Draft Regional Plan
Water Resources South East

Technical Annex 2: Our draft regional plan proposals

November 2022

Draft Regional Plan – Water Resources South East	
Last updated	14.11.2022
Version	November 2022
History of Changes made to this version	
Author	Adams Hendry Consulting Ltd
Approved by	Sarah Green, WRSE Programme Manager
WRSE Director Approval	Meyrick Gough, WRSE Technical Lead

Email: contact@wrse.org.uk

Table of Contents

Tables

Figures

Part 4: Our draft regional plan proposals

1. Context for this Technical Annex

Our draft regional plan

1.1. As part of the draft regional plan consultation, we are publishing three documents on our dedicated consultation website:

A separate **Consultation Document** – which provides a non-technical summary of the draft regional plan

A separate **Technical Annex 1** – which provides:

- Part 1: Context for the draft regional plan
- Part 2: What is the challenge?
- Part 3: How did we select a plan?

This **Technical Annex 2** (this document) which explains the draft regional plan proposals and our justification and assessment of them, including alternatives that we have considered:

- Part 4: Our draft regional plan proposals
- Part 5: Evaluation of our draft regional plan proposals
- Part 6: Consultation, monitoring and review

1.2. This draft regional plan has been developed in partnership with regulators, water companies, water users in other sectors, environmental stakeholders and customers all participating. The plan builds on our emerging plan which was consulted on in January 2022 and the feedback we received.

1.3. Our draft regional plan sets out how we plan to achieve a secure, resilient and sustainable supply of water for our customers and other sectors, across a challenging range of potential futures. This will ensure that water is used in the most sustainable way in the years to come. Our plan will ensure we improve the environment and that we will be able to adapt to climate change, while providing the water needed as the population grows. It will make the region's water supplies more resilient to drought and other shocks – providing 21st century solutions so society always has the water it needs.

1.4. The draft regional plan includes a mix of options that together provide the water needed for the region's people and places, alongside a range of wider benefits to society. Although the cost of our proposals to customers is a key consideration, decisions should not be made on cost alone and the need to consider other factors beyond cost is specified in the Environment Agency's Water Resources Planning Guideline[1]. We have developed a best value plan, so it reflects wider societal expectations and delivers additional environmental benefits.

1.5. The draft regional plan seeks to:

- Ensure there is enough water for a growing population and to support economic growth
- Improve the environment by leaving more water in the region's rivers, streams and underground sources
- Increase the region's resilience to severe drought and other extreme shocks and stresses
- Address the impacts of climate change on demand for water and how much is available

1.6. The best value plan has been selected by WRSE for the purposes of the draft regional plan consultation. It represents the best value combination of options to meet the future challenges.

1.7. The best value plan is better for the environment and increases the resilience of our water supplies when compared to the plan that just considers economic cost (the least cost plan).

1.8. Our draft regional plan identifies how the additional water needed in the future could be supplied, whilst aiming to meet or exceed relevant legal and

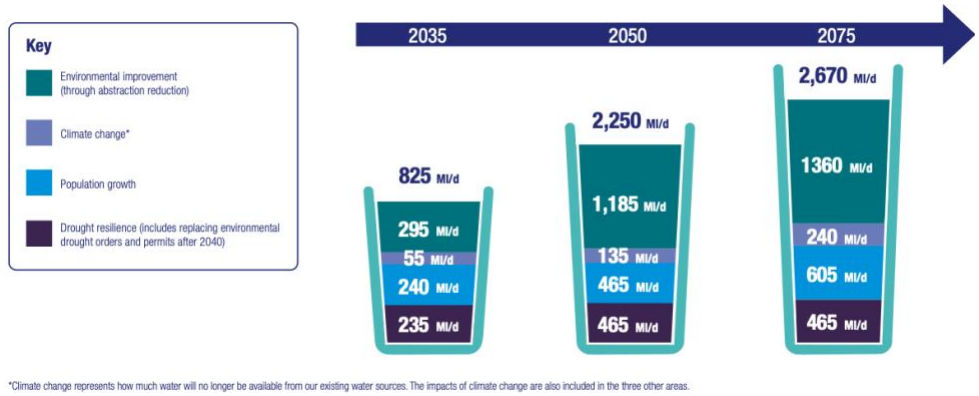
[1] https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline

regulatory requirements as well as policy expectations that water companies must meet. This includes:

- Increasing the resilience of the region's water supplies to reduce the risk of emergency restrictions such as standpipes to no more than once every 500-years, on average by 2040
- Leaving more water in the environment to deliver long-term environmental improvements
- Reducing leakage by at least 50% by 2050 from 2017/18 levels
- Supporting the national ambition to reduce household water use to 110 litres per person per day by 2050

1.9. The scale of the challenge is significant and doing nothing is not an option if we are to deliver increased environmental protection and safeguard supplies to customers into the future. To achieve this, taking into account climate change, population growth and environmental ambition our draft regional plan identifies that we need to plan for up to 2670 Ml/d (megalitres per day) of demand management and new resource developments by 2075.

Figure 1.1 WRSE water needs under our reported pathway



*Climate change represents how much water will no longer be available from our existing water sources. The impacts of climate change are also included in the three other areas.

1.10. Our six member companies that operate in South East England are consulting on their draft Water Resources Management Plans (WRMPs) at the same time as our consultation. The WRMPs reflect our draft regional plan and identify the investment each company needs to make to secure water supplies to their customers. These are separate consultations and submissions can be made directly to our member companies on their draft WRMPs (see Section 16 of this Technical Annex for more information).

How we present our draft plan proposals

1.11. The plans and detailed information in this Technical Annex show the draft regional plan proposals for different time periods within our overall planning period to 2075. Our graphics and text explain how the selection of schemes would vary under different future situations. At the current time we consider that all of the future situations are equally likely.

1.12. We have identified two regionally significant decision points in the first 15 years. The first decision point is associated with the level of population growth, and the second with climate change and the level of abstraction reduction needed to improve the environment.

1.13. The regional plan will be updated every five years to inform our member companies' future WRMPs. The decision points are aligned with the completion of their five-year business plans, so they include the investment needed for the pathway we are following. Decision points come earlier than the branch points when the solutions are needed by to allow the lead-in time. Each water company has committed to follow our adaptive planning approach in their draft WRMP, so they are planning consistently across the region.

1.14. The regulatory guidance water companies must follow requires them to identify a pathway on which to base the first 25 years of their WRMP. We have identified a 'reported' pathway for the draft regional plan. This pathway is compliant with the Water Resources Planning Guideline (WRPG) produced by the Environment Agency. This requires water companies to plan for growth in line with local authority housing plans. It reflects the expectations of our regulators for a level of abstraction reduction that will deliver the required environmental improvement expected in the future, based on analysis carried out to date. It will also achieve the 1 in 500-year level of drought resilience by 2040 and deliver significant leakage reduction

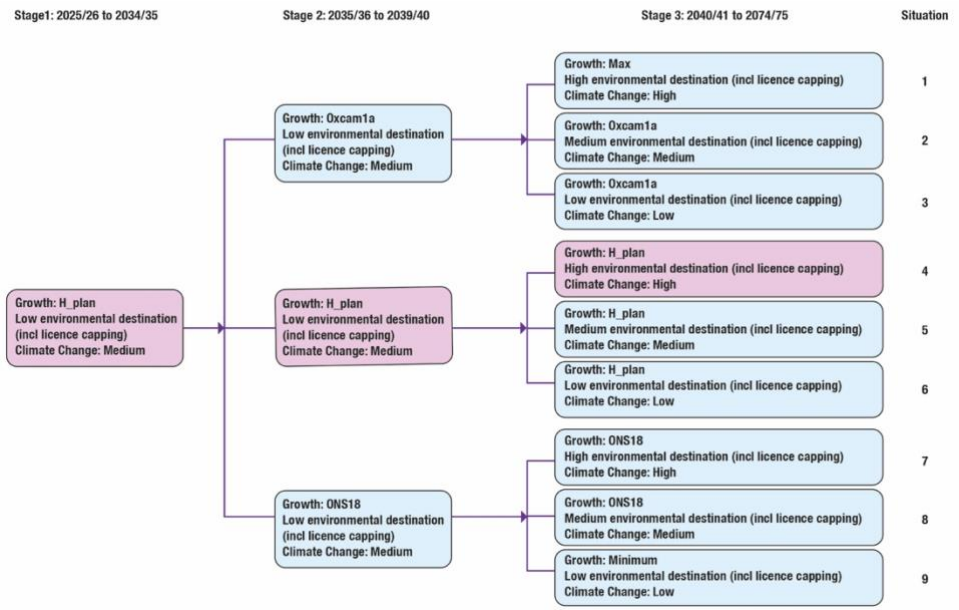
and water efficiency. Our reported pathway is not the most likely or expected pathway, and our plan is genuinely adaptive. Identifying this reported pathway allows the regional plan to fulfil the WRPG requirement.

1.15. As explained in detail in our separate Technical Annex 1 (and illustrated in Figure 1.2), the root branch has been based on the housing plan growth (compliant with guidance), medium climate change and a glidepath of environmental ambition that allows implementation of abstraction reductions over the interim years before finalising the future ambitions in the next set of branches. The resulting options identified for this period are required under any of the future challenges we face and will enable us to adapt to any of the future pathways beyond 2035.

1.16. The next three branches seek to cover the range of decision making on population growth, utilising different growth forecasts for the three branches. This ranges from housing plan growth with OxCam impacts in the upper branch, the central branch continuing with the housing plan growth scenario, and the lower branch using the ONS18 principal forecast. The climate change and potential environmental ambitions are the same as for the initial root branch period.

1.17. The final set of nine branches focus on how climate change and decisions on environmental ambition would continue to impact on the future availability of water. We have selected a range of scenarios to characterise the potential spread of future challenges whilst trying to avoid planning for the absolute extremes of the combinations of discrete scenarios. This ensures that these branches are realistic and reasonable alternatives that characterise the range of potential challenges in the future. Likewise based on this root and branch approach, the adaptive plan can respond in the future by ensuring the choices that are made at the beginning of the plan are least regret and can also be effective for meeting the challenges in the future. In the final set of nine branches, the range of growth forecasts are also expanded to incorporate a wider range of potential future, ranging from maximum to minimum housing growth.

Figure 1.2: Situation tree 17.03 – the basis for the draft regional plan



1.18. Our approach recognises that while we can't predict exactly what will happen in the future, we can make a series of well evidenced projections and have a strategy to adapt when needed. Crucially it means that the investment needed in the first ten years of our plan has been tested against a range of different futures, so we know it is required. This includes

- options needing to be planned, constructed and delivered or commenced in this period; and
- preparatory work, such as securing planning and other consents, for longer terms options

1.19. These 'least regret' options must be progressed urgently, so we are ready to meet the challenges we face. Least regret does not mean these solutions will

be easy to implement or won't potentially be disruptive while they're being delivered. They are solutions that are needed if we are to have secure and resilient water supplies in the future alongside an improved environment. Least regret options needing to be progressed in the early part of the planning period are those that the water companies must progress (through investigation, consenting processes and implementation/commencement) as they are critical solutions required under the future pathways, irrespective of which is selected in 2030.

1.20. The majority of the options selected for development in our draft regional plan are selected in the period to 2040 and 2050, in which we will achieve increased drought resilience (by 2040) and our environmental ambition (by 2050).

1.21. As will be seen in the subsequent sections of this Technical Annex, from 2035 onwards a greater number and capacity of options is required under the more challenging futures. Particularly over the longer term, these increasingly rely on water recycling, desalination and other infrastructure options. Under less challenging futures, the scale of new resource developments we will need to implement over the longer term will be less. Much will depend on the future scenario we face.

2. Regional plan at a glance

Figure 2.1: Our proposals for 2025 to 2035 – location of the potential schemes identified in the draft regional plan

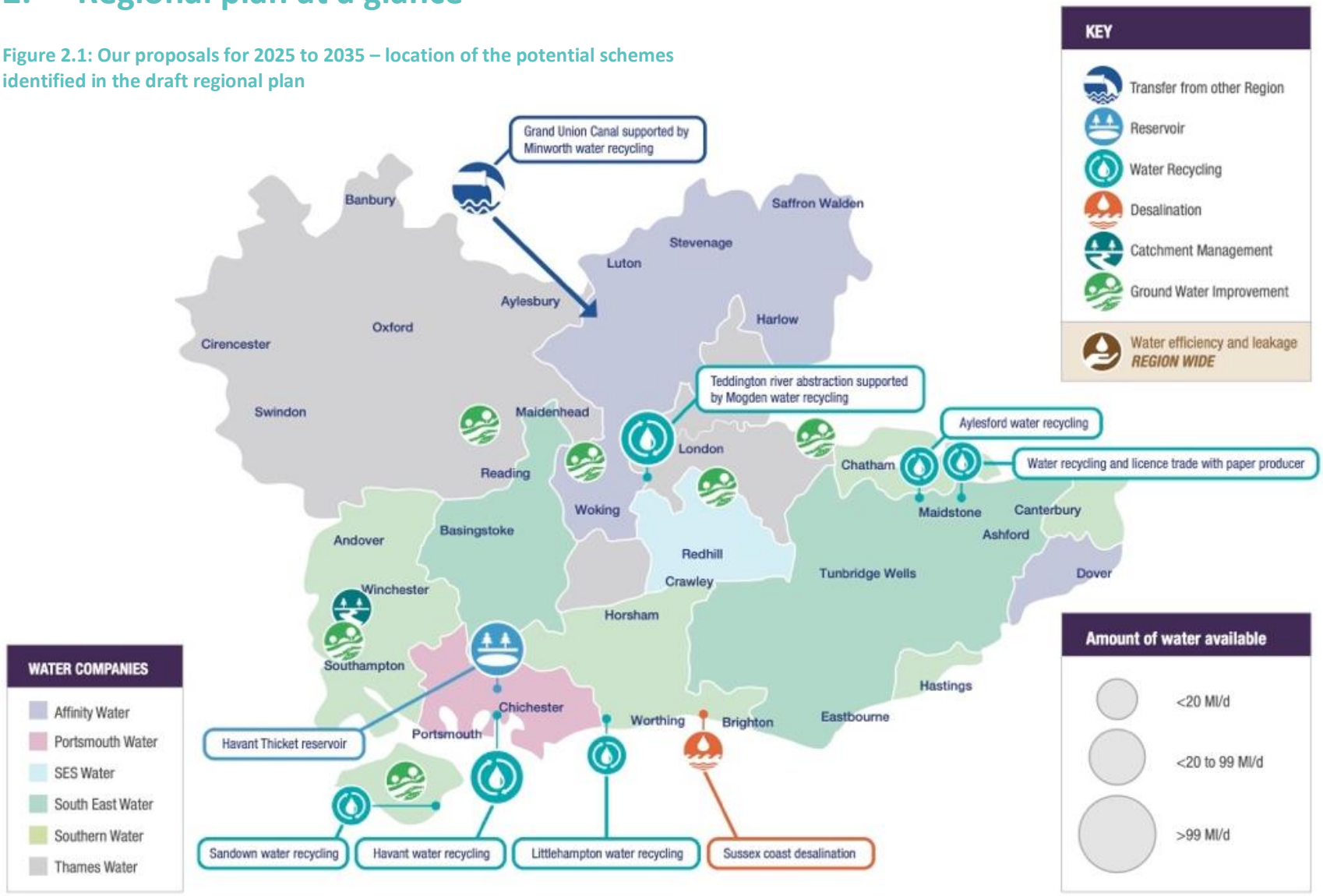
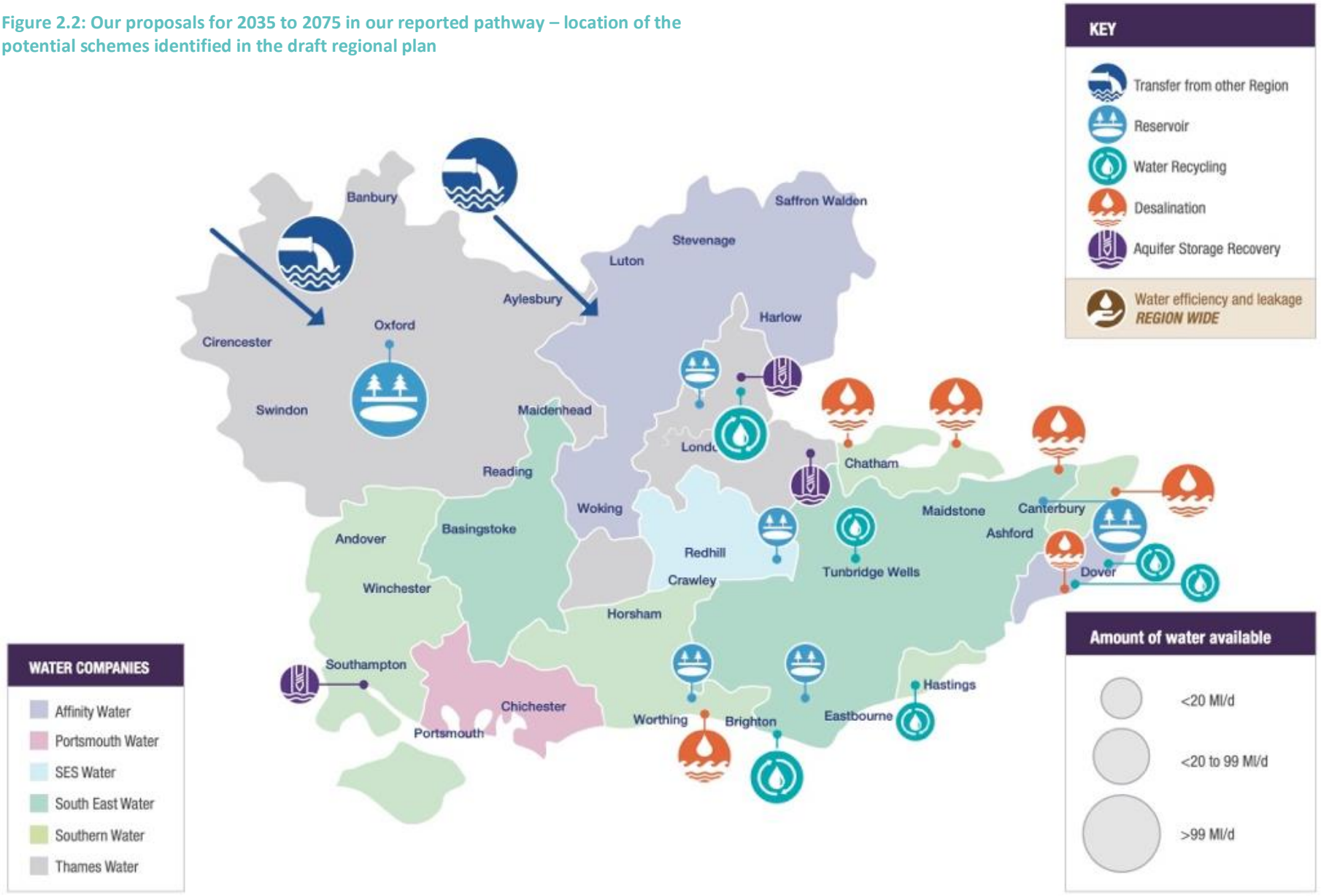


Figure 2.2: Our proposals for 2035 to 2075 in our reported pathway – location of the potential schemes identified in the draft regional plan



3. Regional plan overview diagram

What does the regional overview diagram show?

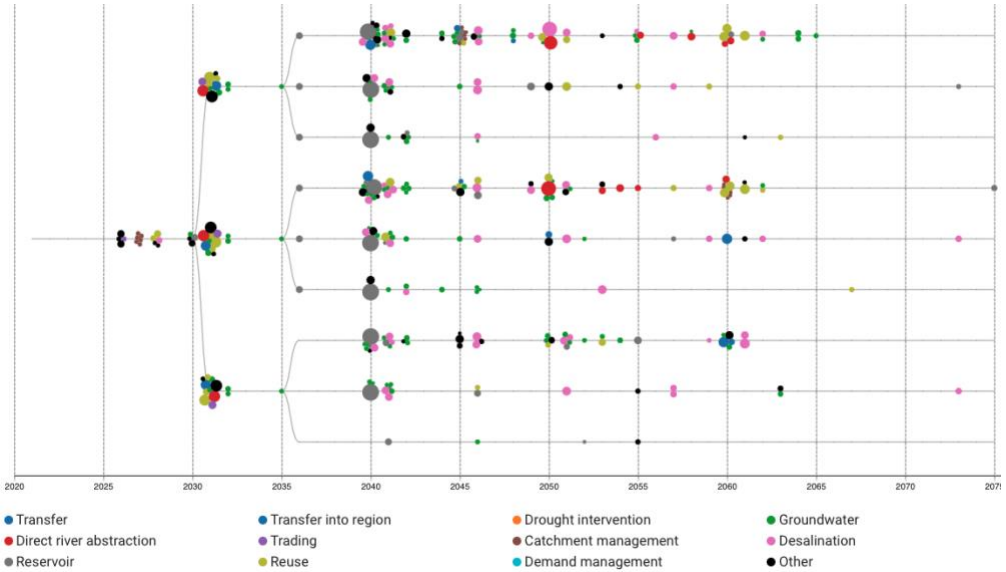
3.1. The regional overview diagram shows the options selected as part of our best value investment modelling which is being published for consultation. Options are identified in different time periods within the planning period from 2025/26 to 2074/75.

3.2. The WRSE investment model is a mathematical optimisation model, which has been collaboratively developed by a number of suppliers. It is a complex problem solving tool to support the development of the regional plan. WRSE commissioned an assurance review of the investment model to confirm the robustness of the work undertaken. This confirmed that the investment model operates in the way it was originally intended, without bias, and that the model is fit for purpose. WRSE has published its Investment Model External Review report in the WRSE document library on its website.

3.3. A visualisation from the model is shown in Figure 3.1 below. The graphical version is then provided in Figure 3.2.

3.4. **The timing shown for the option is the date when the investment modelling first utilises the option**. For many, especially the larger infrastructure schemes, decisions will need to be taken well in advance of these dates (up to 15 years in some cases) to enable the necessary design, assessment, consenting and construction work to take place. This also means that financial costs will be incurred by the companies promoting the options, ahead of the date when they are first utilised – in some cases many years ahead. The options may be completed ahead of their first utilisation – potentially in the Asset Management Plan (AMP) period before, and this plan presents the regional best value plan proposals.

Figure 3.1: Best value plan model visualisation



3.5. **The new resource options only appear once in each branch of the diagram** – in the period that they are first selected in the investment modelling. The model then utilises them again in that branch through the rest of the period to 2075 – so they continue to be available for use. Where a new resource option appears in more than one branch, but in different periods, this means the model selects them earlier or later, depending on the scale of challenge it is seeking to solve (normally selecting more options and earlier, to meet the more challenging futures).

3.6. **Any figures shown in the diagram (in Ml/d) for an option are the maximum capacity** under the 1:500 Dry Year Annual Average (DYAA) scenario – what is currently termed an extreme drought. This is a total capacity figure and not a representation of how much the option would actually be utilised. The investment model optimises its selection across all of the different design scenarios.

3.7. **It is important to note that the options may have different utilisations under different design scenarios** – e.g., Normal conditions, 1;100 DYAA, 1:500 Dry Year Critical Period (DYCP) and 1:500 DYAA figure. The regional plan focuses mainly on the 1:500 DYAA figures, as this is the drought resilience scenario that we are planning to achieve.

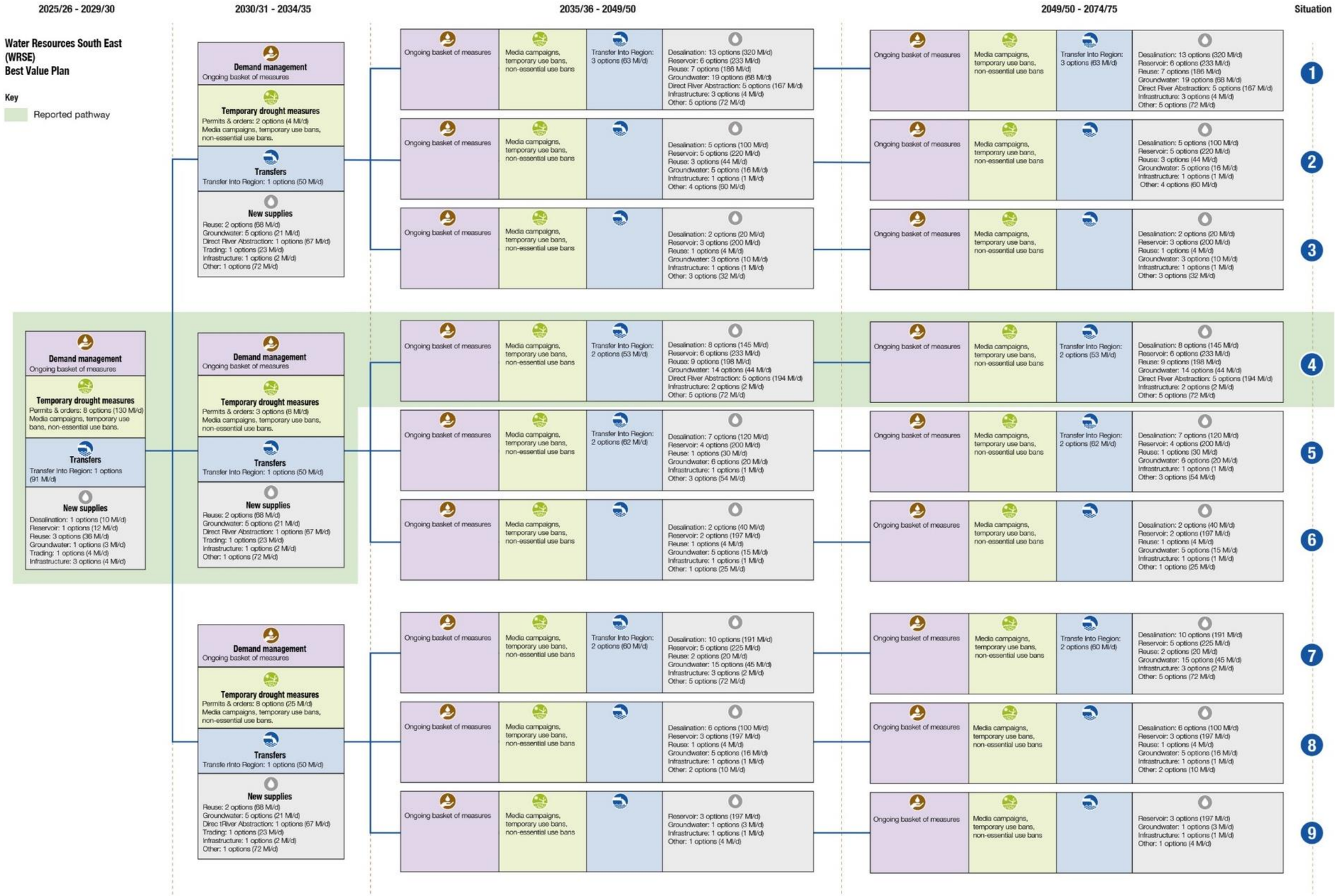
3.8. **Utilisation may vary across the planning period** - this does not mean that the maximum capacity would be immediately implemented when the scheme is first utilised, as it may vary over the duration of the planning period. For some options the utilisation gradually increases over time as the scale of the supply demand deficit that the modelling is seeking to solve increases. Other options may only need to be utilised for a period of time within the overall planning period, however the investment modelling seeks to optimise the overall selection of options as part of the best value plan.

3.9. Alongside the preparation of the best value regional plan, our six member companies are preparing their individual draft WRMPs. Those WRMPs present each company's detailed proposals for their own supply areas and are being published for consultation alongside this draft regional plan. The detailed selection and timing of options will be set out by our member companies in their WRMPs. National guidance makes clear that a WRMP should reflect the regional plan unless there is clear justification for not doing so. It is for the WRMP to explain how it has reflected the regional plan and why the preferred programme has been selected.

3.10. We have prepared company level overview diagrams to show the options selected at a company level in the draft regional plan. These are enclosed at Appendix 2 to this Technical Annex for context. As noted above, the individual company WRMPs provide the detailed explanation of each water company's strategy which must reflect the strategy set out in this regional plan. The linkages between the regional plan and WRMPs, and website linkages to the draft WRMPs, are set out in Section 16 of this Technical Annex.

3.11. Part 5 of this Technical Annex evaluates the proposals in this draft regional plan in more detail, including testing alternative plans that we have considered, and different combinations and timings of options selected in those plans.

Figure 3.2: WRSE draft regional plan options selected under 1:500 DYAA in each model pathway



4. Overview of types of options selected

4.1. Another way of illustrating the mix of proposals in our plan, and how this changes over time and under different potential futures is to explore the numbers of the different types of options that are selected under each of the model pathways (situations) for the 1:500 DYAA scenario (our core planning scenario).

4.2. Table 4.1 below provides a summary at the regional level, highlighting for each of the 9 situations, data at 5 different time slices:

- 2025/26 – the first year of the planning period
- 2029/30
- 2034/35
- 2049/50
- 2074/75 – the end of the planning period

4.3. The columns in the table show how the mix and utilisation of options changes, under the following headings:

- Number of options – the total number of options utilised across the option types in each time slice.
- Option utilisation (Ml/d) – the actual utilisation of the options as per the option types in the various time slices tabulated.
- Utilisation (%) – the percentage utilisation compared to the utilisation of all new options.

4.4. There are two rows at the bottom of each situation table for existing options and within region transfers (i.e., internal transfers) which are not included in the new options summary lines.

4.5. Consistent with the regional plan overview diagram, the table shows both the increasing numbers of options required under the more challenging futures, and how there is an increasing selection of options including water recycling and desalination over the longer term, in the absence of other potential options to meet the larger supply demand deficits being faced.

4.6. Following on from this table, the subsequent sections of Part 4 of this Technical Annex describe the proposals in the draft regional plan in more detail, in a series of sections covering our proposals for:

- Efficient use of water and minimal wastage across society (Section 5)
- New resources that provide sustainable and resilient supplies (Section 6)
- A network that can move water around the region (Section 7)
- Catchment and nature-based solutions to improve the water sources we rely on (Section 8)
- Drought Orders and Drought Permits (Section 9)

4.7. Part 5 of this Technical Annex evaluates the proposals in this draft plan, including testing alternative plans that we have evaluated.

Table 4.1: Types of options selected in 1:500 DYAA regional plan

Situation 1	Number of options utilised					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**
Demand management and leakage	37	54	54	60	60	39	221	400	772	1,195	15%	50%	57%	46%	53%
desalination	0	1	1	10	14	-	2	3	147	214		0%	0%	9%	9%
Into the region	1	1	2	7	9	-	-	25	122	112			4%	7%	5%
New storage underground	0	1	4	20	25	-	1	4	38	56		0%	1%	2%	2%
Other	69	95	107	115	115	222	207	224	306	324	85%	47%	32%	18%	14%
Reservoir	0	1	1	6	7	-	6	14	205	236		1%	2%	12%	10%
Recycle and reuse	0	2	5	7	9	-	5	27	89	130		1%	4%	5%	6%
New options (excl internal transfers)	**107**	**155**	**174**	**225**	**239**	**262**	**442**	**696**	**1679**	**2267**	**100%**	**100%**	**100%**	**100%**	**100%**
Existing WRSE transfers	36	37	41	42	39	224	211	236	376	411	94%	74%	47%	24%	23%
All within region transfers	40	46	56	83	84	238	287	497	1,589	1,809					

Situation 2	Number of options utilised					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**
Demand management and leakage	37	54	54	60	60	39	221	400	772	1,195	15%	50%	57%	59%	67%
desalination	0	1	1	5	6	-	2	3	52	86		0%	0%	4%	5%
Into the region	1	1	2	2	2	-	-	25	15	14			4%	1%	1%
New storage underground	0	1	4	11	10	-	1	4	22	20		0%	1%	2%	1%
Other	69	95	107	104	104	222	207	224	279	280	85%	47%	32%	21%	16%
Reservoir	0	1	1	5	6	-	6	14	117	109		1%	2%	9%	6%
Recycle and reuse	0	2	5	5	8	-	5	27	59	91		1%	4%	4%	5%
New options (excl internal transfers)	**107**	**155**	**174**	**192**	**196**	**262**	**442**	**696**	**1315**	**1794**	**100%**	**100%**	**100%**	**100%**	**100%**
Existing WRSE transfers	36	37	41	41	39	224	211	236	348	353	94%	74%	47%	29%	29%
All within region transfers	40	46	56	70	71	238	287	497	1,217	1,232					

Situation 3	Number of options utilised					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**
Demand management and leakage	37	54	54	60	60	39	221	400	772	1,195	15%	50%	57%	67%	74%
desalination	0	1	1	2	3	-	2	3	7	11		0%	0%	1%	1%
Into the region	1	1	2	2	2	-	-	25	13	13			4%	1%	1%
New storage underground	0	1	4	8	7	-	1	4	17	16		0%	1%	1%	1%
Other	69	95	107	102	101	222	207	224	241	260	85%	47%	32%	21%	16%
Reservoir	0	1	1	4	4	-	6	14	53	58		1%	2%	5%	4%
Recycle and reuse	0	2	5	5	6	-	5	27	44	57		1%	4%	4%	4%
New options (excl internal transfers)	**107**	**155**	**174**	**183**	**183**	**262**	**442**	**696**	**1148**	**1610**	**100%**	**100%**	**100%**	**100%**	**100%**
Existing WRSE transfers	36	37	41	40	38	224	211	236	288	283	94%	74%	47%	33%	29%
All within region transfers	40	46	56	66	65	238	287	497	881	965					

Situation 4 (Reported Pathway)	Number of options utilised					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**
Demand management and leakage	37	54	54	60	60	39	221	400	772	1,195	15%	50%	57%	48%	56%
desalination	0	1	1	7	9	-	2	3	88	142		0%	0%	6%	7%
Into the region	1	1	2	6	8	-	-	25	99	93			4%	6%	4%
New storage underground	0	1	6	20	19	-	1	5	37	42		0%	1%	2%	2%
Other	69	95	108	108	114	222	207	224	303	318	85%	47%	32%	19%	15%
Reservoir	0	1	1	6	7	-	6	14	208	223		1%	2%	13%	10%
Recycle and reuse	0	2	5	8	11	-	5	27	90	116		1%	4%	6%	5%
New options (excl internal transfers)	**107**	**155**	**177**	**215**	**228**	**262**	**442**	**697**	**1599**	**2128**	**100%**	**100%**	**100%**	**100%**	**100%**
Existing WRSE transfers	36	37	40	42	39	224	211	238	400	398	94%	74%	48%	26%	24%
All within region transfers	40	46	56	84	81	238	287	501	1,542	1,627					

Situation 5	Number of options utilised					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**
Demand management and leakage	37	54	54	60	60	39	221	400	772	1,195	15%	50%	57%	58%	66%
desalination	0	1	1	5	8	-	2	3	43	92		0%	0%	3%	5%
Into the region	1	1	2	3	2	-	-	25	16	14			4%	1%	1%
New storage underground	0	1	6	12	12	-	1	5	21	21		0%	1%	2%	1%
Other	69	95	108	103	105	222	207	224	277	290	85%	47%	32%	21%	16%
Reservoir	0	1	1	4	5	-	6	14	136	127		1%	2%	10%	7%
Recycle and reuse	0	2	5	6	6	-	5	27	55	65		1%	4%	4%	4%
New options (excl internal transfers)	**107**	**155**	**177**	**193**	**198**	**262**	**442**	**697**	**1320**	**1803**	**100%**	**100%**	**100%**	**100%**	**100%**
Existing WRSE transfers	36	37	40	40	39	224	211	238	361	342	94%	74%	48%	29%	28%
All within region transfers	40	46	56	72	71	238	287	501	1,226	1,226					

Situation 6	Number of options utilised					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**
Demand management and leakage	37	54	54	60	60	39	221	400	772	1,195	15%	50%	57%	67%	74%
desalination	0	1	1	2	3	-	2	3	8	16		0%	0%	1%	1%
Into the region	1	1	2	2	2	-	-	25	13	13			4%	1%	1%
New storage underground	0	1	6	10	8	-	1	5	17	17		0%	1%	1%	1%
Other	69	95	108	101	99	222	207	224	241	260	85%	47%	32%	21%	16%
Reservoir	0	1	1	3	3	-	6	14	53	51		1%	2%	5%	3%
Recycle and reuse	0	2	5	5	6	-	5	27	44	58		1%	4%	4%	4%
New options (excl internal transfers)	**107**	**155**	**177**	**183**	**181**	**262**	**442**	**697**	**1148**	**1609**	**100%**	**100%**	**100%**	**100%**	**100%**
Existing WRSE transfers	36	37	40	40	37	224	211	238	289	279	94%	74%	48%	33%	29%
All within region transfers	40	46	56	66	69	238	287	501	884	957					

Situation 7	Number of options utilised					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**
Demand management and leakage	37	54	54	60	60	39	221	400	772	1,195	15%	50%	61%	55%	62%
desalination	0	1	1	6	10	-	2	2	77	130		0%	0%	5%	7%
Into the region	1	1	2	2	2	-	-	0	27	25			0%	2%	1%
New storage underground	0	1	4	15	16	-	1	4	24	21		0%	1%	2%	1%
Other	69	95	110	112	108	222	207	216	291	300	85%	47%	33%	21%	15%
Reservoir	0	1	1	4	6	-	6	14	153	173		1%	2%	11%	9%
Recycle and reuse	0	2	5	6	7	-	5	22	69	94		1%	3%	5%	5%
New options (excl internal transfers)	**107**	**155**	**177**	**205**	**209**	**262**	**442**	**657**	**1412**	**1936**	**100%**	**100%**	**100%**	**100%**	**100%**
Existing WRSE transfers	36	37	33	42	37	224	211	200	345	353	94%	74%	44%	29%	28%
All within region transfers	40	46	47	79	77	238	287	452	1,173	1,277					

Situation 8	Number of options utilised					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**
Demand management and leakage	37	54	54	60	60	39	221	400	772	1,195	15%	50%	61%	65%	72%
desalination	0	1	1	3	7	-	2	2	20	61		0%	0%	2%	4%
Into the region	1	1	2	2	2	-	-	0	19	8			0%	2%	0%
New storage underground	0	1	4	9	9	-	1	4	18	19		0%	1%	2%	1%
Other	69	95	110	99	100	222	207	216	252	264	85%	47%	33%	21%	16%
Reservoir	0	1	1	4	3	-	6	14	40	36		1%	2%	3%	2%
Recycle and reuse	0	2	5	6	6	-	5	22	59	74		1%	3%	5%	4%
New options (excl internal transfers)	**107**	**155**	**177**	**183**	**187**	**262**	**442**	**657**	**1180**	**1657**	**100%**	**100%**	**100%**	**100%**	**100%**
Existing WRSE transfers	36	37	33	39	40	224	211	200	251	268	94%	74%	44%	34%	33%
All within region transfers	40	46	47	64	68	238	287	452	738	814					

Situation 9	Number of options utilised					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**	**2025/26**	**2029/30**	**2034/35**	**2049/50**	**2074/75**
Demand management and leakage	37	54	54	60	60	39	221	400	772	1,195	15%	50%	61%	75%	82%
desalination	0	1	1	1	1	-	2	2	3	2		0%	0%	0%	0%
Into the region	1	1	2	2	1	-	-	0	0	-			0%	0%	
New storage underground	0	1	4	4	4	-	1	4	7	9		0%	1%	1%	1%
Other	69	95	110	98	98	222	207	216	197	204	85%	47%	33%	19%	14%
Reservoir	0	1	1	2	2	-	6	14	20	21		1%	2%	2%	1%
Recycle and reuse	0	2	5	5	5	-	5	22	28	35		1%	3%	3%	2%
New options (excl internal transfers)	**107**	**155**	**177**	**172**	**171**	**262**	**442**	**657**	**1026**	**1466**	**100%**	**100%**	**100%**	**100%**	**100%**
Existing WRSE transfers	36	37	33	33	33	224	211	200	197	170	94%	74%	44%	41%	34%
All within region transfers	40	46	47	52	53	238	287	452	475	503					

5. Efficient use of water and minimal wastage across society

Understanding the region's water use today

5.1. Water companies measure how much water they put into supply each day using a measure called distribution input (DI). Over the last 20 years, DI has fallen by 21 million litres per day despite the region's population growing by 3.6 million, so there has been no net increase in the amount of water being taken from the environment. This is primarily due to the reduction in leakage, coupled with water efficiency activity and metering, which companies have successfully delivered since privatisation.

5.2. Household customers in the South East use, on average, 145 litres per person per day, which is higher than any other region. Around 18% of water supplied is used by businesses. The region is warmer and drier than most other areas of the country with varying demographics, housing stock and metering levels, all of which have an impact on how much water people use.

5.3. The roll out of water meters across large parts of the region means that water companies have a better understanding of their customers' water use and are helping people make savings. Meters also help to detect leaks on customers' pipes, which makes up around a quarter of the water lost each day through leakage.

Water use during the pandemic

Water use is affected by external factors that influence how much water is used and where. During the Covid-19 pandemic, household demand increased by around 10% while non-household demand fell by around 25% due to lockdowns and more people working at home. In London, the total amount of water being supplied fell by around 3%.

What our draft regional plan proposes

5.4. Reducing water use is as an essential part of tackling the climate and environmental emergency we are facing both nationally and internationally. It will help mitigate the impact of climate change by helping people use water more efficiently, particularly as the population grows, while at the same time cutting the carbon emissions produced by abstracting, treating, moving, and heating water.

5.5. Reducing demand for water is a priority for the regional plan. It is vital in the first decade of the plan while new water sources are developed, and the level of long-term environmental improvement through abstraction reduction is determined.

5.6. The draft regional plan promotes the need, between 2025 and 2040, for very significant investment across the South East to reduce how much water is used and wasted. Temporary measures that reduce discretionary water use during droughts are also included in the plan. In addition, it identifies the need for the Government to introduce new policies that will deliver long-term reductions in water use across society. This does not include the leakage reductions water companies have already committed to between 2020 and 2025.

5.7. More than half of the total water needed in the first 15-years of the draft regional plan will come from reducing how much is used and what is wasted through leakage. This action is required under all the adaptive planning pathways and plays an important role in securing water supplies across the planning period. This level is at the upper end of what we think can be delivered across the majority of the region.

5.8. Achieving and maintaining this lower and more sustainable level of water use across society is a key component of the long-term solution in all the alternative pathways. By 2050, achieving the level of demand reduction identified in our plan could provide over half the additional water we will need to address the shortfall in water supplies.

5.9. The levels of leakage and usage reductions in this plan are ambitious but our analysis shows this increased level of activity, beyond what was committed to by some companies in their previous WRMPs, is required if more significant reductions to abstractions are needed to protect the environment in the long-term. Delivering them will rely on new approaches and technologies that are yet to be tried and tested, as well as changes to customer behaviour and Government policy.

5.10. Progress against the plan will need to be monitored closely, as if it is not achieved, we risk not having enough water to supply the people of the region and we could need to develop alternative water sources instead. Alternatively, we could develop more new sources of water earlier in the planning period to reduce our reliance on demand management measures.

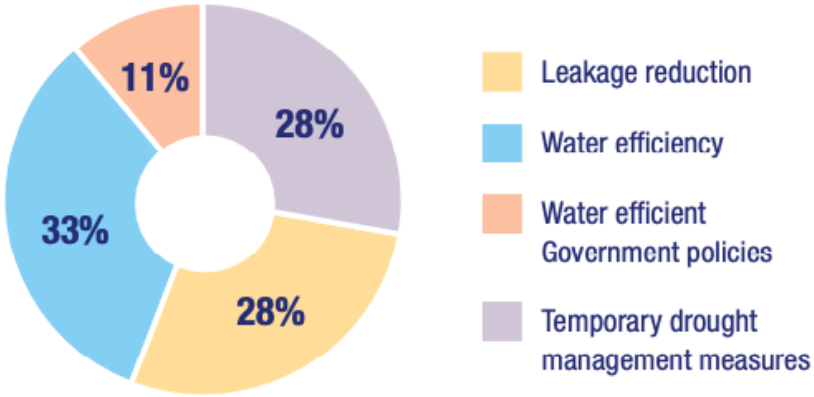
How we will deliver reductions in demand for water

5.11. The draft regional plan sets out how much total demand must reduce across the region and in each water company area, but it gives our member companies the flexibility to deliver leakage and water efficiency programmes that best meet the needs of their customers, address the specific challenges of their local areas, and use new technologies as they develop.

5.12. Our six member companies have prepared a range of demand management strategies that include leakage reduction and water efficiency activities such as smart metering, tariffs and behaviour change.

5.13. Our collective action across these areas seeks to achieve the proportional split in demand reduction across the region by 2050 (for our reported pathway) as shown in Figure 5.1.

Figure 5.1 Contribution of leakage reduction and demand management schemes



Leakage reduction

5.14. The regional plan will deliver the ambition of halving leakage levels across the region by 2050, a commitment made in 2019. It will build on the reductions planned to be achieved between 2020 and 2025 in current WRMP and business plans.

5.15. In total, leakage will be reduced by 556 million litres of water per day by 2050, of which 286 million is delivered through this regional plan. This will see our six member companies reduce leakage in the South East by 50% from 2017/18 levels by 2050. Activities to reduce leakage could include the following:

- Installing sensors in water pipes that use smart technology to detect smaller and less visible leaks, so they can be found and fixed more quickly
- Replacing old water mains so there are fewer leaks and bursts and fewer interruptions to service
- Managing the pressure inside water pipes so less water is lost through leakage
- Working with customers to identify and repair leaks on their own water pipes.

5.16. Halving leakage by 2050 is a major challenge, but the water industry is committed to delivering it and is developing a roadmap that sets out how it will get there. This includes working to develop innovative solutions to reduce leakage as alternatives to large scale and costly mains replacement programmes.

5.17. The proposals in our draft regional plan will achieve a 51% reduction in leakage at a regional level. At a company level the figures range from 50% to 56% as illustrated in Table 5.1 below. The percentage leakage reduction is a total figure, based on the volume of water lost through leakage (in Ml/d). The 2017/18 and 2050 leakage figures in comparison are litres per property per day, and so are affected over time by the increasing number of household properties.

Table 5.1: WRSE and company leakage reduction by 2050

Company	Total Leakage (% reduction)	2017/18 Leakage (l/property/d)	2050 leakage (l/property/d)
Affinity Water	53%	121	42
Portsmouth Water	50%	101	39
SES Water	56%	89	32
South East Water	51%	103	39
Southern Water	51%	90	36
Thames Water	50%	176	66
WRSE	**51%**	**140**	**52**

5.18. The differences between the company figures result from different approaches to leakage reduction and different scales of challenges being faced. Further details of the leakage reduction measures being proposed by our six member companies are set out in their draft WRMPs.

5.19. In the longer-term, reducing leakage beyond 50% will become increasingly difficult and less cost efficient. Our draft regional plan promotes an ongoing reduction in leakage beyond 2050 but at a slower rate because of uncertainties around how this will be done, how much it will cost and its value for money. As the regional plan is monitored and reviewed into the future, we will continue to balance leakage reduction and uncertainty, particularly as technological advancements are made, and we better understand the costs.

Water company water efficiency activity

5.20. The draft regional plan identifies the need for water companies to do more to help their customers use water more efficiently at home and work. This could include:

- Rolling out meters, including smart devices, to more customers to help them understand and reduce their water use. This includes a universal metering programme in Portsmouth Water's area
- Targeting activity and communications to customers about water use
- Delivering more in-home water saving visits and fitting products to help save water
- Running public information campaigns to promote water efficiency
- Testing how different tariffs can encourage water efficient behaviour
- Helping customers and business to reduce wastage from poor plumbing.

5.21. The Government has promoted a national ambition for per capita consumption (PCC) to fall to 110 litres per person by day by 2050.

5.22. The proposals in our draft regional plan will achieve a reduction in per capita consumption at a regional level to 115 l/p/d (litres per person per day) by 2050. At a company level the draft regional plan will achieve per capita consumption between 106 l/p/d and 121 l/p/d as illustrated in Table 5.2 below.

Table 5.2: WRSE and company PCC reduction by 2050

Company	2017/18 Normal year PCC (l/person/d)	2050 Normal Year PCC (l/person/d)
Affinity Water	155	113
Portsmouth Water	147	109
SES Water	147	106
South East Water	144	107
Southern Water	129	106
Thames Water	146	121
WRSE	**145**	**115**

5.23. The variation across the region is due to several factors such as housing types, levels of affluence, household size and other personal choices that influence how water is used. Smart meters are helping companies to better understand how water is used. Consumption data from companies that have installed smart meters shows that many people typically use between 100 and 110 litres per day, but a small proportion of very high users is causing average usage to be higher.

Case study

Thames Water began installing smart meters in 2015 and 620,000 households and businesses now have one. Data from smart meters installed on previously unmeasured households, shows that over a quarter currently use more than 500 litres per day. The company has been targeting these customers and is providing a comprehensive home visit service that includes installing water efficient products and detecting leaks and plumbing losses. This is helping these households save an average of 74 litres per property per day. The data that smart meters produce provides insight into how customers use water so water companies can tailor the support they provide to help them use less. Thames Water will be rolling out a further 600,000 smart meters by April 2025, so more than 48% of their customers will be smart metered by the start of the period covered by this regional plan.

5.24. Further details of water efficiency measures being proposed by our six member companies are set out in their draft WRMPs.

5.25. Achieving the Government's 110 litres per person per day ambition in the South East region will require water company activity combined with greater Government interventions.

Water efficient Government policies

5.26. Our draft regional plan has identified the implementation of new Government policies as being necessary to support long-term sustainable reductions in how much water is used across society and to secure water supplies. Our draft regional plan relies on the following measures being implemented by the following dates:

- Water labelling of all water using products by 2024 (already committed to by Government)
- Minimum standards for all water using products by 2040 at the latest
- Improved building regulations for new homes and retrofits by 2060 at the latest

5.27. These additional policies must be introduced so that a more sustainable level of water use is reached. Our analysis (see Part 5 of this Technical Annex) shows that introducing minimum standards for all water using products by 2030 and new building regulations by 2040 could provide an extra 300 million litres of water per day. This would reduce average water use across the region to 109 litres per person per day by 2050 and reduce the total cost of the plan by £0.5 billion.

5.28. We will continue to support the Government as it develops its roadmap for water efficiency. This action by Government will be an important part of how society invests in its future environment and protects it for future generations. It will also share the cost of delivering sustained reductions in water use beyond just water company customers.

5.29. Sectors that rely heavily on water are facing the same long-term pressures on their supplies. We have established a group that brings together representatives from the sectors that use the most water within the region to work more collaboratively to secure supplies. The group has identified examples of how other users are innovating to reduce their water use and manage water more efficiently such as harvesting rainwater from the roofs of glasshouses and storing the water in new on-site reservoirs.

Reducing water use – a national issue

The Government is considering a national target focussed on reducing water use, which will require water companies, customers and businesses to all take action. We support this approach and the use of a representative measure that captures all aspects of society's water use.

Reduce water use during droughts

5.30. When droughts occur, water companies take emergency action to reduce the demand for water as part of their Drought Plans. This includes introducing Temporary Use Bans (TUBs) on domestic customers and Drought Orders for Non-Essential Use Bans (NEUBs) on business customers, both of which temporarily restrict certain discretionary water-using activities, to help preserve water supplies. For example, washing cars and watering gardens with a hosepipe.

5.31. The regional plan continues to rely on temporary restrictions on customers' water use during droughts. Temporary use bans or 'hosepipe bans' on households and non-essential use bans on businesses will continue to be needed in line with the levels of service our six member companies have committed to in their drought plans. We comment more on these in Section 9 of this Technical Annex.

5.32. The reduction in water use that results from these temporary solutions contributes nearly 300 million litres of water per day to the draft regional plan during periods when demand for water is at its highest

Sensitivity testing

5.33. Part 5 of this Technical Annex explains alternative policy approaches to Government interventions that we have evaluated.

6. New sources that provide sustainable and resilient supplies

Context for new sources of water

6.1. Whilst demand management measures will contribute a significant proportion of our future water resources needs, we also need to plan for and deliver a significant scale and capacity of new resource developments to meet the future challenges we face.

6.2. Our draft regional plan includes a number of schemes that are required, and which are of least regret, and a number of other potential schemes that could provide new water supplies for the future. This is based on our assessment of the feasible options which have been included in our regional investment modelling to identify the most cost-efficient, adaptive solution.

6.3. In the following pages we provide a summary of the schemes that feature in the reported pathway of our draft best value plan. Some of the schemes identified are already being progressed by our member companies and other water companies, including as Strategic Resource Options (SROs) through the gated process governed by the Regulators' Alliance for Progressing Infrastructure Development (RAPID). As explained in our separate Technical Annex 1, the RAPID process involves a more detailed assessment of SROs led through a separate governance process to regional planning and WRMPs, with data and information shared between them.

6.4. Alongside our reported pathway, we also highlight some of the schemes that could be needed in the higher and lower pathways presented in this consultation.

6.5. Some key schemes are described in the following sections to give examples of the locations and types of schemes in our draft plan. Not all options are described in the text. At the end of this section, we provide a table that identifies the main options selected in our draft regional plan.

6.6. Full details of the schemes being proposed by our six member companies are set out in their draft WRMPs.

6.7. Part 5 of this Technical Annex evaluates the proposals in this draft plan in more detail, including testing alternative plans that we have evaluated, and different combinations and timings of options selected in those plan

6.8. We have grouped the options by option type:

- Transfers from other regions
- Reservoirs
- Water recycling
- Enhancing groundwater and aquifer use
- Desalination
- Multi-sector options

New sources of water identified in our draft regional plan

Transfers from other regions

6.9. As part of the planning for our draft regional plan we have carried out a process of reconciliation with the other regional groups to identify opportunities to share water between regions and provide a more joined up national solution to the country's future water needs.

6.10. This has shown that there are two potentially viable transfers from the Water Resources West region into the South East using the existing river and canal network. Other regions have indicated through a regional reconciliation process that they are unlikely to be able to provide additional water, beyond what is required to meet their region's needs. These schemes have therefore been discounted at this stage.

Options selected for utilisation by 2035:

Scheme description	Completion date	Water available
Grand Union Canal (GUC) transfer (phase 1)	2031	50 Ml/d

Options selected for utilisation by 2050:

Description	Completion date	Water available
Grand Union Canal transfer (phase 2)	2040	50 Ml/d
Severn Thames Transfer (STT)	2050	160 Ml/d

Options selected for utilisation after 2050:

Scheme description	Completion date	Water available
Severn Thames Transfer (STT) (additional resource)	2050 to 2060	130 Ml/d

Grand Union Canal

6.11. The Grand Union Canal (GUC) scheme provides a transfer of water between Severn Trent and Affinity Water, so crosses between the Water Resources West and WRSE regions. The GUC runs from Birmingham to London and could be enhanced and used to transfer water that is produced through a new water recycling scheme at Minworth near Birmingham.

6.12. Phase one of the Grand Union Canal scheme (50Ml/d) needs to be delivered in the early 2030s in all future scenarios. The second phase (a further 50Ml/d) is required by 2040 in our reported pathway and the high pathway. In the low pathway, phase two is not needed. If the GUC scheme is not developed, alternative water recycling schemes would be needed which would cost more and produce more carbon.

Severn Thames Transfer (STT)

6.13. This transfer would involve moving water from the North West and the Midlands, via the River Severn to the South East. The River Severn would transfer water to Gloucestershire and from there it would be pumped into the River Thames via a new pipeline or the restored Cotswold Canals. The capacity of this option is up to 500 Ml/d.

6.14. There are a number of possible sources of water that could be used to support this transfer. Which additional sources of water are needed, and when, as part of STT transfers will depend on the future scenario we face. They include taking water directly from the River Severn, using recycled wastewater to supplement flows, and taking water from an existing reservoir and moving it to the South East via a transfer.

6.15. The STT would need to be developed by 2050 in our reported pathway and the high pathway. Initially it would transfer water already available in the River Severn but over time, a range of new sources would need to be developed in the Water Resources West region. The reported pathway in our draft plan identifies that by 2050 the STT scheme would transfer water from a new water recycling scheme at Netheridge.

6.16. After 2050 new water sources could be developed and transferred using the STT, including the Minworth water recycling scheme and enhancements to Lake Vyrnwy in Wales. By 2060, it could provide up to 500 million litres of water per day in total to South East England from a combination of sources.

6.17. The use of the Cotswold Canals as part of the STT, rather than a new pipeline, has been explored but is a more costly option.

6.18. In our reported pathway, the Severn Thames Transfer is needed alongside the South East Strategic Reservoir Option (SESRO). As explored in more detail in Part 5 of this Technical Annex, if SESRO is not developed, the STT would be

required by 2040, along with other additional schemes, which would cost more and produce more carbon.

6.19. In the lower pathway, the STT is not needed at any point in the planning period. In our higher pathway, a transfer using the Oxford canal is also identified. SESRO is selected for all the pathways and fully utilised in all but the lowest challenging pathway. In this scenario it is unlikely that the Government interventions and drought orders / permits would be pursued as the challenges in the South East would be far less severe, which would result in higher utilisation rates of all the additional resource schemes in the plan.

6.20. During the regional reconciliation process Water Resources West (WRW) identified that some of the support options would be required by their member companies. For this plan we have considered scenarios if there was restricted support or unrestricted support available to the South East and the selection does not materially differ.

Reservoirs

6.21. Reservoirs store water when it is available, typically pumping water from a river or spring when water levels are high (usually during the winter) when it would otherwise flow out to the marine environment. The water is then stored until it is needed, when levels of available water in the natural environment are low.

6.22. Building additional reservoir storage will help us to adapt to climate change, capturing more excess water during intense rainfall periods. Water supplies in reservoirs could also be supplemented by other sources such as water recycling schemes. The water will be stored until it is needed before being treated and supplied to customers.

6.23. There are a limited number of locations across the South East where reservoirs can be built due to water availability, geology, and social and environmental factors, and we have considered all of these in the development of our plan. The regional plan has identified the need for both new reservoir schemes and schemes that will increase the size of the region's existing reservoirs.

Options selected for utilisation by 2035:

Scheme description	Completion date	Water available
Havant Thicket reservoir in Hampshire	2029	21 Ml/d

Options selected for utilisation by 2050:

Description	Completion date	Water available
Broad Oak reservoir near Canterbury	2036	22 Ml/d
South East Strategic Reservoir Option (SESRO) near Abingdon, Oxfordshire	2040	185 Ml/d
Brent reservoir in north London	2045	7.5 Ml/d
Blackstone reservoir in West Sussex	2046	19.5 Ml/d

Options selected for utilisation after 2050:

Scheme description	Completion date	Water available
Increase the capacity of Bough Beech reservoir in Kent	2051	12 Ml/d
Broyle Place reservoir near Lewes in East Sussex	2075	18 Ml/d

Havant Thicket reservoir

6.24. Havant Thicket reservoir is a WRMP19 scheme which has planning permission and preparatory work for its construction is underway. It will be able to provide an average of 21 Ml/d initially, and then more if combined with recycled wastewater from the Havant recycling scheme providing additional water (see water recycling section). It will provide a strategic solution to drought resilience in the Hampshire area by addressing the water supply shortfall from changes in abstraction licences.

Broad Oak Reservoir

6.25. Our draft regional plan includes the development of a (5,126 Ml capacity) reservoir at Broad Oak, near Canterbury, in Kent with an intake on the Great Stour, yielding a maximum of 22Ml/d. Broad Oak reservoir is needed in our reported and higher pathways by 2036, and 10 years later in our lower pathway. Preparatory work on the scheme is underway, and the development of a planning application and EIA is in progress. Construction would need to begin by 2030 to deliver the scheme by 2036.

6.26. The scheme would allow groundwater and surface water sources to be operated conjunctively to maximise benefits to the wider environment, i.e., resting chalk sources when groundwater levels are low, and by capturing flood flow and storing in the reservoir so that it can be used during summer/dry periods. The inclusion of the Broad Oak Reservoir is a longstanding option for which South East Water own the necessary land and have completed extensive work over a number of years to carefully develop and assess the impact and potential benefits of a new reservoir.

South East Strategic Reservoir Option (SESRO)

6.27. Our draft plan identifies the South East Strategic Reservoir Option (SESRO) near Abingdon, Oxfordshire as a key solution needed to meet the region's additional water requirements by 2040. Water would be pumped from the River Thames during periods of high flow, stored in the reservoir and released during low flows for abstraction downstream, or treated on site before transfer to supply customers across Oxfordshire, Berkshire and Hampshire.

6.28. SESRO is required in our reported, higher and lower pathways. In all three of these pathways of our draft regional plan, SESRO provides 100 million m^3 of storage and can produce up to 185 million litres of water per day, which will be used to supply the customers of Thames Water, Affinity Water and Southern Water through new transfers (see section 7 of this Technical Annex for more details of the transfers).

6.29. We have modelled a range of alternative sizes for SESRO. The sizes of reservoir which are available for regional planning have been informed by the SESRO SRO options appraisal process. The largest size would provide 150 million m^3 of storage and produce 270 million litres per day. This would also be fully utilised by 2050 in the more challenging future scenarios. If this was developed, more water could be moved to the Hampshire area through a new transfer, so the size of the Havant water recycling scheme could be reduced, and some smaller schemes would not be required or not needed until later in the planning period.

6.30. The regional plan has selected the 100 million m^3 reservoir as it performs better against some of the best value criteria we have assessed, particularly those that provide additional benefits to the environment and society. The larger (150 million m^3) reservoir performs better against the resilience criteria and biodiversity net gain. The choice between the two reservoir sizes is extremely close and each size has some trade-offs regarding other schemes selected across the region, particularly regarding desalination and recycling options. This trade off can be seen in the investment model summary report (in our document library on WRSE website).

6.31. A smaller SESRO that would provide 75 million m^3 of storage was also included in the modelling. This smaller option was not selected in any of the adaptive pathways. The smaller reservoir does not perform as well against any of the best value metrics and is more costly as other schemes need to be developed as well. Our work has shown that both SESRO and STT are needed but the reservoir is a better first option. This is because the reservoir has lower running costs. The plans with the reservoir developed first are less expensive and have lower carbon emissions. Forecasts also suggest that in the future, droughts are likely to occur at the same time across the whole

country. This could mean that less water is available to transfer to the South East as it will be needed in the Midlands and the North West.

6.32. If SESRO is not developed, other resources would need to be progressed instead. This would include larger water recycling schemes including options at Beckton, to provide water for transfer to Affinity, and Peacehaven to provide additional water for transfer to Southern Water. The STT would also need to be developed earlier and would need to provide more water than Water Resources West have previously indicated might be available pre-2050. This might be possible, but it would require some of their member companies to generate alternative sources of water in order to meet their own challenges. These additional schemes could face local challenges and prove difficult to promote. For the reported pathway, a plan without SESRO would cost £500 million more than the best value plan and have significantly higher carbon costs. We comment further on the selection of SESRO and STT in Section 14 of this Technical Annex.

6.33. Detailed technical assessments and studies of SESRO are currently underway through the RAPID gated process, and SESRO will need to be proceeded with by 2025 because it will take 15 years to plan, build and fill with water.

Brent reservoir

6.34. The Brent reservoir in London would involve repurposing an existing Canal and River Trust reservoir for public water supplies. It is required by 2045 in our reported and higher pathways.

Blackstone reservoir

6.35. Blackstone reservoir could provide up to 20 Ml/d and would store water from the River Adur that would then be supplied to Brighton and parts of West Sussex. Blackstone reservoir is needed in the reported pathway and the higher pathway.

Longer term reservoir options

6.36. Over the longer term, beyond 2050, in our reported pathway there is a need to increase the capacity of Bough Beech reservoir in Kent in the early 2050s, and to develop a new reservoir in East Sussex by the end of the planning period (2075). Under some of the alternative pathways in the draft plan there would be a need to increase the storage capacity of Bewl reservoir in Kent.

Water recycling

6.37. Water recycling is where highly treated wastewater is returned to the environment and used to supplement our natural water supplies. It is used extensively in other parts of the world, such as California and Singapore. It typically involves moving a coastal or estuarine treated wastewater release point higher up in the catchment. The water, which would undergo an extra stage of enhanced treatment, would be released at a point where it can support additional water abstraction.

6.38. Consideration needs to be given to the environmental impact on the watercourse or waterbody that receives the additional treated water so that it does not affect its ecology. In some areas, using an environmental buffer such as a reservoir or lake to store the treated water – mixed with river or spring water – instead of releasing it directly into the environment, provides a more suitable alternative and our plan includes these options.

6.39. Our draft regional plan has identified that water recycling will need to form an important part of the solution, with variations in the schemes needed depending on the future scenarios we face. The modelling undertaken for our draft regional plan indicates that recycling will be needed in the early years of the plan to achieve the higher level of drought resilience required by 2040 and the environmental ambitions associated with reducing abstraction.

Options selected for utilisation by 2035:

Scheme description	Completion date	Water available
Sandown water recycling scheme to support abstraction from the River Yar on the Isle of Wight	2028	8 Ml/d

Littlehampton water recycling scheme to support abstraction from the River Rother in West Sussex	2028	15 Ml/d
Havant water recycling scheme to supplement water supplies in Havant Thicket reservoir in Hampshire	2031	60 Ml/d
Teddington direct river abstraction supported by water recycling at Mogden in London	2031	67 Ml/d[2]
Wastewater from the paper production process will be recycled and enable a trade of an existing licence for public water supply in Kent	2031	7.5 Ml/d
Aylesford water recycling scheme into Eccles Lake to supplement abstraction from the River Medway in Kent	2031	13 Ml/d

Options selected for utilisation by 2050:

Description	Completion date	Water available
Peacehaven water recycling to supplement supplies in Arlington reservoir in East Sussex	2041	30 Ml/d
Hythe water recycling scheme in Kent	2045	5 Ml/d
Hastings water recycling scheme to supplement supplies in Darwell reservoir, East Sussex	2046	15 Ml/d

Options selected for utilisation after 2050:

Scheme description	Completion date	Water available
Dover water recycling scheme in Kent	2057	8 Ml/d
Deephams water recycling scheme in London	2061	42 Ml/d
Tunbridge Wells water recycling scheme into Bewl Water in Kent	2062	4 Ml/d

6.40. Six water recycling schemes are identified in the draft regional plan for completion by 2035. They are needed in all alternative pathways. Water companies are already progressing these schemes. They will provide a resilient supply of water to replace existing water sources and are in areas where extra water is needed.

Sandown and Littlehampton

6.41. Sandown and Littlehampton are two WRMP19 schemes that Southern Water are currently progressing through investigations and preparation of applications for necessary consents. The two schemes are required before 2030.

Havant water recycling scheme

6.42. A scheme that uses highly treated wastewater to supplement the water stored in the new Havant Thicket reservoir has been identified in our draft regional plan. Treated wastewater from the Budds Farm wastewater treatment works would receive additional treatment at a new recycling facility in Havant before being pumped to the reservoir where it would be stored to supplement the spring water supply. The water would then be further treated at a water supply works before being supplied to people in the local area or transferred through new pipelines to supply other areas in

[2] *67 Ml/d is the DO benefit of the 75 Ml/d scheme*

both Hampshire and West Sussex. The scheme could deliver up to 60Ml/d. Southern Water consulted on this scheme during Summer 2022 as part of its preparation for applications for consent.

Peacehaven Recycling Scheme

6.43. The Peacehaven water recycling scheme is able to provide a yield of 30 Ml/d and can offer a shared benefit to both South East Water and Southern Water if needed. This option comprises a new effluent treatment plant at Southern Water's Peacehaven WwTW, the treated effluent would then be transferred inland for release into the existing surface reservoir at Arlington for abstraction and treatment at an upgraded existing water treatment works.

Teddington Direct River Abstraction

6.44. The Teddington Direct River Abstraction would use highly treated wastewater from Mogden Wastewater Treatment Works to compensate flows taken from a new abstraction on the River Thames, upstream of Teddington Weir. This could deliver up to 75 Ml/d of water (67Ml/d deployable output) that could be used to supplement the supplies in the Lee Valley reservoirs.

Water recycling in Kent

6.45. Two water recycling schemes are selected in our reported pathway in Kent, both by 2031. The first would provide a supply of up to 7.5Ml/d of highly treated industrial process water to an industrial user and the other would treat and transfer up to 20Ml/d from Aylesford into Eccles Lake to supplement abstraction from the River Medway.

Options beyond 2035

6.46. The recycling schemes needed between 2035 and 2050 are needed in our reported pathway and the higher pathway. In the less challenging pathway, no other recycling schemes are needed, apart from the Tunbridge Wells recycling scheme which is required by 2046. This is because the less challenging pathway plans for less water to be left in the environment so not as much new water needs to be produced to replace existing supplies.

6.47. Beyond 2050 our plan includes the selection of the Deephams water recycling scheme. During the pre-consultation stage of the Thames Water WRMP development, this scheme was identified as being infeasible until such a time as significant flow increases in the Lower River Lee would be made. This decision is documented in a 'Statement of Common Understanding' produced by the EA and Thames Water. These increases in flow would require significant licence reductions at TW's surface water abstractions on the Lee. In Thames Water's Environmental Destination scenarios, such licence reductions are scheduled to be made no earlier than 2060. As such, whilst the Deephams Reuse option is temporarily screened out in the short term, it is available for selection over the longer term.

6.48. Water recycling forms an essential part of our regional plan over the longer term. If water recycling schemes cannot be progressed, then desalination plants or more storage options will need to be built instead. An alternative to the Peacehaven recycling scheme could be a new reservoir at Arlington in East Sussex. However, there are a limited number of other locations for new storage in South East England and they typically take longer to plan and build.

Enhancing groundwater and aquifer use

6.49. Much of the region's water supplies come from groundwater which is stored within the underground aquifers across the South East. They provide a direct supply of water and are the source of the region's many chalk rivers and streams. Our plan will deliver a net reduction in abstraction from our existing sources but also looks to improve how we store water underground, without impacting on the environment.

6.50. Groundwater abstraction improvement schemes involve making changes to existing groundwater storage, where it is sustainable to do so, to make more water available. Groundwater storage schemes can involve using other sources of water to recharge the existing groundwater source known as Managed Aquifer Recharge (MAR). Alternatively, where groundwater conditions are suitable they can create a new area of storage underground so more can be stored. Water can then be pumped back to the surface and treated when needed.

Options selected for utilisation by 2035:

Scheme description	Completion date	Water available
Six groundwater improvement schemes, comprising:	Between 2025 and 2035	Between 0.5 and 9 Ml/d per scheme
Canals and Rivers Trust Slough		
Romsey Groundwater		
Groundwater: Newchurch LGS		
Groundwater development - Addington		
Groundwater development – Southfleet and Greenhithe		
Groundwater development – Woods Farm existing source increase DO		

Options selected for utilisation by 2050:

Description	Completion date	Water available
Eleven groundwater schemes to improve or recommission existing groundwater sources, comprising:	Between 2035 and 2050	Between 0.5 and 5.0 Ml/d per scheme
Egham LGS		
Tappington South		
Outwood Lane borehole – licence increase		
Groundwater licence trade – Halling		
Groundwater: Eastern Yar replacement borehole		
Groundwater: recommission Gravesend source		
Rye groundwater reconfiguration		
Groundwater development – Dapdune licence disaggregation		
Groundwater development – Recommission Mortimer disused source		
Groundwater development – Moulsford groundwater source		
Groundwater development – Britwell groundwater source – removal of constraints		
Managed Aquifer Recharge scheme using water from the River Test to supplement groundwater supplies	2042	5.5 Ml/d
Aquifer Storage and Recovery scheme at Epping	2050	8 Ml/d
Aquifer Storage and Recovery scheme at Horton Kirby	2050	5 Ml/d

Groundwater schemes

6.51. Groundwater abstraction improvement schemes are promoted in areas where the current arrangements are limiting how much water can be abstracted. They are typically cheaper to develop and make the best use of water already available. However, it is important that any developments to groundwater sources and the amount of water taken from them does not damage the environment, particularly where they feed chalk rivers and streams.

6.52. Our draft regional plan identifies six schemes before 2035 that could improve the way groundwater sources are currently configured so they can be used more efficiently and produce more water. They range from producing 0.5 to 9 Ml/d of additional water to the region. A further eleven groundwater schemes are identified before 2050. Groundwater schemes are needed in all the alternative pathways, although the more challenging pathways require more to be delivered.

Managed Aquifer Recharge and Aquifer Storage and Recovery

6.53. Aquifers are underground layers of rock which naturally store water. These schemes involve injecting additional fresh water from other parts of the aquifer, or from rivers, into a confined area within the aquifer. It can then be stored and pumped back to the surface and treated when needed. There are several examples of existing Managed Aquifer Recharge schemes in the South East including Thames Water's North London Artificial Recharge Scheme and SES Water's North Croydon peak management scheme.

6.54. There are a limited number of locations in the South East where this is possible because of the geology of the region, and the technology used is still being developed. Thames Water is already planning an Aquifer Storage and Recovery scheme in its area and the regional plan has identified two schemes in Hampshire and the outskirts of London where this could be used to provide additional storage by 2050. These schemes will require further technical investigation by water companies.

Desalination

6.55. Desalination turns seawater and brackish water into drinking water by removing the salt, providing a reliable source of water, including during droughts. There is one existing large desalination plant in London, and it is a technology that is used extensively in other parts of the world such as the Middle East, where there is a shortfall in available water throughout the whole of the year. Desalination plants can often be expanded to treat more water if needed in the future.

6.56. Producing drinking water in this way uses a lot of energy and the salt that is removed must be safely disposed of to avoid damaging the environment.

Our research shows that customers have concerns about desalination plants, and they are seen as an option of last resort if alternative sources of water are not available. Desalination technology is anticipated to continue to advance over the life of our regional plan and environmental and energy use concerns may be capable of being reduced or mitigated over time.

Options selected for utilisation by 2035:

Scheme description	Completion date	Water available
Sussex coast desalination (phase 1)	2028	10 Ml/d

Options selected for utilisation by 2050:

Description	Completion date	Water available
River Thames estuary desalination in Kent (phase 1)	2040	20 Ml/d
East Thanet coast desalination (phase 1)	2041	20 Ml/d
Hythe beach desalination	2041	5 Ml/d
River Thames estuary desalination in Kent (phase 2)	2041	20 Ml/d
Reculver desalination of brackish water	2046	30 Ml/d
Isle of Sheppey desalination (phase 1)	2046	20 Ml/d

Options selected for utilisation after 2050:

Scheme description	Completion date	Water available
East Thanet coast desalination (phase 2)	2051	20 Ml/d
Sussex coast desalination (phase 2)	2059	10 Ml/d

Sussex Coast desalination scheme

6.57. This is a WRMP19 scheme being promoted by Southern Water to meet the scale of deficits within that part of the region in the early part of the plan period. It would involve building a desalination plant in the Shoreham area on the West Sussex coast. It could produce up to 40 Ml/d to supply to parts of West and East Sussex. Investigations are continuing by Southern Water to assess sites and delivery of this option. It is needed in all pathways of our adaptive plan.

Other desalination schemes beyond 2035

6.58. Additional desalination plants are identified from 2040 in other coastal and estuarine locations across Kent and East Sussex. They feature in the reported pathway and the higher pathway with some variations in the timing. In the higher pathway, more desalination schemes are needed including a new plant in London.

6.59. The need for desalination plants in these areas is primarily driven by the long-term need to protect and improve the freshwater environment. Therefore, the decision on the location and level of future abstraction reductions will determine what additional resources will be needed.

6.60. The WRSE investment modelling indicates that desalination is the least preferred option on a cost-efficient economic basis. We recognise that desalination is not a preferred option for many customers and stakeholders due to its cost and environmental impact. It tends to be identified as the preferred option where the need in an area is so high that there are no other local sources of water to meet it, or where the alternative is a long-distance transfer to move water from another part of the region, which typically have high economic and carbon costs associated with them.

6.61. We will continue to work with our member companies that provide water supplies in these areas, and regulators, to investigate and identify the appropriate solutions to meet the significant abstraction reduction expected in the future.

6.62. With the exception of the scheme on the Sussex Coast, decisions on these desalination plants do not need to be made now and much will depend on how much water needs to be left in the environment and where, and the level of housing growth we see in future. New technology could also make desalination cheaper and less energy intensive. We will also need to monitor whether the other options in the plan are delivered, including the demand management reductions, as if they are, not desalination may be needed sooner and in more locations. Alternatively, new options may be identified that could be used instead of desalination, so our plan will adapt in the future based on the latest evidence available.

Multi-sector options

6.63. We have included a number of multi-sector options in our regional plan which would involve water companies working with other sectors on shared solutions that provide multiple benefits. There are also options, that if modified, could provide water for other sectors.

6.64. Our analysis shows that the additional requirements of the power and agricultural sectors can be met within their existing licence headroom, development of local storage solutions and becoming more efficient with how water is used. However, this is assuming that the existing licence remains unchanged. If their licences are capped, in a similar way to public water supply licence capping being implemented by regulators, then they could require additional water from the regional plan. We will continue to work with the agricultural, horticultural, and power sectors, over the winter to look at alternative future strategies should licence headroom reduce, alongside environmental and economic regulators.

6.65. In addition to power and agriculture, we also looked at the needs of other industry within our region, and how the future needs of the paper industry could be met. Our assessment shows that there is currently capacity across all the licences that are held by paper producers in Kent to meet anticipated growth in the sector's demand for water. The draft regional plan includes a scheme that recycles the wastewater from the paper production process to enable a licence trade that would provide an extra 7.5 million litres per day for public water supply. This could be increased to provide a further 12.5 million litres of water per day for use by paper producers. Furthermore, there is potential opportunity for similar recycling schemes to be developed at other sites. We will continue to work with the paper industry to explore these options further.

6.66. As well as industry needs, we have also considered wider sector water needs in our region. There are two wetland areas which have been identified by Natural England, which would require additional water during a drought. We will continue to work with environmental organisations on a solution, which could involve using recycled water to support the wetland areas.

6.67. We will continue to work with multi-sector stakeholders, particularly through the WRSE Stakeholder Advisory Board, to understand the non-public water supply water needs, and potential multi-sector solutions to meet these needs.

Summary of the main new sources of water identified in our draft regional plan

6.68. Table 6.1 identifies the main new resource options selected by the investment modelling in our draft regional plan for the South East region in the 1:500 DYAA scenario, that will provide water by 2050. The table shows the broad timetable for the planning and construction phases of these main schemes and when the water will become available.

Table 6.1: Main new resource options to provide water by 2050

Scheme	Development Timeline		
	To 2030	To 2040	To 2050
Sandown water recycling scheme	Planning consent, construction with water available from 2028		
Littlehampton water recycling	Planning consent, construction with water available from 2028		
Sussex coast desalination	Planning consent, construction with water available from 2028		
Havant Thicket Reservoir	Construction with water available from 2029		
Grand Union Canal (phase 1)	Planning consent and construction (phase 1&2)	Construction and water available from 2031	
Havant water recycling	Planning consent and construction	Construction and water available from 2031	
Teddington Direct River Abstraction	Planning consent and construction	Construction and water available from 2031	
Wastewater recycling (paper) and licence trade	Planning consent	Construction and water available from 2031	
Aylesford water recycling	Planning consent and construction	Construction and water available from 2031	
Broad Oak reservoir	Planning consent	Construction and water available from 2036	
Grand Union Canal (phase 2)	Planning consent	Construction and water available from 2040	
South East Strategic Reservoir Option (SESRO)	Planning consent	Construction and water available from 2040	
River Thames estuary desalination (phase 1)		Planning consent, construction, and water available from 2040	
Thames to Southern Transfer	Planning consent	Planning consent, construction, and water available from 2040	
Peacehaven water recycling		Planning consent, construction	Construction and water available from 2041
East Thanet Coast desalination (phase 1)		Planning consent, construction	Construction and water available from 2041
Hythe beach desalination		Planning consent, construction	Construction and water available from 2041
River Thames estuary desalination (phase 2)		Planning consent, construction	Construction and water available from 2041
Managed Aquifer Storage River Test		Planning consent, construction	Construction and water available from 2042
Hythe water recycling		Planning consent, construction	Construction and water available from 2045
Brent reservoir		Planning consent, construction	Construction and water available from 2045
Hastings water recycling			Planning consent, construction and water available from 2046
Blackstone reservoir		Planning consent, construction	Construction and water available from 2046
Reculver desalination		Planning consent, construction	Construction and water available from 2046
Isle of Sheppey desalination (phase 1)			Planning consent, construction and water available from 2049
Severn Thames Transfer (STT)		Planning consent, construction	Construction and water available from 2050

7. A network that can move water around the region

Transfers in the region today

7.1. Our six member companies already share some of the region's water supplies through pipelines that link their supply areas. Currently, up to 115 million litres of water per day can be moved between our member companies.

7.2. There are also pipelines that link the companies' water resource zones (WRZs) which enable them to move water around their own supply areas, and imports into the region from companies outside of the WRSE area. The total volume of transfers in the region in 2026 at the start of the regional plan is 420Ml/d.

What our draft regional plan proposes

7.3. The draft regional plan has identified new transfers to increase how much water can be moved around the region. As new sources of water are developed, they will be shared between companies helping to increase the resilience of the region's water supplies.

7.4. Alongside the options needed to make more water available to transfer (covered in the previous section), the draft regional plan has identified new transfers to move water around the South East more easily by 2060, depending on the future scenario we face.

7.5. This will see more transfers between different parts of our six member companies' supply areas and between different water companies, increasing the connectivity of the region. These transfers don't produce any extra water, but they do move water from areas where more is available to those where there is less; and they will help make supplies to homes and businesses more resilient as water companies will have more sources to rely upon.

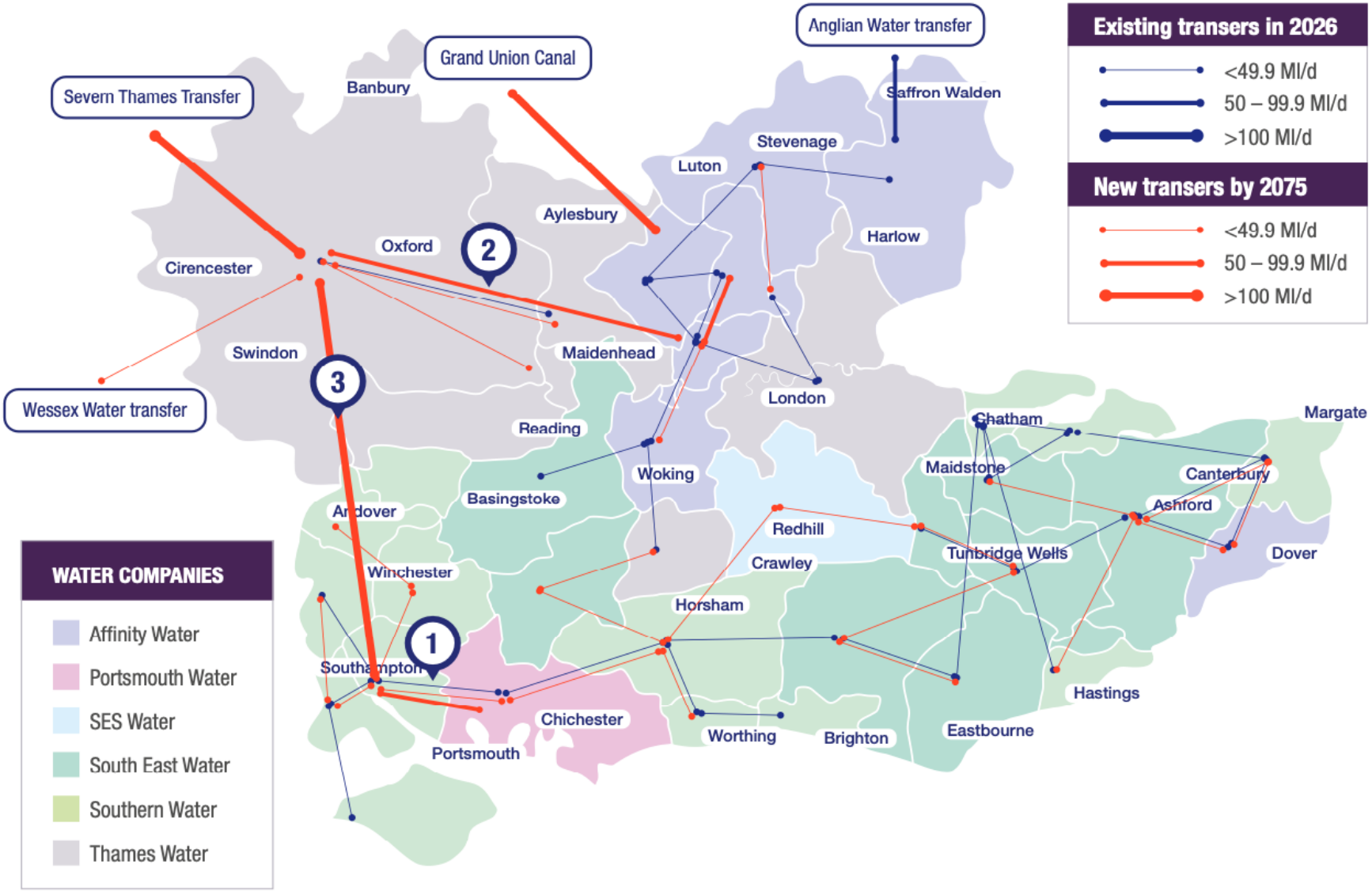
7.6. As part of this network, the draft regional plan identifies that some new strategic transfers are required, to enable water produced by the major schemes to be transferred other areas. These include:

- **1. Havant Thicket to Southampton** - A pipeline that would move up to 90Ml/d of water by 2030 from Havant Thicket reservoir, in conjunction with the Havant water recycling scheme, to deliver the required quantity of water supply to Southern Water's customers in the Hampshire area.
- **2. Thames to Affinity Transfer -** A transfer that would move up to 100Ml/d of water by 2040 from the River Thames to Affinity Water's supply area. Water could be supplied from a range of sources, including SESRO, the STT, or reuse. Water is most likely to be transferred to a water treatment works in Iver, but water could be transferred to North Mymms if the Thames-Lee Tunnel is used and water is transferred from North East London
- **3. Thames to Southern Transfer** – A transfer that would enable up to 120Ml/d of water by 2040 from either or both of SESRO and STT to be treated in a new water treatment works and then transferred by pipeline to supply Southern Water's customers in Hampshire.

7.7. All these schemes are being investigated through RAPID's gated process. The schemes are illustrated in Figure 7.1 below, alongside the network of other transfer improvements that are planned to be delivered.

7.8. By 2075, an additional 970 million litres of water per day will be able to be moved through the enhanced regional water network compared to the start of the plan in 2026.

Figure 7.1 – Transfers within the region 2026-2075



Diagrams to explain our water transfer proposals

7.9. The plots in this section illustrate how water moves into and around the region, and how this will change under the proposals in our draft plan. The hexagons in the plots are the individual water resource zones (WRZs) in the South East region, and WRZ outside of the region that provide a transfer of water either into or out of the region.

7.10. Each of the plots shows transfers at a particular point in time, under our 1:500 DYAA planning scenario. The thicker the lines between the WRZ, the larger the transfer. The plots demonstrate how increased connectivity within the region, and from other regions, will significantly increase the flow of water that is transferred over time. All of the plots represent the position under our reported pathway – situation 4.

7.11. A key for the WRZ abbreviations used in the plots is in the table below:

WRZ	Water Company	Zone Name
AZ1	Affinity Water	Misbourne
AZ2	Affinity Water	Colne
AZ3	Affinity Water	Lee
AZ4	Affinity Water	Pinn
AZ5	Affinity Water	Stort
AZ6	Affinity Water	Wey
AZ7	Affinity Water	Dour
PRT	Portsmouth Water	Portsmouth
SES	SES Water	SES
RZ1	South East Water	Tunbridge Wells
RZ2	South East Water	Haywards Heath
RZ3	South East Water	Eastbourne
RZ4	South East Water	Bracknell
RZ5	South East Water	Farnham
RZ6	South East Water	Maidstone
RZ7	South East Water	Cranbrook
RZ8	South East Water	Ashford
HAZ	Southern Water	Hampshire Andover
HKZ	Southern Water	Hampshire Kingsclere
HRZ	Southern Water	Hampshire Rural
HSE	Southern Water	Hampshire Southampton East
HSW	Southern Water	Hampshire Southampton West
HWZ	Southern Water	Hampshire Winchester
IOW	Southern Water	Isle of Wight
KME	Southern Water	Kent Medway East
KMW	Southern Water	Kent Medway West
KTZ	Southern Water	Kent Thanet
SBZ	Southern Water	Sussex Brighton
SHZ	Southern Water	Sussex Hasting
SNZ	Southern Water	Sussex North
SWZ	Southern Water	Sussex Worthing
GUI	Thames Water	Guildford
HEN	Thames Water	Henley
KVZ	Thames Water	Kennet Valley
LON	Thames Water	London
SWA	Thames Water	Slough, Wycombe and Aylesbury
SWX	Thames Water	Swindon and Oxfordshire

7.12. In addition, a number of zones have been included for investment modelling purposes only, which represent transfer and distribution constraints in the WRSE network, shown in grey on the hexagons plot. A list of the abbreviations for these zone names is in the table below:

WRSE Zone	Zone Name
HON	Honor Oak Junction
HTE	Havant Thicket Exchange

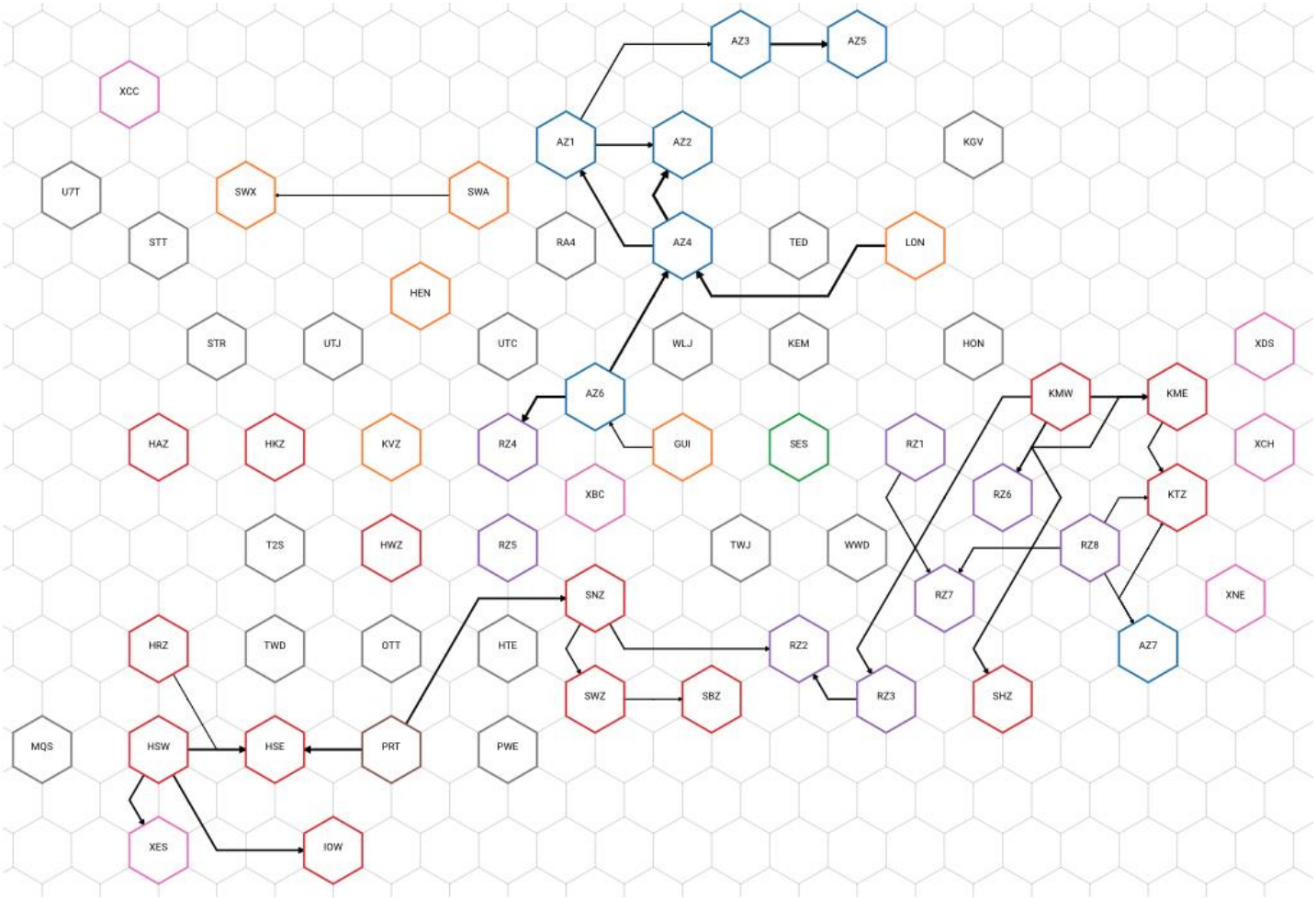
KGV	King George V Junction
OTT	Otterbourne Junction
PWE	Portsmouth Water East
RA4	Raw AZ4 Junction
STR	Strategic Thames Resource
STT	Severn Thames Junction
T2S	Thames to Southern Junction
TWD	Testwood Junction
TWJ	Thames-Weirwood Junction
UTC	Upper Thames Constrained
UTJ	Upper Thames Junction
WLJ	West London Junction
WWD	Weirwood Junction

7.13. The pink hexagon zones which begin with the letter “X” refer to specific investment modelling zones created to facilitate the third party and non-public water supply options.

Existing Network (2026)

7.14. Figure 7.2 identifies the existing transfers at the start of our regional planning period.

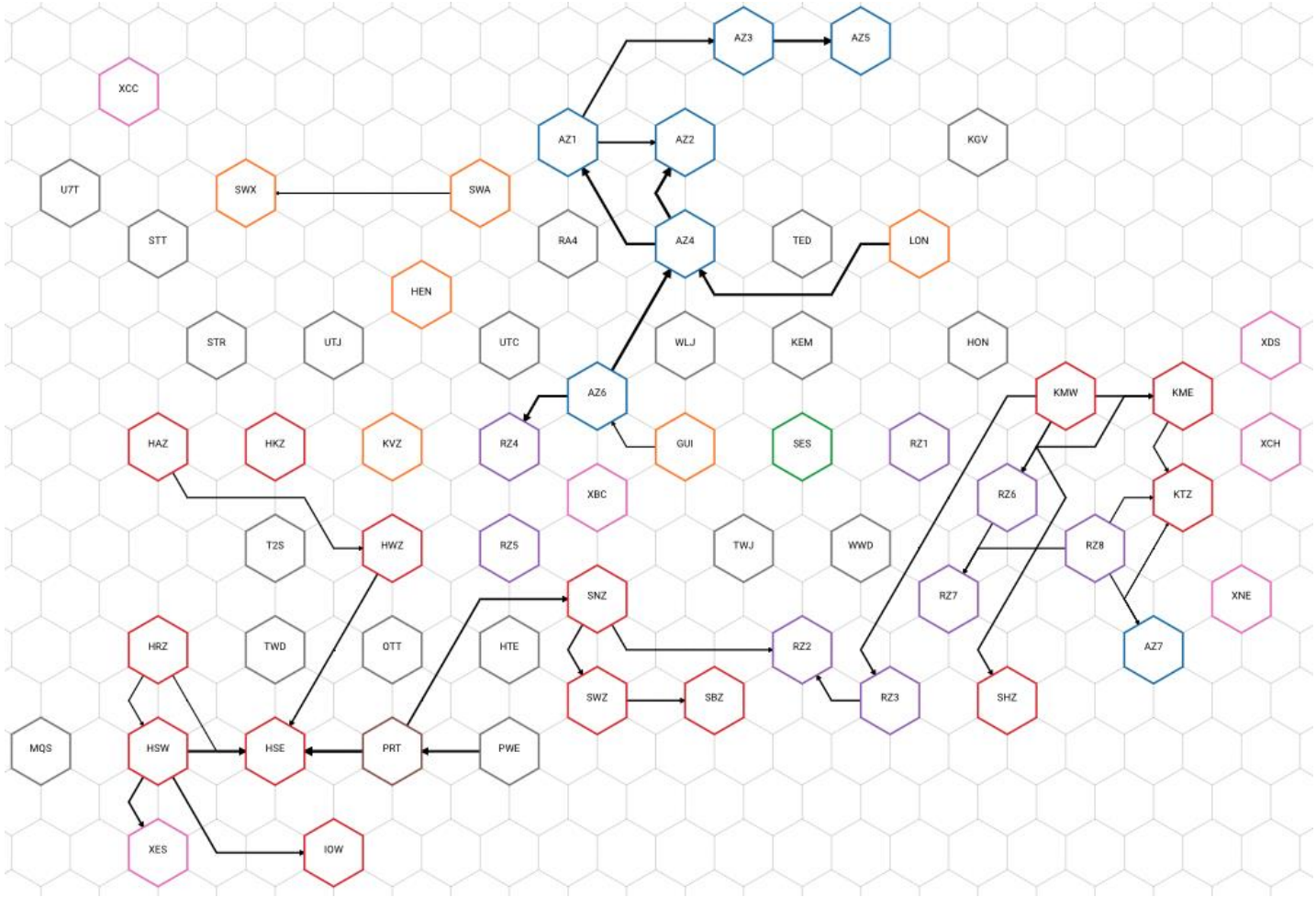
Figure 7.2: Transfers in 2026 at start of the plan period



Network at 2029/30

7.15. Figure 7.3 identifies the transfers at the end of 2029/30.

Figure 7.3: Transfers at end of 2029/30



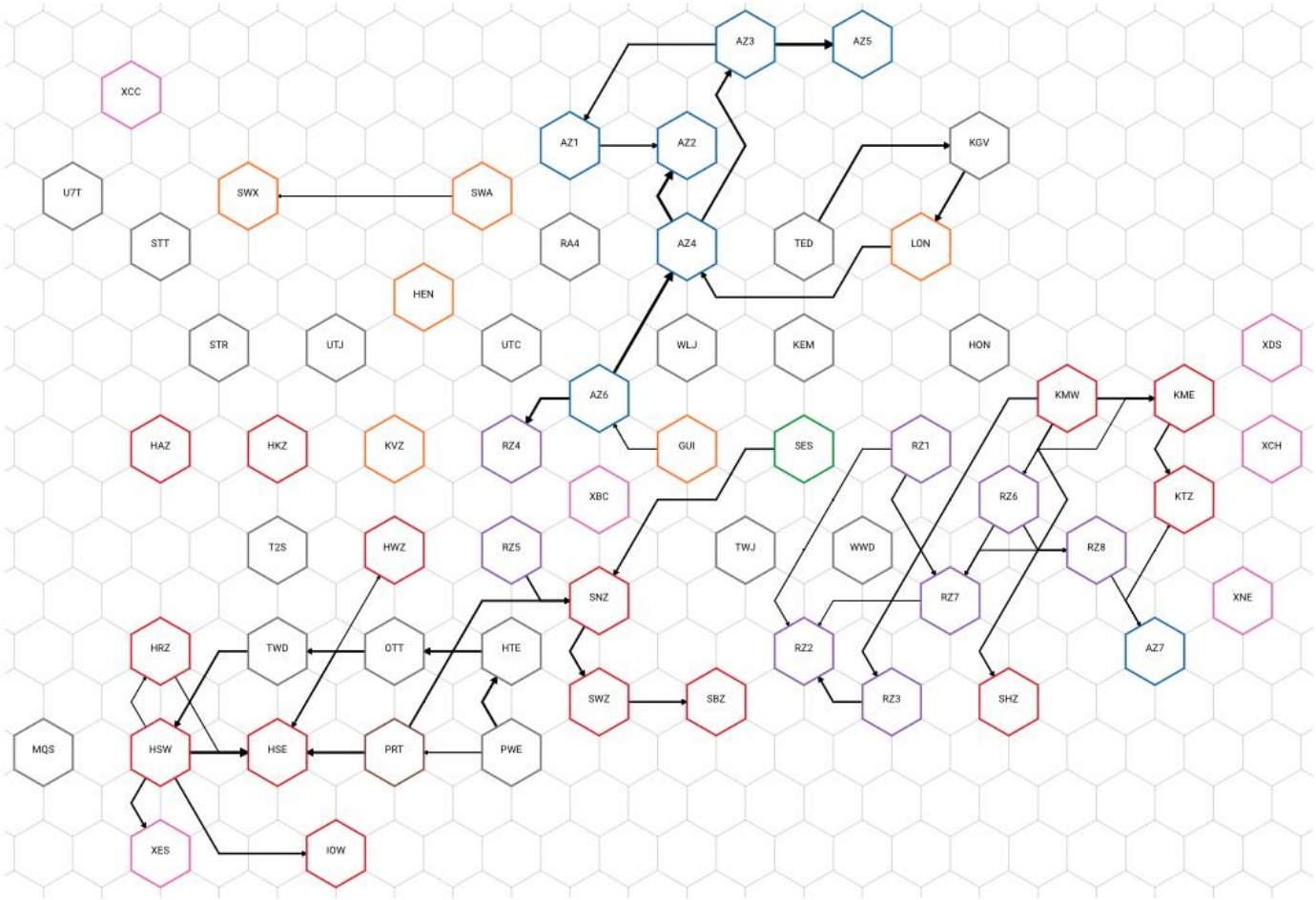
7.16. By the end of 2029/30 we start to see increased connectivity across the network, including:

- Additional connections between Portsmouth Water and Southern Water relating to Havant Thicket Reservoir.
- Additional connections between Southern Water and South East Water in the east of the region.

Network at 2034/35

7.17. Figure 7.4 identifies the transfers at the end of 2034/35.

Figure 7.4: Transfers at end of 2034/35



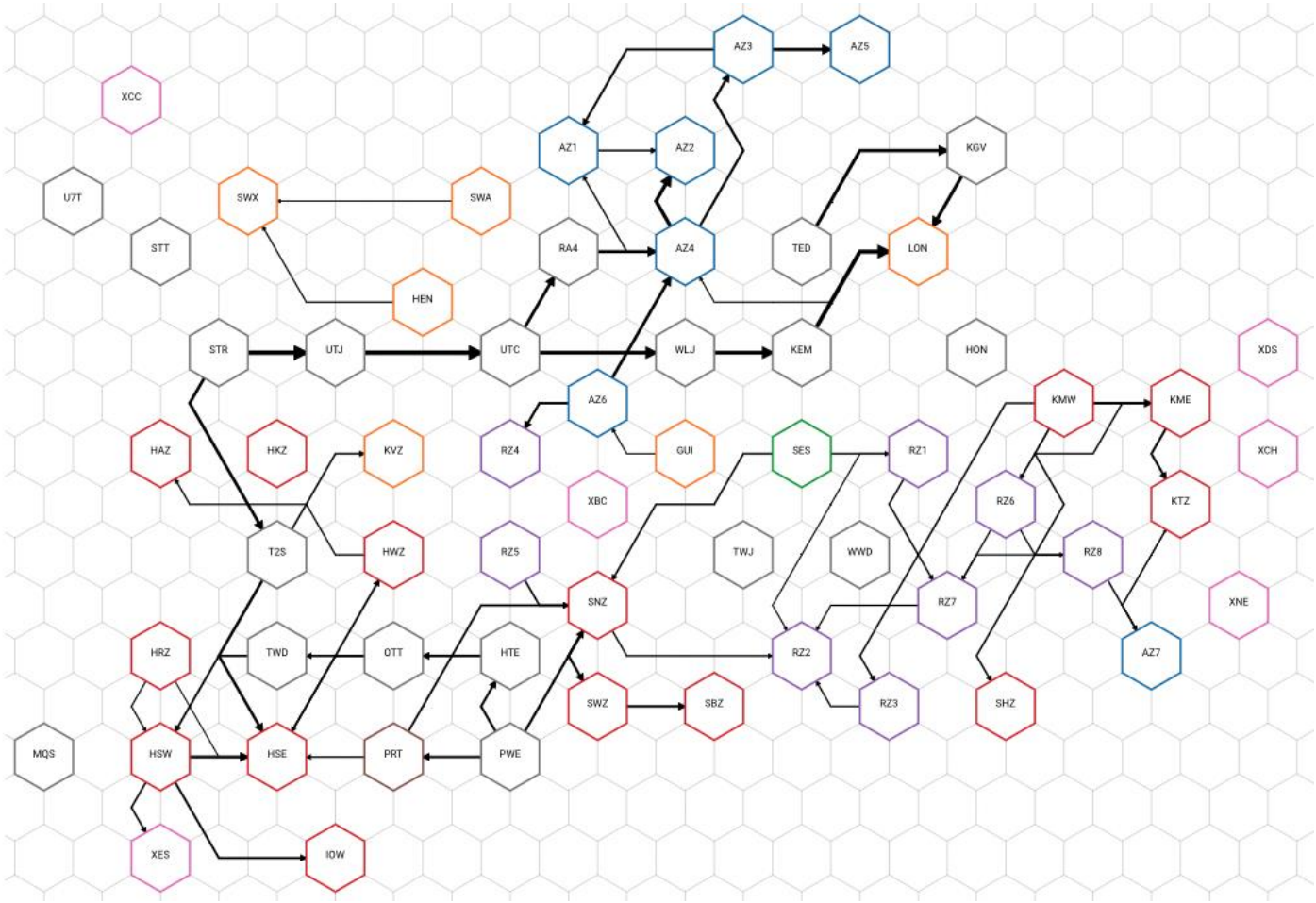
7.18. By the end of 2034/35 the increasing connectivity across the network is becoming more pronounced, but a number of the strategic transfers have not yet been developed. The key changes by this date are:

- Additional transfers from Havant Thicket reservoir to Portsmouth Water and Southern Water.
- Additional water transferred by Thames Water from Teddington.

Network at 2039/40

7.19. Figure 7.5 identifies the transfers at the end of 2039/40.

Figure 7.5: Transfers at end of 2039/40



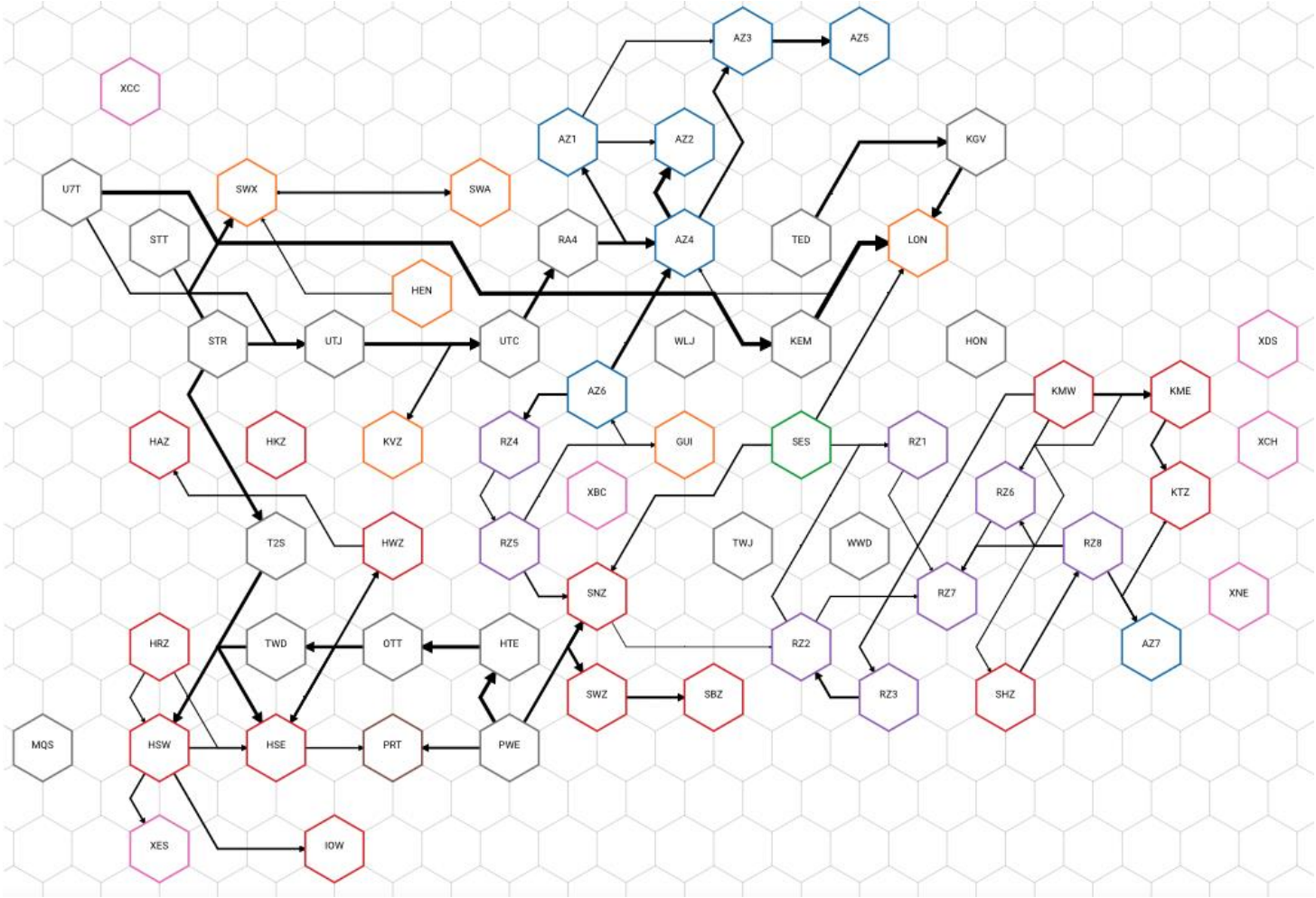
7.20. By the end of 2039/40 SESRO has been developed, facilitating a number of strategic transfers across the network. The key changes by this date are:

- Transfers from Thames Water to Affinity Water and Southern Water, relating to SESRO.
- Additional connectivity between Southern Water zones.
- Additional connectivity between SES Water and Southern Water.
- Additional connectivity between SES Water and South East Water.

Network at 2049/50

7.21. Figure 7.6 identifies the transfers at the end of 2049/50.

Figure 7.6: Transfers at end of 2049/50



7.22. By the end of 2049/50 other strategic transfers such as STT have been developed. The key changes by this date are:

- Transfers relating to STT, to Thames Water, Affinity Water and Southern Water.
- Additional connectivity between SES Water and Thames Water.
- Additional connectivity between South East Water and Southern Water.
- Additional connectivity between South East Water and Thames Water.

Network at 2059/60

7.23. Figure 7.7 identifies the transfers at the end of 2059/60.

Figure 7.7: Transfers at end of 2059/60

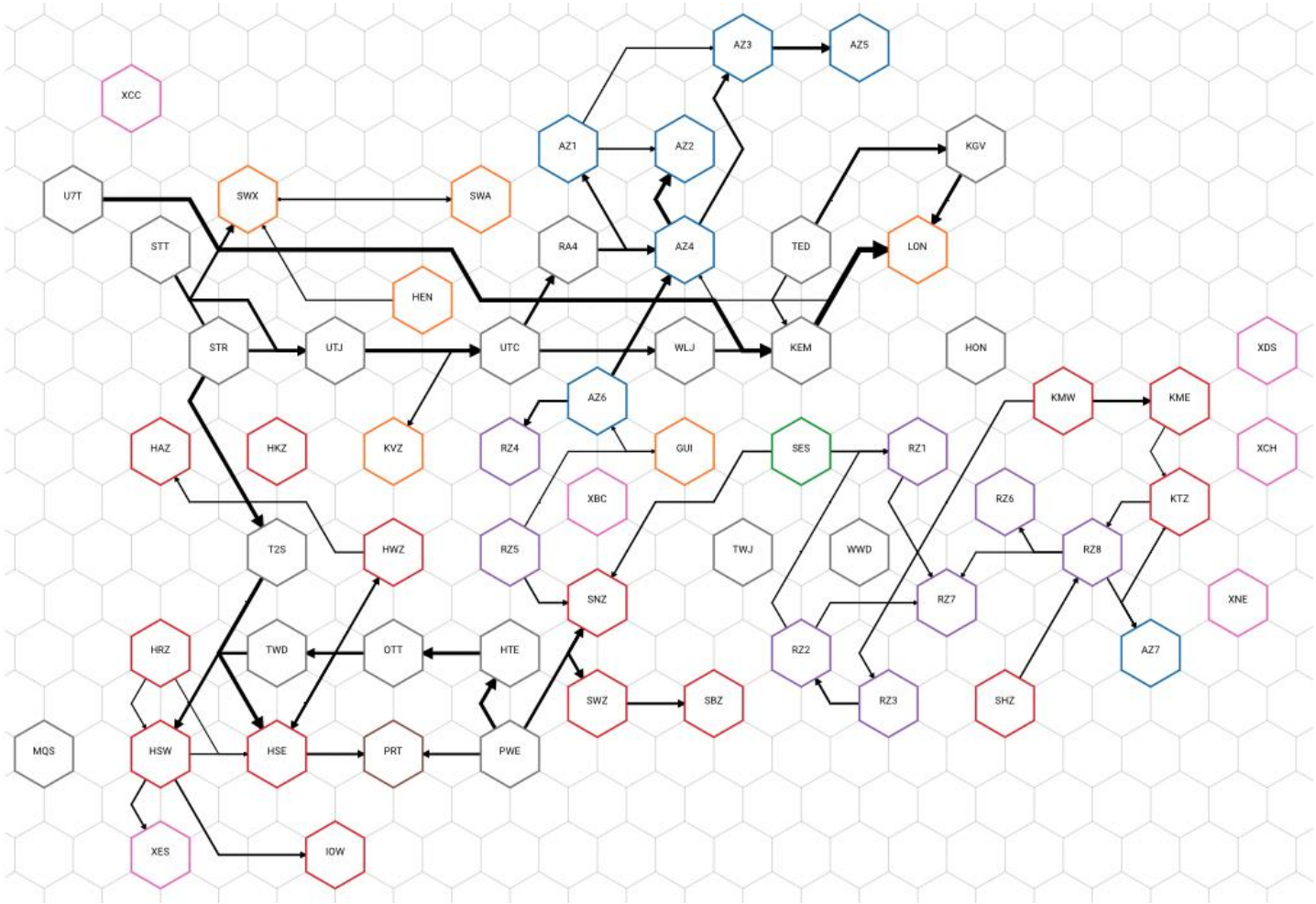
7.24. By the end of 2059/60 the regional transfer network proposed in our draft regional plan is fully developed. There are no key changes by this date compared to the network in 2049/50, but there are some increased volumes of water being transferred.

Network at 2074/75 – end of the planning period

7.25. Figure 7.8 identifies the transfers at the end of the planning period in 2074/75.

7.26. By the end of 2074/75 the transfer network across the region is stable, and there are no changes compared to the network in 2059/60.

Figure 7.8: Transfers at end of 2074/75



7.28. Table 7.1 below shows how the total volumes of water (in Ml/d) being transferred around the region change over time, highlighting the contribution of some of the larger transfers into the region, and larger transfers between companies.

Table 7.1: Changes in regional transfers over time

	2026	2035	2050	2075
Existing	**309**	**338**	**367**	**331**
Within company	196	238	284	281
Between WRSE companies	103	90	73	40
Refinery supply	10	10	10	10
Baseline	**91**	**94**	**116**	**116**
Imported from Grafham	91	91	91	91
Havant Thicket consented transfer	0	3	25	25
New	**21**	**179**	**782**	**943**
Non-SRO transfers	21	107	358	358
Severn Thames Transfer (STT) (SRO)	0	0	34	189
Thames to Southern Transfer (T2ST) (SRO)	(0)	(0)	(69)	(102)
Southern Water Hamphire (SRO)	0	23	130	130
SESRO (SRO)	0	0	161	165
Thames to Affinity Transfer (T2AT) (SRO)	(0)	(0)	(71)	(49)
Grand Union Canal (GUC) (SRO)	0	50	100	100
TOTAL (Ml/d)	**421**	**612**	**1265**	**1389**

7.29. The SRO schemes help to move water around the region, but if all the volumes of these were tabulated and summed, the volumes would be duplicated. For example, STT and SESRO bring new water into the region, and this is transferred on through T2ST and T2AT, so by adding the totals of all these schemes, the volumes would be double counted. Therefore, only new sources of water are shown in the table below, and any potentially duplicated volumes are shown in brackets and not included in the totals.

8. Catchment and nature-based solutions to improve the water sources we rely on

Context for catchment solution planning

8.1. Our six member companies abstract water from 28 river catchments across the South East region along with other users who have their own licences to abstract the water they need. Improving these catchments is a priority for the regional plan to ensure the ongoing quality and quantity of our water supplies, and to deliver wider environmental benefits that help achieve the targets set in the Government's 25-year plan for the environment. They will help make the environment more resilient and better able to adapt to climate change.

8.2. Catchment schemes and nature-based solutions could play an important role in securing resilient and sustainable water supplies for the future. The environmental forecasts we have produced show that by 2050, we may need to leave 1.1 billion litres of water in the environment that we currently use to supply our customers. This will require our member companies to significantly reduce how much water they abstract from certain sources and replace that water with new sources.

8.3. Exploration of a more integrated approach that combines the use of catchment and nature-based solutions with more moderate levels of abstraction reduction could be undertaken. This may deliver better outcomes for our rivers at a more efficient cost and deliver wider environmental benefits such as improving water quality and reducing flood risk.

8.4. It is important that we build our understanding and evidence-base over the next 10 years to help inform the decisions that will need to be taken in the future about the level of abstraction reduction that is required. This will ensure we continue to abstract water in a sustainable way and help strike the right balance between environmental improvement and cost to customers.

What our draft regional plan proposes

8.5. Working with stakeholders, we identified more than 200 potential catchment and nature-based schemes across 20 catchments in South East England, which were included in our emerging regional plan.

8.6. The nature-based schemes in our draft plan include the following activities:

- River restoration
- Nutrient and sediment reduction
- Integrated catchment management
- Working with farmers to improve land management practices
- Water retention measures such as natural flood management and wetland creation
- The creation and management of terrestrial habitats
- Sustainable Drainage Systems (SuDS) schemes.

8.7. Some of these options will help catchments to function more naturally, and to allow groundwater catchments to function so that rainwater stays on the land longer and replenishes groundwater stocks (which in turn support the flows in rivers). We also want to work with other land and water users to reduce their water demand and reduce the impact of their own activities on raw water quality (which will mean that water is easier to treat, using less chemicals, carbon, waste) and provide a long-term biodiversity benefit.

8.8. For our draft best value regional plan, we have applied the regulatory guidance and only included schemes that result in a direct increase in our region's supplies. This results in integrated catchment activity being required on the River Itchen and River Test in Hampshire in the first five years of the plan. This is part of the programme of work to deliver long-term improvements to these rivers through sustainable abstraction. Other catchment schemes are, in accordance with guidance, not included within the draft plan as at this point a specific deployable output benefit cannot be assigned to them.

8.9. Our six member companies are considering a wide range of catchment options, which are being driven by other plans they produce such as

Drainage and Wastewater Management Plans, the Water Industry National Environment Programme (WINEP) and drinking water quality plans (Section 1 of our separate Technical Annex 1 explains the links between these plans). The companies will identify the schemes to be included in their five-year business plans to secure funding from Ofwat.

8.10. These schemes could deliver multiple benefits, including helping to provide resilient water resources. Developing a better understanding of the benefits these schemes can deliver and improve the way we measure their impact will be important to help inform their use in future regional plans and WRMPs.

8.11. Delivery of catchment and nature-based schemes will require our member companies to work in partnership with other agencies. There is also the potential for alternative funding to be accessed through Environmental Land Management Schemes to help deliver wider environmental benefits.

8.12. WRSE will continue to work with environmental stakeholders and regulators to understand the potential impacts and benefits of catchment and nature-based solutions in our region.

9. Drought Orders and Permits

Context for Drought Permits and Drought Orders

9.1. During droughts, water companies can apply for temporary drought orders and drought permits on certain water sources that allow them to temporarily abstract more water, or abstract at a different time of year, to help them supply customers if the drought becomes more severe.

What our draft regional plan proposes

9.2. Our six member companies and the Environment Agency reviewed the impact of the 78 drought permits and orders available to them and have excluded 53 from the draft regional plan because of the potential impact they would have on the environment. This was undertaken through the Drought Plan process, separate to the regional planning process. The remaining 25 drought permits and orders are available for selection in the investment model.

9.3. In the draft regional plan 13 drought permits and orders will continue to be used as options in the early years of the plan until the region reaches 1 in 500-year drought resilience in 2040. The most significant of the drought permits and orders in the draft plan are those in the Test and Itchen catchments in Hampshire, where Southern Water has already reduced its abstractions during a drought by more than 180 million litres per day. There are options being developed to replace this water but, in the meantime, they will need to be used should a drought occur.

9.4. After 2040, drought orders and drought permits will only be used in our plan if we experience a drought more serious than a 1:500 year event with monitoring and mitigation measures agreed with the Environment Agency and Natural England to help protect the environment. They have not been included as options after 2041 in our draft plan, as the increased drought resilience that will have been achieved means that we will not need to rely on them.

Data and information

9.5. The impact of the increased drought resilience proposed in the regional plan is that the chance of experiencing the impacts of droughts by the public is reduced. The events will still occur but the consequences on the public water supply system reduces.

9.6. Table 9.1 below shows how the chances of experiencing certain events reduces over the duration of the plan. The figures in the table represent the chances of experiencing a particular event during the course of the proposed plan compared with the current chance.

Table 9.1: Chance of experiencing drought event change under best value plan

Drought intervention	Current	Best value plan
Temporary use ban (TUB)	99.48%	97.04%
Non-essential use ban (NEUB)	63.58%	48.88%
Environmental drought order / permit	46.68%	18.23%

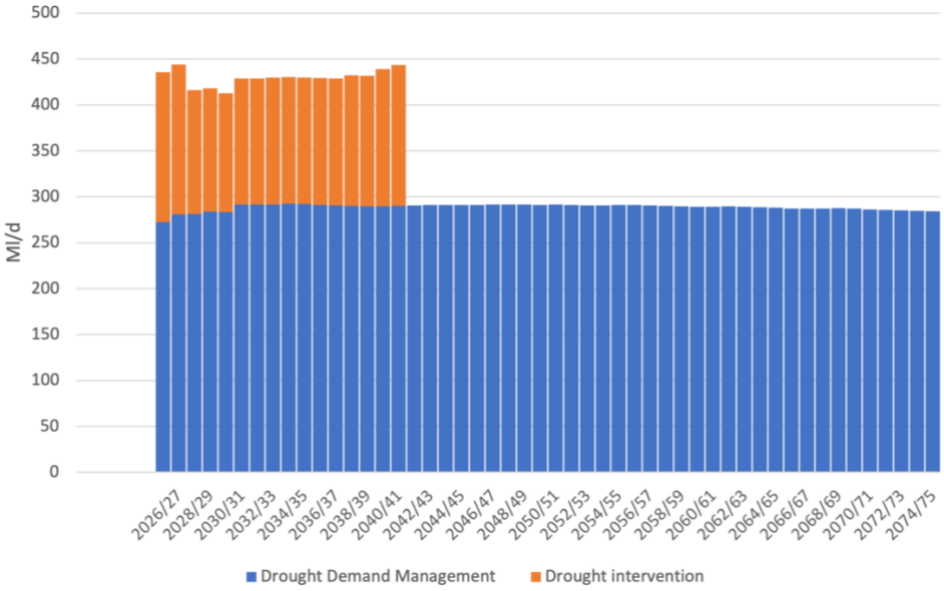
9.7. The figures are indicative. The reductions in the chance of experiencing certain events occur once the 1:500 year drought resilience standard has been met and although we have modelled the policy to not use drought orders and permits after we have achieved this standard, there remains a chance, albeit much reduced, that an event more severe than a 1:500 year drought occurs and triggers the use of drought permits and drought orders. Table 9.2 below identifies the drought permits and drought orders selected in the investment modelling between 2025 and 2040 in the 1:500 DYAA scenario. They would not all be required under other planning scenarios. They are not available for selection beyond 2041.

9.8. Figure 9.1 shows the contribution that the drought permits and drought orders (drought interventions) would make in the context of the Temporary Use Bans (TUBs) and Non Essential use Bans (NEUBs) (Drought Demand Management) that would also be applied as part of our member companies' responses to drought.

Table 9.2: Drought permits and orders selected in the draft regional plan 1:500 DYAA (Ml/d)

Drought Permit or Order	Company	DO (Ml/d)
Lower Itchen Drought Order	Southern Water	38
Test Drought Order	Southern Water	80
River Medway Drought Permit/Order	Southern Water	17
Pulborough Drought Permit/Order	Southern Water	23
Weir Wood Reservoir Drought Permit/Order	Southern Water	1.4
North Arundel Drought Permit/Order	Southern Water	2.5
Candover Drought Order	Southern Water	4.87
Drought option: Caul Bourne	Southern Water	1.5
East Worthing Drought Permit/Order	Southern Water	0.63
Faversham Drought Permit/Order	Southern Water	7.5
Darwell Reservoir Drought Permit/Order	Southern Water	1.4
Drought Permit: Source S	Portsmouth Water	1.3
Drought option: Lukely Brook	Southern Water	3
Hackbridge borehole - drought permit	SES Water	4
Gatehampton Drought Permit	Thames Water	3.5
Playhatch Drought Permit	Thames Water	4.1
Kenley and Purley boreholes - drought permit	SES Water	2.1
Total		**195.8**

Figure 9.1: Water resources benefit (Ml/d) from drought interventions and demand management measures.



10. The effect of our proposals on the supply demand balance

10.1. Section 13 of our separate Annex 1 identified the supply demand balance (SDB) deficits which the South East region faces, based on the situation tree selected as the basis for the adaptive pathway for the draft regional plan.

10.2. The figures provided a geographical representation of the DYAA 1:500 supply demand balances across the South East, by individual water resource zones. This highlights that the challenges differ between WRZs and between companies, and increase over time through the planning period, but not on a consistent basis.

10.3. This section repeats the figures from Section 13 of Annex 1, but each with an additional figure that identifies the supply demand balance effect of our regional plan proposals being in place. It can clearly be seen that with the regional plan proposals in place the forecast significant deficits are met and overcome.

10.4. The key for the figures is as follows – with the numbers being supply demand balance surplus or deficits, in Ml/d.

-200	-150	-100	-75	-50	-25	-10	-5	0	5	10	25	50
-200	-150	-100	-75	-50	-25	-10	-5	0	5	10	25	50

Figure 10.1: 2026 SDB by WRZ (DYAA 1:500) – WITHOUT regional plan

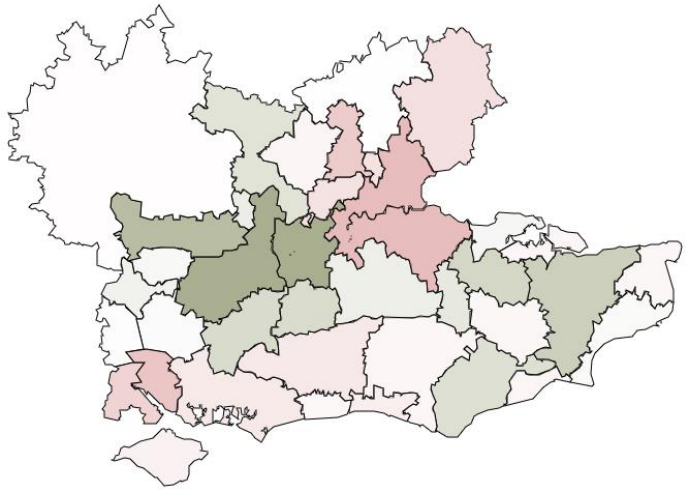


Figure 10.2: 2026 SDB by WRZ (DYAA 1:500) – WITH regional plan

Figure 10.3: 2040 SDB by WRZ (DYAA 1:500) WITHOUT regional Plan

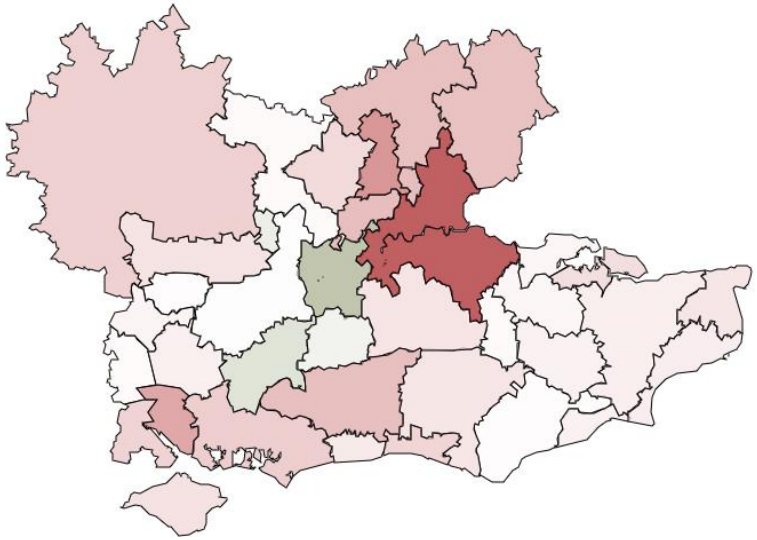


Figure 10.4: 2040 SDB by WRZ (DYAA 1:500) WITH regional Plan

Figure 10.5: 2060 SDB by WRZ (DYAA 1:500) WITHOUT regional Plan

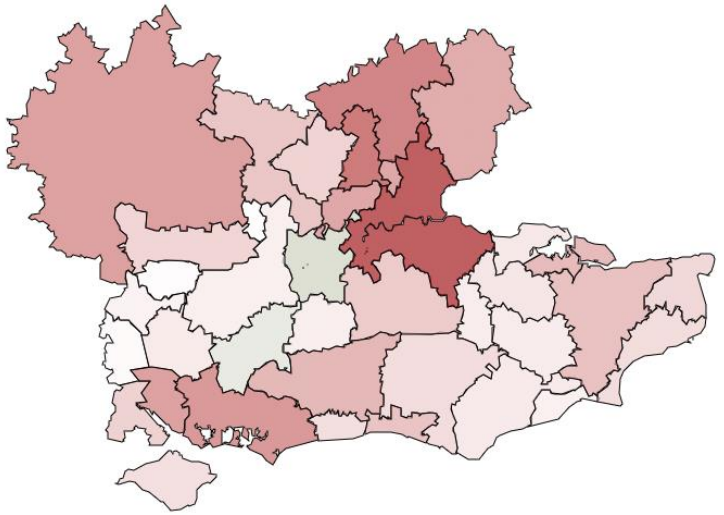


Figure 10.6: 2060 SDB by WRZ (DYAA 1:500) WITH regional Plan

Figure 10.7: 2075 SDB by WRZ (DYAA 1:500) WITHOUT regional Plan

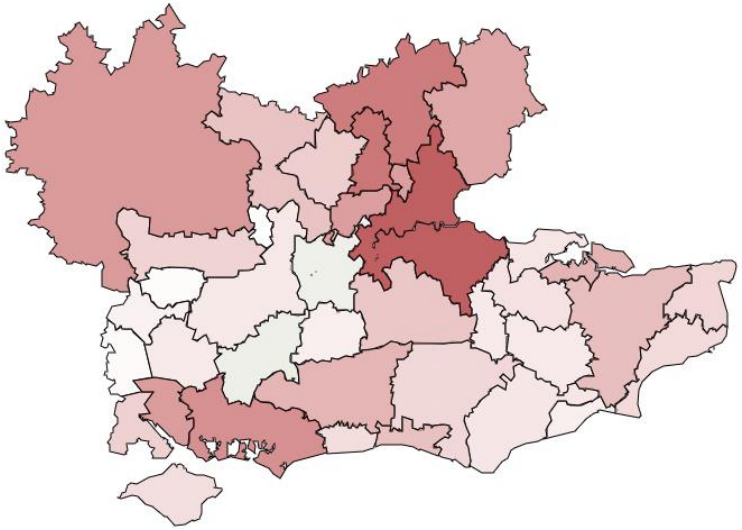
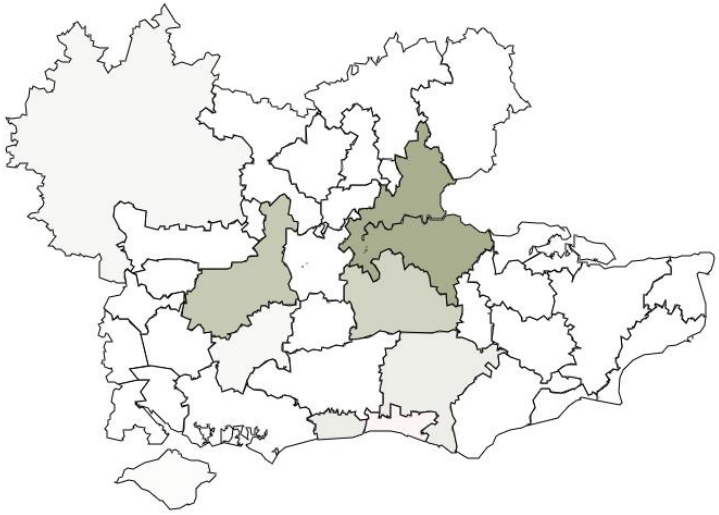


Figure 10.8: 2075 SDB by WRZ (DYAA 1:500) WITH regional Plan



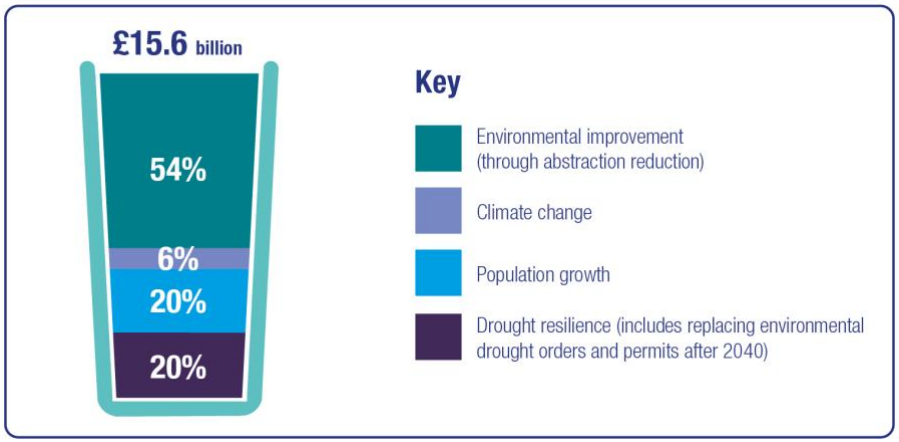
11. Cost and Carbon

How much will it cost?

11.1. The cost of our draft best value plan for the pathway reported in this consultation is £15.6 billion between 2025 and 2075. The £15.6 billion includes the cost to build and operate new infrastructure and transfers, and to deliver leakage reduction and water efficiency activities. These figures are Net Present Value (NPV).

11.2. Just over half of the investment needed is being driven by the need to protect and improve the environment, as shown in Figure 11.1.

Figure 11.1 Factors that are driving the investment in the draft regional plan



11.3. The range of potential costs associated with the full adaptive plan pathways (covering more or less challenging pathways) from 2025 to 2075 is between £10.7 billion and £16.4 billion.

11.4. The figures are expressed as totex (total expenditure), which combines the operational, capital and carbon costs of these options. The totex will be spread across the planning period.

11.5. Investment in water resources is largely funded through customer water bills. Delivery of the proposals in our regional plan will require an increase in bills. The actual bill increases will be different, depending on which water company provides your water, their current bill and the level of investment they need to make in other areas of their service.

11.6. The indicative bill impacts for each company will be reported in their draft WRMPs. The company dWRMPs may also include options and costs which have not been included in the regional plan – for example network enhancements and transfers within company water resource zones.

11.7. Bill increases over the 2025 to 2030 period will be set through the water company business plan process, which will see draft business plans submitted to Ofwat in 2023, before being finalised in 2024.

11.8. We have undertaken various sensitivity runs to assess the cost implications of the policy choice and decisions that we have made as part of the regional plan preparation. The result of these model runs, and the cost differences that result, are set out in Section 14 of this Technical Annex. We have also explored the cost sensitivity of the options selected in the draft regional plan, including testing whether option cost increases would make a material difference to the selection of options in the draft regional plan.

Carbon

11.9. Building and running new infrastructure, whether for new resources, or to manage demand, will create carbon emissions.

11.10. In the development of this plan, we have considered the carbon cost of the schemes. This includes the carbon emissions created through the construction process (capital carbon) and the emissions produced through their ongoing operation (operational carbon). This has taken account of the

carbon reductions that will come as a result of the decarbonisation of the electricity network in our modelling.

Capital carbon

11.11. Capital carbon emissions have been estimated for the draft regional plan. This includes the emissions generated on site from construction activities (such as excavators working on site or HGVs transporting materials), as well as the embodied emissions in the construction materials brought to site (such as the emissions generated when producing concrete, which is then used on site).

11.12. As most of these schemes will not be built until several years from now, time is available to work with the supply chain (e.g. steel and concrete manufacturers) to find new lower carbon solutions to construction. The All Company Working Group (ACWG), made up of the water companies with Strategic Resource Options (SROs), have engaged with the supply chain to estimate just how much progress with reducing emissions might occur over the next 60 years. This engagement has produced emission reduction estimates for most facets of construction, ranging from the types of construction equipment moving around on site, to the type of steel that might be used in future pipelines. Three different scenarios have been produced, a worst case, middle case and best case scenario; to allow for the industry moving slower or faster than expected.

11.13. An example to illustrate this approach is for pipelines. For many large pipelines conveying vast quantities of drinking water around the region, 70% of the capital carbon emissions are attributed to producing the pipeline material itself[3]. In the middle case (a moderate level of ambition), estimates by the ACWG indicate that 7% of carbon could be reduced in the manufacture of ductile iron pipes in the next 15 years, increasing to 39% in 15 to 35 years. Physically this would mean manufacturers of iron deploying stove flue or top gas recycling in most blast furnace-basic oxygen furnace sites, which is a transition the water companies can help promote by requiring contractors to use lower carbon materials thereby generating demand for these new materials.

11.14. Concrete is another building material with a large carbon footprint. Many of the assets needed in the SROs include concrete, either to build above ground tanks, foundations for buildings, or underground structures. Building on the work of the Low Carbon Concrete Routemap[4], the ACWG estimates that by optimising current practice in manufacturing and using supplementary cementitious materials, 20% of carbon emissions generated when building tanks could be eliminated if built within the next 15 years.

11.15. The output of this work from the ACWG is that SRO types, for example a pipeline, or a water treatment works, now have carbon reduction estimates calculated assuming certain progress is made in the supply chain over the next 10, 30 or 60 years. These percentages can then be applied to the list of resource options contained within a given plan, accounting for how far into the future they will be delivered, which then provides WRSE with an initial estimate of the carbon emissions that can be avoided if engagement with the supply chain occurs.

11.16. The ACWG carbon consistency work has been documented, and the report is saved on the WRSE website in the document library.

Operational carbon

11.17. Water resources options are provided to WRSE by our six member companies and by cross-company teams developing SROs. As part of this process, each water company and SRO prepares their own cost and carbon emissions estimate for each resource option. There is currently no sector wide standard for completing the carbon assessments, but the approach is improving all the time. As a minimum, operational carbon is closely accounted for. For operational electricity (e.g. Scope 2), this is relatively straightforward to calculate and Government published datasets (by BEIS), provide consistency in estimating the carbon emissions arising from electricity consumed. This component will largely be decarbonised as the UK electrical grid transitions to more renewable generation, however the water

[3] *For a ductile iron pipeline, which is a common material at this pipe size.*

[4] *https://www.ice.org.uk/media/q12jkljj/low-carbon-concrete-routemap.pdf*

companies are still striving to promote efficiency and reduce electrical consumption to help make that transition easier.

11.18. Operational emissions also encompass direct emissions from plant and operations (e.g. Scope 1), which for most schemes relates to the fuel consumed on site for operational activities or fugitive emissions which may arise on site due to processes (mostly during wastewater treatment). While these Scope 1 emissions are more difficult to estimate, water companies have made an estimate of them. These emissions sit directly within the control of water companies, and mitigation activities are planned (such as switching to electric maintenance vehicles).

11.19. The last component accounted for within operational emissions is consumption of chemicals (such as chlorine for disinfecting drinking water). These fall into Scope 3 emissions, as using chemicals on site does not emit carbon, but for every litre of chemical consumed there is an embodied carbon footprint. Estimating the embodied emissions of these purchased chemicals (Scope 3) is difficult, as suppliers can change and transportation distances from supplier to site can vary. Nevertheless, water companies have estimated embodied carbon from chemical consumption.

11.20. Within the chemicals production sector in the UK, decarbonisation is not expected to happen rapidly. For water companies, this means exploring opportunities for switching chemicals used to lower embodied carbon chemicals, finding efficiencies, or working with the supply chain to reduce emissions.

Estimated carbon emissions

11.21. The estimated carbon emissions for the reported pathway of the draft regional plan are shown in Table 11.1, covering the period from 2021 to 2075. The table shows the carbon estimates before and after applying the "middle case" mitigation factors for capital carbon and also shows the impact on power related emissions if the increased power demand could be met through renewable generation and/or a mix of green procurement opportunities.

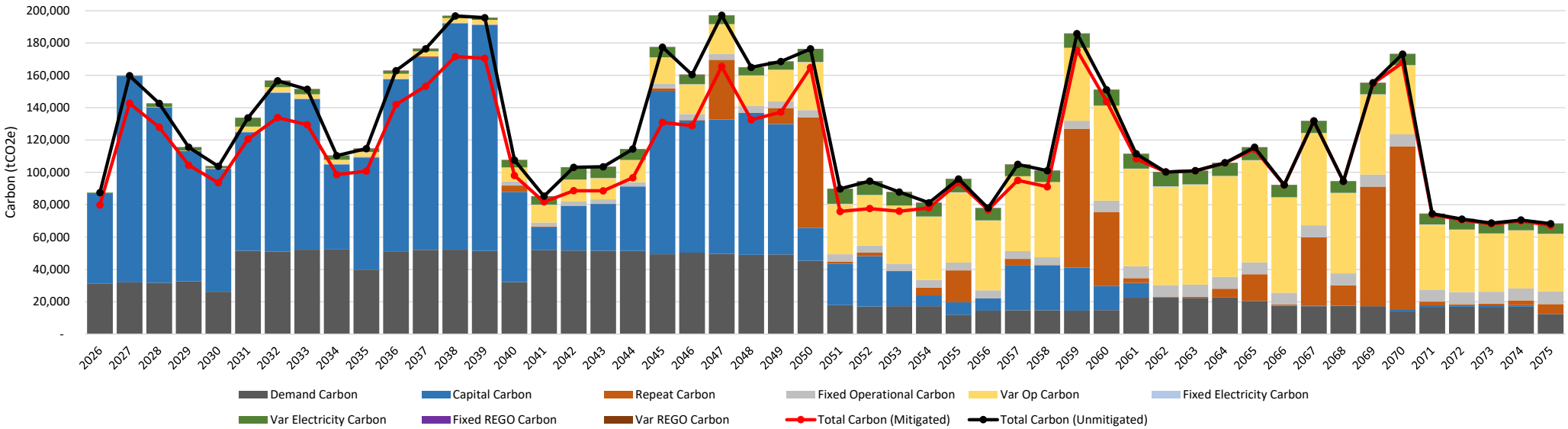
11.22. It can be seen that total carbon emissions over the period are estimated at 6.2 MtCO2e (metric tonnes of carbon dioxide equivalent), which might be reduced by approximately 10% by the middle case capital carbon mitigation scenario, or 14% if, in addition, the increased power demand could be met through renewable generation. The same data is presented in an annual profile in Figure 11.2.

Table 11.1: Estimate of emissions from 2021 to 2075 (DYAA, reported pathway)

Category	Estimated carbon emissions				% Mitigation
	Without capital carbon mitigations		With capital carbon mitigations		
	'000 tCO_2e	% of total	'000 tCO_2e	% of total	
Capital Carbon	2,200	36%	1,630	31%	26%
Replacement Carbon	560	9%	540	10%	4%
Operational Carbon - Electricity related	300	5%	-	0%	100%
Operational Carbon - Non-power related	1,580	25%	1,580	30%	0%
Demand management carbon	1,570	25%	1,570	29%	0%
Total Carbon	**6,210**	**100%**	**5,320**	**100%**	**14%**

11.23. In interpreting the above data it is important to note that there is uncertainty around the carbon estimates. A particular area of weakness that is acknowledged is around estimation of carbon emissions associated with demand management interventions (particularly metering and leakage reduction activities, including mains renewals). Due to gaps in some carbon data for demand management options the demand management emissions estimate is based upon high level analysis of carbon intensities for demand management interventions, but further work is planned to refine this for the Final Regional Plan.

Figure 11.2 Draft regional plan carbon emissions with and without capital carbon mitigation for the reported pathway



Notes: The reductions noted above have been estimated based on the reductions calculated in the ACWG report. This report estimated savings for asset types that provide a large part of the capital carbon emissions for a 'typical' reservoir project, pipeline project, and for a treatment plant project. The potential reductions for each asset type have then been applied to all the resource options within the best value plan. Not all asset types were considered in the ACWG report and for those asset types not considered, for example tunnels, no reduction has been assumed. For other components that had a similar but not identical description, estimates have been assumed that are in line with similar reductions estimated by the ACWG report. The Total Carbon (Mitigated) line shown does not include the additional mitigation potential from use of renewable generation for additional power requirements.

11.24. Currently investigations around potential for mitigating emissions have focused upon certain key categories of capital carbon. However, there is potential to identify significant further mitigation potential from considering future operational carbon mitigation (particularly chemicals), other types of capital carbon assets not yet considered for mitigation, and demand management carbon.

11.25. Further supply chain engagement is needed as other manufacturing and construction sectors respond to climate legislation and begin to implement decarbonisation activities within their own supply chains. Through collaboration, the aim is to accelerate this process to help maximise decarbonisation potential in the timeframes relevant to the WRSE plan.

Residual emissions and offsetting

11.26. After applying carbon reductions, there is still a significant quantity of residual emissions left, estimated at 5 MtCO2e. Whilst this quantity of residual emissions is very uncertain, it provides our member companies with an idea of scale when planning further work to drive emissions reductions and for potential sequestration or carbon offsetting activities.

11.27. Indicative regional carbon sequestration activities and challenges are described below, and WRSE will continue to work with its member companies to look at the reduction of carbon emissions across the region.

11.28. Sequestering carbon through land use changes (e.g. such as planting trees), requires very large areas for the level of emissions generated during construction. Applying this requirement on a scheme-by-scheme basis would require significantly larger areas of land, to accommodate both the planned infrastructure and the planted space to sequester the equivalent amount of carbon.

11.29. Related to ecological considerations, planning land use changes (e.g. vegetated spaces) with only a carbon purpose in mind, might yield sub-optimal or even negative results from a biodiversity and ecological perspective. For example, to sequester the most carbon in the least amount of land, one might propose planting a single crop that is known to sequester carbon best. While this would fulfil the carbon requirements best, from an ecological perspective, encouraging biodiversity by planting different flora and promoting a diverse habitat, would be far better despite the reduced carbon sequestration that might occur. Such an approach would also contribute to achieving the Biodiversity Net Gain (BNG) requirements that will need to be provided associated with delivery of resource options.

11.30. In addition to the carbon and ecological considerations, there are also potential synergies with water resources, from interventions that slow run off and store water in the environment either in surface water bodies such as wetlands, or through increasing groundwater recharge. Such interventions also have the potential benefit of slowing flows through rivers and mitigating flooding risks.

11.31. Whist progress has been made on identifying catchment management interventions as part of the regional plan, further work is needed to assess the potential carbon sequestration and BNG benefits of these interventions. These are important drivers that help build the case for implementation of catchment management schemes, which then have the potential to also deliver other tangible, but more difficult to quantify, water resources and flood risk management benefits.

11.32. Further development of these regional catchment management schemes then has the potential to provide options for mitigating residual carbon emissions whilst also delivering other environmental and societal benefits.

12. Assessment of environmental effects and benefits

12.1. As explained in Appendix 3 of our separate Technical Annex 1, we have undertaken a number of assessments of the environmental effects and benefits associated with the proposals in our draft regional plan.

Assessment of environmental effects

12.2. To determine the environmental effects of the options in our draft regional plan and alternative plans, the following staged assessment process was undertaken:

- Options-level assessment (including Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA), Water Framework Directive (WFD), Natural Capital Assessment (NCA), Biodiversity net gain (BNG), and Invasive Non-Native Species (INNS) assessments)
- Programme Appraisal – including cumulative and in-combination effects for SEA, HRA, WFD, NCA and BNG.

12.3. Summaries of the environmental assessments undertaken have been published alongside this draft regional plan. The following documents are available for review in the WRSE Document Library:

- Strategic Environmental Assessment Summary Report
- Strategic Environmental Assessment Environmental Report
- Habitats Regulation Assessment
- Natural Capital and Biodiversity Net Gain
- Water Framework Directive Assessment

12.4. The overall findings are captured within the SEA Environmental Report. The findings are reported for two periods, firstly options selected by 2050 and separately those selected post 2050 (and up until 2075). The majority of the proposals in the plan are for the period pre-2050 and we have summarised their assessment of that period below. The detailed environmental assessment reports include both the pre-2050 and post 2050 period assessments.

12.5. The assessments undertaken reflect the strategic nature of the regional plan and the current stage of its preparation. It should be noted that there are separate and more detailed environmental assessments of our member company WRMPs that are published as part of the consultation on those draft WRMPs. Further and more detailed assessments, including (where appropriate) Environmental Impact Assessments will also be undertaken of individual schemes as part of future applications for planning and other consents.

12.6. For the SROs, there are also separate detailed environmental assessments undertaken and submitted to RAPID as part of the Gate 2 submissions. Copies of these separate assessments will be available on publication of those WRMPs and Gate 2 submissions, on our relevant member company websites (see Section 16 of this Technical Annex for website details).

Assessment of draft regional plan proposals pre-2050

Strategic Environmental Assessment (SEA)

12.7. Major and moderate positive residual effects are identified across numerous multiple SEA topics and objectives due to the inclusion of the catchment management and demand management schemes. SEA objectives with positive residual effects include biodiversity, flora and fauna, soils; flood risk; water environment; climate resilience; landscape; and population and human health. The catchment management schemes include options such as river restoration, wetland creation and enhancement, and terrestrial habitat creation/management, natural flood management, education and engagement, which are likely to contribute to cumulative positive effects.

12.8. At the current stage of assessment, major negative residual effects were identified for the construction and operational phase for the objective on biodiversity, flora and fauna. The HRA in-combination assessment

undertaken for the best value plan identified that there are potential for in-combination construction and/or operational effects as a result of options within the best value plan. Further assessments of these potential affects will be undertaken ahead of the finalisation of the plan, taking account of HRA Appropriate Assessment (Stage 2) information from our member water companies, including appropriate mitigation to be included in the assessment process.

12.9. Moderate negative residual effects were identified in relation to the SEA objective on the water environment. The WFD in-combination assessment identified a potential risk of WFD deterioration as a result of the simultaneous operation of two drought permit options within the best value plan. Mitigation would be secured through the Drought Plan and drought permitting processes.

12.10. Major negative residual effects have also been identified for the objective on carbon emissions for both construction and operation due to the cumulative impact of materials used to construct the new infrastructure and construction activities (embodied carbon), and from operation. During operation, moderate negative residual effects have also been identified for climate resilience given the cumulative effect of options which involve groundwater or surface water abstraction, particularly during periods of drought, which will reduce the resilience of the natural environment to climate change. Moderate negative residual effects on landscape and the historic environment have been identified during the construction phase. The construction phase is also identified to have moderate negative residual effects on material assets due to the resource use and waste which will be cumulatively generated through the construction phase. Further assessments of these potential affects will be undertaken ahead of the finalisation of the plan, taking account of information from our member water companies, including appropriate mitigation to be included in the assessment process.

12.11. The SEA assessment summary table for the best value plan is included within Appendix 3 to this Technical Annex. The separate detailed SEA Environmental Report (in WRSE Document Library) includes assessments of the best value plan, least cost plan and best environmental and societal plan (see section 15 of this Technical Annex for information on these plans). This is considered to be an appropriate level of assessment at this draft regional plan stage, and the need for further assessment of alternatives will be considered following draft plan consultation, and taking account of information from our member water companies and consultation on their draft WRMPs.

Habitats Regulations Assessment summary

12.12. At the current stage of assessment, the HRA in combination assessment identified that there are options within the best value plan (pre-2050) that have the potential for in-combination effects on the National Sites Network sites due to the construction and/or operational phase. At this stage, it is not possible to identify and quantify in more detail the potential in-combination effects on the National Sites Network sites. Further assessments of these potential affects will be undertaken ahead of the finalisation of the plan, taking account of HRA Appropriate Assessment (Stage 2) information from our member water companies, including appropriate mitigation to be included in the assessment process.

Water Framework Directive Assessment summary

12.13. At the current stage of assessment, the WFD in-combination assessment identified that there are 29 waterbodies which are impacted by two or more best value plan (pre-2050) options where at least one intersects 500m water company boundary corridors. Of these waterbodies, 23 are assessed as having no risk of in-combination effects and thus no increased risk of WFD deterioration within these waterbodies. In five of the remaining waterbodies, in combination effects have been identified but there is not anticipated to be changes to the overall WFD risk to the waterbody. In the final water body the assessment suggested that in the event of a drought, where two emergency drought groundwater options were operational, an in-combination effect would occur which could lead to temporary reduction in groundwater levels, leading to potential changes in the water balance and surface water dependant status elements. These effects would be mitigated through the Drought Plan and drought permitting processes. Further assessments of these potential affects will be undertaken ahead of the finalisation of the plan, taking account of information from our member

water companies, including appropriate mitigation to be included in the assessment process.

Natural Capital Assessment summary

12.14. At the current stage of assessment, two of the options within the best value plan (pre-2050) result in the overall net increase in ecosystem services. The options are both reservoirs and the overall net increase in ecosystem services can be accounted to the addition of habitat creation associated with their reservoir landscape plans. The options are expected to generate new services during operation including the provision of recreational and amenity value due to their landscape plans, offering recreation & amenity benefits to the public. Further assessments of these potential affects will be undertaken ahead of the finalisation of the plan, taking account of information from our member water companies.

Biodiversity Net Gain (BNG) Assessment summary

12.15. At the current stage of assessment, there are four options that result in an overall net gain in BNG for the best value plan selected pre-2050. These are new reservoirs and the overall net gain in BNG can be accounted to the addition of new surface water that is created during construction. Additionally, two of the options results in habitat creation associated with their reservoir landscape plans. At draft plan stage, the catchment management schemes have not been included in the BNG assessments, and the next stage of work will seek to determine BNG from these schemes to incorporate them into the overall assessment of the plan. Many of the infrastructure options in the best value plan (pre-2050) result in a net loss of BNG as a result of temporary and permanent loss of habitats as a result of the construction of the options. However, the BNG results for the draft regional plan are an indicator of each options' impact on BNG as their overall net unit change for BNG does not include the catchment management options which have the potential to provide BNG and additional benefits. It should be noted that ancient woodland is excluded from the current BNG metric and therefore there may be negative effects which are not captured. The BNG metric has been developed using the Defra BNG tool version 2.0, which is due to be updated. WRSE will review the BNG assessments against the most up-to-date version of the tool (anticipated to be version 4.0) before the regional plan is finalised.

Assessment of environmental benefits relating to environmental ambition (environmental improvements from abstraction reduction)

12.16. Section 7 of our separate technical Annex 1 explained in detail how the draft regional plan has followed the approach of the National Framework and WRPG in identifying an appropriate level of environmental ambition for the draft regional plan. Improving the environment of South East England is a priority for the regional plan. It will help to deliver the Government's ambition to achieve clean and plentiful water by improving at least three-quarters of our waters to as close to their natural state as is practicable. Abstraction, the process of taking water from the environment, is one of many things that can have an impact on the health of our waters. It can affect river flows, wetlands and ecology.

12.17. Our regional plan proposals will enable significant reductions in levels of abstraction reduction to be achieved, through licence changes, delivering flow benefits in catchments and overall environmental improvement across the South East region.

12.18. We have identified the abstraction reductions that are necessary to achieve the high levels of environmental ambition that we are planning for (in terms of Ml/d reductions in abstraction). However, the flow benefits that will accrue from them and wider environmental benefits of achieving these reductions, need more detailed investigation and assessment.

12.19. Section 3 and Appendix 4 of our separate Technical Annex 1 identified the current assessed 'health' of the 531 waterbodies in the 29 catchments within the South East region. This analysis showed that 32.6% of waterbodies are currently in 'good' status and that the remaining 67.4% are below good (being either classified as moderate poor or bad status). This is an aggregate condition status, incorporating the six individual components – Fish, Clarity, Invertebrates, Flow, Plants and Safety.

12.20. Reductions in abstraction facilitated by the proposals in the draft regional plan will impact or benefit some of the six individual components more than others. For this draft plan we have not tried to assess each of the impacts that abstraction reduction will have on each of the water bodies for each of the criteria. However, we have illustrated what the overall benefit to the South East could be if all of water bodies were at 'good' ecological status.

12.21. In 2012 the Environment Agency updated their National Water Environment Benefit Survey (NWEBS) values. These can be used to assess the monetary benefit of improving the water courses in the South East from their current state to good. There are values per km, and for each of the six health components. Revising the NWEBS values to 2020 prices took into account national average population growth (by household numbers) and GDP deflators to better reflect the values NWEBS have in present day (2020) prices.

12.22. Taking these values and applying them to the current status, lengths of the water courses and the duration of the regional plan, the resultant benefits are assessed to be between £2.3bn and £3.4bn, as explained in table 12.1 below. This indicates that achieving a good status across the region brings significant benefits. It is recognised that these benefits do not occur from abstraction reductions alone; other actions will be required by industries and people who work and/or operate within a catchment.

12.23. The risk adjusted benefits assume that 30% of the measures put in place will not fully succeed in the catchment and therefore some of the water bodies for a specific health indicator do not reach 'good' status.

12.24. The scale of environmental benefits that can be achieved through achieving 'good' ecological status is relevant to the consideration of the cost of the draft regional plan proposals. The cost to the plan as a whole, when including environmental ambition, is significant and one of the largest cost drivers that we have. On face value the increased cost does not balance out with the benefits. A significant part of the regional environmental ambition may become a legal requirement (to ensure that WFD status does not deteriorate) subject to any necessary cost benefit consideration of the

Table 12.1: Benefits of achieving good ecological status in South East

Catchments	Sum of Benefits (£m)	Sum of Risk adjusted benefits (£m)
Adur and Ouse	£ 129	£ 90
Arun and Western Streams	£ 178	£ 125
Cam and Ely Ouse (including South Level)	£ 6	£ 4
Cherwell	£ 52	£ 36
Colne	£ 344	£ 241
Combined Essex	£ 8	£ 6
Cotswolds	£ 92	£ 65
Cuckmere and Pevensey Levels	£ 51	£ 36
Darent	£ 85	£ 60
East Hampshire	£ 30	£ 21
Isle of Wight	£ 26	£ 18
Kennet and Pang	£ 55	£ 38
Loddon	£ 90	£ 63
London	£ 638	£ 446
Maidenhead to Sunbury	£ 156	£ 109
Medway	£ 355	£ 248
Mole	£ 195	£ 136
New Forest	£ 1	£ 1
North Kent	£ 9	£ 6
Roding, Beam and Ingrebourne	£ 15	£ 11
Rother	£ 113	£ 79
Severn Vale	£ 102	£ 71
Stour	£ 101	£ 71
Test and Itchen	£ 42	£ 29
Thame and South Chilterns	£ 146	£ 102
Upper and Bedford Ouse	£ 2	£ 1
Upper Lee	£ 187	£ 131
Warwickshire Avon	£ 2	£ 1
Wey	£ 190	£ 133
Grand Total	**£ 3,399**	**£ 2,379**

licence changes required as part of sustainability reductions, or other legal mechanism that may be used.

12.25. If the BAU+ scenario, which has been locally verified by the EA, is taken as a conservative view of the future legal requirements then the difference between this BAU+ scenario and the high environmental ambition scenario is within this overall benefit range.

12.26. There are clearly a lot of assumptions relating to these environmental benefit figures. WRSE will continue to work through these assumptions with our member water companies, our advisory board and regulators over the winter period to update the environmental ambition assessment.

Part 5: Evaluation of our draft plan strategy

13. Why we selected our best value draft regional plan proposals

13.1. Our separate Technical Annex 1 has explained in detail the scale of the water resources challenge facing the South East, and the detailed work that WRSE and its six member companies has undertaken in response.

13.2. If we did nothing, then the South East could face a shortfall of up to 2.7 billion litres of water a day by 2075, arising from the need to:

- improve the environment by leaving more water in rivers, streams and underground
- address the impact of climate change
- supply a growing population
- make our water supplies more resilient to drought

13.3. Our best value plan is designed to respond to the challenges we face, and meet the policy and legislative requirements for regional water resource planning set out particularly in the National Framework for Water Resources and the Water Resources Planning Guideline.

13.4. The future is uncertain and our best value plan is specifically designed to be adaptive, capable of reacting to future decisions relating to population growth and the scale of environmental ambition that is to be achieved in the future.

13.5. The schemes presented in the preceding section of this Technical Annex collectively represent our best value plan. This includes significant measures to both reduce demand and to deliver additional water resources, in a twin track approach.

13.6. Leakage reduction and demand management measures are core to our overall strategy. They will deliver 70% of the overall solution in the first five years of the plan and remain at over 50% of the solution by the end of the planning period.

13.7. However, these measures alone are not sufficient, and significant additional new water resources will be required to be planned and delivered.

13.8. Where other regions have resilient supplies of water that can be supplied to the South East our plan utilises them, however the level of water available from outside the South East is much lower than had previously been anticipated, given challenges other regions are facing to secure water supplies for their own customers.

13.9. As a result, the solution to the South East's water resources needs will be principally delivered within the region itself, both through the delivery of new water resources schemes, as well as a network of new water transfers between our six member companies and the water resource zones they supply.

13.10. We have considered a wide range of potential new water resource options as part of the preparation of our plan. We have assessed the schemes against a range of best value metrics, including financial, environmental and customer preferences. The best value plan selects those which our investment modelling has clearly identified as being the optimum overall solution.

13.11. Our assessment of the outputs from the investment modelling, including the comparable best value metrics, and the environmental assessments we have undertaken, has provided the basis for our decision making. The plan we have put forward provides high best value plan scores and the most cost-effective solution.

13.12. We have applied our governance structure so that through discussions with our six member companies (at technical and senior leader levels), with our respective boards and sub-groups, and with our regulators, we have decided that our best value plan is the most appropriate from the detailed technical work and investment modelling we have undertaken.

13.13. The plan that we have selected and are consulting on is the plan that delivers the highest overall best value metric scores from the alternative plans that we have considered. It is also the plan with the highest customer preference metrics. This is not the only plan capable of meeting the challenges that we face. The combination or timing of schemes within the respective plans can also vary when weighted in favour of individual metrics, but the plan that we have selected represents what we consider to be the most appropriate and optimum best value regional solution across all best value metrics.

13.14. We have undertaken hundreds of investment model runs as part of the preparation and testing of our draft regional plan. It is not appropriate nor possible to present the detailed outputs of all of these as part of this Technical Annex. We have, however, presented an explanation of how we have tested key decisions underpinning our plan. Section 14 of this Technical Annex provides a summary of this information, to explain how we considered alternative policy choices, used model runs to test the inclusion and exclusion of various options, and considered the sensitivity of the costs and timing of options. This testing is an important part of ensuring that the plan is robust. Our wide-reaching discussions around the plans are an equally important part of our appraisal as it provides a more general sense check of technical outputs to reaffirm the plan as appropriate based on collective opinion as well as the metric scores.

13.15. In addition, the Water Resources Planning Guideline requires us to also present a least cost plan and a best environmental and societal plan, and we present information on these in Section 15 of this Technical Annex, and related Appendices. Our best value plan delivers additional value over and above that which would be delivered through our least cost plan. It achieves greater resilience and overall value when compared to the best environmental and societal plan.

13.16. The schemes are consistently selected across a wide range of different plans, policy scenarios and sensitivity tests which indicates a stable solution for the South East region given the wide range of challenges and uncertainties it faces in the future. In addition the key core schemes that are selected in the early part of the plan provide a basis to adapt from in the future.

14. Testing our decisions and choices

Context

14.1. We have undertaken hundreds of investment model runs as part of the preparation and testing of our draft regional plan. We have included a summary list of some of the main investment model runs in Appendix 4 to this Technical Annex to provide a flavour of the breadth of the analysis and sensitivity testing that we have undertaken. This includes work as part of selecting our best value plan, least cost plan and best environmental and societal plan (see Section 15 of this Technical Annex), and assessing the sensitivity of key choices and scheme selection in the investment modelling.

14.2. It is not appropriate nor possible to present the detailed outputs of all of this investment modelling in this Technical Annex. However, the following section provides a summary of the key considerations from our assessment work.

Achieving policy expectations

14.3. As explained in our separate Technical Annex 1, we have explored many different combinations of policies, and timings for achieving key objectives including drought resilience as part of the preparation of the draft regional plan. The conclusion of this work was our decision to base the plan on:

- Government water efficiency policy B
- Achieving the 1:500 year drought resilience by 2039/40
- Thames Water achieving its 1:200 year drought resilience by 2031
- The inclusion of TUBs and NEUBs, which is in line with company drought plans
- The inclusion of less environmentally damaging drought permits up until the time we achieve the resilience standard of 1:500 year

14.4. Taking account of consultation feedback on our emerging regional plan (January 2022), and the potential for key policy decisions around drought resilience and Per Capita Consumption to influence cost and scheme selection in the regional plan, we have considered the sensitivity of the plan to the following policies:

- **The year in which we achieve the 1:500 year drought resilience**. These runs consider whether an earlier (2035) or later (2045 or 2050) date changes the plan, and have been undertaken due to a specific request from regulators. These sensitivity runs also consider the use of drought orders and permits. In the emerging regional plan, we included a policy that when the 1:500 year drought resilience standard is reached, the use of these drought orders and permits would stop in the following year. Whilst this approach was broadly supported, regulators and stakeholders wanted to understand how this cessation policy impacted the plans. We have undertaken a number of investment model runs to show the impact.
- **Per Capita Consumption (PCC)** - Each of our six member companies have put forward a number of potential demand reduction policies, at each WRZ, to meet leakage targets and reduce PCC. To complement these strategies, we have developed a series of Government-led interventions which complete the companies' strategies to try to meet the national PCC ambition of 110 l/p/d by 2050. Individual company ambitions have been combined with one of the Defra demand management policies into a regional PCC outcome which supports the broader ambition of the Government. Sensitivity runs around this PCC outcome have been undertaken.

14.5. By assessing the results of these sensitivity runs we can explore the impacts of the different policies and timings on the regional plan, including best value metric scores, the cost of the plan, and key schemes selected. These results are explored in the sections below.

Testing when we achieve the 1 in 500 year drought resilience

14.6. The Water Resources Planning Guideline sets out the Government expectation that water supply systems should become more resilient in the future. This has a number of components:

- The aim should be to achieve the 1 in 500 year resilience in the financial year starting in 2039, or before
- Optimum timing for achieving this, considering the costs and benefits of alternative approaches, should be explored
- Some flexibility in the timescales for achieving a resilience of 1 in 500 year is possible, where costs are exceptionally high locally in comparison to benefits
- Where more flexibility is considered appropriate, meeting a 1 in 500 year by 2050 scenario should be presented
- Whilst in the short term, the increased use of drought management options can be considered, these should not be relied on in the medium to longer term

14.7. For our draft regional plan we have explored potential timelines for achieving this level of resilience: in 2035; 2040; 2045 and 2050. Associated with each of these dates is the continuation of our policy that we will stop relying on drought orders and drought permits one year after we reach the drought resilience standard. This additional year ensures that schemes can be delivered in time to meet the resilience standard, and provides a contingency in the event of a drought in the final year of this period.

14.8. The impact on the cost of the plans from achieving the 1:500 year drought resilience in the different years is shown in Table 14.1 below.

Table 14.1: Comparison of cost of achieving drought resilience

1:500 year resilience by	Cost (£m)	Drought permits/orders finish by
FY 2034/35	13,294	FY 2035/36
FY 2039/40	12,991	FY 2040/41
FY 2044/45	12,251	FY 2045/46
FY 2049/50	12,195	FY 2050/51

14.9. The table shows that the cost of the plan increases the earlier the drought resilience standard of 1:500 is met. Therefore, meeting the 2034/35 timeframe increases the average discounted cost of the plan by £303m compared with the 2039/40 timeframe, which has been adopted for the best value plan.

14.10. Conversely, if WRSE and our six member companies were to (contrary to current Government expectations) wait and delay the implementation of the drought resilience standard to 2049/50 then the average cost of the plan reduces by £796m, however the cost to society would be far greater should there be a severe drought in the meantime and supplies to customers in the South East fail.

14.11. The reduction in cost is due to several factors. Firstly, a delay in the implementation of the resilience standard allows a prolonged use of drought orders and permits. These permits continue to be used which reduces the need to develop some smaller recycling schemes. This delayed transition to a more resilient future also allows further Government interventions which marginally reduce the supply demand balances. This combined effect reduces the challenges to allow a range of groundwater schemes to be utilised rather than some of the recycling schemes. However, the key point to note from these drought resilience runs are that the strategic regional options in the best value plan are still selected in the same order in the reported pathway.

14.12. For our draft regional plan, we have continued to align with meeting the WRMP requirements of meeting the policy in 2039/40. In preparing the final regional plan we will take into account feedback from stakeholders and regulators on our approach and whether accelerating the drought resilience standard earlier or delaying it further than 2039/40 would be preferred.

14.13. The cost differences of accelerating or delaying drought resilience compared to the best value plan are due to the investment model selecting different combinations of schemes for each of the scenarios in the investment modelling runs. The key schemes remain consistent between the different plans.

Testing different levels of per capita consumption

14.14. The second key policy area that we have tested sensitivity around is how the combination of Government interventions and actions by the water companies could drive the PCC down within the region, supporting the Government's ambition of achieving 110 l/p/d across all five regions in England by 2050.

14.15. For the emerging regional plan we discussed the potential use of several different Government intervention strategies with regulators and Defra and at the time, "Hybrid scenario B" was selected as it represented a scenario that had the lowest risk of overestimating the savings that would be delivered through Government interventions. The phased introduction of the low, medium and high policies would give successive Governments time to introduce these policies, but at a rate which balances the risks of public water supply and their statutory duties against progressive improvement in water efficiency delivered throughout 10 or more Government terms.

14.16. Since the emerging plan we have explored a wider range of different Government interventions and the impact they have on our draft regional plan. In our Government demand management savings technical note (in the document library on the WRSE website), we set out a range of possible policies and the timing of their introductions. The policies are designed to introduce water labelling; standards for water fittings; building regulation standards and further Government campaigns to promote water efficiency. We grouped these activities into three levels of interventions by the Government, resulting in either a low, medium, or high level of water efficiency reductions at a per person or capita level. These three levels of interventions were then applied over the planning period in different ways to generate a series of "Government Intervention" profiles, which have been labelled Government Intervention A through to Government Intervention G. In addition to these demand management strategies, set out in our demand savings report in more detail, we also considered an additional two scenarios: low only (based on Government only adopting water labelling) and no Government scenarios (based on no Government interventions being adopted).

14.17. Government Intervention B in our draft regional plan is the same scenario that was in Hybrid scenario B in our emerging plan.

14.18. For each of the Government intervention policies we used our investment model to generate a cost-efficient strategy to meet the future deficits in the region. This provided an objective understanding of the impact these policies could have on investment plans, but it also highlighted the risk that arises if these objectives are not fully achieved by Government intervention, as the benefit from some of the policies are greater than the output from one or more strategic resource options. I.e. there is a risk of reliance on Government to implement these interventions to create demand savings, as any shortfall in supply would have to be met by one or more large water company schemes.

14.19. Table 14.2 sets out the different Government interventions that have been modelled. It summarises the impact on each of the policies have on the cost of the plan and the savings they generate.

14.20. Government Intervention G would reach the highest level of savings the quickest (high by 2040), however this is highly dependent on a number of Government interventions and policies being committed to in the coming years, and is not deemed to be realistic. Government Intervention B would reach the same level of savings but over a much longer time period, which WRSE and member companies believe is a more conservative but realistic profile to use in our draft regional plan. Government Intervention G, E, C, D and B all reach high levels of water efficiency savings, however Government Intervention B is the most conservative of the modelled profiles to reach the high level of Government intervention (high from 2080).

14.21. The plan which implements Government Intervention F is cheaper on average than the plan with Government Intervention B, however it does not reach the same level of savings across the planning period – it only ever delivers the medium level of water efficiency savings. It has therefore been discounted as a viable scenario, as WRSE and our six member companies believe it is important to plan to reach the high levels of water efficiency. The model runs which adopt Government Intervention A and the Low

Government Intervention profile have also been discounted for the same reason.

14.22. The model run where Government Interventions are excluded entirely did not solve in the WRSE investment model, i.e. there was a remaining deficit in the supply-demand balance, which means it is technically a non-compliant plan. It is also unrealistic, as the Government have committed to the policy interventions required to meet the low levels of water efficiency. The uncertainty remains, however, around when these committed policy changes will be implemented – hence the need to test the profiles of these interventions being adopted throughout the planning period.

14.23. Whilst there are other potential combinations and timings for implementation of the low, medium and high interventions, WRSE feels that the broad range of potential Government-led water efficiency policies have been considered, as shown in Table 14.2

14.24. The results of the runs, summarised in Table 14.2, show the costs of the regional plan when certain Government intervention policies are implemented. The table also shows the range of volumetric savings from 71 Ml/d to 437Ml/d that could arise from various levels of Government intervention by 2050.

14.25. The table shows that with higher levels of Government intervention, there is a decrease in the overall cost of the plan. In the case of some Government policy interventions (G, E and C), our assessment shows that there is also an improvement in the average BVP metric scores.

14.26. The runs demonstrate that cheaper overall plans could be achieved with higher levels of Government interventions and the sooner the Government moves to higher levels of interventions the earlier these savings could be achieved. This is most evident in the investment model runs which explore policies G, E and C. The regional plans where the Government policy remains at low for the remainder of the plan are more expensive, as further resource development is required to meet the needs of water company customers in the future.

Table 14.2: Costs and savings associated with Government interventions

	Savings in Ml/d				
WRSE Government policy intervention	**2030**	**2040**	**2050**	**Cost of Regional Plan (£m)**	**Comments**
Government A	13	51	157	£13,001	low until 2040 and medium from 2060 (interim between 2040 to 2060)
Government B	13	51	115	£12,977	low until 2040 and medium from 2060 and high from 2080 (interim between 2040 to 2060 to 2080)
Government C	13	91	303	£12,453	low until 2040 and medium from 2050 and high from 2060 (interim between 2040 to 2050 to 2060)
Government D	13	131	182	£12,875	Government interventions by transitioning from low to medium and then high to allow the target to be met (Low from 2025; medium by 2040; high by 2075)
Government E	43	243	437	£12,068	Government interventions by transitioning from low to medium and then high to allow the target to be met (Low from 2025; medium by 2035; high by 2050)
Government F	39	172	182	£12,617	Low government savings by 2030 and medium by 2040
Government G	39	412	437	£11,392	Low government savings by 2030 and high by 2040.
Low intervention	12	45	71	£13,276	Low government savings from 2025
No Government intervention	0	0	0	£13,276	No government savings from 2025

Note: It should be noted that although the costs of the low Government interventions and no Government interventions investment model runs look the same, the no Government intervention run contains deficits of 5.1Ml/d and is therefore technically a non-compliant plan.

14.27. The two additional policies we tested: low only (a continuation of the water labelling policy with continued promotion by the companies); and a no Government intervention policy (water labelling withdrawn) result in very similar strategies, however there was a deficit in the supply demand balance for the run with no Government interventions, and therefore the plan in this investment run is technically non-compliant.

14.28. Based on our analysis, Government intervention policy B remains the selected policy for the draft regional plan. The selection of policy B still provides a balanced approach of the pace of the interventions being introduced and the ability of the water companies to counter any risks or compromises to their statutory duties to supply water over the period of the plan, should it be necessary. These timescales, coupled with our proposals for monitoring, provide sufficient time for course corrections of the investment strategies during each five-year cycle and the investments in the first part of the plan rely more on the water company actions than Government interventions.

14.29. In lieu of any further Government policy announcements we have maintained this policy position of Government Intervention B in our investment modelling. However, we will review the work being undertaken by Water Wise; Water UK and Defra and the pathway to 100 l/p/d over the winter of 2022/23, together with draft regional plan consultation responses, to identify any potential amendments to our approach.

14.30. We considered but rejected several alternative approaches, including:

- Following the interventions that Government have committed to and waiting for future policies to be rolled out before building them into our plan – this would involve adopting a low Government intervention policy which would increase the cost of the plan as more and bigger schemes would be needed to deal with the supply shortfalls in the future. It would also fall significantly short of the Government commitment to meet the ambitious target of 110 l/p/d in England by 2050 (only reaches 118 l/p/d by 2050).
- Building the highest level of interventions into the plan as quickly as possible as this derives the lowest cost plan – this would introduce a high level of reliance on the Government to push forward with these policies without any prior commitment to do so. This level of interventions might also be contrary to future Government choices and leave WRSE and its six member companies in a high-risk position. If the strategies change, potentially significant new sources of water would need to be developed quickly in order to meet their statutory duty to supply water.

14.31. In preparing our revised draft regional plan we will take into account feedback from stakeholders and regulators on our approach and whether it is considered that we have correctly balanced risk and the commitment of the Government. Defra is also expected to publish its pathway to per capita consumption reductions and, if published in time, we will consider implications arising from this for the revised draft regional plan.

14.32. In summary, we have looked at several different water efficiency policies which the Government could enact going forward. The Government policies which save the most water rely on the implementation of the high savings the quickest. Whilst we have tested a range of policies, we have continued to base our approach on the Government intervention B policy as we did in the emerging plan as this balances the pace of interventions being implemented and the risk of relying on Government policies which have not yet been committed to. This is summarised in Table 14.3.

Table 14.3: Government interventions basis for draft regional plan

Savings in Ml/d						
WRSE Government policy intervention	2030	2040	2050	Cost of Regional Plan (£m)	Comments	Regional plan position
Government B	13	51	115	£12,977	low until 2040 and medium from 2060 and high from 2080 (interim between 2040 to 2060 to 2080)	Policy position to be taken into the least cost and best value plan

Testing sensitivity around scheme selection, timing and cost

14.33. Under both of the policy choices and decisions described above, the comparative assessment we undertook also enables us to consider what effect different policy choices and decisions would have on the schemes that are selected by the investment model. In this way we can evaluate whether the selection of schemes is influenced by the policy choices and decisions that we take, or whether schemes are consistently selected by the investment model irrespective of the policy choices and decisions we have taken.

Schemes selected under different drought resilience scenarios

14.34. We have identified in Table 14.4 below how the investment model selection of some of the key schemes changes between the different drought resilience scenarios, i.e. achieving 1:500 year drought resilience by 2034/5, 2039/40 (as proposed in our best value plan), 2044/45 or 2049/50.

14.35. The table identifies that adoption of different drought scenarios does not influence the selection of most of the main options that the investment model selects for the plan, with Broad Oak reservoir, Grand Union Canal (GUC) transfer, SESRO, Water recycling to Havant Thicket, STT (pipeline), Teddington DRA and Deephams Reuse consistently selected.

Table 14.4: Comparison of scheme selection under drought resilience scenarios

Key Scheme	2035	2040	2045	2050
Beckton desalination	X	X	✓	✓
Beckton reuse (water recycling)	X	X	X	✓
Broad Oak reservoir	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Deephams re-use (water recycling)	✓	✓	✓	✓✓
Grand Union Canal (GUC)	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Water recycling to Havant Thicket	✓✓✓	✓✓✓	✓✓✓	✓✓✓
SESRO (reservoir)	✓✓✓	✓✓✓	✓✓✓	✓
STT (canal option)	X	X	X	X
STT (pipeline option)	✓	✓	✓	✓
Teddington direct river abstraction (DRA)	✓✓✓	✓✓✓	✓✓✓	✓✓✓

Key:
✓✓✓ is present in 7 or more adaptive plan branches
✓✓ is present in between four and six adaptive plan branches
✓ is present in 3 or fewer adaptive plan branches
X is not present in any of the adaptive plan branches

14.36. The scenario in which achieving the drought resilience is delayed until 2049/50 has the greatest effect on scheme selection, with SESRO selected in fewer pathways (adaptive plan branches), and with Beckton Desalination, Beckton Reuse and Deephams Reuse being selected by the investment model in some pathways, where they were not previously being selected. However, this scenario (and the delay to achieving drought resilience) conflicts with current Government expectations for achieving drought resilience by 2040, and would delay decisions beyond the current branch points in our adaptive plan.

Schemes selected under different PCC scenarios

14.37. On a similar basis, we can assess how the investment model selection of some of the key schemes changes with different Government intervention scenarios. This is summarised in Table 14.5. Generally, additional schemes are selected in scenarios with lower savings from Government water efficiency policies.

Table 14.5: Key schemes selected under Government Intervention model runs

Key Scheme	Government intervention A	Government intervention B	Government intervention C	Government intervention D	Government intervention E	Government intervention F	Government intervention G	Low Government intervention	No Government intervention
Beckton desalination	✓	x	x	✓	x	✓	✓	✓	✓
Beckton reuse (water recycling)	x	x	x	x	x	x	✓	✓	✓
Broad Oak reservoir	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓
Deephams re-use (water recycling)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Grand Union Canal (GUC)	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓	✓✓✓	✓✓✓
Water recycling to Havant Thicket	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
SESRO (reservoir)	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
STT (canal option)	x	x	x	x	x	x	x	x	x
STT (pipeline option)	✓	✓	✓	✓	✓	✓	x	✓	✓
Teddington direct river abstraction (DRA)	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓	✓✓✓	✓✓✓

Key:
✓✓✓ is present in 7 or more adaptive plan branches
✓✓ is present in between four and six adaptive plan branches
✓ is present in 3 or fewer adaptive plan branches
X is not present in any of the adaptive plan branches

14.38. Table 14.5 shows that a number of schemes are consistently selected across the Government intervention policies across similar numbers of adaptive plan branches.

14.39. Government Intervention policies C, D, B and A have relatively consistent scheme selection, apart from Beckton Desalination which is not selected in Government Intervention C or B but is selected in D and A. Government Intervention F is similar to D and A, but selects GUC in fewer adaptive plan branches.

14.40. In comparison, schemes are typically selected less consistently for the Government G policy scenario, which achieves the highest level of savings in the fastest time. In this policy scenario, GUC, Broad Oak reservoir and Teddington DRA are selected in fewer branches compared to the other policies, Beckton Re-use is also selected, but STT is not.

14.41. Government Intervention E achieves the highest level of savings from Government water efficiency policies in the second fastest time (second to Government G), and is similar in scheme selection to Government Interventions C and B, but selects SESRO across fewer branches. In this plan, although SESRO is selected in fewer branches, it is still selected in situation 4, the reported pathway for the draft regional plan. Testing the effect of optimising on certain best value metrics

14.42. Our least cost plan and best environmental and societal plan (see Section 15 of this Technical Annex) are investment model runs when the model was required to optimise its selection based on certain criteria. WRSE is required to present these two plans as part of this draft regional plan, and Section 15 provides comparable information on these plans and our best value plan.

14.43. We have used our investment model to also consider the effect of seeking to optimise our plan based on other criteria and metrics.

14.44. If the investment model is required to optimise on resilience, natural capital or biodiversity net gain scores, then the model typically selects additional schemes as part of the plan which provide additional capacity, at an additional cost of about £1.5bn compared to our best value plan. However, the additional capacity is not required to meet the supply demand challenges that the region is facing, and so this additional investment is otherwise unnecessary.

14.45. If the investment model is required to optimise resilience and environmental metrics at the same time, then there is an inherent trade-off between them, as the model is seeking to optimise resilience (through incorporation of additional capacity) at the same time as seeking to optimise environmental metrics (which are adversely affected by the additional capacity). Our best value plan is considered to perform well and is a good balance between these metrics.

14.46. Optimising between carbon and best value plan scores as a whole also involves inherent tensions, as model runs optimising on carbon tend to have lower overall best value metric scores. Again, our best value plan provides a good balance between these metrics.

Testing the implications of ruling in or ruling out main schemes

14.47. Our best value plan is reliant on adequate funding to maintain the baseline supplies; and the consenting and commencement of construction, and/or completion, of a number of schemes in the first ten years. These are key as they form the building blocks for the subsequent branches to adapt from. Key schemes in this part of the plan are company demand management measures, schemes already committed to in existing WRMPs (see Appendix 6 of our separate Technical Annex 1 for an explanation of how AMP7/8 schemes have been included in the regional plan), and the strategic resource options including Havant Thicket, GUC and Teddington DRA. The consenting and commencement of construction of Broad Oak and SESRO are also essential parts of the plan, as these reservoirs would need to be constructed by 2036 and 2040 respectively.

14.48. Our best value plan is dependent next on the STT scheme, which acts as the adaptable scheme by providing the additional water that is required to meet the environmental ambition challenges. In respect of STT, typically the investment model adopts the STT scheme pipeline option rather than the canal transfer because it allows a greater volume of the unsupported water to be transferred across (the maximum pipeline capacity assessed is 500Ml/d, whereas the maximum canal capacity assessed is 300Ml/d). The STT pipeline option is selected by the investment model in branches which feature the higher environmental ambition and higher climate change scenarios.

14.49. We have used investment model runs to explore what the effect on the regional plan would be if key schemes were ruled out, or excluded, and also what effect ruling in schemes which the investment model is not currently selecting would have. This enables us to compare the best value metric performance and cost of alternative potential solutions, and to be confident on the robustness of the best value plan that we have selected.

14.50. Our assessment concluded that there was a clear consistency between the investment model selection of the main schemes in the plan. The investment model consistently selected these schemes across different model runs. Only if individual main schemes were ruled out (or excluded) from selection was the model then forced to select alternative and additional options, at additional cost and with lower best value metric scores. This again gives confidence in the selection of schemes within our best value plan.

14.51. We tested a number of options, and present below a summary of the results for SESRO and STT as an example. SESRO and STT are utilised in this example as the options from our emerging regional plan that attracted the highest response to the January 2022 consultation.

14.52. In order to provide sufficient new supplies of water to meet the regional supply-demand balance deficit in our preferred pathway, at least one of STT and SESRO is required (due to the west of the region having a large deficit), and two large options are required for the regional solution. This could be SESRO and STT, or SESRO and a recycling (or desalination) scheme, or STT and a recycling (or desalination) scheme.

14.53. Our modelling identifies that the least-cost and best value way of delivering sufficient new water resources to the South East is utilising SESRO, followed by the utilisation of STT. These are the most cost-efficient and best value large, strategic options to meet the required need. The data used for our modelling shows that SESRO has a lower operating cost than STT, and so is utilised first. The larger volume STT options involve relatively high fixed operating costs associated with purchasing water from its support sources. By utilising SESRO first, these costs can be deferred until later in the planning period.

14.54. We modelled a range of alternative sizes for SESRO. The largest size would provide 150 million m^3 (Mm^3) of storage and produce 270 million litres per day. Our assessment shows that the larger (150Mm3) size of SESRO is more cost effective than smaller sizes, as it delivers around twice the water resources of a smaller (75Mm3) reservoir, but at approximately 25% additional cost.

14.55. The 100 Mm^3 reservoir is selected in the draft regional plan as it performs better against some of the best value criteria we have assessed, particularly those that provide additional benefits to the environment and society. The larger (150 Mm^3) reservoir performs better against the resilience criteria and biodiversity net gain compared to the 100 Mm^3. The plans in which either

the option size of SESRO is 100 Mm^3 or 150 Mm^3 have better overall BVP metric scores than the least cost plan.

14.56. A smaller SESRO that would provide 75 Mm^3 of storage was also included in the modelling. This smaller option was not selected in any of the adaptive pathways and when it was forced into the model, the reduction in capacity was offset by increases in desalination capacity. The smaller reservoir also does not perform as well against any of the best value metrics and the overall plan is more costly as other schemes need to be developed.

14.57. If SESRO is not developed, other resources would need to be progressed instead. This would include larger water recycling schemes including options at Beckton, to provide water for transfer to Affinity, and Peacehaven to provide additional water for transfer to Southern Water. The STT would also need to be developed earlier and would need to provide more water than Water Resources West have previously indicated might be available. For the reported pathway, a plan without SESRO would cost £500 million more than the best value plan, and have significantly higher carbon costs.

14.58. Our six member companies' draft WRMPs provide more detailed assessment and sensitivity analysis relating to the schemes forming part of their individual plans (see Section 16 of this Technical Annex for more information on the company WRMPs and individual company website addresses).

Testing the sensitivity of the cost and timing of main schemes

14.59. In addition to the sensitivity testing outlined above, we have also considered the sensitivity of the investment model to the costs and timings of schemes. To assess this, we undertook a number of sensitivity runs to explore the effect of increasing the costs of the main options in the plan, and to test the effects of delaying the date when schemes would become available.

14.60. The investment model consistently selected the main schemes notwithstanding increased costs, or delays to the timing of the schemes, giving us confidence that the investment model runs that we have adopted as the basis for our best value plan are robust.

15. Best value plan comparison

Overview

15.1. This section provides a summary comparison of the best value plan with the least cost plan and the best environmental and societal plan. The reported numbers in the tables are based on the reported pathway, which is situation 4 in the adaptive plan. These are two alternative plans which WRSE is specifically required to present, through guidance in the Water Resources Planning Guideline.

15.2. The least cost plan is the plan which the WRSE investment modelling determines is the least overall cost. The investment model was run to select a least cost plan by only using the cost information to optimise the solution and does not optimise on the best value metrics.

15.3. The best environmental and societal plan is the plan which the WRSE investment modelling determined has the highest metric score when optimised on the environmental and customer preference metrics. It therefore does not try to improve the resilience metric scores in the plans.

Comparison of the three plans

15.4. Tables 15.1 and 15.2 below show how these plans compare against each other in terms of costs and metrics. Table 15.3 shows how these plans differ with regards to scheme selection. There is very little difference between these three plans, both in terms of costs, metrics and strategic scheme selection.

15.5. Appendix 5, 6 and 7 of this Technical Annex 2 present comparable summary information from the investment model for the best value plan (Appendix 5), the least cost plan (Appendix 6) and the best environmental and societal plan (Appendix 7). This includes tables showing the full set of best value metrics for all of the adaptive plan pathways within the plans, together with other key model run outputs.

15.6. Our best value plan delivers additional value over and above that which would be delivered through our least cost plan. The best value plan achieves greater resilience and overall best value when compared to the best environmental and societal plan.

Comparison of best value and least cost plans

15.7. Table 15.1 below provides comparative cost and best value metric information for the best value and least cost plans.

15.8. The table illustrates that for the reported pathway (Situation 4) whilst the best value plan has a higher cost than the least cost plan, the differential is low – 1.4% higher cost.

15.9. A comparison of the best value metrics shows that whilst the least cost plan is typically cheaper overall and provides slightly better SEA benefits than the best value plan, it performs worse against all the other best value plan metrics. The biggest difference is the natural capital metric where there is a 30% difference in values between the two plans.

Table 15.1: Best value plan and least cost plan comparison

Net Present Value (Cost) (£m)	Best Value Plan (BVP) value	Least Cost Plan value	Absolute Difference from BVP	Percentage Difference from BVP
Cost w/ deficit (STPR)	15,587	15,370	−216.60	−1.39
Cost w/o deficit (STPR)	15,587	15,370	−216.60	−1.39
Cost w/ deficit (IGEQ)	24,913	24,491	−421.80	−1.69
Cost w/o deficit (IGEQ)	24,913	24,491	−421.80	−1.69
Cost w/ deficit (LTDR)	17,361	17,106	−254.73	−1.47
Cost w/o deficit (LTDR)	17,361	17,106	−254.73	−1.47

Environmental	Best Value Plan (BVP) value	Least Cost Plan value	Absolute Difference from BVP	Percentage Difference from BVP
SEA environmental benefit	83,476	84,475	999.00	1.20
SEA environmental disbenefit	112,972	115,629	2657.00	2.35
Natural capital	10,790,008	7,494,195	−3295813.31	−30.55
Bio-diversity net gain	−260,076	−258,496	1580.00	0.61

Social	Best Value Plan (BVP) value	Least Cost Plan value	Absolute Difference from BVP	Percentage Difference from BVP
Customer preference	35,620	32,452	−3168.00	−8.89

Reliability	Best Value Plan (BVP) value	Least Cost Plan value	Absolute Difference from BVP	Percentage Difference from BVP
Reliability	42	38	−3.86	−9.13
R1: Uncertainty of option supply/demand benefit	13	11	−2.03	−15.48
R3: Risk of service failure due to other physical hazards	11	10	−1.11	−10.05
R4: Availability of additional headroom	7	7	0.08	1.28
R5: Catchment/raw water quality risks (incl. climate change)	1	1	0.19	20.14
R6: Capacity of catchment services	0	0	0.00	−0.32
R7: Risk of service failure to other exceptional events	11	10	−0.99	−9.42
R8: Soil health	0	0	0.00	0.00

Adaptability	Best Value Plan (BVP) value	Least Cost Plan value	Absolute Difference from BVP	Percentage Difference from BVP
Adaptability	21	19	−1.55	−7.52
A3: Operational complexity and flexibility	10	9	−1.17	−11.20
A4: WRZ connectivity	10	10	−0.38	−3.73
A7: Customer relations support engagement with demand management	0	0	0.00	−0.11

Evolvability	Best Value Plan (BVP) value	Least Cost Plan value	Absolute Difference from BVP	Percentage Difference from BVP
Evolvability	30	27	−3.02	−10.10
E1: Scaleability and modularity of proposed changes	12	11	−1.57	−12.58
E2: Intervention lead times	7	7	−0.20	−2.76
E3: Reliance on external bodies to deliver changes	10	9	−1.24	−12.52
E5: Collaborative land management	0	0	0.00	0.00

Comparison of best value and best environmental and societal plans

15.1. Table 15.2 below provides comparative cost and best value metric information for the best value and best environmental and societal plans. The best environmental and societal plan uses the environmental metrics (SEA +'ve; SEA –'ve; natural capital; and biodiversity net gain) together with the customer preference metric when trying to improve the overall score of the plan. It does not optimise on the resilience metrics.

15.2. The table illustrates that for the reported pathway (situation 4) whilst the best value plan has a higher cost than the best environmental and societal plan, the differential is low – 1.2% higher cost.

15.3. A comparison of the best value metrics shows that whilst the best environmental and societal plan scores better against the SEA benefit metric, the best value plan performs better against the natural capital and resilience metrics.

Table 15.2: Best value plan and best environmental and societal plan comparison

Net Present Value (Cost) (£m)	Best Value Plan (BVP) value	Best Environmental and Societal Plan value	Absolute Difference from BVP	Percentage Difference from BVP
Cost w/ deficit (STPR)	15,587	15,398	−189.06	−1.21
Cost w/o deficit (STPR)	15,587	15,398	−189.06	−1.21
Cost w/ deficit (IGEQ)	24,913	24,562	−351.08	−1.41
Cost w/o deficit (IGEQ)	24,913	24,562	−351.08	−1.41
Cost w/ deficit (LTDR)	17,361	17,141	−219.88	−1.27
Cost w/o deficit (LTDR)	17,361	17,141	−219.88	−1.27

Environmental	Best Value Plan (BVP) value	Best Environmental and Societal Plan value	Absolute Difference from BVP	Percentage Difference from BVP
SEA environmental benefit	83,476	84,103	627.00	0.75
SEA environmental disbenefit	112,972	115,980	3008.00	2.66
Natural capital	10,790,008	7,681,917	−3108091.48	−28.81
Bio-diversity net gain	−260,076	−240,648	19428.00	7.47

Social	Best Value Plan (BVP) value	Best Environmental and Societal Plan value	Absolute Difference from BVP	Percentage Difference from BVP
Customer preference	35,620	35,365	−255.00	−0.72

Reliability	Best Value Plan (BVP) value	Best Environmental and Societal Plan value	Absolute Difference from BVP	Percentage Difference from BVP
Reliability	42	42	−0.56	−1.33
R1: Uncertainty of option supply/demand benefit	13	13	−0.48	−3.65
R3: Risk of service failure due to other physical hazards	11	11	−0.18	−1.61
R4: Availability of additional headroom	7	7	0.08	1.18
R5: Catchment/raw water quality risks (incl. climate change)	1	1	0.11	12.18
R6: Capacity of catchment services	0	0	0.00	−0.32
R7: Risk of service failure to other exceptional events	11	10	−0.10	−0.91
R8: Soil health	0	0	0.00	0.00

Adaptability	Best Value Plan (BVP) value	Best Environmental and Societal Plan value	Absolute Difference from BVP	Percentage Difference from BVP
Adaptability	21	20	−0.59	−2.85
A3: Operational complexity and flexibility	10	10	−0.24	−2.31
A4: WRZ connectivity	10	10	−0.35	−3.42
A7: Customer relations support engagement with demand management	0	0	0.00	−0.11

Evolvability	Best Value Plan (BVP) value	Best Environmental and Societal Plan value	Absolute Difference from BVP	Percentage Difference from BVP
Evolvability	30	29	−1.16	−3.89
E1: Scaleability and modularity of proposed changes	12	12	−0.64	−5.10
E2: Intervention lead times	7	7	−0.18	−2.49
E3: Reliance on external bodies to deliver changes	10	10	−0.34	−3.44
E5: Collaborative land management	0	0	0.00	0.00

Scheme selection

15.4. Table 15.3 below shows the key schemes selected across the three plans; best value plan, least cost plan and best environmental and societal plan.

15.5. In all three plans, key schemes are selected in the reported pathway (Situation 4) including Blackstone Reservoir; Deephams re-use (water recycling); Grand Union Canal (GUC); SESRO; STT (pipeline) and Teddington DRA. Only SESRO; GUC and Teddington DRA are selected across all three plans and all nine branches.

15.6. The key differences between the plans, in terms of scheme selection, are regarding Broyle Place Reservoir and Peacehaven water recycling. Broyle Place reservoir features in the best value and least cost plans, but not in the best environmental and societal plan. The use of the recycled water from Peacehaven is used to recharge Arlington reservoir in the best value and best environmental and societal plans, whereas it is used to recharge the river Ouse in the least cost plan.

15.7. There are other minor scheme differences across the three plans which give rise to the differences in the best value plan metrics and costs. However, there is very little difference between the three plans which indicates a stable set of scheme selections across the plans. This provides confidence in the choice of schemes in the best value plan.

Table 15.3: Comparison of scheme selection in best value, least cost, and best environmental and societal plans

Key Scheme	Situation 1	Situation 2	Situation 3	Situation 4	Situation 5	Situation 6	Situation 7	Situation 8	Situation 9
Least cost plan									
Blackstone reservoir	✓	✓	X	✓	X	X	✓	✓	X
Broyle reservoir	X	X	X	X	X	X	✓	X	X
Deephams re-use (water recycling)	✓	X	X	✓	X	X	✓	X	X
Grand Union Canal (GUC)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peacehaven water recycling to Barcombe	✓	X	X	✓	X	X	X	X	X
SESRO (reservoir)	✓	✓	✓	✓	✓	✓	✓	✓	✓
STT (pipeline option)	✓	X	X	✓	X	X	X	X	X
Teddington direct river abstraction (DRA)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Best environmental and societal plan									
Blackstone reservoir	✓	✓	X	✓	X	X	✓	✓	X
Deephams re-use (water recycling)	✓	X	X	✓	X	X	✓	X	X
Grand Union Canal (GUC)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peacehaven water recycling to Arlington reservoir	✓	X	X	✓	X	X	X	X	X
SESRO (reservoir)	✓	✓	✓	✓	✓	✓	✓	✓	✓
STT (pipeline option)	✓	X	X	✓	X	X	X	X	X
Teddington direct river abstraction (DRA)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Best value plan									
Beckton desalination	✓	X	X	X	X	X	X	X	X
Blackstone reservoir	✓	✓	X	✓	X	X	✓	X	X
Broyle reservoir	✓	X	X	✓	X	X	✓	X	X
Deephams re-use (water recycling)	✓	X	X	✓	X	X	X	X	X
Grand Union Canal (GUC)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peacehaven water recycling to Arlington reservoir	✓	✓	X	✓	✓	X	X	X	X
SESRO (reservoir)	✓	✓	✓	✓	✓	✓	✓	✓	✓
STT (pipeline option)	✓	X	X	✓	X	X	X	X	X
Teddington direct river abstraction (DRA)	✓	✓	✓	✓	✓	✓	✓	✓	✓

Part 6: Consultation, monitoring and review

16. Consultation on the draft regional plan

Draft regional plan consultation process

16.1. The draft regional plan is published for a period of engagement and public consultation, ending on 20th February 2023.

16.2. We have a dedicated consultation website where you will find more information about our draft regional plan and an online survey where you can answer our consultation questions and provide other feedback.

16.3. The consultation website also contains details of consultation events and workshops that are to be held about the draft regional plan.

16.4. We are inviting responses to our consultation questions and other written feedback through the following means:

- through our online feedback and response form on our consultation website.
- by emailing your response to us at contact@wrse.org.uk
- by post to:
  WRSE
  c/o Adams Hendry Consulting Ltd
  Sheridan House, 40-43 Jewry Street
  Winchester
  Hampshire
  SO23 8RY

16.5. Comments must be submitted by 23:59 on 20th February 2023.

Further information

16.6. All our background documents and technical information can be found at www.wrse.org.uk/library

16.7. If there is information you are looking for and you cannot locate it, please contact us at contact@wrse.org.uk and we would be pleased to help.

16.8. To keep up to date with our regional planning work please visit our website www.wrse.org.uk You can sign up for email updates and monthly/quarterly newsletters. We explain in Section 17 of this Technical Annex how we will finalise our regional plan following the consultation.

Relationship with draft WRMP consultations

16.9. WRSE is an alliance of our six member companies. We work very closely with them and with other water companies and other regions in preparing the draft regional plan. This work ensures that WRSE has prepared a consistent and comprehensive regional plan, which integrates and builds on the other regional plans and supports the individual companies draft WRMPs.

16.10. Our six member companies' draft WRMPs are being separately consulted on and will also be published for a period of public consultation this Autumn and Winter.

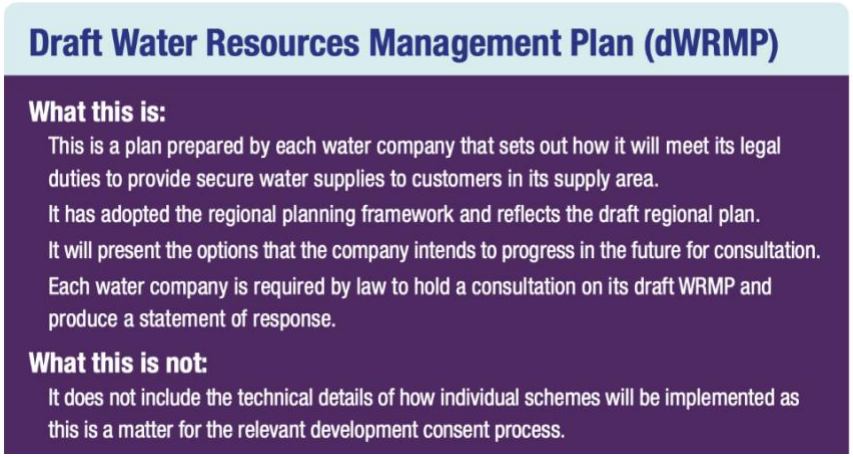
16.11. You can read and respond to the individual draft WRMPs directly through their statutory consultation processes:

- Affinity Water www.affinitywater.co.uk
- Portsmouth Water www.portsmouthwater.co.uk
- SES Water www.seswater.co.uk
- South East Water www.southeastwater.co.uk
- Southern Water www.southernwater.co.uk
- Thames Water www.thameswater.co.uk

16.12. These are separate consultations and submissions should be made directly to the water companies on their draft WRMPs. Please ensure that you direct your response to the appropriate consultation. You are free to respond to more than one consultation if you wish, and we have produced the following guide to help you direct your response to the right consultation:

Figure 16.1: The WRSE draft regional plan consultation

Figure 16.2: Our six member company draft WRMPs consultation



16.13. The WRMPs are statutory plans, and following the public consultation on each WRMP, each company will prepare their own Statement of Response for their own WRMP. They will then seek the approval of the Secretary of State (Defra) to publish their final WRMP24s.

16.14. Depending on the consultation feedback on the draft WRMPs and the nature and scale of issues and changes required to the plans, the Secretary of State can decide that a Public Inquiry is required before the plans are finalised, or direct that certain changes are made to the draft WRMP before it is finalised.

Relationship with RAPID process for SROs

16.15. Some of the schemes identified in our draft regional plan are being progressed by our member companies and other water companies as Strategic Resource Options (SROs) through the gated process governed by the Regulators' Alliance for Progressing Infrastructure Development (RAPID).

16.16. As explained in our separate Technical Annex 1, the RAPID process involves a more detailed assessment of SROs led through a separate governance process to regional planning and WRMPs, with data and information shared between them.

16.17. Reports that have been submitted to RAPID on the SROs that our member companies are assessing will be published on the relevant water company website at the same time as their draft WRMPs. Southern Water's reports are already published as they are working to an accelerated timetable.

17. Finalising our regional plan

How we will consider responses on our draft plan

17.1. We will carefully review all of the consultation responses and wider engagement feedback we receive on the draft regional plan. This will help us to identify levels of support for the approach we are planning to take, and any key issues and concerns relating to the regional plan.

17.2. We will prepare a 'Consultation Response' document following the close of the consultation period. This document will summarise the engagement undertaken and the comments and feedback received and provide WRSE's response to the consultation responses and engagement outcomes.

17.3. The Consultation Response document will identify, in light of the comments and feedback we have received, how we will incorporate and respond to the issues as we move towards our final regional plan later in 2023. It will also explain any areas of comment and feedback where we are not proposing to change the regional plan in response.

17.4. WRSE will use the Consultation Response document to also signpost the next stages of work on the regional plan, including an update on other technical work, modelling and regional co-operation and reconciliation that will have taken place since the publication of the draft regional plan.

17.5. The Consultation Response document will be published on our consultation website and a notification of its publication will be sent to all those who respond to the draft regional plan consultation and who indicate that they wish to be kept informed of our progress.

Finalisation of the regional plan

17.6. We anticipate that our final regional plan will be produced in 2023, informing the final company WRMPs and their 2025 to 2030 business plans which will include the investment needed to secure water resources for the future. The timing for the finalisation of the regional plan and company WRMPs is dependent on the outcome of the consultation on the draft plans, the detail of any consultation responses received, and whether the Secretary of State determines that further information or potentially a hearing or public inquiry is required before individual WRMPs are finalised.

17.7. Figure 17.1 below provides an overview of the timing and relationship between the plans.

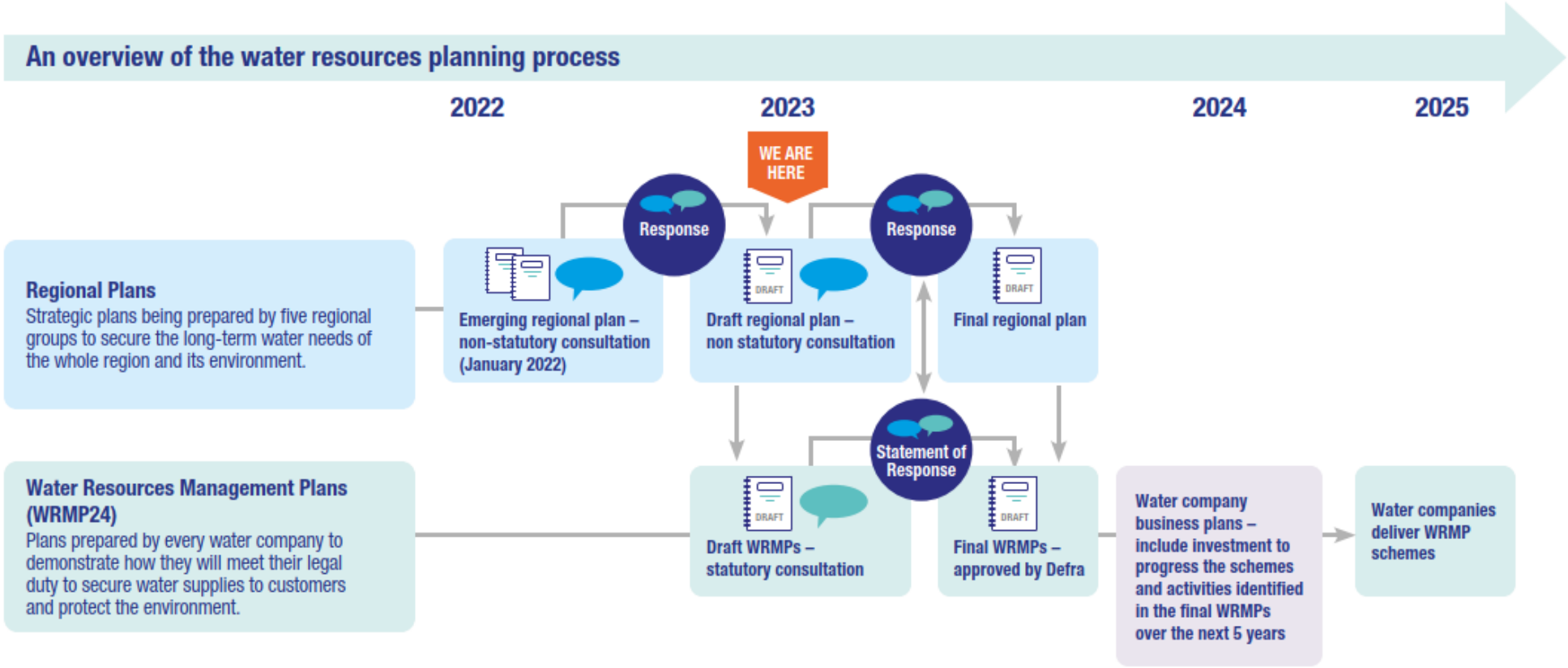
Reviews of the regional plan

17.8. WRSE will prepare a review of the regional plan on a five yearly cycle, timed to coincide with the preparation of the next cycle of water company WRMPs, due to be completed in 2029.

17.9. In advance of this, WRSE will ensure that it prepares and publishes an Annual Monitoring Report, building on the content of the company WRMP Annual Reviews (normally published in June of each year). This will enable WRSE to monitor data and trends in the implementation of the plan, policy and legislative changes, and other factors relevant to the plan.

17.10. Further information on monitoring and review of progress is set out in the following section of this Technical Annex.

Figure 17.1: Regional plan relationship with our member company WRMP and business plan processes



18. Monitoring and review of progress

Context

18.1. WRSE and our six member companies will carefully monitor progress with the implementation of the regional plan, and the key population, environmental and climate data trends relevant to the scale and nature of the water resource challenges facing the South East region.

18.2. WRSE will ensure that it prepares and publishes an Annual Monitoring Report, building upon the content of the company WRMP Annual Reviews (normally published in June of each year).

18.3. WRSE will also ensure that it provides a regular update to its commentary on the factors that could change the regional plan, as summarised in table 18.1 below, and explained in more detail through the remainder of this section. These factors and issues will be monitored together with member companies as well as regulators, and will also take stakeholder and customer feedback into account where possible.

Table 18.1: Factors which could change the regional plan and key issues which will be monitored by WRSE

Factors which could change the regional plan	Key issues to be monitored and resolved where possible
Environmental ambition	WRSE have worked with the EA and Natural England to develop the existing environmental ambition profiles, and to incorporate licence capping. The profiles will need to be reviewed to ensure they meet policy expectations, particularly regarding licence capping.
Quantifying environmental benefits	WRSE will continue to work with our member companies, regulators and catchment partners to better understand schemes and ecological benefits from environmental ambition.
Demand side options	TUBs and NEUBs have been included in the regional plan as one of the measures to meet the challenges ahead. The default regional position is that this will remain the case unless there is feedback to change this policy position. WRSE have tested several different Government water efficiency policies. Government Policy C brings the region to 110 l/p/d by 2050 but this puts a lot of onus on Government to deliver a significant component of the plan. Unless there is a strong consultation response or regulatory direction, WRSE will continue to use Government Policy B which gets the region to 115 l/p/d by 2050.
Supply side options	Uncertainties relating to supply side schemes will be monitored and resolved where possible. In particular, WRSE will monitor regulatory and stakeholder direction resulting from the dWRMP and RAPID Gate 2 consultations. Key schemes to monitor include SESRO, STT, GUC and Teddington DRA. Drought orders and permits continue in the draft regional plan until 2040, however WRSE will monitor regulatory positioning on the continued use of drought orders and permits and adjust our approach accordingly. WRSE have investigated accelerated cessation of the use of drought orders and permits (2035) as well as delayed cessation (2045 and 2050). WRSE will continue to work with the All Company Working Group (ACWG) and the National Advisory Unit (NAU) to look at emerging substances relating to reuse and water recycling schemes and compliance with the Water Framework Directive.
Carbon reduction	We will monitor cost of carbon and mitigation options.
Future environmental policies	WRSE will continue to work with Government and regulators throughout the regional planning process to inform and support resolution of outstanding environmental policy uncertainties.

Regional reconciliation	There will need to be further regional reconciliation to ensure consistency is maintained between the regions in future.
Multi-sector options	WRSE will continue to engage with stakeholders and multi-sector groups to improve our understanding of non-public water supply demand forecasts, potential multi-sector options, and impacts on non-public water supply sources from droughts and licence capping.
Drought resilience	We have tested several different implementation timescales for 1:500 year drought resilience timing. Unless there is a strong consultation response or regulatory direction, the default WRSE position is 2040 for achieving 1:500 year drought resilience.

Factors influencing our regional plan

18.4. At the time of publishing this draft regional plan for consultation, there are a number of specific risks and uncertainties that remain, which could influence and affect the proposals in the regional plan. This section highlights what these risk and uncertainties are, how they could potentially affect the plan, and the monitoring proposals and action that WRSE is planning to take in response.

18.5. This section also sets out the longer-term monitoring beyond this regional plan that WRSE will undertake to enable it to update its forecasts in preparation for the next regional plan preparation.

Environmental ambition

18.6. WRSE supports the development of long-term planning scenarios for achieving environmental outcomes. Without understanding the potential scale and distribution of future changes to water available for abstraction, it limits the ability to plan strategically and risks poorer value decisions on investment, resilience and environmental outcomes in the plan.

18.7. These longer-term scenarios for sustainability reductions are, however, not based on the quality of empirical evidence needed for decision 'making' in isolation. The relatively low confidence in these longer-term scenarios means that they can only be used to inform planning decisions with caution. They should be used to help 'inform, support and provide context' for decisions.

18.8. The degree of variance in the scale of the environmental ambition challenge that we face is clear from the draft regional plan Consultation Document and Technical Annexes we have published. For the higher levels of environmental ambition to be achieved, requires a significant number of existing sources to be switched off or reduced in scale and use, necessitating large numbers of new water resource options to be developed, additional to the demand management and other baseline elements of the regional plan. The number and size of new schemes required increases with the level of environmental ambition.

18.9. The increased number of schemes needing to be selected leads to increased cost, as the cost of delivering sustainability reductions will generally increase, per unit volume, with higher levels of ambition. Simply put, in investment modelling, the more cost-effective options are utilised first and as more are required so it becomes necessary to develop increasingly more expensive options. These tend often not only to be more expensive in terms of financial cost but also in terms of the environmental, carbon and social costs of these options.

18.10. For the highest levels of environmental ambition, we have not been able to solve the supply demand balance deficits by 2050 without allowing the model to select options that would have otherwise been excluded due to their level of environmental risk or environmental performance. We have allowed these to be selected later in the plan, from 2045 onwards, but this does not mean that the options would be developed. The regional plan will have been reviewed before the time when those schemes will need to be promoted for consenting. There may be technological advances, reductions in costs and environmental impacts, or new options identified before then which may ultimately be selected in a subsequent regional plan, and WRMPs.

18.11. What this does mean, however, is that there is undoubtedly a choice to be made, balancing the policy driven need to achieve environmental ambition

on the one hand, with the increased cost and need to develop and use potentially environmentally damaging water resources options over the longer term as a result. The need for evidence of ecological benefits and decisions on the most appropriate level of environmental ambition are key uncertainties facing the draft regional plan.

WRSE action in response

18.12. We will continue to discuss the wide range of potential environmental futures, the extent to which they drive the scale of the challenge being faced, and their implications for the type and number of options selected, as part of the consultation on our draft regional plan.

18.13. We will continue to engage with our regulators and stakeholders beyond the draft regional plan and draft WRMP consultation processes and support the further consideration of these issues by our environmental and economic regulators ahead of their determination of the environmental ambition to be delivered through this and subsequent regional and company plans.

Quantifying environmental benefits

18.14. Whilst the water resource impact of environmental policies or ambitions may be clearly defined in terms of the Ml/d reduction in deployable output that could be required, there are difficulties in quantifying the benefits of sustainability reductions in economic terms. There is currently no commonly agreed framework across regulators, Government, companies and others. Furthermore, there is a lack of evidence that reductions will necessarily benefit the water environment.

18.15. This lack of evidence of the precise ecological benefits of making different volumes of abstraction reduction is problematic, as aside from achieving a specific environmental target, there is a lack of quantifiable benefits to be balanced against the water resources impacts and the economic and environmental costs of the new resources that are required to be delivered as a result.

18.16. There is a concern that focusing on the benefits of delivering sustainability reductions in isolation could lead to sub-optimal investment decisions.

18.17. We have prioritised achieving environmental ambition within chalk stream catchments in the draft regional plan and it is likely that the plan will enable tangible progress to be made with respect to recovering chalk streams. Despite this, we recognise that the progress may not meet the expectations of all stakeholders.

18.18. As our six member companies seek funding and approval for, and then implement and further develop their programmes of catchment management measures (including through catchment partnerships), we will review the deployable output benefits of more real-world schemes to inform the identification of more catchment management options for future regional plan preparation

WRSE action in response

18.19. We will continue to work with our member companies, regulators and catchment partners to better understand schemes and ecological benefits. Where data can be made available, we will seek to capture this information within modelling for the final regional plan. This data and information will also inform company business plan submissions to Ofwat.

Demand Side Options

18.20. Demand management and leakage reductions are core to the draft regional plan. These schemes coupled with temporary use bans (TUBs) and non-essential use bans (NEUBs) provide the greatest contribution to the future challenges in the South East of England.

18.21. However, we have seen during the Covid-19 pandemic how quickly customer behaviour can change, with data indicating that household demand increased by around 10% while non-household demand fell by around 25% due to lockdowns and more people working at home.

18.22. The Government has an ambition for a per capita consumption (PCC) reduction to 110 litres per person by day by 2050. This is a particular challenge in the South East region, requiring not only water company activity, but also Government interventions. We have included within our plan the assumptions that Government will implement:

- Mandatory water labelling of water using products to help consumers make more informed choices about the products they use in their home by 2024
- Minimum standards for water using products to remove all inefficient products from the market by 2045
- Tighter building regulations which are enforced by 2060

18.23. This combination of policies (Government Intervention Scenario B) are a good balance between cost-effectiveness, deliverability and risk. Whilst the Government has committed to introducing mandatory water labelling by 2024, the impacts arising from this, and the commitment to other Government interventions is not yet clear.

18.24. The high level of savings within the draft regional plan are therefore not without risks, and the level of risk varies according to the solutions selected – but might be as much as 300 million litres of water per day.

WRSE action in response

18.25. WRSE will continue technical work and engagement with Government, regulators and our six member companies beyond the draft regional plan on these issues. This includes developing a consistent approach to managing this risk, particularly around delivery of demand reductions, and ensuring alternative options are investigated and capable of being brought forward if required. Moving forward, WRSE will also be seeking clearer guidance from Government on the profile of their introduction and Ml/d savings that would be derived from these interventions.

Supply Side Options

18.26. The draft regional plan includes a significant number of supply side options to respond to the scale of future challenges being faced.

18.27. As with any large and complex strategic plan, at draft stage there are still uncertainties relating to these supply side options, many of which will be overcome and mitigated as more detailed work is undertaken through WRMPs, through the RAPID gated process for SROs, and as detailed feasibility and environmental assessments are completed ahead of and in support of applications for planning and other consents.

WRSE action in response

18.28. WRSE will consider updated data and information on the individual supply side options, which will be generated as a result of ongoing and more detailed assessment of the engineering, environmental, consenting and land risks relating to options through the RAPID gated process for SROs, and through further work at company level in relation to WRMP preparation. Companies may need to factor in commercial and regulatory aspects, including procurement and delivery mechanisms for their schemes, in the context of PR24.

18.29. WRSE will also consider company level customer and stakeholder engagement around the options and overall strategies as a result of draft WRMP consultation and engagement, including on the public perception and affordability of options including water reuse and desalination options.

Carbon reduction

18.30. English water companies have committed to reaching net zero operational carbon emissions by 2030. Many of the options in the regional plan will produce capital carbon while they are being built and operational carbon when they are used.

18.31. There is also the potential that the Government may increase the cost of carbon in construction projects to promote more environmentally friendly solutions. This has the potential to change the carbon assessments that we have undertaken, and could influence the selection of options in our draft regional plan.

WRSE action in response

18.32. The draft regional plan has been optimised for new carbon associated with the options, as part of the determination of the best value plan. This has highlighted the costs and benefits of carbon optimisation against other best value criteria to inform the best value decision making.

18.33. Even with carbon optimisation included in the option selection process, the regional plan does not achieve net zero: carbon is still emitted during construction (capital carbon), and new emissions are generated during the life of the assets (operational carbon). The additional carbon will need to be incorporated within Company net zero route maps and strategies, and mitigation and offsetting activities may be identified in business plans.

Future environmental policies

18.34. There are a series of emerging policy and regulatory risks that have the potential to impact on individual options available for selection as part of the WRSE modelling, and on the WRSE strategy as a whole.

18.35. WRSE and the other regional groups (through the National Framework) and Companies through the All Company Working Group and individual SRO working groups, are working constructively with regulators to understand and engage on these risks and uncertainties.

18.36. The range of potential policy and regulatory risks and uncertainties are wide-ranging but through the gated process and consultations these risks are reducing over time. Following the gate 2 submissions and the consultations on the draft WRMPs we expect the policy uncertainties to further reduce.

WRSE action in response

18.37. WRSE will continue to work in collaboration with key partners, particularly regulators, beyond the draft regional plan as the regional plan is finalised, and beyond this looking forward to the next regional plan.

18.38. Engagement and working with regulators is a key regional activity. Whilst some outstanding policy issues are within the gift of regulators, other policy decisions may benefit from the evidence which the regional planning approach can support – particularly the scale and timing of investment decisions which may be impacted by either policy decisions or policy uncertainty. We will continue to work with Government and regulators throughout the process to inform and support resolution of outstanding policy uncertainties.

Regional reconciliation

18.39. WRSE has engaged extensively with the other regions in preparing the draft regional plan. A key part of this work has been the regional reconciliation process, where the regions have shared their emerging proposals for consistency checks and assessments with the other regions.

18.40. The reconciliation process has demonstrated that with the higher levels of environmental ambition, there are fewer water resources available for sharing and transfer between the regions than had perhaps been anticipated at the outset of the regional planning process. Regions which had been thought to potentially be able to supply resources to the South East have been shown to have deficits of their own under the more challenging futures.

18.41. Although there is less water available to transfer into the region than originally anticipated, nevertheless, transfers into the region form a critical part of the draft regional plan and it is essential that WRSE and our six member companies have certainty on the availability of resources to transfer, and the cost and assessed impacts associated with them.

WRSE action in response

18.42. The regional groups are consulting on their draft regional plans alongside consultation on draft WRMPs. The regional reconciliation report to support the draft regional plans is saved on the WRSE website, in the WRSE document library.

18.43. There will need to be further regional reconciliation rounds in 2023 as the plans are updated before finalisation, to ensure consistency is maintained between the regions.

Multi-sector options

18.44. The draft regional plan has taken account of the anticipated future water needs of other sectors. Further analysis is required but at this stage the impacts on scheme/option decisions currently appears limited in extent.

18.45. Whilst WRSE have worked to integrate the needs of multiple sectors into our draft regional plan, there is significant further work which can be undertaken to improve our understanding of non-public water supply demands, vulnerabilities and options in future.

18.46. There is further work needed to understand the future demands of other sectors and fully embed them into the regional plan. This includes:

- Understanding the impact that the Environment Agency's licence capping policy will have on the other sectors' existing abstraction licences
- Understanding whether any reductions are needed to the licences of other sectors to achieve long-term environmental improvement
- Working with the other sectors to determine how resilient they will need their water supplies to be in the future under different planning scenarios so this can be built into the regional plan
- Considering a wider range of future scenarios for different sectors and how this could impact on their demand for water in the future.
- Continuing to identify and develop multi-sector options that can be included in future regional plans
- Working with regulators to establish how schemes that supply water to other sectors should be funded, that avoids water company customers cross subsiding investment by other sectors

18.47. Energy UK have provided WRSE with updated future power needs for the South East, which follows a consistent approach which has been used for all the regional groups. Further discussions are required with stakeholders and power and water regulators to understand potential commercial sensitivities and anti-competition laws to progress the development of multi-sector options in the South East.

18.48. NFU are working closely with Water Resources East (WRE) on a number of pilot schemes, given the agriculture demand in the East of England is much greater than elsewhere in the country. WRSE will continue to work with the NFU to look at the agricultural demands in the South East, and WRSE are supportive of NFU ambitions of the development of a national agricultural water framework.

WRSE action in response

18.49. Between the draft and final regional plans, we will continue to engage with WRSE stakeholder and multi-sector groups to better our understanding of non-public water supply demand forecasts, potential multi-sector options, and drought impacts on non-public water supply sources. In the development of multi-sector options, WRSE will continue to facilitate discussions around risks and commercial implications for schemes.

18.50. WRSE will also continue to work with stakeholder and multi-sector groups and regulators to specifically understand the impacts of proposed licence capping regulations on non-public water supply abstractions.

Our longer-term monitoring proposals

Long-term projections

18.51. As well as the level of environmental ambition that is to be achieved through the regional plan proposals, the other key determinants of the scale of water resources challenge the region faces are climate change and population growth.

18.52. For population growth, the longer-term forecasts secured for the regional plan model different scenarios ranging from an increase of 12% by 2040, 26% by 2060 and 33% by 2075 in the highest growth scenario, to an increase of 0.3% by 2040, 1.3% by 2060 and 2.0% by 2075 under the lowest growth scenario. These forecasts are highly influenced by factors outside of the influence or control of WRSE, including global, national and regional economic conditions, international migration and others.

18.53. The draft regional plan has been based on the latest available climate change projections, and there remains a wide range of variability between the highest and lowest climate change scenarios that have been used. The uncertainty in the longer-term forecasts is a key factor influencing the scale and types of options being selected in the draft regional plan, particularly in the mid to latter parts of the planning period.

18.54. Whilst the baseline projections for the regional plan go forward to 2100, the draft regional plan proposals set out in the draft plan cover the period to 2075. At the time of publishing the emerging regional plan in January 2022, it had been thought that the draft regional plan could be extended to 2100, however the modelling undertaken for the draft plan has concluded that it remains appropriate to retain the 2075 end date for the regional plan.

18.55. The sensitivity testing undertaken has shown that extending the plan to 2100 does not change the options selected in the period to 2075. Extending the regional plan to 2100 includes additional supply side options towards the end of the plan period, a number of which are desalination or other carbon intensive options given the relative lack of other options available for selection at that time.

18.56. WRSE will ensure that it uses the most appropriate and up to date forecasts to inform its modelling and assessment work, commissioning its own research and forecasting when required. It will monitor actual data to determine the accuracy of forecasts it has used, to inform subsequent rounds of regional plan preparation.

Water resources performance data

18.57. Each water company is required to submit data annually to Defra and the Environment Agency on key indicators relating to its water supply performance in an 'Annual Data Return'. This data, reported at Company and individual WRZ level, includes a series of metrics on supply, demand and customers, covering the security of supplies to customers, including water abstracted, outage, metered and unmetered PCC, and population and property data.

18.58. In addition, each company must prepare and submit a WRMP Annual Review annually, in which performance is reported, including progress towards the delivery of WRMP plans and proposals. This includes consideration of whether there may have been a material change in circumstances such that re-consultation on the WRMP is required.

18.59. These annual review mechanisms provide a consistent level of information for companies and their WRZs to feed into WRSE. Working closely with our six member companies, WRSE can then analyse this information, to identify and assess trends in performance on the key regional plan proposals. This enables WRSE to update its information to feed into the next regional plan

18.60. The key areas of monitoring relevant to the next regional plan include the following.

- **Leakage reduction**: performance towards the leakage reduction targets, including company and WRZ level progress, any delays being experienced and potential barriers (and mitigation necessary) to achieving the high levels of leakage reduction set out within the regional plan
- **Demand management**: progress with the implementation of the water efficiency and metering programmes that our member companies have committed to in the regional plan, and the reductions in water usage that have been achieved as a result, compared to that forecast
- **Environmental benefits and outputs achieved**: including identifying and monitoring specific metrics for the level of environmental benefit that will be delivered in individual catchments as a result of the environmental ambitions being planned for – so that benefits can be captured and quantified in the regional planning work, and we can consider outcomes-based approaches as well as policy driven measures
- **Catchment management**: as our member companies implement and further develop their programmes of catchment management measures (including through catchment partnerships), to review the deployable output benefits of more real-world schemes to inform the identification of more catchment management options for future plan preparation

18.61. We will also need to ensure we utilise the most update forecasts available. To help inform future regional plans we will:

- ensure we utilise the latest climate change and other long-term forecasts when published, as well as commissioning our own research and forecasts for population and household growth

- continue to collaborate regionally and nationally in developing long range forecasting and modelling techniques to help us plan for and manage future uncertainties
- work with the other regions to ensure consistency of approaches to regional plan preparation.

Monitoring the implementation of individual options

18.62. We will work closely with our six member companies to review progress with the implementation of the individual options identified within the regional plan and subsequent WRMP24s, including those larger SROs being progressed through the RAPID gated process.

18.63. Reviewing the progress of these schemes helps us to refine and adapt implementation programmes and risks relating to the longer-term options identified in the regional plan, and for new options that are identified as part of the preparation of the next regional plan.

18.64. It is important to note that WRSE does not have a role in securing the delivery of individual schemes, as this falls to individual companies or other scheme promoters. WRSE will provide information and technical support to our member companies as part of their work.

Appendices

Appendix 1: Glossary and abbreviations

Acronym	Term	Definition
1:500	1:500 year level of drought resilience	Being resilient to a drought that would happen on average once every 500 years – or it has a 0.2% chance of happening every year
	Abstraction	Taking water from the environment (under license from the Environment Agency) for use in the public water supply or industry
	Adaptive Planning	Adaptive planning allows us to account for uncertainty, such as different impacts of population growth and climate change, which is useful when planning for the future. For each new plan, we monitor how previous ones have been implemented and incorporated new forecasts into modelling. We're then able to adapt future plans to meet different scenarios, based on this understanding.
AMP	Asset Management Plan	Water company business plan (prepared on five yearly cycle)
	Aquifer	A body of rock and/or sediment that holds groundwater
ASR	Aquifer Storage and Recovery	Injecting additional fresh water from other parts of an aquifer or from the rivers into a confined area within the aquifer. It can then be stored and pumped back to the surface and treated when needed
	Best Value Plan	A best value plan is one that considers factors alongside economic cost and seeks to achieve an outcome that increases the overall benefit to customers, the wider environment and overall society. Regional plans should identify the best options to meet the challenges we face, delivering best value for the environment and society.
	Business Plan	Water companies develop and submit business plans every five years to Ofwat, the economic regulator. These plans set out the commitments companies make to their customers and how they will meet them.
	Catchment	The area from which precipitation (rainfall) and groundwater would naturally collect and contribute to the flow of a river
	Cost-efficient	A cost-efficient planning process assesses all options which meet both company and WRSE feasibility threshold against whole life delivery costs including the cost of carbon. The resulting plan therefore represents the lowest programme costs to deliver required policy outcomes and core strategic objectives. A cost-efficient plan does not include, in its selection processes, other benefits, additional value and/or wider objectives.
Defra	Department of Environment, Food & Rural Affairs	UK Government department responsible for environmental matters – including water resources.

	Desalination	A process where seawater or brackish water is turned into drinking water by removing the salt, providing a reliable source of water including during droughts
	Demand management	Measures taken by water companies to support customers reduce the amount of water they use, and leakage
DO	Deployable output	The output of a source or bulk supply as constrained by licence (if applicable); pumping plant and/or well/aquifer properties; raw water mains and/or aqueducts; transfer and/or output main; treatment; water quality
DI	Distribution Input	The flow entering the water supply distribution network
	Draft Regional Plan	The draft WRSE regional plan published for consultation in November 2022.
	Drought Permit	An authorisation granted by the Environment Agency under drought conditions, which allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis
	Drought Order	Powers granted by the Secretary of State during drought to modify abstraction/discharge arrangements on a temporary basis
DYAA	Dry year annual average	Represents a period of low rainfall and unrestricted demand and is used as the basis of a WRMP
DYCP	Dry year critical period	The period(s) during the year when water resource zone supply demand balances are at their lowest
ERP	Emerging Regional Plan	The document published by WRSE for consultation in January 2022
EA	Environment Agency	The regulator responsible for environmental protection and enhancement – part of the Defra family
	Groundwater	Water held underground in the soil or in voids in rock
GUC	Grand Union Canal	A canal stretching 137 miles from London to Birmingham with arms into Slough, Aylesbury, Leicester and Northampton
HRA	Habitat Regulations Assessment	Assessment to consider the likely significant effects on designated Habitats (European) sites
	Headwater	Permanently flowing tributaries feeding a river system
INNS	Invasive Non-Native Species	Any non-native animal or plant with the ability to spread, causing damage to the environment and the way we live

Ml/d	Mega litres per day	Millions of litres per day. Unit of measurement for flow in a river or pipeline.
mtCO2e	Metric tons of carbon dioxide equivalent	The unit "CO2e" represents an amount of a greenhouse gas whose atmospheric impact has been standardized to that of one unit mass of carbon dioxide (CO2), based on the global warming potential of the gas.
	Natural Capital	Our stock of natural resources, including, soils, air, water and all living organisms. Some natural capital assets provide "goods and services", often called ecosystem services.
	Nature-based solutions	Sustainably managing natural features and processes to deliver wider benefits for customers – such as catchment management or river restoration
NE	Natural England	The Government's adviser for the natural environment in England
NEP	National Environment Programme	A list of environment improvement schemes that ensure water companies meet European and national targets related to water
	National Framework for Water Resources	An Environment Agency document that sets the strategic direction for long-term regional water resource planning
	Net zero operational carbon emissions	The water sector, through Water UK, has pledged to achieve net zero carbon emissions from its operations by 2030
NEUB	Non-Essential Use (Ban)	A drought order approved by the Secretary of State to restrict specific water uses by businesses
	Non-household	Use by businesses and public bodies such as schools and hospitals
NYAA	Normal Year Annual Average	This is the demand for water expected under normal conditions
Ofwat	Office of Water Services	The economic regulator of the water sector in England and Wales
	Outage	Temporary loss of deployable output
PCC	Per capita consumption	Amount of water a person typically uses every day
RAPID	Regulatory Alliance for the Progression of Infrastructure Development	An organisation formed by Ofwat, Environment Agency and Drinking Water Inspectorate to help accelerate the development of new water infrastructure and design future regulatory frameworks
	Regional groups	The five regional groups outlined in the water resources framework – Water Resources South East, West Country Water Resources, Water Resources East, Water Resources North and Water Resources West.
	Regional reconciliation	The process to understand how each region could support the others' developing plans

	River Restoration	The process of managing rivers to reinstate natural processes
SRO	Strategic Resource Option	Large-scale infrastructure solutions for securing additional water
STPR	Social Time Preference Rate	A method used to put a present value on costs and benefits that occur at a later date
	Source	A named input to a water resource zone where water is abstracted from a well, spring or borehole, or from a river or reservoir
SEA	Strategic Environmental Assessment	Assessment of likely significant effects of certain plans and programmes
	Supply-demand balance	The difference between total water available for use (as supply) and forecast distribution input (as water demand) at any given point in time over the planning period/horizon
	Sustainability Reduction	Reductions in deployable output required to meet statutory and/or environmental requirements
TUB	Temporary Use Ban	Drought management measures imposed by water companies on customers – previously known as hosepipe ban
WFD	Water Framework Directive	Environmental Legislation relating to river basin management and committing all EU member states to achieving good quantitative status to all water bodies and retained as UK law following Brexit
WINEP	Water Industry National Environment Programme	A programme issued to water companies by the EA which outlines what regulators expect companies to include in future investment plans to meet environmental obligations
	Water recycling	A process where wastewater is treated above usual standards to be returned to the environment and then abstracted downstream to process for drinking water
WRMP	Water Resource Management Plan	A plan produced by each water company every five years that follows a statutory process and sets out how they will provide water over the long-term
WRPG	Water Resources Planning Guideline	Published Guidance for the preparation of WRMP and Regional Plans from the Environment Agency, Natural Resources Wales and Ofwat
WRSE	Water Resources in the South East	Partnership of water companies and regulators in South East England working together to make best use of available water resources
WRZ	Water Resource Zone	The largest possible zone in which all resources, including external transfers, can be shared and hence the zones in which all customers experience the same risk of supply failure from a resource shortfall
	Water UK	The trade association for water companies

Appendix 2: Company level diagrams

The diagrams in Figures App2.1 to App2.6 overleaf shows at a company level how the options selected under each of the branches in the draft regional plan change, depending on the scale of the challenges being faced.

The same context and commentary apply to these diagrams as is explained in Section 1 and 2 of this Technical Annex for the regional overview. Including that:

- Given the number of options selected for some companies, options have been grouped together where necessary to keep the diagrams readable.
- The timing shown for the option is the date when the investment modelling first utilises the option
- The figures shown in the diagram (in Ml/d) for the option is the maximum capacity of the option in the 1:500 Dry Year Annual Average (DYAA) scenario.
- Options may have different utilisations under different design scenarios, and utilisation may vary across the planning period – for some options starting lower and increasing, or for others peaking at a point where the resource is most needed to meet supply demand balances.
- The new resource options only appear once in each branch of the diagram – the model then utilises them again in that branch through the rest of the period to 2075.
- Where a new resource option appears in more than one branch, but in different periods, this means the modelling selects them earlier or later, depending on the scale of challenge it is seeking to solve
- Our six member companies are publishing their individual draft WRMPs for consultation alongside this draft regional plan and it is for the WRMP to explain how it has reflected the regional plan and why the preferred programme has been selected.

The company level diagrams illustrate that some companies are facing larger challenges than others, with more options being selected by the investment model as a result.

Figure App2.1: Affinity Water – WRSE best value plan proposals

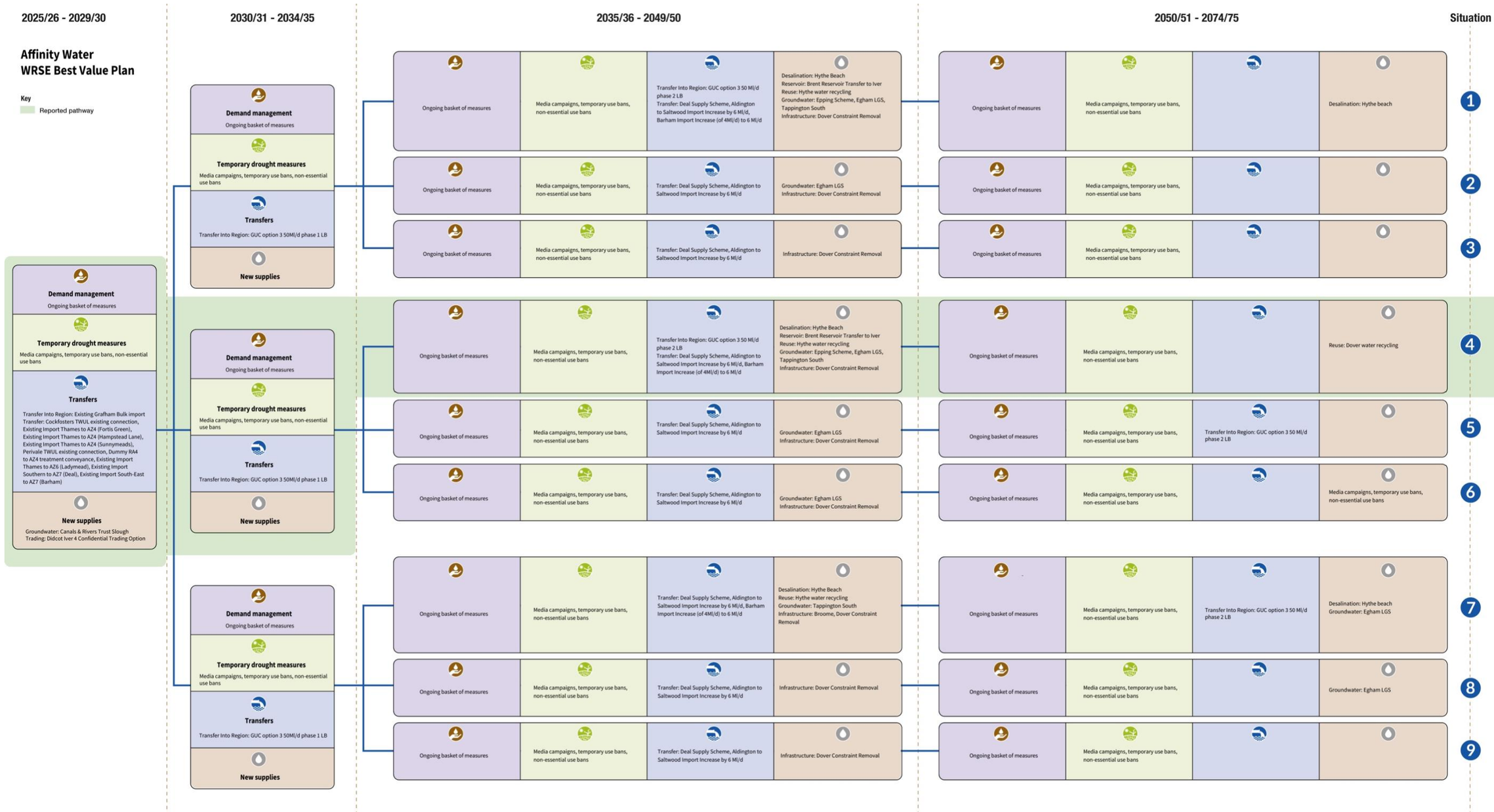


Figure App2.2: Portsmouth Water – WRSE best value plan proposals

Figure App2.3: SES Water – WRSE best value plan proposals

Figure App2.4: South East Water – WRSE best value plan proposals

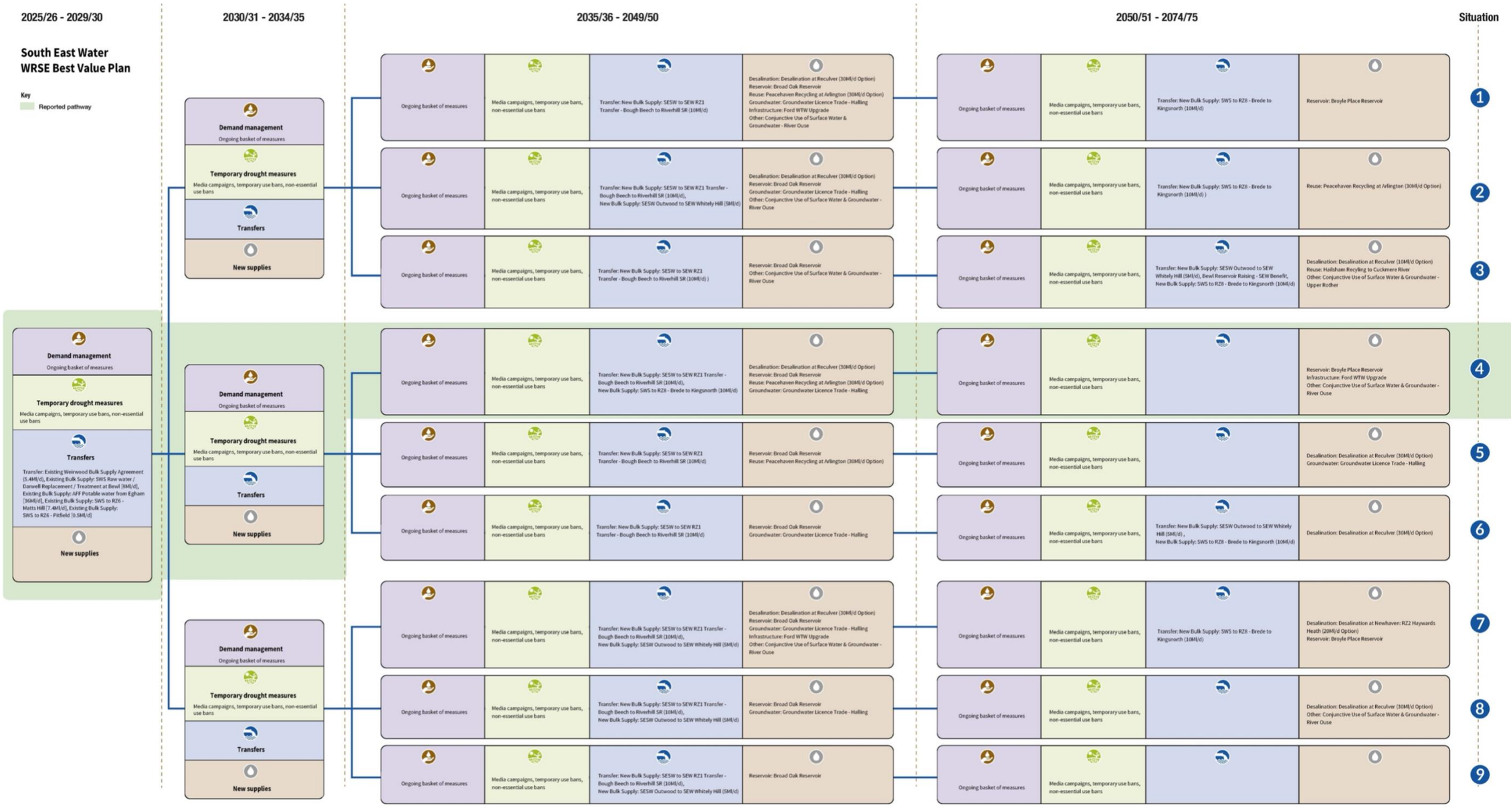
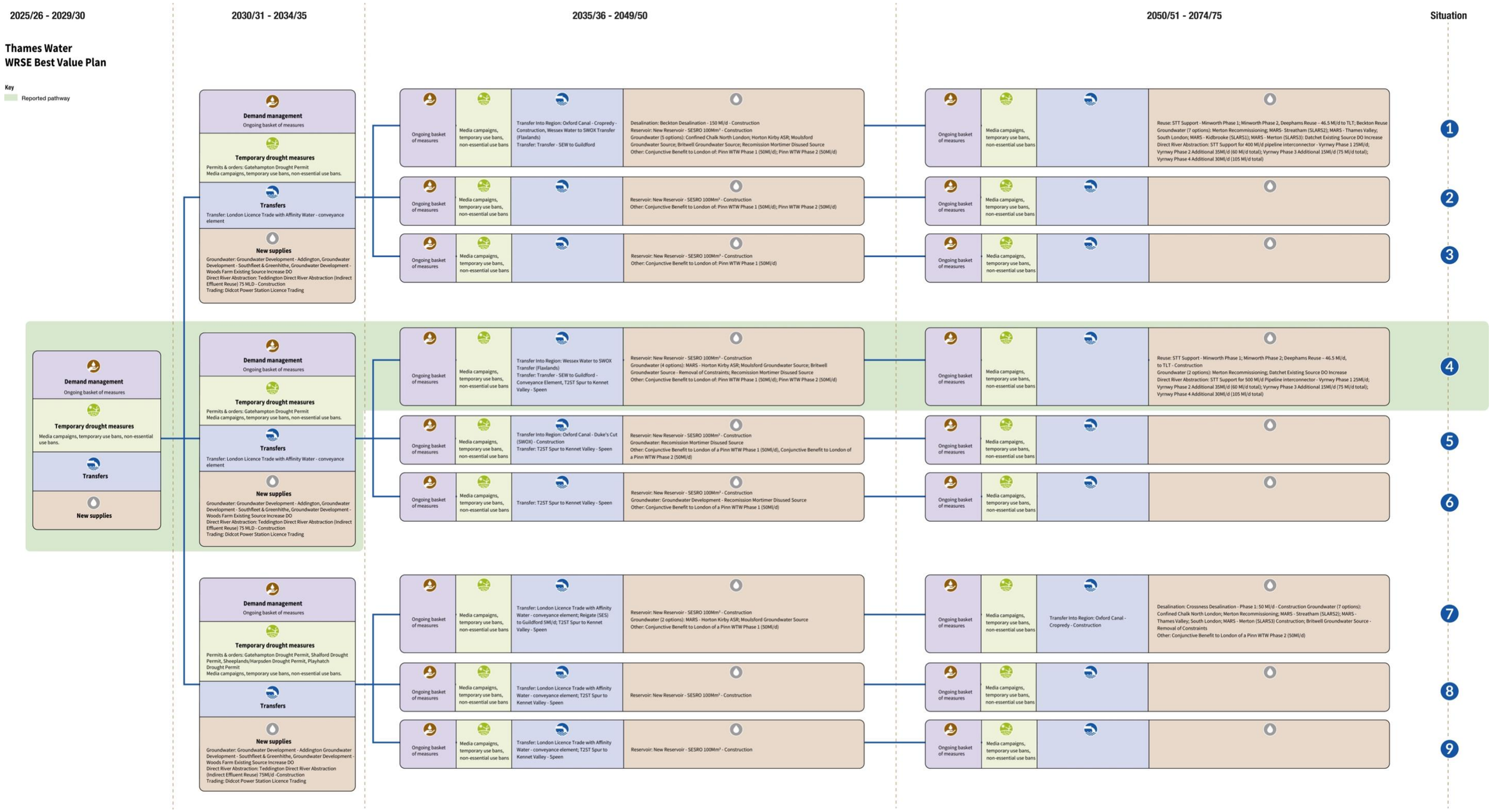


Figure App2.5: Southern Water – WRSE best value plan proposals

Figure App2.6: Thames Water – WRSE best value plan proposals



Appendix 3: Strategic Environmental Assessment summary table

Table App3.1 is taken from the SEA Environmental Summary Report (full report in the WRSE Document Library). This summarises the SEA outcomes from the assessment of the Best Value Plan.

Effect	Description
+++	Major Positive
++	Moderate Positive
+	Minor Positive
0	Neutral
-	Minor Negative
--	Moderate Negative
---	Major Negative

Table App3.1: SEA summary assessment of Best Value Plan

SEA Topic	SEA Objective	Best Value Plan (Pre-2050)							
		Construction Pre-mitigation		Operation Pre-mitigation		Construction Post-mitigation		Operation Post-mitigation	
		+	-	+	-	+	-	+	-
Biodiversity, flora and fauna	Protect and enhance biodiversity, priority species, vulnerable habitats and habitat connectivity (no loss and improve connectivity where possible)	0	---	+++	---	0	---	+++	---
Soil	Protect and enhance the functionality, quantity and quality of soils	0	--	++	-	0	-	++	0
Water	Increase resilience and reduce flood risk	0	0	++	0	0	0	++	0
	Protect and enhance the quality of the water environment and water resources	0	--	+++	--	0	-	+++	--
	Deliver reliable and resilient water supplies	0	0	+++	0	0	0	+++	0
Air	Reduce and minimise air emissions	0	--	0	-	0	-	0	-
Climatic Factors	Reduce embodied and operational carbon emissions	0	---	0	---	0	---	0	---
	Reduce vulnerability to climate change risks and hazards	0	0	++	--	0	0	++	--
Landscape	Conserve, protect and enhance landscape, townscape and seascape character and visual amenity	0	--	++	0	0	--	++	0
Historic Environment	Conserve, protect and enhance the historic environment, including archaeology	0	--	0	0	0	--	0	0
Population and Human Health	Maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing	0	--	+	0	0	-	+	0
	Maintain and enhance tourism and recreation	0	-	+	0	0	-	+	0
Material Assets	Minimise resource use and waste production	+	---	+	0	+	--	+	0
	Avoid negative effects on built assets and infrastructure	0	--	0	0	0	-	0	0

Appendix 4: Summary of investment model runs

Table App4.1 summarises the comparison investment model runs undertaken as part of the draft regional plan preparation and evaluation. Detailed outputs of these investment model runs are available in our separate "Investment Modelling Draft Regional Plan Results" report, which is in the document library on the WRSE website.

Key information for the best value plan, the least cost plan and the best environmental and societal plan investment model runs are in Appendix 5, 6 and 7 of this Technical Annex.

Table App4.1: Investment Plan Model Run names and key characteristics

Model Run Name	Description	Govt policy	1:500 Drought by	Drought orders stop by	STT	Type of Run	Purpose	Type of Test
Achieving 1:500 year drought resilience by 2035	Least cost plan with the reduced set of STT support options available to WRSE; 1:500 yr resilience by 2035 and cessation of drought permits / orders by March 2037; Government policy B; optimised on cost grounds only.	B	2035	2037	Reduced	Least cost	Sensitivity	Policy
Achieving 1:500 year drought resilience by 2045	Least cost plan with the reduced set of STT support options available to WRSE; 1:500 yr resilience by 2045 and cessation of drought permits / orders by March 2047; Government policy B; optimised on cost grounds only.	B	2045	2047	Reduced	Least cost	Sensitivity	Policy
Achieving 1:500 year drought resilience by 2050	Least cost plan with the reduced set of STT support options available to WRSE; 1:500 yr resilience by 2050 and cessation of drought permits / orders by March 2052; Government policy B; optimised on cost grounds only.	B	2050	2052	Reduced	Least cost	Sensitivity	Policy
Higher level of water efficiency through policy interventions by 2050	Least cost plan with the reduced set of STT support options available to WRSE; 1:500year drought resilience by 2040; Government policy A; optimised on cost grounds only. low until 2040 and medium from 2060 (interim between 2040 to 2060).	A	2040	2042	Reduced	Least cost	Sensitivity	Policy
Least cost plan	Least cost plan with the reduced set of STT support options available to WRSE; 1:500year drought resilience by 2040; Government policy B; optimised on cost grounds only.	B	2040	2042	Reduced	Least cost	Plan	Plan
Best value plan with multiple sizes of Sesro	Best value plan with no restrictions on what size Sesro can be selected in any of the branches in the plan.	B	2040	2042	Reduced	Best value	Sensitivity	Scheme
Best environmental and social plan	Best environmental and societal plan	B	2040	2042	Reduced	Best value	Plan	Plan
Best resilience plan	Best resilience plan	B	2040	2042	Reduced	Best value	Plan	Plan
Least cost plan to 2100	Least cost plan to 2100 instead of 2075. This plan highlights if any of the schemes in the 2075 plan would change if we planned over a longer period of time	B	2040	2042	Reduced	Least cost	Plan	Plan
Least cost plan but with all of STT support options available to WRSE	Sensitivity test of the least cost plan using all of the support options in the Severn Thames Transfer	B	2040	2042	Reduced	Least cost	Scenario	Scheme
Removing the drought provision clause to E&S water by 2030	Removing the drought provision clause from the Thames to Essex Water by 2030 to provide more water earlier. This results in the bulk supply to Essex going to 91 Ml/d by 2030 in a drought as opposed to the current arrangement where Thames can only supply 70 Ml/d in a drought and 90 Ml/d in a normal year.	B	2040	2042	Reduced	Least cost	Scenario	Scheme
Earliest start date for Beckton desalination is delayed a year	This is a sensitivity test to see what happens if the earliest start date for the Beckton desalination plant is delayed by a year.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Earliest start date for Beckton recycling scheme is delayed a year	This is a sensitivity test to see what happens if the earliest start date for the Beckton recycling plant is delayed by a year.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Earliest start date for GUC recycling scheme is delayed a year	This is a sensitivity test to see what happens if the earliest start date for the GUC recycling plant is delayed by a year.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Earliest start date for Sesro is delayed a year	This is a sensitivity test to see what happens if the earliest start date for the Sesro is delayed by a year.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Earliest start date for STT connecting pipe is delayed a year	This is a sensitivity test to see what happens if the earliest start date for the STT pipe is delayed by a year.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Earliest start date for Teddington recycling scheme is delayed a year	This is a sensitivity test to see what happens if the earliest start date for the Teddington recycling scheme is delayed by a year.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Earliest start date for Beckton desalination is delayed three years	This is a sensitivity test to see what happens if the earliest start date for the Beckton desalination plant is delayed by three years.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Earliest start date for Beckton recycling scheme is delayed three years	This is a sensitivity test to see what happens if the earliest start date for the Beckton recycling plant is delayed by three years.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Earliest start date for GUC recycling scheme is delayed three years	This is a sensitivity test to see what happens if the earliest start date for the GUC recycling plant is delayed by three years.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme

Model Run Name	Description	Govt policy	1:500 Drought by	Drought orders stop by	STT	Type of Run	Purpose	Type of Test
Earliest start date for Sesro is delayed three years	This is a sensitivity test to see what happens if the earliest start date for the Sesro is delayed by three years.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Earliest start date for STT scheme is delayed three years	This is a sensitivity test to see what happens if the earliest start date for the STT pipe is delayed by three years. .	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Earliest start date for Teddington recycling scheme is delayed three years	This is a sensitivity test to see what happens if the earliest start date for the Teddington recycling scheme is delayed by three years.	B	2040	2042	Reduced	Least cost	Sensitivity	Scheme
Achieving 1:500 year drought resilience by 2040	1:500 yr resilience by 2040 but drought permits / orders are still allowed to continue to be used in the plan to meet 1:500year droughts.	B	2040	2042	Reduced	Least cost	Sensitivity	Policy
Regional plan excluding the Budds Farm recharge of Havant Thicket	This is a scenario test to see what would happen if the direct recharge of Havant Thicket was not available.	B	2040	2042	Reduced	Least cost	Scenario	Policy
Regional plan excluding drought orders and permits	This investment model run tests to see what additional interventions would be required if drought orders or permits are not used to meet the regional deficits	B	2040	2042	Reduced	Least cost	Scenario	Policy
Regional plan excluding the GUC option	This investment model run tests to see what additional interventions would be required if the GUC option was not available. All the other options are available for selection.	B	2040	2042	Reduced	Least cost	Scenario	Scheme
Regional plan excluding the high demand management options	This investment run seeks a solution for the range of regional challenges but without the water companies high demand management baskets being available	B	2040	2042	Reduced	Least cost	Scenario	Scheme
Regional plan excluding the high & medium demand management options	This investment run seeks a solution for the range of regional challenges but without the water companies high & medium demand management baskets being available	B	2040	2042	Reduced	Least cost	Scenario	Scheme
Regional plan excluding media; temporary use bans; and non-essential use bans	This investment run seeks a solution for the range of regional challenges but without the water companies being able to use media campaigns; temporary use bans and non-essential use bans	B	2040	2042	Reduced	Least cost	Scenario	Scheme
Regional plan excluding Sesro based on cost	This investment model run determines what the regional plan would be if the South East Strategic Reservoir option and the other reservoirs in the upper Thames were unavailable for selection in the regional plan. This regional plan is based on cost alone	B	2040	2042	Reduced	Least cost	Scenario	Scheme
Regional plan excluding Sesro based on best value metrics	This investment model run determines what the regional plan would be if the South East Strategic Reservoir option and the other reservoirs in the upper Thames were unavailable for selection in the regional plan. This regional plan is based on cost and best value metrics	B	2040	2042	Reduced	Best value	Scenario	Scheme
Regional plan excluding Sesro but with all STT options available - based on least cost	This investment model run determines what the regional plan would be if the South East Strategic Reservoir option and the other reservoirs in the upper Thames were unavailable for selection in the regional plan. This regional plan is based on cost alone	B	2040	2042	Full	Least cost	Scenario	Scheme
Regional plan excluding Sesro but with all STT options available - based on cost and BVP metrics	This investment model run determines what the regional plan would be if the South East Strategic Reservoir option and the other reservoirs in the upper Thames were unavailable for selection in the regional plan. This regional plan is based on cost and best value metrics	B	2040	2042	Full	Best value	Scenario	Scheme
Regional plan which forces the STT 300 options in 2040	This investment model run forces the STT 300 options in 2040 across all of the branches. Sesro is also excluded but the other options are available for the investment model to select. The costs and performance of the plan shows what happens if this option is selected and implemented by 2040.	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan which forces the STT 300 interconnector in by 2040	This investment model run forces the STT 300 pipe in by 2040 across all of the branches. Sesro is also excluded but the other options are available for the investment model to select. The costs and performance of the plan shows what happens if this option is selected and implemented by 2040.	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan which excludes Sesro and forces the STT 400 options in 2040	This investment model run forces the STT 400 options in 2040 across all of the branches. Sesro is also excluded but the other options are available for the investment model to select. The costs and performance of the plan shows what happens if this option is selected and implemented by 2040.	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan which excludes Sesro and forces the STT 500 options in 2040	This investment model run forces the STT 500 options in 2040 across all of the branches. Sesro is also excluded but the other options are available for the investment model to select. The costs and performance of the plan shows what happens if this option is selected and implemented by 2040.	B	2040	2042	reduced	Least cost	Scenario	Scheme

Model Run Name	Description	Govt policy	1:500 Drought by	Drought orders stop by	STT	Type of Run	Purpose	Type of Test
Regional plan which excludes Sesro forces the STT 500 interconnector in by 2040	This investment model run forces the STT 500 pipe in by 2040 across all of the branches. Sesro is also excluded but the other options are available for the investment model to select. The costs and performance of the plan shows what happens if this option is selected and implemented by 2040.	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan which excludes Sesro and only allows the STT canal options	This investment model run excludes Sesro and the STT pipeline options. The other STT support options are available. The costs and performance of the plan shows what happens if these options are excluded.	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan which excludes the Thames to Southern transfer option	This investment plan shows what additional interventions would be required if the Thames to Southern transfer was not available	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan which excludes Teddington DRA	This investment plan shows what additional interventions would be required if the Teddington DRA scheme is not available	B	2040	2042	reduced	Least cost	Scenario	Scheme
West Berkshire groundwater scheme is not available after 2060	The EA operate the West Berkshire Groundwater scheme which supports a Thames water abstraction during a drought. This scenario shows what would happen if this scheme was decommissioned by 2060	B	2040	2042	reduced	Least cost	Scenario	Scheme
Worlds End groundwater scheme is excluded	The Worlds End is a groundwater source owned and operated by Portsmouth Water. This investment model run shows what happens if this source is not available.	B	2040	2042	reduced	Least cost	Scenario	Scheme
Limit Sesro to 100Mm3	This investment model run excludes all other Sesro options and the other upper Thames reservoirs	B	2040	2042	reduced	Least cost	Scenario	Scheme
Limit Sesro to 125Mm3	This investment model run excludes all other Sesro options and the other upper Thames reservoirs	B	2040	2042	reduced	Least cost	Scenario	Scheme
Limit Sesro to 150Mm3	This investment model run excludes all other Sesro options and the other upper Thames reservoirs	B	2040	2042	reduced	Least cost	Scenario	Scheme
Limit Sesro to 75Mm3	This investment model run excludes all other Sesro options and the other upper Thames reservoirs	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan which forces the STT 300 pipe in 2040	This investment model run forces the STT 300 pipe in by 2040 across all of the branches. The costs and performance of the plan shows what happens if this option is selected and implemented by 2040.	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan which forces the STT 400 pipe in 2040	This investment model run forces the STT 400 pipe in by 2040 across all of the branches. The costs and performance of the plan shows what happens if this option is selected and implemented by 2040.	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan which forces the STT 500 pipe in 2040	This investment model run forces the STT 500 pipe in by 2040 across all of the branches. The costs and performance of the plan shows what happens if this option is selected and implemented by 2040.	B	2040	2042	reduced	Least cost	Scenario	Scheme
GUC cost sensitivity run	The SRO scheme provided an updated set of costs for the GUC option based on increased treatment costs	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
GUC BVP cost sensitivity run	The SRO scheme provided an updated set of costs for the GUC option based on increased treatment costs but optimised on costs and BVP metrics	B	2040	2042	reduced	Best value	Scenario	Scheme
Least cost plan based on an intergenerational equity discount rate	This discount rate is slightly different to the social time preference rate	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Regional plan but allowing the Mendip option to be selected	The WCWRG Mendip option is excluded for the runs but this is a scenario run which tests to see if the Mendip option would be selected if it was available. This plan optimised on cost alone	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan but allowing the Mendip option to be selected	The WCWRG Mendip option is excluded for the runs but this is a scenario run which tests to see if the Mendip option would be selected if it was available. This plan optimised on cost and BVP metrics	B	2040	2042	reduced	Best value	Scenario	Scheme
1:200 yr drought resilience in London by 2031	This option shows what would happen if London was resilient to a 1:200 yr drought by 2031 instead of 2030 in the regional plan	B	2040	2042	reduced	Least cost	Scenario	Scheme
1:200 yr drought resilience in London by 2032	This option shows what would happen if London was resilient to a 1:200 yr drought by 2032 instead of 2030 in the regional plan	B	2040	2042	reduced	Least cost	Scenario	Scheme
1:200 yr drought resilience in London by 2033	This option shows what would happen if London was resilient to a 1:200 yr drought by 2033 instead of 2030 in the regional plan	B	2040	2042	reduced	Least cost	Scenario	Scheme

Model Run Name	Description	Govt policy	1:500 Drought by	Drought orders stop by	STT	Type of Run	Purpose	Type of Test
1:200 yr drought resilience in London by 2034	This option shows what would happen if London was resilient to a 1:200 yr drought by 2034 instead of 2030 in the regional plan	B	2040	2042	reduced	Least cost	Scenario	Scheme
Least cost plan based on the Long term discount rate	This discount rate is slightly different to the social time preference rate	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Decrease the cost of Beckton desalination	Decrease the cost of Beckton desalination by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Decrease the cost of Beckton reuse	Decrease the cost of Beckton recycling by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Decrease the cost of GUC reuse	Decrease the cost of GUC by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Decrease the cost of Sesro	Decrease the cost of Sesro by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Decrease the cost of STT	Decrease the cost of STT by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Decrease the cost of STT pipe	Decrease the cost of STT pipe by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Decrease the cost of Teddington	Decrease the cost of Teddington by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Increase the cost of Beckton desalination	Increase the cost of Beckton desalination by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Increase the cost of Beckton reuse	Increase the cost of Beckton recycling by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Increase the cost of GUC reuse	Increase the cost of GUC by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Increase the cost of Sesro	Increase the cost of Sesro by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Increase the cost of STT	Increase the cost of STT by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Increase the cost of STT pipe	Increase the cost of STT pipe by reducing the optimism bias	B	2040	2042	reduced	Least cost	Sensitivity	Scheme
Increase the cost of Teddington	Increase the cost of Teddington by reducing the optimism bias	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional plan only allowing Sesro 100Mm3 option	This regional plan limits the Sesro options to just the 100 Mm3 version and excludes the other options. The regional plan is optimised on least cost only	B	2040	2042	reduced	Least cost	Scenario	Scheme
Best value plan	This regional plan limits the Sesro options to just the 100 Mm3 version and excludes the other options. The regional plan is optimised on least cost and BVP only	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional Environmental and societal plan only allowing Sesro 100Mm3 option	This regional plan limits the Sesro options to just the 100 Mm3 version and excludes the other options. The regional plan is optimised on least cost and the Environmental and Societal metrics only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional resilience plan only allowing Sesro 100Mm3 option	This regional plan limits the Sesro options to just the 100 Mm3 version and excludes the other options. The regional plan is optimised on least cost and resilience metrics only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional plan only allowing Sesro 100Mm3 option and including SEW reservoirs	This regional plan limits the Sesro options to just the 100 Mm3 version and excludes the other options. The regional plan is optimised on least cost only	B	2040	2042	reduced	Best value	Scenario	Scheme

Model Run Name	Description	Govt policy	1:500 Drought by	Drought orders stop by	STT	Type of Run	Purpose	Type of Test
Regional plan only allowing Sesro 125Mm3 option	This regional plan limits the Sesro options to just the 125 Mm3 version and excludes the other options. The regional plan is optimised on least cost only	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional BVP only allowing Sesro 125Mm3 option	This regional plan limits the Sesro options to just the 125 Mm3 version and excludes the other options. The regional plan is optimised on least cost and BVP only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional Environmental and societal plan only allowing Sesro 125Mm3 option	This regional plan limits the Sesro options to just the 125 Mm3 version and excludes the other options. The regional plan is optimised on least cost and the Environmental and Societal metrics only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional resilience plan only allowing Sesro 125Mm3 option	This regional plan limits the Sesro options to just the 125 Mm3 version and excludes the other options. The regional plan is optimised on least cost and resilience metrics only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional plan only allowing Sesro 150Mm3 option	This regional plan limits the Sesro options to just the 150 Mm3 version and excludes the other options. The regional plan is optimised on least cost only	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional BVP only allowing Sesro 150Mm3 option	This regional plan limits the Sesro options to just the 150 Mm3 version and excludes the other options. The regional plan is optimised on least cost and BVP only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional Environmental and societal plan only allowing Sesro 150Mm3 option	This regional plan limits the Sesro options to just the 150 Mm3 version and excludes the other options. The regional plan is optimised on least cost and the Environmental and Societal metrics only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional resilience plan only allowing Sesro 150Mm3 option	This regional plan limits the Sesro options to just the 150 Mm3 version and excludes the other options. The regional plan is optimised on least cost and resilience metrics only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional plan only allowing Sesro 75Mm3 option	This regional plan limits the Sesro options to just the 75 Mm3 version and excludes the other options. The regional plan is optimised on least cost only	B	2040	2042	reduced	Least cost	Scenario	Scheme
Regional BVP only allowing Sesro 75Mm3 option	This regional plan limits the Sesro options to just the 75 Mm3 version and excludes the other options. The regional plan is optimised on least cost and BVP only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional Environmental and societal plan only allowing Sesro 75Mm3 option	This regional plan limits the Sesro options to just the 75 Mm3 version and excludes the other options. The regional plan is optimised on least cost and the Environmental and Societal metrics only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional resilience plan only allowing Sesro 75Mm3 option	This regional plan limits the Sesro options to just the 75 Mm3 version and excludes the other options. The regional plan is optimised on least cost and resilience metrics only	B	2040	2042	reduced	Best value	Scenario	Scheme
Regional plan only allowing the STT canal and support options	The regional investment model excludes the STT pipeline transfer options and only allows the STT canal transfer option. The STT support options are also available.	B	2040	2042	reduced	Least cost	Scenario	Scheme
Reduce the Affinity bulk supply by 2040	The regional investment model finds a solution based on a reduced bulk supply from Grafham reservoir to Affinity by 2040	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Reduce the Affinity bulk supply by 2050	The regional investment model finds a solution based on a reduced bulk supply from Grafham reservoir to Affinity by 2050	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Government interventions C	Least cost plan with the reduced set of STT support options available to WRSE; 1:500year drought resilience by 2040; Government policy C; optimised on cost grounds only. low until 2040 and medium from 2050 and high from 2060 (interim between 2040 to 2050 to 2060)	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Government interventions D	Least cost plan with the reduced set of STT support options available to WRSE; 1:500year drought resilience by 2040; Government policy D; optimised on cost grounds only. Government interventions by transitioning from low to medium and then high to allow the target to be met (Low from 2025; medium by 2040; high by 2075)	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Government interventions E	Least cost plan with the reduced set of STT support options available to WRSE; 1:500year drought resilience by 2040; Government policy E; optimised on cost grounds only. Government interventions by transitioning from low to medium and then high to allow the target to be met (Low from 2025; medium by 2035; high by 2050)	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Government interventions F	Least cost plan with the reduced set of STT support options available to WRSE; 1:500year drought resilience by 2040; Government policy F; optimised on cost grounds only. Low government savings by 2030 and medium by 2040	B	2040	2042	reduced	Least cost	Sensitivity	Policy

Model Run Name	Description	Govt policy	1:500 Drought by	Drought orders stop by	STT	Type of Run	Purpose	Type of Test
Government interventions G	Least cost plan with the reduced set of STT support options available to WRSE; 1:500year drought resilience by 2040; Government policy G; optimised on cost grounds only. Low government savings by 2030 and high by 2040.	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Government interventions H	Least cost plan with the reduced set of STT support options available to WRSE; 1:500year drought resilience by 2040; Government policy H; optimised on cost grounds only. Government interventions remain low from 2025	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Medium environmental destination in the initial branch	This regional plan is based on meeting a medium Environmental Destination in the core, initial branch as opposed to a low Environmental Destination in the core branch	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Medium climate change	Regional plan, optimised on cost. Tree 16.08 is the same as Tree 16.05 but uses medium climate change across all of the situations	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Low climate change	Regional plan, optimised on cost. Tree 16.09 is the same as Tree 16.05 but uses low climate change across all of the situations	B	2040	2042	reduced	Least cost	Sensitivity	Policy
High climate change	Regional plan, optimised on cost. Tree 16.10 is the same as Tree 16.05 but uses high climate change across all of the situations	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Long Term Delivery strategy with Government policy B	Ofwat long term delivery strategy tree which is only based on Housing plan forecasts and ONS forecasts. It also limits Environmental destinations to BAU+ or High. The plan incorporates government policy B	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Long Term Delivery strategy with Government policy C	Ofwat long term delivery strategy tree which is only based on Housing plan forecasts and ONS forecasts. It also limits Environmental destinations to BAU+ or High. The plan incorporates government policy C	B	2040	2042	reduced	Least cost	Sensitivity	Policy
Long Term Delivery strategy with Government policy G	Ofwat long term delivery strategy tree which is only based on Housing plan forecasts and ONS forecasts. It also limits Environmental destinations to BAU+ or High. The plan incorporates government policy G	B	2040	2042	reduced	Least cost	Sensitivity	Policy

Appendix 5: Best value plan key model run information

The following tables and figures give comparable information including best value metrics and other key data and plan information for the best value plan

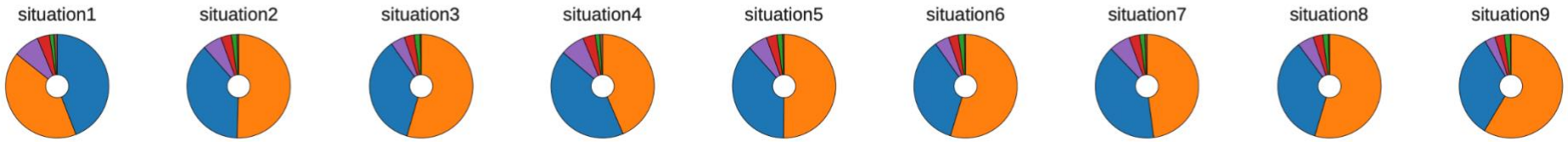
Metrics

Net present value (Cost)

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Cost w/ deficit (STPR)	16,453	12,790	11,655	15,587	12,879	11,604	13,543	11,663	10,749	(£m)
Cost w/o deficit (STPR)	16,453	12,790	11,655	15,587	12,879	11,604	13,543	11,663	10,749	(£m)
Cost w/ deficit (IGEQ)	26,544	19,742	17,666	24,913	19,919	17,578	21,289	17,791	16,103	(£m)
Cost w/o deficit (IGEQ)	26,544	19,742	17,666	24,913	19,919	17,578	21,289	17,791	16,103	(£m)
Cost w/ deficit (LTDR)	18,367	14,126	12,817	17,361	14,231	12,759	15,022	12,844	11,787	(£m)
Cost w/o deficit (LTDR)	18,367	14,126	12,817	17,361	14,231	12,759	15,022	12,844	11,787	(£m)

Cost breakdown (STPR)

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Capex	7,254	4,858	4,167	6,652	4,926	4,115	5,403	4,104	3,559	(£m)
Fixed opex	6,842	6,452	6,348	6,784	6,456	6,347	6,485	6,367	6,293	(£m)
Fixed operational carbon	233	223	219	231	221	220	216	209	205	(£m)
Embedded carbon	635	423	361	602	437	359	451	349	318	(£m)
Variable opex	1,325	764	519	1,183	774	521	896	594	352	(£m)
Variable carbon opex	164	70	40	134	66	41	93	40	20	(£m)



Emissions breakdown

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Capital emissions	4,063,385	2,590,399	2,176,191	3,826,117	2,669,899	2,165,614	2,828,853	2,112,622	1,901,815	(tonnes)
Operational emissions	2,118,082	1,450,845	1,279,772	1,918,402	1,417,911	1,290,727	1,557,675	1,181,092	1,064,074	(tonnes)

Electricity breakdown

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Generated (on site)	0	0	0	0	0	0	0	0	0	(GWh)
Grid	25,684	13,732	6,638	21,554	13,070	6,704	16,809	10,574	4,873	(GWh)
Renewable	1,986	1,436	600	1,921	1,458	626	1,347	785	162	(GWh)

Environmental

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
SEA environmental benefit	84,252.00	78,877.00	77,171.00	83,476.00	77,480.00	77,065.00	80,836.00	76,897.00	76,642.00	
SEA environmental disbenefit	122,674.00	90,711.00	82,025.00	112,972.00	88,106.00	80,826.00	103,672.00	81,489.00	72,999.00	
Natural capital	10,163,502.36	11,611,978.30	11,979,384.83	10,790,008.09	11,946,114.20	12,223,620.49	11,408,615.74	13,632,458.24	16,165,209.99	
Bio-diversity net gain	−260,076.00	−190,310.00	−185,348.00	−260,076.00	−223,408.00	−169,801.00	−202,077.00	−159,159.00	−148,418.00	

Social

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Customer preference	36,131.00	34,218.00	33,668.00	35,620.00	34,015.00	33,668.00	35,057.00	33,614.00	33,203.00	

Reliability

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Reliability	41.36	43.48	46.87	42.28	43.55	46.58	43.47	46.25	53.22	
R1: Uncertainty of option supply/demand benefit	12.80	13.22	14.24	13.12	13.35	14.19	13.25	13.82	16.00	
R3: Risk of service failure due to other physical hazards	10.83	11.43	12.41	11.05	11.44	12.34	11.40	12.25	14.26	
R4: Availability of additional headroom	6.61	7.01	7.19	6.61	6.93	7.12	7.00	7.42	7.92	
R5: Catchment/raw water quality risks (incl. climate change)	0.90	0.97	1.04	0.94	0.91	1.03	0.99	1.06	1.26	
R6: Capacity of catchment services	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	
R7: Risk of service failure to other exceptional events	10.18	10.83	11.96	10.52	10.89	11.87	10.81	11.67	13.76	
R8: Soil health	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

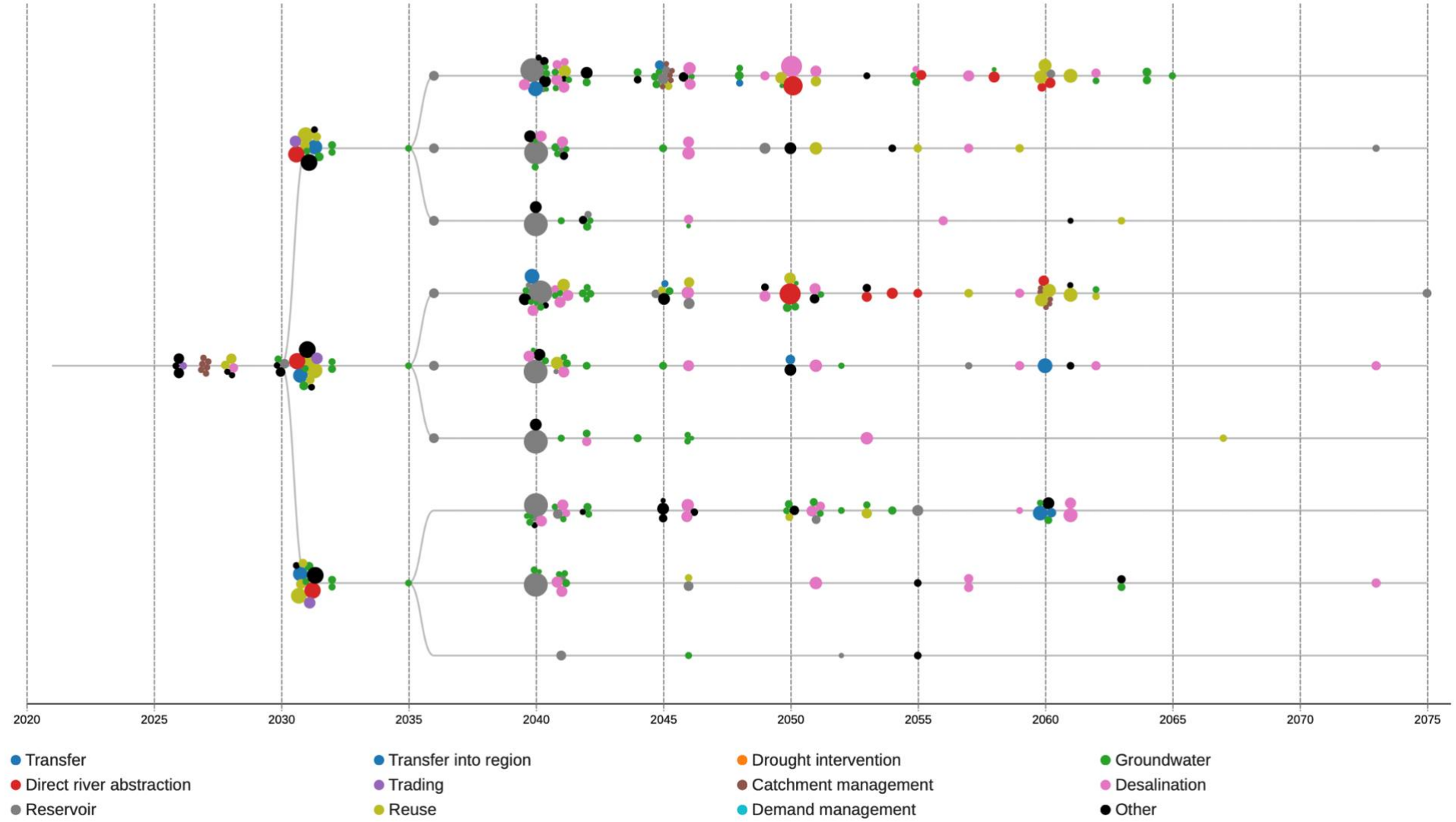
Adaptability

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Adaptability	19.76	21.63	24.09	20.60	21.77	23.84	21.59	23.58	27.64	
A3: Operational complexity and flexibility	10.15	10.90	12.01	10.48	10.92	11.94	10.84	11.74	13.86	
A4: WRZ connectivity	9.58	10.71	12.06	10.08	10.83	11.88	10.73	11.82	13.76	
A7: Customer relations support engagement with demand management	0.04	0.02	0.02	0.04	0.02	0.02	0.02	0.02	0.02	

Evolvablility

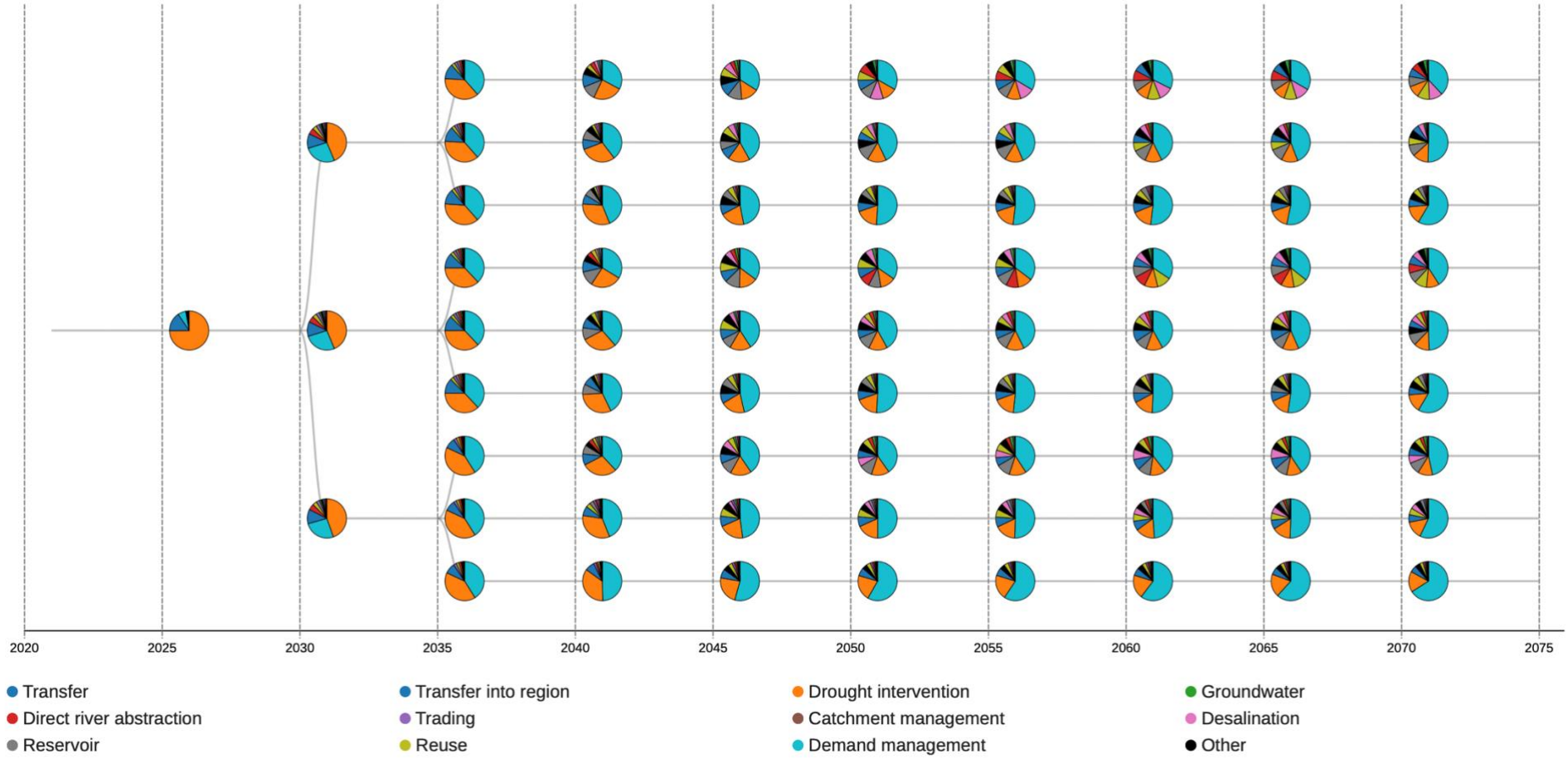
Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Evolvability	29.33	29.89	32.41	29.89	30.09	32.25	30.02	32.15	37.40	
E1: Scaleability and modularity of proposed changes	12.25	12.84	13.98	12.48	12.93	13.93	12.87	13.91	16.18	
E2: Intervention lead times	7.27	6.72	7.11	7.39	6.78	7.07	6.82	7.15	8.27	
E3: Reliance on external bodies to deliver changes	9.74	10.29	11.27	9.94	10.33	11.21	10.29	11.05	12.91	
E5: Collaborative land management	0.07	0.04	0.04	0.07	0.04	0.04	0.04	0.04	0.04	

Option Selection (Regional)

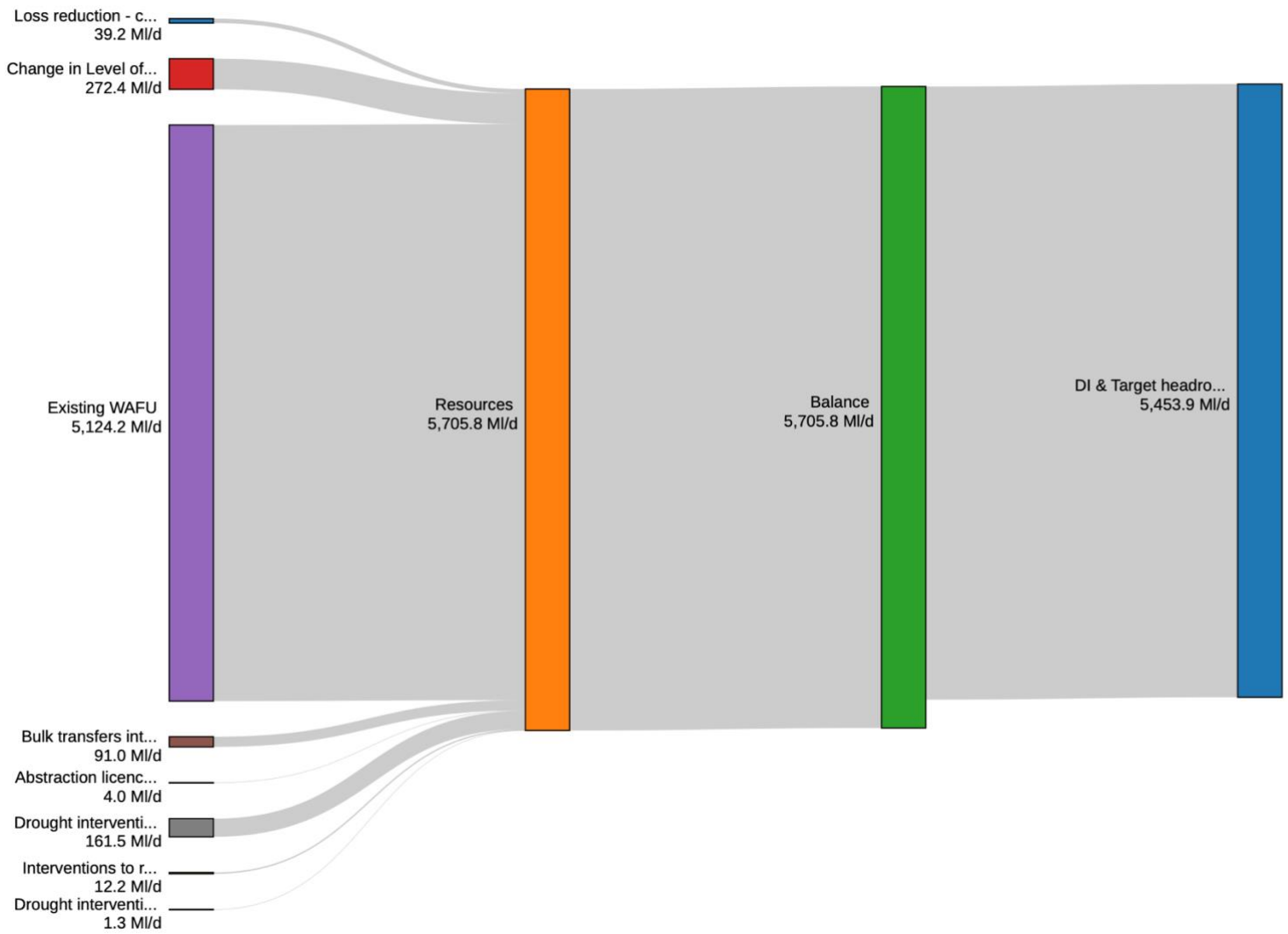


Utilisation (Regional)

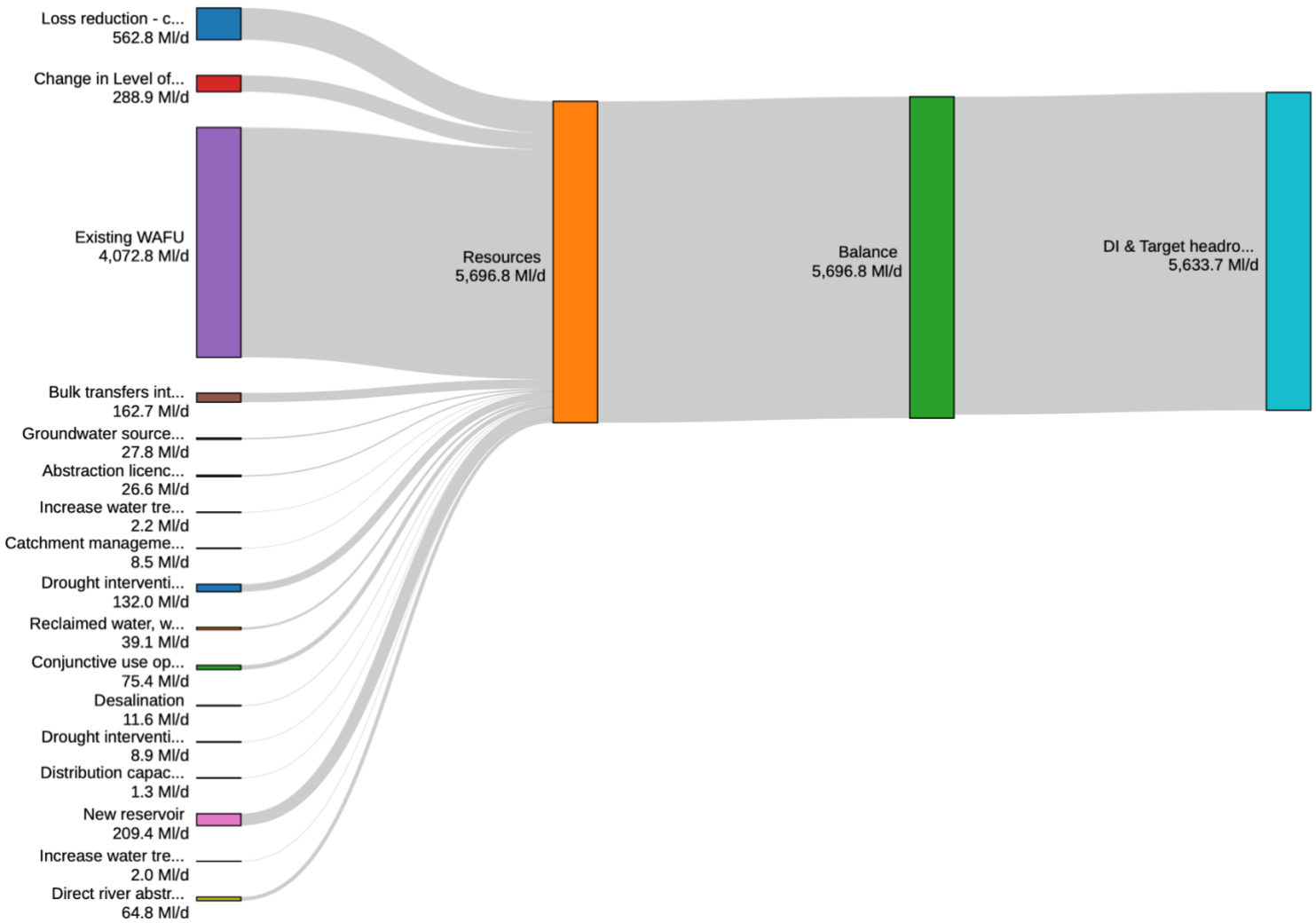
Pie charts show the breakdown of option utilisation by option category.



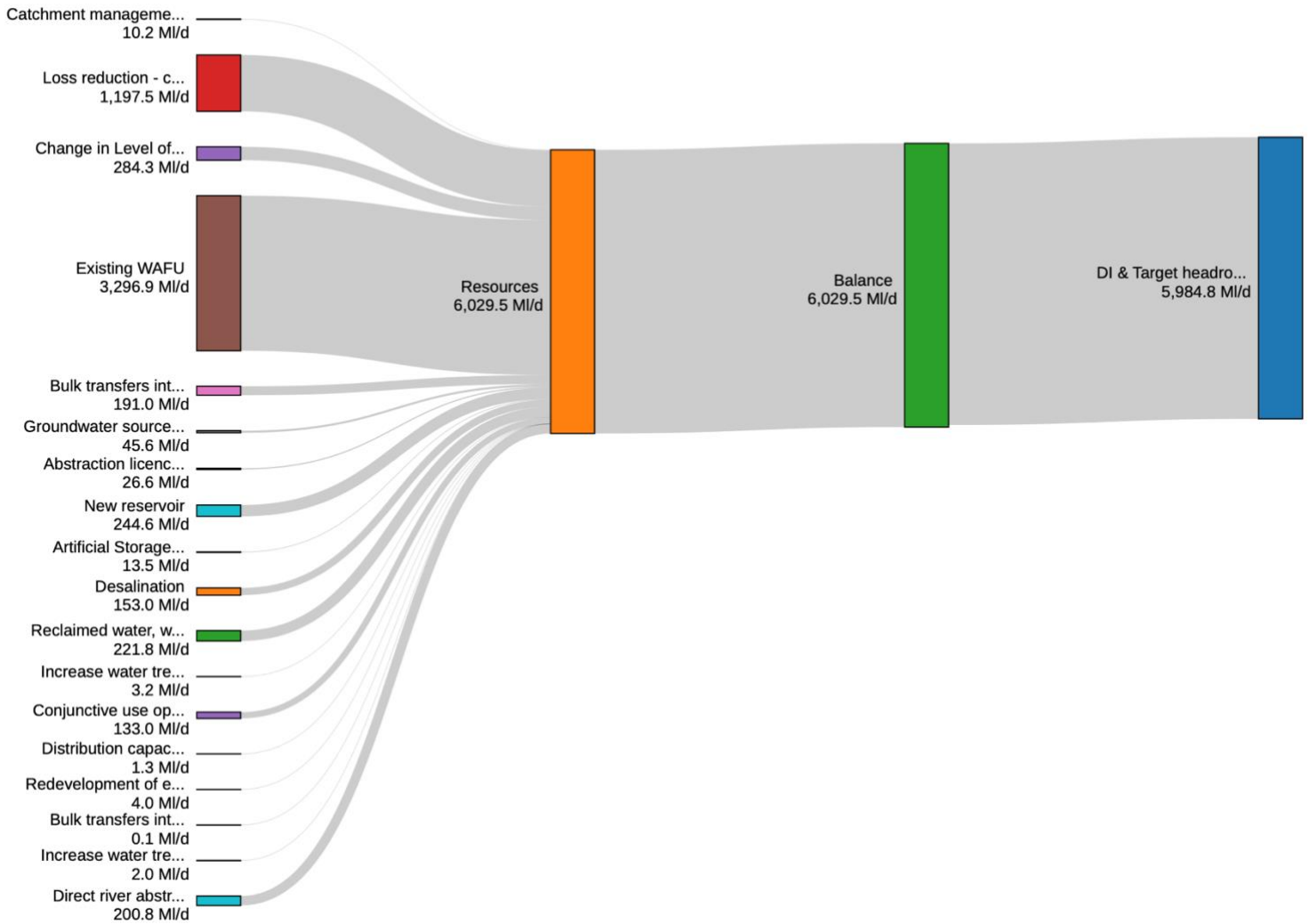
Situation 4 - 2026 (Regional)



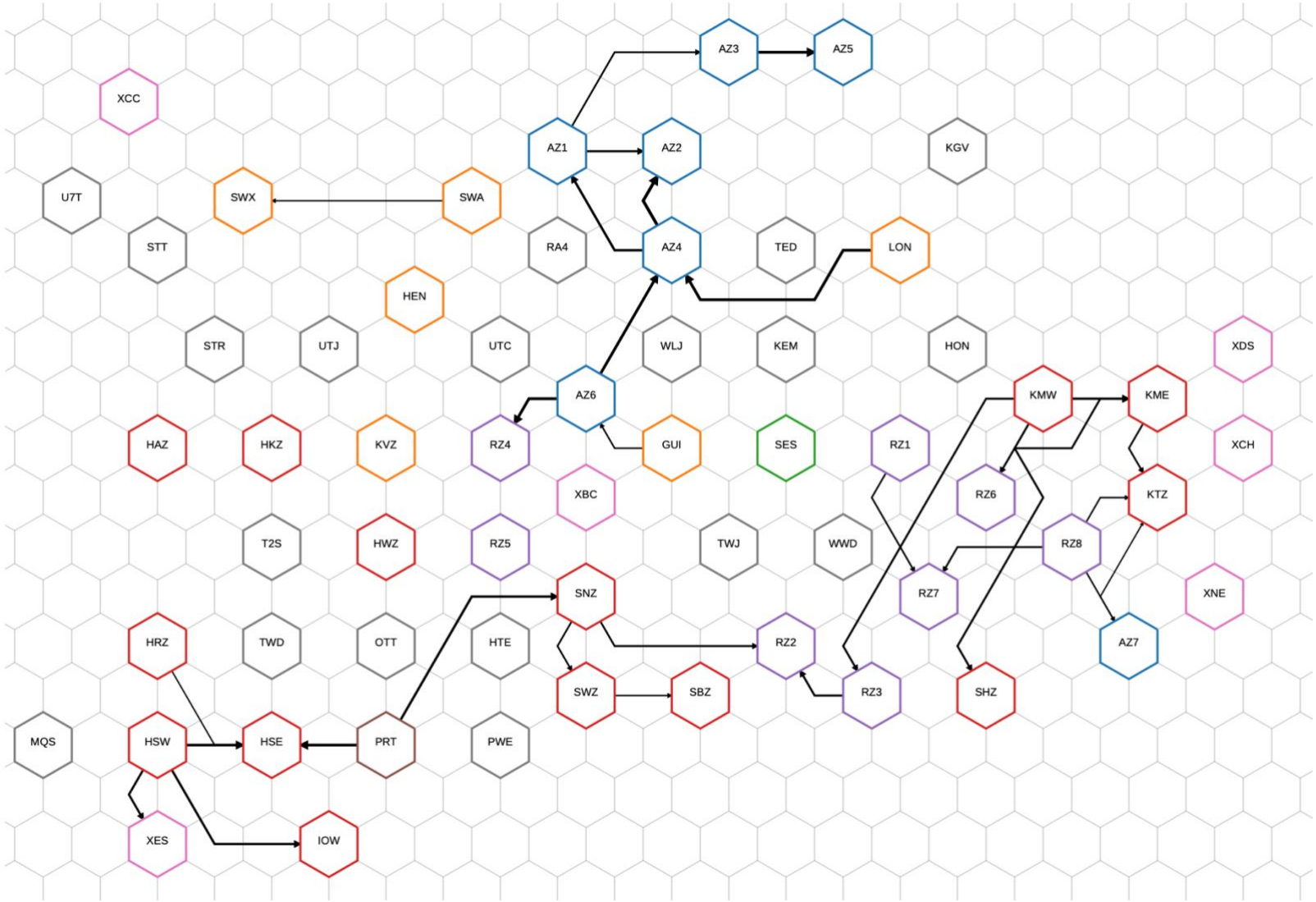
Situation 4 - 2040 (Regional)



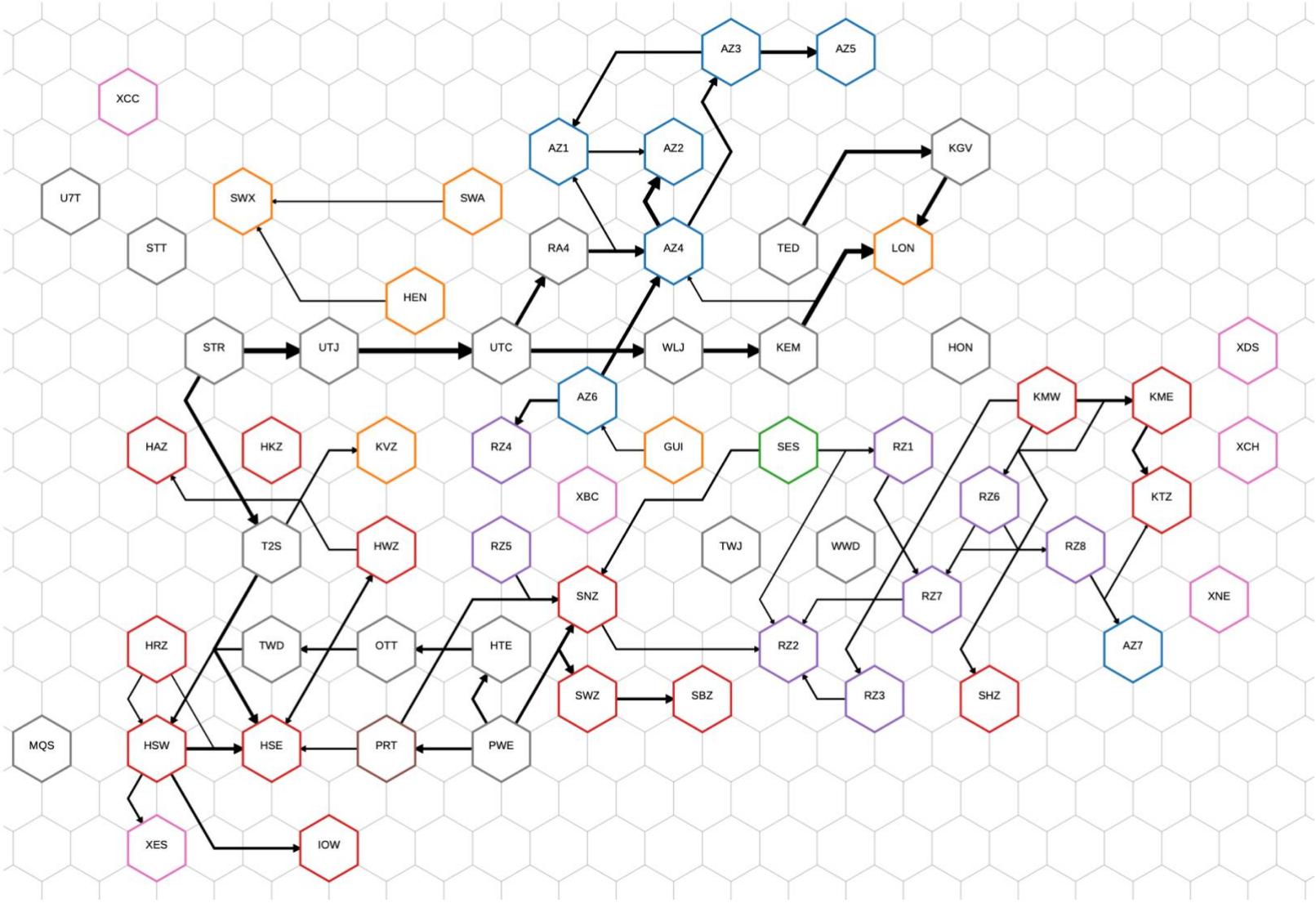
Situation 4 - 2075 (Regional)



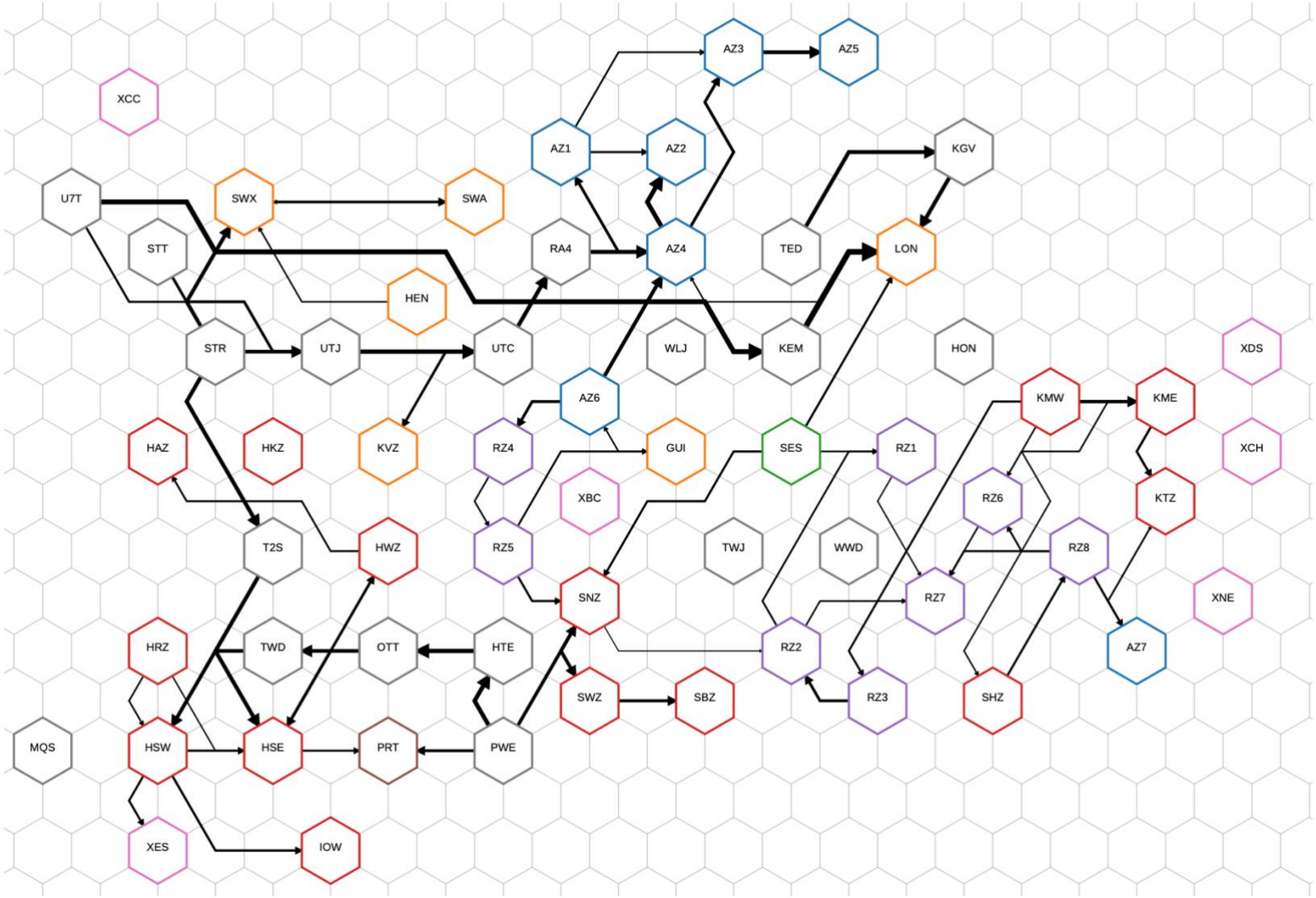
Situation 4 - 2026



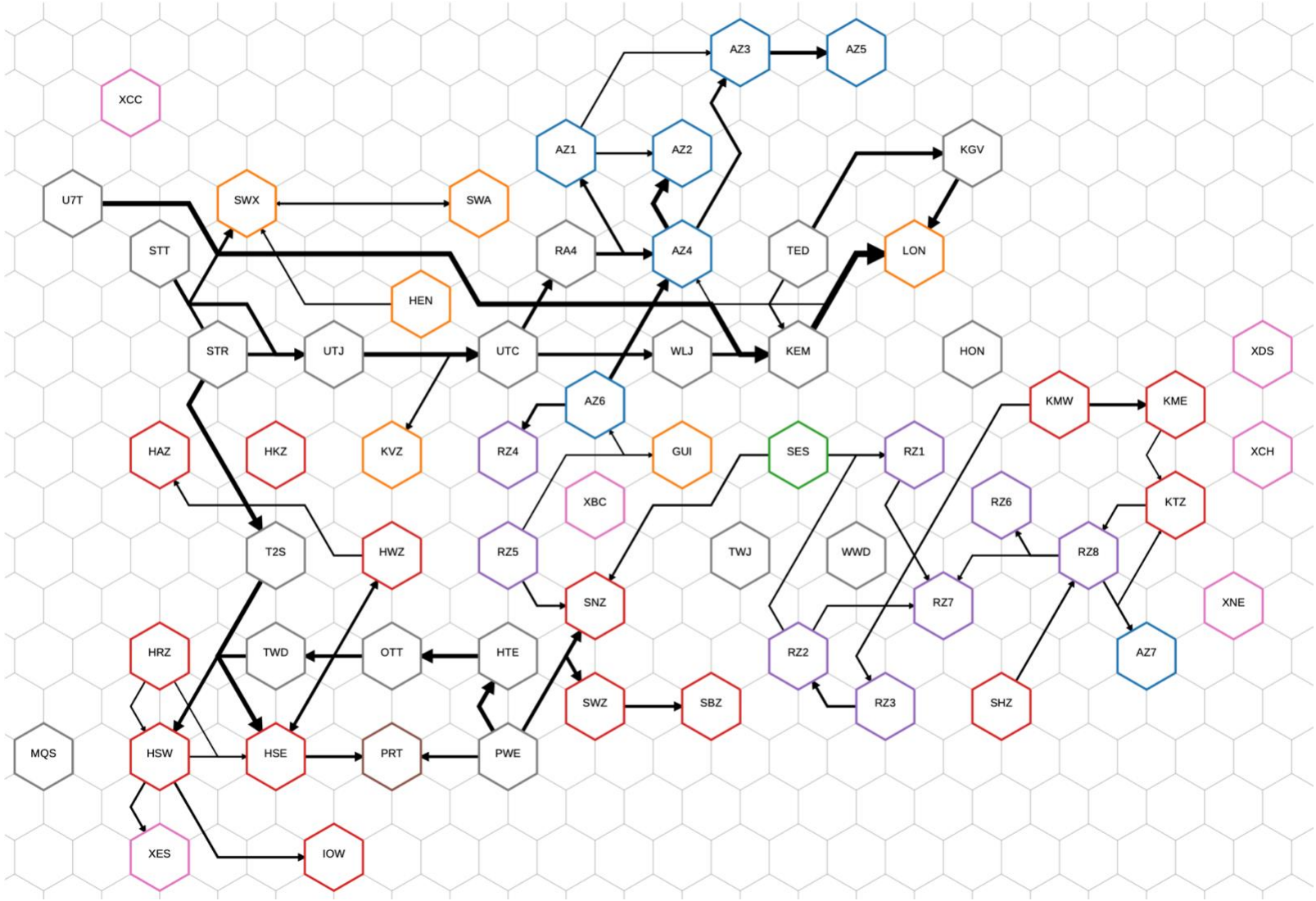
Situation 4 - 2040



Situation 4 - 2050



Situation 4 - 2075



Appendix 6: Least cost plan key model run information

The following tables and figures give comparable information including best value metrics and other key data and plan information for the least cost plan

Metrics

Net present value (Cost)

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Cost w/ deficit (STPR)	16,240	13,062	11,770	15,370	13,060	11,706	13,400	11,572	10,614	(£m)
Cost w/o deficit (STPR)	16,240	13,062	11,770	15,370	13,060	11,706	13,400	11,572	10,614	(£m)
Cost w/ deficit (IGEQ)	26,158	20,183	17,839	24,491	20,145	17,737	21,079	17,688	15,935	(£m)
Cost w/o deficit (IGEQ)	26,158	20,183	17,839	24,491	20,145	17,737	21,079	17,688	15,935	(£m)
Cost w/ deficit (LTDR)	18,121	14,431	12,943	17,106	14,424	12,872	14,866	12,751	11,645	(£m)
Cost w/o deficit (LTDR)	18,121	14,431	12,943	17,106	14,424	12,872	14,866	12,751	11,645	(£m)

Cost breakdown (STPR)

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Capex	7,095	5,124	4,253	6,485	5,120	4,192	5,222	3,999	3,421	(£m)
Fixed opex	6,848	6,477	6,379	6,785	6,476	6,377	6,521	6,386	6,311	(£m)
Fixed operational carbon	233	223	220	230	223	220	218	211	206	(£m)
Embedded carbon	642	435	369	591	428	364	444	350	311	(£m)
Variable opex	1,272	735	508	1,152	745	511	898	582	345	(£m)
Variable carbon opex	150	67	40	127	68	41	97	44	20	(£m)

Emissions breakdown

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Capital emissions	4,105,396	2,671,856	2,225,314	3,741,893	2,621,292	2,196,831	2,782,641	2,128,821	1,863,909	(tonnes)
Operational emissions	2,035,763	1,440,987	1,288,471	1,868,508	1,450,496	1,291,717	1,597,546	1,220,897	1,069,776	(tonnes)

Electricity breakdown

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Generated (on site)	0	0	0	0	0	0	0	0	0	(GWh)
Grid	24,348	12,936	6,554	20,565	12,880	6,909	16,700	10,564	4,727	(GWh)
Renewable	2,064	1,041	589	1,946	1,038	589	1,212	772	132	(GWh)

Environmental

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
SEA environmental benefit	86,220.00	79,709.00	78,217.00	84,475.00	79,727.00	78,071.00	81,584.00	77,143.00	75,842.00	
SEA environmental disbenefit	124,026.00	91,292.00	82,358.00	115,629.00	91,160.00	83,196.00	103,105.00	80,300.00	71,530.00	
Natural capital	7,278,532.71	7,887,030.52	8,533,578.93	7,494,194.78	8,557,242.02	8,544,439.94	11,380,568.54	14,765,373.55	16,048,010.36	
Bio-diversity net gain	−262,703.00	−143,687.00	−132,152.00	−258,496.00	−144,728.00	−129,938.00	−202,457.00	−167,965.00	−145,901.00	

Social

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Customer preference	32,870.00	30,760.00	30,204.00	32,452.00	30,876.00	30,268.00	31,729.00	29,968.00	29,372.00	

Reliability

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Reliability	38.21	40.30	42.37	38.42	40.03	42.02	37.92	39.39	45.07	
R1: Uncertainty of option supply/demand benefit	11.07	11.41	11.85	11.09	11.38	11.74	10.83	10.88	12.47	
R3: Risk of service failure due to other physical hazards	9.92	10.57	11.17	9.94	10.49	11.09	9.85	10.37	12.03	
R4: Availability of additional headroom	6.65	7.11	7.29	6.69	7.03	7.22	7.00	7.37	7.88	
R5: Catchment/raw water quality risks (incl. climate change)	1.05	1.12	1.21	1.12	1.07	1.21	0.81	0.83	1.01	
R6: Capacity of catchment services	0.05	0.02	0.02	0.03	0.03	0.02	0.03	0.02	0.02	
R7: Risk of service failure to other exceptional events	9.44	10.08	10.82	9.53	10.02	10.74	9.38	9.91	11.66	
R8: Soil health	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

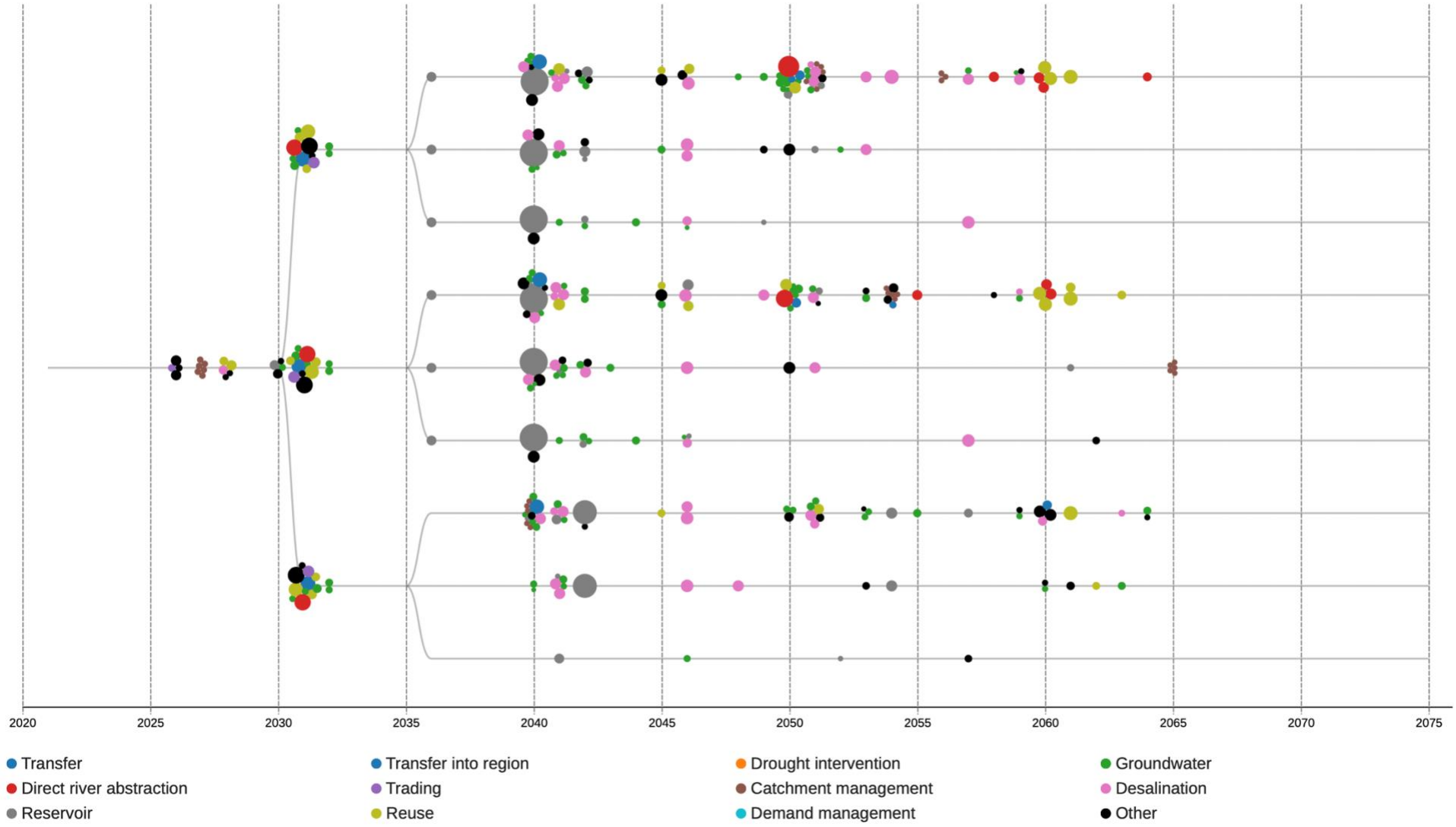
Adaptability

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Adaptability	18.67	21.20	22.66	19.05	21.16	22.26	19.92	21.52	25.11	
A3: Operational complexity and flexibility	9.24	9.99	10.72	9.31	9.91	10.64	9.24	9.79	11.55	
A4: WRZ connectivity	9.38	11.20	11.92	9.70	11.20	11.60	10.63	11.71	13.54	
A7: Customer relations support engagement with demand management	0.05	0.02	0.02	0.04	0.04	0.02	0.04	0.02	0.02	

Evolvablility

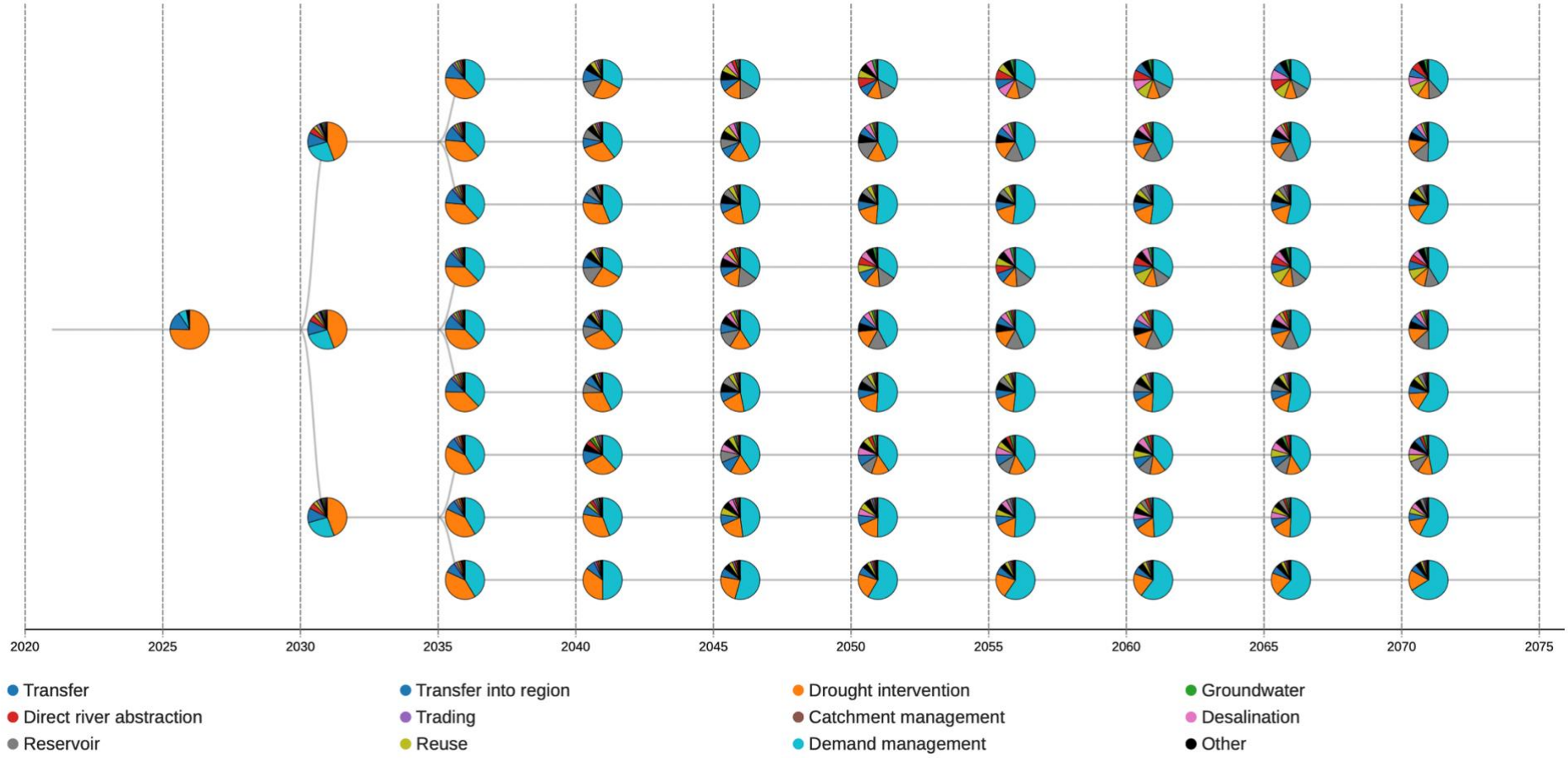
Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Evolvability	27.17	27.69	29.42	26.87	27.63	29.22	27.32	28.70	33.31	
E1: Scaleability and modularity of proposed changes	10.94	11.50	12.29	10.91	11.46	12.20	11.52	12.24	14.18	
E2: Intervention lead times	7.43	6.91	7.29	7.19	6.89	7.25	6.98	7.21	8.36	
E3: Reliance on external bodies to deliver changes	8.69	9.23	9.81	8.70	9.20	9.73	8.75	9.21	10.73	
E5: Collaborative land management	0.10	0.04	0.04	0.07	0.07	0.04	0.07	0.04	0.04	

Option Selection (Regional)

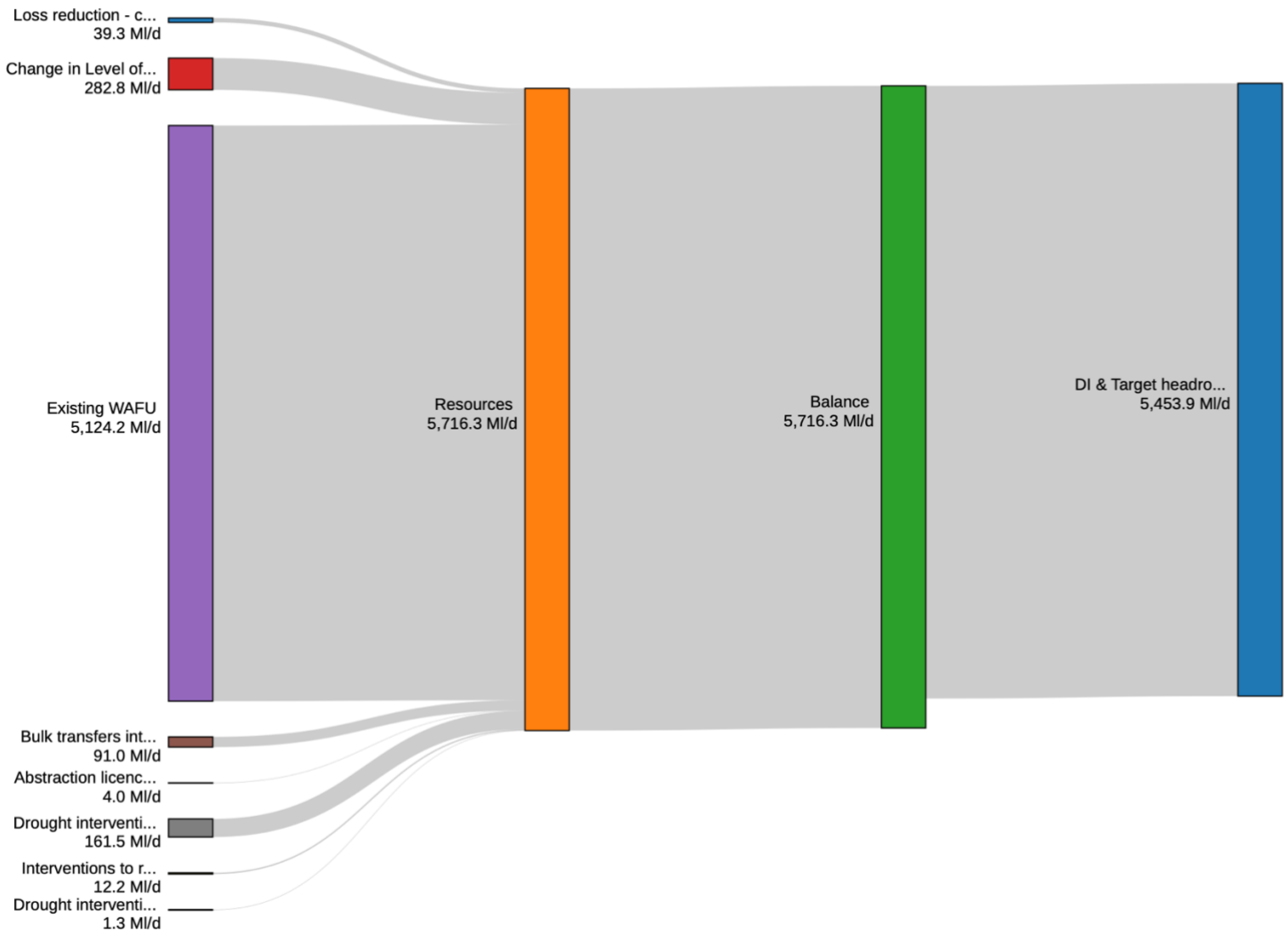


Utilisation (Regional)

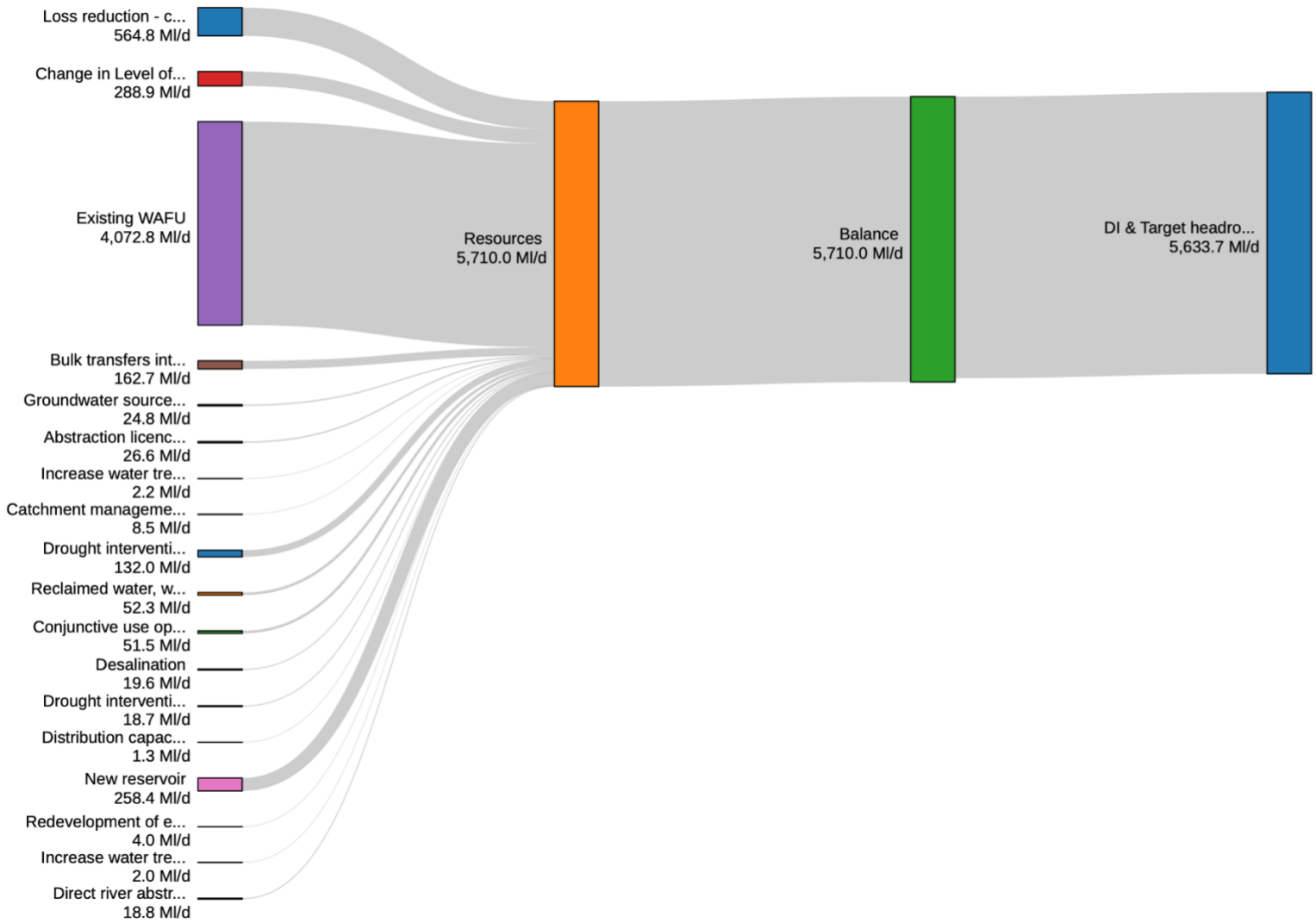
Pie charts show the breakdown of option utilisation by option category.



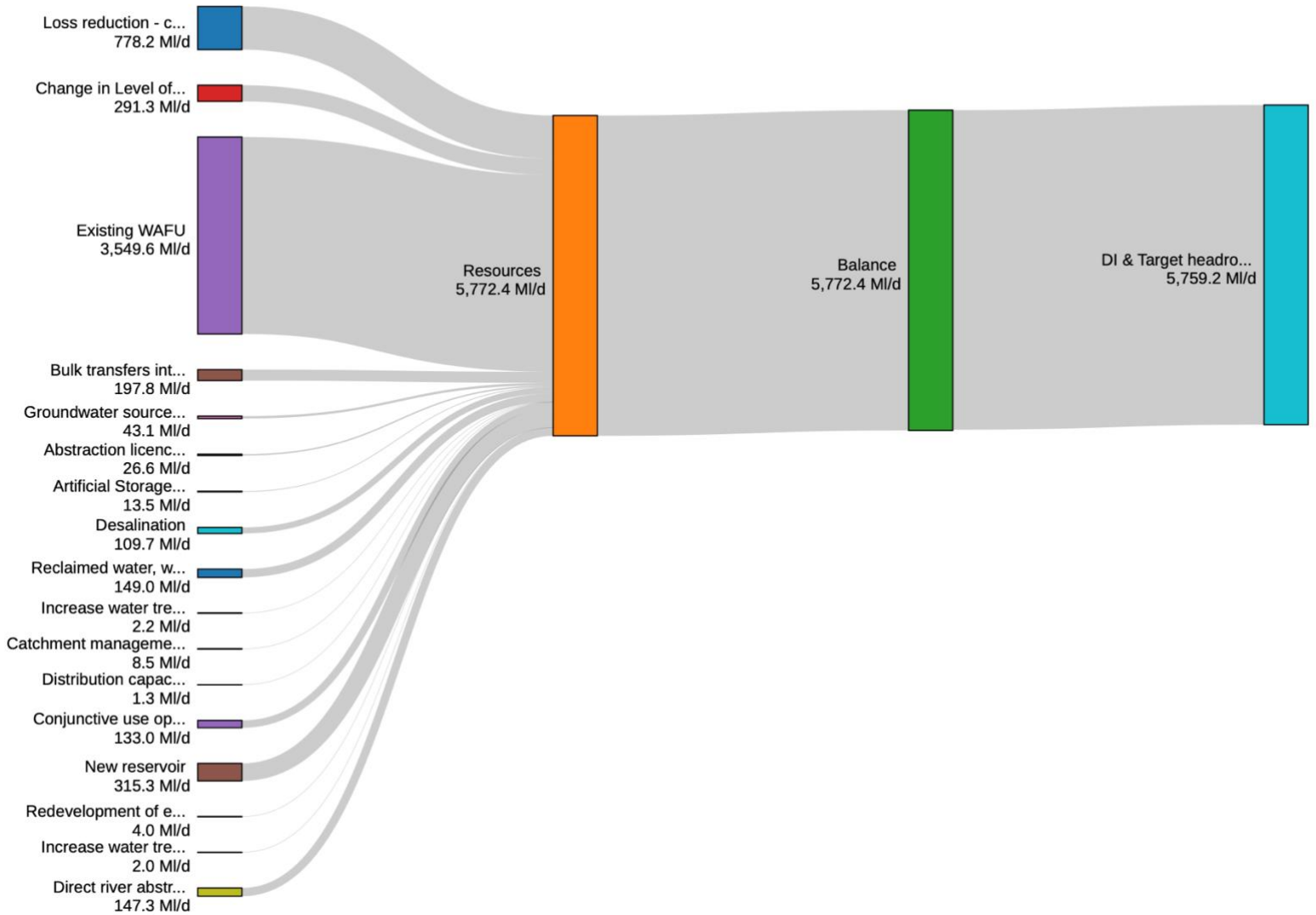
Situation 4 - 2026 (Regional)



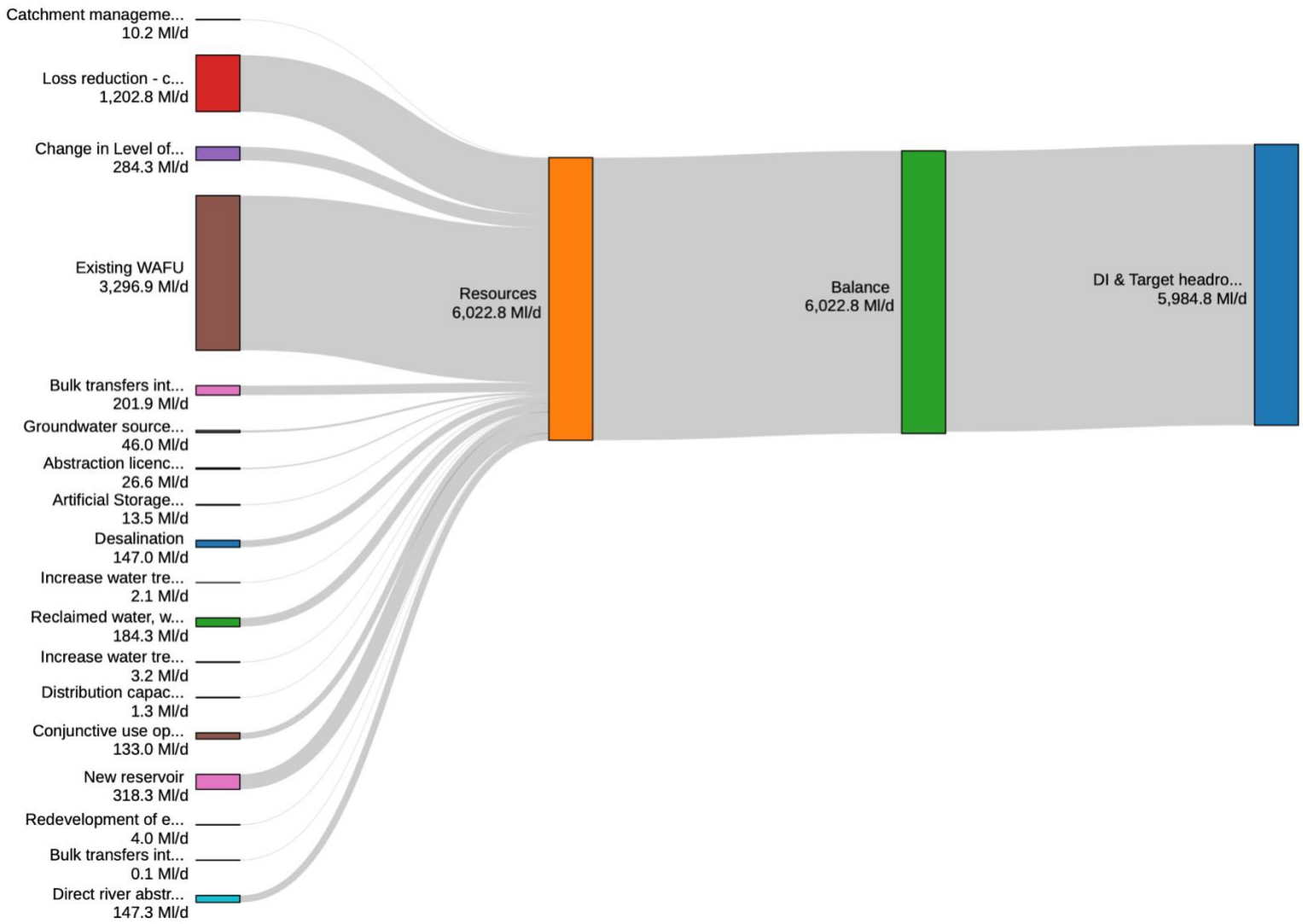
Situation 4 - 2040 (Regional)



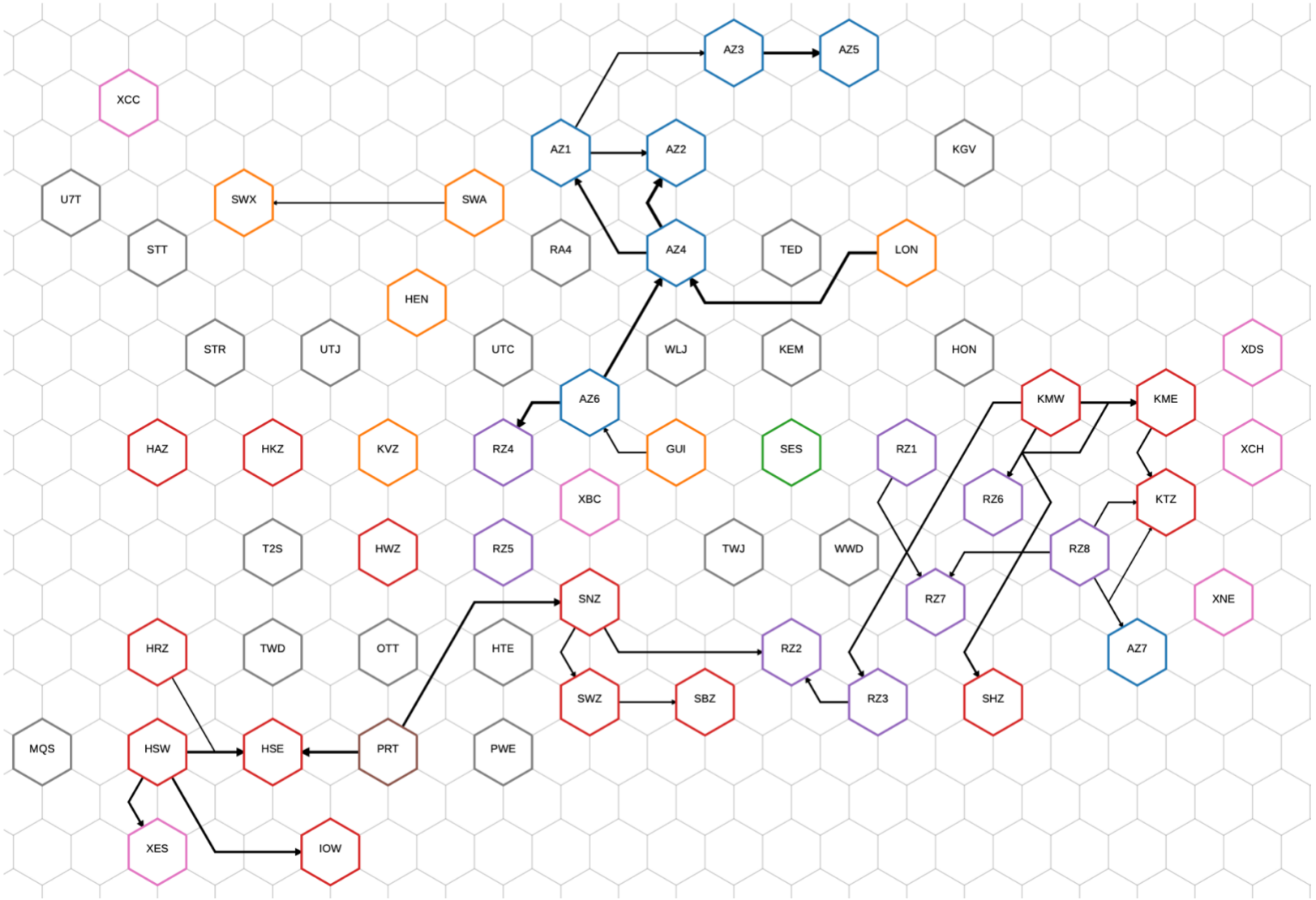
Situation 4 - 2050 (Regional)



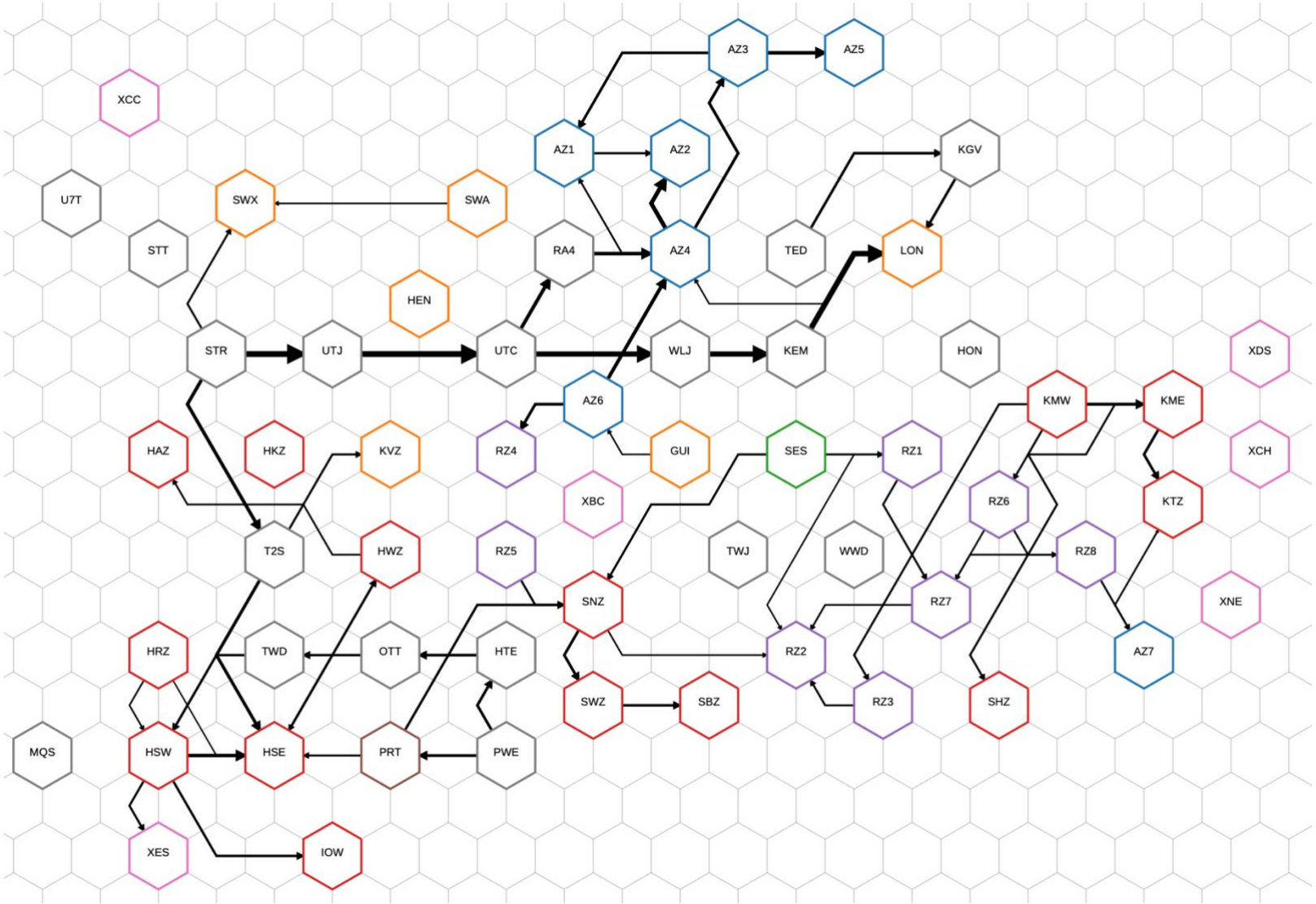
Situation 4 - 2075 (Regional)



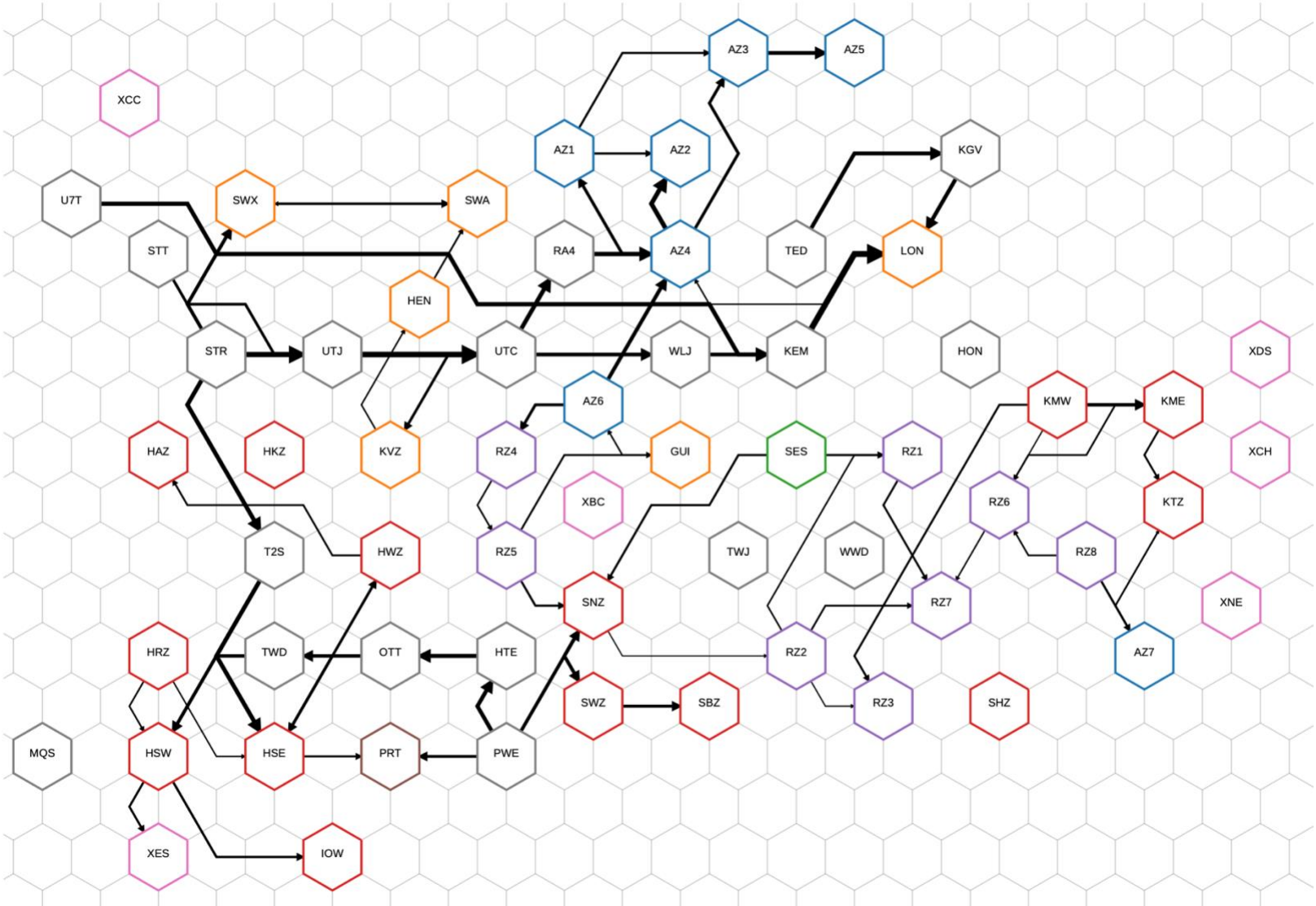
Situation 4 - 2026



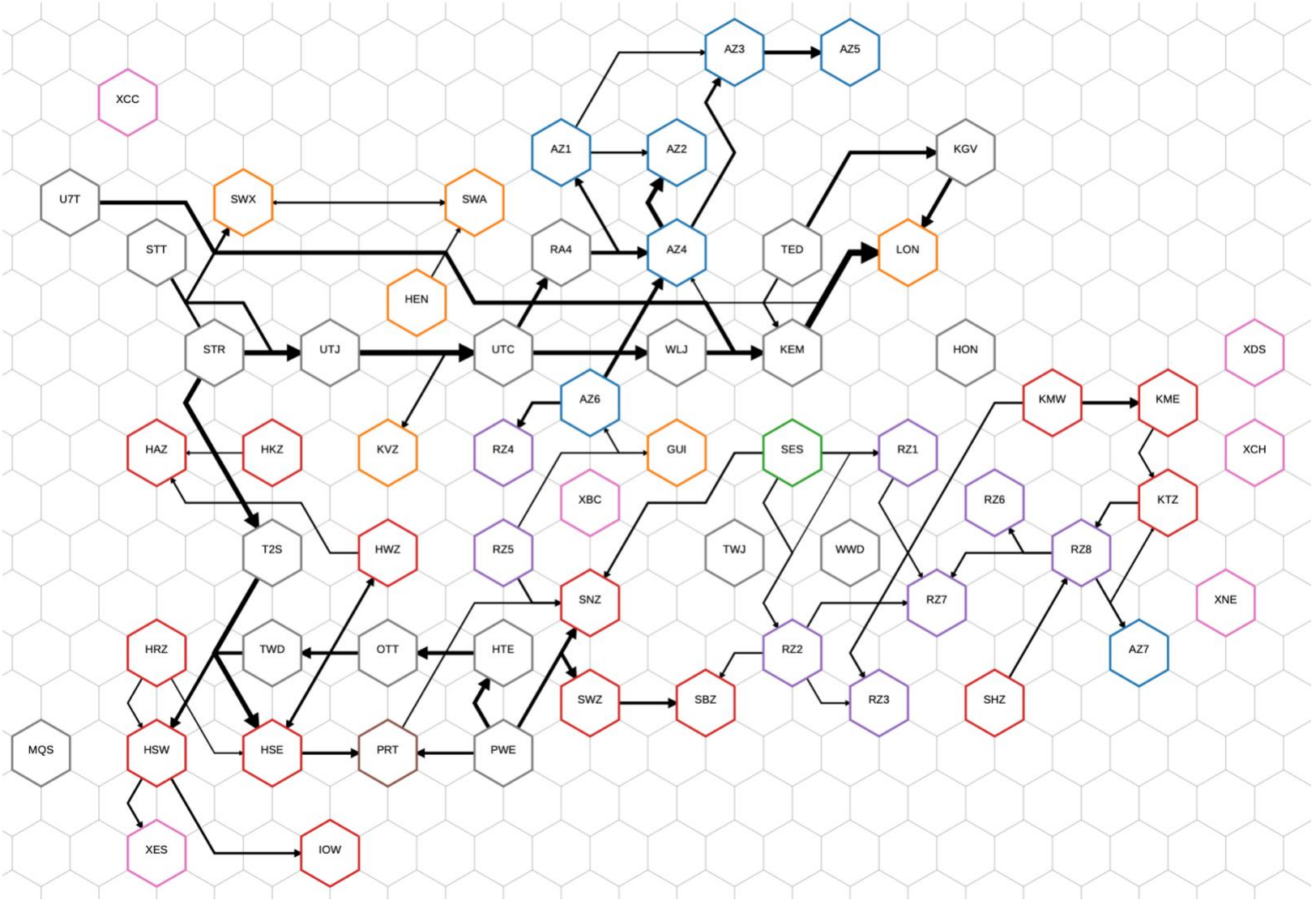
Situation 4 - 2040



Situation 4 - 2050



Situation 4 - 2075



Appendix 7: Best environmental and societal plan key model run information

The following tables and figures give comparable information including best value metrics and other key data and plan information for the best environmental and societal plan

Metrics

Net present value (Cost)

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Cost w/ deficit (STPR)	16,210	13,048	11,730	15,398	12,993	11,717	13,407	11,594	10,614	(£m)
Cost w/o deficit (STPR)	16,210	13,048	11,730	15,398	12,993	11,717	13,407	11,594	10,614	(£m)
Cost w/ deficit (IGEQ)	26,103	20,130	17,772	24,562	20,046	17,748	21,087	17,735	15,935	(£m)
Cost w/o deficit (IGEQ)	26,103	20,130	17,772	24,562	20,046	17,748	21,087	17,735	15,935	(£m)
Cost w/ deficit (LTDR)	18,086	14,410	12,898	17,141	14,350	12,883	14,874	12,777	11,645	(£m)
Cost w/o deficit (LTDR)	18,086	14,410	12,898	17,141	14,350	12,883	14,874	12,777	11,645	(£m)

Cost breakdown (STPR)

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Capex	7,058	5,119	4,215	6,519	5,059	4,199	5,221	4,013	3,420	(£m)
Fixed opex	6,871	6,469	6,376	6,787	6,472	6,382	6,521	6,390	6,311	(£m)
Fixed operational carbon	233	223	219	232	225	220	217	211	206	(£m)
Embedded carbon	631	428	366	580	424	362	449	344	311	(£m)
Variable opex	1,268	741	513	1,150	745	515	903	591	345	(£m)
Variable carbon opex	149	67	40	129	68	40	95	45	20	(£m)

Emissions breakdown

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Capital emissions	4,034,367	2,622,749	2,207,619	3,687,535	2,597,435	2,184,881	2,816,168	2,084,410	1,863,597	(tonnes)
Operational emissions	2,020,833	1,443,941	1,280,550	1,889,533	1,462,127	1,278,182	1,582,840	1,225,596	1,069,550	(tonnes)

Electricity breakdown

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Generated (on site)	0	0	0	0	0	0	0	0	0	(GWh)
Grid	24,616	12,475	6,815	21,028	12,873	7,156	16,634	10,890	4,727	(GWh)
Renewable	2,021	1,038	527	1,768	1,058	456	1,330	773	132	(GWh)

Environmental

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
SEA environmental benefit	85,993.00	78,561.00	79,222.00	84,103.00	80,114.00	78,593.00	81,403.00	76,981.00	76,668.00	
SEA environmental disbenefit	122,594.00	87,922.00	83,482.00	115,980.00	89,745.00	81,152.00	102,862.00	78,112.00	70,090.00	
Natural capital	8,404,628.35	9,447,628.43	12,042,429.64	7,681,916.61	8,712,554.18	8,582,430.71	12,054,448.12	15,174,590.48	16,048,010.36	
Bio-diversity net gain	−235,231.00	−147,489.00	−131,154.00	−240,648.00	−133,929.00	−123,858.00	−223,096.00	−169,691.00	−145,901.00	

Social

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Customer preference	35,831.00	33,445.00	33,423.00	35,365.00	33,774.00	33,217.00	34,662.00	32,843.00	32,445.00	

Reliability

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Reliability	41.32	43.91	46.79	41.71	43.94	46.57	41.86	44.13	50.81	
R1: Uncertainty of option supply/demand benefit	12.54	13.09	13.83	12.64	13.16	13.78	12.65	13.09	15.08	
R3: Risk of service failure due to other physical hazards	10.78	11.54	12.38	10.87	11.56	12.34	10.92	11.67	13.59	
R4: Availability of additional headroom	6.64	7.09	7.29	6.68	7.02	7.23	7.00	7.37	7.87	
R5: Catchment/raw water quality risks (incl. climate change)	0.99	1.10	1.21	1.05	1.07	1.21	0.80	0.79	1.01	
R6: Capacity of catchment services	0.05	0.02	0.02	0.03	0.02	0.02	0.03	0.02	0.02	
R7: Risk of service failure to other exceptional events	10.30	11.07	12.04	10.42	11.10	11.99	10.45	11.18	13.23	
R8: Soil health	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

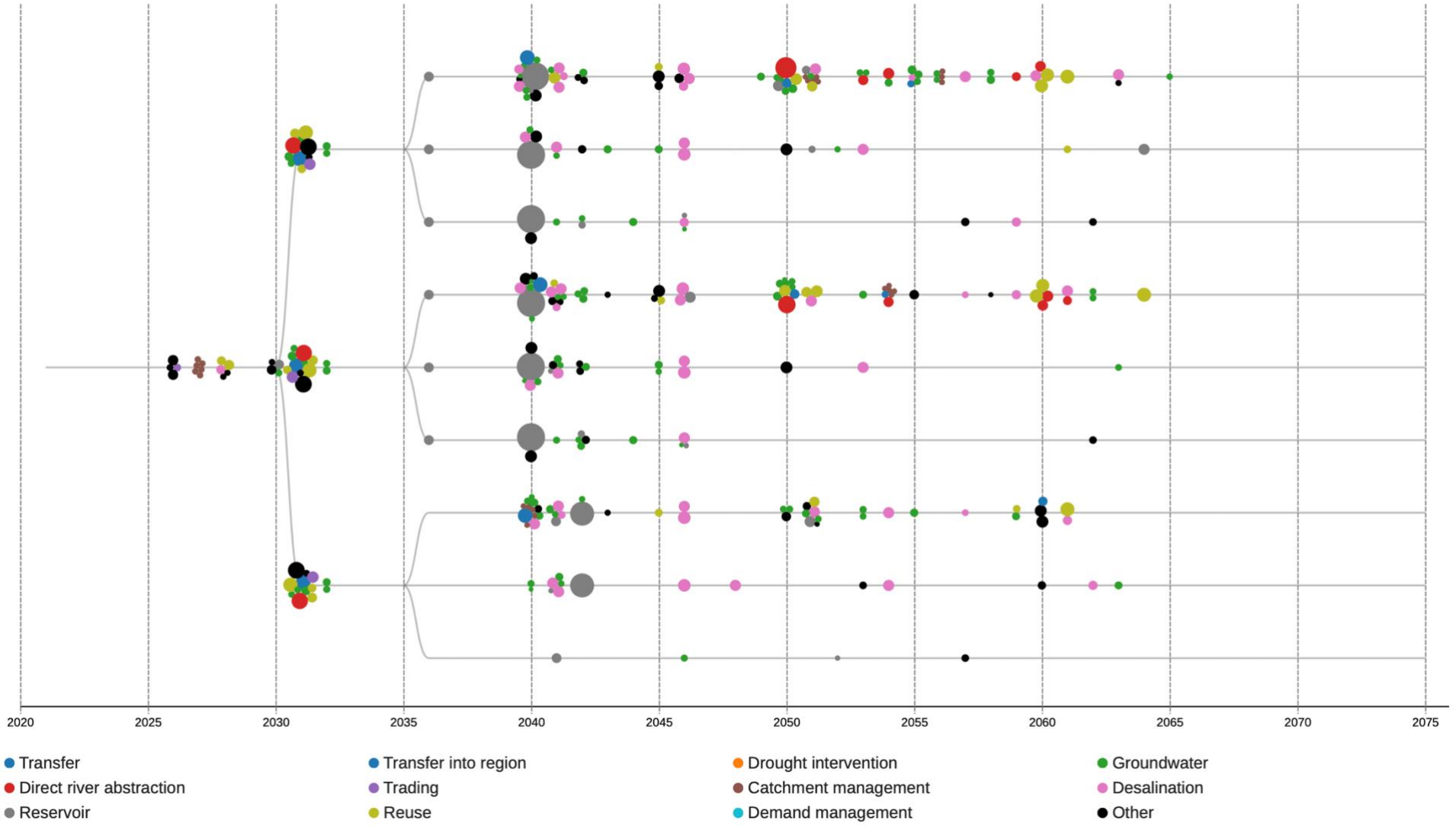
Adaptability

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Adaptability	19.61	22.13	23.72	20.01	22.24	23.55	21.10	22.85	26.77	
A3: Operational complexity and flexibility	10.13	10.96	11.93	10.24	10.99	11.87	10.31	11.05	13.11	
A4: WRZ connectivity	9.43	11.15	11.77	9.74	11.24	11.66	10.75	11.79	13.63	
A7: Customer relations support engagement with demand management	0.05	0.02	0.02	0.04	0.02	0.02	0.04	0.02	0.02	

Evolvablility

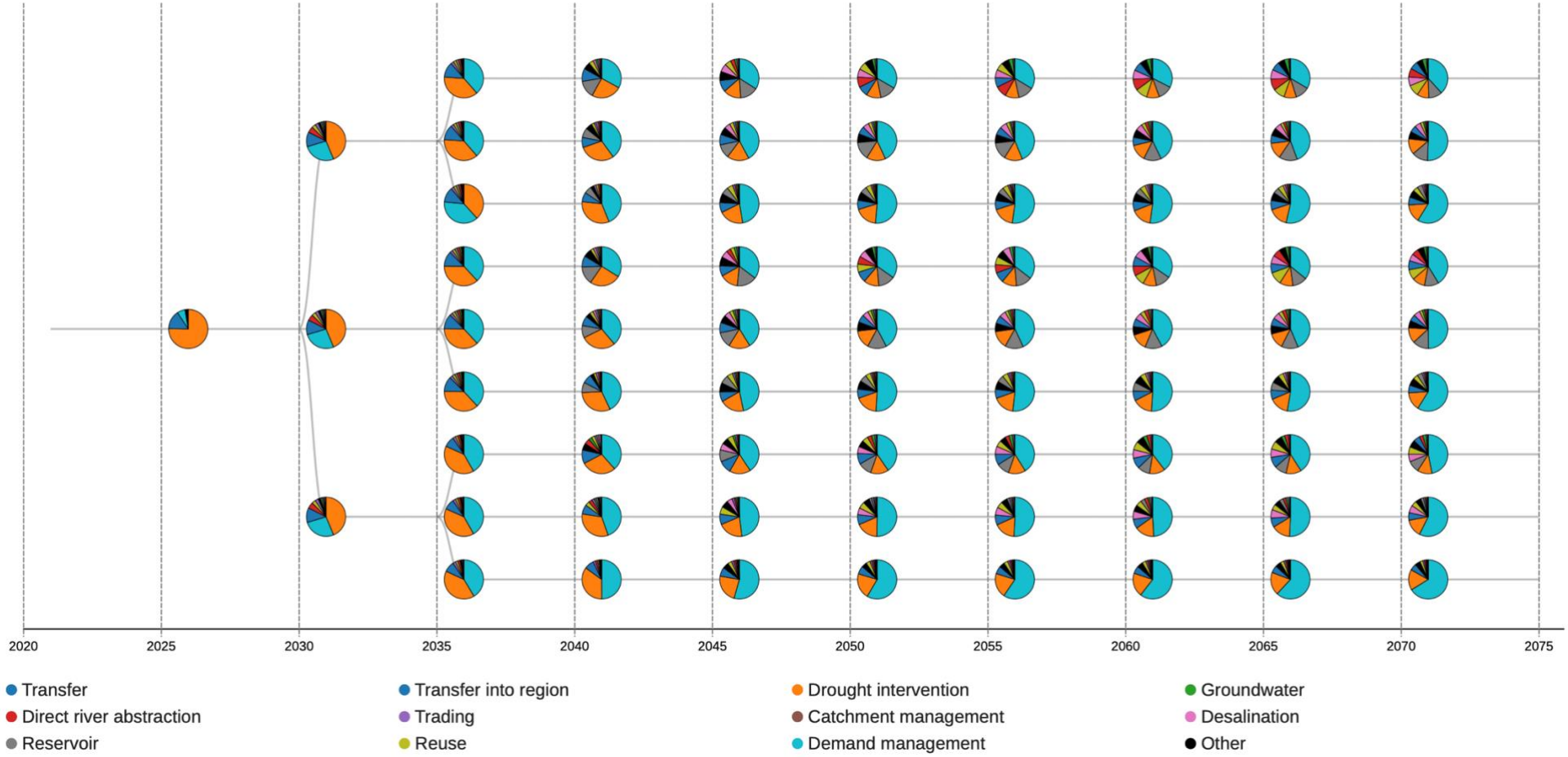
Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Evolvability	28.97	29.66	31.82	28.72	29.73	31.69	29.48	31.37	36.44	
E1: Scaleability and modularity of proposed changes	11.83	12.51	13.47	11.85	12.53	13.42	12.62	13.58	15.75	
E2: Intervention lead times	7.51	6.88	7.30	7.21	6.88	7.27	6.96	7.24	8.36	
E3: Reliance on external bodies to deliver changes	9.53	10.23	11.01	9.60	10.28	10.96	9.83	10.52	12.30	
E5: Collaborative land management	0.10	0.04	0.04	0.07	0.04	0.04	0.07	0.04	0.04	

Option Selection (Regional)

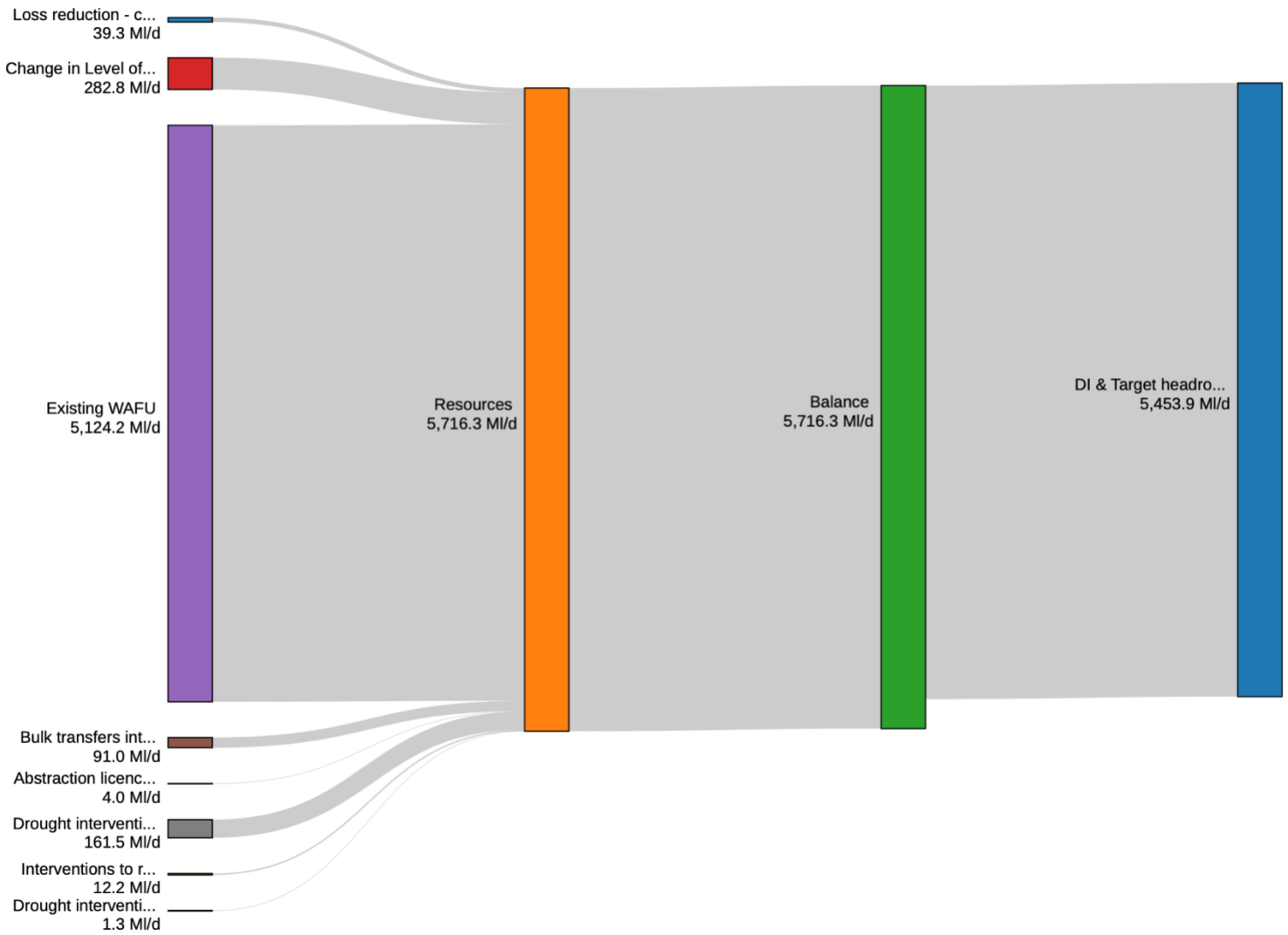


Utilisation (Regional)

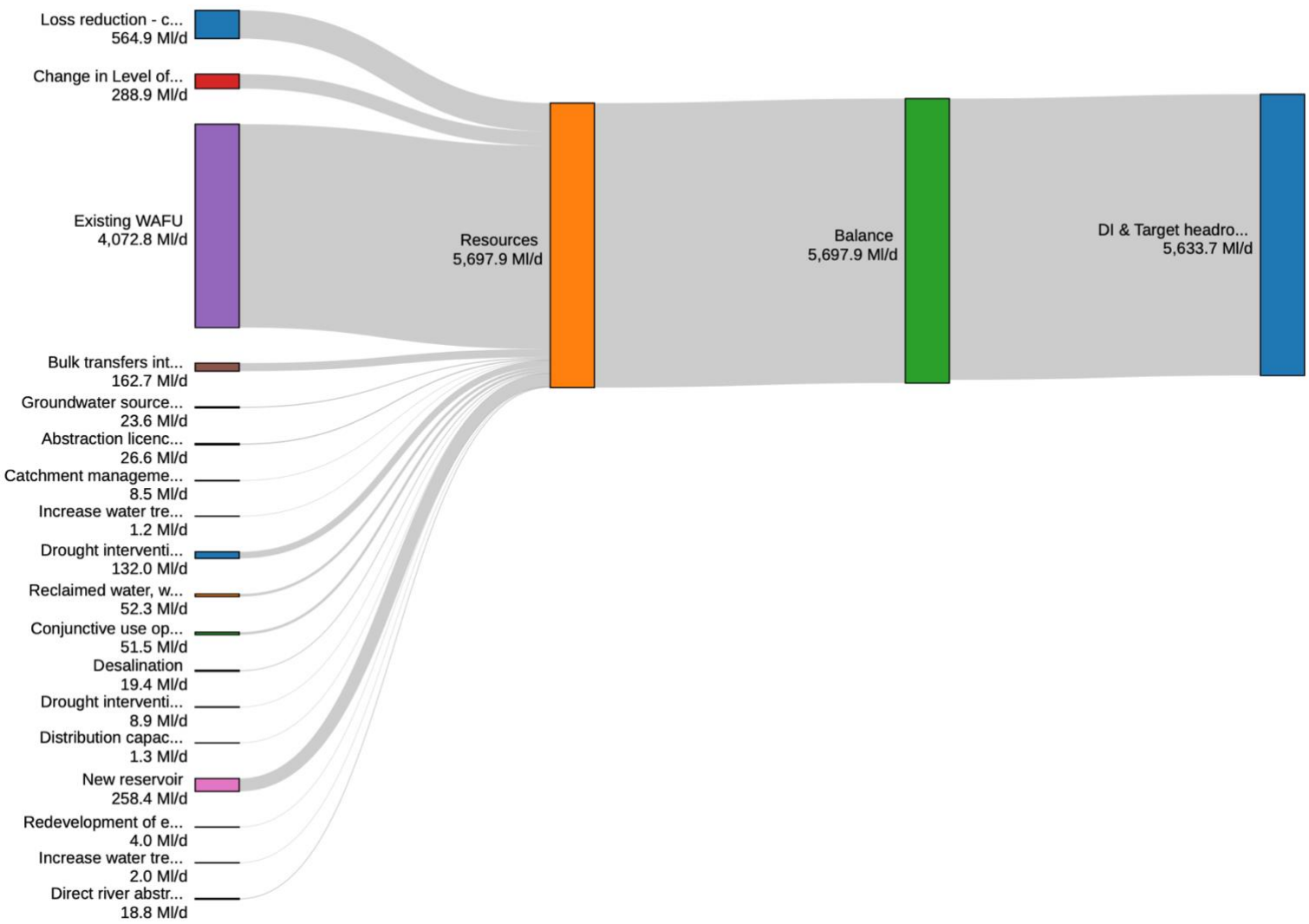
Pie charts show the breakdown of option utilisation by option category.



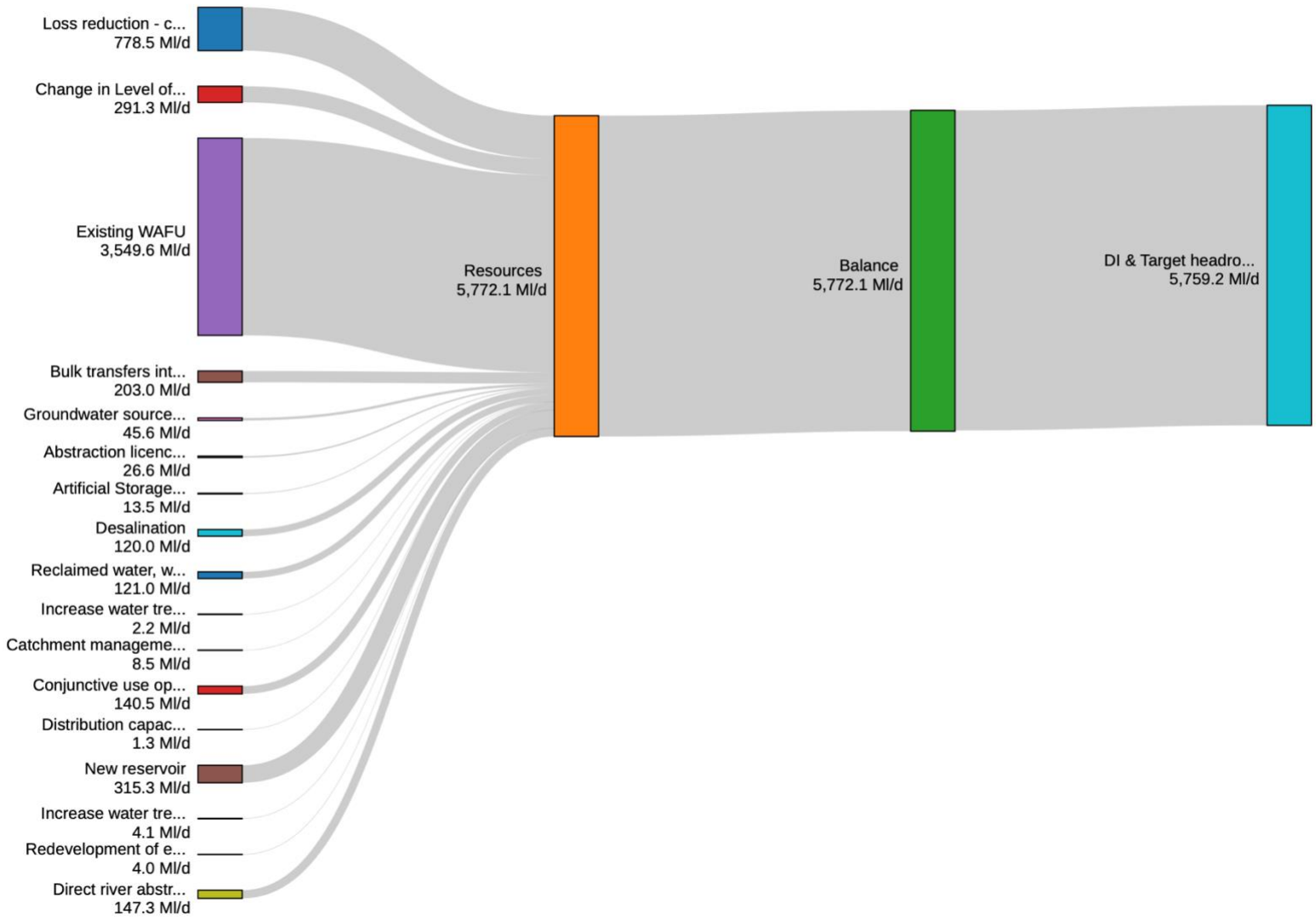
Situation 4 - 2026 (Regional)



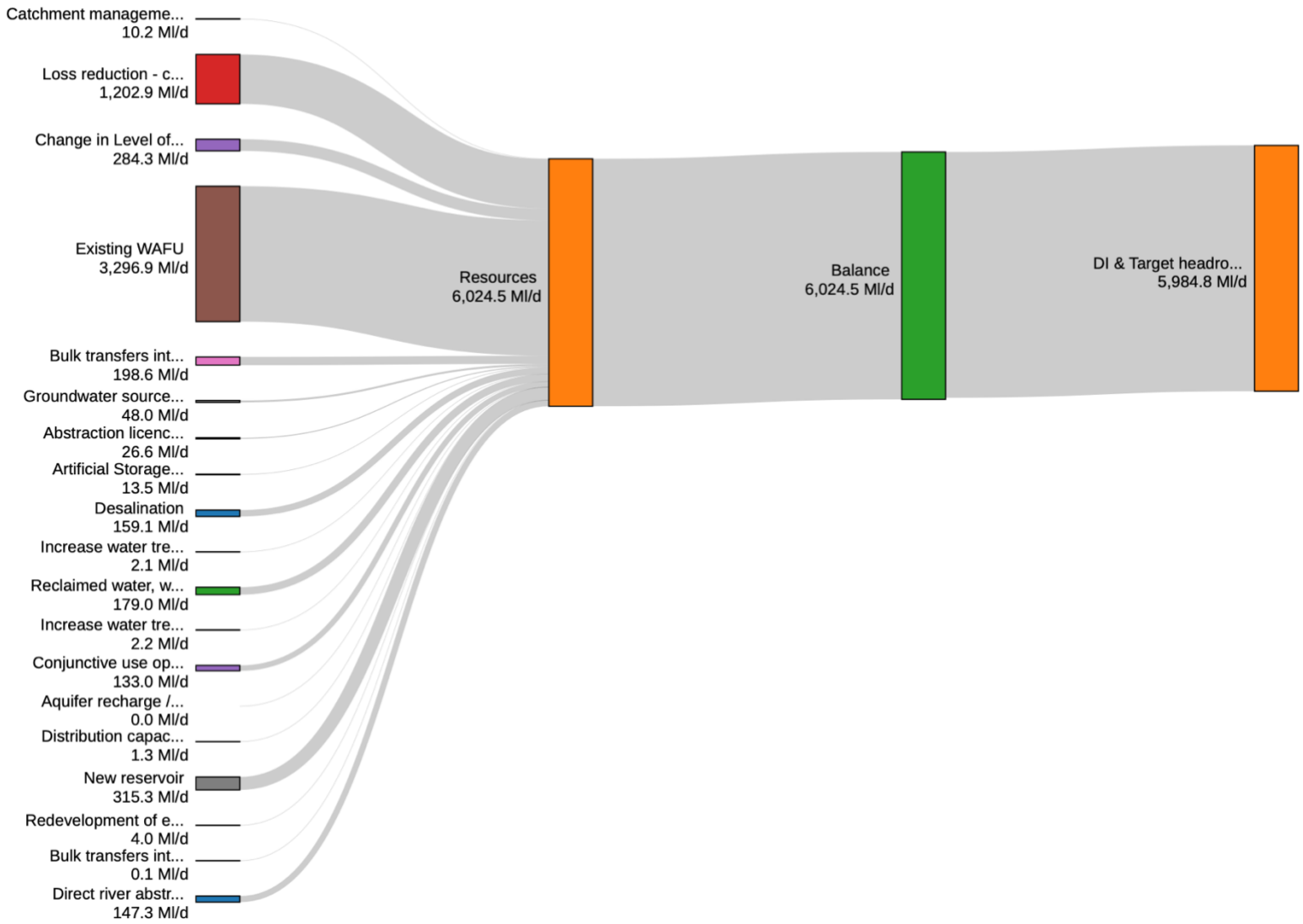
Situation 4 - 2040 (Regional)



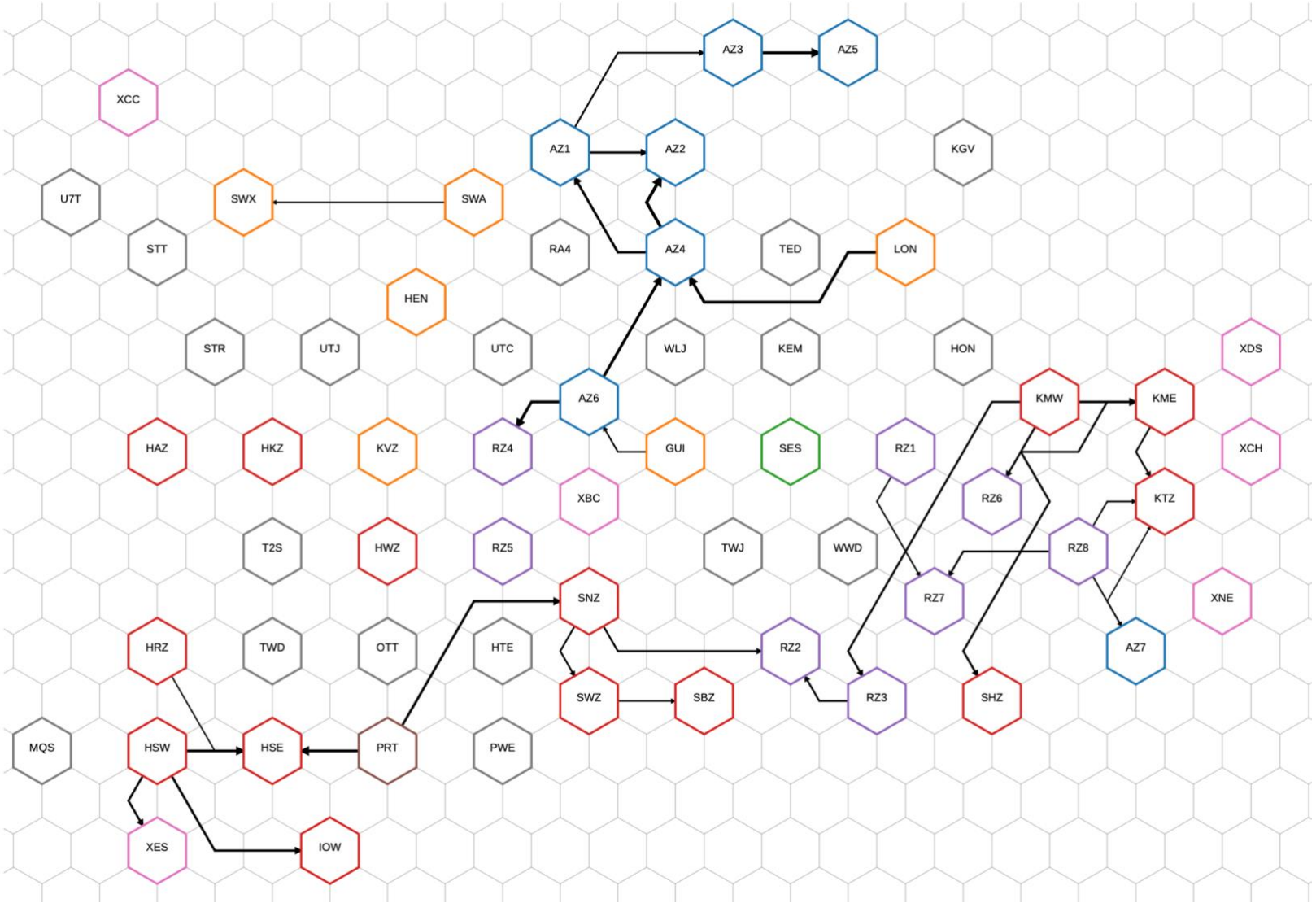
Situation 4 - 2050 (Regional)



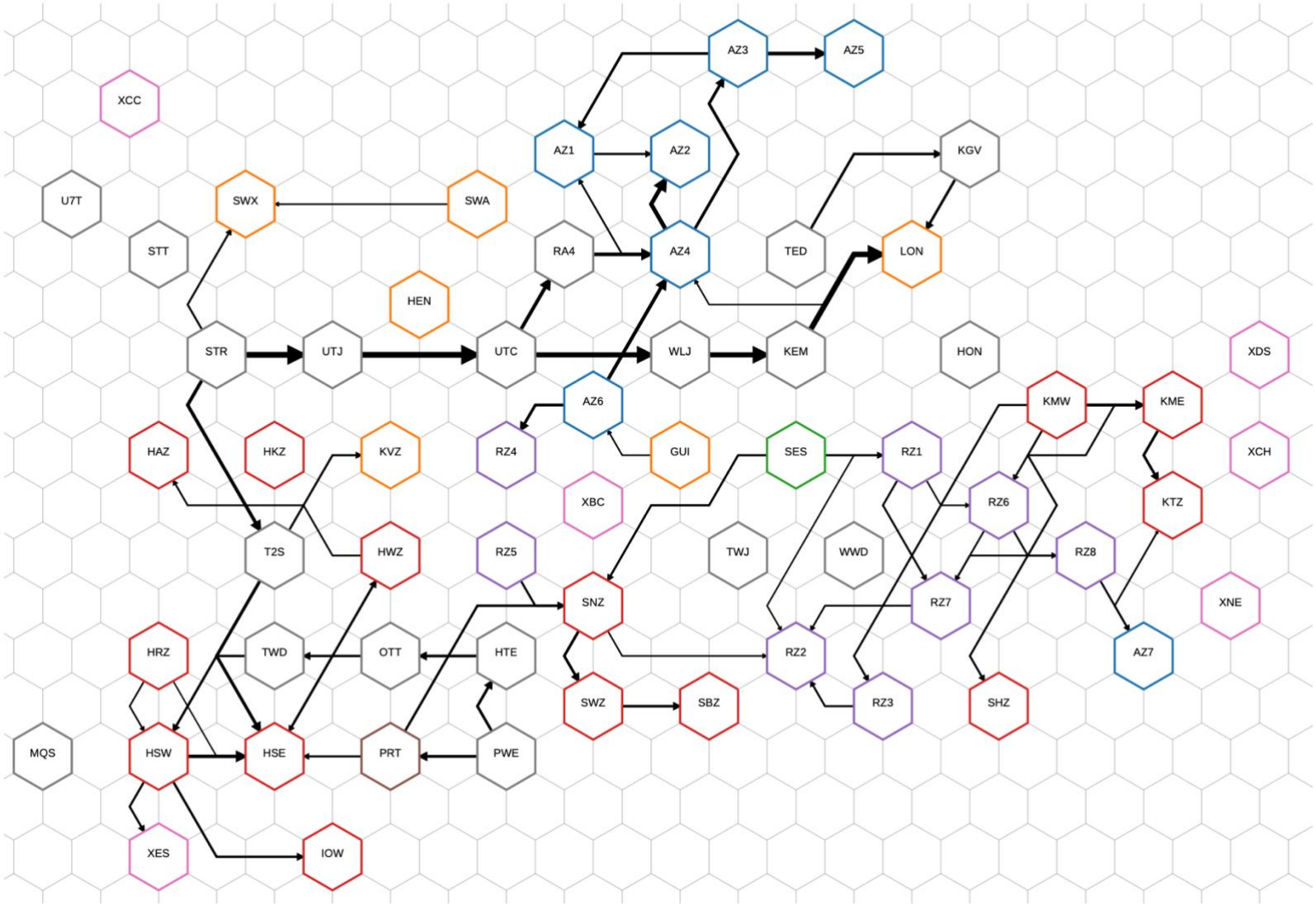
Situation 4 - 2075 (Regional)



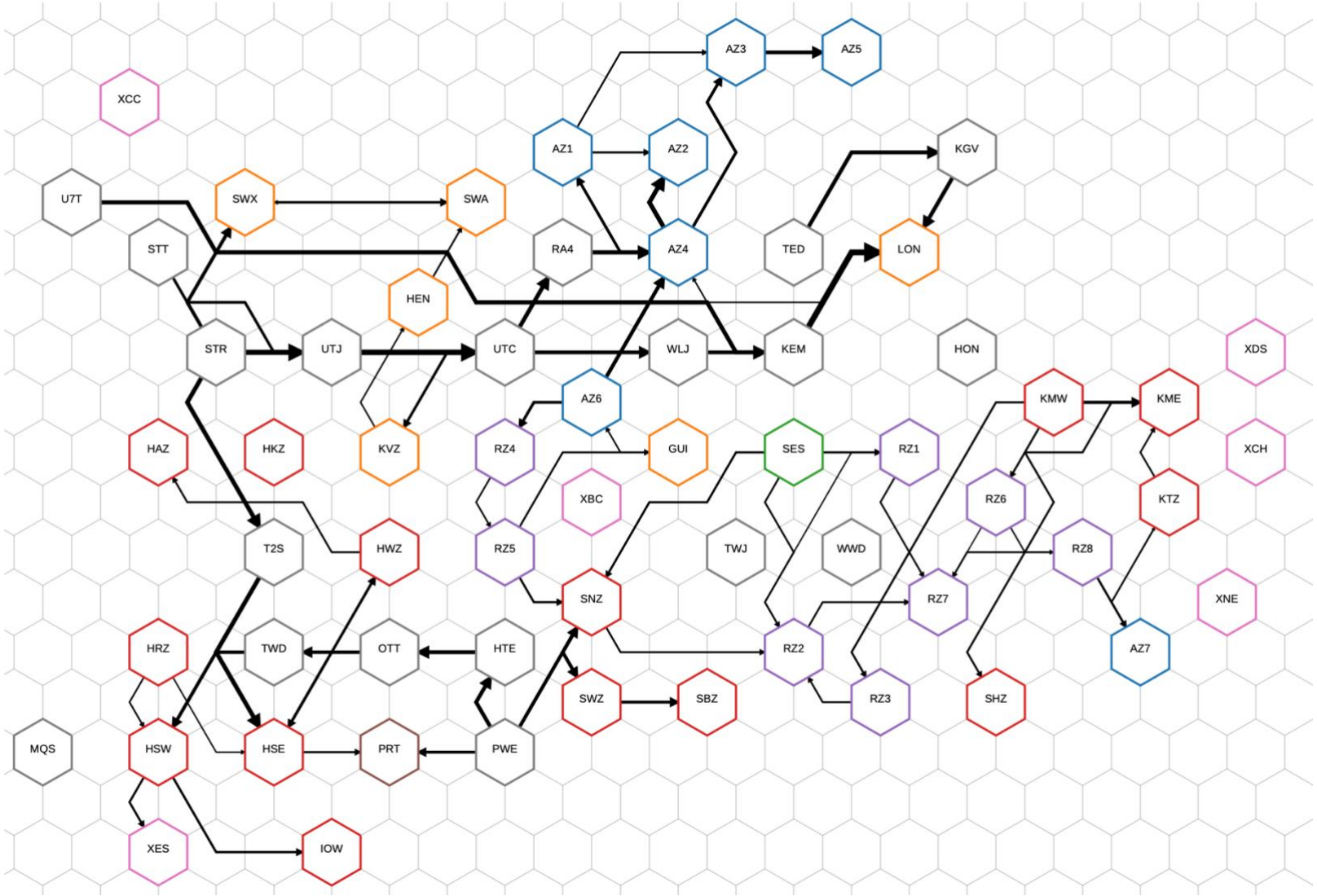
Situation 4 - 2026



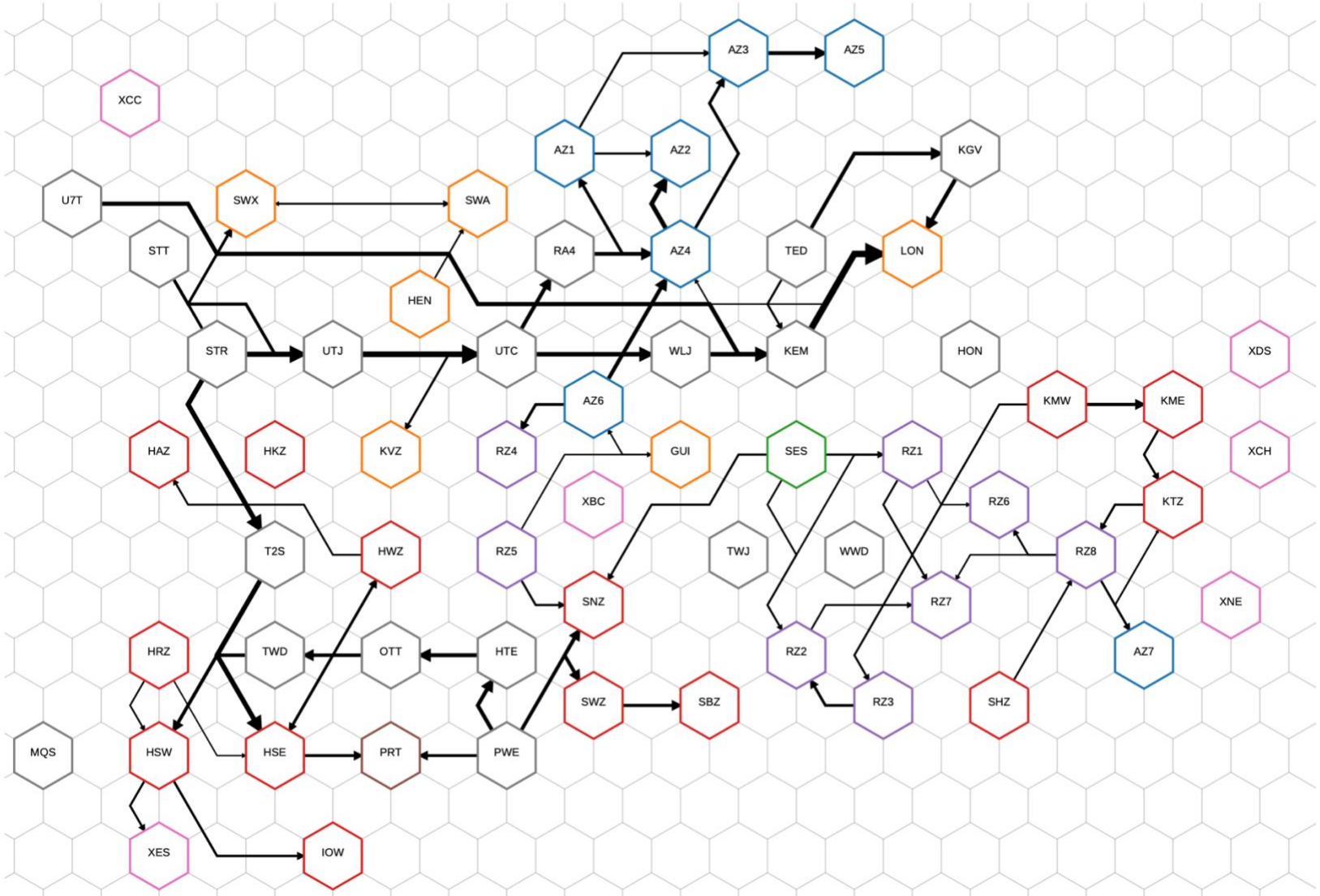
Situation 4 - 2040



Situation 4 - 2050



Situation 4 - 2075



www.wrse.org.uk