Draft Water Resource Management Plan 2024

Appendix F – Decision making

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F Decision making

F1 Overview

This draft WRMP has been produced in the context of the Environment Agency's National Framework for Long Term Water Resources Planning and regional water resources planning. Severn Trent is a core member of Water Resources West and the objectives, decision making criteria and recommendations made in our draft WRMP are consistent with those in the wider regional plan.

In the sections below we describe our decision-making approach and how a wide range of considerations beyond construction and operating costs have informed the recommendations made in this draft plan. We have considered how our options could deliver wider value to the environment and society and we have demonstrated how our recommended best value plan compares to a more traditional least cost plan.

F2 Outline of our approach

Our decision-making approach follows the principles set out in the Environment Agency's draft Water Resources Management Planning Guidelines. Figure F2.1 illustrates how the stages of our approach correspond to those principles.

Figure F2.1: How STW's best value decision tools map to Chapters 9 & 10 of the EA's WRMP guidelines

EA's WRMP Guidelines	STW's Best Value Planning Tools		
Set Best Value Planning Objectives	Policy Expectations	SEA Scoping	Consultation
Develop Metrics	Valuestream		
Decision Making Approach	WISDM	DMU	Valuestream
Identify Least Cost Plan Baseline	WISDM	DMU	
Appraise & Compare Programmes	DMU Pathways		
Engagement	Internal: Board	WRW Consultation	STW Consultation
Assess Adaptive Plan Choices	DMU	SEA, WFD, HRA etc	Valuestream
Test the Plan	SEA, WFD, HRA etc	DMU	
Justify the Preferred Plan	Draft WRMP	Draft Regional Plan	

Appendix E of this draft WRMP explains how we have identified feasible supply and demand options and how we have evaluated their costs, benefits, environmental impacts and social impacts. We have used these costs, benefits and wider metrics within our decision-making models. Our decision-making models are an evolution of the investment optimisation tools we used for WRMP19 / PR19 and for our Green Recovery investment plans.

F3 Our Planning Objectives

The fundamental objective of our draft WRMP is to ensure a secure supply of wholesome drinking water for our customers while protecting and enhancing the water environment.

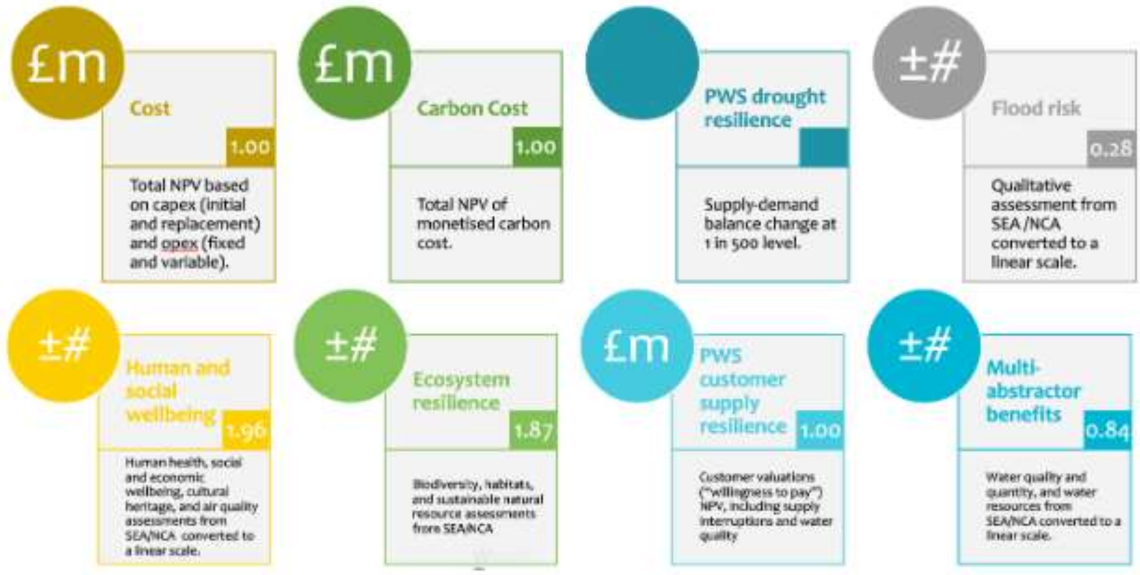
While our plan is driven by this fundamental objective, the decisions on how to achieve it are shaped by a range of regulatory policies as well as customers' and stakeholders' priorities. Ultimately, we seek to reconcile these different policies and priorities to present an overall best value plan that is affordable for customers and that provides wider benefits to the environment and society.

Using our understanding of the different policy requirements and stakeholders' priorities we have defined the high-level planning objectives shown in Figure F3.1. These objectives have shaped the options and decisions that we have taken to inform this draft WRMP.

Figure F3.1: WRW's and STW's water resources planning objectives

While these high-level objectives set the overall direction of travel for our plan, we have used the evidence from our ongoing customer and stakeholder engagement to define a series of quantified environmental and social cost metrics based around the outputs from our Strategic Environmental Assessment scoping consultation. These metrics have been used in our multi-criteria decision-making framework to inform our assessment of an overall 'best value' dWRMP. These multi-criteria metrics are summarised in Figure F3.2.

Figure F3.2: Definition of metrics and initial weightings



Sections 4 and 5 below describe the different government and regulatory policy objectives that our plan delivers, while Section 6 describes the different ways we have assessed how our dWRMP24 could impact on the wider environment and society. Section 7 then describes how we bring all of these different planning objectives together to optimise the solutions that will deliver the best value overall.

F4 Policy considerations

Our plan is shaped by the many policies and ambitions set by government and regulators for long term water resources planning. Below is a description of how these different policies and ambitions have been taken into account and how they affect our assessment of the best value plan.

F4.1 Leakage

The government has stated the expectation that companies will reduce leakage by a minimum of 50% by 2050 from 2017/18 levels with ambitious milestones to achieve this. This policy led leakage reduction goes beyond the traditional sustainable economic level of leakage and instead sets a performance target that we need to deliver in the most efficient way.

Our dWRMP24 approach prioritises leakage reduction over supply investment and is built around a plan to achieve a 50% leakage reduction by 2045. This is consistent with the long-term performance target originally set in WRMP19.

The delivery glidepath to achieve this long-term target has been informed by the size and timing of the emerging supply / demand deficits in our different water resources zones. Our PR24 investment plan will include the additional costs of proactive mains renewal, active leakage control, system optimisation, pressure management and technical innovation needed to achieve this long-term leakage performance.

F4.2 Metering and demand management

The government has set clear policy expectations that water companies should commit to actions required to reduce per capita consumption to 110 l/h/d by 2050.

To help achieve this target the government expects that:

- water companies consider all available water metering options and present their preferred metering programme in the draft WRMP along with evidence of customer support.
- smart meters become the standard meter installed, given the wider benefits or there should be justification for using older technology.
- water companies help customers reduce water demand and water lost through leaks by adopting consistent approaches to support repair and replacement of supply pipes.
- there will be more coordinated and strategic communications between companies, regional groups and retailers to encourage efficient use of water throughout the year and monitor the impacts of these messages on water consumption.

Our draft WRMP builds on the commitments made in our 2019 plan to achieve near universal household meter coverage by 2035.

In the 2019 WRMP we demonstrated that universal metering formed part of our best value long term plan, but in that plan, we proposed to achieve this goal using a ‘prompted optants’ approach. Since the 2019 WRMP, the Environment Agency has declared that our region is classified as a water scarce area and as such we now are able to use legal powers that allow us to roll out compulsory water meters. Our latest metering strategy has explored the different smart metering technologies available, and our chosen metering technology will allow us to target water lost through leaking supply pipes and will allow us to provide customers with accurate and up to date information on their water consumption.

Our metering strategy is accompanied by an enhanced water efficiency programme that will help customers to reduce water consumption and save money on their water bills. As a result, this draft WRMP prioritises water demand management and leakage reduction activities to achieve government policy expectations.

F4.3 Drought measures

Our Drought Plan includes details of the potential drought orders and drought permits that we may need to rely on under severe drought conditions.

For this latest draft WRMP, the Environment Agency has asked water companies to make plans to reduce the use of such drought measures in the future while Natural Resources Wales has instructed companies not to include any drought measures if they would have significant environmental impacts.

As such, the supply and demand investment plans described in our draft WRMP will allow us to achieve 1 in 500-year drought resilience and reduce the use of any drought permits or orders by 2040.

F4.4 Sustainable abstraction

The government expects water companies’ WRMPs to set a destination for environmental enhancement that will deliver a healthy and resilient environment. The government expects water companies’ plans to:

- be pro-active in understanding the short, medium and long-term risks to the environment, and identifying options to manage these.
- protect habitats that have statutory designations and/or have locally significant importance such as chalk streams.

- set out where, when and how abstraction will be sustainable, for example flow and groundwater level measures to support good status or to prevent deterioration of status.
- include appropriate catchment solutions and green infrastructure, based on strong stakeholder engagement and evidence, to maximise wider environmental benefits.
- conserve and enhance nature and the water environment, ensuring delivery of biodiversity net gain and using natural capital in your decisions to deliver wider environmental improvement and reduce risks from natural hazards.

The Environment Agency has provided technical guidance that describes how companies should plan to prevent growth in abstraction from impacting vulnerable water bodies. The Environment Agency has also provided detailed guidance on the environmental targets that should inform the long-term environmental destination and how these should be used in draft WRMP scenario planning. Table F4.1 sets out the Environmental Agency's expectations for short, medium and long term sustainable abstraction planning and describes how the BAU+ scenario should be used as the baseline scenario in the draft WRMP.

Table F4.1: Environmental Destination Planning Scenarios

Environment Agency Scenario	Supports Good Status (WFD) by 2027	Supports Good Status (WFD) by 2050	CSMG met for Protected Areas (European sites)	CSMG Met for SSSI's	Enhanced Abstraction Sensitivity Banding for Chalk	Enhanced Abstraction Sensitivity Band for Salmon
2025 Baseline (current planned action)	Yes	No	No	No	No	No
2050 Business as Usual (BAU)	Yes	Yes	No	No	No	No
2050 BAU+	Yes	Yes	Yes	No	No	No
2050 Enhanced	Yes	Yes	Yes	Yes	Yes	Yes
2050 Locally enhanced	Enhanced plus additional priorities					

Our draft WRMP is strongly shaped by these sustainable abstraction policy expectations and builds on the commitments we had already made in our 2019 WRMP. Our plan describes the investment we need to make between now and 2040 to prevent the deterioration of the water bodies from which we abstract.

Looking even further ahead to 2050 and beyond, our draft WRMP sets out the large-scale changes we would need to make to our water resources and supply network in order to achieve the environmental destination scenarios described by the Environment Agency.

F5 The Environment and Society

We have used multiple lines of evidence to test the costs and benefits of our different supply / demand options in order that we can demonstrate how our recommended dWRMP24 will deliver wider benefits to the environment and society. The types of evidence we have gathered ranges from monetary valuation of the externalities created by the options, through to a qualitative scoring assessment of the potential environmental and social impacts. These different lines of evidence have been collated and used to support the investment decisions that we recommend.

In the sections below we summarise these different sources of evidence and how we have used them to shape our preferred plan.

F5.1 Strategic Environmental Assessment

SEA is required under Statutory Instrument 2004 No.1633 - The Environmental Assessment of Plans and Programmes Regulations 2004. Throughout the course of the development of the plan, policy or programme, the aim of SEA is to identify the potential impact of options proposed in the plan in terms of their environmental, economic and social effects.

In this context, the purpose of the SEA of the draft WRW Regional Plan and WRMPs has been to:

- identify the potentially significant environmental effects of the draft plans in terms of the water resource management options being considered.
- help identify appropriate measures to avoid, reduce or manage adverse effects and to enhance beneficial effects associated with the implementation of the draft plan wherever possible.
- give the statutory SEA bodies, stakeholders and the wider public the ability to see and comment upon the effects that the draft plans may have on them, and encourage them to make responses and suggest improvements to the draft plans; and
- inform the selection of water resource management options to be taken forward into the final versions of the plans.

In summary the SEA identifies, describes and assesses the likely significant effects arising from the following aspects of the WRW Regional Plan and WRMPs:

- The revised feasible water resource options;
- The preferred water resources options;
- The preferred programme of options selected to comprise the preferred plan to address the supply demand deficit;
- Any alternative plans proposed to address the supply demand deficit;
- The interaction with the Strategic Resource Options (SROs) being taken forward by the companies;
- Any proposed WRW Regional Plan non-public water (non-PWS) supply options;
- Any cumulative, secondary and/or synergistic effects of implementing the plans.

Through the SEA scoping consultation in 2021 we defined a series of 17 headline objectives that we have used to assess each of our supply options. For each of these objectives we have assessed both the negative and positive impacts that each scheme option would have. An example of the initial assessment of the 17 SEA objectives are show in Figure F5.1 below.

Figure F5.1: Example of the initial assessment of the 17 SEA objectives considered

Option	Stage	1. Biodiversity	2. Sustainable Natural Resources	3. INNS	4. Soils, Geodiversity and Land Use	5. Water Quantity	6. Water Quality	7. Flood Risk	8. Air Quality	9. Greenhouse Gas Emissions	10. Climate Resilience	11. Economy	12. Tourism and Recreation	13. Human Health and Well-being	14. Water Resource Use	15. Waste and Resource Use	16. Cultural Heritage	17. Landscape
[illegible]	Construction (negative)	-/?	?	?	0	0	0	-	-/?	-/?	-	-/?	-	-	0	-	0	0
	Construction (positive)	0	?	?	+	0	0	0	0	0	0	+	0	0	0	0	0	0
	Operation (negative)	-/?	?	?	0	-/?	-/?	-	0	-/?	-	0	0	0	0	-/?	0	0
	Operation (positive)	0	?	?	0	0	0	0	0	0	+	++	0	++	+	0	0	0

An in-combination assessment of our preferred plan has been carried out and is described in the SEA report that accompanies this dWRMP24. Any material items that arise as a result of the in-combination assessment will be addressed between draft and final WRMP. If we find any material issues, we will seek alternative routes to the preferred pathway that perform better environmentally.

We have not carried out an in-combination assessment of the adaptive pathways that are described in dWRMP24 data table 7. Our adaptive pathways are solutions to more extreme and uncertain future supply/demand situations. We would not pursue these solutions unless they are required. Over the next two AMPs we will complete further investigations and monitoring to understand if these adaptive solutions are required. At that time we will complete in-combination assessments when we have more certainty that those solutions are required.

F5.2 Natural Capital and Ecosystem Services

We have worked with the other water companies that make up Water Resources West to develop a consistent methodology for undertaking a Natural Capital Assessment (NCA) assessments (including assessment of habitat enhancement opportunities) of our feasible options. We have also ensured that the approach is appropriate for the specific ecosystem resilience ambitions in Wales and wellbeing goals.

Our combined approach draws on the regulators' Water Resource Planning Guideline (WRPG) produced by the along with guidance from UK Water Industry Research (UKWIR, 2021) on the application of natural capital assessment to WRMPs. The methodology also draws on the principles of the Natural Capital Register and Account Tool (EA, 2021) and the approach outlined in Defra's Enabling a Natural Capital Approach (ENCA) (Defra, 2020).

For assessment of options in Wales, the methodology is consistent with the principles of Sustainable Management of Natural Resources, wellbeing goals and the supplementary guidance note "Setting an environmental destination for water resources: Enhancing ecosystems in Wales", recognising that these are supported by local area statements and associated ambitions. Our approach will consider the principles of ecosystem resilience to ensure that plans in Wales are consistent with Welsh Government policy, as well as aligning to the strategic aims of the all the WRW Companies.

The use of NCA assessment is an important part of our overall environmental valuation process and can highlight the opportunities for social and environmental gains as well as helping to engage with environmental stakeholders.

The purpose of NCA assessment is to evaluate the benefits and disbenefits to society that arise from changes to natural capital assets. The NCA approach sits alongside the SEA which, traditionally focusses on environmental impacts, and BNG which is concerned with habitat improvement for the purposes of ecosystem resilience rather than for the associated benefits to society.

The NCA, Strategic Environmental Assessment (SEA) and BNG assessments should be seen as complementary and the outputs of all three have been considered in decision-making.

F5.3 Habitats Regulations Assessment

Water Resources Management Plans are subject to the provisions of Regulation 63 of the Conservation of Habitats and Species Regulations 2017 (as amended) (the 'Habitats Regulations'). The water company has a statutory duty to prepare a WRMP and is therefore the Competent Authority for the HRA of that plan. For this dWRMP24 we have worked with the other water companies who make up Water Resources West to ensure we are following a consistent, regional assessment of the WRMPs against the provisions of Regulations 63 and (if required) 64, a process known as 'Habitats Regulations Assessment' (HRA). These HRAs will then support an HRA of our draft WRMP as well as the WRW Regional Plan.

Regulation 63 essentially provides a test that the final plan must pass; there is no statutory requirement for HRA to be undertaken on draft plans or similar developmental stages. However, as with Strategic Environmental Assessment (SEA), it is accepted best-practice for the HRA of WRMPs to be run as an iterative process alongside plan development to ensure that potential effects on European sites can be identified at an early stage and factored into the selection of options. In practice, therefore, HRAs of WRMPs have two functions: they informally guide each water company as it determines which water resource options will be included in the published WRMP (and hence the WRW plan); and they subsequently provide a formal assessment of the published WRMP against Regulation 63.

Our HRA of the feasible options included in our dWRMP24 has highlighted that a HRA Stage 2 Appropriate Assessment (AA) is required for a number of individual options, covering the preferred plan and alternative plan options. Additional in-combination assessment of options may also be required. The HRA Stage 2 AAs are being progressed and the outcomes are not yet confirmed.

The separate HRA report that accompanies our dWRMP24 is available on request.

F5.4 Water Framework Directive

Our plan is shaped in many ways by the legal requirements set out in the Water Framework Directive (WFD) regulations. WFD requires that we take action to prevent deterioration of the water environment, and this has been taken into account in our supply / demand forecasts and in our water supply options screening process. Our plan also needs to contribute to the government's long term aims of improving the water environment and achieving WFD targets. These WFD requirements have a material impact on our long-term plan:

- the Environment Agency's abstraction licensing policy requires us to cap many of our existing licences in the near term in order to prevent growth in abstraction that could cause future environmental deterioration.
- in the longer term, we are exploring the Environment Agency's environmental destination scenarios which will mean reducing future abstraction to support WFD flow objectives.

The combined effect of these licence capping and abstraction reduction requirements is that we need to invest in new supply capacity to provide alternative, more sustainable sources of supply. Where it is clear that a new supply option is likely to cause deterioration of a surface or groundwater body, we have removed that option from our plan. As a result, many options to further utilise our existing groundwater sources have been removed from this plan due to the risk of further deteriorating those groundwater bodies.

Our dWRMP24 explicitly considers how we will manage the risk of future deterioration caused by our abstractions and how WFD objectives influence the options included in our preferred plan. Overall, the WFD is one of the most material factors that drives the choices in our dWRMP24.

F5.5 Enhancing Biodiversity

We have worked with the other water companies that make up Water Resources West to develop a consistent methodology for undertaking a Natural Capital Assessment (NCA) and Biodiversity Net Gain (BNG) assessments (including assessment of habitat enhancement opportunities) of our feasible options. We have also ensured that the approach is appropriate for the specific ecosystem resilience ambitions in Wales and wellbeing goals.

Our combined approach draws on the regulators' Water Resource Planning Guideline (WRPG) produced by the EA along with guidance from UK Water Industry Research (UKWIR, 2021) on the application of natural capital assessment to WRMPs. The methodology also draws on the principles of the Natural Capital Register and Account Tool (EA, 2021) and the approach outlined in Defra's Enabling a Natural Capital Approach (ENCA) (Defra, 2020).

For assessment of the options in Wales, the methodology is consistent with the principles of Sustainable Management of Natural Resources, wellbeing goals and the supplementary guidance note "Setting an environmental destination for water resources: Enhancing ecosystems in Wales", recognising that these are supported by local area statements and associated ambitions. Our approach will consider the principles of ecosystem resilience to ensure that plans in Wales are consistent with Welsh Government policy, as well as aligning to the strategic aims of all the WRW Companies.

The use of NCA and BNG assessment is an important part of our overall environmental valuation process and can highlight the opportunities for social and environmental gains as well as helping to engage with environmental stakeholders:

- The BNG assessment demonstrates how options and plans can maximise biodiversity gain and facilitate the incorporation of BNG into supply option design. This will underpin delivery of wider environmental net gain through provision of improved habitat quality and quantity.

- The purpose of NCA assessment is to evaluate the benefits and disbenefits to society that arise from changes to natural capital assets. The NCA approach sits alongside the SEA which, traditionally focusses on environmental impacts, and BNG which is concerned with habitat improvement for the purposes of ecosystem resilience rather than for the associated benefits to society.

The NCA, Strategic Environmental Assessment (SEA) and BNG assessments should be seen as complementary and the outputs of all three have been considered in decision-making. The separate NCA and BNG assessment reports are available on request.

F5.6 Carbon

Severn Trent has committed to achieving net zero carbon emissions by 2030. It is important that the decisions we take in our dWRMP24 support this ambition and help us to maintain this performance over time. Therefore, our decision making explicitly considers the carbon impacts and costs of our supply and demand investment options.

One of the key metrics used in our decision making methodology is the carbon cost of the individual options available to us for our WRMP. This is key in helping us decide on our "best value plan". When assessing new options, we need to consider that adapting to climate change requires solutions which in turn have their own climate change impacts. These solutions will be designed to first reduce carbon ahead of offsetting. Carbon assessments of new options are assessed on a whole life carbon basis and utilise the latest government guidance[1].

The carbon metric we use is the net present value (NPV) of monetised CO_2 equivalent emissions as a result of constructing and implementing the option. It is measured in £m and has been calculated with reference to Water Resources Planning Guidelines (WRPG) together with the information below:

- UKWIR report Framework for Accounting for Embodied Carbon in Water Industry Assets (UKWIR, 2012) (12/CL/01/15).
- For carbon costs associated with the projected emissions - latest government guidance on the cost of carbon including the Green Book Supplementary Guidance.
- The Carbon Accounting (Wales) Regulations 2018
- Environmental Reporting Guidelines: Including streamlined energy and carbon reporting guidance'
- PAS 2080: Carbon Management in Infrastructure
- HM treasury Infrastructure Carbon Review
- Towards a Science Based Approach to Climate Neutrality in the Corporate Sector

The carbon cost for both embodied and operational carbon of each option has been assessed to calculate their value in tonnes of carbon dioxide (tCO2). We have developed a carbon tool to account for the embodied carbon of the assets that are proposed for construction. In addition to this, the tool captures the operational carbon of the proposed scheme and holds an integrated 'materials guidance' document that has been produced using the Inventory of Carbon and Energy (ICE) database of materials. Use of the tool is designed to aid the delivery of more carbon conscious projects and also aligns us with the regulatory requirements for carbon accounting.

F5.7 Supply Resilience

The water supply and demand options that we consider in the dWRMP24 are primarily designed to provide additional deployable output to our supply systems. The types of solutions that are considered are typically ones that increase supply / demand capacity and that will allow us to meet future growth and maintain supplies during droughts.

However, these solutions may also provide benefits to operational resilience and could help with our ability to cope with short term events that would otherwise disrupt customers' water supplies. We have captured these wider resilience benefits and we have included these in our appraisal of the different options and the overall value they provide.

As our preferred dWRMP24 takes shape we have also explored synergies with our wider PR24 investment plan. Outside of the dWRMP24 process there are many other drivers for investment in our water supply assets, such as improving supply resilience and protecting drinking water quality. There are instances where these multiple investment drivers require intervention at the same asset and where this is the case, we have explored opportunities to design a solution that can achieve all of these performance requirements in the most cost-effective way.

[1] https://www.gov.uk/government/collections/carbon-valuation--2

F6 Our Decision-Making Framework

We use a number of different decision-making tools and optimisation models that have helped us to understand the costs and benefits of the supply and demand options available to us. These tools range from qualitative assessments using simple scoring criteria through to quantitative assessments using weighted preferences and monetary valuations of wider environmental and social costs.

We use these different tools to collate the multiple lines of evidence needed to support our preferred investment choices and to understand the trade-offs, risks and sensitivities around those choices.

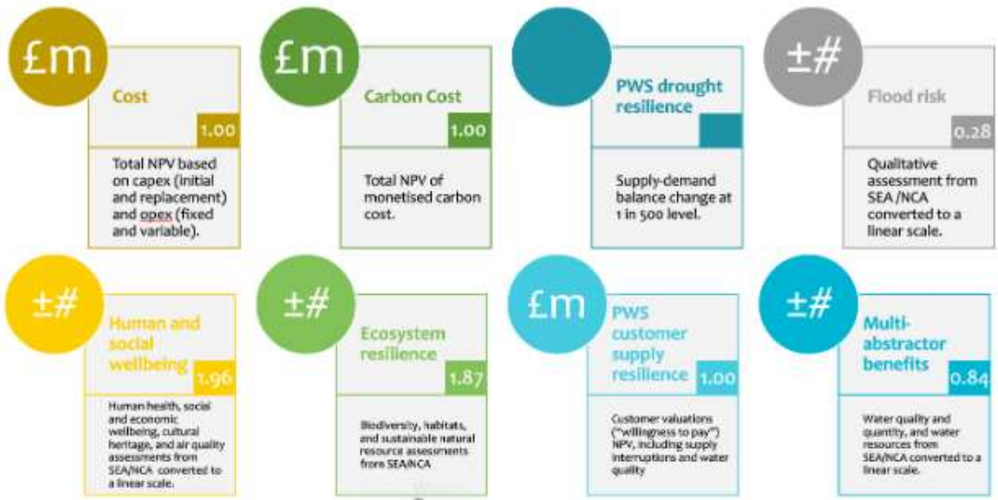
The framework for how these tools fit together and inform the overall best value plan is outlined in the sections below.

F6.1 Valuestream and Best Value Metrics

Working with Water Resources West, we are using a common methodology to use multi-criteria analysis (MCA) to incorporate a range of environmental and social cost metrics and objectives into our decision making. Water Resources West has developed the Valuestream tool that takes different value metrics which are then weighted and monetised according to relative preferences. These weighted metrics can then be used to form an optimisation that maximises value.

The water companies that make up Water Resources West are using a selection of eight common metrics to select the best value plan (see Figure F6.1).

Figure F6.1: The eight common of metrics and initial weightings



These metrics were defined and consulted on as part of Water Resources West's Emerging Regional Plan and the weighting of metrics has been informed by the understanding of customer preferences and stakeholder views as well as the technical definitions of the metrics.

These metrics have been used in Severn Trent's decision-making process to inform the best value programme of supply / demand options. A number of the metrics are derived from our wider Strategic Environmental Assessment, Natural Capital Assessment and Biodiversity Net Gain studies which strengthens how those environmental appraisals directly inform our decision making. For each supply option we have derived positive (benefits) and negative (dis-benefits) metric values and we consider these separately within our optimisation to avoid basing decisions on net values.

Severn Trent has taken these common Valuestream derived weighted metric values and has incorporated them into our DMU investment optimisation tool. Within the DMU these metric values are used alongside capital and operating costs to optimise the overall NPV of the programme to achieve the fundamental supply / demand balance target under a range of scenarios. More information on the DMU tool and our approach is given in section 6.4.

F6.2 WISDM

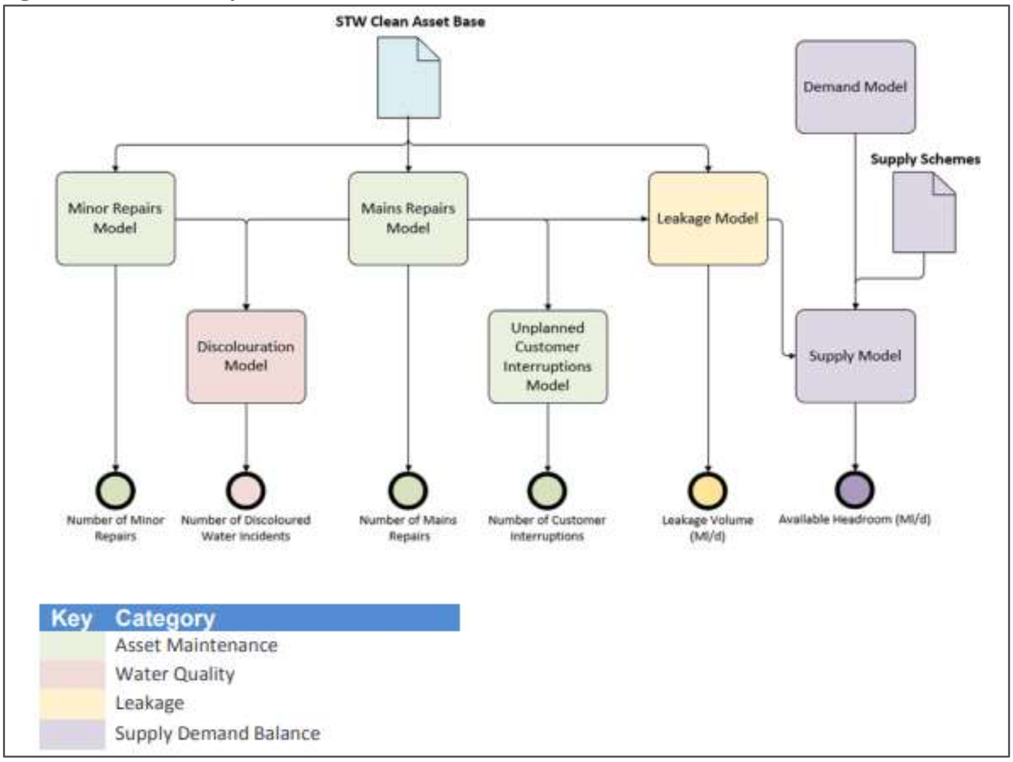
Our leakage investment plan has been derived using our Water Infrastructure Supply Demand Model (WiSDM). The model allows us to assess the costs and benefits of different levels of mains renewal, leakage reduction, demand management and metering alongside options to increase supply capability. The WiSDM model allows us to predict the future performance of our water distribution assets, the investment needed to achieve different levels of performance, and the scale of investment needed to make sure we have sufficient water supply to meet future demand. As a result, we can be confident that we are able to generate a truly optimised package of demand and supply investment measures needed to meet different planning scenarios, and we can fully explore the economics of different leakage decisions. Our approach means that the supply and demand solutions included in our dWRMP24 are fully integrated into the broader PR24 investment plans.

The WiSDM model is made up of six linked sub-models:

- Headroom
- Leakage
- Mains repair
- Interruptions
- Discolouration
- Ancillaries

The relationship between these sub models is illustrated in Figure F6.2.

Figure F6.2: The components of Severn Trent's WISDM model



There are essentially three primary sub-models that predict the performance of our infrastructure asset base; mains repairs, minor repairs and leakage. The mains repairs model calls upon the asset attributes such as pipe material, diameter, year laid and soil setting to generate a mains deterioration profile. The repairs, by failure mode and diameter are then input to two secondary sub-models; unplanned customer interruptions and discolouration.

The minor repairs model is driven by the weighted average mains age of each WRZ, a component of which is also used by the discolouration model (valve repairs).

The leakage sub-model contains the base level of leakage by WRZ and applies a leakage deterioration component (NRR), which is driven by the weighted average age and material type of mains in the WRZ.

Future demand and headroom requirements are also taken into consideration in the model. The integrated model calculates, for each water resource zone, the least cost mix of capital and operational interventions needed to prevent mains bursts and leakage increasing due to network deterioration, as well as to achieve the desired service targets for burst frequency, supply interruptions and leakage as well as maintaining target headroom throughout the planning horizon.

One of the most important outputs from the WISDM model is the optimised water resource zone leakage targets based on the infrastructure assets, cost of leakage reduction, cost of available water supply options and the long-term supply / demand balance. These optimised leakage targets then feed into our DMU model where we explore the uncertainties around future supply / demand scenarios and the uncertainties around the supply options themselves.

F6.3 DMU

The Decision-Making Upgrade (DMU) to our WISDM investment model gives us the ability to compute large amounts of supply / demand and options data, explore the uncertainty around investment decisions, investigate multiple alternative future pathways and present the results in a repeatable format. The DMU considers the uncertainty around the different supply intervention options and allows us to test the levels of certainty that we have around the model decisions.

The DMU model allows the supply / demand investment optimisation to more explicitly account for uncertainty parameters around the supply and demand options, as well as considering a range of alternative future scenarios. Unlike the WISDM model, the DMU is able to explore uncertainty around the investment decision options and to test the reliability of these decisions in achieving our supply / demand targets. For each supply investment option, the DMU considers the uncertainty around:

- Scheme cost (capex and opex)
- Scheme WAFU benefit Ml/d
- Scheme time to construct (years)

The DMU processes 100 optimisations for each scenario tested and, using Latin Hypercube sampling, tests the frequency and timing for each option investment decision based on the uncertainty around the scheme cost / benefit decision variables. For our draft WRMP we have tested 26 different supply / demand scenarios reflecting the uncertainty around future supply / demand pathways, and so have 2600 investment optimisations that inform the robustness of the supply investment decisions available to us across those different pathways.

The DMU model outputs have informed our internal decision making, and our ability to test the cost implications of meeting different stakeholders' expectations and what our whole life cost investment plan might look like under a range of alternative futures.

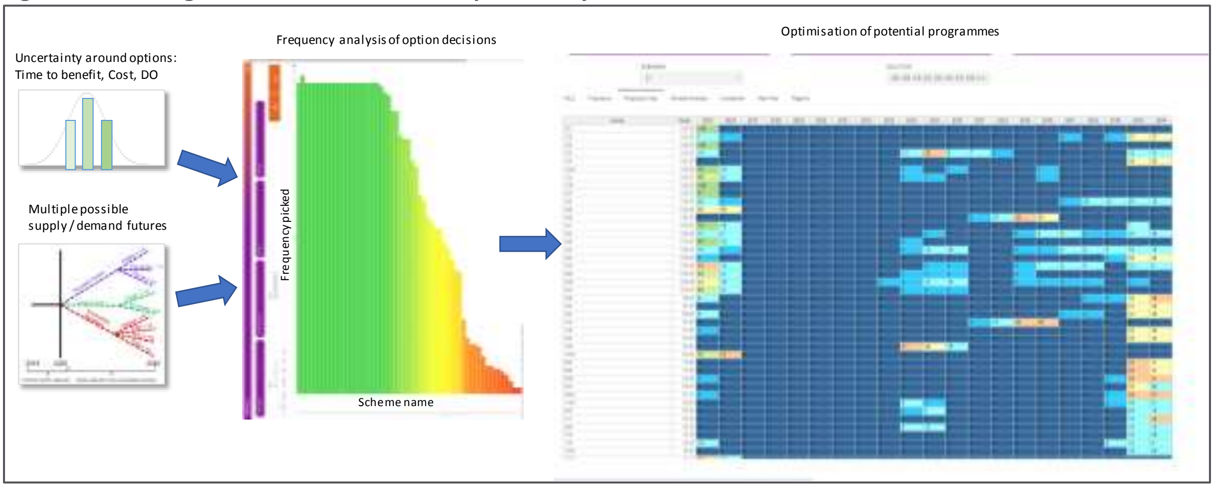
For this latest draft WRMP we have further enhanced the DMU model to explicitly incorporate the weighted multi-criteria metric values that are described in section 6.2 above. This enhancement means that we are able to optimise using a full suite of best-value metrics as well as a traditional cost-based optimisation and we can directly compare how the two approaches perform across multiple different supply / demand scenarios. This provides important evidence to demonstrate how our best value plan compares with our least cost plan.

We have used the DMU to model a large number of different supply / demand scenarios to examine how sensitive our investment decisions are to different planning assumptions. These scenarios represent different possible 'alternative futures' which have allowed us to test the sensitivity of our plan to different combinations of events. These alternative futures were generated by varying those supply / demand factors that have the greatest uncertainty, including long term environmental destination, climate change and future demand for water. Each scenario used a bespoke "water available for use" profile reflecting the deployable output impacts of the component being investigated and a "high", "mid" or "low" demand profile.

From the DMU analysis we are able to build an understanding of how the different scheme options perform in many different supply / demand scenarios and how sensitive those decisions are to the cost, benefit and timing of those options. We are also able to explore how sensitive those investment decisions are to the best value metrics and whether a truly least cost plan would lead to different investment decisions.

Figure F6.3 below illustrates examples outputs from the DMU modelling and illustrates the probability analysis showing how frequently specific schemes get picked across all 100 scenario optimisations, and the analysis indicating the timing of when those schemes are chosen.

Figure F6.3: Using the DMU to understand probability of scheme decisions



Section 7 gives more explanation of the supply / demand scenarios we have tested and how the DMU optimisation has informed our adaptive pathways.

F7 Adaptive Planning

Our draft WRMP describes how we will maintain the long-term supply and demand for water in an uncertain future. In the preceding dWRMP24 appendices we have described how population and housing growth, climate change and environmental impacts could affect the future security of public water supplies. We can make informed projections of how these different drivers are likely to change over time, but the further ahead we look the less certainty we can have.

At the same time, we are able to make informed assumptions around the different interventions we can make to influence future water demand or improve water supply. However, there are uncertainties around the benefits and deliverability of the supply and demand schemes we may deliver. For example, environmental constraints mean that future water supply solutions may become increasingly complex to construct and deliver.

Our dWRMP24 explicitly considers these different elements of planning uncertainty. Our decision-making approach and investment modelling has explored a wide range of potential future supply / demand scenarios and we have tested the robustness of our decisions based on the confidence we have in our investment options.

As a result, our dWRMP24 describes the low-regret decisions that we need to take in the near term to ensure we can adapt to known supply and demand changes between now and the 2030s, such as the Environment Agency's abstraction licence capping policy. Our dWRMP24 also describes the different decisions that we may need to take in the very long term to 2050 and beyond, such as protecting the water environment from the impacts of climate change. We present our preferred plan which is based on our best estimates of what the future might look like, and we also present alternative future pathways that demonstrate how we will adapt to changing circumstances.

In the sections that follow we describe the scenarios that have informed our dWRMP 24 and we set out our recommendations for how we will ensure long term security of supply while managing uncertainty.

F7.1 Baseline Scenario

The baseline scenario is the starting point for understanding the scale of our future potential supply / demand investment needs.

Under the future demand baseline scenario we quantify what water consumption would look like if we were to take no further action to help customers be more water efficient and if we simply maintained leakage performance at 2024-25 levels. Under this scenario, demand for water would grow due to increasing population and non-household water use and total leakage would remain at 2025 levels. Further details can be found in Appendix B.

Under the future supply baseline we quantify how our water supply system would perform without any investment to offset known abstraction licence changes, water quality deterioration, impacts of climate change and the long-term abstraction reductions needed to achieve the Environment Agency's BAU+ environmental destination scenario. Further details can be found in Appendix A.

The details of the future supply / demand deficit under the baseline scenario are found in dWRMP 24 data tables *3A Baseline.*

F7.2 The Most Likely Pathway

While the baseline scenario describes our assessment of what the future supply / demand balance would look like if we did not intervene, the most likely pathway describes our best understanding of how we propose to maintain future supplies and mitigate for future uncertainties. Under this pathway we make 'best central estimates' of what the future supply and demand for water might look like along with our recommended interventions to ensure we can maintain security of water supplies. Throughout the planning period we will continue to investigate new supply opportunities such as trading water rights with third parties, and we reserve the right, where there is benefit to our customers and the environment, to amend our plan and schemes accordingly.

The traditional WRMP approach recognises that there is increasing uncertainty around these 'best central estimates' of future supply and demand and so we plan to maintain a minimum level of headroom to accommodate these increasing uncertainties.

The details of the future supply / demand balance under the most likely scenario are found in dWRMP 24 data tables *3F Final Plan.*

F7.3 Core Pathway

The core pathway aligns with Ofwat's PR24 business planning approach to long term delivery strategies. Ofwat defines the core pathway as one that is "*…designed to support long term adaptive planning by identifying no-and low-regret options in the first instance…. It is not a central or most likely pathway*".

The core pathway should include the following:

- No and/or low regrets investments, for example investments that are required:
    - In both benign and adverse scenarios
    - Across a wide range of plausible scenarios; or

- Need to be undertaken to meet short term requirements; and
- Investment required to keep future options open (such as enabling work and monitoring), where possible, or is required to minimise the cost of future options.

Therefore, the core pathway should include all activities that need to be undertaken to be ready for all plausible future scenarios. Activities which could only be carried out under certain circumstances, such as under more adverse future scenarios, are then set out in alternative pathways (see section 7.4 below). This provides a framework for assessing the likely best timing for 'higher regret' investments, taking into account factors such as long-term efficiency, future uncertainties, customer preferences and fairness between current and future customers.

For our dWRMP24, the core and the most likely scenarios are effectively the same for AMP8 and AMP9 due to the certainty of the 2030's supply / demand deficits being driven by the effects of the EA's abstraction licence capping policy.

F7.4 Scenario Testing and Alternative Pathways

For dWRMP24 we have adopted an adaptive pathways approach to our supply / demand investment modelling. As well as presenting our assessment of the most likely supply / demand future scenario, we have also explored a wide range of plausible alternative future scenarios. Many of the factors that will influence future water supply and demand are highly uncertain and can be largely outside of our direct control. The advantage of an adaptive planning approach is that it allows us to test how robust our investment decisions might be in different scenarios, and it allows us to better understand when critical investment decisions might need to be taken.

To inform our decision making we have identified which key planning assumptions would have a material impact on our plans if they were to deviate from the best central estimate. We have then quantified alternative projections of the future supply and demand for water that could arise under these alternative scenarios. For example, our most likely plan uses climate change assumptions based on the median RCP6.0 projections of global greenhouse gas emissions, but we have also explored what investment would be required if the effects become more severe or if future emissions follow the RCP8.5 higher emissions pathway. We have also tested the sensitivity of our investment decisions against Ofwat's common reference supply / demand scenarios.

The full range of scenarios we have so far used to inform our investment planning and decision making is shown in Table F7.1. These scenarios explore different projections of demand, climate change impacts and environmental needs. We have also explored the materiality of certain key investment decisions, for example the use of the option to transfer water from United Utilities' Vyrnwy Reservoir into the River Severn. Each of these scenarios has been considered to be an equally likely, discrete scenario and we have used our DMU investment modelling to explore how our investment choices would perform in each of these. Therefore, we do not include increasing headroom uncertainty in these adaptive pathway investment scenarios. We have also tested how our 'best value' decisions might differ from our 'least cost' decisions.

Table F7.1: Supply / Demand investment planning scenarios tested through DMU

Scenario Ref	Scenario name	Summary
6	March 22 Core + Mid CC	This is the 'core' scenario but with no CC & demand headroom allowance - to inform adaptive pathways
7	25% ED + Mid CC	This is the core scenario plus a smaller Environmental Destination scenario but with no 7CC & demand headroom allowance - to inform adaptive pathways
8	50% ED + Mid CC	This is the core scenario plus a medium Environmental Destination scenario but with no CC & demand headroom allowance - to inform adaptive pathways
9	75% ED + Mid CC	This is the core scenario plus a larger Environmental Destination scenario but with no CC & demand headroom allowance - to inform adaptive pathways
10	BAU ED + Mid CC	This is the core scenario plus the full 'BAU' Environmental Destination scenario but with no CC & demand headroom allowance - to inform adaptive pathways
11	Enhanced ED + Mid CC	This is the core scenario plus the full 'Enhanced' Environmental Destination scenario but with no CC & demand headroom allowance - to inform adaptive pathways
12	High climate change	The driest of the UKCP18 RCM scenarios. This is the upper limit of the climate impact scenarios and so no additional uncertainty included in headroom - to inform adaptive pathways
13	Low climate change	The wettest of the UKCP18 RCM scenarios. This is the lower limit of the climate impact scenarios and so no additional uncertainty included in headroom - to inform adaptive pathways
14	BAU ED + High CC	The full BAU environmental destination plus the driest of the UKCP18 RCM scenarios. This is the upper limit of the climate impact scenarios and so no additional uncertainty included in headroom. - to inform adaptive pathways
15	BAU ED + Low CC	The full BAU environmental destination plus the wettest of the UKCP18 RCM scenarios. This is the upper limit of the climate impact scenarios and so no additional uncertainty included in headroom - to inform adaptive pathways
30	Ofwat low CC scenario	The low climate change Ofwat's common reference scenarios
31	Ofwat high CC scenario	The high climate change Ofwat's common reference scenarios
32	Ofwat low demand scenario	The low demand Ofwat's common reference scenarios
33	Ofwat high demand scenario	The high demand Ofwat's common reference scenarios
34	Ofwat low ED scenario	The low environmental ambition from Ofwat's common reference scenarios
38	Compound Ofwat high scenario	This is a compound of Ofwat's high scenarios and is used for WRW's inter-regional reconciliation exercise
39	Compound Ofwat low scenario	This is a compound of Ofwat's low scenarios and is used for WRW's inter-regional reconciliation exercise

We have used this insight to inform our low regret investment decisions that should be prioritised for the early period of the plan, as well as the decisions that would need to be taken in the longer term if the more extreme scenarios start to materialise. This approach gives us a better understanding of how future uncertainty might affect our decision making, rather than simply adding in an increasing headroom allowance on top of a single, best central estimate of the future.

As an example, Figure F7.1 illustrates the materiality of a sample of these different planning scenarios and assumptions for the Strategic Grid and shows that:

- Scenarios 1 and 4 reflect the traditional WRMP approach of planning to maintain headroom around a single 'best central estimate' of the future. The range of difference between these two scenarios shows the magnitude of lost deployable output resulting from the long term environmental destination requirements in the Strategic Grid zone.

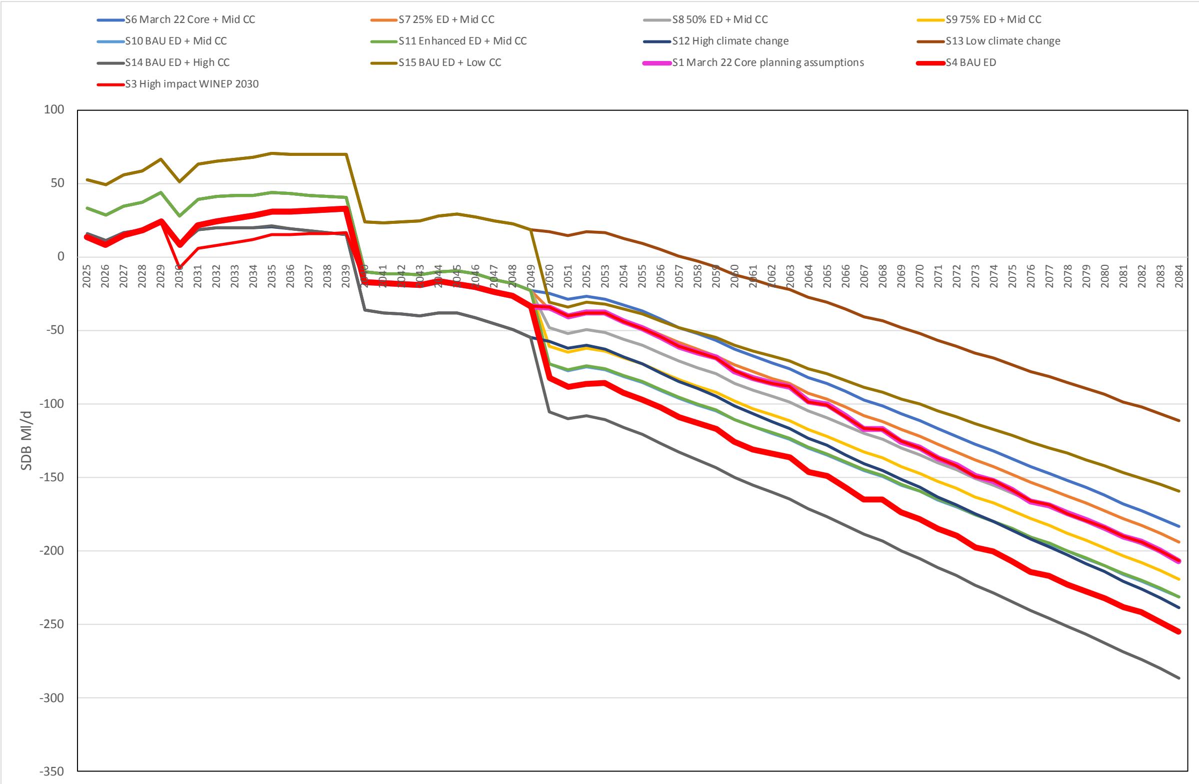
- Scenarios 5-15 reflect the adaptive pathways approach to our WRMP planning and show the different supply / demand impacts that would result from plausible different futures. We do not make any judgement on which of these futures is more or less likely to occur, but rather we test the robustness of our decision making against each of these futures and we establish what might be considered no / low regret decisions.

- In the first 10-15 years of the dWRMP there is relatively high certainty around the magnitude of deployable output that will be lost as a result of abstraction licence capping to prevent WFD deterioration. However, there is uncertainty around the timing of when those licence caps should be made and the magnitude of impact on our investment planning choices is material.

- Beyond 2040 there is a very wide range of uncertainty around the impacts of the long term environmental destination on our deployable output. The magnitude of this uncertainty will have material impacts on the investment decisions we make and so it is important that we identify the milestones at which we will know more and the decision points when we will need to take action.

- Across the full planning period of the dWRMP there is high uncertainty around the magnitude of climate change impacts on our supply / demand balance. We cannot have confidence about which of the climate impacted futures will materialise and so we need to be confident how our investment decisions will perform in each of these potential futures.

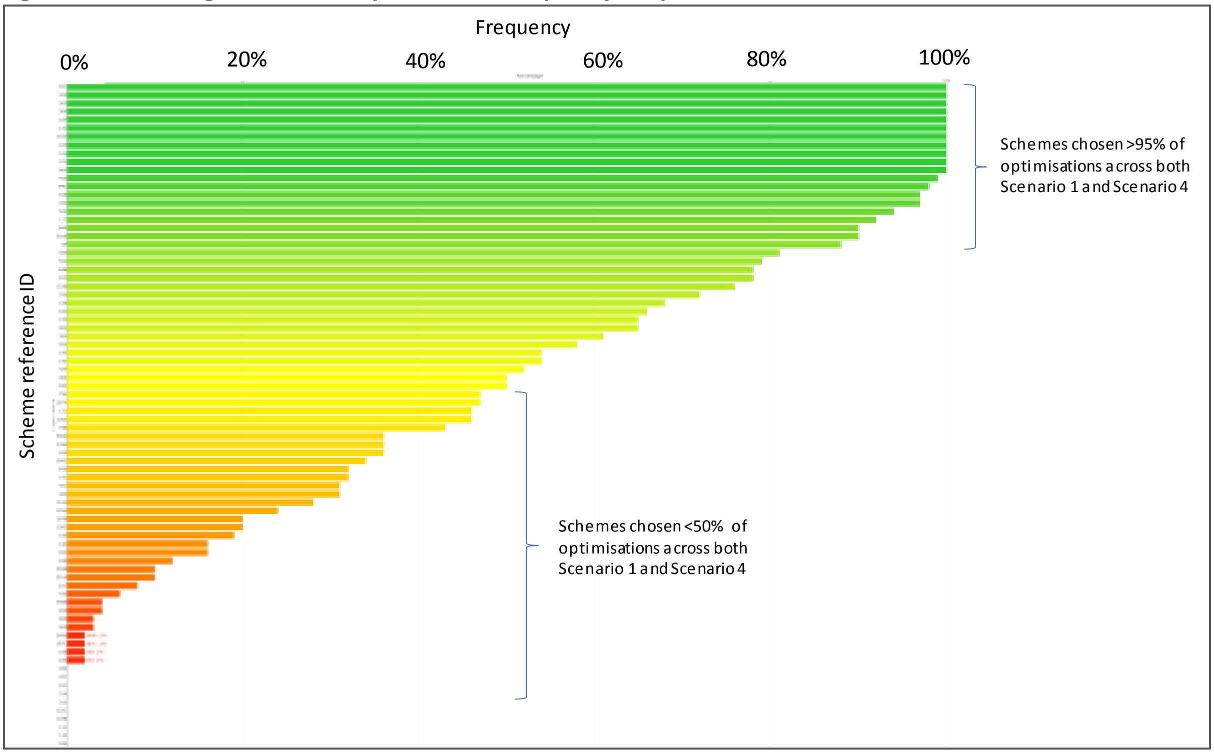
Figure F7.1: Strategic Grid future SDB pathways



We use our DMU investment modelling tool to explore the different investment options we have available to maintain future supply / demand balance. The DMU modelling approach allow us to explore multiple potential supply / demand scenarios as well as the uncertainty around the investment decisions that we have available. Using this approach we can get insight into those 'low regret' decisions that are robust to a wide range of very different future scenarios and we are able to identify the timing of when those investment decisions will need to be made.

Figure F7.2 follows on from the different supply / demand pathways illustrated in figure F7.1 above. Figure F7.2 illustrates the frequency that individual water supply options are chosen in both scenario 1 (core) and scenario 4 (WRMP baseline). The only difference between these two scenarios is the magnitude of impact arising from the long term environmental destination scenario – scenario 1 assumes that there is no deployable output lost to environmental destination whereas scenario 4 includes the full deployable impact losses associated with the Environment Agency's BAU+ scenario.

Figure F7.2: Strategic Grid DMU optimisation frequency outputs for scenario 1 and scenario 4

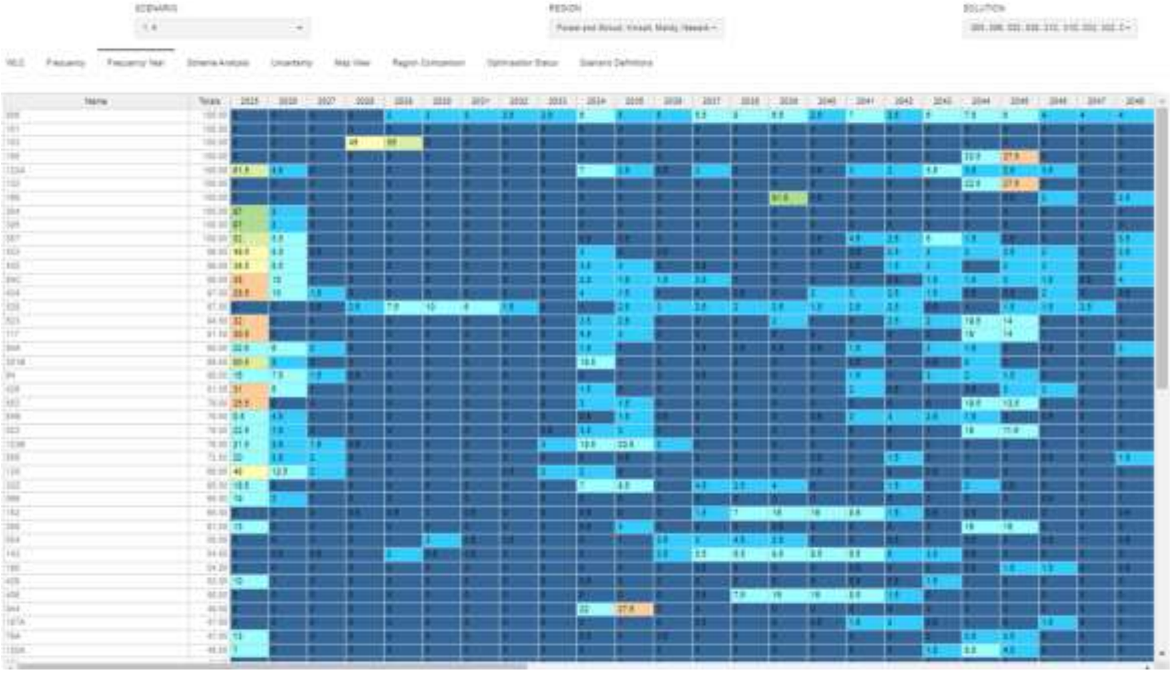


This frequency analysis helps us to understand which options could be considered no- or low-regret decisions. Figure F7.2 illustrates how there are a number of supply scheme options that get chosen in over 95% of the optimisations based around scenarios 1 and scenario 4. This indicates that regardless of the uncertainty around the impacts of long term environmental destination, these schemes represent good choices under both supply / demand scenarios. At the other extreme, Figure F7.2 also illustrates that there are some schemes that get chosen very infrequently and so may be considered high-regret investment decisions.

As well as understanding the overall frequency of these investment options being chosen across both scenarios, we can also interrogate the DMU outputs to understand the timing of those investment decisions. As explained in section 6.4, for each supply option the DMU considers the uncertainty around the expected Ml/d supply benefit, the project cost and the time it will take to implement the solution. Using these uncertainty parameters in the multiple investment optimisation runs, the model is able to offer a view of the optimal timing of implementing the preferred solutions.

Figure F7.3 illustrates an example of the DMU outputs for the Strategic Grid under both scenario 1 and scenario 2. While Figure F7.2 showed the overall combined frequency of certain schemes being chosen under the two optimised scenarios, Figure F7.3 shows the frequency of when these schemes were picked in the planning period. This gives further insight into those solutions that might be considered no- or low-regret decisions for AMP8 and AMP9. It also indicates those schemes that we have a high confidence of needing in the very long term and where the low regret decision would be to initiate more detailed feasibility work in AMP8 to help prepare for the long term delivery.

Figure F7.3: Strategic Grid DMU optimisation frequency year chosen for scenario 1 and scenario 4



We have applied this analysis to the full range of supply / demand pathways to generate our core and most likely investment scenarios, as well as a number of alternative pathway investment scenarios. In section 8.5 we explain how we have used this approach to define our preferred investment plan, what the alternative investment plans might look like and how we will manage the uncertainty around these.

F7.5 Triggers and Managing Uncertainty

Understanding our long-term supply / demand investment needs is a complex problem. We are facing multiple potential future pathways and can't be certain about which of these will become reality while we also need to make allowances for the future deliverability of complex schemes.

The main areas of uncertainty stem from:

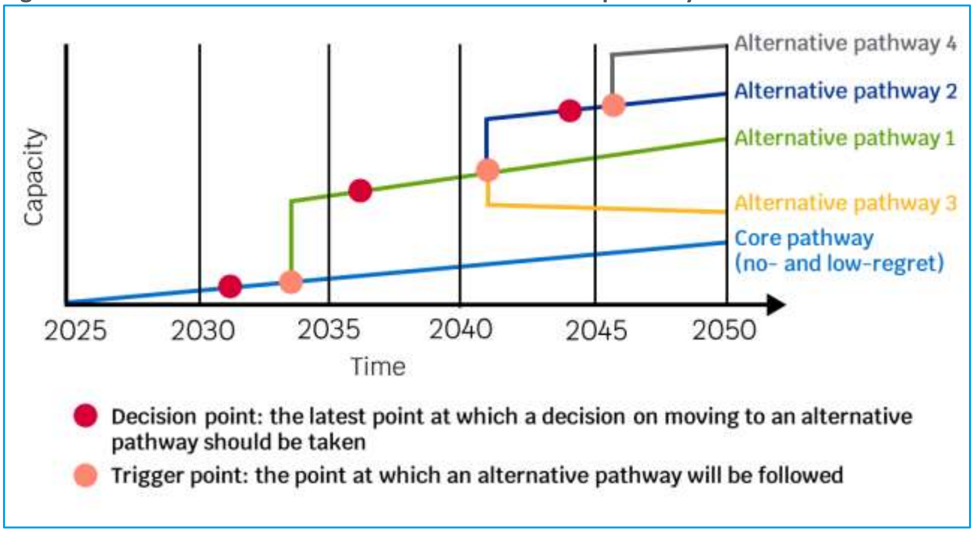
- Exogenous factors – uncertainty around trends that will unfold over time;
- Future policy decisions - uncertainty around binary decision points (eg change in future government policy);
- The company's ability to deliver planned solutions – a combination of trends and binary decision points.

When we are exploring these potential future investment decisions, we don't just consider the financial costs of delivery. We need to account for the wider costs / benefits of taking no / low regret decisions in the face of future uncertainty. For example, we need to understand non-financial benefits of our choices, the risks around the length of time it will take to construct and implement solutions and we need to avoid regret if we pass the point of no return on specific strategic choices.

Our 'core' pathway reflects our preferred approach to achieving our long-term goals and includes the actions needed to be ready for all plausible future scenarios. The alternative pathways are those that could be triggered depending on how future uncertainties develop.

Figure F7.4 below illustrates what is meant by the core pathway and the alternative adaptive pathways we might take.

Figure F7.4: An illustration of the core and alternative pathways



As well as defining what these future pathways might look like we also need to consider the signals that we will monitor to help us understand which of these pathways is actually unfolding over time. Finally we need to define the trigger points at which we will need to make different decisions in our delivery plans as our understanding of the actual supply / demand balance develops over time.

Our assessment of the future water supply and demand pressures faced by Severn Trent demonstrates that the most material uncertainties that we face are:

- The pace at which existing abstraction licences become restricted under the Environment Agency's licence capping policy;
- The scale and pace of abstraction reductions that may be needed to achieve the Environment Agency's long term environmental destination scenarios;
- The scale and pace of climate change impacts on supply availability;
- The scale of future changes in demand for water, either due to growth in population, due to more efficient water using appliances or other exogenous factors such as industrial changes in demand;
- The deliverability of complex, strategic new supply options.

Our dWRMP24 includes the no-regret decisions for AMP8 and the recommended low-regret decisions for AMP9/10, taking account of both low and high impact scenarios. Our plan also demonstrates which longer term decisions could be triggered if the more extreme pathways unfold.