APPENDIX C – Target Headroom and the Supply-Demand Balance

C1. The headroom modelling approach

While we have endeavoured to use the most up-to-date technology, methods and data available to produce our supply and demand forecasts, there is always an element of uncertainty in all forecasts. As part of the development of our WRMP19 we have therefore analysed and quantified the variability and uncertainty that are built into the dry year annual average scenarios.

As agreed with NRW and EA, we have used the UKWIR methodology *A Practical Method for Converting Uncertainty into Headroom (1998)* to do this. Although a newer headroom methodology was published by UKWIR in 2002, we feel that the relative simplicity of our supply system and small number of water resource zones is more suited to the original methodology.

'Target headroom' is defined as *"the minimum buffer that a prudent water company should allow between supply (including raw water imports and excluding raw water exports) and demand to cater for specified uncertainties (except for those due to outages) in the overall supply-demand balance. Introducing this buffer into the overall supply-demand balance will help to ensure that the water company's chosen level of service can be achieved".* This methodology calculates the target headroom on a WRZ basis. This can then be compared to the 'available headroom' to determine the final supply-demand balance.

The 'available headroom' in a WRZ is equal to the difference between water available for use (WAFU) and demand at specified points in time. If the available headroom is greater than or equal to target headroom, then the desired level of service should be achieved. However, if our available headroom were to fall below the target headroom, we would face the risk of failing to meet our chosen level of service.

The methodology we are using to determine our target headroom was designed to identify the principal uncertainties in the supply-demand balance and convert these into headroom. The calculation is based on assigning a score to each source of uncertainty and then converting the total score for each WRZ to target headroom.

The sources of uncertainty have been grouped under eleven headings – eight are supply related and three are demand related.

Supply Factors	Demand Factors
Vulnerable Surface Water Licences Vulnerable Groundwater Licences Time Limited Licences Bulk Transfers Gradual Pollution Causing a Reduction in Abstraction Accuracy of Supply-side data	Accuracy of Sub-Component Data Demand Forecast Variation Uncertainty of Climate Change on Demand

Single Source Dominance and Critical Periods Uncertainty of Climate Change on Yield	

Table C1.1 - Target headroom calculation factors

The methodology works through each of the factors, assigning an appropriate headroom score which is directly related to the degree of uncertainty and the impact it may have on the supply-demand balance for the WRZ under assessment. The scores are aggregated for each WRZ and then transformed by means of a conversion chart into a value for target headroom. Copies of the assessment for each WRZ can be found in Appendix G – Supporting documents and the results of the assessment are shown below.

	Present Day → Planning Horizon						
	2016/17						2044/45
Water Available for Use (Ml/d)	28.98						27.25
Target Headroom (%)	6.45 Of which 0% CC						6.55 Of which 0.27% CC
Target Headroom (Ml/d)	1.87 Of which 0 CC						1.78 Of which 0.074 CC
Available Headroom (Ml/d)	3.90						3.41

Table C1.2 - Chester WRZ target headroom results

	Present Day → Planning Horizon						
	2016/17						2044/45
Water Available for Use (Ml/d)	49.75						48.79
Target Headroom (%)	4.50 Of which 0% CC						5.00 Of which 0.45% CC
Target Headroom (Ml/d)	2.24 Of which 0 CC						2.44 Of which 0.22 CC
Available Headroom (Ml/d)	7.12						10.37

Table C1.3 - Wrexham WRZ target headroom results

The results of the headroom assessment, combined with the supply and demand forecasts provide us with our 'supply-demand balance' details of which are set out in the next section.

Components

As explained above, the methodology considers a number of components to make up the headroom score. The explanation of our calculations for some of the key components is set out below. In addition, we have included justification for those components that were not included in the uncertainty calculation, resulting in 0 scores.

S1 and S2 – licensing vulnerabilities

In their Water Resources Planning Guidelines (2016), NRW and EA instruct water companies not to include any allowances in target headroom for uncertainty related to sustainability changes to permanent licences. The guidelines state that they will work with water companies to ensure that sustainability changes will not impact on security of supply, and so there is no need for a headroom allowance to be made.

In accordance with the planning guidelines therefore, we have made no allowances for S1 (vulnerable surface water licences) or S2 (vulnerable groundwater licences) issues in our target headroom assessment. All sustainability changes are dealt with outside of target headroom, as part of the supply demand balance calculation. We have no vulnerable surface water licences within our supply area and the impact on the SDB of possible changes to our groundwater licence in Chester WRZ has been considered in App A – section A2.1.3.

S3 Issues – time limited licences

Although the NRW and EA's Water Resource Planning Guidelines now allow companies to make an allowance for uncertainty around non-renewal of time limited licences we have made no explicit allowance for it in our headroom assessment. We currently have one time limited licence which is due to expire in March 2018. We have applied to renew the licence and have assumed renewal for the purposes of the SDB, as advised by NRW. We have therefore made no uncertainty allowance for time limited licences in the headroom calculation.

S4 Issues - uncertainties relating to bulk transfers

Any significant bulk transfers are included within the modelled deployable output, and so any corresponding uncertainty is allowed for under S6 (accuracy of supply side data) issues. Consistent with our WRMP14, no explicit allowance has been made for S4 issues in our headroom assessment.

S5 – Gradual pollution causing a reduction in abstraction

None of our abstractions have been identified as being as risk from gradual pollution.

S6 – Accuracy of supply side data

NRW provided a historical time series of cutbacks for the River Dee (1927 to 2015) which were fed into the Aquator model for initial DO assessment and we therefore have fairly high confidence in this data. However, our reservoir catchments are ungauged and there was therefore no gauged flow data that could be used as reservoir inflows in Aquator. Overall, therefore, we feel sufficiency of supply side data is average.

S7 – Single Source Dominance and critical periods

Due to over 85% of our water coming from the River Dee, it meets the criteria for single source dominance.

S8 – Uncertainty of climate change on yield

The DO under climate change was assessed for both WRZs. NRW tested 100 scenarios and used the six median scenarios to generate climate change versions of the abstraction tables from the Dee General Directions. The net abstraction volume for DVW was reduced by 1.61 Ml/d based on this assessment. As the Chester zone is 100% consumptive the most efficient way to appy the reduction was at the Dee Chester abstraction point. The cutback levels remained the same as they were in the baseline run, as did the maximum allowable abstraction. For WRX WRZ, this meant that the safe yield allocation, stage 1 and stage 2 cutbacks DO was 41.50 Ml/d.

For WRX WRZ, the monthly climate change factors were applied to the baseline inflows to the DVW reservoirs previously generated using a resampling procedure. This created a perturbed time series of flows for each of the six climate change scenarios, and similarly, new time series for the NRW imposed cutbacks were created for each scenario.

D1 – Accuracy of sub-component data

Our baseline demand forecasts assume a continuation of current rates of optional metering of unmeasured households - this is 3.2% of unmeasured household properties opting for a meter each year. For demand headroom analysis, a triangular distribution has been assumed around the central rate with upper and lower parameters set as follows:

- Lower bound – 2.85% of unmeasured customers opt per annum
- Upper bound – 3.55'% of unmeasured customers opt per annum

The 2019 EA WRMP guidelines explicitly instruct water companies to account for the local council projections of household growth for supply capacity planning purposes. In light of this, we are adopting Local Council projection of growth from AMP7 onwards for the WRMP19 central housing growth forecast. We have prepared the new property forecast using the Welsh Governments Local Authority Households Projections data set published March 2017 and local authority data sets for English councils.

However, the local authority forecasts represent a stepped increase in new households over current. For uncertainty analysis we have assumed a triangular distribution using the LPA growth projections and historically observed growth in our region:

- Upper/central assumption - LPA projections
- Lower bound – Historic average growth rate

For estimates of future total population we have used trends from the latest Cheshire West/Chester Council population forecasts and Welsh Government Local Authority population projections and applied these to our base year data.

Population uncertainty is based on high and low population projections for Welsh Government Local Authorities and Cheshire West/Chester Council projections , each of which are based on projections combining variants of births, deaths and migration for Wales and England.

D2 – Demand Forecast Variation

Two scenarios based on micro-component trends are added to account for variations within the future predicted rate of change in consumption:

- Sustainable development - in this most extreme efficiency scenario, we have assumed that water saving is driven by both technological advancements and attitudinal changes. Sophisticated filtration technology would allow recirculation of shower water saving both energy and water. Waste water and washing functions are fulfilled by greywater recycling, aided by hydrophobic frictionless surfaces. Bathing is pretty much obsolete.
- Market trend - this scenario assumes that the projected trend in micro-components does not continue beyond 2022. This would require a situation such as Brexit where UK building regulations may be de-coupled from current standards and the logical decline in flush volumes is curtailed. The observed upward trend in showering continues to increase.

For measured non-household water consumption, we have based uncertainty bounds on a high and low economic growth scenario forecast, relative to the central estimate. Plausible economic scenarios were constructed to provide a range of possible outcomes. These involved variations in the macro assumptions to create alternative water demand forecasts as explain below.

The high scenario envisages that the UK economy will quickly recover after a modest initial post-referendum dip. This assumes that the rapid formation of the new government reassures investors and leads to good early progress on negotiating new trade arrangements with the EU, perhaps similar to the existing EEA member status for the UK but including a provision for some emergency brakes on migration. It also assumes promising initial discussions with other major trading partners such as the US, China and the Commonwealth countries, although actual deals would take longer to agree.

In the medium to long-term, the UK economy will slowly return to long-term growth rates of 2.5 per cent projected by the Office for Budget Responsibilities[1] (OBR) which was produced prior to the EU referendum and represents a more optimistic outlook for the UK's long-term growth path. The inflation pressure has soon subsided following the recovery of the value of Sterling, stronger economic fundamentals allow the Bank of England to raise interest rates at a faster pace than the central scenario.

The low scenario assumes that negotiation with the EU has proved difficult, raising concerns for a possible 'hard-Brexit' and the UK perhaps relying on WTO rules to trade with the EU. This has led to a further fall of the value of Sterling, which in turn leads to a further increase in inflation coupled with the loss of consumer and business confidence which undermine both consumer spending and business investment. In this case, the UK could enter a period of

[1] The assumptions are set out in the OBR's fiscal sustainability report June 2015. http://budgetresponsibility.org.uk/fsr/fiscal-sustainability-report-june-2015/

recession for the next 12-24 months and permanently lower the nation's growth potential. The Bank of England keeps the interest rates low in support of economic growth despite a period of higher inflation, the pace of interest rates rises is likely to be slow and gradual. The UK economy finally emerges from the recession stabilising at a below trend growth trajectory until the end of the forecast period.

D3 – Uncertainty of Climate Change on demand

We used the UKWIR (2013) Impact of Climate Change on Water Demand methodology, as required by the EA/NRW guidance, to determine the likely impact of climate change on our demand forecast. Reference data used was the Severn Trent Household Relationship - Annual Average, 50th percentile scaling factor. This results in a less than 1% increase in demand over the planning period.

C2. Supply-Demand Balance

To calculate the supply-demand balance, we take the water that is available to supply and subtract our required demand and headroom to give the balance. Our assessment of the dry year annual average supply-demand balance indicates that there will be adequate resources to meet water needs in Chester and Wrexham WRZs through to 2044/45. The balance for each WRZ is shown in Figure C2.1 below.

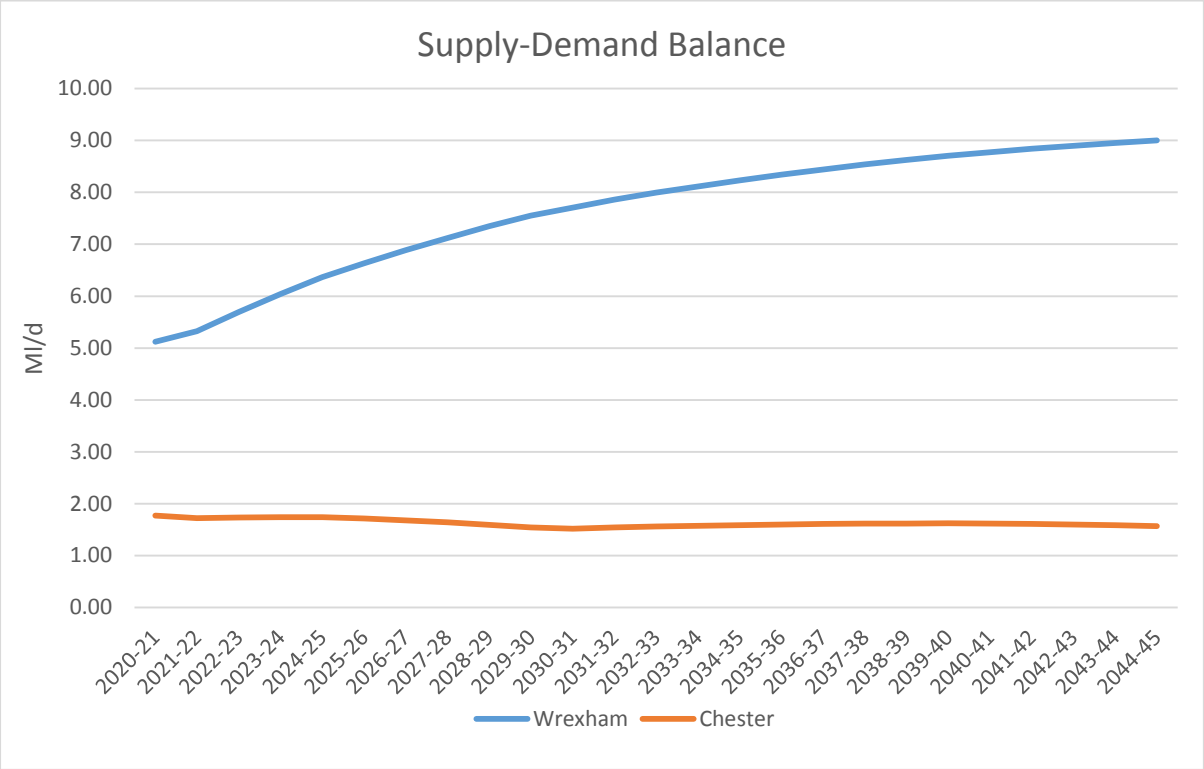

Figure C2.1 - Supply-Demand balance for Wrexham & Chester WRZs

Figures C2.2 and C2.3 show the results of the headroom analysis for each of the WRZs. As can be seen, the available headroom never crosses the target headroom, indicating that there is no deficit throughout the planning horizon and therefore we do not need to develop any new supply options or invest in any significant demand management options at this time.

Appendix C – Target Headroom and the Supply-Demand Balance

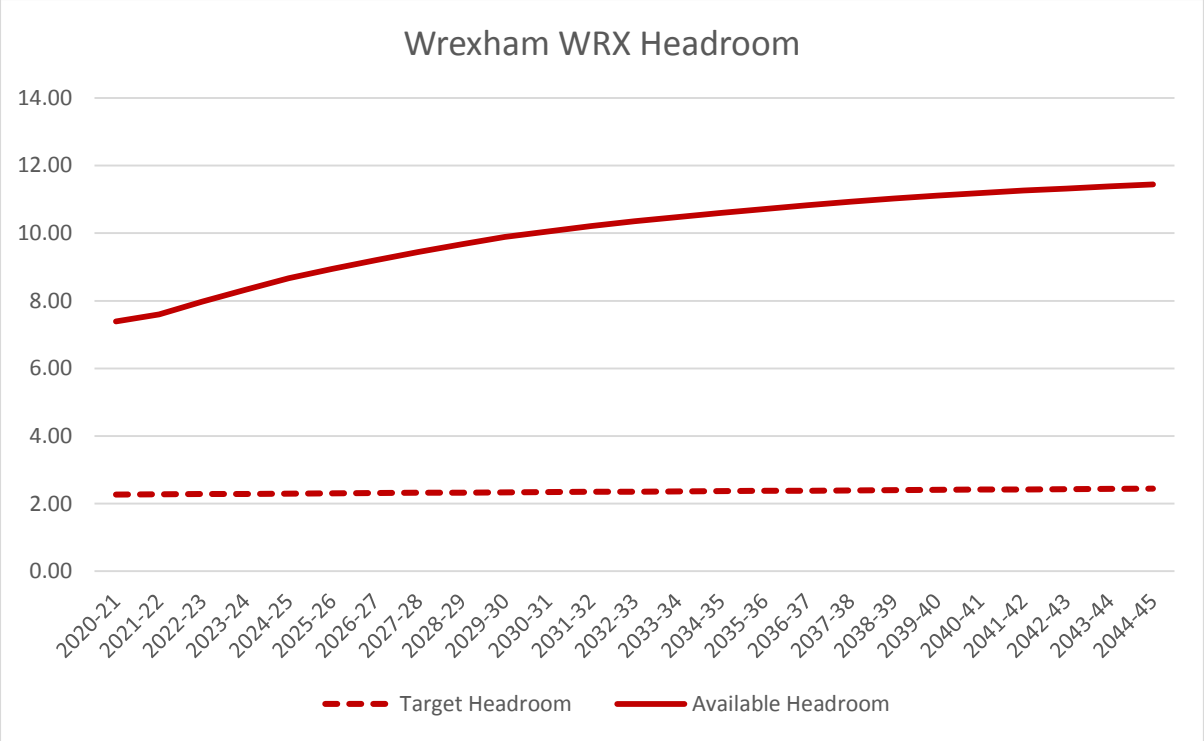

Figure C2.2 - Wrexham WRZ headroom profile for WRMP19

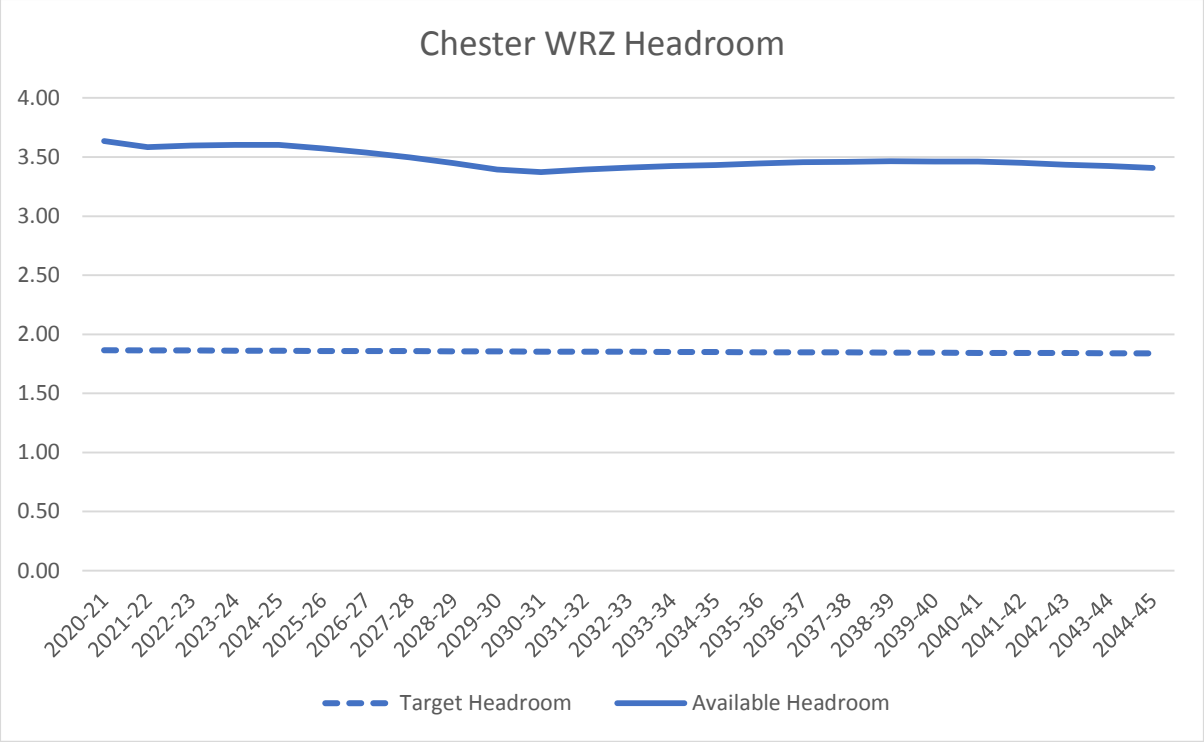

Figure C2.3 - Chester WRZ headroom profile for WRMP19