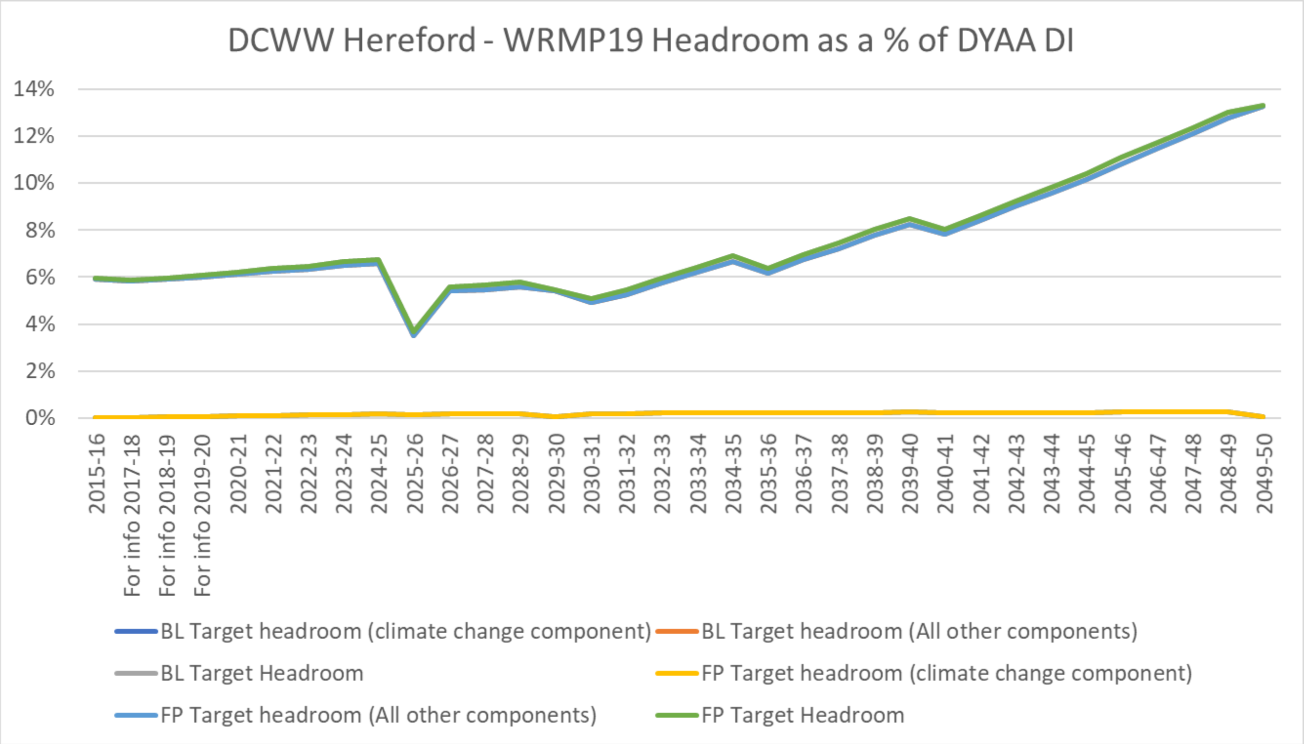
2048-49
2049-50
BL Target headroom (climate change component)
BL Target headroom (All other components)
BL Target Headroom
FP Target headroom (climate change component)
FP Target headroom (All other components)
FP Target Headroom


DCWW Hereford - WRMP19 Headroom as a % of DYAA DI
14%
12%
10%
8%
6%
4%
2%
0%
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For info 2017-18
For info 2018-19
For info 2019-20
2020-21
2021-22
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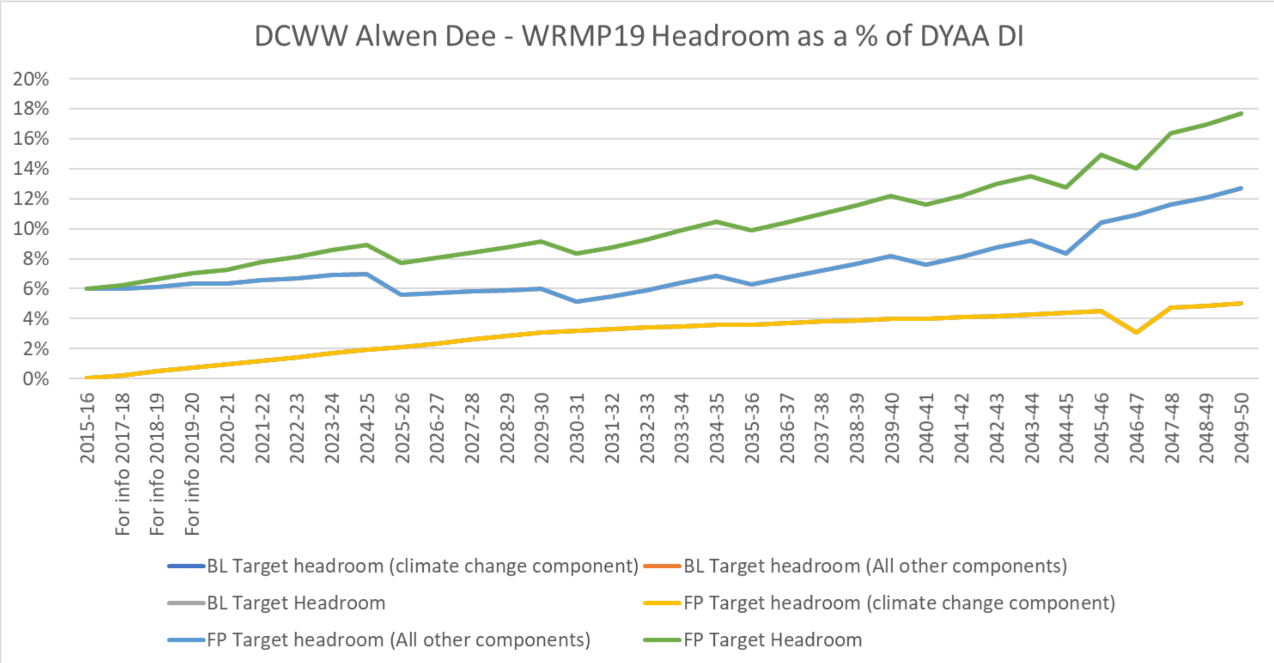
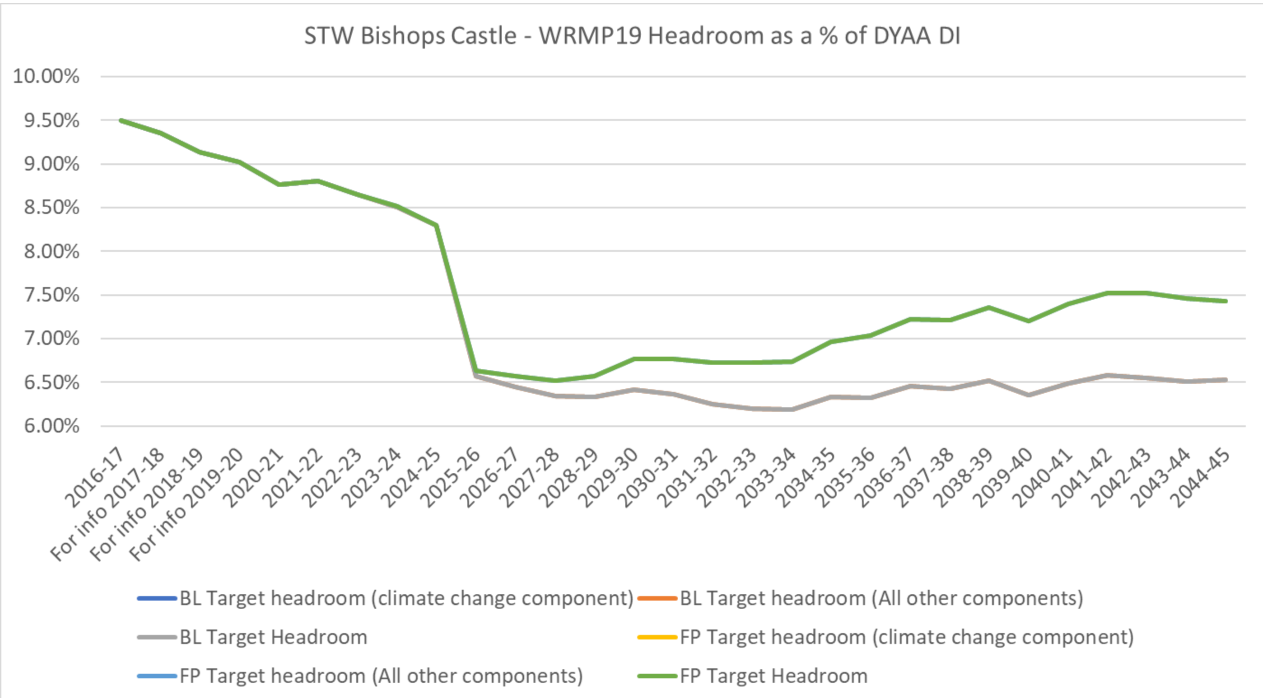
2049-50
BL Target headroom (climate change component)
BL Target headroom (All other components)
BL Target Headroom
FP Target headroom (climate change component)
FP Target headroom (All other components)
FP Target Headroom

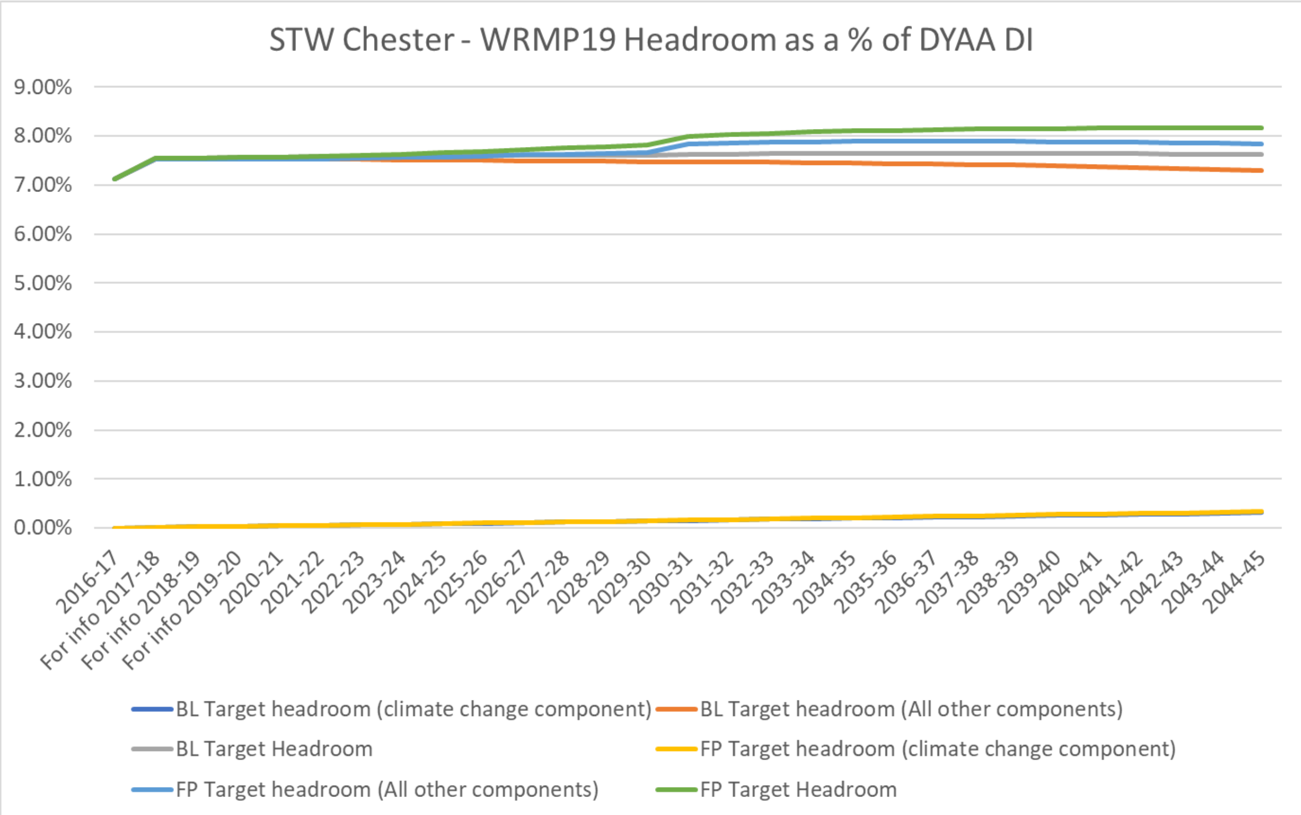


A3: Severn Trent Water

N.B.

- Rutland WRZ has zero Headroom reported for WRMP09 baseline or final plan.
- Lines showing zero for every year of the planning period are not shown on graphs.




STW Chester - WRMP19 Headroom as a % of DYAA DI
9.00%
8.00%
7.00%
6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
2016-17
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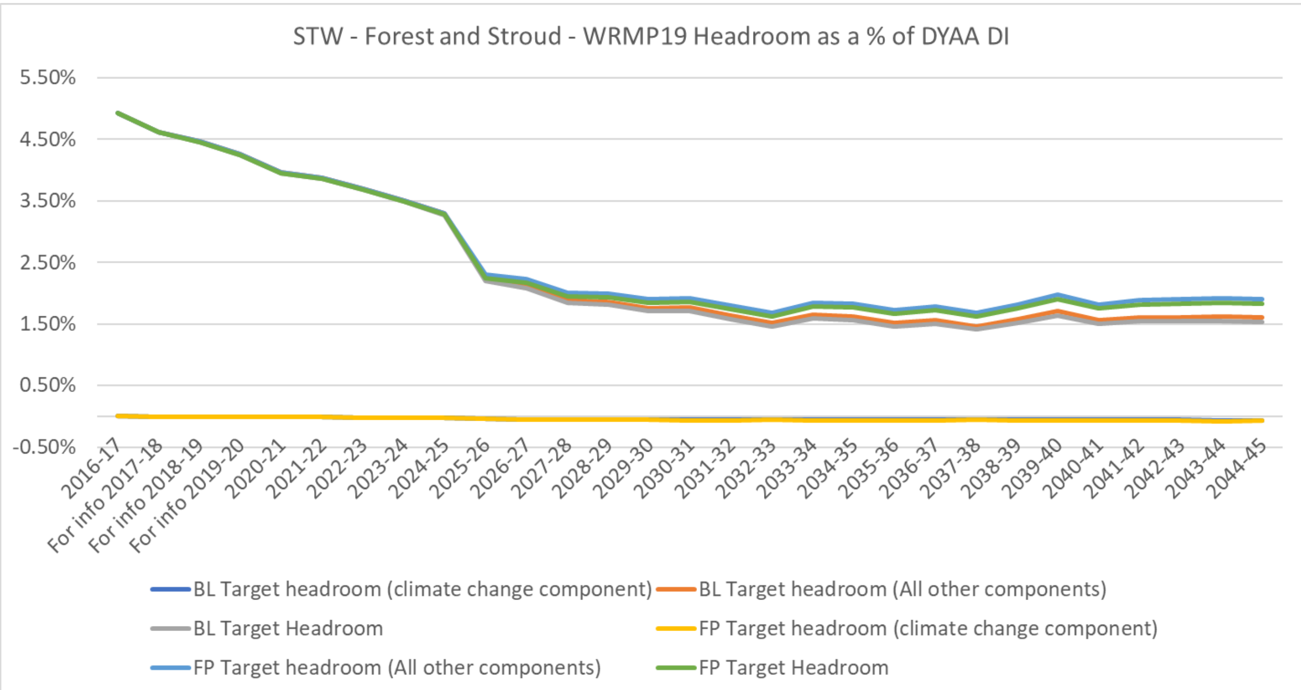
2044-45
BL Target headroom (climate change component)
BL Target headroom (All other components)
BL Target Headroom
FP Target headroom (climate change component)
FP Target headroom (All other components)
FP Target Headroom


STW - Forest and Stroud - WRMP19 Headroom as a % of DYAA DI
5.50%
4.50%
3.50%
2.50%
1.50%
0.50%
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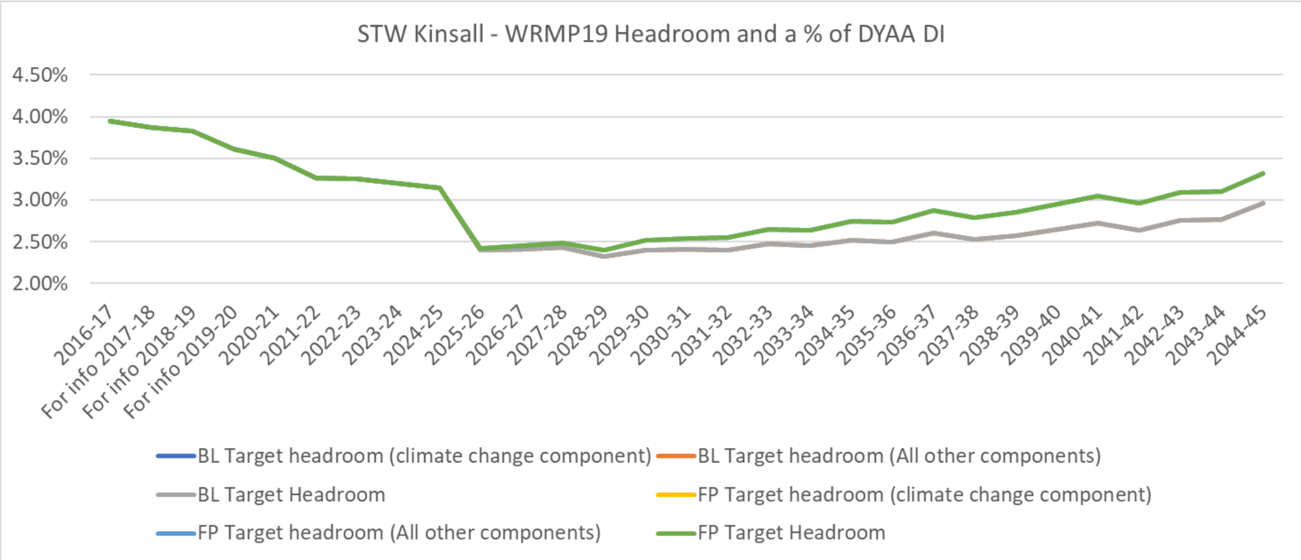
STW Kinsall - WRMP19 Headroom and a % of DYAA DI
4.50%
4.00%
3.50%
3.00%
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2016-17
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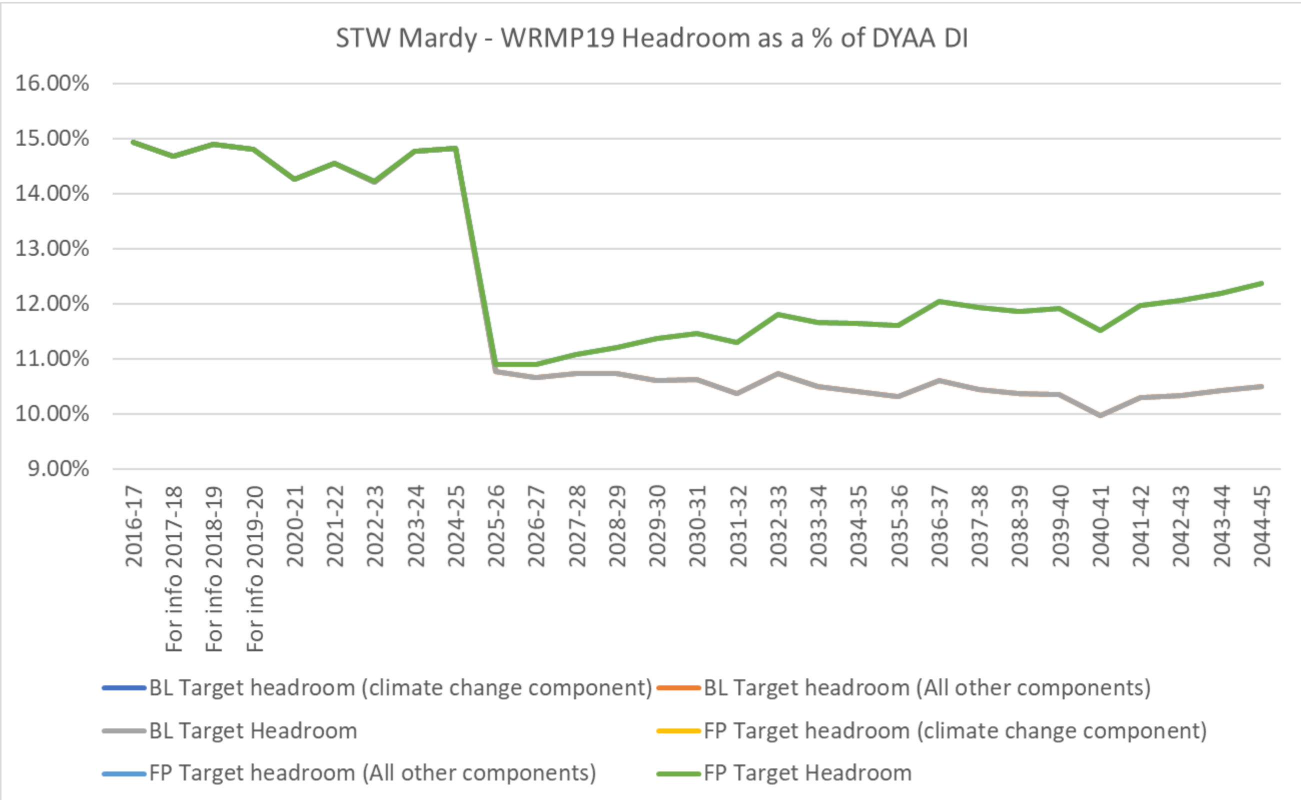
STW Mardy - WRMP19 Headroom as a % of DYAA DI
16.00%
15.00%
14.00%
13.00%
12.00%
11.00%
10.00%
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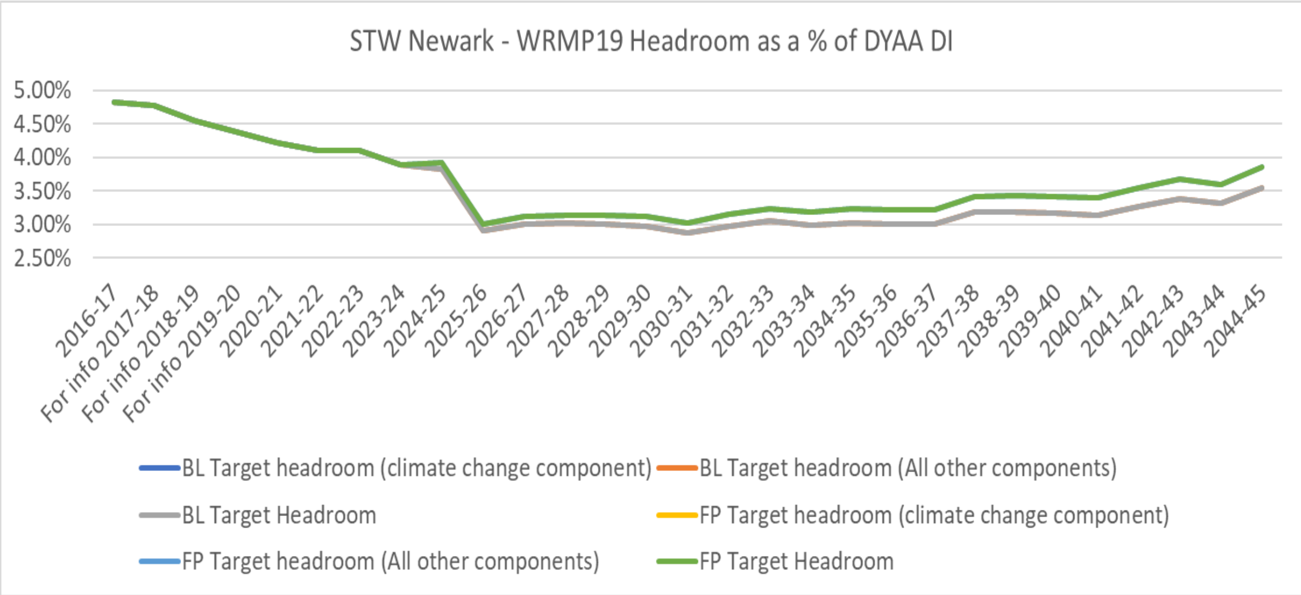
STW Newark - WRMP19 Headroom as a % of DYAA DI
5.00%
4.50%
4.00%
3.50%
3.00%
2.50%
2016-17
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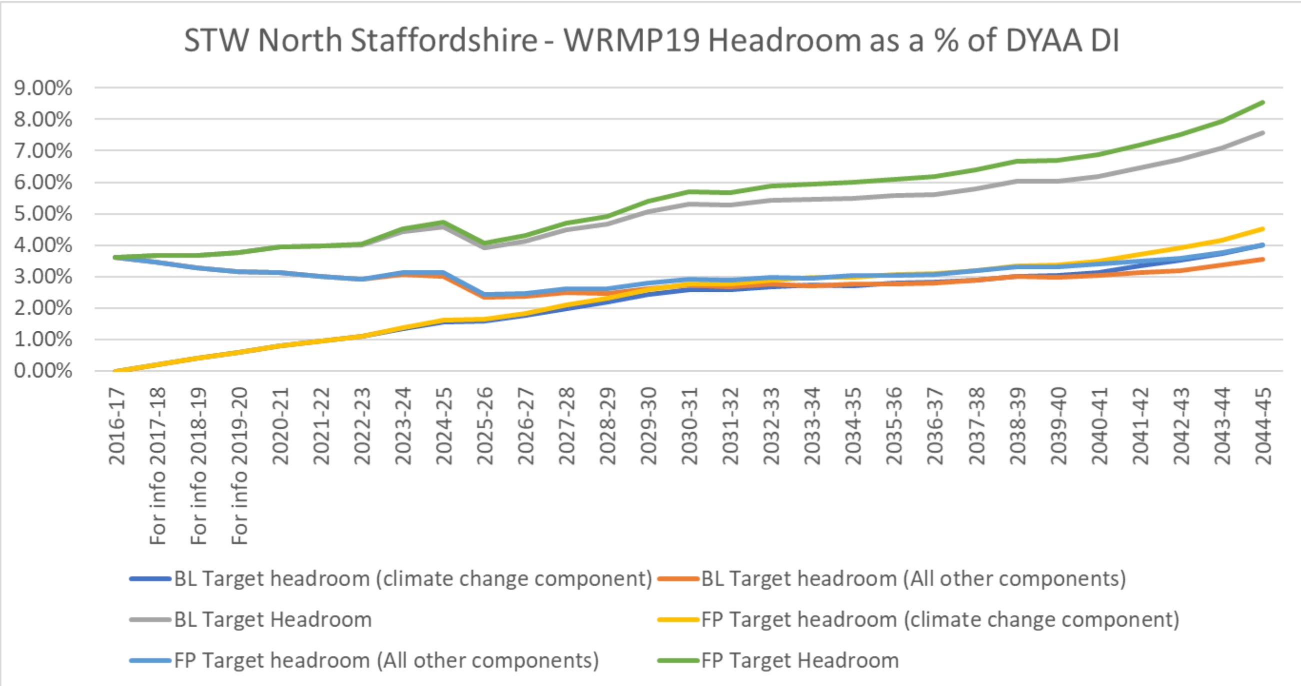
STW North Staffordshire - WRMP19 Headroom as a % of DYAA DI
9.00%
8.00%
7.00%
6.00%
5.00%
4.00%
3.00%
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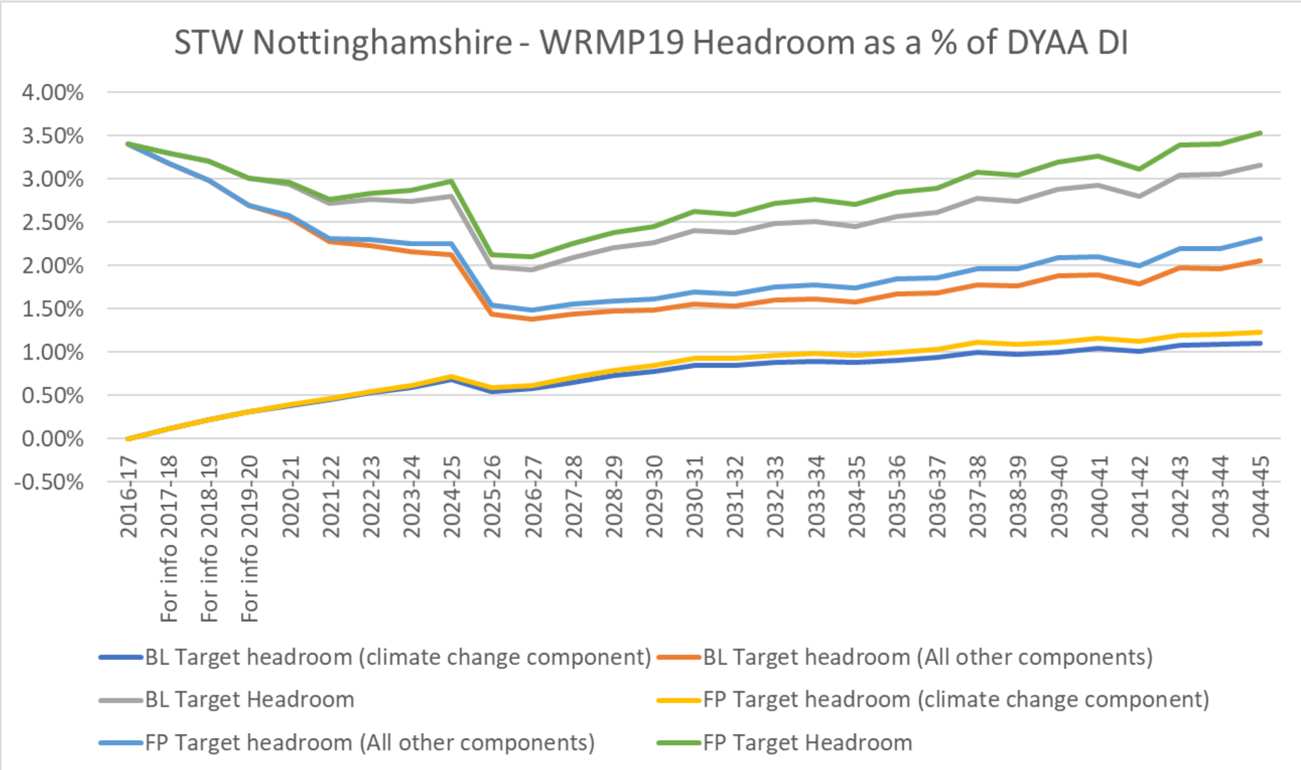
STW Nottinghamshire - WRMP19 Headroom as a % of DYAA DI
4.00%
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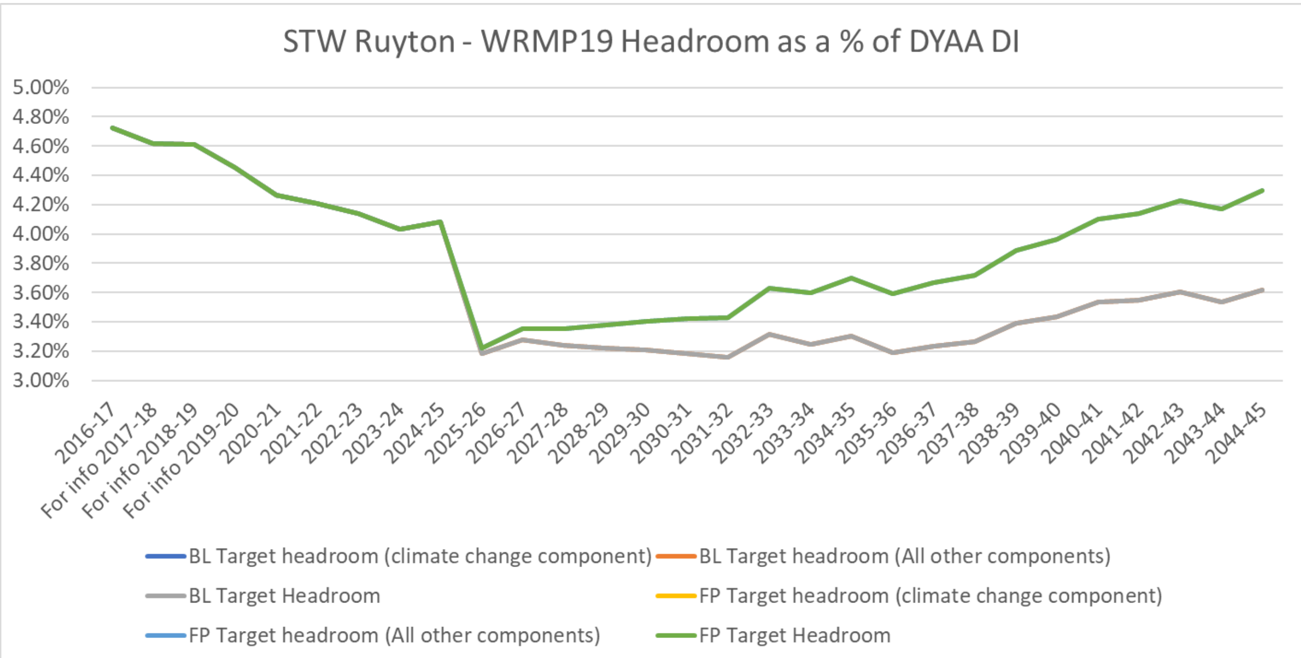
STW Ruyton - WRMP19 Headroom as a % of DYAA DI
5.00%
4.80%
4.60%
4.40%
4.20%
4.00%
3.80%
3.60%
3.40%
3.20%
3.00%
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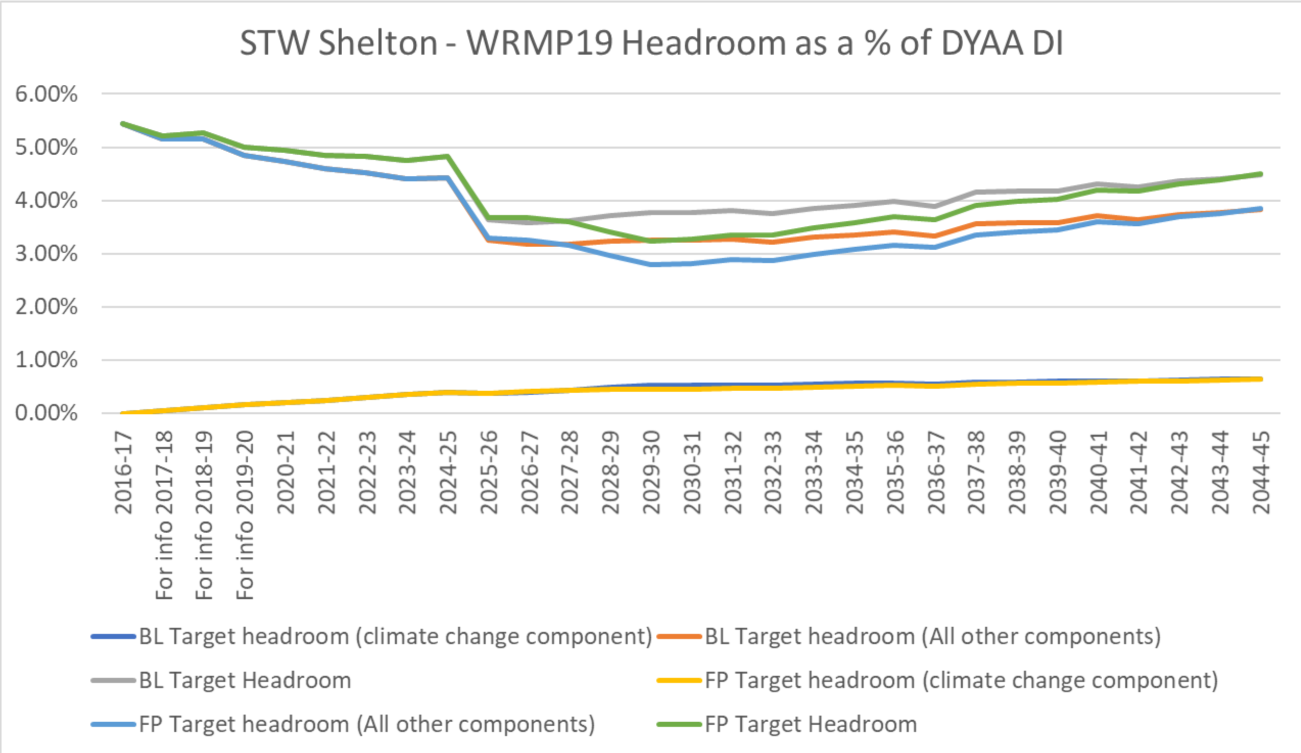
STW Shelton - WRMP19 Headroom as a % of DYAA DI
6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
2016-17
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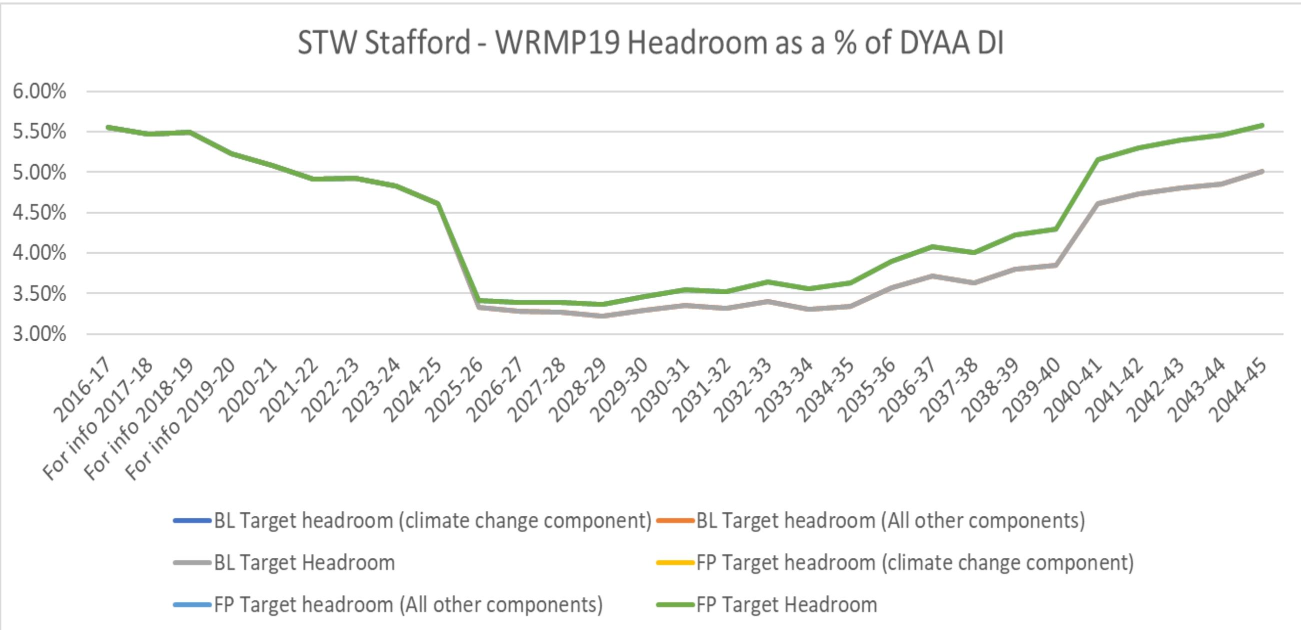
STW Stafford - WRMP19 Headroom as a % of DYAA DI
6.00%
5.50%
5.00%
4.50%
4.00%
3.50%
3.00%
2016-17
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BL Target headroom (All other components)
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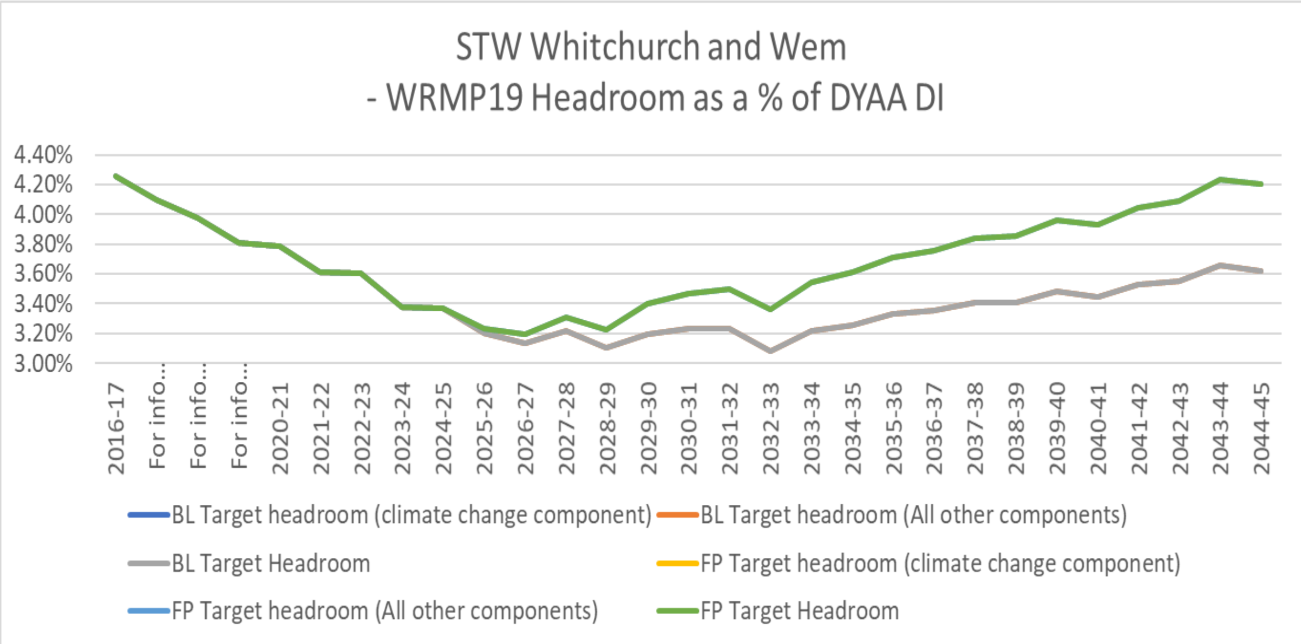
STW Whitchurch and Wem
- WRMP19 Headroom as a % of DYAA DI
4.40%
4.20%
4.00%
3.80%
3.60%
3.40%
3.20%
3.00%
2016-17
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For info...
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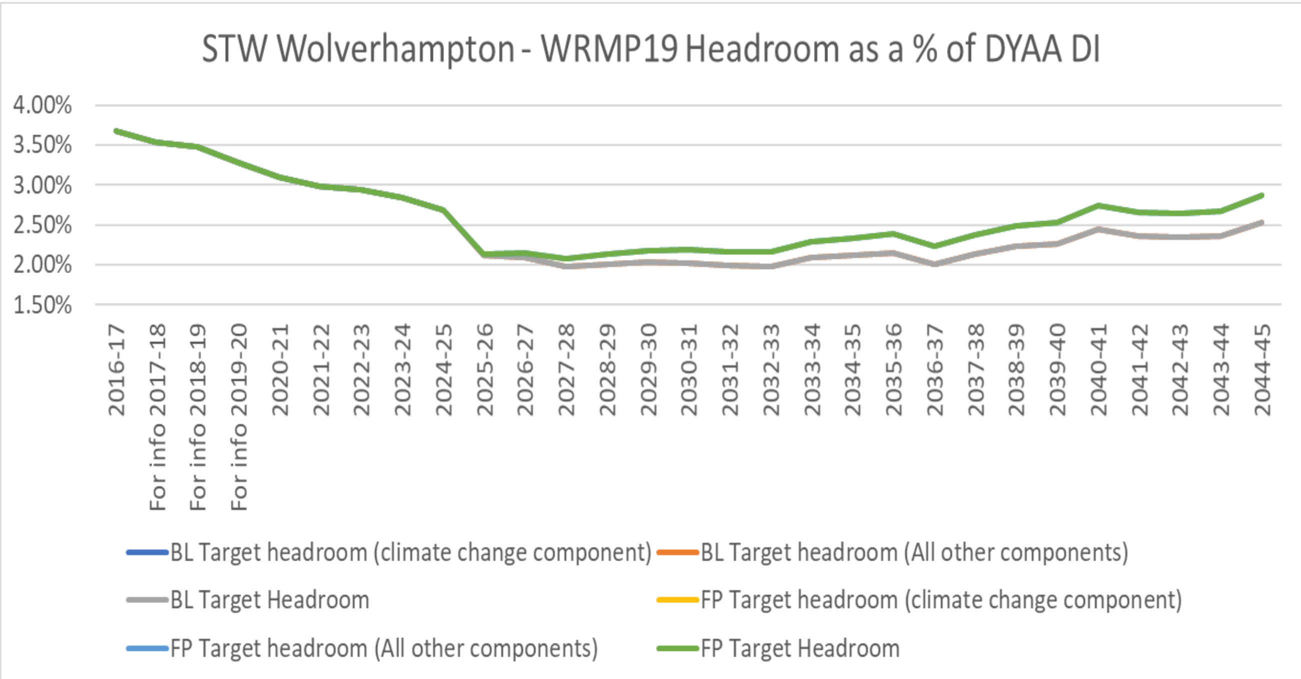
STW Wolverhampton - WRMP19 Headroom as a % of DYAA DI
4.00%
3.50%
3.00%
2.50%
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1.50%
2016-17
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For info 2019-20
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BL Target headroom (climate change component)
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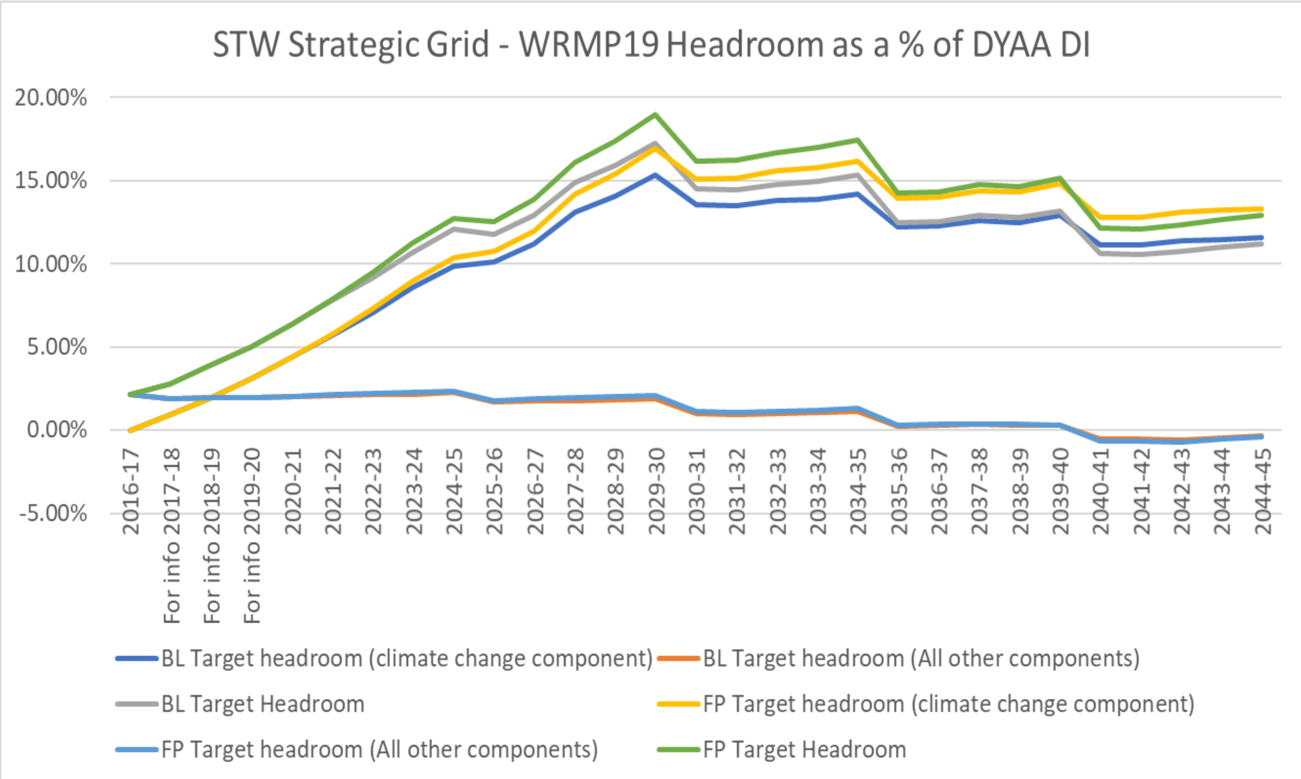
STW Strategic Grid - WRMP19 Headroom as a % of DYAA DI
20.00%
15.00%
10.00%
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2016-17
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FP Target headroom (All other components)
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Appendix B: WRPG (Dec 2021 Update): Section 7 – Allowing for Uncertainty (ep74-75)

You should use the most up-to-date and appropriate tools, methods and data available to produce your supply and demand forecasts. Given there is uncertainty in all forecasts you should include an uncertainty allowance relating to your supply and demand forecasts depending on your chosen methods.

You should analyse the sources of uncertainty around the components of your supply-demand balance and the range of uncertainty around these variables. The following documents set out different approaches to assessing uncertainty:

UKWIR (2016) Risk-based planning

UKWIR (2016) Decision making process guidance

UKWIR (2002) An improved methodology for assessing headroom

If you use risk-based planning tools or a decision-making tool to assess uncertainty and variability you may not need to calculate target headroom. Alternatively you may need to exclude some target headroom components. If so, you will need to explain the methods and assumptions you have used and demonstrate that you have not double counted or omitted uncertainties. It is recommended however, that you provide a headroom value which represents uncertainty. This is so that the uncertainties in your plan are explicit, even if you are using more advanced methodologies.

You should consider the appropriate level of risk for your plan. If target headroom is too large it may drive unnecessary expenditure. If it is too small, you may not be able to meet your planned level of service. You should accept a higher level of risk further into the future. This is because as time progresses the uncertainties will reduce and you have time to adapt to any changes.

You should provide a clear justification of the assumptions and the information you use to assess your uncertainties. You should assess the relative contributions of uncertainty, showing which uncertainties have the biggest impact in each water resource zone. You should communicate this clearly so that regulators, customers and interested parties can understand it easily. You should also consider whether there are any steps you could take to reduce uncertainty during the planning period.

You should ensure your plans can adequately adapt to over or under-achievement of demand management activity. You should use scenario testing to examine the potential uncertainty of any future demand forecasts.

You should not include uncertainty related to non-replacement of time-limited licences on current terms. If there are risks to supply because your licences may not be renewed, you should address this uncertainty directly in your plan through investigations and planning alternative supplies as necessary.

You should work with the Environment Agency or Natural Resources Wales, and regional groups (where applicable) to discuss how to consider possible future sustainability changes. Longer term potential sustainability changes can be explored through the environment destination work carried out locally and at a regional level. You should not include any allowance for uncertainty related to sustainability changes to permanent licences, as the Environment Agency or Natural Resources Wales will work with you to ensure that these do not impact your security of supply.

Your final plan headroom should reflect the preferred options in your final plan.

If you have uncertainty you should consider whether an adaptive planning approach would be beneficial. For further details see Section 10 of this guideline and the supplementary guidance ‘Adaptive planning’. When you use adaptive planning, you should consider what implications this will have for your management of uncertainty, for example target headroom.

If you are a company in Wales you should discuss your adaptive planning approach with Natural Resource Wales.