APPENDIX F:

Target headroom

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1. Role of target headroom

Target headroom is an essential component of water resources planning to ensure that appropriate allowances are defined to account for the uncertainties that are inherent within many aspects of water resources planning. These include political, social, environmental, climatic and technical factors that may significantly influence components of the supply-demand balance. It is important that these uncertainties are incorporated into the planning process. In water resources planning, uncertainty is generally handled through the calculation of target headroom. This is defined as:

"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."[1]

2. Methodologies

There are three main guidance documents relevant to the calculation and application of target headroom:

- A practical method for converting uncertainty into headroom, UKWIR 1998
- An improved method for assessing headroom, UKWIR 2002
- WRMP19 Methods – Risk-based planning, UKWIR 2016

The previous plan WRDMP21 assessment followed the UKWIR 1998 methodology which is a pragmatic scoring approach that is simple to use and provides a coarse estimate of target headroom allowance. Given the scale of the water resources issues Jersey Water face that was considered to be the most appropriate approach over the more complex 2002 methodology, which involves ascribing probability density functions to each element of uncertainty and running multiple Monte Carlo simulations, or the newer risk-based approaches developed in the 2016 methodology.

For this current plan we have retained the simpler 1998 methodology with some updates to specific components to account for improved understanding of the uncertainties in the supply demand balance and to align with the scenario planning approach we have adopted, which requires that some target headroom components are excluded to avoid double counting (see Section 9.1 and Appendix H).

The headroom approach involves scoring the potential effects on the supply-demand balance of the following issues:

- S1. Vulnerable surface water licences
- S2. Vulnerable groundwater licences
- S3. Time limited licences
- S4. Bulk transfers
- S5. Gradual pollution causing a reduction in abstraction
- S6. Accuracy of supply-side data (assessed separately as outlined in the following section)
- S7 Single source dominance and critical periods
- S8. Uncertainty of climate change on yield (not assessed to avoid double counting with the scenario framework)
- D1. Accuracy of sub-component data

[1] An improved method for assessing headroom, UKWIR 2002

- D2. Demand forecast variation (not assessment to avoid double counting with the scenario framework)
- D3. Uncertainty of climate change on demand (not assessed to avoid double counting with the scenario framework)

2.1 Methodology for assessing accuracy of supply-side data (S6)

For this WRDMP we have undertaken work to improve the quality of the hydrological models and datasets, however Jersey Water acknowledge that the accuracy of the supply side data remains a significant part of the overall supply demand balance uncertainty. This component of the target headroom (S6) has therefore been removed from the scoring approach but with separate analysis carried out to estimate the scale of uncertainty.

To estimate potential scale of impact on system deployable outputs (DO's) we used two approaches and selected a reasonable uncertainty percentage based on the outputs of these analyses.

Change in total system DO's

As outlined in Section 4.2.3 and Appendix D we have built and calibrated new hydrological models for the Jersey system. The modelling package used employs an optimisation approach to find the 'optimal' calibration parameters based on a chosen set of metrics. This means that the final selected calibration parameters are just one set of a range of parameters that could be considered plausible. To understand the potential impact of this uncertainty on system DO's we selected an alternative parameter set that exhibited lower flows than the 'optimal' model. The uncertainty risk of significance in this case is the uncertainty that lower flows could lead to a lower DO and risk supplies; therefore, we only considered the uncertainty on the lower end however the same logic could be applied to a set of higher flows. The alternative low flow parameter set was chosen based on a review of both hydrographs and flow duration curves, to provide a lower flow estimate that was still reasonable in relation to observed flows.

Figure 2-1 compares the flow duration curves for the observed data, calibrated model and the two alternative low flow scenarios.

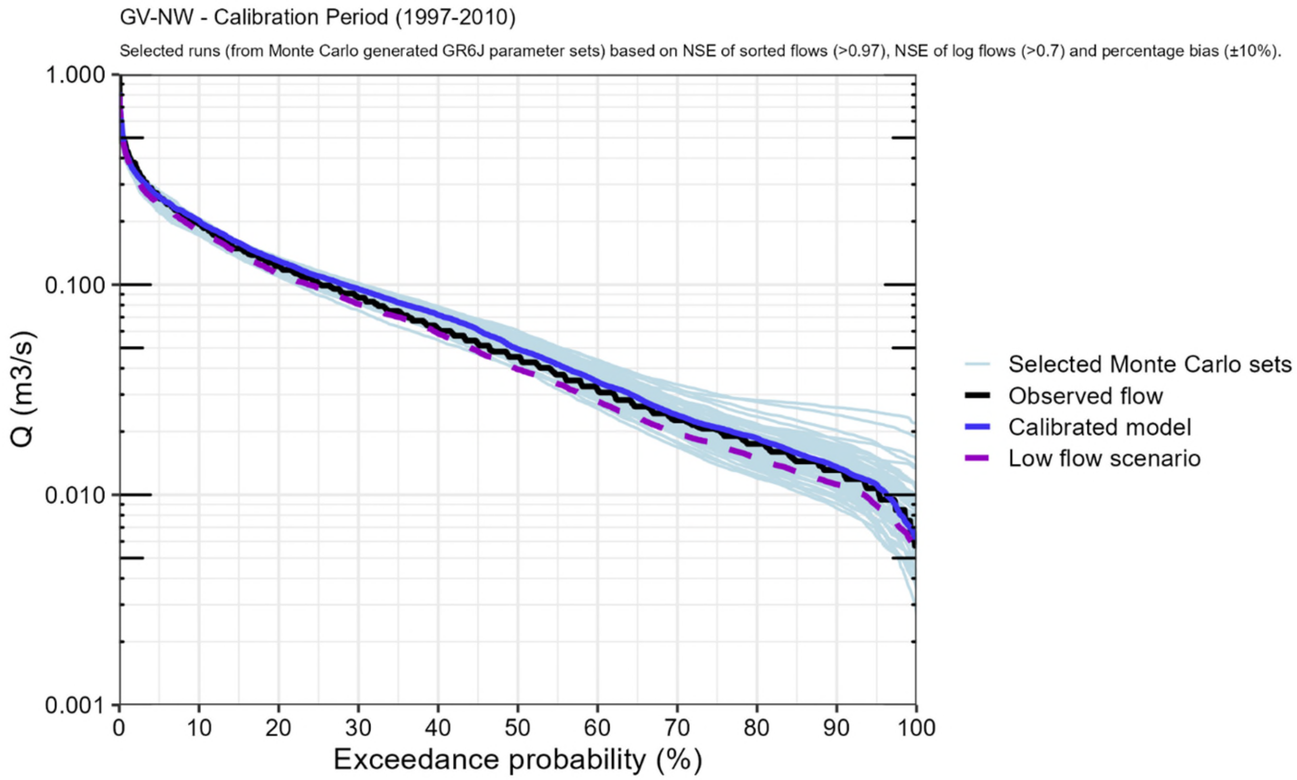

Figure 2-1 - Flow duration curves (FDC) for observed record and range of modelled parameter sets. The blue line indicates the selected model with the purple line showing a plausible alternative low flow scenario.

We ran the low flow scenario through the water resources Pywr model and calculated the impact on system DO's across the range of return periods to compare with the calibrated model flows.

Comparison of modelled and observed storage during drought

The summer and autumn of 2018 were selected as an example within the available observed record of a drought event. We assessed the scale of potential DO uncertainty by analysing the difference in the minimum modelled and minimum observed storage during this period and calculated this as a percentage of total storage.

3. Calculation of target headroom

Table 3-1 summarises the target headroom components alongside the assessed scores for 2025 and 2065 (i.e. the start and end of the planning horizon). These have been derived by applying the UKWIR 1998 methodology for each component. The 1998 UKWIR methodology includes a graph (see Figure XX) that is used to convert the calculated total target headroom scores (from the final row of Table 3-1) to determine the target headroom as a percentage of Water Available for Use (WAFU).

Table 3-1 - Assessment of target headroom components

Factor	Description	2025 score	2065 score
S1. Vulnerable surface water licences	Whilst it is difficult to assess the effects of future regulation in Jersey, this assessment has concluded that 5-10% of Jersey Water sources at present and >10% by 2065 are at low risk of being reduced or revoked. According to the UKWIR guidance this	1	2

	corresponds to a score of 1 at present and 2 by the end of the planning horizon.		
S2. Vulnerable groundwater licences	None. Jersey Water have no groundwater licences at risk of reduction due to environmental protection reasons.	0	0
S3. Time limited licences	None. Jersey Water have no time limited licences.	0	0
S4. Bulk transfers	None. Jersey Water have no bulk transfers.	0	0
S5. Gradual pollution causing a reduction in abstraction	Some sources are at risk, e.g. reservoirs being impacted by contamination or algal blooms that cannot be resolved by remedial measures. Additionally, boreholes being impacted by PFAS. For the purposes of target headroom scoring, it is assumed up to 5% of sources are at "likely" risk in the present and future. According to the associated UKWIR guidance this should be given a risk score of 2.	2	2
S6. Accuracy of supply-side data	Taken out of 1998 scoring methodology and added separately (see below Section 3.1).		
S7. Single source dominance	None. The Jersey Water resource zone has a range of water sources and so no single source dominates the annual DO of the zone.	0	0
S8. Uncertainty of climate change on yield	Taken out of headroom to avoid double counting as climate change uncertainty is covered in the scenario modelling.		
D1. Accuracy of demand sub-component data	Data sources for average base year demand are generally good and distribution input data is good. Gaps in water balance are allocated to unaccounted for water, so assume initial water balance is acceptable which aligns with a score of 2 according to the UKWIR guidance.	2	2
D2. Demand forecast variation	Taken out of headroom to avoid double counting as population uncertainty is covered in the scenario modelling.		
D3. Uncertainty of climate change on demand	Taken out of headroom to avoid double counting as climate change uncertainty is covered in the scenario modelling.		
Combining scores:	Sum of scores for S1, S2, S3, S4 and S5	**3.0**	**4.0**
	Square root of sum of squares of S6, S7, S8, D1, D2 and D3 as per UKWIR 1998 methodology (although note S6 and S8 not assessed here)	**2.0**	**2.0**
	Total score:	**5.0**	**6.0**
	Target headroom %	**5.32%**	**5.83%**

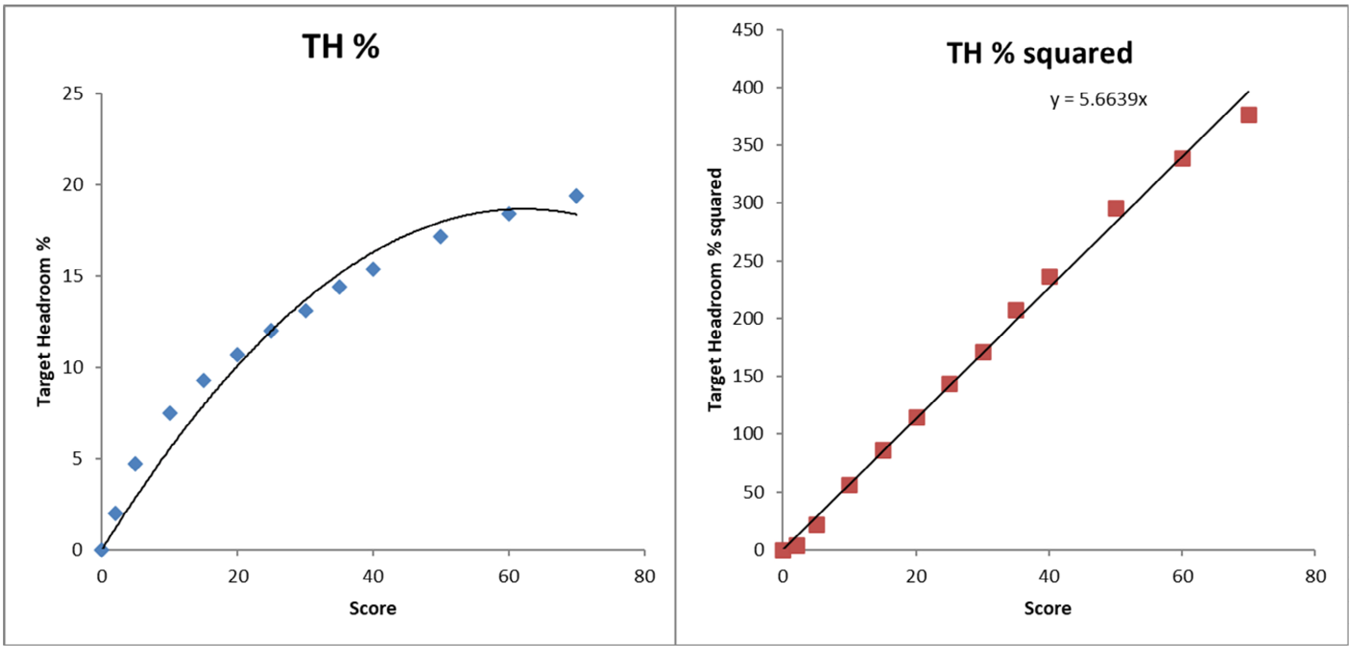

Figure 3-1 - Relationship between Target Headroom score and Target Headroom percentage as provided in A practical method for converting uncertainty into headroom, UKWIR 1998

3.1 Assessing S6. Accuracy of supply-side data

Change in total system DO's

Table 3-2 summarises the calculated DO impact for the low flow scenario outlined in Section 2.1..

Table 3-2 – Summary of change in DO between baseline assessment and alternative plausible 'low flow' scenario

Return Period	Baseline DO (Ml/d)	Low Flow Scenario (Ml/d)	Change in DO (%)
2	31.5	27.9	**11.4**
10	25.8	22.8	**11.8**
100	20.4	18.1	**11.0**
200	19.4	17.4	**10.4**
500	18.4	16.5	**10.0**

Comparison of modelled and observed storage during drought

Figure 3-2 shows total observed storage during 2018-19 as well as total modelled storage during this period. This indicates an approximately 7% difference in the minimum storage during this event.

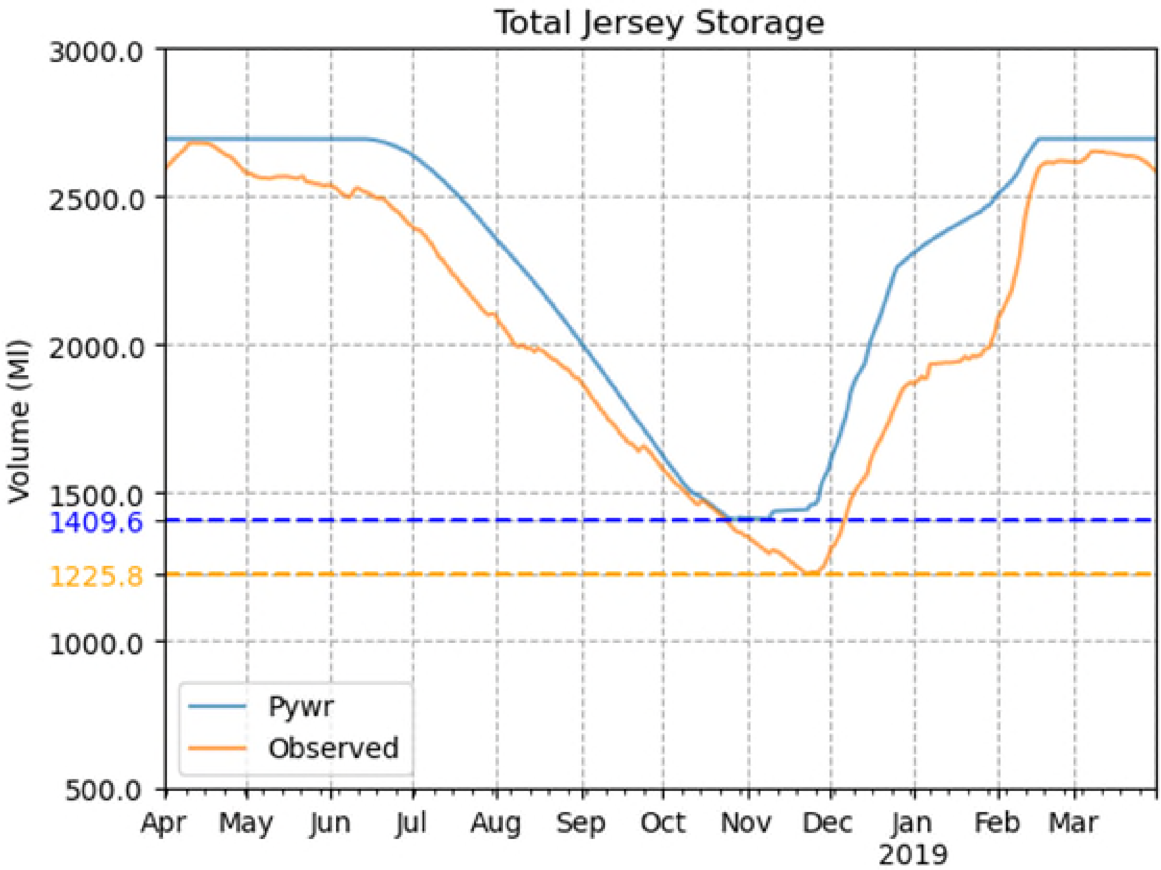

Figure 3-2 – Comparison of observed and Pywr modelled total storage during 2018-19 drought event. The dashed horizontal lines show the minimum storage level across each dataset.

Both these analyses suggest a potential range of uncertainty of between 7% - 11.4% on system DO, but with 10% being the maximum at the 1in500-year return period. A figure of 10% was therefore assumed for this component on the basis that this represents a conservative, but reasonable estimate based on the sources of analysis.

3.2 Final target headroom

The final headroom percentage and Ml/d scores are calculated from the combined uncertainty of the scored assessment and the separate supply side uncertainty analysis[2] and are summarised in Table 3-3 below. The values range from 11.33% to 11.58%. The final headroom profile is flatter than in the previous headroom assessment for the last plan largely due to the exclusion of climate change from the headroom uncertainty (as this is included within the scenario planning approach).

Table 3-3 – Summary of final target headroom values. Values in Ml/d have been linearly interpolated between the 2025 and 2065 amounts.

	2025	2030	2040	2050	2065
Target Headroom (as % of WAFU)	11.33	-	-	-	11.58

[2] Both percentage uncertainty values are combined based on the square root of the sum of squares of each of these two components.

Target Headroom for 1in500 (as Ml/d)	1.93	1.94	1.95	1.96	1.98

4. Conclusions

The target headroom allowance to be included as a buffer for uncertainty in the supply-demand balance projections has been calculated as **11.33% of WAFU in 2025 (1.93 Ml/d)**, rising marginally to **11.58% of WAFU in 2065 (1.98 Ml/d)**. This is on the upper side of typical values applied by water companies due to the assessed supply side uncertainty.

Whilst target headroom remains a necessary buffer in the supply-demand balance calculations, adaptive planning and scenario testing methodologies are increasingly used to test the resilience of water resource plans to different futures. Appendix H outlines our approach to scenario planning and sensitivity testing.