APPENDIX G – Supporting Information

G1. Problem Characterisation

Introduction

The **problem characterisation** assessment is a tool for assessing a company's vulnerability to various strategic issues, risks and uncertainties, to allow the development of a proportional response, in terms of effort and cost devoted to adopting the selected decision making approach. Its purpose is thus to help guide planners to the most appropriate decision making tools given the planning problem that they face, and provide them with an understanding that will help them select the **Risk Composition** and **component methods** that they need to use¹.

Assess strategic needs ("How big is the problem?")

This entails three simple 'headline' questions that explore the size of any potential supply demand deficit, and the cost (in relative terms) of the supply and demand management options.

The supply demand deficit has been separated into a supply component and a demand component, as it is possible to have a significant deficit that is mainly caused by either increasing demand or reducing yield (e.g. from climate change or the Restoring Sustainable Abstraction programme), so only one component may be 'of concern'.

Strategic WRMP risks	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
S. Level of concern that customer service could be				
significantly affected by	0	-	-	
current or future supply side risks, without investment.				
D. Level of concern that				
customer service could be	0			
significantly affected by	0			
current or future demand side				
risk, without investment.				
I. Level of concern over the				
acceptability of the cost of the				
likely investment programme,	0			
or that the likely investment	0			
programme contains				
contentious options (including				
environmental / planning				
risks).				

Table 1 - Assessment of the strategic needs for WRMP purposes

¹ UKWIR (16/WR/02/11): WRMP 2019 Methods – Risk Based Planning

Assess complexity factors ("How difficult is it to solve?")

The second part of the problem characterisation stage is an assessment of the 'complexity factors'. The purpose of these is to explore the nature of the risks and vulnerabilities that exist within the WRMP, with a particular emphasis on identifying whether these complexities, in combination with the level of strategic risk, indicate that methods beyond the previous EBSD may be required. These factors will be used to provide general guidance on suitable approaches.

It is recommended that companies record any other concerns that they identify during the assessment of complexity factors. These may need further discussion with regulators and to be taken into account in determining the degree of modelling complexity required.

Supply side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
S(a): Are there concerns about				
near term supply system				
performance, either because of				
recent Level of Service failures or				
because of poor understanding of				
system reliability / resilience under	✓			
different or more severe droughts				
than those contained in the				
historic record? Is this exacerbated				
by uncertainties about the benefits				
of operational interventions				
contained in the Drought Plan?				
S(b): Are there concerns about				
future supply system performance,				
primarily due to uncertain impacts				
of climate change on vulnerable	✓			
supply systems, including				
associated source deterioration				
(water quality, catchments etc), or				
poor understanding?				
S(c): Are there concerns about the				
potential for 'stepped' changes in				
supply (e.g. sustainability	✓			
reductions, bulk imports etc) in the				
near or medium term that are				
currently very uncertain?				
S(d): Are there concerns that the				
DO metric might fail to reflect				
resilience aspects that influence				
the choice of investment options				
(e.g. duration of failure), or are	✓			
there conjunctive dependencies				
between new options (i.e. the				
amount of benefit from one option				

depends on the construction of		
another option). These can both be		
considered as non-linear problems.		

Table 2 - Assessment of supply side complexity for WRMP purposes

Demand side complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
D(a): Are there concerns about				
changes in current or near term				
demand e.g. in terms of demand	\checkmark			
profile, total demand, or changes				
in economics / demographics or				
customer characteristics?				
D(b): Does uncertainty associated				
with forecasts of demographic /				
economic / behavioural changes	\checkmark			
over the planning period cause				
concerns over the level of				
investment that may be required?				
D(c): Are there concerns that a				
simple 'dry year / normal year'				
assessment of demand is not				
adequate e.g. because of high	✓			
sensitivity of demand to drought				
(so demand under severe events				
needs to be understood), or				
because demand versus drought				
timing is critical.				

Table 3 - Assessment of demand side complexity for WRMP purposes

Investment programme complexity factors	No significant concerns (Score = 0)	Moderately significant concerns (Score = 1)	Very significant concerns (Score = 2)	Don't know
I(a): Are there concerns that capex uncertainty (particularly in relation to new or untested technologies) could compromise the company's ability to select a 'best value' portfolio over the planning period?	√			
I(b): Does the nature of feasible options mean that construction lead time or scheme promotability are a major driver of the choice of investment portfolio?		√		
I(c): Are there concerns that tradeoffs between costs and non-monetised 'best value' considerations (social, environment) are so complex that	√			

they require quantified analysis (beyond SEA) to justify final investment decisions.			
I(d): Is the investment programme sensitive to assumptions about the utilisation of new resources, mainly because of large differences in variable opex between investment options?	√		

Reviewing the outcomes of problem characterisation

			Strategic Needs Score ("How big is the problem")		
		0-1	2-3	4-5	6
		(None)	(Small)	(Medium)	(Large)
Complexity	Low (<7)	☺			
Factors Score ("How difficult it	Medium (7-11)				
is to solve")	High (11+)				

Low level of concern

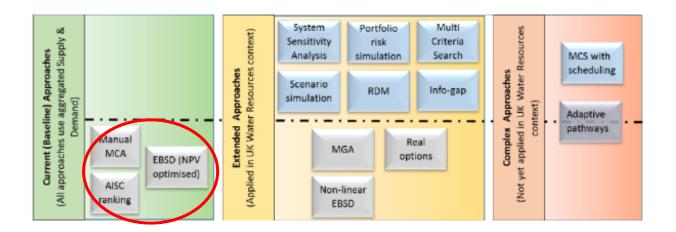
• 'Current' approaches (EBSD) should be adequate, and specific complexities can be examined through the steps recommended in the parallel UKWIR *Risk Based Planning Methods* project.

Moderate level of concern

• 'Extended' approaches to modelling may add considerably to a company's understanding.

High level of concern

• Consider whether it would be useful to apply more than one of the 'extended' approaches to decision making, or even the use of the 'complex' approaches, as these could add considerably to the company's understanding.



Characterisation Aspect	What to note to support Risk Based Method Decisions	What the notes will be used for
Overall Strategic Need	Whether the area falls into the Low, Medium or High vulnerability classification.	Higher levels of strategic need are likely to require more complex Risk Composition, and can lead planners towards adopting more complex integration methods.
Supply Side Complexity concerns	 a) Significance of concerns about the uncertainties that the company faces in terms of (current day) drought resilience (question S(a)). b) Significance of concerns about the adequacy of a single 'DO' metric in describing drought risk for the supply system (question S(d)). 	Supports the decision about the Risk Composition but also guides practitioners to consider more complex methods for determining: a) The definition of risk / return period for supply / DO variability or generated timeseries. b) The need for, and complexity of methods used for the generation of Drought Events or Libraries outside of the events observed in the historic record.
Demand Side Complexity concerns	 c) Significance of concerns about uncertainties in the demand forecast (question D(a)). d) Significance of concerns about the level of sensitivity of DO calculations to the inter-annual variability and 'shape' of demand profiles (question D(d)). 	Supports the decision about the Risk Composition but also guides practitioners to consider more complex methods for determining: c) The possible need for probabilistic demand forecasting (as opposed to simple Target Headroom type assessments). d) The need to define the variability in demand beyond a simple dry year / normal year evaluation.
Investment Complexity concerns	e) Significance of concerns about the sensitivity of the plan to capex uncertainties. f) Significance of concerns about the sensitivity of the Plan to utilisation and opex of new options (e.g. where options such as desalination or effluent re-use might form part of the Plan).	Leads practitioners to consider the use of the following extended methods for investment / cost analysis: e) Risk based discounting and/or improved methods for evaluating capex uncertainty. f) More complex integration methods (probabilistic methods or complex sampling) that better define utilisation.

G2. Target Headroom Assessment

As discussed in Appendix C, we used A Practical Method for Converting Uncertainty into Headroom (UKWIR Report Ref. 98/13/1) methodology to determine our target headroom. The assessments for each WRZ are set out below.

Chester WRZ

Form 1A

	e Summary informatio				
Use		resource zone details and calculation	n summary		
Ref	Steps 1, 7 and 8 of th	e step-by-step guide			
COMPA	ANY AND RESOURCE ZON	IE DETAILS			
Compa	iny name	Dee Valley Water			
Resour	rce zone name / ref	Chester (CHR)			
Level o	of service	1 in 40			
Climate	e change incorporated?				
Version	n	Draft			
Prepare	ed by	Liz Franks			
	,				
Job Titl	le or Position	Water Resources & Catchment Sp	pecialist (Wales)		
			` , ,		
Review	ved by				
	,				
loh Titl	le or Position				
300 110	ic of rosition				
DECLIIT	TS OF HEADROOM CALCU	HATION			
KESULI	13 OF HEADROOM CALCO	Present day —		→ Planning h	orizon
Row		2016/17		- Plaililling II	2044/45
NOW		2010/17			2044/45
H1	Water available for u	se (MI/d) 28.98			27.25
пт	vvater available for t	Se (IVII/U) 28.98			27.25
шэ	Target Headres := /0/	6.45			6.55
H2	Target Headroom (%				6.55
112	T	0% CC			0.27% CC
Н3	Target Headroom (M				1.78
		0CC			0.074 CC
H4	Available Headroom	(MI/d) 3.90			3.41

Form 1B

Purpose	Select those factors that affect the resource zone under			
Use	study	the step by step guide	-	
Ref	Step 2 or	the step-by-step guide	_	
	Factor		Include	
Row	ref.	Factor	(Y or N)	Justification for exclusion of factor
H5	S1	Vulnerable Surface Water Licences	N	NRW have confirmed no change or unlikely to change
Н6	S2	Vulnerable Groundwater Licences	N	As above
H7	S 3	Time Limited Licences	N	No time limited licences in this WRZ
Н8	S4	Bulk Transfers	N	Negligible (Old Warren - DCWW import)
		Gradual Pollution Causing a Reduction in		We have not been made aware of any abstractions within the WRZ that
Н9	S 5	Abstraction	N	are susceptible to gradual pollution
H10	S6	Accuracy of Supply-Side Data	Υ	This factor must be assessed for all resource zones
H11	S7	Single Source Dominance and Critical Periods	Υ	River Dee
				Our climate change assessment for Chester WRZ doesn't meet the
H12	S8	Uncertainty of Climate Change on Yield	N	methodology criteria.
H11	D1	Accuracy of Sub-Component Data	Υ	This factor must be assessed for all resource zones
H12	D2	Demand Forecast Variation	Υ	This factor must be assessed for all resource zones
H13	D3	Uncertainty of Climate Change on Demand	Υ	

Form 2A

Purpose	Data requirements and availability			
	Check list of data required for the			
Use	headroom calculation			
Ref	Step 3 of the step-by-step guide			
Factor Ref.	Factor	Data required	Units	Data available (Y/N)
iter.	1 detoi	Water Available for Use from the present day to the	Omes	1
	General	planning horizon	MI/d	✓
	General	The names of all the surface water licences that the water	, «	
		company believes may be vulnerable to a reduction in		
		abstraction. This does not include reductions due to gradual pollution.	-	-
S1	Vulnerable Surface Water Licences	Estimate of DO at risk for each source	MI/d	0
S2	Vulnerable Groundwater Licences	The names of all the ground water licences that the water	IVII/U	U
32	vullerable diodiluwater Licences	company believes may be vulnerable to a reduction in		
		abstraction. This does not include reductions due to gradual	-	-
		pollution.		
		Estimate of DO at risk for each source	MI/d	0
S3	Time Limited Licences	The names and expiry dates for all the Time Limited Licences		
		that the water company will actively pursue for renewal	YYYY	-
		The Time Limited Licence volume at risk	MI/d	0
S4	Bulk Transfers	Names of all the bulk transfers into the resource zone	, «	√
		The DO or transfer rate of bulk transfer	MI/d	✓
S5	Gradual Pollution Causing a Reduction in	The names of all sources whose abstraction is at risk from		
	Abstraction	reduction due to gradual pollution	-	-
		The DO at risk from gradual pollution for each source	MI/d	0
S6	Accuracy of Supply-Side Data	Average, or typical, length of gauging and/or level record		/
		used in calculation of resource zone WAFU	yrs	•
		Sufficiency of data used in analysis	-	✓
		Accuracy of flow naturalisation (if applicable)	-	✓
S7	Single Source Dominance and Critical	The largest deployable output from a source in the resource		√
	Periods	zone. This DO figure should be that quoted in the WR	MI/d	, ,
		The name of the above source		✓
		The critical period of the resource zone		✓
		Resource zone WAFU at planning horizon for the four		
		climate change scenarios detailed in the UKWIR/EA 'Effects		✓
		of climate change on river flows and ground water recharge'		
S8	Uncertainty of Climate Change on Yield	report 97/CL/04/1	MI/d	

Form 2B

Purpose	Data requirements and availability Check list of data required for the			
Use	headroom calculation			
Ref	Step 3 of the step-by-step guide			
Factor Ref.	Factor	Data required	Units	Data available (Y/N)
D1	Accuracy of Sub-Component Data	The reliability band for the data components used in the initial water balance and the demand forecasts		✓
		An estimate of the reconciliation item from the initial water balance	MI/d	✓
D2	Demand Forecast Variation	Either Dry year annual average unrestricted demand (best estimate) up to planning horizon	MI/d	✓
		Dry year annual average unrestricted demand up to planning horizon - upper forecast	MI/d	✓
		Dry year annual average unrestricted demand up to planning horizon - lower forecast	Ml/d	✓
		Or Dry year unrestricted crtical demand (best estimate) up to planning horizon	MI/d	-
		Dry year unrestricted critical demand up to the planning horizon - upper forecast	YYYY	-
		Dry year unrestricted critical demand up to the planning horizon - lower forecast	MI/d	-
D3	Uncertainty of Climate Change on Demand	Water company best estimate forecast of the impact of climate change on demand	Ml/d	✓

Form 3A

Purpose	Target F	leadroom Calculation														
Jse	To calcu	late the target headroom for the resource zone														
Ref	Steps 4,	5 and 6 of the step-by-step guide / Score guidance	e notes													
			Pres	ent day ———		Planning horize	on	9	5 ²	% of score attributable to climate change:						
	Factor		201	6/17		204	4/45				1) S8 ² + D	3 ²				
Row	ref.	Factor	201	0/1/		204	4/43	2016/17	2044/55		2) Square	root of S8	² + D3 ² divi	ded by sun	n of	
H14	S1	Vulnerable Surface Water Licences	(0			0						2 ² +D3 ² then			
H15	S2	Vulnerable Groundwater Licences	(0			0						n climate c			oom %
H16	S3	Time Limited Licences	(0			0						result of s	-	-	
H17	S4	Bulk Transfers	(0			0									•
		Gradual Pollution Causing a Reduction in														
H18	S 5	Abstraction	(0			0									
119	S6	Accuracy of Supply-Side Data	1	5		1	L.5	2.25	2.25							
120	S7	Single Source Dominance and Critical Periods		7			7	49	49							
H21	S8	Uncertainty of Climate Change on Yield	(0			0	0	0		-					
H22	D1	Accuracy of Sub-Component Data	- 2	2			2	4	4							
H23	D2	Demand Forecast Variation	(0			2	0	4							
H24	D3	Uncertainty of Climate Change on Demand	(0			1	0	1							
H25		SUM OF SCORES FOR S1, S2, S3, S4 AND S5	(0			0			1.66	5					
H26		SQUARE ROOT OF S6 ² +S7 ² +S8 ² +D1 ² +D2 ² +D3 ²	7.	43		7.	.76	55.25	60.25		_					
127		TOTAL SCORE (H25+H26)	7	43		7	.76									
14/		TOTAL SCORE (1125+1120)	7.	43		7.	.70									
H28		TARGET HEADROOM (%)	6.	45		6	.55									
							0.11									

Form OA

orm QA	4												
urpose	To record all da	ta and assur	nptions used ir	the Hea	droom Calcu	ulation							
se	To perform the	target head	room calculation	n									
ef	Refer to step 4	of the step-l	by-step guideli	nes and t	he guidance	notes for further	details						
IOTE													
) The fo	rm is divided into	sections re	lating to the ur	certainty	y factors in t	he headroom cald	ulation						
ne facto	rs are:												
	Supply related	S1	Vulnerable	Surface	Water Licen	ces							
		S2	Vulnerable	Ground	water Licenc	ces							
		S 3	Time Limit	ed Licenc	ces								
		S4	Bulk Transt	ers									
		S 5	Gradual Po	Ilution C	ausing a Rec	luction in Abstrac	ion						
		S6	Accuracy o	f Supply-	Side Data								
		S7	Single Sou	rce Domi	nance and C	ritical Periods							
		\$8	Uncertaint	y of Clima	ate Change	on Yield							
	Demand related	d D1	Accuracy o	f Sub-Cor	mponent Da	ta							
		D2	Demand Fo		•								
		D3	Uncertaint	v of Clima	ate Change	on Demand							
				•	J								
All sec	tions of Form QA	MUST be co	mpleted. If the	uncerta	inty factor is	not relevant to t	ie resource	zone, ente	r N/A in tl	he space p	rovided for	a score.	
	ref.' refers to th		-		-			,	•				
•		•	-	_		dance notes is to	ecord the	source nam	e - this is i	reference	d as action (b) on this fo	orm.
Ü	J			•	, 0						`	,	
eneral													
IOTE													
The W	AFU should be th	ose figures	from the Wate	Resourc	es Planning	Guidelines:							
,						C a. a.cco.							
	Pres	ent day —				Planning horizon							
		6/17				2044/4	5						
		.98				27.25							
	VV/AI U 20	.50				21.20	(۱۷۱۱/ ۵)						+

Form S1

ulnerab	le Surface Water Licences											
No.	Name of Vulnerable Licences	DO at risk (MI/d)		of license ed or abstr								
				Likely as			Total DO a	t rial for a) (aluma a (1) (d)		
	1 N/A		Likely	not	Officery		Total DO a		Likely	Volume (Ml/d)	(1)	
	2								Likely as not		(2)	
	3								Unlikely		(3)	
	4											
	5						Estimated	total DO a	t risk		MI/d (4)	(1)+(2)+(3)
	6											
	7						Estimated	total DO a	s % of WAFU		% (5)	(4)/WAFU*100
	8											
			DO as % of total vol at risk		Score for each likelihood as % of WAFU at risk			Weighted headroom scores				
	Likely	(1)/(4)*100		(6)		(9)	(6)*(9)/100					
	Likely as not	(2)/(4)*100		(7)		(10)	(7)*(10)/100					
	Unlikely	(3)/(4)*100		(8)		(11)	(8)*(11)/100					
				Headroon	n score	0	out of 10					

Form S2

ulnerable	Groundwater Licences												
No.	Name of Vulnerable Licences	DO at risk (MI/d)	1	of license ed or absti									
			Likely	Likely as			Total DO a	t risk for e	ach category	Volume (MI/d)			
	1 N/A		LIKETY	1100	Officery		Total bo a		Likely	Volume (IVII/a)	(1)		
	2								Likely as not		(2)		
	3								Unlikely		(3)		
	4 5						Estimated	total DO a	t rick		MI/d (4)	(1)+(2)+(3)	
	6						LStilliated	lotar bo a	LTISK		1VII/ U (4)	(1)+(2)+(3)	_
_	7						Estimated	total DO a	s % of WAFU		% (5)	(4)/WAFU*100	0
	8												
			DO as % of total vol at risk		Score for each likelihood as % of WAFU at risk			Weighted headroom scores					
	Likely	(1)/(4)*100		(6)		(9)	(6)*(9)/100						
	Likely as not	(2)/(4)*100		(7)		(10)	(7)*(10)/100						
	Unlikely	(3)/(4)*100		(8)		(11)	(8)*(11)/100						
				Headroon	n score	0	out of 10						

Form S3

ime Limite	ed Licences											
No.	Name of Source with Time Limited Licence	DO at risk (MI/d)		of license ed or abstr								
	Emitted Electrice		Likely	Likely as			Total DO a	t risk for ea	ach category	Volume (MI/d)		
	1 N/A		Likely	1100	Ominery .		rotar Bo u		Likely		(1)	
:	2								Likely as not		(2)	
	3								Unlikely		(3)	
	4 5						Estimated	total DO a	t rick		MI/d (4)	(1)+(2)+(3)
	6						LStimuteu	lotal DO al	LIISK		1VII/ U (4)	(1)+(2)+(3)
	7						Estimated	total DO as	s % of WAFU		% (5)	(4)/WAFU*100
	8								_			
			DO as % of total vol at risk		Score for each likelihood as % of WAFU at risk			Weighted headroom scores				
	Likely	(1)/(4)*100		(6)		(9)	(6)*(9)/100					
	Likely as not	(2)/(4)*100		(7)		(10)	(7)*(10)/100					
	Unlikely	(3)/(4)*100		(8)		(11)	(8)*(11)/100					
				Headroon	n score	0	out of 10					

Form S4

ılk Transfe	ers			
No.	Name of Bulk transfers into Resource Zone	DO or Transfer Rate from Bulk Transfers (MI/d)		
1	N/A			
2				
3	3			
	1			
5	5			
			Tick	
	Overall reliability of the bulk transfer	Very reliable		
		Reliable		
		Less reliable		
	Total DO or transfer rate			MI/d
	Total DO or transfer rate as % of WAFU at			
	the present day			%
	Headroom score		0	out

Form S5

	ution Causing a Reduction in Al											
No.	Name of Source at Risk	DO at risk	Threat	of license	d being							
		(Ml/d)	revoke	ed or abstr	action							
		. , ,		Likely as								
			Likely	not	Unlikely		Total DO a	t risk for ed	ach category	Volume (MI/d)		
1	N/A								Likely		(1)	
2									Likely as not		(2)	
3									Unlikely		(3)	
4												
5							Estimated	total DO a	t risk		MI/d (4)	(1)+(2)+(3)
6												
7							Estimated	total DO a	s % of WAFU		% (5)	(4)/WAFU*100
8												
					Score for each							
					likelihood							
			DO as % of		as % of			Weighted				
			total vol at		WAFU at			headroom				
			risk		risk			scores				
	Likely	(1)/(4)*100		(6)		(9)	(6)*(9)/100					
	Likaluaa nat	(2) // 4) * 4 0 0		(7)		(40)	(7)*(40) (400					
	Likely as not	(2)/(4)*100		(7)		(10)	(7)*(10)/100					
	Unlikely	(3)/(4)*100		(8)		(11)	(8)*(11)/100					
	•	· // /										

Form S6

36 /	ccuracy of Si	upply-Sid	e Data									
		appiy Sidi	- Data									
a)	Average, o	r typical, l	ength of g	gauged and	d/or level r	ecords use	ed in WAFU	calculation		88	years	
b)	Select cate	gory to de	escribe suf	ficiency o	f data usec	l in WAFU	calculation				Tick	
										Good		
										Average	✓	
										Poor		
_	Record ius	tification	for salacti	ng an aver	age or noo	r category	(if applicat	le)				
_								7 to 2015) w	hich			
_							•	•				
			•					efore have f				
	_							d and there				
	therefore r	no gauged	I flow data	that could	d be used a	as reservoi	r inflows in	Aquator. C	verall,			
	therefore,	we feel st	ufficiency	of supply	side data is	average.						
)	Select which	ch catego	ry best des	cribes the	sufficienc	y of flow r	 naturalisatio	on used in			Tick	
	calculating	Resource	Zone WA	FU (if appl	icable)					Good		
										Average	✓	
										Poor		
										N/A		
d)	Select the	annronria	te score fr	om Table	S6 in the so	ore guida	nce notes f	for each				
			10 30010 11	OIII TUDIC	JO 111 CITE 30	Jore Baraa	nee notes i	or cacii				
1)		na ciinniv.	ctch ahis-								Entersco	re
<i>.</i> ,	aspectorti	ne suppiy	-side data					Length of	gallged re	cord	Enter sco	ore
	aspect of the	ne suppiy	-side data					Length of		cord	0	ore
	aspect of the	ne suppiy	-side data					Length of Sufficienc Accuracy of	y of Data			ore
	aspect of the	ne suppiy	-side data					Sufficienc	y of Data		0	ore

Form S7

River Dee	2				
YES/ NO	*delete	e as appropriate	2		
Construction					
		rce	✓		
		voir			
27	7.11	MI/d	(1)		
93	3.55	%	[(1)/WAFU at	present day]*100	
resource zone					
	Cate	egory	Tick		
more tha	n a singl	e season			
single sea	son (de	fined as 3 mont	ths)		
1 to 3 mo	nths				
>1 week	but < 1 n	nonth			
≤1 week					
not critica	al		✓		
space provided below					
	nut we h	ave heen worki	ing on the		
-		are been work	ing on the		
ne score so largery interes	uire.				
	-	7	out of 15		
		/	out of 15		L
	yES/NO Groundw River sou Impound Pumped: 27 92 resource zone more tha single sea 1 to 3 mo >1 week ≤1 week not critica space provided below ore than a single season' be	Groundwater sou River source Impounding reset Pumped storage r 27.11 93.55 resource zone Cate more than a single single season (de 1 to 3 months > 1 week but < 1 n ≤ 1 week not critical space provided below	YES/NO *delete as appropriate Groundwater source River source Impounding reservoir Pumped storage reservoir 27.11 MI/d 27.11 MI/d 93.55 % resource zone Category more than a single season single season (defined as 3 mont 1 to 3 months > 1 week but < 1 month ≤ 1 week not critical space provided below ore than a single season' but we have been work	YES/NO *delete as appropriate Groundwater source River source Impounding reservoir Pumped storage reservoir 27.11 MI/d (1) 93.55 % [(1)/WAFU at resource zone Category Tick more than a single season single season (defined as 3 months) 1 to 3 months > 1 week but < 1 month < 1 week not critical space provided below ore than a single season' but we have been working on the ne score so largely irrelevant.	YES/NO *delete as appropriate Groundwater source River source Impounding reservoir Pumped storage reservoir 27.11 MI/d (1) 93.55 % [(1)/WAFU at present day]*100 resource zone Category Tick more than a single season single season (defined as 3 months) 1 to 3 months > 1 week but < 1 month ≤ 1 week not critical space provided below ore than a single season' but we have been working on the ne score so largely irrelevant.

Form S8

1 011	11 50									
S8 U	ncertainty	of Climate	e Change o	n Yield						
	Climate	e Change	WAFU a	t planning						
	Sce	nario	horizo	n (Ml/d)						
(a)	HAI	DCM1								
(a)	GC	51m								
(a)	GS	51m								
(a)	G	S1t								
(b)	EA so	enario								
c)	Case		Desc	cription		Tick appr	opriate box			
	CASE 1	Two high	and two l	ow forecast						
	CASE 2	Three lov	w forecasts	and one h	gh forecast					
	CASE 3	Three hig	gh forecast	s and one I	w forecast					
(d)	Maximun	n spread ir	n WAFU at	planning ho	rizon			MI/d	(A)	
e)	Maximun	n spread a	s % of WAF	U at the pl	nning horiz	on		[(A)/WAFU a	t planning h	orizon]*100
(f)	Headroor	m score					0	out of 10		

Form D1
D1 Accuracy of Sub-Component Data

Component	Source	Reliability Band	Data type used (tick)
Initial Population Estimates	Local councils	A	(tick) ✓
	Census Agency	A	√
	OPCS	A	•
Initial Property Estimates	Billing Records	A	✓
	Other	A	✓ ×
Forecast of Future Population	Combination	В	,
·	Local councils	В	✓
	OPCS	В	
	Census Agency	В	✓
Forecast of Future Properties	Combination	A	√
·	DoE	В	
	Local councils	В	✓
Unmeasured Household	Own consumption monitor	Α	✓
Consumption	Other company monitor	В	
	Micro-component analysis	С	
	Continuous DMZ monitoring	С	✓
	Same as measured households	D	
	Residual in balance	D	
Unmeasured Non-household	Micro-component analysis	Α	
Consumption	Matching to measured customers	В	✓
	Industry average	D	
	Residual in balance	D	
Distribution losses	Widespread night flow tests	Α	✓
	Continuous DMZ monitoring	Α	✓
	Nat. Leak. Int. Models	В	
	Residual in balance	С	
Unmeasured Household	Micro-component analysis	А	✓
Consumption	Constant growth rate	В	
	Include effect of household size	Α	✓
Measured Household	Micro-component analysis	Α	✓
Consumption	Constant % of measured	С	
	Constant growth rate	С	
	Same growth as unmeasured	С	
	Include effect of household size	В	✓
	Separate different measured types	В	
Measured Non-household	Econometric forecast	Α	
Consumption	Constant growth rate	В	✓
	Consultation with large customers	Α	

		Price/competition scenarios	А	
				1
b)	Overall data reliability		Tick	
		Mostly class A	✓	
		Class A, B and C		
		Class B, C or worse		
			_	1
	Reconciliation item from initial			
c)	water balance		Tick	
		Good		
		Acceptable	✓	
		Poor		
				_
d)	Headroom score		2	out of 5

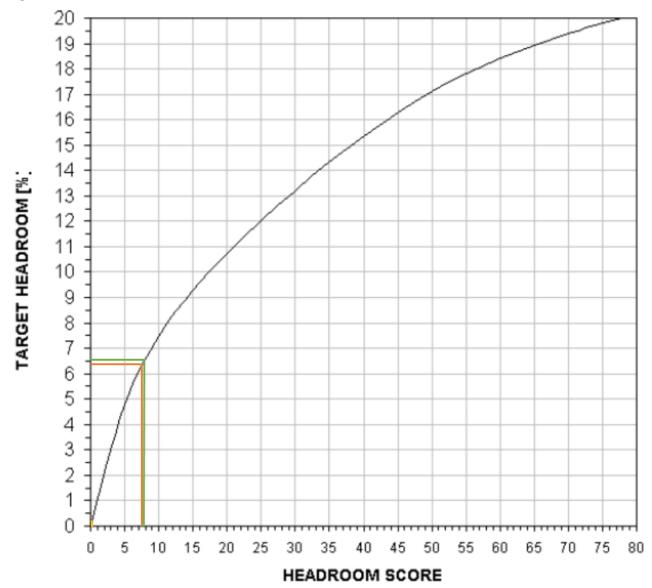
Form D2

D2 L	Demand Fo	precast Variation							
(a)		Forecast type	Present d	ay ——				Planning l	norizon
			2016/17						2044/45
		Dry year unrestricted daily demand (best estimate)	26.30						25.34
		Dry year unrestricted daily demand - upper forecast	26.30						24.45
		Dry year unrestricted daily demand - lower forecast	26.30						22.61
		or							
		Dry year unrestricted critical demand (best estimate)							
		Dry year unrestricted critical demand - upper forecast							
		Dry year unrestricted critical demand - lower forecast							
(b)	Case	Description	Tick appro	priate box					
	CASE 1	Best estimate forecast tends to lower forecast							
	CASE 2	Best estimate forecast tends to upper forecast	,	/					
c)	Maximu	m spread in demand forecasts at planning horizon	2.	7 3	MI/d	(1)			
c)	Spread i	n demands/WAFU at planning horizon as %	10	.02		[(1)/\/\ΔΕΙΙ	at 2044/45]*	*100	
٠,	Spicauli	action as your planning notized as 70	10			1(1), **, " O	2.2044,43]	100	
(d)	Headroo	m Score		2	out of 15				

Form D3

D3 (Incertainty of Climate Change on Demand		
			Tick
(b)	Select the category that best describes the impact of	Low	✓
	climate change on resource zone demand	Medium	
		High	
		Very High	
c)	Justify the selection in the space provided below:		
	_		

Target Headroom Conversion Chart



Wrexham WRZ

Form 1A

Purpos	e Summary information ar								
Use	Record company and res			d calculati	on summa	ary			
Ref	Steps 1, 7 and 8 of the st	ep-by-ste	p guide						
COMPA	ANY AND RESOURCE ZONE D	ETAILS							
Compa	iny name	Dee Vall	ey Water						
•	•		,						
Resour	rce zone name / ref	Wrexhar	m (WRX)						
Level o	of service	1 in 40							
Climate	e change incorporated?	Υ							
Versior	n	Draft							
Prepare	ed by	Liz Frank	is.						
Job Titl	le or Position	Water Ro	esources & C	atchment	Specialist	(Wales)			
Review	ved by								
Job Titl	le or Position								
RESULT	TS OF HEADROOM CALCULAT	TION							
			Present da	v —				Planning	horizon
Row			2016/17	•					2044/45
H1	Water available for use	(MI/d)	49.75						48.79
H2	Target Headroom (%)		4.50						5.00
			0% CC						0.45% CC
Н3	Target Headroom (MI/d)		2.24						2.44
			0 CC						0.22 CC
H4	Available Headroom (M	/d)	7.12						10.37

Form 1B

Purpose	_	ght those uncertainties that affect the resource ose factors that affect the resource zone under		
Use	study			
Ref		the step-by-step guide		
	Factor		Include	
Row	ref.	Factor	(Y or N)	Justification for exclusion of factor
H5	S1	Vulnerable Surface Water Licences	N	NRW have confirmed no change or unlikely to change
Н6	S2	Vulnerable Groundwater Licences	N	As above
				Current time limited licence due for renewal in 2018 so not relevant for
H7	S3	Time Limited Licences	N	this planning period
				Negligible (Farndon - UU export; Pontyblew - STW import; Glyndyfrdwy -
Н8	S4	Bulk Transfers	N	DCWW import)
		Gradual Pollution Causing a Reduction in		We have not been made aware of any abstractions within the WRZ that
Н9	S 5	Abstraction	N	are susceptible to gradual pollution
H10	S6	Accuracy of Supply-Side Data	Υ	This factor must be assessed for all resource zones
H11	S7	Single Source Dominance and Critical Periods	Υ	River Dee
H12	S8	Uncertainty of Climate Change on Yield	Υ	
H11	D1	Accuracy of Sub-Component Data	Y	This factor must be assessed for all resource zones
H12	D2	Demand Forecast Variation	Y	This factor must be assessed for all resource zones
H13	D3	Uncertainty of Climate Change on Demand	Y	This factor must be assessed for an resource zones

Form 2A

Purpose	Data requirements and availability			
,	Check list of data required for the			
Use	headroom calculation			
Ref	Step 3 of the step-by-step guide			
Factor Ref.	Factor	Data required	Units	Data available (tick)
iter.	1 actor	Water Available for Use from the present day to the	Offics	<u> </u>
	General	planning horizon	MI/d	✓
		The names of all the surface water licences that the water		
		company believes may be vulnerable to a reduction in	_	
		abstraction. This does not include reductions due to gradual		
		pollution.		
S1	Vulnerable Surface Water Licences	Estimate of DO at risk for each source	MI/d	0
S2	Vulnerable Groundwater Licences	The names of all the ground water licences that the water		
		company believes may be vulnerable to a reduction in	_	
		abstraction. This does not include reductions due to gradual	-	
		pollution.		
		Estimate of DO at risk for each source	MI/d	0
S3	Time Limited Licences	The names and expiry dates for all the Time Limited Licences	YYYY	
		that the water company will actively pursue for renewal	1111	
		The Time Limited Licence volume at risk	MI/d	0
S4	Bulk Transfers	Names of all the bulk transfers into the resource zone		
		The DO or transfer rate of bulk transfer	MI/d	0.03
S5	Gradual Pollution Causing a Reduction in	The names of all sources whose abstraction is at risk from		
	Abstraction	reduction due to gradual pollution	_	
		The DO at risk from gradual pollution for each source	MI/d	0
S6	Accuracy of Supply-Side Data	Average, or typical, length of gauging and/or level record	vrc	80
		used in calculation of resource zone WAFU	yrs	80
		Sufficiency of data used in analysis	-	✓
		Accuracy of flow naturalisation (if applicable)		N/a
S7	Single Source Dominance and Critical	The largest deployable output from a source in the resource	MI/d	41.5
	Periods	zone. This DO figure should be that quoted in the WR	IVII/ U	41.3
		The name of the above source		Twll
		The critical period of the resource zone		n/a
				✓
				Equivalent
				scenarios used
		Resource zone WAFU at planning horizon for the four	MI/d	as provided by
		climate change scenarios detailed in the UKWIR/EA 'Effects		NRW to Dee
		of climate change on river flows and ground water recharge'		catchment
S8	Uncertainty of Climate Change on Yield	report 97/CL/04/1		Catchinent

Form 2B

Purpose	Data requirements and availability			
	Check list of data required for the			
Use	headroom calculation			
Ref	Step 3 of the step-by-step guide			
Factor Ref.	Factor	Data required	Units	Data available (tick)
D1	Accuracy of Sub-Component Data	The reliability band for the data components used in the initial water balance and the demand forecasts	-	✓
		An estimate of the reconciliation item from the initial water balance	MI/d	✓
D2	Demand Forecast Variation	Either Dry year annual average unrestricted demand (best estimate) up to planning horizon	MI/d	✓
		Dry year annual average unrestricted demand up to planning horizon - upper forecast	MI/d	✓
		Dry year annual average unrestricted demand up to planning horizon - lower forecast	MI/d	✓
		Or Dry year unrestricted crtical demand (best estimate) up to planning horizon	MI/d	
		Dry year unrestricted critical demand up to the planning horizon - upper forecast	YYYY	
		Dry year unrestricted critical demand up to the planning horizon - lower forecast	MI/d	
		All demand forecasts are as defined in the EA/NRW Water Resources Planning Guidelines		✓
D3	Uncertainty of Climate Change on Demand	Water company best estimate forecast of the impact of climate change on demand	MI/d	✓

Form 3A

D	T	landon on Calaulatian										
•	-	eadroom Calculation										
Use		late the target headroom for the resource zone										
Ref	Steps 4,	5 and 6 of the step-by-step guide / Score guidance	e notes									
			Present day	Planning horizon		S ²				ble to clima	te change:	
	Factor		2016/17	2044/45				1) S8 ² +	D3 ²			
Row	ref.	Factor	2010/17	2044/43	2016/17	2044/55		2) Squa	re root of S8	3 ² + D3 ² divid	ed by sum of	
H14	S1	Vulnerable Surface Water Licences	0	0				S6 ² +S7 ²	+S8 ² +D1 ² +D2	2 ² +D3 ² then r	nultiplied by	100
H15	S2	Vulnerable Groundwater Licences	0	0							ange = target	
H16	S3	Time Limited Licences	0	0							ep 2) and divi	
H17	S4	Bulk Transfers	0	0						•		•
		Gradual Pollution Causing a Reduction in	0	0								
H18	S5	Abstraction	0	Ů,								
H19	S6	Accuracy of Supply-Side Data	1.5	1.5	2.25	5 2.25						
H20	S7	Single Source Dominance and Critical Periods	4	4	16	5 16						
H21	S8	Uncertainty of Climate Change on Yield	0	2	() 4						
H22	D1	Accuracy of Sub-Component Data	2	2	4	4 4						
H23	D2	Demand Forecast Variation	0	2	() 4						
H24	D3	Uncertainty of Climate Change on Demand	0	1	() 1						
							5					
H25		SUM OF SCORES FOR S1, S2, S3, S4 AND S5	0	0								
H26		SQUARE ROOT OF S6 ² +S7 ² +S8 ² +D1 ² +D2 ² +D3 ²	4.72	5.59	22.25	5 31.25						
							2.24	7.16				
H27		TOTAL SCORE (H25+H26)	4.72	5.59								
H28		TARGET HEADROOM (%)	4.50	5.00								
				0.36								

Form QA

Supply related 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 S7 Single Source Dominance and Critical Periods S8 Uncertainty of Climate Change on Yield Demand related D1 Accuracy of Sub-Component Data D2 Demand Forecast Variation D3 Uncertainty of Climate Change on Demand 2) All sections of Form QA MUST be completed. If the uncertainty factor is not relevant to the resource zone, enter N/A ir 3) 'Action ref.' refers to the guidance action given in the guidance notes for each factor e.g. For Single Source Dominance and Critical Periods action (b) in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance notes is to record the source name - this in the guidance name - this in the		
NOTE 1) The form is divided into sections relating to the uncertainty factors in the headroom calculation The factors are: Supply related		
1) The form is divided into sections relating to the uncertainty factors in the headroom calculation The factors are: Supply related \$1 Vulnerable Surface Water Licences \$2 Vulnerable Groundwater Licences \$3 Time Limited Licences \$4 Bulk Transfers \$5 Gradual Pollution Causing a Reduction in Abstraction \$6 Accuracy of Supply-Side Data \$7 Single Source Dominance and Critical Periods \$8 Uncertainty of Climate Change on Yield Demand related D1 Accuracy of Sub-Component Data D2 Demand Forecast Variation D3 Uncertainty of Climate Change on Demand 2) All sections of Form QA MUST be completed. If the uncertainty factor is not relevant to the resource zone, enter N/A ir 3) 'Action ref.' refers to the guidance action given in the guidance notes for each factor e.g. For Single Source Dominance and Critical Periods action (b) in the guidance notes is to record the source name - this inception of the complete of the source of the source name - this inception of the complete of the source name - this inception of the complete of the source name - this inception of the complete of the source name - this inception of the complete of the source name - this inception of the complete of the source name - this inception of the complete of the source name - this inception of the complete of the source name - this inception of the complete of the complete of the complete of the complete of the source name - this inception of the complete of the co		
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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 S7 Single Source Dominance and Critical Periods S8 Uncertainty of Climate Change on Yield Demand related D1 Accuracy of Sub-Component Data D2 Demand Forecast Variation D3 Uncertainty of Climate Change on Demand 2) All sections of Form QA MUST be completed. If the uncertainty factor is not relevant to the resource zone, enter N/A ir 3) 'Action ref.' refers to the guidance action given in the guidance notes for each factor e.g. For Single Source Dominance and Critical Periods action (b) in the guidance notes is to record the source name - this in General NOTE 1) The WAFU should be those figures from the Water Resources Planning Guidelines:		
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S4 Bulk Transfers S5 Gradual Pollution Causing a Reduction in Abstraction S6 Accuracy of Supply-Side Data S7 Single Source Dominance and Critical Periods S8 Uncertainty of Climate Change on Yield Demand related D1 Accuracy of Sub-Component Data D2 Demand Forecast Variation D3 Uncertainty of Climate Change on Demand 2) All sections of Form QA MUST be completed. If the uncertainty factor is not relevant to the resource zone, enter N/A in Action ref.' refers to the guidance action given in the guidance notes for each factor e.g. For Single Source Dominance and Critical Periods action (b) in the guidance notes is to record the source name - this in General NOTE 1) The WAFU should be those figures from the Water Resources Planning Guidelines:		
S5 Gradual Pollution Causing a Reduction in Abstraction S6 Accuracy of Supply-Side Data S7 Single Source Dominance and Critical Periods S8 Uncertainty of Climate Change on Yield Demand related D1 Accuracy of Sub-Component Data D2 Demand Forecast Variation D3 Uncertainty of Climate Change on Demand 2) All sections of Form QA MUST be completed. If the uncertainty factor is not relevant to the resource zone, enter N/A in Action ref.' refers to the guidance action given in the guidance notes for each factor e.g. For Single Source Dominance and Critical Periods action (b) in the guidance notes is to record the source name - this in General NOTE 1) The WAFU should be those figures from the Water Resources Planning Guidelines:		
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2) All sections of Form QA MUST be completed. If the uncertainty factor is not relevant to the resource zone, enter N/A in 3) 'Action ref.' refers to the guidance action given in the guidance notes for each factor e.g. For Single Source Dominance and Critical Periods action (b) in the guidance notes is to record the source name - this is General NOTE 1) The WAFU should be those figures from the Water Resources Planning Guidelines:		
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NOTE 1) The WAFU should be those figures from the Water Resources Planning Guidelines:		form.
1) The WAFU should be those figures from the Water Resources Planning Guidelines:		
1) The WAFU should be those figures from the Water Resources Planning Guidelines:		
<u> </u>		
Drocant day — Planning horizon		
rresenrady Frianning nonzon I		
2016/17 2044/45		
WAFU 49.75 48.79 (MI/d)		-

Form S1

ulnerable	Surface Water Licences											
No.	Name of Vulnerable Licences	DO at risk (MI/d)		of license								
			Likely	Likely as			Total DO a	t risk for ea	ach category	Volume (MI/d)		
1	N/a				J		1010.200		Likely		(1)	
2									Likely as not		(2)	
3									Unlikely		(3)	
5							Estimated	total DO a	t risk		MI/d (4)	(1)+(2)+(3)
E												
7	,						Estimated	total DO a	s % of WAFU		% (5)	(4)/WAFU*100
8												
			DO as % of total vol at risk		Score for each likelihood as % of WAFU at risk			Weighted headroom scores				
	Likely	(1)/(4)*100		(6)		(9)	(6)*(9)/100					
	Likely as not	(2)/(4)*100		(7)		(10)	(7)*(10)/100					
	Unlikely	(3)/(4)*100		(8)		(11)	(8)*(11)/100					
				Headroon	n score	0	out of 10					

Form S2

ulnerabl	e Groundwater Licences												
No.	Name of Vulnerable Licences	DO at risk	Threat	of license	e being								
		(MI/d)	revoke	ed or abstr	raction								
		' '		Likely as									
			Likely	not	Unlikely		Total DO a	t risk for ed	ach category	Volume (MI/d)			
	1 N/a								Likely		(1)		
	2								Likely as not		(2)		
	3								Unlikely		(3)		
	4												
	5						Estimated	total DO a	t risk		MI/d (4)	(1)+(2)+(3)	
	6												
	7						Estimated	total DO a	s % of WAFU		% (5)	(4)/WAFU*1	00
	8												
					Score for								
					each								
			DO as % of		likelihood as % of			Weighted					
			total vol at		WAFU at			headroom					
			risk		risk			scores					
	Likely	(1)/(4)*100		(6)		(9)	(6)*(9)/100						
	Likely as not	(2)/(4)*100		(7)		(10)	(7)*(10)/100						
	Unlikely	(3)/(4)*100		(8)		(11)	(8)*(11)/100						
	,												
				Headroon	n score	0	out of 10						

Form S3

ime Limite	d Licences											
No.	Name of Source with Time Limited Licence	DO at risk (MI/d)		of license ed or abstr								
	Emilieu Electrice		Likely	Likely as			Total DO a	t rick for p	ach category	Volume (MI/d)		
1	N/a		LIKETY	1100	Officery		Total Bo a		Likely	Volume (IVII/a)	(1)	
2	2								Likely as not		(2)	
3	3								Unlikely		(3)	
4												
ī							Estimated	total DO a	t risk		MI/d (4)	(1)+(2)+(3)
-							Estimated	total DO a	s % of WAFU		% (5)	(4)/WAFU*100
							Locarioteca		7,00,11,110		70 (3)	(4), 7711 0 100
			DO as % of total vol at risk		Score for each likelihood as % of WAFU at risk			Weighted headroom scores				
	Likely	(1)/(4)*100		(6)		(9)	(6)*(9)/100					
	Likely as not	(2)/(4)*100		(7)		(10)	(7)*(10)/100					
	Unlikely	(3)/(4)*100		(8)		(11)	(8)*(11)/100					
				Headroon	n score	0	out of 10					

Form S4

ılk Transfe	rs 			
No.	Name of Bulk transfers into Resource Zone	DO or Transfer Rate from Bulk Transfers (MI/d)		
1	Combination of STW/DCWW/UU	0.03		
2				
3				
4				
5				
			Tick	
	Overall reliability of the bulk transfer	Very reliable		
		Reliable		
		Less reliable		
	Total DO or transfer rate		0.03	MI/d
	Total DO or transfer rate as % of WAFU at			
	the present day		0.06	%
	Headroom score		0	out o

Form S5

	Ilution Causing a Reduction in Al	550,000,011											
No.	Name of Source at Risk	DO at risk	Threat	of license	d being								
		(MI/d)	revoke	ed or abstr	action								
		. , ,		Likely as	;								
			Likely	not	Unlikely		Total DO a	t risk for ed	ach category	Volume (MI/d)			
	1 N/a								Likely		(1)		
	2								Likely as not		(2)		
	3								Unlikely		(3)		
	4												
	5						Estimated	total DO at	t risk		MI/d (4)	(1)+(2)+(3)	
	6												
	7						Estimated	total DO as	s % of WAFU		% (5)	(4)/WAFU*100	,
	8												
					Score for								
					each likelihood								
			DO as % of		as % of			Weighted					
			total vol at		WAFU at			headroom					
			risk		risk			scores					
	Likely	(1)/(4)*100		(6)		(9)	(6)*(9)/100						
						-							_
	Likely as not	(2)/(4)*100		(7)		(10)	(7)*(10)/100						_
	Unlikely	(3)/(4)*100		(8)		(11)	(8)*(11)/100						_
				Headroon	n score	0	out of 10						_

Form S6

FOTT	136									
S6 A	ccuracy of Supply-Side Data									
(a)	Average, or typical, length of a	gauged and	d/or level	records us	ed in WAFL	J calculation	<u> </u>	88	years	
(b)	Select category to describe su	fficiency o	f data used	d in WAFU	calculation	1			Tick	
1~/								Good		
								Average	✓	
								Poor		
	Record justification for selecti	ing an aver	age or noc	or category	(if applica	hle)				
	NRW provided a historical tim					•	ı vhich			
	were fed into the Aquator mo				•	•				
	confidence in this data. Howe									
	therefore no gauged flow data					n Aquator. (Overall,			
	therefore, we feel sufficiency	of supply s	side data i	s average.						
			rr			1			T- 1	
c)	Select which category best de			cy of flow	naturalisati	on used in			Tick	
	calculating Resource Zone WA	FU (if appl	icable)					Good		
								Average	✓	
								Poor		
								N/A		
(d)	Select the appropriate score f	rom Table '	S6 in the s	core guida	nce notes	for each				
ر سر	aspect of the supply-side data			Julius Baraa	1.000				Enter scor	P
	aspect of the supply side data					Length of	gauged re	cord	0]
						Sufficience		Cora	1	
							of naturali	sation	0.5	

Form S7

	111 37								
S7 Si	ngle Source Dominan	ce and Critic	al Periods						
(b)	Name of source with	the largest l	DO in the resourc	ce zone	River Dee	!			
_	Source is a valid inclusion for factor				VEC (NO	* 1 1 .			
c)	Source is a valid incli	usion for fact	tor		YES/ NO	*delet	e as appropriate		
					Groundw	ater sou	ırce		
					River sou			✓	
					Impound	ng rese	rvoir		
					Pumped :	torage	reservoir		
(4)	Deployable output f	rom course			2-	7.86	MI/d	(a)	
(d)	Deployable output i	om source			37	.80	IVII/U	(1)	
e)	Percentage of WAFL	J from larges	t source		76	5.10	%	[(1)/WAFU	at present day]*100
(f)	Select which categor	y describes t	the critical period	of the reso	urce zone				
						Cat	egory	Tick	
					more tha	n a singl	e season		
					single sea	ison (de	efined as 3 months)		
					1 to 3 mo	nths			
					>1 week	but < 1 r	month		
					≤1 week				
					not critica	al		✓	
(g)	Enter any comments	on the critic	al pariod calacta	d in the case	co provided below				
(9)	For WRMP14, the tar		•				ana baan maddaa a	n aba	
		-			•		lave been working o	on the	
	basis of no critical pe	rioa. Howev	er, not critical g	ives same so	ore so largely irrelev	ant.			
		,						ĺ	

Form S8

S8 U	ncertainty	of Climate	Change on Yield							
		Change nario	WAFU at planning	g						Supporting Information The DO under climate change was assessed for both WRZs. NRW tested 100
(a)		007	51.0							scenarios and used the six median scenarios to generate climate change versions
(a)		015	50.5							of the abstraction tables from the Dee General Directions. The net abstraction
(a)		032	50.6							volume for DVW was reduced by 1.61 MI/d based on this assessment. As the
(a)		032 067	50.6							Chester zone is 100% consumptive the most efficient way to appy the reduction
(b)		075	50.9							was at the Dee Chester abstraction point. The cutback levels remained the same
(0)		073 089		_						as they were in the baseline run, as did the maximum allowable abstraction. For
			50.6	-						WRX WRZ, this meant that the safe yield allocation, stage 1 and stage 2 cutbacks
	Best es	stimate	50.7							DO was 41.50 MI/d.
										For WRX WRZ, the monthly climate change factors were applied to the baseline
c)	Case		Description		Tick appro	priate box				inflows to the DVW reservoirs previously generated using a resampling
	CASE 1	Two high:	and two low foreca	ists	✓					procedure. This created a perturbed time series of flows for each of the six
	CASE 2	Three low	forecasts and one	high forecast	t					climate change scenarios, and similarly, new time series for the NRW imposed
	CASE 3	Three high	forecasts and one	low forecast	t					cutbacks were created for each scenario.
										The mean DO results for the climate change scenarios are given in the S8 table
(d)	Maximum	spread in	WAFU at planning	horizon		C	.5	MI/d	(A)	(the mean DO is the average daily demand that could be met over every day of
										the run). The average DO across the six scenarios was 50.7 Ml/d, implying a
e)	Maximum	spread as	% of WAFU at the	olanning hori:	zon	1.	01	[(A)/WAFU at	t planning horizon]*100	median climage change impact on DO of 0.5 Ml/d (0.53 Ml/d in the peak month of
										July).
(f)	Headroom	n score					2	out of 10		

Form D1
D1 Accuracy of Sub-Component Data

			Reliability	Data type used
	Component	Source	Band	(tick)
	Initial Population Estimates	Local councils	Α	✓
_		Census Agency	А	✓
tior		OPCS	А	
ma	Initial Property Estimates	Billing Records	Α	✓
Jfor		Other	А	✓
Customer Information	Forecast of Future Population	Combination	В	
Ū O		Local councils	В	✓
ust		OPCS	В	
		Census Agency	В	✓
	Forecast of Future Properties	Combination	А	✓
		DoE	В	
		Local councils	В	✓
			1	
4)	Unmeasured Household	Own consumption monitor	Α	✓
ance	Consumption	Other company monitor	В	
Bala		Micro-component analysis	С	✓
J.		Continuous DMZ monitoring	С	✓
Wai		Same as measured households	D	
ia		Residual in balance	D	
Major Components of Initial Water Balance	Unmeasured Non-household	Micro-component analysis	Α	
s of	Consumption	Matching to measured customers	В	
ent		Industry average	D	✓
hod		Residual in balance	D	
lwo	Distribution losses	Widespread night flow tests	Α	✓
r C		Continuous DMZ monitoring	Α	✓
/ajc		Nat. Leak. Int. Models	В	
_		Residual in balance	С	
ast	Unmeasured Household	Micro-component analysis	Α	✓
rec	Consumption	Constant growth rate	В	
요		Include effect of household size	А	✓
anc	Measured Household	Micro-component analysis	Α	✓
	Consumption	Constant % of measured	С	
of D		Constant growth rate	С	
nts		Same growth as unmeasured	С	
lauc		Include effect of household size	В	✓
μpc		Separate different measured types	В	
Cor	Measured Non-household	Econometric forecast	А	
Major Components of Demand Forecast	Consumption	Constant growth rate	В	✓
Σ̈́		Consultation with large customers	А	

		Price/competition scenarios	Α	
				1
b)	Overall data reliability		Tick	
		Mostly class A	✓	
		Class A, B and C		
		Class B, C or worse		
				_
	Reconciliation item from initial			
c)	water balance		Tick	
		Good		
		Acceptable	✓	
		Poor		
			•	•
d)	Headroom score		2	out of 5

Form D2

D2 D	emand Fo	recast Variation								
(a)		Forecast type	Present d	ay —			-	Plannin	g horizon	Supporting Information:
			2016/17						2044/45	Present day figure = sum of
		Dry year unrestricted daily demand (best estimate)	45.00						40.41	(34BL+35BL+36BL+37BL+38BL+39BL) + (19BL+20BL+21BL+22BL) -
		Dry year unrestricted daily demand - upper forecast	45.00						38.92	i.e. consumption plus leakage
		Dry year unrestricted daily demand - lower forecast	45.00						36.42	
		or								
		Dry year unrestricted critical demand (best estimate)								
		Dry year unrestricted critical demand - upper forecast								
		Dry year unrestricted critical demand - lower forecast								
(b)	Case	Description	Tick appro	priato hov						
	CASE 1	Best estimate forecast tends to lower forecast	пск арргс	philate nox						
	CASE 2	Best estimate forecast tends to lower forecast Best estimate forecast tends to upper forecast		√						
c)	Maximur	n spread in demand forecasts at planning horizon	3.	.99	MI/d	(1)				
c)	Spread in	n demands/WAFU at planning horizon as %	8.	.18		[(1)/WAFL	J at 2044/45]*100		
(d)	Headroo	m Score		2	out of 15					

Form D3

D3 U	Incertainty of Climate Change on De	mand			
					Tick
(b)	Select the category that best descri	bes the impa	ct of	Low	✓
	climate change on resource zone de	emand		Medium	
				High	
				Very High	
c)	Justify the selection in the space pr	ovided belov	v:		
	factor. This results in a less than 1%	increase in c	demand over t	the plannin	g period
			_		
(d)	Headroom score	4	out of 5		

Target Headroom Conversion Chart

