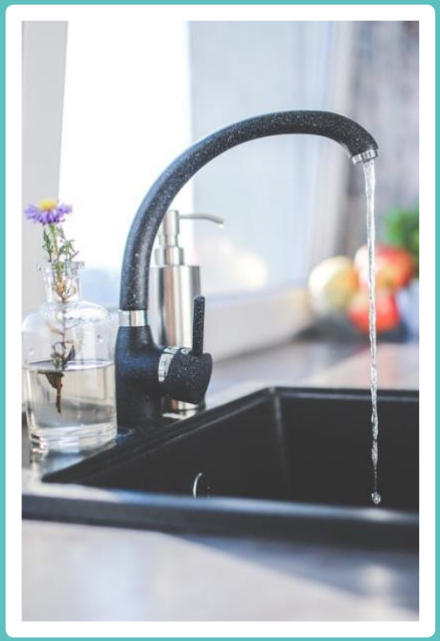

Emerging Regional Plan
Water Resources South East

Annex 3 – Our emerging regional plan (technical details)

January 2022 (Consultation version)

Emerging Regional Plan – Water Resources South East	
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Table of Contents

Figures

1. Regional overview of options selected in the emerging regional plan

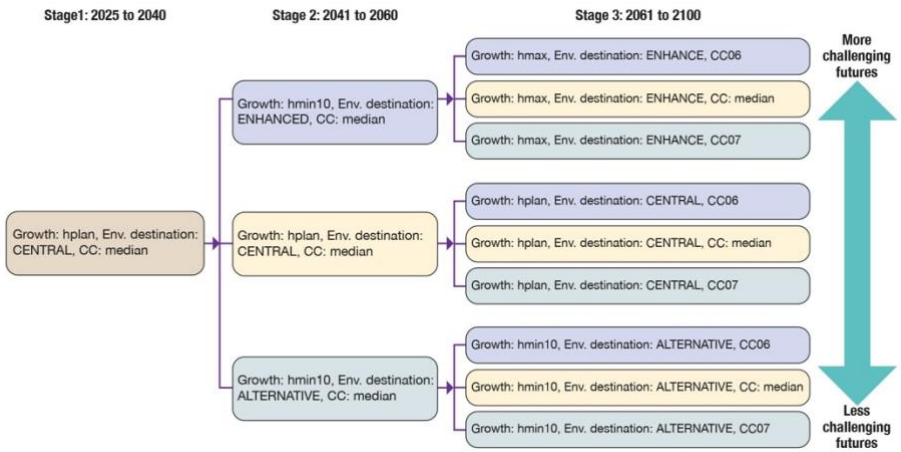
1.1. The detailed diagram later in this section shows at a regional level how the options selected under each of the branches in the adaptive regional plan change, depending on the scale of the challenges being faced.

Context

1.2. As explained in detail in our separate Annex 1 (and illustrated in Figure 1.1), the root branch (2025-2040) has been based on the housing plan growth (compliant with guidance), median climate change and a glidepath of environmental ambitions that allows implementation of abstraction reductions over the interim years before finalising the future destinations in the next set of branches. Those options identified for the period 2025 to 2040 are required under any of the future challenges we face, and will enable us to adapt to any of the future pathways beyond 2040.

1.3. The next three branches (2040-2060) seek to cover the range of potential environmental destinations. The enhance and BAU+ scenarios, which are derived for the National Framework scenarios, have the greatest impact on the supply forecasts. These therefore define the most challenging scenarios along with the maximum housing growth scenario and median climate change impacts. The central branch continues with the root branch scenario whilst the least challenging branch uses a low growth forecast, a low environmental ambition forecast (at a regional level) and medium climate change. These three branches help define the range of potential challenges that the region could experience in the future.

Figure 1.1 Illustration of scenarios underpinning selected root and branch



1.4. The final set of branches focus on how climate change could continue to impact of the future availability of water. Like the other branches 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. Inspection of this root and branch construction show a good range of coverage of the potential futures. 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 the adaptive plan can adapt in the future by ensuring the choices that are made at the beginning of the plan can also be effective for the challenges in the future.

1.5. From 2040 onwards a greater number and capacity of options is required under the more challenging futures (the upper branches), and these increasingly rely on water recycling, desalination and other infrastructure options.

What does the regional overview diagram show?

1.6. For the emerging plan, the regional overview diagram shows the options selected as part of our cost-efficient investment modelling which is being published for consultation. Options are identified in different time periods within the planning period from 2025 to 2075 (this will be extended to 2100 for the draft plan later in 2022).

1.7. **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 options may be shown in an earlier period in draft company WRMPs later in 2022.

1.8. **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 modelling 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).

1.9. **The utilisation figure shown in the diagram (in Ml/d) for the option is the maximum utilisation under the 1:500 Dry Year Annual Average (DYAA) scenario** – what is currently termed an extreme drought. The options may have different utilisations under other design scenarios – e.g. Normal conditions, 1;100 DYAA, 1:500 Dry Year Critical Period (DYCP). Only the 1:500 DYAA figure is presented in this diagram.

1.10. **The utilisation figure shown in the diagram (Ml/d) is the maximum utilisation of the option across the planning horizon** - this does not mean that this utilisation would be immediately implemented when the scheme is first utilised, as it may vary over the duration of the planning period.

1.11. 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 cost-efficient plan.

1.12. It should be noted that WRSE is continuing its regional planning work and the (cost efficient) emerging plan will be used as a benchmark to understand cost and value when we are developing our 'best value' plans in the next stage of the process in 2022. This is explained more in our separate Annex 4 (how we are developing our plan).

1.13. This continuing work means that the detail in the diagram overleaf may change between now and the draft regional plan, and the selection of some options, and their timing may vary.

1.14. Alongside this regional work, the companies are continuing the preparation of their individual draft WRMPs and those plans will present each company's detailed proposals for their own supply areas when published for consultation later in 2022. The detailed selection and timing of options will be set out by the 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.

1.15. The investment modelling used for WRSE uses 'net present value' optimisation to identify the lowest cost solution across the region to the supply and demand needs that it faces. It incorporates the 'must do' items identified by the Water Resources Planning Guidance and sets them as conditions that the model must meet (i.e. supply must be greater than (or

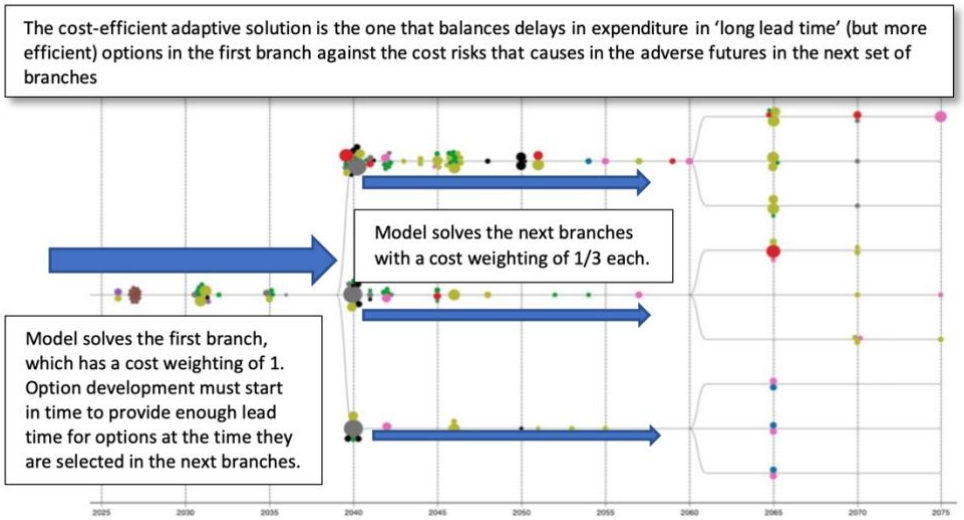
equal to) demand given the level of environmental ambition and drought resilience that is required for that scenario, and leakage reduction must be at least 50%).

1.16. For the emerging plan only those factors that can be given a monetary cost have been considered. Requirements such as net zero carbon are included in the monetary analysis by calculating the amount of operational and embedded carbon associated with options, and multiplying these by governmental 'cost of carbon factors'. The model then uses optimisation algorithms to identify the combination of options that can meet those requirements at the lowest overall programme cost (net present value), taking into account the capital costs of option development and maintenance, and the operational costs of options once they have been implemented.

1.17. The other metrics described in our separate Annex 4, that will be used to support the 'Best Value Plan' evaluation, are enabled within the investment model, and it is able to optimise against those metrics. For the purposes of this emerging plan these were not enabled, to allow the initial cost-efficient plan to be identified and consulted on first.

1.18. The model manages future uncertainties through the use of the 'adaptive pathway trees' described in Annex 1. The investment model works by simultaneously solving all branches of the tree (each of which represent a different set of future conditions). For each branch it seeks to minimise the cost associated with meeting the need on that branch, whilst ensuring that sufficient intervention activity is carried out prior to the 'break point' to allow future branches to build on that investment and solve their own requirements. The lowest cost plan is the one that does this for the lowest total expected programme expenditure (net present). Except for the first branch, which is common to all futures, all other futures are considered equally likely and the costs weighted accordingly. For example, each of the three 2040 to 2060 branches are attributed a third of the calculated cost when calculating the overall programme cost. The adaptive pathway branches have been selected so that they are similarly likely given what we know about future risks at this point. These key concepts are illustrated in the figure below.

Figure 1.2 Illustration of investment modelling approach

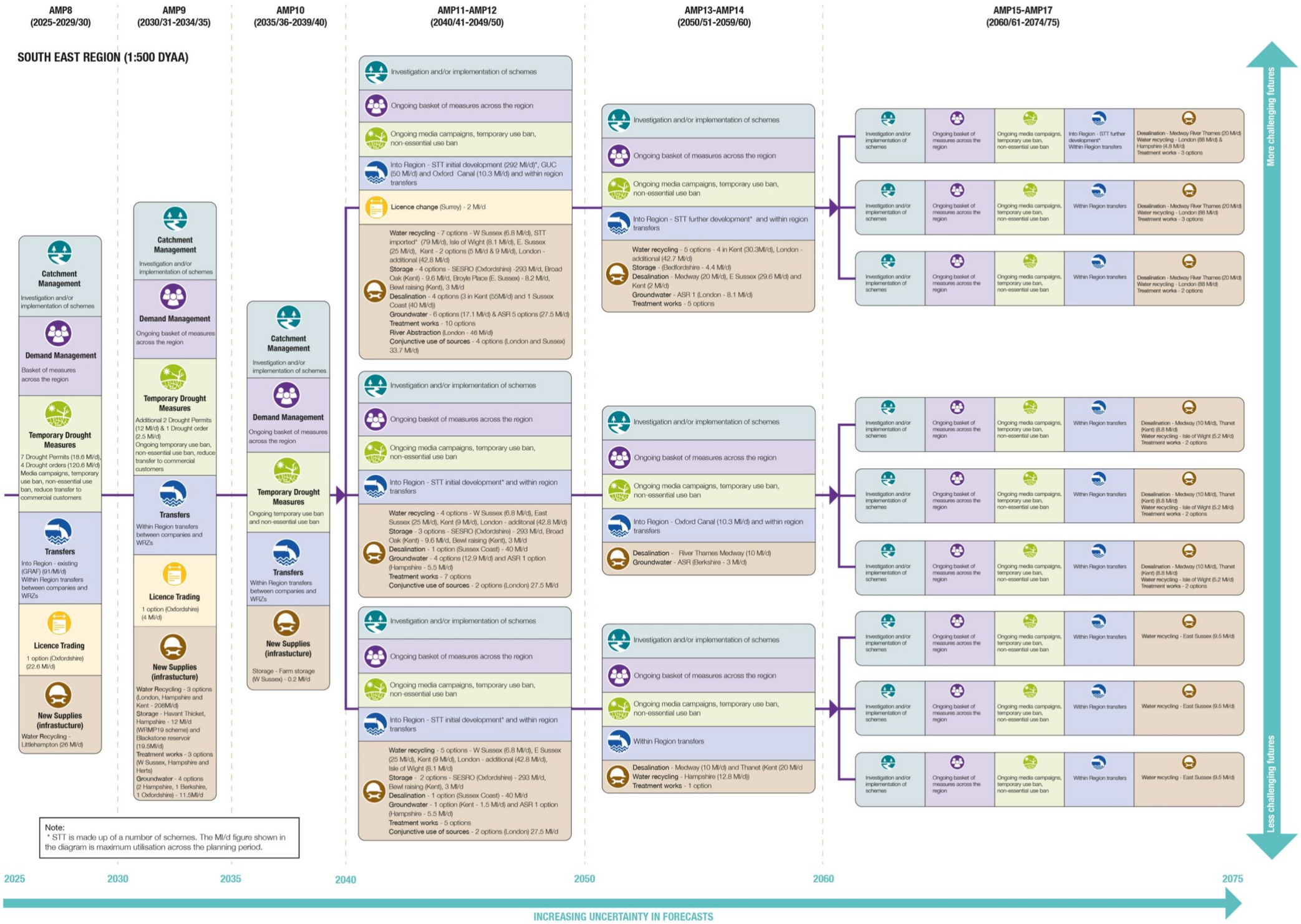


1.19. Further explanation of the investment modelling approach is detailed in our Investment Model Summary report[1], published in 2019.

1.20. The runs presented in this Annex reflect the configurations of supply system operations and infrastructure that may be required to share schemes on a regional basis as they were understood at the time. Where ongoing studies indicate that there are uncertainties in this configuration that have the potential to affect the choice and timing of cost-efficient scheme selection, then the implications of this are presented in Annex 2.

[1] REA Report and Proof of Concept Modelling (wrse.org.uk)

Figure 1.3 Emerging regional plan overview



2. Emerging regional plan – Company summaries

2.1. The diagrams in Figures 2.1 to 2.6 overleaf shows at a Company level how the options selected under each of the branches in the (cost efficient) emerging regional plan change, depending on the scale of the challenges being faced.

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

- The timing shown for the option is the date when the investment modelling first utilises the option
- The utilisation figure shown in the diagram (in Ml/d) for the option is the utilisation in the 1:500 Dry Year Annual Average (DYAA) scenario - the options may have different utilisations under other design scenarios
- The utilisation figure shown in the diagram (in Ml/d) for the option is its maximum utilisation across the planning period - this does not mean that this utilisation would be immediately implemented when the scheme is first utilised, as it may vary over the duration of the planning period.
- 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
- WRSE is continuing its regional planning work and the (cost efficient) emerging plan will be used as a benchmark to understand cost and value when we are developing our 'best value' plans in the next stage of the process in 2022
- This continuing work means that the detail in the diagram overleaf will change between now and the draft regional plan, and the selection of some options, and their timing may vary
- The companies are continuing the preparation of their individual draft WRMPs and It is for the WRMP to explain how it has reflected the regional plan and why the preferred programme has been selected.

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

Figure 2.1 Affinity Water emerging regional plan overview

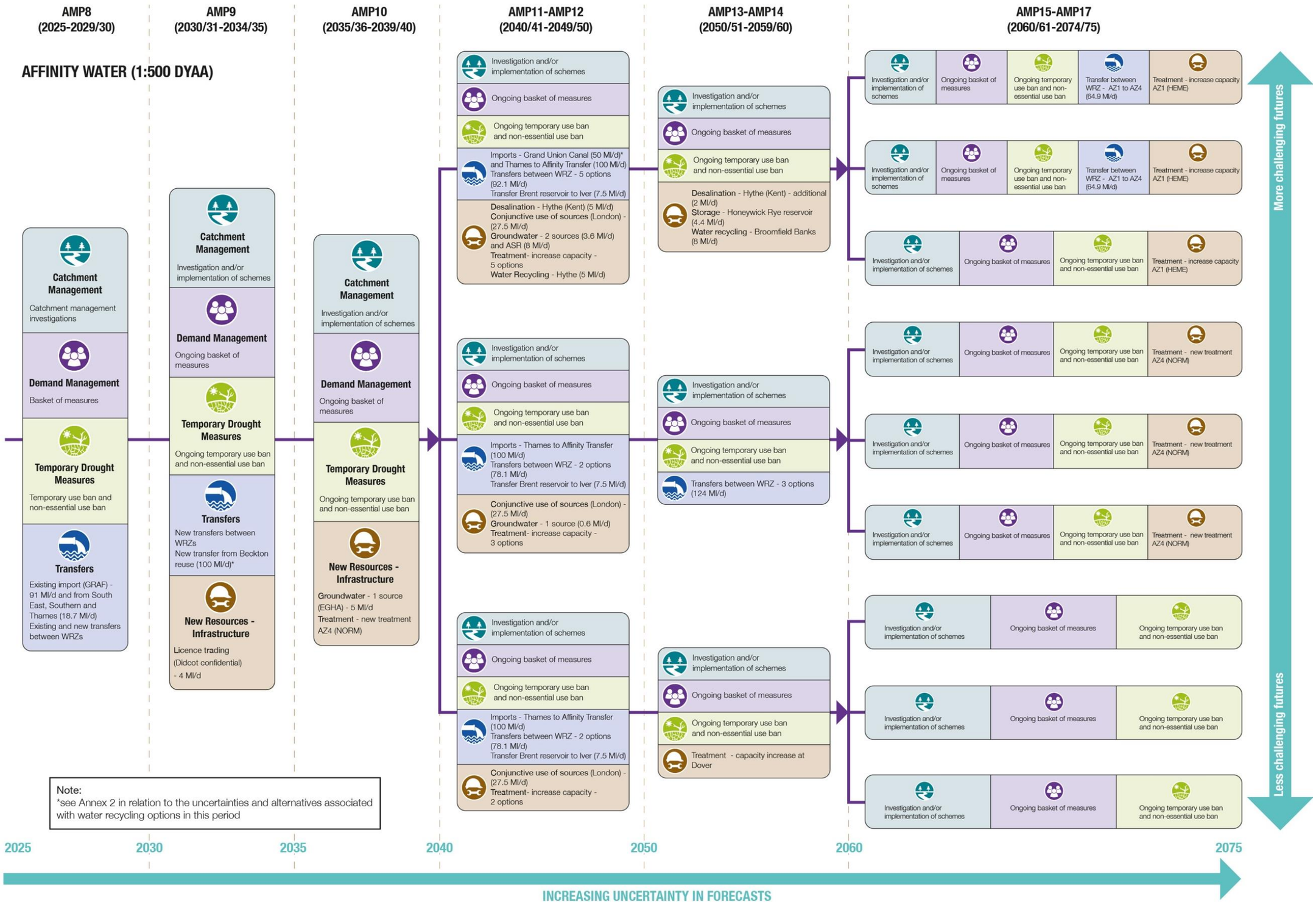


Figure 2.2 Portsmouth Water emerging regional plan overview

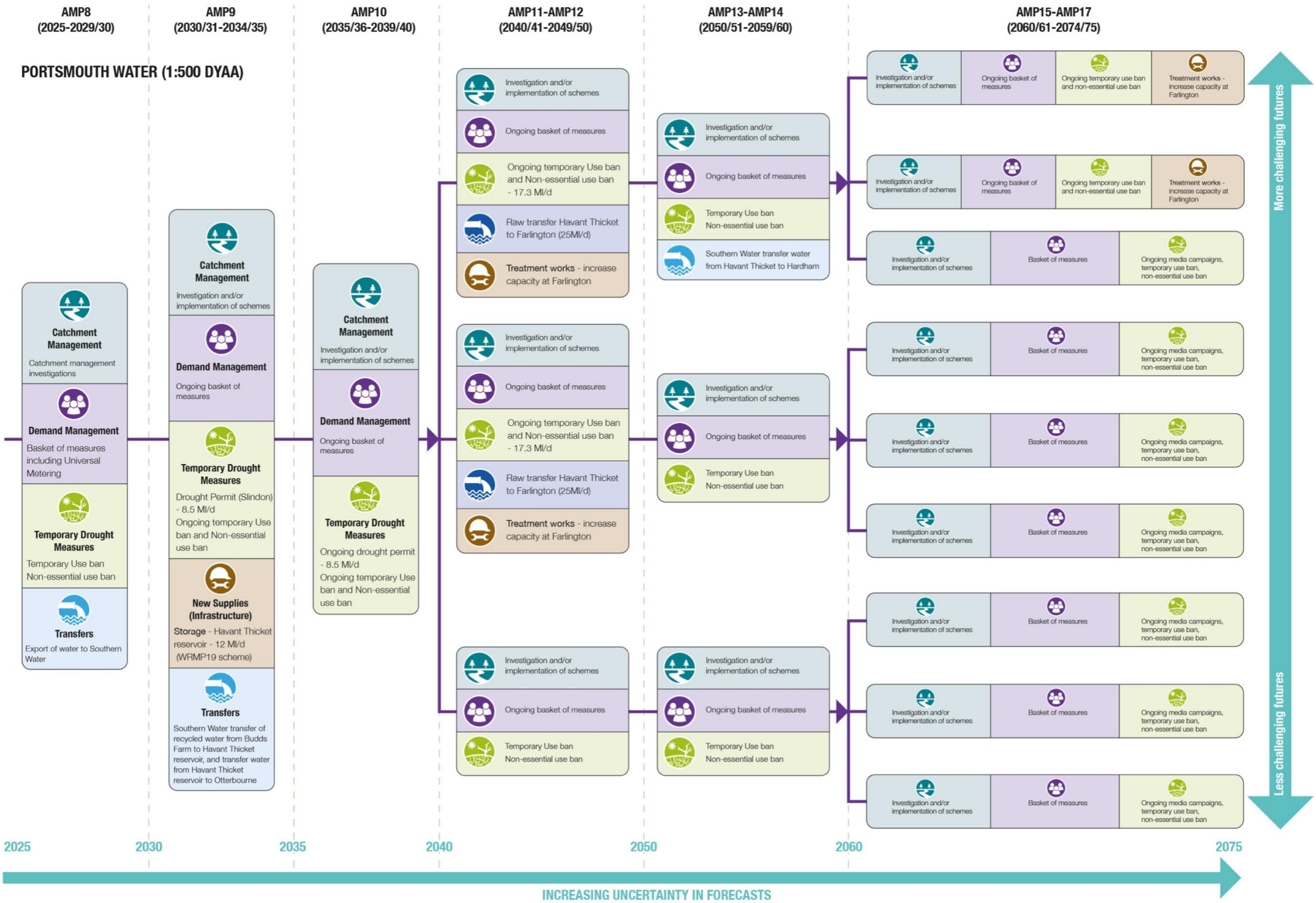


Figure 2.3 SES Water emerging regional plan overview

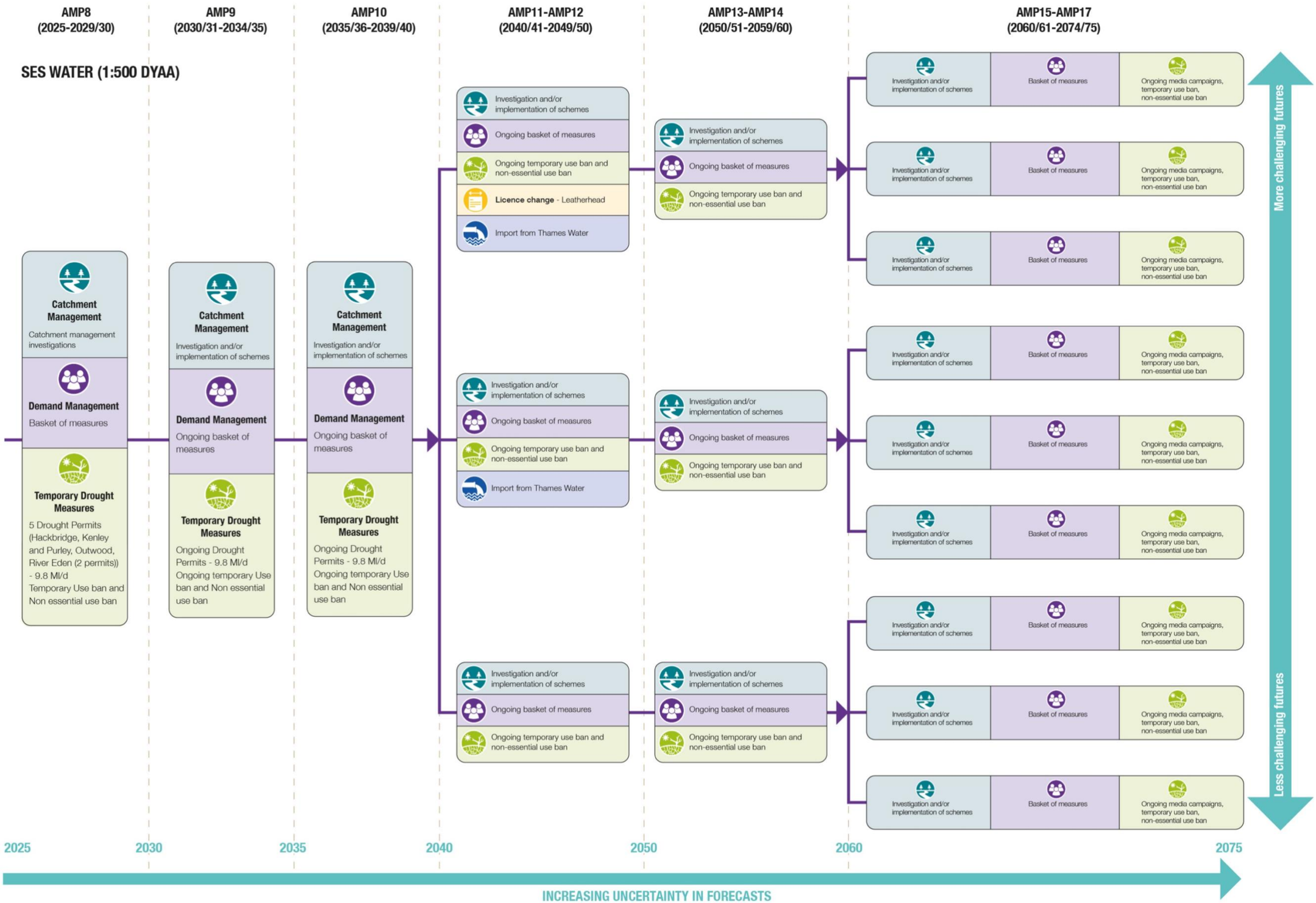


Figure 2.4 Southern Water emerging regional plan overview

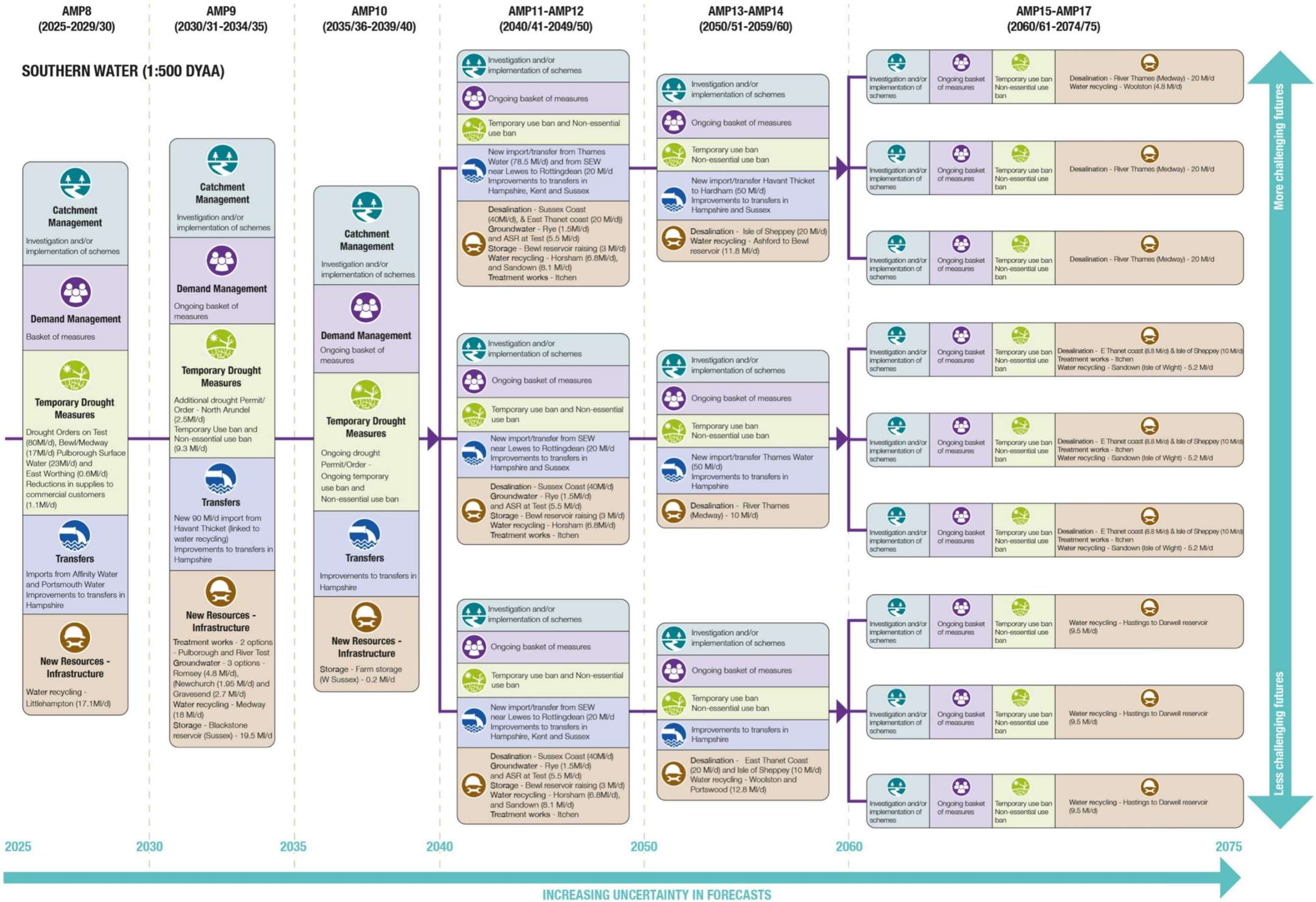


Figure 2.5 South East Water emerging regional plan overview

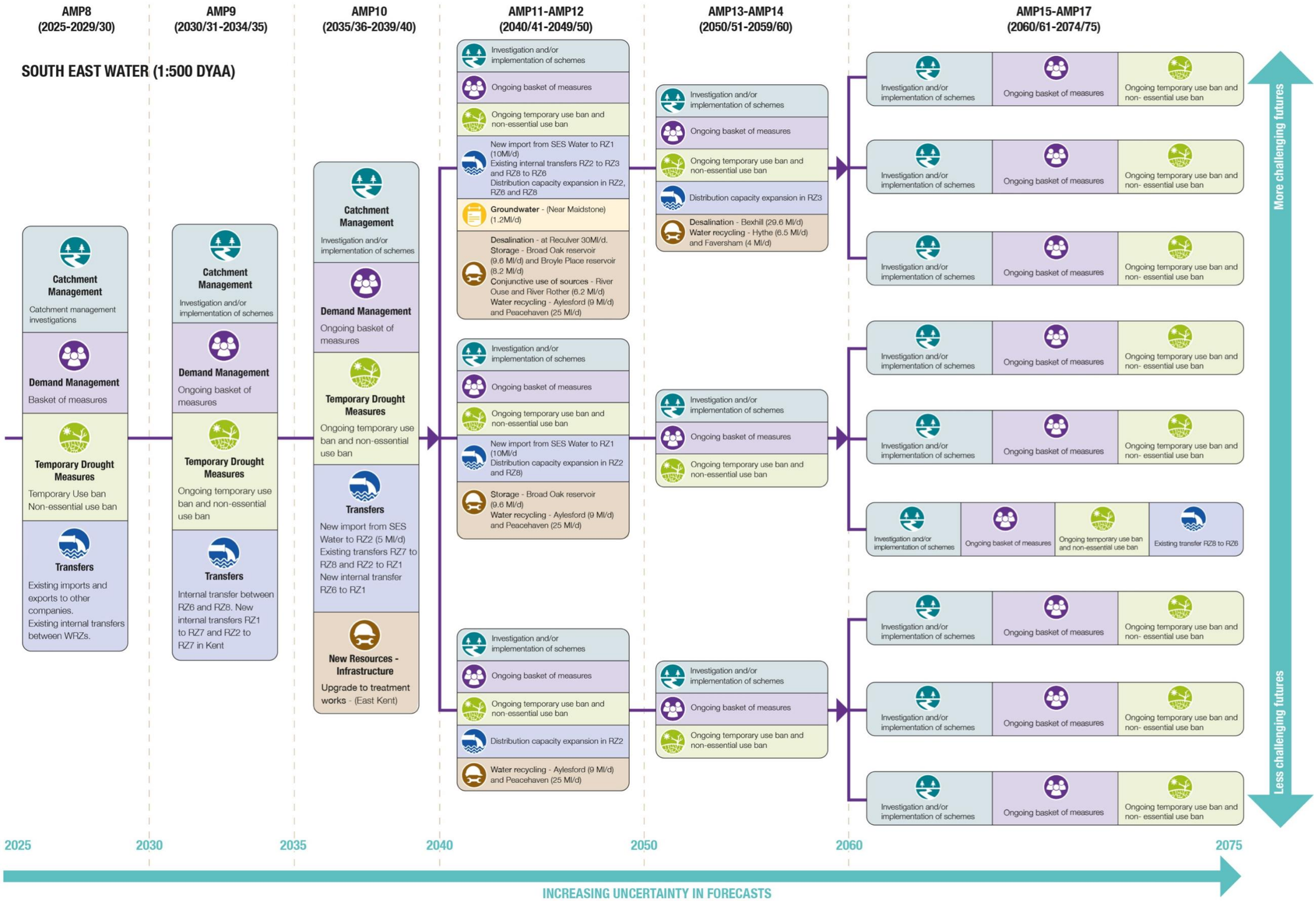
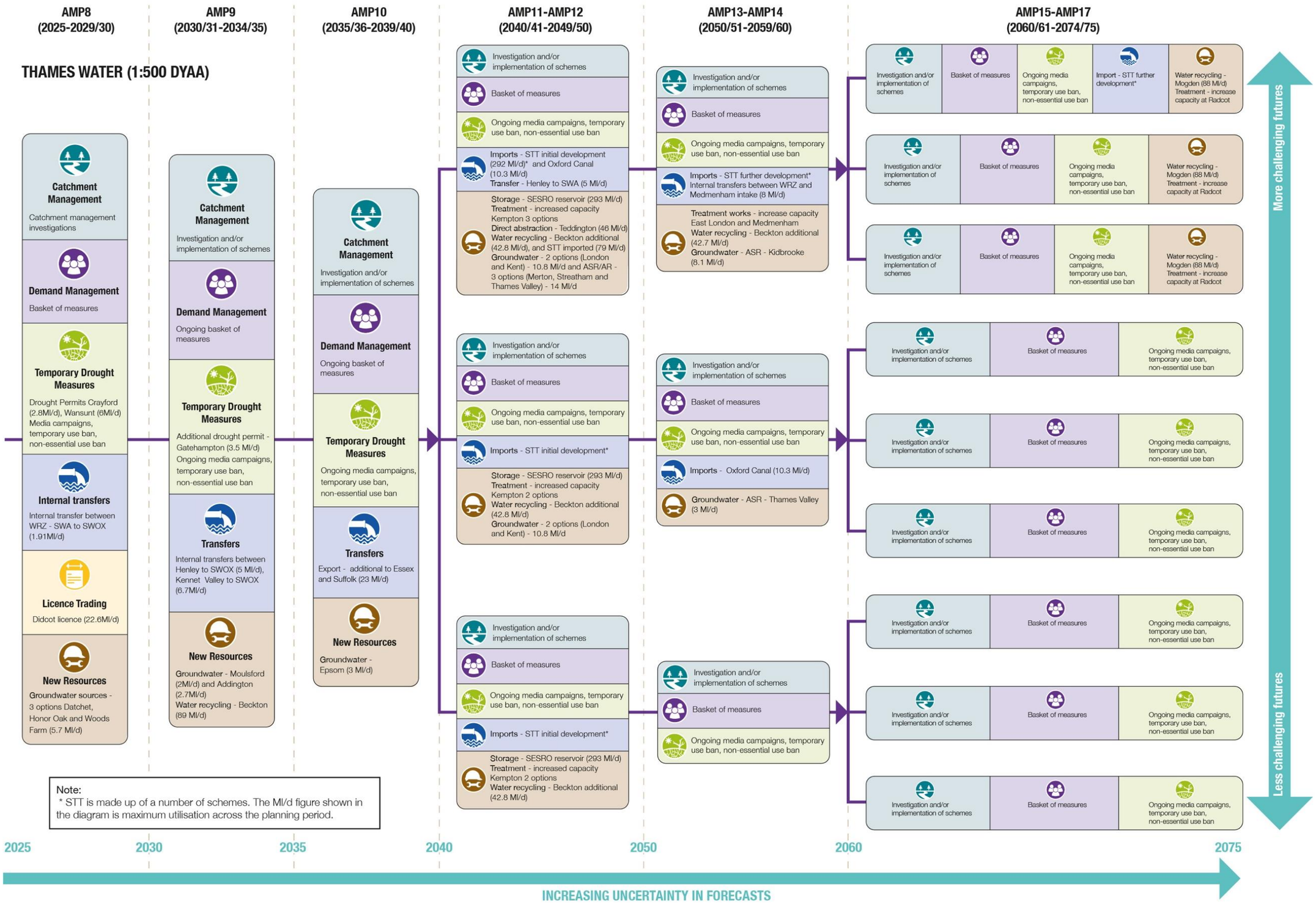


Figure 2.6 Thames Water emerging regional plan overview



3. Overview of types of options selected in the emerging regional plan

3.1. The table below provides a summary at the regional level of the numbers of the different types of options selected under each of the model pathways for the 1:500 DYAA scenario.

3.2. This highlights 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, in the absence of other potential options to meet the larger supply demand deficits being faced.

3.3. For each of the 9 situations, the table shows the data at 5 different time slices:

- 2025/26 – the start of the modelled planning horizon
- 2039/40 – the first branching point
- 2050/51
- 2060/61 – the second branching point
- 2074/75 – the end of the current modelled planning horizon (the draft regional plan which will be published later this year will plan out to 2100).

3.4. The five column groups in the table are as follows:

- Resource capacity (Ml/d) – this is the maximum built capacity of the options.
- As a percentage (%) – the percentage of the individual option type capacities compared to the total capacity of all new options.
- 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.

3.5. 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.

South East Region 1:500 DYAA

Situation 1 (most challenging)	Resource Capacity Ml/d					As a percentage					Number of options					Option Utilisation Ml/d					Utilisation %				
Category	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75
Demand management and leakage	68	629	831	944	1,186	13%	33%	35%	37%	40%	0	54	60	60	60	68	629	831	939	1,186	15%	39%	35%	37%	41%
Desalination	0	45	117	147	167	0%	2%	5%	6%	6%	0	2	6	7	8	0	13	115	142	166	0%	1%	5%	6%	6%
Transfers into the region	0	154	248	282	293	0%	8%	10%	11%	10%	0	2	5	7	8	0	80	238	268	289	0%	5%	10%	11%	10%
Groundwater and new storage underground	6	34	72	81	81	1%	2%	3%	3%	3%	3	12	21	22	22	1	13	71	79	79	0%	1%	3%	3%	3%
Other (including drought measures)	422	452	330	333	337	82%	24%	14%	13%	11%	0	106	80	80	80	369	425	327	324	328	84%	26%	14%	13%	11%
Reservoir	0	325	353	357	357	0%	17%	15%	14%	12%	0	4	8	9	9	0	325	353	357	357	0%	20%	15%	14%	12%
Recycle and reuse	17	239	411	427	519	3%	13%	17%	17%	18%	0	5	13	15	17	1	133	411	419	512	0%	8%	18%	17%	18%
New options (excl internal transfers)	**512**	**1,879**	**2,362**	**2,570**	**2,940**	**100%**	**100%**	**100%**	**100%**	**100%**	**3**	**185**	**193**	**200**	**204**	**439**	**1618**	**2345**	**2529**	**2917**	100%	100%	100%	100%	100%
Existing																0	4,153	3,477	3,454	3,311					
Within region transfers	609	302,818	404,005	404,215	404,313						1	88	111	114	117	324	2,215	3,173	3,304	3,448		137%	135%	131%	118%

Situation 2	Resource Capacity Ml/d					As a percentage					Number of options					Option Utilisation Ml/d					Utilisation %				
Category	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75
Demand management and leakage	68	629	831	944	1,186	13%	33%	35%	37%	40%	0	54	60	60	60	68	629	831	939	1,186	15%	39%	35%	37%	42%
Desalination	0	45	117	147	167	0%	2%	5%	6%	6%	0	2	6	7	8	0	13	115	142	157	0%	1%	5%	6%	6%
Transfers into the region	0	166	259	293	293	0%	9%	11%	11%	10%	0	3	6	8	8	0	80	238	268	236	0%	5%	10%	11%	8%
Groundwater and new storage underground	6	34	72	81	81	1%	2%	3%	3%	3%	3	12	21	22	22	1	13	71	79	79	0%	1%	3%	3%	3%
Other (including drought measures)	422	452	330	333	337	82%	24%	14%	13%	11%	0	106	80	80	80	369	425	327	324	328	84%	26%	14%	13%	12%
Reservoir	0	325	353	357	357	0%	17%	15%	14%	12%	0	4	8	9	9	0	325	353	357	357	0%	20%	15%	14%	13%
Recycle and reuse	17	239	411	427	515	3%	13%	17%	17%	18%	0	5	13	15	16	1	133	411	419	480	0%	8%	18%	17%	17%
New options (excl internal transfers)	**512**	**1,890**	**2,373**	**2,582**	**2,935**	**100%**	**100%**	**100%**	**100%**	**100%**	**3**	**186**	**194**	**201**	**203**	**439**	**1618**	**2345**	**2529**	**2822**	100%	100%	100%	100%	100%
Existing																0	4,153	3,477	3,454	3,417					
Within region transfers	609	302,818	404,005	404,215	404,313						1	88	111	114	117	324	2,215	3,173	3,304	3,200		137%	135%	131%	113%

Situation 3	Resource Capacity Ml/d					As a percentage					Number of options					Option Utilisation Ml/d					Utilisation %				
Category	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75	2025/26	2039/40	2050/51	2060/61	2074/75
Demand management and leakage	68	629	831	944	1,186	13%	33%	35%	37%	40%	0	54	60	60	60	68	629	831	939	1,186	15%	39%	35%	37%	43%
Desalination	0	45	117	147	167	0%	2%	5%	6%	6%	0	2	6	7	8	0	13	115	142	166	0%	1%	5%	6%	6%
Transfers into the region	0	166	259	293	293	0%	9%	11%	11%	10%	0	3	6	8	8	0	80	238	268	213	0%	5%	10%	11%	8%
Groundwater and new storage underground	6	34	72	81	81	1%	2%	3%	3%	3%	3	12	21	22	22	1	13	71	79	76	0%	1%	3%	3%	3%
Other (including drought measures)	422	452	330	333	337	82%	24%	14%	13%	11%	0	106	80	80	80	369	425	327	324	328	84%	26%	14%	13%	12%
Reservoir	0	325	353	357	357	0%	17%	15%	14%	12%	0	4	8	9	9	0	325	353	357	357	0%	20%	15%	14%	13%
Recycle and reuse	17	239	411	427	515	3%	13%	17%	17%	18%	0	5	13	15	16	1	133	411	419	405	0%	8%	18%	17%	15%
New options (excl internal transfers)	**512**	**1,890**	**2,373**	**2,582**	**2,935**	**100%**	**100%**	**100%**	**100%**	**100%**	**3**	**186**	**194**	**201**	**203**	**439**	**1618**	**2345**	**2529**	**2732**	100%	100%	100%	100%	100%
Existing																0	4,153	3,477	3,454	3,511					
Within region transfers	609	302,818	404,005	404,215	404,239						1	88	111	114	115	324	2,215	3,173	3,304	3,030		137%	135%	131%	111%

Situation 4	Resource Capacity Ml/d					As a percentage					Number of options					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**
Demand management and leakage	68	629	831	944	1,186	13%	33%	35%	37%	40%	0	54	60	60	60	68	629	831	939	1,186	15%	45%	49%	51%	56%
Desalination	0	40	40	50	70	0%	2%	2%	2%	2%	0	1	1	2	4	0	8	8	12	33	0%	1%	0%	1%	2%
Transfers into the region	0	90	113	113	113	0%	5%	5%	4%	4%	0	3	4	4	4	0	0	23	23	23	0%	0%	1%	1%	1%
Groundwater and new storage underground	6	33	49	49	49	1%	2%	2%	2%	2%	3	11	16	16	16	1	8	43	43	44	0%	1%	3%	2%	2%
Other (including drought measures)	431	460	275	278	282	84%	24%	12%	11%	10%	0	107	76	76	76	369	395	273	278	282	84%	29%	16%	15%	13%
Reservoir	0	325	345	345	345	0%	17%	15%	13%	12%	0	4	7	7	7	0	292	338	338	337	0%	21%	20%	19%	16%
Recycle and reuse	17	239	298	298	303	3%	13%	13%	12%	10%	0	5	8	8	9	1	52	169	191	229	0%	4%	10%	10%	11%
New options (excl internal transfers)	**521**	**1,816**	**1,951**	**2,077**	**2,347**	**102%**	**97%**	**83%**	**81%**	**80%**	**3**	**185**	**172**	**173**	**176**	**439**	**1385**	**1684**	**1825**	**2133**	100%	100%	100%	100%	100%
Existing																0	4,350	4,138	4,113	3,973					
Within region transfers	609	202,839	303,480	303,560	303,590						1	86	97	99	100	324	1,742	2,080	2,125	2,210		126%	123%	116%	104%

Situation 5	Resource Capacity Ml/d					As a percentage					Number of options					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**
Demand management and leakage	68	629	831	944	1,186	13%	33%	35%	37%	40%	0	54	60	60	60	68	629	831	939	1,186	15%	45%	49%	51%	58%
Desalination	0	40	40	50	70	0%	2%	2%	2%	2%	0	1	1	2	4	0	8	8	12	25	0%	1%	0%	1%	1%
Transfers into the region	0	90	113	113	113	0%	5%	5%	4%	4%	0	3	4	4	4	0	0	23	23	3	0%	0%	1%	1%	0%
Groundwater and new storage underground	6	33	49	49	49	1%	2%	2%	2%	2%	3	11	16	16	16	1	8	43	43	42	0%	1%	3%	2%	2%
Other (including drought measures)	431	460	275	278	282	84%	24%	12%	11%	10%	0	107	76	76	76	369	395	273	278	282	84%	29%	16%	15%	14%
Reservoir	0	325	345	345	345	0%	17%	15%	13%	12%	0	4	7	7	7	0	292	338	338	335	0%	21%	20%	19%	16%
Recycle and reuse	17	239	298	298	303	3%	13%	13%	12%	10%	0	5	8	8	9	1	52	169	191	182	0%	4%	10%	10%	9%
New options (excl internal transfers)	**521**	**1,816**	**1,951**	**2,077**	**2,347**	**102%**	**96%**	**82%**	**80%**	**80%**	**3**	**185**	**172**	**173**	**176**	**439**	**1385**	**1684**	**1825**	**2054**	100%	100%	100%	100%	100%
Existing																0	4,350	4,138	4,113	4,075					
Within region transfers	609	202,839	303,480	303,560	303,590						1	86	97	99	100	324	1,742	2,080	2,125	2,006		126%	123%	116%	98%

Situation 6	Resource Capacity Ml/d					As a percentage					Number of options					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**
Demand management and leakage	68	629	831	944	1,186	13%	33%	35%	37%	40%	0	54	60	60	60	68	629	831	939	1,186	0%	45%	49%	51%	60%
Desalination	0	40	40	50	70	0%	2%	2%	2%	2%	0	1	1	2	4	0	8	8	12	37	0%	1%	0%	1%	2%
Transfers into the region	0	90	113	113	113	0%	5%	5%	4%	4%	0	3	4	4	4	0	0	23	23	0	0%	0%	1%	1%	0%
Groundwater and new storage underground	6	33	49	49	49	1%	2%	2%	2%	2%	3	11	16	16	16	1	8	43	43	22	100%	1%	3%	2%	1%
Other (including drought measures)	431	460	275	278	282	84%	24%	12%	11%	10%	0	107	76	76	76	369	395	273	278	259	0%	29%	16%	15%	13%
Reservoir	0	325	345	345	345	0%	17%	15%	13%	12%	0	4	7	7	7	0	292	338	338	291	0%	21%	20%	19%	15%
Recycle and reuse	17	239	298	298	303	3%	13%	13%	12%	10%	0	5	8	8	9	1	52	169	191	179	0%	4%	10%	10%	9%
New options (excl internal transfers)	**521**	**1,816**	**1,951**	**2,077**	**2,347**	**102%**	**96%**	**82%**	**80%**	**80%**	**3**	**185**	**172**	**173**	**176**	**439**	**1385**	**1684**	**1825**	**1974**	100%	100%	100%	100%	100%
Existing																0	4,350	4,138	4,113	4,172					
Within region transfers	609	202,839	303,480	303,560	303,601						1	86	97	99	101	324	1,742	2,080	2,125	1,781		126%	123%	116%	90%

Situation 7	Resource Capacity Ml/d					As a percentage					Number of options					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**
Demand management and leakage	68	629	831	944	1,186	13%	33%	35%	37%	40%	0	54	60	60	60	68	629	831	939	1,186	15%	54%	57%	60%	64%
Desalination	0	40	50	70	70	0%	2%	2%	3%	2%	0	1	2	3	3	0	8	11	17	29	0%	1%	1%	1%	2%
Transfers into the region	0	90	90	90	90	0%	5%	4%	4%	3%	0	3	3	3	3	0	0	0	0	0	0%	0%	0%	0%	0%
Groundwater and new storage underground	6	33	35	35	35	1%	2%	1%	1%	1%	3	11	12	12	12	1	1	17	17	17	0%	0%	1%	1%	1%
Other (including drought measures)	431	460	275	278	282	84%	24%	12%	11%	10%	0	107	76	76	76	369	378	248	251	255	84%	33%	17%	16%	14%
Reservoir	0	325	328	328	328	0%	17%	14%	13%	11%	0	4	5	5	5	0	94	157	157	157	0%	8%	11%	10%	9%
Recycle and reuse	17	239	319	319	328	3%	13%	13%	12%	11%	0	5	10	10	11	1	49	186	193	200	0%	4%	13%	12%	11%
New options (excl internal transfers)	**521**	**1,816**	**1,927**	**2,063**	**2,318**	**102%**	**97%**	**82%**	**80%**	**79%**	**3**	**185**	**168**	**169**	**170**	**439**	**1159**	**1450**	**1575**	**1844**	100%	100%	100%	100%	100%
Existing																0	4,352	4,171	4,146	3,992					
Within region transfers	609	202,841	203,117	203,208	203,253						1	86	91	93	95	0	857	1,319	1,320	1,305		74%	91%	84%	71%

Situation 8	Resource Capacity Ml/d					As a percentage					Number of options					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**
Demand management and leakage	68	629	831	944	1,186	13%	33%	35%	37%	40%	0	54	60	60	60	68	629	831	939	1,186	15%	54%	57%	60%	64%
Desalination	0	40	50	70	70	0%	2%	2%	3%	2%	0	1	2	3	3	0	8	11	17	25	0%	1%	1%	1%	1%
Transfers into the region	0	90	90	90	90	0%	5%	4%	3%	3%	0	3	3	3	3	0	0	0	0	0	0%	0%	0%	0%	0%
Groundwater and new storage underground	6	33	35	35	35	1%	2%	1%	1%	1%	3	11	12	12	12	1	1	17	17	17	0%	0%	1%	1%	1%
Other (including drought measures)	431	460	275	278	282	84%	24%	12%	11%	10%	0	107	76	76	76	369	378	248	251	255	84%	33%	17%	16%	14%
Reservoir	0	325	328	328	328	0%	17%	14%	13%	11%	0	4	5	5	5	0	94	157	157	157	0%	8%	11%	10%	9%
Recycle and reuse	17	239	319	319	328	3%	13%	13%	12%	11%	0	5	10	10	11	1	49	186	193	200	0%	4%	13%	12%	11%
New options (excl internal transfers)	**521**	**1,816**	**1,927**	**2,063**	**2,318**	**102%**	**96%**	**81%**	**80%**	**79%**	**3**	**185**	**168**	**169**	**170**	**439**	**1159**	**1450**	**1575**	**1840**	100%	100%	100%	100%	100%
Existing																5,117	4,352	4,171	4,146	4,105					
Within region transfers	609	202,841	203,117	203,208	203,208						1	86	91	93	93	0	857	1,319	1,320	1,289		74%	91%	84%	70%

Situation 9 (least challenging)	Resource Capacity Ml/d					As a percentage					Number of options					Option Utilisation Ml/d					Utilisation %				
Category	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**	**2025/26**	**2039/40**	**2050/51**	**2060/61**	**2074/75**
Demand management and leakage	68	629	831	944	1,186	13%	33%	35%	37%	40%	0	54	60	60	60	68	629	831	939	1,186	15%	54%	57%	60%	64%
Desalination	0	40	50	70	70	0%	2%	2%	3%	2%	0	1	2	3	3	0	8	11	17	36	0%	1%	1%	1%	2%
Transfers into the region	0	90	90	90	90	0%	5%	4%	3%	3%	0	3	3	3	3	0	0	0	0	0	0%	0%	0%	0%	0%
Groundwater and new storage underground	6	33	35	35	35	1%	2%	1%	1%	1%	3	11	12	12	12	1	1	17	17	17	0%	0%	1%	1%	1%
Other (including drought measures)	431	460	275	278	282	84%	24%	12%	11%	10%	0	107	76	76	76	369	378	248	251	255	84%	33%	17%	16%	14%
Reservoir	0	325	328	328	328	0%	17%	14%	13%	11%	0	4	5	5	5	0	94	157	157	157	0%	8%	11%	10%	8%
Recycle and reuse	17	239	319	319	328	3%	13%	13%	12%	11%	0	5	10	10	11	1	49	186	193	200	0%	4%	13%	12%	11%
New options (excl internal transfers)	**521**	**1,816**	**1,927**	**2,063**	**2,318**	**102%**	**96%**	**81%**	**80%**	**79%**	**3**	**185**	**168**	**169**	**170**	**439**	**1159**	**1450**	**1575**	**1850**	100%	100%	100%	100%	100%
Existing																5,117	4,352	4,171	4,146	4,206					
Within region transfers	609	202,841	203,117	203,208	203,223						1	86	91	93	94	0	857	1,319	1,320	1,271		74%	91%	84%	69%

4. Demand management and leakage reduction data

4.1. The following table provides data by company and for the region to show the profile of demand management savings from changes in levels of services (temporary use bans and non-essential use bans) selected in the investment modelling.

Profiles of changes in levels of service by Company and for the region (1:500DYAA) - Ml/d

	2030/31	2035/36	2040/41	2045/46	2060/61	2074/75
Affinity Water	49.2	49.2	49.2	49.2	49.2	49.2
Portsmouth Water	17.3	17.3	17.3	17.3	17.3	17.3
SES Water	19.1	19.4	19.7	20.0	20.6	20.8
South East Water	10.4	10.4	10.4	10.4	10.4	10.4
Southern Water	10.3	10.4	10.4	1.1	1.1	1.1
Thames Water	103.4	96.3	98.5	101.8	105.8	109.2
South East Region	**209.7**	**203.0**	**205.4**	**199.8**	**204.5**	**208.0**

4.2. The following table provides data at a regional level which shows the increasing contribution of Government led measures to achieve the demand reductions over the planning period. It also indicates the level of savings associated with demand side drought intervention measures (Temporary Use Bans and Non-Essential Use Bans), which have been incorporated into the Plan solution.

Profiles of demand savings at Regional level (Ml/d)

Selected Portfolio	2025-6	2030-31	2035-36	2040-41	2045-46	2050-51	2055-56	2060-61	2065-66	2070-71	2074-75
Demand reduction schemes, of which	67.63	313.92	507.35	608.36	676.51	720.83	738.67	751.70	770.40	793.43	811.49
Leakage component	26.30	112.12	173.62	224.15	269.91	296.55	302.79	307.94	313.63	319.74	323.65
Water efficiency	41.33	201.80	333.73	384.21	406.60	424.28	435.88	443.76	456.77	473.69	487.84
Government interventions	0.00	12.28	25.23	34.53	71.20	109.78	142.36	188.07	256.63	326.39	374.13
TUBs and NEUBs	237.06	209.72	202.96	205.43	199.77	201.60	203.24	204.47	205.82	207.05	208.02
Total Reductions	304.69	535.92	735.54	848.32	947.48	1032.21	1084.27	1144.24	1232.85	1326.87	1393.64

5. New water sources

2025-2040 Period

5.1. The following table identifies the new resource options selected by the investment modelling for the South East region in the **1:500 DYAA scenario in the period 2025-2040.**

5.2. It should be noted that the options involving additional treatment works capacity do not generate additional water – they treat water that is provided through another option.

New Resource Options Selected (2025-2040) under 1:500 DYAA scenario
Abstraction licence trading
Third Party Trading Option at Didcot (Confidential)
Didcot Licence Trading
Artificial Storage and Recovery wells (or Aquifer Storage and Recovery (ASR))
Test Managed Aquifer Recharge
Conjunctive use operation of sources
Conjunctive Use benefit to London from Thames to Affinity Transfer (Phase 1)
Conjunctive Use benefit to London from Thames to Affinity Transfer (Phase 2)
Desalination
Sussex Coast Desalination
Hythe Desalination
Direct river abstraction
Severn Thames Transfer - initial development
Groundwater sources
Datchet Groundwater Source Improvement
Dorney Groundwater Source Improvement
New Groundwater source in AZ6 (EGHA)
Removal of constraints on DO at Epsom source
New Groundwater Source at Addington
Honor Oak Groundwater Source Improvement
Newchurch Groundwater Source Improvement
New Groundwater Source at Moulsford
Gravesend Groundwater Source Improvement
Tappington South Groundwater Source Improvement
New Groundwater Source at Romsey
New Groundwater Source at Woods Farm
Increase water treatment works (WTW) capacity
Removal of Licence Constraint at Dover
New Water Treatment Works at Kempton - Additional Phase
New Water Treatment Works AZ4 (IVER) (Phase 1) (part of the Thames to Affinity Transfer SRO)
New Water Treatment Works AZ4 (IVER) (Phase 2) (part of the Thames to Affinity Transfer SRO)
New Water Treatment Works AZ4 (NORM) (Phase 1) (part of the Thames to Affinity Transfer SRO)
Upgrade to Water Treatment Works at Itchen
New Water Treatment Works at Itchen
Upgrade to Water Treatment Works (East Kent)
Increase water treatment works (WTW) efficiency
Upgrade to Water Treatment Works at Pulborough
New reservoir
New Reservoir - Havant Thicket
New Reservoir - Blackstone
New Reservoir – Abingdon (South East Strategic Reservoir Option (SESRO) SRO)
Western Rother Catchment - New Winter Farm Storage and Changes to Abstraction Licences
Reclaimed water, water re-use, effluent re-use
Severn Thames Transfer imported
Aylesford WwTW Water Reuse
Peacehaven Water Recycling
Littlehampton Water Recycling
Transfer of Recycled Water to Havant Thicket Reservoir
New Water Reuse Works at Beckton

2040-2060 Period

5.3. The following table identifies the new resource options selected by the investment modelling for the South East region in the **1:500 DYAA scenario in the period 2040-2060**, identifying under which of the situations in the adaptive plan they are selected**.**

New Resource Options Selected (2040/41 - 2059/60) under 1:500 DYAA scenario	Selected under which situations		
	Situation 1	Situation 5	Situation 9
Abstraction licence trading			
Leatherhead Licence Increase	■		
Aquifer recharge /Artificial recharge (AR)			
Kidbrooke Artificial Recharge Scheme	■		
Merton Artificial Recharge Scheme	■		
Streatham Artificial Recharge Scheme	■		
Artificial Storage and Recovery wells (or Aquifer Storage and Recovery (ASR))			
Epping Aquifer Storage & Recovery	■		
Test Managed Aquifer Recharge	■	■	■
Thames Valley Central Aquifer Storage and Recovery	■	■	
Conjunctive use operation of sources			
Conjunctive Use benefit to London from Thames to Affinity Transfer (Phase 1)	■	■	■
Conjunctive Use benefit to London from Thames to Affinity Transfer (Phase 2)	■	■	■
Conjunctive Use of Surface Water & Groundwater - River Ouse	■		
Conjunctive Use of Surface Water & Groundwater - Upper Rother	■		
Desalination			
Bexhill Desalination	■		
Sussex Coast Desalination	■	■	■
Thanet Desalination	■		■
Hythe Desalination	■		
Isle of Sheppy Desalination (10 Ml/d)			■
Isle of Sheppy Desalination (20 Ml/d)	■		
Reculver Desalination	■		
River Thames Medway Desalination		■	

Direct river abstraction			
Severn Thames Transfer - further development			
River Thames Direct River Abstraction			
Groundwater sources			
Groundwater Licence Trade at Slough			
Groundwater Licence Trade (near Maidstone)			
New Groundwater Source in Noth London Confined Chalk			
Rye Groundwater source improvement			
Southfleet and Greenhithe new Groundwater Source			
Tappington South Groundwater Source Improvement			
Increase water treatment works (WTW) capacity			
Removal of Licence Constraint at Dover			
Transfer from Havant Thicket to Pulborough			
New Water Treatment Works in East London (Phase 2)			
New Water Treatment Works in East London (Phase 1)			
Upgrade to Water Treatment Works at Farlington (part of Havant Thicket development)			
New Water Treatment Works AZ1 (Phase 1) (part of the Grand Union Canal SRO)			
New Water Treatment Works at Kempton			
New Water Treatment Works at Kempton - Additional Phase			
New Water Treatment Works at Medmenham			
New Water Treatment Works AZ4 (IVER) (Phase 1) (part of the Thames to Affinity Transfer SRO)			
New Water Treatment Works AZ4 (IVER) (Phase 2) (part of the Thames to Affinity Transfer SRO)			
New Water Treatment Works AZ4 (NORM) (Phase 2) (part of the Thames to Affinity Transfer SRO)			
New Water Treatment Works at Itchen			
New reservoir			
Brent Reservoir Transfer to AZ4 (IVER)			
New Reservoir - Broad Oak			
New Reservoir - Broyle Place			
New Reservoir - Honeywick Rye			
New Reservoir – Abingdon (South East Strategic Reservoir Option (SESRO) SRO)			
Bewl Reservoir - Dam Raising			

Reclaimed water, water re-use, effluent re-use			
Severn Thames Transfer - imported			
Severn Thames Transfer - imported			
Ashford Water Recycling			
Aylesford Water Recycling			
Woolston and Portswood Water Recycling			
Broomfield Banks Effluent Reuse			
Hythe Water Recycling			
Peacehaven Water Recycling			
Faversham Water Recycling			
Horsham Water Recycling			
Hythe Effluent Reuse			
New Water Reuse Works at Beckton - Additional Phase			
New Water Reuse Works at Beckton - Additional Phase			
Sandown Water Recycling			

2060-2075 Period

5.4. The table below identifies the new resource options selected in the investment modelling for the period **2060-2075** under the 1:500 DYAA scenario, identifying under which of the situations in the adaptive plan they are selected. Situation 1 is the most challenging future and situation 9 is the least challenging future.

New Resource Options Selected (2060/61/41 - 2074/75) under 1:500 DYAA scenario	Selected under which situations								
	Situation 1	Situation 2	Situation 3	Situation 4	Situation 5	Situation 6	Situation 7	Situation 8	Situation 9
Desalination									
Thanet Desalination				■	■	■			
Isle of Sheppey Desalination				■	■	■			
River Thames Medway Desalination	■	■	■						
Direct river abstraction									
Severn Thames Transfer - further development	■								
Increase water treatment works (WTW) capacity									
Upgrade to Water Treatment Works at Farlington (part of Havant Thicket development)	■	■							
New Water Treatment Works AZ1 (HEME) (Phase 2) (part of the Thames to Affinity Transfer SRO)	■	■	■						
New Water Treatment Works AZ4 (NORM) (Phase 2) (part of the Thames to Affinity Transfer SRO)				■	■	■			
New water treatment works at Itchen				■	■	■			
New Water Treatment Works at Radcot	■	■	■	■	■	■			
Reclaimed water, water re-use, effluent re-use									
Hastings Water Recycling							■	■	■
Mogden Effluent Reuse Scheme	■	■	■						
Sandown Water Recycling				■	■	■			
Woolston Water Recycling	■								

6. Water transfers data

6.1. The plots in this section illustrate how water moves into and around the region, and how this will change under the proposals in our emerging plan.

6.2. 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.

6.3. Each of the plots shows transfers at a particular point in time, under different future situations. The thicker the lines between the WRZ, the larger the transfer.

6.4. 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.

6.5. All of the plots represent the position in the 1 in 500 DYAA scenario.

6.6. 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

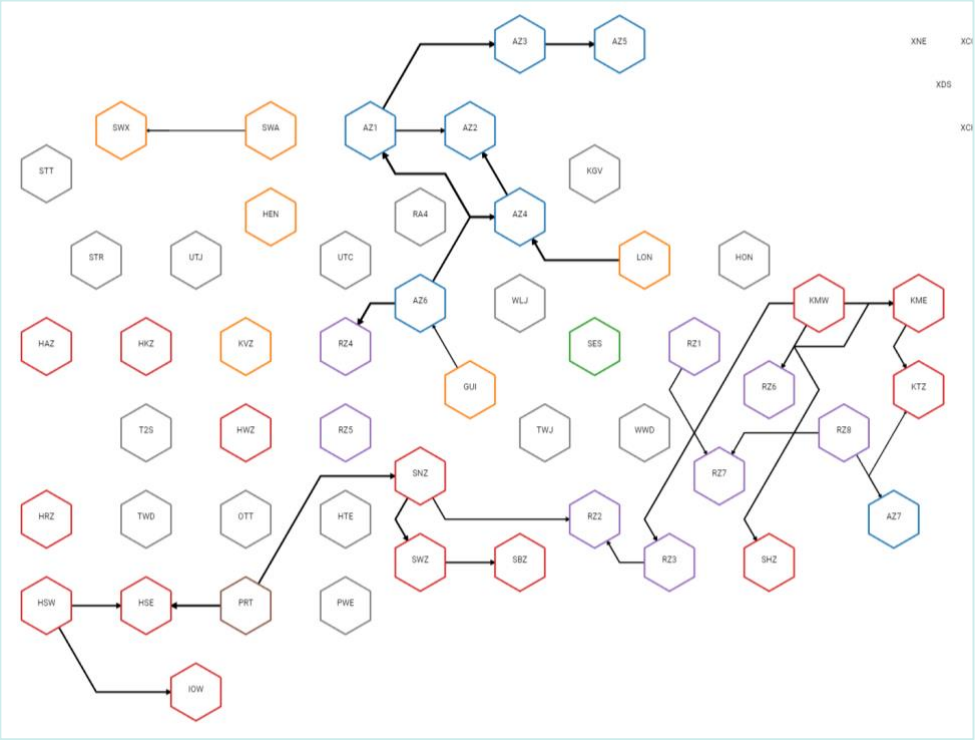
KVZ	Thames Water	Kennet Valley
LON	Thames Water	London
SWA	Thames Water	Slough, Wycombe and Aylesbury
SWX	Thames Water	Swindon and Oxfordshire

6.7. In addition, a number of zones have been included for investment modelling purposes only, which represent transfer and distribution constraints in the WRSE network. A list of these abbreviations are 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

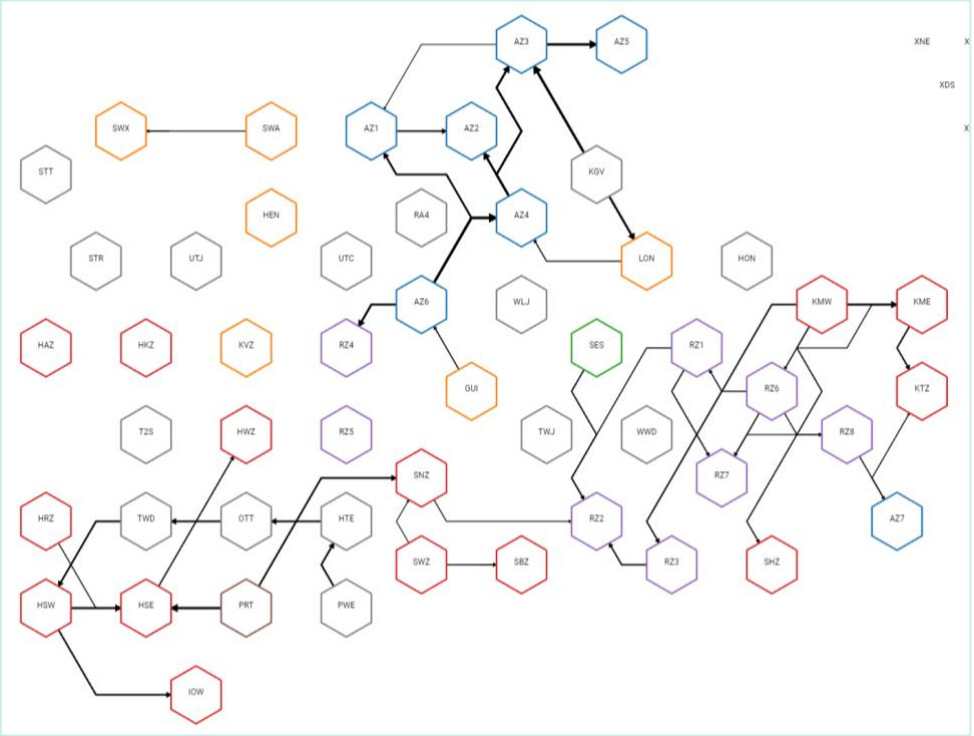
Existing Network (2026)

Figure 6.1 Transfers in 2026 at start of the plan period



Network at the end of the "root" branch (2039)

Figure 6.2 Transfers in 2039 before first split in situation branches



6.8. By the end of the "root" branch in 2039, there is generally increased connectivity across the network, including:

- New connections between Thames Water (LON London) and Affinity Water (AZ3 Lee)
- Increased internal connections at Affinity Water
- New connections between South East Water (RZ2 Haywards Heath) and SES Water (SES)
- New connections between Portsmouth Water (Havant Thicket) and Southern Water (Hampshire zones)
- New internal connections at South East Water (RZ1 Tunbridge Wells to RZ6 Maidstone)
- New internal connections at Southern Water (both in Kent and Hampshire zones)

Network in 2050

Figure 6.3 Transfers in 2050 under Situation 1 (most challenging future)

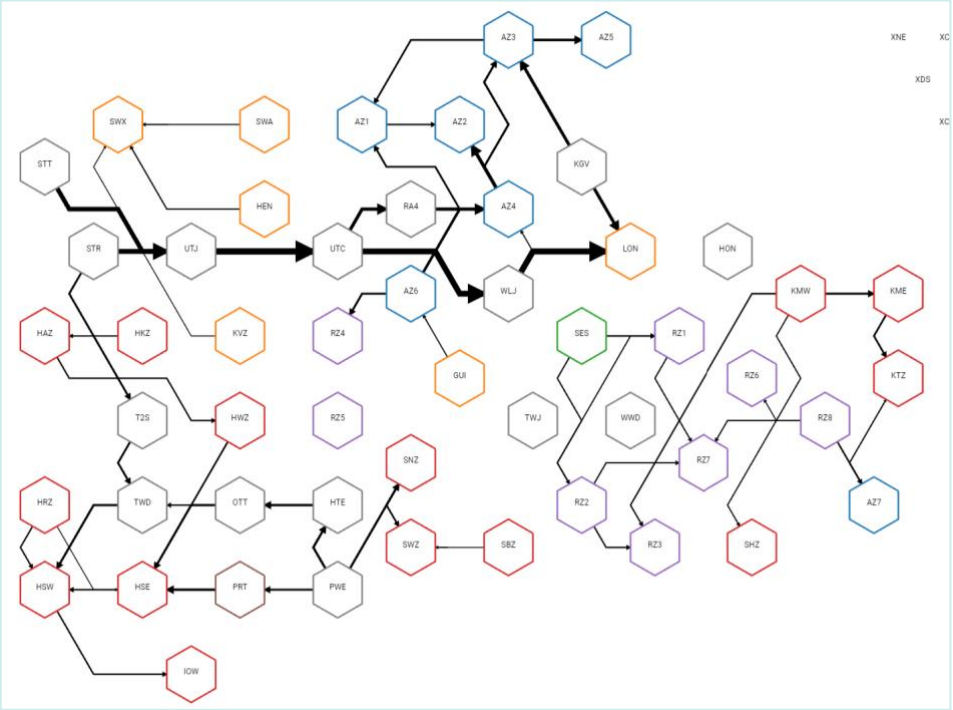
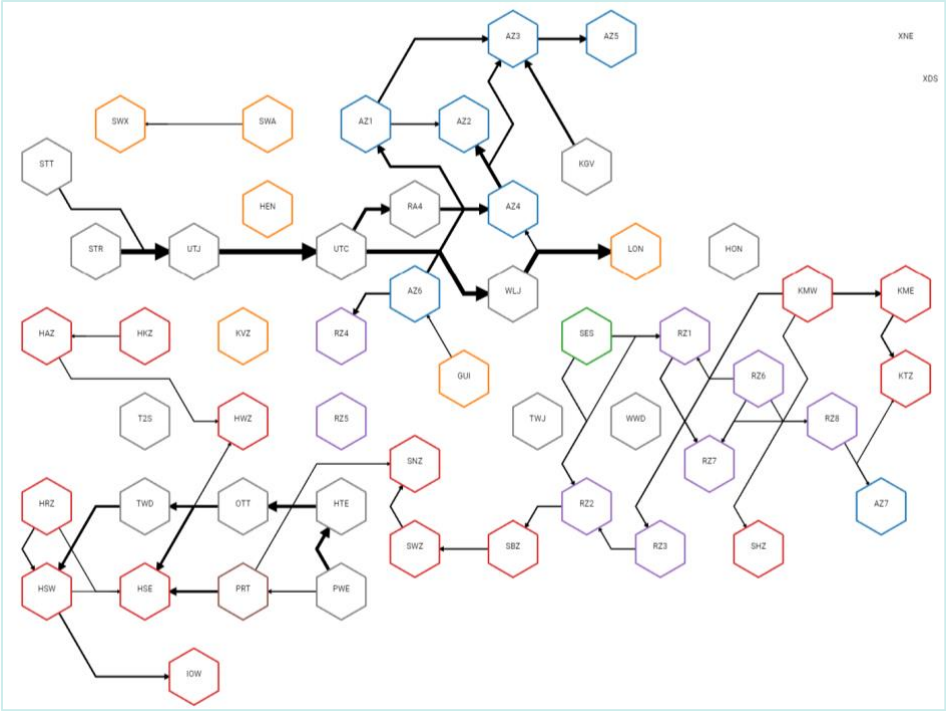


Figure 6.4 Transfers in 2050 under Situation 5



6.9. In 2050, across all three situations shown in Figures 6.3 to 6.5, there is generally increased connectivity related to the selection of four key strategic schemes:

- SESRO
- STT (connections not required under Situation 9)
- Thames to Affinity Transfer (connections not required under Situation 9)
- Thames to Southern Transfers (connections not required under Situation 5 or 9)

Network at the end of 2075

Figure 6.5 Transfers in 2050 under Situation 9 (least challenging future)

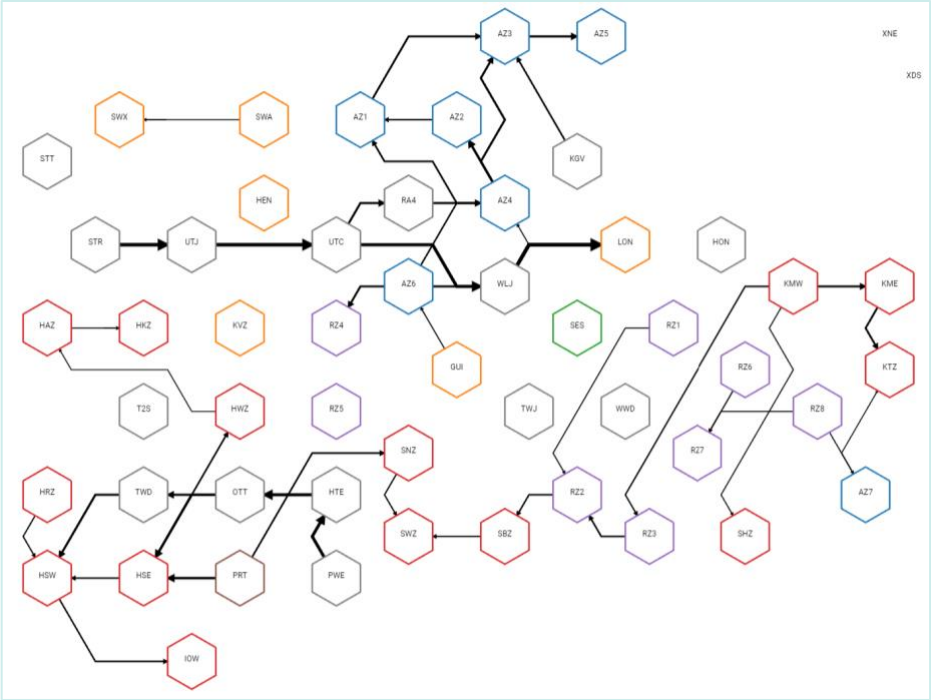
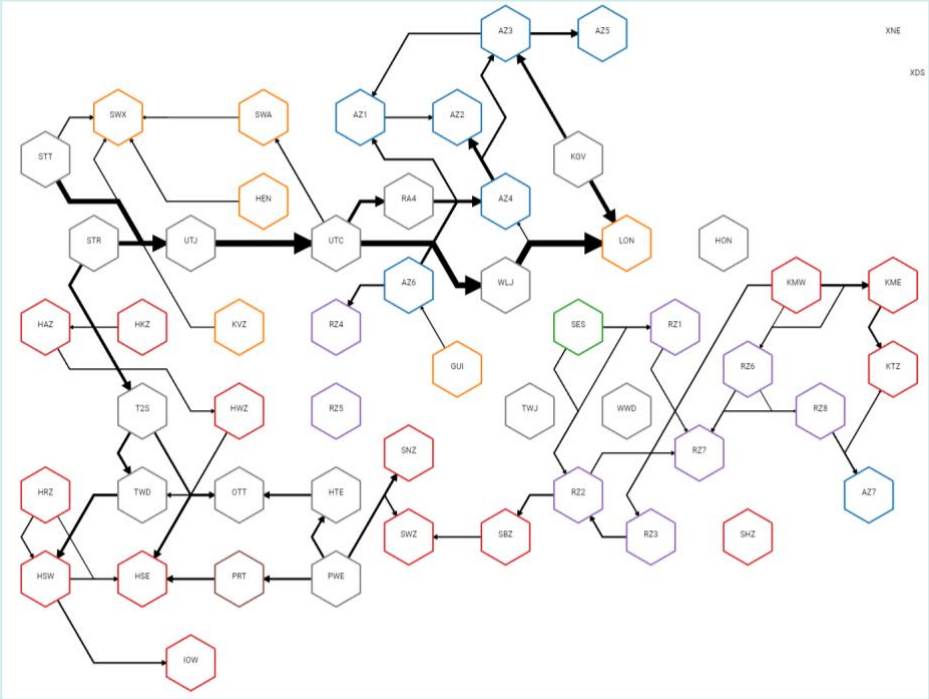


Figure 6.6 Transfers in 2075 under Situation 1 (most challenging future)



6.10. There is very little change in the regional network between 2050 and 2075, across all three situations represented in Figures 6.6 to 6.8.

Figure 6.7 Transfers in 2075 under Situation 5

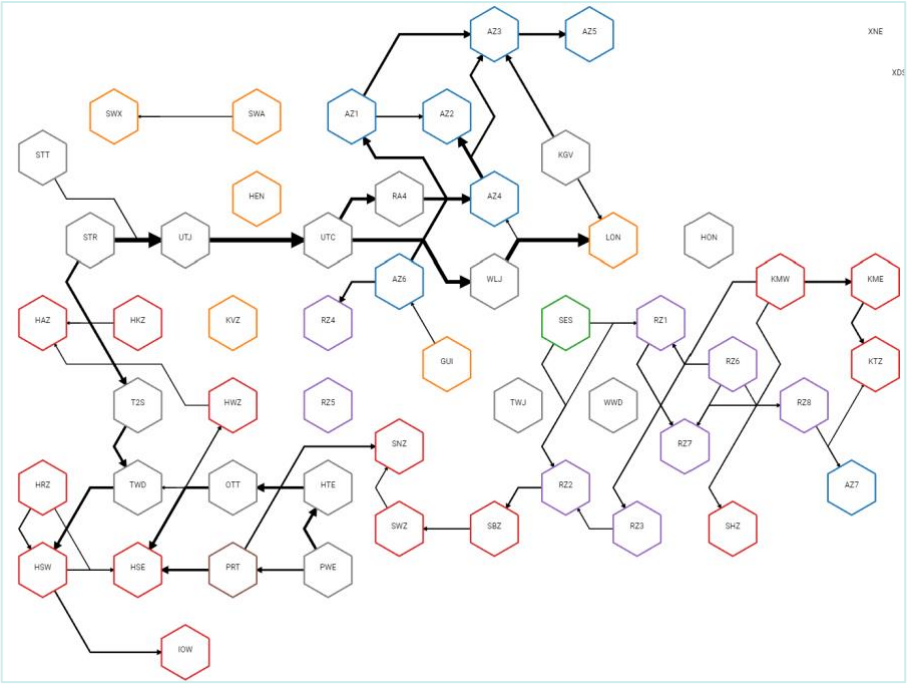
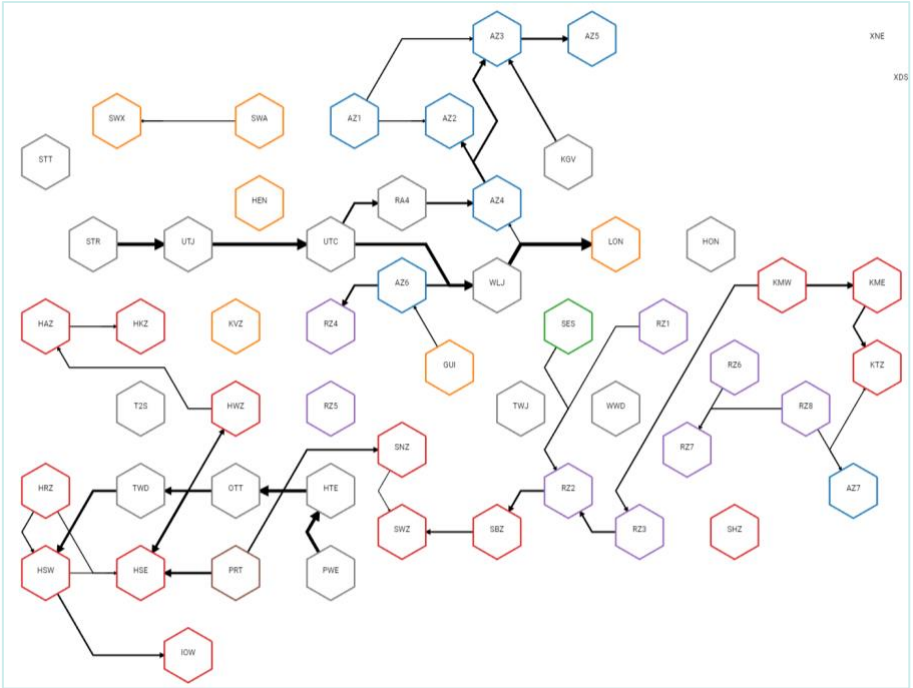


Figure 6.8 Transfers in 2075 under Situation 9 (least challenging future)



6.11. The table 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.

Transfers	2026	2040/41	2060/61	2075	Difference over the planning horizon
Imports to the region	91.0	262.1	406.9	419.8	328.8
Exports from the region	71.6	91.6	91.6	91.6	20.0
Inter regional transfers (import+export)	162.6	353.7	498.5	511.4	348.8
Net regional transfers (import - export)	19.4	170.5	315.3	328.2	308.8
Existing transfers between zones	324.6	532.7	586.8	582.2	257.6
New strategic transfers	-	30.0	172.8	185.1	185.1
Intra regional	209.2	455.5	647.0	643.6	434.3
Total water moved	371.8	809.2	1,145.5	1,155.0	1,534.7

7. Catchment and nature based solutions data

7.1. As part of the preparation of the emerging regional plan, companies put forward a series of portfolios of catchment management options for inclusion as potential options within the investment modelling. Further information on the consideration of options is set out in our separate Annex 4 (How we are developing our plan).

7.2. The table below identifies the portfolios of catchment management schemes that were put forward. The catchment schemes are wide ranging and involve actions by the companies and by other catchment management partners and other sectors, and require a combination of funding sources.

7.3. The companies will be undertaking additional work on the catchment schemes and will include details of their catchment management proposals in their draft Water Resource Management Plans (WRMPs) and draft Drainage and Wastewater Management Plans (DWMPs) later in 2022. These schemes would be identified for investigation, and/or implementation. The potential for any water resources benefit from catchment schemes will require further investigation, and the scale of any benefit will depend on the outcome of the investigations undertaken.

7.4. These options have the potential to provide wider environment and social benefits as well as benefits to water resources' and consideration for inclusion within the draft regional plan will form part of WRSE's ongoing best value planning phase of the work.

Catchment Management Portfolio	Summary Description of the Portfolio
Adur and Ouse	This portfolio consists of 7 individual options. This includes, 1 integrated catchment management option, 1 knowledge exchange, education and agricultural activity option, 1 nutrient and sediment reduction option, 2 pesticide reduction options, 1 river restoration option and 1 other option (investigating sediment and phosphate pollution).
Arun and Western Streams	This portfolio consists of 19 individual options. This includes 1 flow augmentation and licensing options, 2 knowledge exchange, education and agricultural activity options, 3 natural water retention measures (including NFM and wetland creation) options, 9 nutrient and sediment reduction options, 1 river restoration option and 3 terrestrial habitat creation/management options.
Cherwell and Ray	This portfolio consists of 3 individual options. This includes 1 knowledge exchange, education and agricultural activity option and 2 pesticide reduction options.
Colne	This portfolio consists of 19 individual options. This includes 4 integrated catchment management options, 1 knowledge exchange, education and agricultural activity option, 2 natural water retention measures (including NFM and wetland creation) options, 2 nutrient and sediment reduction option, 5 river restoration options, 2 SUDS options and 3 terrestrial habitat creation/management options.
Cotswolds	This portfolio consists of 23 individual options. This includes 2 flow augmentation and licensing options, 2 integrated catchment management options, 9 natural water retention measures (including NFM and wetland creation) options, 4 nutrient and sediment reduction options, 3 river restoration options and 3 terrestrial habitat creation/management options.
Cuckmere and Pevensey Levels	This portfolio consists of 14 individual options. This includes 1 fisheries management option, 2 knowledge exchange, education and agricultural activity options, 2 natural water retention measures (including NFM and wetland creation) options, 3 nutrient and sediment reduction options, 3 pesticide reduction options, 1 river restoration option, 1 integrated catchment management option and 1 terrestrial habitat creation/management options.
Darent and Cray	This portfolio consists of 1 individual natural water retention measures (including NFM and wetland creation) option.
East Hampshire	This portfolio consists of 15 individual options. This includes 1 flow augmentation and licensing option, 5 nutrient and sediment reduction options, 7 river restoration options and 2 terrestrial habitat creation/management options.
Gloucestershire and the Vale	This portfolio consists of 28 individual options. This includes 1 flow augmentation and licensing option, 4 integrated catchment management options, 2 knowledge exchange, education and agricultural activity options, 5 natural water retention measures (including NFM and wetland creation) options, 1 nutrient and sediment reduction option, 1 pesticide reduction option, 5 river restoration options, 4 SUDS options and 5 terrestrial habitat creation/management options.
Isle of Wight	This portfolio consists of 6 individual options. This includes 2 integrated catchment management options, 1 knowledge exchange, education and agricultural activity options, 1 natural water retention measures (including NFM and wetland creation) option and 2 river restoration options.
Kennet and tributaries	This portfolio consists of 1 individual option. This includes 1 river restoration option.
Loddon and tributaries	This portfolio consists of 5 individual options. This includes 1 knowledge exchange, education and agricultural activity option, 1 natural water retention measures (including NFM and wetland creation) option, 2 SUDS options and 1 terrestrial habitat creation/management option.

London	This portfolio consists of 12 individual options. This includes 1 integrated catchment management option, 1 knowledge exchange, education and agricultural activity option, 2 natural water retention measures (including NFM and wetland creation) option, 4 river restoration options, 2 SUDS options and 2 terrestrial habitat creation/management option.
Maidenhead and Sunbury	This portfolio consists of 11 individual options. This includes 1 integrated catchment management option, 1 knowledge exchange, education and agricultural activity option, 1 natural water retention measures (including NFM and wetland creation) option, 4 river restoration options, 2 SUDS options and 2 terrestrial habitat creation/management options.
Medway	This portfolio consists of 5 individual options. This includes 1 integrated catchment management option, 1 knowledge exchange, education and agricultural activity option, 1 natural water retention measures (including NFM and wetland creation) option, 1 nutrient and sediment reduction option, 1 pesticide reduction option and 1 other option (targeting septic tanks).
Mole	This portfolio consists of 12 individual options. This includes 1 knowledge exchange, education and agricultural activity option, 4 natural water retention measures (including NFM and wetland creation) options, 5 nutrient and sediment reduction option, 1 river restoration options and 1 terrestrial habitat creation/management option.
New Forest	This portfolio consists of 5 individual options. This includes 2 integrated catchment management options, 2 knowledge exchange, education and agricultural activity options and 1 nutrient and sediment reduction option.
North Kent	This portfolio consists of 3 individual options. This includes 2 nutrient and sediment reduction options and 1 river restoration option.
Roding, Beam and Ingrebourne	This portfolio consists of 5 individual options. This includes 1 knowledge exchange, education and agricultural activity options, 1 natural water retention measures (including NFM and wetland creation) option, 2 SUDS options and 1 terrestrial habitat creation/management option.
Rother	This portfolio consists of 5 individual options. This includes 1 knowledge exchange, education and agricultural activity option, 1 natural water retention measures (including NFM and wetland creation) option, 2 SUDS options and 1 terrestrial habitat creation/management option.
Stour	This portfolio consists of 7 individual options. This includes 1 integrated catchment management options, 1 knowledge exchange, education and agricultural activity option, 2 SUDS schemes, 2 Natural Water Retention measures (including NFM and wetland creation) and 1 terrestrial habitat and creation option
Test and Itchen	This portfolio consists of 1 individual option. This includes 1 nutrient and sediment reduction option.
Thames and South Chilterns	This portfolio consists of 6 individual options, including 2 SUDs scheme, 1 knowledge exchange, education and agricultural activity option, 1 Terrestrial habitat and creation option, 1 Natural Water Retention measures (including NFM and wetland creation) and 1 nutrient and sediment reduction option
Upper Lee	This portfolio consists of 28 individual options. This includes 1 flow augmentation and licensing option, 7 integrated catchment management options, 1 knowledge exchange, education and agricultural activity options, 2 natural water retention measures (including NFM and wetland creation) options, 13 river restoration options, 1 other (INNS scheme) and 3 terrestrial habitat creation/management options.
Wey and tributaries	This portfolio consists of 8 individual options, including 2 SUDs scheme, 1 knowledge exchange, education and agricultural activity option, 2 River Restoration schemes, 1 Terrestrial habitat and creation option and 2 Natural Water Retention measures (including NFM and wetland creation) options

8. Drought orders and permits

8.1. The table 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 2040.

Drought Permits and Orders selected (2025-2040) under 1:500 DYAA scenario	Company	DO (Ml/d) capacity
Bewl Water / River Medway Scheme (stages 1 to 4) Drought Permit/Order (2025 onwards)	Southern Water	17.00
Pulborough surface water (Phases 1 to 3) Drought Permit/Order (2025 onwards)	Southern Water	23.00
North Arundel Drought Permit/Order (2025 onwards)	Southern Water	2.50
East Worthing Drought Permit/Order (2025 onwards)	Southern Water	0.63
River Test Drought Permit (from 2027 onwards)	Southern Water	80.00
Woodnesborough Drought Permit/Order (2025 onwards)	Southern Water	1.27
Crayford (London) Drought Permit	Thames Water	2.80
Gatehampton (SWOX) Drought Permit	Thames Water	3.50
Wansunt (London) Drought Permit	Thames Water	6.00
Slindon Drought Permit	Portsmouth Water	8.50
Hackbridge drought permit	SES Water	4.00
Kenley and Purley drought permit	SES Water	2.10
Outwood Lane drought permit	SES Water	1.98
River Eden May drought permit	SES Water	0.30
River Eden Summer drought permit	SES Water	1.40
Total		**155.0**

9. Alternatives

9.1. A number of sensitivity tests have been carried out to examine the potential alternatives that might exist to the emerging cost-efficient plan described in previous sections. These have included sensitivity runs to interrogate the investment model set up, and sensitivity runs to test the alternative scheme selection if key schemes are made unavailable.

9.2. A summary of these sensitivity tests is displayed in the table below, with further details in the rest of this section.

Sensitivity Test Description	Summary of Impact on the Emerging Regional Plan
Modelling the full planning horizon to 2100	No significant impacts on the key strategic schemes selected. Increase in cost.
Changing the initial branch point from 2040 to 2035	No significant impacts on the key strategic schemes selected. Increase in cost.
Excluding the South East Strategic Resource Option (SESRO) (New Reservoir – Abingdon)	Alternative strategic schemes selected, and at larger capacities. Increased levels of demand management activities. More desalination and water recycling schemes. More reservoirs later in the planning period. Some small deficits remaining. Increase in cost.
Excluding all external imports to the region	Alternative strategic schemes internal to WRSE selected. Increased levels of demand management activities. More desalination and water recycling schemes. Increase in cost.
Excluding the Severn Trent Transfer (STT) SRO elements supported by Severn Trent Water - i.e. STT only supported by United Utilities	More water recycling and groundwater schemes, but no significant changes in strategic schemes selected. Similar cost to the emerging cost efficient plan.
Excluding all Government-led demand management activities which go beyond water labelling	Unable to meet the supply demand balance challenge – unresolved deficits in the sensitivity run.
Using the "Alternative" environmental ambition scenario	Fewer schemes selected, but generally the key strategic schemes are still selected (SESRO, Havant Thicket), but some with smaller capacities (STT). Generally lower demand management activities. Decreased cost compared to the emerging regional plan.

Modelling the full planning horizon to 2100

9.3. The cost efficient regional plan has been developed until 2075 due to practical reasons. For the best value plan this planning horizon will be extended out to 2100. To ensure there are no significant changes when extending the planning horizon, we have undertaken a sensitivity run which plans out to 2100.

9.4. To find a solution for this run some additional schemes from the potentially damaging environmental list of schemes had to be used later in the planning horizon to find an overall solution.

9.5. As we are planning for a longer period of time, more schemes are required and therefore the overall cost of the plan also increases. There are no significant changes to the key strategic schemes or demand management strategies selected when compared to the cost-efficient plan.

Changing the initial branch point from 2040 to 2035

9.6. The first branch point in the cost-efficient plan has been set at 2040 to take account of the policies being introduced into the plan at this point, and the limited variation in climate change and population forecasts up to 2040 relative to their future uncertainties.

9.7. The year 2040 also represents a point in time when the future environmental sustainability reductions would have been agreed to enable the final stages of delivery over the subsequent 10 years (i.e. by 2050).

9.8. In the sensitivity run, we have tested what would happen if the decision on environmental ambition could be made by 2035 – assuming that a final set of reductions can be agreed upon by this time (by regulators, water companies and other sectors affected), and that no further changes occur once the decision has been made. For this decision to be made by 2035, all the necessary investigations must be completed by 2031 in order to inform the final set of reductions and feed into the WRMP process to be delivered.

9.9. For such a decision to be made all the necessary investigative work and regulatory discussions would have to be completed by 2031 for them to be included in the draft regional plans and then company WRMPs in 2032; assuming that a similar sequential consultation process is still running in 10 years' time. These reductions would also have to be agreed with other sectors.

Sensitivity runs excluding key strategic schemes

9.10. A number of sensitivity runs have been undertaken to test the effects on the plan of excluding key strategic schemes which have been selected in the emerging cost-efficient regional plan.

9.11. This includes excluding:

- The South East Strategic Resource Option (SESRO) (New Reservoir – Abingdon)
- All external transfers coming into the region
- The Severn Trent Transfer (STT) SRO elements supported by Severn Trent, i.e. only elements of the STT SRO scheme which are supported by United Utilities
- Government-led demand management activities beyond water labelling.

9.12. When excluding SESRO and external strategic transfers in the sensitivity runs, the investment model generally selects larger capacity SRO schemes compared to the cost-efficient run, including for GUC, London Reuse and Thames to Affinity Transfer SROs. The levels of demand management activities also increase, with more high demand management strategies selected. The number and capacity of desalination and water recycling schemes also increases, and in the case of the SESRO sensitivity run, there are still some small remaining unresolved deficits in the supply demand balance.

9.13. The sensitivity run which excludes the Severn Trent elements of the STT SRO scheme has a relatively similar scheme selection and cost compared to the cost-efficient run. There are more water recycling and groundwater schemes, and also more London Reuse SRO schemes. There are relatively limited changes to the selected demand management strategies.

9.14. The investment model is unable to find a solution without significant deficits in the supply demand balance when excluding all Government-led demand management activities beyond water labelling.

Environmental ambition sensitivity runs

9.15. In terms of environmental ambition, sensitivity testing has been carried out to understand the difference between the four modelled scenarios; central, alternative, BAU+ and Enhance. In the 'alternative' scenario, the lower environmental ambition scenario, there are fewer schemes selected when compared to the emerging cost-efficient plan, so the plan is inevitably lower in cost. However the majority of the large strategic schemes are still included across the situations, although some are at lower capacities. The levels of demand management activities are also reduced.

10. Carbon

10.1. As noted in Annex 2, water companies have committed to reaching net zero operational carbon emissions by 2030, 20 years before the Government target of 2050. The water efficiency activity within the plan will help to reduce carbon emissions, however, many of the options in our regional plan will add to the companies' carbon emissions once they are operational. Therefore, implementing the regional plan will make it harder for companies to maintain net zero in the long-term.

10.2. Companies have provided information on carbon emissions associated with options as part of data upload to the WRSE options database. For resource options the following information was provided:

- Embodied carbon from the construction of infrastructure
- Carbon from electricity generation, which is provided in KWh (fixed and variable), which is then converted to carbon using emissions factors for the relevant year that the energy is consumed. Companies can also input if energy is supplied from the grid, self generated from renewable sources or from Renewable Energy Guarantees of Origin (REGO) – this then determines the emissions factors applied.
- Operating carbon (excluding electricity), primarily related to chemicals (fixed and variable)

10.3. Electricity and operating carbon can be provided as a fixed annual amount (per year) or as a variable amount (per Ml of water utilised).

10.4. The resulting profile of carbon is shown in the chart in Figure 10.1 below, with the total emissions in Table 10.1. The basis for these figures is the Situation 3, to 2075.

10.5. As can be seen from this information, we estimate that the additional operational activities driven by the plan, combined with the carbon associated with new infrastructure, could produce 14 MtCO2e (Metric tons of carbon dioxide equivalent) carbon emissions over the next 50 years.

Table 10.1: Estimate of emissions from 2021 to 2075 (situation 3)

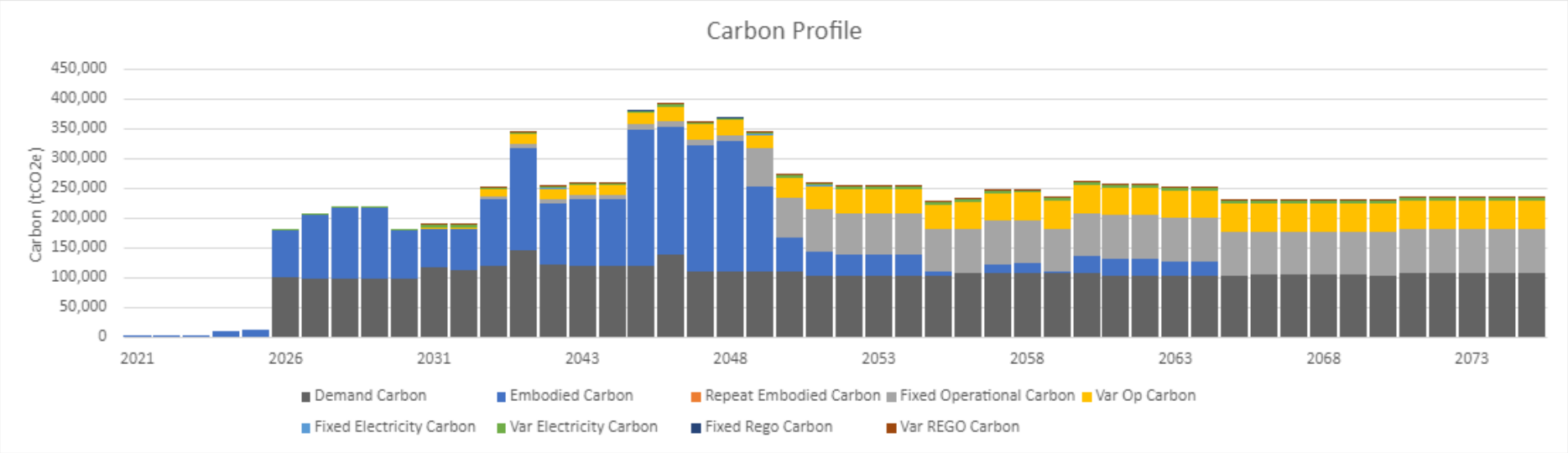
Type of Carbon	Total (MtCO2e)
Embodied Carbon	3,795,391
Repeat Embodied Carbon	1,057,423
Carbon associated with demand management activities	5,508,940
Fixed Operational Carbon	2,022,739
Variable Operational Carbon	1,394,096
Fixed Electricity Carbon	11,406
Variable Electricity Carbon	152,493
Fixed REGO Carbon	5,581
Variable REGO Carbon	1,603
Total	13,949,671

10.6. The following observations are relevant to the figures:

- The carbon from electricity is comparatively insignificant – this appears to be due to a combination of new lower grid emissions factors and relatively low utilisation
- Approaches for estimating embodied carbon emissions are not standardised across companies. Further work is recommended to increase consistency of carbon estimation across demand management programmes.
- The embodied carbon data have is currently under review pending update of carbon estimates for those items.
- With a longer planning horizon, to 2100, more options are likely to be required than is identified in the model run analysed above, giving a higher estimate of emissions.

10.7. The graphic in Figure 10.1 below shows that:

Figure 10.1 Carbon profile of the emerging regional plan



- Demand activities add a baseline level of carbon through the planning period. These include mains replacement and metering installation and replacement.
- Embodied carbon associated with infrastructure activities builds through the early part of the plan and then reduces after 2050
- As infrastructure comes online in the 2040s and 2050s so operational carbon increases and continues through the planning period

10.8. In the next phase of our work we will

- Optimise carbon as a best value metric which may bring forward low carbon options
- Complete an assessment on how emerging technology and innovation may reduce the carbon budget in the future
- Work with companies, regulators and others on how any additional carbon from the regional plan will be managed in the PR24 process.