SSC36
Evidencing our enhancement expenditure in 2025-2030

Contents

1. Introduction

This appendix provides a set of full business cases for enhancement expenditure contained within our AMP8 business plan. These enhancements, laid out in thirteen cases through **sections 2 to 5**, are a critical part of our Long-Term Delivery Strategy (LTDS) working towards achieving our 2050 ambition we developed with our customers. More information on this alignment can be found in our appendix **'SSC02 South Staffordshire Water - long term delivery strategy,'** and in the cases themselves within this appendix.

You can expect each of our business cases to cover:

- How our enhancement cases form a critical part of our Performance Commitments (PC) ambitions. Alongside our base expenditure programme, they are essential for achieving the targets. Each business case, where possible, has established a link to a PC.
- Where it has not been possible to link an investment with a step change in a PC, how we have sought to develop and propose a comprehensive package of Price Control Deliverables (PCDs) to protect customers from non-delivery of the schemes (see section 1.5).
- How we have engaged with our customers on all aspects of our enhancement programme and the individual business cases. Customers support these schemes, as well as our other important stakeholders, and their feedback is presented within each case.
- How we have worked with independent engineering contractors, and our delivery function, in developing a set of accurate and efficient costs that reflect the work needed to achieve the outcomes for each case. These costs have been benchmarked, challenged by our asset experts, and undergone significant scrutiny to ensure they are as efficient as possible.
- How the cases have also been developed following the widely recognised HM Treasury Green Book principles. We have made substantial improvements to our underlying tools, techniques, methodologies, and processes to generate these business cases.

More detailed information around all of the above, in terms of need, solution and cost generation, can be found in our appendix **'SSC37 Our Asset Management Approach to best-value investment planning through 2025-2030 and beyond'**

1.1.1 Enhancement case structure in this appendix

Each business case follows a common structure, setting out the evidence behind each investment aligned with the Ofwat criteria. Using the first case, WRMP Supply Demand Balance, as an example, these are set out to support clear evidencing for all thirteen cases as follows;

2.1 Case 1: WRMP Supply Demand Balance
- 2.1.1 Summary
- 2.1.2 Background information
- 2.1.3 Need for investment
- 2.1.4 Customer support
- 2.1.5 Best option for customers
- 2.1.6 Cost efficiency
- 2.1.7 Customer protection
- 2.1.8 Delivery

Through PR24 we have developed our enhancement needs through our Asset Management process (see **appendix SSC37**) in collaboration with our customers, and the priorities they have communicated to us. And we align our resulting enhancement case investment in this appendix with those clear customer priorities established through our ongoing engagement in AMP7, and that form a core part of our **'Looking to the Future'** long term vision that we published in November 2022 (published on our website here)

Figure 1 – our customer priorities that were identified as part of various consultation processes. 'Delivering an efficient customer service' and 'Affordable bills for all customers' are covered by other areas of our business plan.

1.1.2 Summary of enhancement Totex at PR24

Below we set out a summary of the enhancement Totex investment that have been developed within each of these customer priority areas – reflecting our commitment to ensuring line of sight in with those outcomes most important to our customer's needs. **All costs are in £K.**

Making the best use of our water resources

Enhancement Case	Opex	Capex	CW3 lines
Case 1: Supply-Demand Balance	0	12,427	CW3.53
Case 2: Water Efficiency	8,360	4,657	CW3.44
Case 3: Smart Metering	0	36,337	CW3.60, 3.63, 3.66, 3.81, 3.84, 3.87
Total	8,360	53,421	

Running a sustainable business

Enhancement Case	Opex	Capex	CW3 lines
Case 4: Our Water Industry National Environment Programme (WINEP)	0	19,911	CW3.1, 3.7,3.10, 3.16, 3.28, 3.31, 3.34
Case 5: Our stretching leakage ambition	2,240	1,236	CW3.47
Case 6: Energy Security and Carbon Emission Reductions	0	7,236	CW3.127
Case 7: Cyber Security	0	2,754	CW3.124
Case 8: Security & Emergency Measures (SEMD)	0	526	CW3.121
Total	2,240	31,663	

Providing high-quality drinking water

Enhancement Case	Opex	Capex	CW3 lines
Case 9: Addressing raw water deterioration	0	28,069	CW3.97
Case 10: Reducing lead supplies	0	7,164	CW3.106, 3.109
Total	0	35,233	

Delivering water at the right pressure

Enhancement Case	Opex	Capex	CW3 lines
Case 11: Distribution Network Resilience	0	8,285	CW3.118
Case 12: Production Resilience	0	7,337	CW3.118
Case 13: Smart Water System Trials	0	3,557	CW3.118
Total	0	19,179	

	Opex	Capex
Total Enhancement Programme	10,600	139,497

1.1.3 An overview of enhancement expenditure in our proposed Totex portfolio

The enhancement cases we have developed for PR24 have been subject to more rigour than ever before in assessing whether they deliver those step changes in those areas customers have told us they see as priority. And in response, we will deliver a combination of regulatory driven and risk-based enhancements covering five key work programmes; water quality, resilience, supply side enhancements, demand side enhancements and the environment.

We will continue to invest to meet our regulatory requirements including those defined by our Water Resource Management Plan (WRMP), and the Water Industry National Environment Programme (WINEP), with notable schemes relating to a new transfer main at Grafham in the Cambridge region, together with a significant uplift in our demand side investment through our Universal metering, enhanced leakage detection and water efficiency programmes. We also include a number of water quality improvement schemes supported by the DWI as recognised needs in AMP8, including enhanced nitrate and manganese treatment in addition to our cyber security commitments through the Network and Information Systems regulations. We have also worked to develop a key part of our Net Zero strategy as investment in renewables at sites across our network.

Finally, in addition to the significant base programme investment supporting increased resilience of our production and network assets, we include enhancement solutions across both areas to ensure we are protecting customers in the long term from the impacts of climate change and growth driven events that can have catastrophic consequences to our continued ability to provide high quality, reliable supplies to our customers in any scenario.

1.2 Defining base and enhancement investment

Our base and enhancement capital programmes at PR24 have been built in parallel, with a wealth of modelled and SME input to generate a clear view of investment needs and an unconstrained list of options. We decided that, ahead of moving into more detailed solution development and costing phases, it was important to clearly define whether those solutions we had identified as being required in the period 2025-2030 should be classed as either base or enhancement investment. The following flow process in **figure 2**, demonstrates the questions we asked of ourselves in this sense, with the main focus being on what the investment was delivering for our customers.

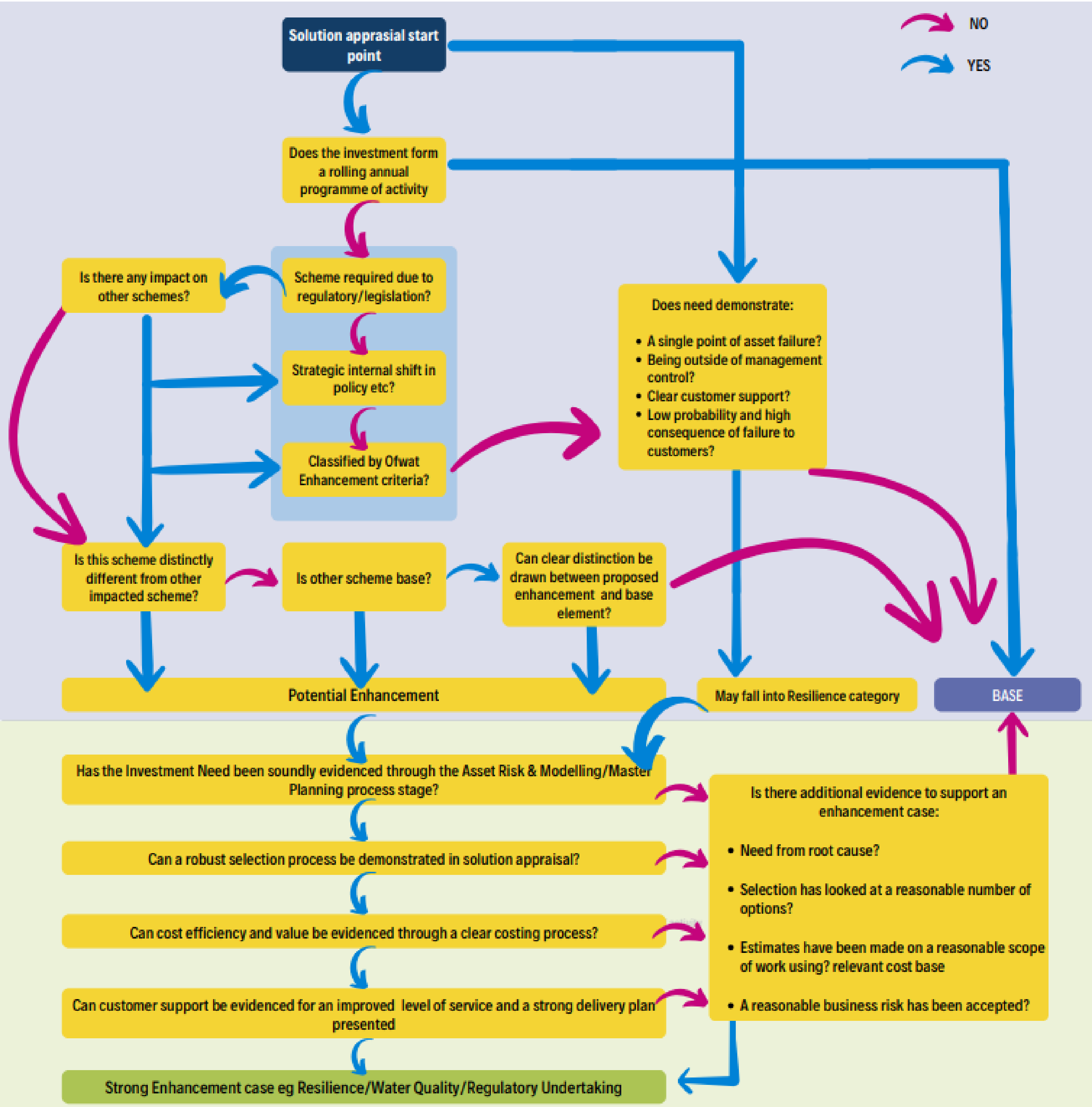


Figure 2 - decision tree used to determine the categorisation of our priority schemes across our base and enhancement programmes

1.3 Developing stretching cost efficiency targets

There are two processes that we have undertaken to ensure that the best value options for customers are delivered at an efficient cost. Throughout development of the business plan, we have worked with a third-party engineering contractor, Aqua Consulting, to develop the scope and options that best address the business needs. The detailed processes we undertook to develop, challenge, and continually refine our cost estimates can be found in **section 3** of our appendix **'SSC37 Our Asset Management Approach to best-value investment planning through 2025-2030 and beyond.'**

We worked with Aqua in delivered two distinct phases of solution and cost development. The initial phase focusing on defined a long list of options that could potentially be considered for delivering against each need. The second phase focused on homing in on a shortlist that the business would move forward with in the business plan. All longlist options were developed with business SME's along with their individual benefits and constraints. The team used Multiple Capital Value analysis to determine the best options to take forward into the business plan. The analysis looked at categories like:

- Ability to meet project drivers and regulatory compliance
- Provide a long-term solution to SSW
- Providing Green solutions
- Technically Feasibility
- Deliverability
- Cost

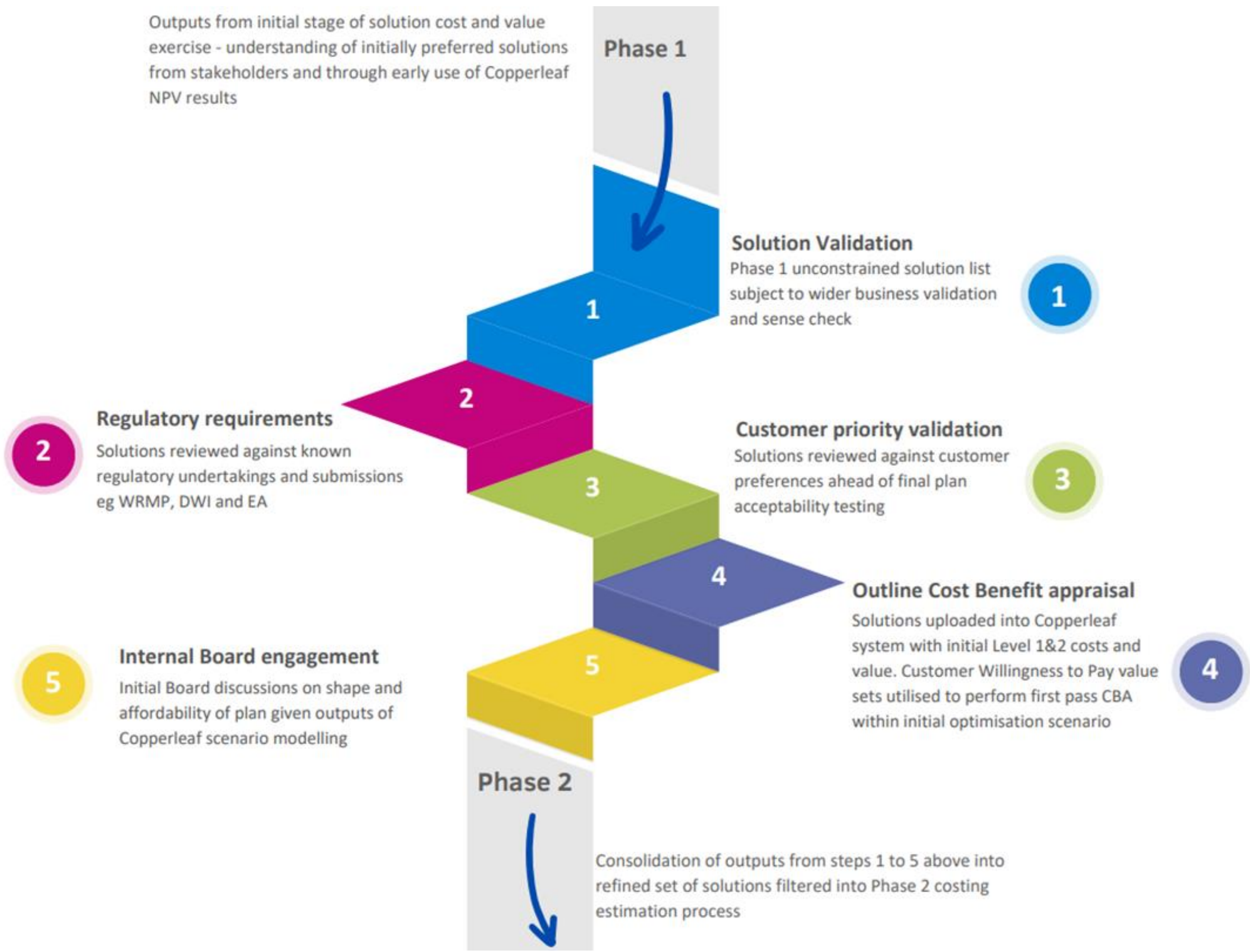
Schemes that scored highly in these areas were selected for further cost estimation and inclusion within the business plan. Further sessions were then undertaken to ensure detailed scopes could be achieved prior to costing. AQUA elicited information specific to sites included current process and schematics to help inform where new solutions could be accommodated into the current make-up of the sites. This ensured that all scope were rationalised by what is present on site and assumptions were limited.

Final options were then subject to AQUA cost estimation that achieved +/-30% cost confidence. AQUA consultants have a wealth of data in databases that consist of actual outturn costs within the water industry that inform their cost models. Where necessary, third-party companies were consulted to get exact quotations for bespoke equipment or solutions. AQUA has also been involved in benchmarking exercises for OFWAT in previous work they have completed.

Operational and Embodied Carbon have also formed part of the cost benefit analysis process. As the options went through vigorous costing processes with a third-party engineering consultancy both carbon types could be quantified and taken into consideration. SSW took the decision to engage directly with an engineering consultancy to ensure options and costs could be developed robustly and efficiently with the objective to satisfy OFWATs enhancement criteria in mind at all stages along the way.

Figure 3, below, defines the movement through Phase 1 and Phase 2 of this solution definition, shortlisting and cost estimation process that we undertook with AQUA consultants undertook when developing the enhancement cases contained within this appendix.

SSC believe that the costs developed for the options discussed above are efficient as they have been based on a good understanding of the existing infrastructure found at the locations where they will be installed thus reducing the level of assumptions around the costs.



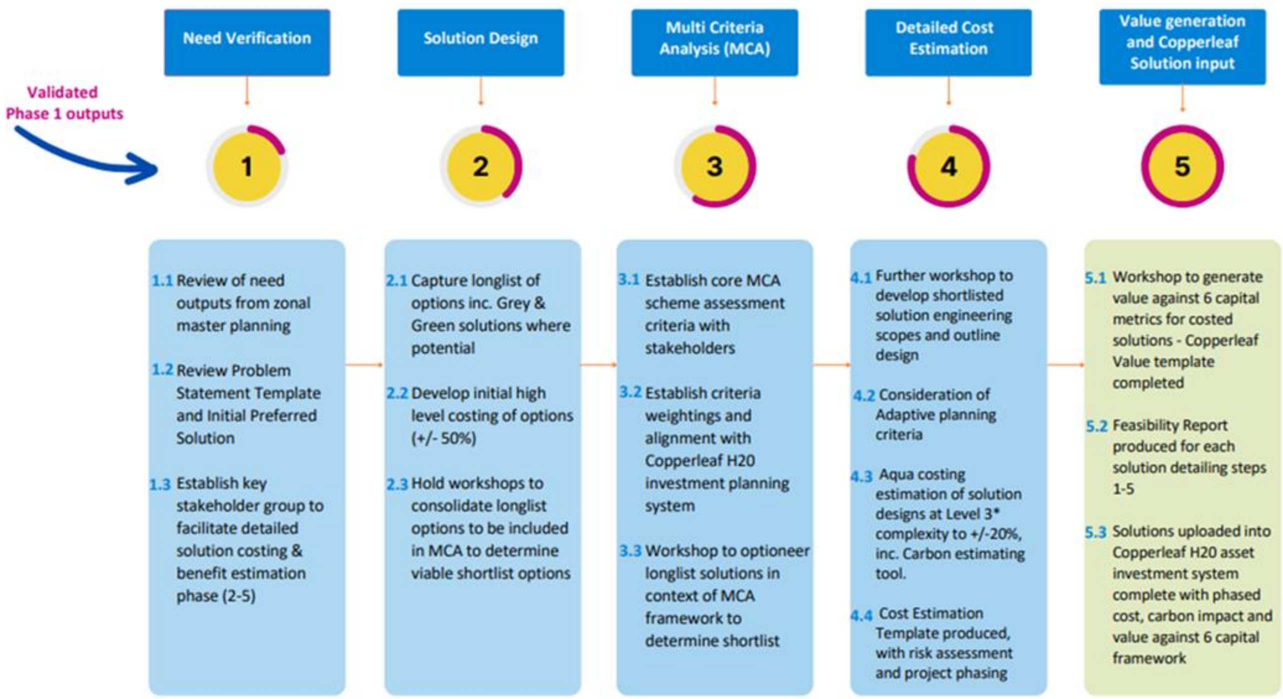


Figure 3 – Phase 1 and 2 solution definition, shortlisting and cost estimation process developed with Aqua

1.3.1 Optimisation of our plan

All shortlisted options were included in a risk and value stage within the Copperleaf investment software. Copperleaf is an investment decision making support tool to house investments and ultimately turn them into a deliverable and affordable plan for customers. The system itself uses multiple components to achieve this through a process called optimisation. A Six Capitals based value framework made up of more than twenty value models allow the business to capture risk and value against categories that are pertinent to the business and its customers (**see Figure 4**)

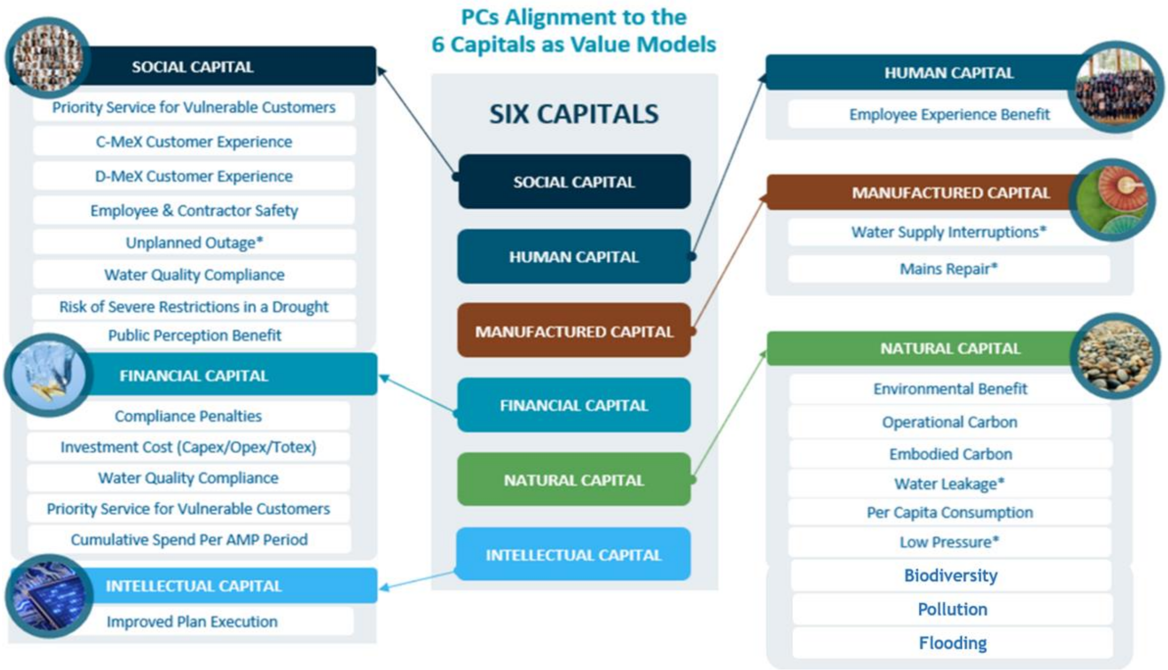


Figure 4 - Copperleaf Six Capitals risk and value Framework

Applicable value models are attached to investments and scored appropriately using standard questionnaire templates to ensure consistency of input across a portfolio. Current and forecasted risk profiles are used to create a baseline risk position that value can be offset against for all solution options within a given investment. All value models are attached to a value function that contains up to three value sets, Private, Societal and Willingness to Pay. The value sets contain monetised values that align model outputs. Private costs are based on those that we would expect to incur if the risk was realised, Societal costs are based on the expected socio-economic impact of the risk being realised and Willingness to Pay costs are based on customer expressed values for areas of service improvement.

The optimisation process takes into account financial and performance constraints that are inputted as parameters to affect its decision-making around the solutions it chooses in context of cost, risk and value in the wider business plan.

When we are looking for the best options for customers, we are taking into consideration affordability as well as cost and value. Final options are selected based on the value that they offer at two levels, the first is the options value at an investment level and the second is the value that they offer at a portfolio level to ensure that we are getting the best value plan across the board based on the portfolio level constraints applied.

Further detail around our AMP8 optimisation approach can be found in **Section 4 of our appendix, 'SSC37 Our Asset Management Approach to best-value investment planning through 2025-2030 and beyond.'**

1.3.2 Evidencing our delivery approach for 2025-2030

Common with convention across the water sector, South Staffs Water delivers its capital investment programmes primarily through an external supply chain of consultants and contractors. This supply chain will work to an optimised programme managed by the SSW Asset Management Function and delivered by the SSW Capital Investment Delivery function.

For the AMP7 PR19 programme these consisted of several multi supplier framework agreements and standalone contracts. These frame contracts may be extended into AMP8 if required for expediency of early AMP8 project delivery, or in the case of standalone contracts will continue to be in force until the natural completion of the specific projects.

In early 2023, a process was commenced to appoint delivery partners under framework agreements for the delivery of the AMP8 PR24 programme. This process will comply with the Utilities Contract Regulations 2016.

The AMP8 framework agreements will utilise the Institution of Civil Engineers NEC4 suite of contracts, specifically the Professional Services Contract and the ECC with Options A (priced activity schedule), B (priced BoQ) Priced C (target cost) and E for emergency works (cost reimbursable). This suite of contracts has been chosen because it is the prevailing contract form used across UK utilities and has been developed to provide flexibility, encourage good project management, be clear and concise and provides a balanced Client Contractor/Consultant relationship. Each framework will consist of a number of 'Lots' for which successful delivery partners can be appointed to service one or multiple Lots.

The core of the programme will be delivered by 3 main framework contracts and for projects with a higher capital expenditure and degree of complexity through stand-alone contracts.

- Infrastructure Assets Delivery Framework - New build, Improvements, Renewals, Refurbishments, and Capital Maintenance [BOUNTY]

- Non- Infrastructure Assets Delivery Framework - New build, Improvements, Renewals, Refurbishments, and Capital Maintenance [BCM]

- Professional Services Delivery Framework – Technical Engineering Design, Specialist Modelling and Analytics, Commercial and Regulatory Advisory. [Services]

- Standalone Contracts – Singel projects requiring a bespoke structure to enable early contractor involvement and 2 stage delivery where appropriate, a feasibility, design and pricing contract commission followed by a delivery contract commission to ensure efficient pricing.

This will be supplemented by a number of direct procurement contracts to procure components, such as infrastructure instrumentation, meters, sensors etc. Works will be let on either a mini tender competition basis or via direct allocation with independent cost verification to assure value for money.

The model has been designed to deliver;

- Value for money

- Minimise internal 'cost to serve'

- Resilient and reliable delivery

- Flexibility, adaptability, innovation

Further detail around our AMP8 delivery approach can be found in **Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.**

1.4 Alignment of our enhancement expenditure with our LTDS

For this price review, we have recognised the importance of linking our AMP8 plans with the long-term. The new requirement to submit a 25-year Long-term Delivery Strategy (LTDS) alongside our 5-year business plan for 2025-2030 came at a good time for us as we sought to improve our asset management maturity. Many of the new approaches, tools, and models that we have developed and used to define investment outlined in this appendix were built to serve both.

For example, our new resilience model for all supply zones in our network. We sought to have a model that could assess the resilience of our supply zones to climate change, demand, operating environment, and reservoir level. The model calculates a robust supply-demand position (hours of storage available) based on a wide range of operating scenarios (hydraulic constraints, available sources etc.) and conditions. And we have generated associated investment cases across our production (for example power resilience) and network (for example new strategic resilience mains) assets that have been subject to detailed cost and value estimates and tested extensively with our customers prior to their inclusion in the plan. **Section 1.5** of our appendix **'SSC37 Our Asset Management Approach to best-value investment planning through 2025-2030 and beyond,'** provides further information around how we defined our core pathway for both AMP8 and as part of the longer term LTDS ambition for operational resilience planning.

Similarly, in our base programme, our improved model for predicting bursts spans the full horizon of the LTDS, builds in new variables driven by the Common Reference Scenarios (notably climate change in this case), and determines our 5-year infrastructure renewals expenditure linked to the desired AMP8 Performance Commitment Level (PCL).

This maturity in our thinking has created an inextricable link between our asset management plans, business plan and the LTDS. Whilst there are areas we can still improve; we are pleased with the coverage of models and data-driven approaches to decision-making across all horizons. This has been further enhanced with our ability to test uncertainty and scenario analysis in Copperleaf, which has supported strategy reviews and provided maturity in focus and decision making around core and adaptive planning through value analysis linked to risk.

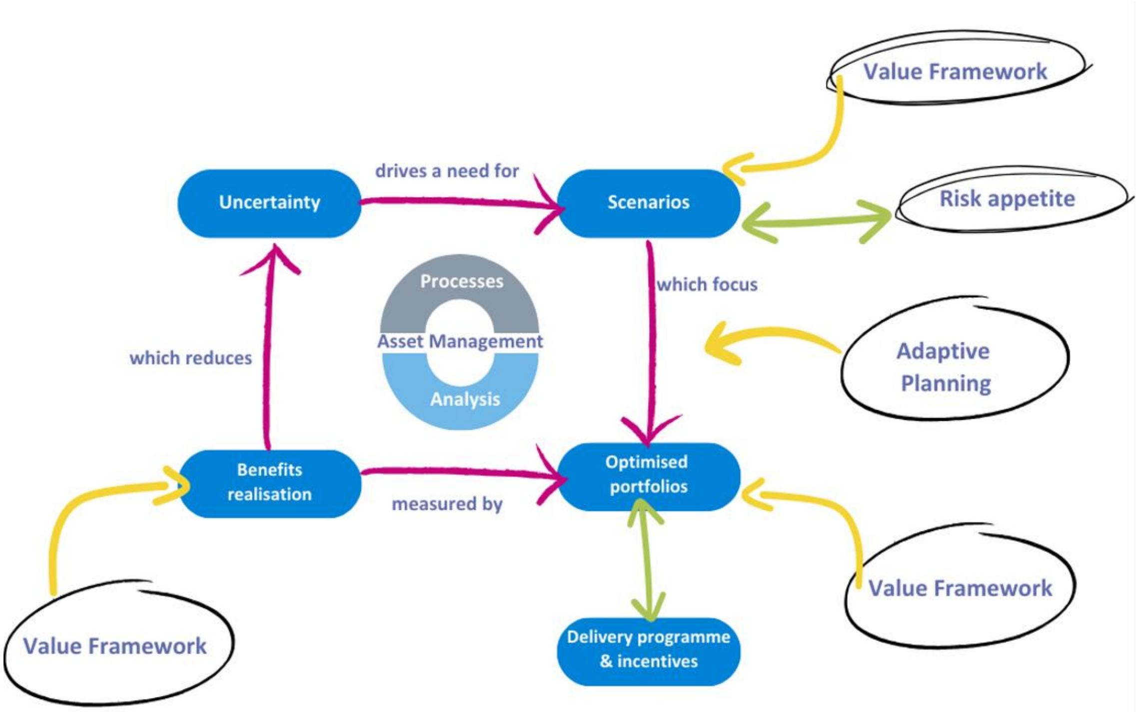


Figure 5 – evidencing Asset Management maturity and improved decision making at PR24 in context of the LTDS

The specific links to our LTDS from each case are contained in the relevant section detail. For further information on our LTDS, see appendix '**SSC02 South Staffordshire Water – long term delivery strategy'.**

1.5 Protecting customers with a comprehensive set of Price Control Deliverables

We have analysed our enhancement investments to identify where there is no direct link or an easy to measure benefit to our Performance Commitments or ODI's. We have taken those identified enhancement schemes and grouped them into six price control deliverable (PCD) categories. These are:

- Supply resilience
- Storage resilience
- Smart water system trial
- Quality
- WRMP
- Metering

Within each PCD we have set out our PCD payment rates to protect our customers against non-delivery of enhancement investments. The PCD will set out the key outputs or outcomes expected to be delivered through enhancement funding. If the outputs or outcomes are not delivered in the control period, the PCD will ensure the funding provided will be returned to our customers plus the time value of money to the cost of capital. We propose to add late delivery penalties through the AMP based on the phasing provided in the individual PCD forecast deliverables, utilising the time value of money to the cost of capital.

Where we have DWI support for enhancement, we consider this offers sufficient customer protection and no PCD is required. The individual cases pertaining to improvements in raw water quality (section 4.1), cyber security and SEMD (section 3.4 and 3.5 respectively), fall into this category. Section 6.1 contains the DWI support notices.

Supply resilience PCD - This includes a variety of schemes. Due to this we felt that using a unit rate didn't provide the best price control for our customers. We have instead used penalties based on the individual scheme's enhancement funded allowance. On top of that we will apply a time value of money to the cost of capital for the appropriate period required. The enhancement investments included within this PCD can be found in cases 11 and 12 (section 5.1 and 5.2).

Table 1 – Our Supply resilience PCD

Supply resilience PCD				
Description	Power, supply and, network improvements to deliver water Ml/d improved resilience capacity.			
Output or Outcome measurement and reporting	The outputs of this PCD will be measured in Ml/d improved resilience capacity. The forecasted Ml/d deliverables are set out in the table below. Delivery of Ml/d improved resilience capacity will be reported and monitored through the control period following the existing APR process. Reported at the end of the financial reporting year.			
Assurance	Independent third-party assurance to confirm completed milestones			
Conditions on schemes	Due to the variance in schemes included within this PCD, we feel the unit rates don't provide a fair price control for our customers. Therefore, we propose to measure deliverables in Ml/d improved resilience capacity but, will apply penalties based on individual scheme enhancement funded allowance.			
	Scheme	Forecast delivery	Cost £s	Ml/d
	Fleam Dyke station – Power resilience	2028/29	£312,685	2.4
	Grantchester road station - Power resilience	2029/30	£541,270	40.8
	West Bromwich station - Power resilience	2026-27	£1,362,994	104.0
	Euston borehole – Supply resilience	2028/29	£1,920,016	10.0
	Heydon borehole - Supply resilience	2029/30	£2,095,749	1.1
	Gentleshaw relift pump – Supply resilience	2028/29	£1,104,698	10.0
	Hanbury resilience - Network resilience	2029/30	£2,911,049	7.8
	Burntwood resilience - Network resilience	2029/30	£395,780	8.1
PCD payment rate	**Option A -** Late delivery for in-AMP phasing, will apply a time value of money penalty to the enhancement funded amount applied for the individual scheme which will be returned to our customers. The time value of money will be applied at the appropriate rate for the period required. **Option B –** Late delivery where the project has started but isn't delivered by the end of the control period will apply, the time value of money on late delivery (This will apply a cut off period to the end of year 1 of AMP 9 (2030/31). If by the end of year 1 AMP 9 the project is still incomplete, we will return the enhancement amount funded **not spent** on that scheme back to the customer. **Non-delivery** of Ml/d improved resilience capacity will be applied where the project hasn't been started within the control period. We will return the full enhancement funded amount for that specific scheme **plus** the time value of money back to our customers. The time value of money will apply the appropriate rates for the period required.			

Deliverables	Unit	Forecast deliverables				
		2025-26	2026-27	2027-28	2028-29	2029-30
Ml/d improved resilience capacity	Ml/d		104		22.4	57.86

Storage resilience PCD – This PCD is aimed to protect our customers from non-delivery of the Langley Reservoir enhancement investment included within the distribution network resilience case 11 (section 5.1). The scheme is made up of base and enhancement spend to deliver the project. The PCD will protect customers on the enhancement allowance provided to deliver this investment.

Table 2 - Our Storage resilience PCD

Storage resilience PCD	
Description	Storage improvement - to deliver a storage improved resilience capacity.
Output measurement and reporting	The outputs of this PCD will be measured in megalitres improved resilience capacity. The forecasted Ml deliverable is set out in the table below. Delivery of storage improved resilience capacity will be reported and monitored through the control period following the existing APR process. Reported at the end of the financial reporting year.
Assurance	Independent third-party assurance to confirm completed milestones
Conditions on scheme	This PCD is to provide customer protection against non and late delivery of Langley Reservoir enhancement funding. The below PCD payment rates will apply to the enhancement funded allowance. There is a significant amount of base allowance to complete this project which will not be subject to a price control deliverable.
PCD payment rate	**Option A –** Late delivery where the project has started but isn't delivered by the end of the control period will apply, the time value of money on late delivery (This will apply a cut off period to the end of year 1 of AMP 9 (2030/31). If by the end of year 1 AMP 9 the project is still incomplete, we will return the enhancement amount funded **not spent** on that scheme back to the customer. **Non-delivery -** of storage improved resilience capacity will be applied where the project hasn't been started within the control period. We will return the full enhancement funded amount for the specific scheme **plus** the time value of money back to our customers. The time value of money will apply the appropriate rates for the period required.

Deliverables	Unit	Forecast deliverables					
		2025-26	2026-27	2027-28	2028-29	2029-30	Total
Storage available for use	Ml					5.41	5.41

Smart water system trial PCD – The Smart Water system trial PCD requires the deliverable of an open data report on a full smart water system. The scheme doesn't meet the materiality threshold for a PCD, but we want to apply a PCD as we believe it will provide a platform for which informed decisions can be made within the water industry for the future. The report will provide insights into a Smart water system and the quantified benefits for customers. This PCD applies to the enhancement investment case 13 (section 5.3).

Table 3 - Smart water system trial PCD

Smart water system trial PCD	
Description	Smart water system trial in the Outwoods Water Supply Zone (WSZ) to quantify the benefits of a smart water system.
Output measurement and reporting	The output of this PCD will be through the mechanism of an open data report on the quantifiable benefits of a smart water system. The forecasted deliverable is set out in the table below. Delivery of the open data report should be published in the first quarter of year 4 of the control period (June 2028).
Assurance	Independent third-party assurance to confirm completed milestones
Conditions on scheme	We don't propose any late delivery penalties on this scheme as it does not meet the materiality threshold for a PCD. We do however want to apply a PCD as we are confident, we can deliver the project and feel it will deliver insights for the water industry to make informed decisions on the benefits of a Smart water system looking into future price control periods.
PCD payment rate	Non-delivery by the end of the control period will be applied where the project hasn't been started within the control period. We will return the full enhancement funded amount for the specific scheme **plus** the time value of money back to our customers. The time value of money will apply the appropriate rates for the period required.

Deliverables	Unit	Forecast deliverables				
		2025-26	2026-27	2027-28	2028-29	2029-30
Smart water system trial	Open data report				Open data report	

Quality PCD – This PCD covers our lead enhancement investments. We don't propose any late delivery penalties as these schemes don't meet the materiality threshold. We do want to apply a PCD to protect our customers from non-delivery. We want to provide an open data report on our lead pilot scheme to encourage shared learning and benefits with the industry. We hope this will provide insights into the benefits and provide a platform for the industry to make informed decision looking to the future. This PCD provides customer protection for case 10 (section 4.2).

Table 4 - Quality PCD

Quality PCD	
Description	Lead pilot scheme and a lead replacement program for vulnerable customers.
Output measurement and reporting	The output of the lead pilot scheme will be through the mechanism of an open data report. The outcome of the lead replacement program will be based on 373 vulnerable customers lead replacements. Forecasted deliverables are set out in the table below. Delivery of the open data report should be published in the first quarter of year 4 of AMP 8 (June 2028). Reporting of the lead replacement programme will be reported at the end of the control period through the existing APR process.
Assurance	Independent third-party assurance to confirm completed milestones
Conditions on scheme	We don't propose any late delivery penalties on this PCD as it does not meet the materiality threshold. We do however want to apply a PCD as we are confident, we can deliver the project and feel the shared open data report will provide insights for the water industry to make informed decisions on the benefits of lead replacements to reduce the risk of lead failure to customers for future price control periods.
PCD payment rate	Non-delivery of the open data report for the lead pilot scheme will be applied where the project hasn't been started within the control period. We will return the full enhancement funded amount for the specific scheme **plus** the time value of money back to our customers. Non-delivery of lead replacement programme will apply a unit rate per replacement not delivered by the end of the control period. The unit rate will be based of the enhancement funded amount. A time value of money cost of capital will also be applied to the applicable value amount. The time value of money will apply the appropriate rates for the period required.

Deliverables	Unit	Forecast deliverables				
		2025-26	2026-27	2027-28	2028-29	2029-30
Lead pilot scheme	Open data report				Open data report	
Lead replacements	Number					373

WRMP PCD – This PCD is to protect our customer from non-delivery of the Grafham water transfer scheme. We don't propose any late delivery penalties for this scheme as there are several dependencies that are out of our control. What we do propose is non-delivery means full enhancement amount to be returned to our customers plus the time value of money. This PCD provides customer protection for case 1 (section 2.1).

Table 5 - WRMP PCD

WRMP PCD	
Description	Installation of a 26 Ml/d capacity pipeline for use when water is available.
Output measurement and reporting	The output of the Grafham import will be measured Ml/d capacity pipeline for use when water is available. Delivery will be reported and monitored through the control period following the existing APR process. Reported at the end of the financial reporting year. Forecasted deliverables are set out in the table below.
Assurance	Independent third-party assurance to confirm completed milestones
Conditions on scheme	Grafham Transfer – a 26 Ml/d transfer of water from Anglian Water's Grafham Reservoir. This scheme is dependent upon the construction of Anglian Water's Grafham to Rede pipeline which has approximately 26 Ml/d of spare capacity until 2040. This 26 Ml/d will be available upon completion of the Grand Union Canal (GUC) option under development by Affinity Water that will enable them to reduce their current take from Grafham Water. This is currently scheduled to be completed by 2032. We don't propose any late delivery penalties on this PCD due to variables which are out of our control.
PCD payment rate	Non-delivery by the end of the control period will be applied where the project hasn't been started within the control period. We will return the full enhancement funded amount for the specific scheme **plus** the time value of money back to our customers. The time value of money will apply the appropriate rates for the period required.

Deliverables	Unit	Forecast deliverables				
		2025-26	2026-27	2027-28	2028-29	2029-30
Grafham import	Ml/d					26

Metering PCD – This PCD looks to protect our customers from non-delivery of the proposed meters installations. We propose a final figure at the end of the control period based on a unit rate cost for non-delivery and not any phasing penalties. The unit rate cost provided below are based on the enhancement case and funding amount proposed to deliver our target of installations. This PCD provides customer protection for case 3 (section 2.3).

Table 6 - Metering PCD

Metering PCD	
Description	Installation of advanced monitoring infrastructure (AMI) meters which are capable of recording and transmitting data at least once every 24 hours to measure supplies of water to premises. This involves new AMI meter installations and replacement of existing meters with new AMI meters. The new AMI smart meter installation includes both HH and NHH meters. AMI for basic / AMR replacements covers only NHH replacements as per our enhancement case.
Output measurement and reporting	SSC output will be measured in the number of meters installed by the end of the period. We have put forward a flat phased strategy as can be seen in the table below. Delivery of meters will be reported and monitored through the existing APR process.
Assurance	Independent third-party assurance to confirm completed milestones
Conditions on scheme	We are confident in the delivery over the AMP period but recognise there may be a risk of a lower first year as we phase up the start of our universal programme. Therefore, we expect the PCD to relate to whole AMP delivery, rather than in year.
PCD payment rate	A unit rate per meter will be applied at the end of the control period for non-delivery based on the enhancement funded allowance for the schemes. New AMI smart meter installation = 161,455 units. Current unit cost rate of £204 AMI for basic / AMR replacement = 22,135 units. Current unit cost rate of £109 Per capita consumption performance commitment penalty will add additional penalty for late/non delivery of the schemes.

Cumulative forecast of number of meters (flat phased)

Deliverables	Unit	Forecast deliverables				
		2025-26	2026-27	2027-28	2028-29	2029-30
New AMI smart meter install	Number of meters	32,291	64,582	96,873	129,164	161,455
AMI for basic / AMR replacements	Number of meters	4,427	8,854	13,281	17,708	22,135

2. Making the Best Use of our Water Resources

The enhancement cases in this section 2 have been developed to secure the investment needed for delivery of our Water Resources Management Plan 2024 (WRMP24).

The summary of our proposed Enhancement Totex is in **Table 7** below, presented in £K.

Table 7 – Section 2 Proposed Enhancement

Making the best use of our water resources			
Enhancement Case	**Opex**	**Capex**	**CW3 lines**
Case 1: Supply-Demand Balance	0	12,427	CW3.53
Case 2: Water Efficiency	8,360	4,657	CW3.44
Case 3: Smart Metering	0	36,337	CW3.60, 3.63, 3.66, 3.81, 3.84, 3.87
Total	8,360	53,421	

2.1 Case 1: WRMP Supply-Demand Balance

2.1.1 Summary

Every 5 years, water companies develop the Water Resource Management Plan outlining how they intend to sustainably meet the forecasted water demand needs of customers and the environment. Demand management is prioritised, and then if needed, supply side options are evaluated in order determine the best value plan for resolving any deficits.

Cambridge Water's draft WRMP24 was submitted to Defra and the Environment Agency in 2022 and was issued for consultation in early 2023. Following this, we have reviewed all of the consultation feedback and provided a revised draft WRMP which is currently with Defra for review alongside our statement of response.

The Cambridge Water WRMP outlines significant challenges regarding water resource availability and demand for water in both the short and long term. Growth in the Cambridge region is forecasted to be faster than anywhere else in the UK. This growth is both houses and commercial growth. A large proportion of the non-household growth relates to developments in the biomedical and technological fields, aligned with the Government's aim for Cambridge to be "supercharged as Europe's science capital".[1] In addition to this, there are some significant restrictions to our current

[1] Long-term plan for housing - GOV.UK (www.gov.uk)

water resources required in order to deliver environmental improvements and protection. Cambridge Water's geography is unique in that 100% of its water is supplied by chalk aquifers. By 2030 we need to reduce our current abstraction by circa 25%, with further potential reductions of the same magnitude required before 2040. When we take into account the impacts of climate change on supply availability and demand, the combination of these factors mean that demand outstrips supply and creates a supply demand deficit.

The plan includes ambitious demand management activity that aligns with the Government Environment Act targets, published in 2022. However, this is not sufficient to resolve the deficit. As such, we have identified over 130 supply side options which have been screened to produce a list of feasible options. These options are assessed and costed for all of the benefits and disbenefits the option could bring e.g., flood mitigation, carbon impact, tourism & amenity etc. This, along with the cost of the scheme, is used to assess and compare options through the use of a multi-criteria analysis tool to determine the set of options to resolve the supply demand balance that deliver best value for society and the environment.

The Cambridge Water revised draft WRMP24 includes two supply side options:

- Grafham Transfer – a 26 Ml/d transfer of water from Anglian Water's Grafham Reservoir. This scheme is dependent upon the construction of Anglian Water's Grafham to Rede pipeline which has approximately 26 Ml/d of spare capacity until 2040. The Grafham to Rede pipeline will be constructed through the Cambridge Water area and by connecting into this pipeline and maximising this spare capacity in the pipe we are able to facilitate a 26 Ml/d transfer of water into our system. This 26 Ml/d will be available upon completion of the Grand Union Canal (GUC) option under development by Affinity Water that will enable them to reduce their current take from Grafham Water. This is currently scheduled to be 2032 and the cost of the scheme is £12.427m.

- Fens Reservoir – the development of a 50 Mm^3 reservoir jointly with Anglian Water on a 50:50 basis to supply water into the Cambridge Water region from 2036. This option will supply circa 44 Ml/d of water to the Cambridge region and total cost for the programme is £1.96bn. The Fens reservoir features as an appendix to the Business Plan and is not included in this enhancement case.

We have shared these options with our customers and stakeholders to ensure any concerns are understood and factored into our planning, as well as determining support and future communication and engagement requirements. Overall, our customers support these options, seeing water transfers as a positive way to address the water needs but believe that the reservoir offers a longer-term solution that sees less reliance on other companies which is preferred.

Our WRMP24 forms our core pathway for AMP8. We have undertaken scenario testing on our plan to understand how the Ofwat reference scenarios may impact the selection of these options.

The Grafham transfer scheme involves pipeline construction and connection, and this would be designed and delivered through our AMP8 capital delivery partners working in collaboration with Anglian Water. This scheme will secure the medium-term supply resilience for Cambridge Water customers, as well as enabling critical abstraction reductions from the chalk aquifers which will deliver environmental improvement aligned to the Water Framework Directive objectives and protection from climate change. Prior to the building of this scheme, we need to undertake network feasibility studies to determine key connection locations, changes needed to the configuration of our system, operational changes required to network operation and set up, as well as water quality transfer reviews and impact mitigation work.

The table below summarise our planned investment.

Table 8 - Investment Summary

Investment	Enhancement Investment	AMP 8 TOTEX £k	AMP 8 Enhancement OPEX £k	AMP 8 Base CAPEX £K	AMP 8 Enhancement CAPEX £k
Grafham Transfer	Network feasibility, connection, and associated infrastructure to enable transfer of 26 Ml/d from Anglian Water's Grafham Water	12,427	£0	£0	12,427
	Totals	**12,427**	**£0**	**£0**	**12,427**

2.1.2 Background Information

The WRMP24 process for Cambridge Water assesses the future water demand needs for our region, including those for both household and non-household customers, as well as identifying those for the environment. This process has shown that there is a significant increase in demand required in the Cambridge Water region of approximately 18% by 2050. This is driven by the ambitious growth forecasts in the region. Whilst many other regions of the country are experiencing household growth, the Cambridge Water region is forecasting significant non-household growth too, and in high water consumption in activities such as laboratory and medical functions. As a result, the non-household growth constitutes 54% of this forecasted demand increase.

In addition to this, there are significant abstraction reductions that need to be met. Currently the majority of the Cambridge Water supply comes from chalk aquifers, and as a result of current and forecasted growth rates, there is a need to cap these licences by nearly 30 Ml/d by 2030 in order to prevent deterioration of these water environments. This equates to over 25% of our current abstraction capacity. In addition, the Environment Agency National Framework, released in 2021, identified the potential scale of abstraction reductions prior to 2050 in order to protect the environment from climate change and help deliver the Water Framework Directive objectives for watercourses to meet good ecological status. These abstraction reductions, when combined with the earlier ones, will lead to a reduction in over 50% of our current water resource availability.

The WRMP24 focuses on demand management in the first instance to meet the new demand and close the gap between lost water resource availability. Our plan aims to achieve the Environment Act targets, published in December 2022, including:

- 50% leakage reductions by 2050, including all interim targets.
- Reduce household consumption to 122 l/p/d by 2038 and 110 l/p/d by 2050.
- Reduce non-household consumption by 9% by 2038.

However, due to the scale of the non-household growth planned in the Cambridge region, it is not possible to reduce overall non-household consumption by 9% from the baseline 19/20 level as this would require all new development to be water neutral as well as reducing existing consumption. As such, we deliver a reduction that equates to 9% of the forecasted demand in 2038 by this date.

Despite these ambitious demand reductions proposals, there is still a significant deficit to be resolved to achieve an appropriate supply demand balance. As such, new supply side options are required to enable the abstraction reductions required as well as meet the significant growth in the area. However, due to the chalk geology of the Cambridge Water region, there are very limited opportunities for new supply options in the area. At WRMP24 pre-consultation phase, many options were screened out through our environmental assessment process or removed following feedback from the Environment Agency. Our initial long list of potential options numbered over 130, but following these reviews we are now reduced to 18 feasible options, several of which are iterations of the same option (e.g., different size transfers from the same source). Most of these rely on our neighbouring water companies through transfers, licence trades or effluent reuse.

Our planning process looks to the value each option provides; here value does not only relate to cost but also to additional benefits afforded through the option such as flood reliance, tourism and amenities, natural capital, and biodiversity. All options are included in the Water Resources East (WRE) multi-criteria analysis tool, called the simulator. The simulator then assesses each option against the others to determine the best value options required to solve the challenge. Following selection of the schemes through this method, the options are included in the Economic Balance of Supply and Demand model (EBSD) which determines the required timing for these options. The selected supply side options for Cambridge Water are:

- Transfer of water from Grafham Transfer
- Fens Reservoir

Both options are being developed in partnership with our neighbours Anglian Water.

The Grafham Water transfer option will see the transfer of 26 Ml/d of water from Grafham Water into the Cambridge Water region via a pipeline currently proposed for construction by Anglian Water to connect Grafham to Rede as part of their strategic grid development. Upon commissioning there will be spare capacity in this pipe until 2040 which enables the supply of a 26 Ml/d transfer of water into the Cambridge Water region. Our option requires the installation of connecting pipework and ancillary infrastructure to enable the incorporation of this water into our system. The cost of this work is £12.43m.

This water will be available from Grafham Water as a result of the Grand Union Canal strategic resource option under development by Affinity Water. This additional water availability will enable Affinity Water to reduce its transfer of water from Graham Water and thereby enable capacity to transfer to Cambridge Water. As a result of this reliance on the Grand Union Canal (GUC) option, the earliest start date for the Grafham Water transfer option is 2032.

In order to ensure that our WRMP preferred plan is low or no regrets, it is tested against a range of scenarios. This includes low and high scenarios for both climate change and growth. The different climate change scenarios provide little impact (less than 1%) to the available DO (Deployable Output) and therefore do not impact on either the options selected or the timing of these options.

The differing growth scenarios do show an impact on forecasted demand. Our plan utilises the adopted local plan data, as instructed in the Water Resource Planning Guidelines (WRPG). The high growth projection is included in our plan as an adaptive pathway. The low growth projection utilises the ONS data and actually shows demand to decrease, as shown in the table below:

Table 9 - Growth Scenario comparison

HH Demand in Ml/d	2029/30	2034/35	2039/40	2044/45	2049/50
Local Plan	48.1	50.5	51.5	52.7	53.4
ONS	45.2	44.8	44.4	44.2	44.0
Difference	2.9	5.7	7.1	8.5	9.4

This shows that the ONS data actually forecasts a reduction in demand. This is because the forecasted new build growth for the ONS scenario is very low. Our demand forecast assumes a general reduction in water usage due to a continued downward trend in micro-component use. In addition, it assumes the current rate of customers opting to switch to a meter is sustained and takes into account the reduction in demand this typically brings. As a result, this modest increase in growth is offset by these elements leading to an overall reduction in demand.

Throughout 2022, there have been regular meetings between Cambridge Water, the Environment Agency, Defra and the Greater Cambridge Shared Planning teams regarding the risk that the existing levels of growth pose to the environment and the water resource availability in the area. The Environment Agency has objected to several proposed developments on the grounds of water resource availability in the catchment and the risk that any increases in demand may pose to the environment. These are issues we are facing in the region now based on the current level of proposed growth, and therefore we believe it to be inappropriate to plan for a level of growth that we know to be lower than both the local published plan and the aspirations set out by Government departments such as DHLUC for the Cambridge area, and which actually shows demand falling rather than increasing.

As a result, we believe our plan delivers for the most likely scenarios, and our best value planning shows that these are the best value options.

2.1.3 Need for Investment

When including all of the required elements in the Cambridge Water WRMP24 planning process such as growth, climate change, and environmental needs, the following supply demand balance is calculated:

Table 10 - WRMP24 supply demand deficit

	2029/30	2034/35	2039/40	2044/45	2049/50
SDB (Ml/D)	-10.27	-32.95	-36.15	-69.24	-69.63

Upon inclusion of the demand management activities, as outlined in the Environment Act targets, the SDB is updated to those detailed in table 4 below:

Table 11 - WRMP24 supply demand deficit

	2029/30	2034/35	2039/40	2044/45	2049/50
SDB (Ml/D)	5.76	-12.44	-13.14	-46.23	-46.35

As a result, new supply side options are required to deliver a positive supply demand balance for Cambridge Water.

In 2022 Defra announced an opportunity for companies to apply for funding to accelerate infrastructure development relating to supply resilience. As such, Cambridge Water put the 15 Ml/d Grafham Transfer scheme that was selected in the draft WRMP forward for acceleration. As previously noted, this scheme is dependent upon Anglian Water's installation of their Grafham to Rede pipeline for Cambridge Water to connect to. To this end, Anglian Water also put forward their Grafham to Rede pipeline for the accelerated infrastructure development funding.

However, the scheme was rejected primarily due to Environment Agency concerns regarding the sustainability of the water source being utilised for the transfer. The 15 Ml/d transfer utilised an existing Anglian Water drought permit, and the Environment Agency confirmed in the draft WRMP consultation process that the drought permit was not sustainable and therefore the original 15 Ml/d transfer was no longer deemed feasible.

As a result, we worked closely with Water Resources East, Affinity Water and Anglian Water to identify an alternative transfer option. Affinity Water currently have a transfer of water from Grafham Water which could instead be utilised by Cambridge Water if a suitable alternative source for Affinity Water could be identified. Affinity Water are currently proposing a strategic resource option through the RAPID process known as the Grand Union Canal option (GUC), which also has a dependency upon the Minworth SRO (Strategic Resource Option). The GUC option has several alternatives relating to the potential size of the scheme, and Affinity Water's draft WRMP had previously selected the smallest option size of 50 Ml/d. By instead selecting the 100 Ml/d option, this provided Affinity Water with enough water to release their existing transfer of water from Grafham Water, therefore making it available for transfer to Cambridge Water. It also enabled a larger transfer of water to Cambridge Water than the original 15 Ml/d, and the transfer opportunity is now 26 Ml/d which is the maximum spare capacity in the Anglian Water Grafham to Rede pipeline which will be delivered by Anglian Water in AMP8. The transfer is time-limited to 2040 as this is the date where Anglian Water require the full capacity of the pipeline.

The revised draft WRMPs of Anglian Water, Affinity Water and Cambridge Water all include this option in their preferred plans. Through inter-regional planning, this option is selected in a wide range of scenarios run by the WRE simulator as well as individual company EBSD and multi-criteria modelling. The option is selected from its first availability in 2031/32, which is when the GUC option is forecast to be available, until 2036 when the Fens reservoir comes online and the need for the transfer is removed.

Costs for this scheme were developed alongside our other supply side options by Atkins. Please see Section 6.2 in this appendix for further detail on the Atkins cost estimation process.

A cross-connection will be constructed where the new Anglian Water circa 90km strategic main from Grafham to Rede (west to east) intersects the existing Cambridge Water supply mains. This will notionally be located approximately 2km north of Longstanton. The infrastructure required for this option includes:

- 750m of 500mm diameter cross-connection pipework has been included in this option for variable allowance and costing purposes due to the uncertainty of the final Anglian Water strategic main location.
- 8000m of 1000mm pipework as a notional additional Grafham Rede strategic main spur pipeline or contribution allowance to Anglian Water for Grafham Rede pipeline route which will enable a short cross connectivity into the Cambridge Water network. The preferred solution will be subject to route optimisation.
- The pipework will be equipped with flowmeters, pressure reducing valves (PRV) and other ancillary instrumentation.
- Water quality mitigation – breakpoint chlorination, including;
    - Sodium Hypochlorite dosing rig and storage (26 Ml/d)
    - Chemical dosing storage and kiosk building
    - Chlorine contact tank (516 m^3)
    - Land requirement for treatment site (600 m^2)
    - Power grid connection for chemical dosing
- Land compensation associated with 12,750m of pipeline.

These costs are summarised in the table below. The costs include 25% on-cost and design included and COPI.

Table 12 - Grafham Transfer construction cost only breakdown

Option ID	Pipeline cost (£k)	Civils cost (£k)	M&E cost (£k)	Optimism bias	Total cost (£k)
CW24-75Diii Op2	6,524.7	1,319.1	381.1	44%	11,844

Table 13 - Spend profile feasibility, design and construction costs

Option ID	Year 1 (£k)	Year 2 (£k)	Year 3 (£k)	Year 4 (£k)	Year 5 (£k)	Total (£k)
CW24-75Diii Op2	50	145	1,775	5,834	4,623	12,427

Year 1 and 2 additional costs relate to network feasibility required prior to design, pipeline route design optimisation and own staff costs.

Key aspects of the scheme as envisaged are:

- Ongoing collaboration with Anglian Water to develop the optimal pipeline route option for progression and delivery.
- Pumping will not be required as part of this option, as the hydraulic head already developed in the Anglian Water main to reach Rede will be sufficient.
- Anglian Water are undertaking the costing and environmental assessment of the new strategic main therefore it is the assessment of the Grafham Transfer pipeline and connections will be minimal or is not required as part of this option.
- The existing CAM network has the capability to deploy the additional water from this option at the connection point.
- Land compensation is assumed for all lengths of pipeline included in the option.

Key risks include:

- The enabling SRO schemes do not progress as planned.
- The estimated pipe lengths are notional based on a review of GIS for the most appropriate pipeline locations and these are subject to change after detailed design, environmental impact assessment and land accessibility negotiations with landowners.
- Potential degradation of water quality over time in the Grafham Rede strategic main providing the water to the Cambridge Water.

There is notable variety in the different asset types and cost considerations across the WRMP24 supply-side options. This influenced the selection of appropriate cost models and approaches to employ. The need to achieve consistency in cost estimates with the parallel PR24 processes was a key factor which influenced the use of the WRc's TR61 industry wide cost tool TR61. However, recognising that not all of the required assets for all options could be represented in this tool gave rise to using and combining alternative cost approaches. These can be summarised as:

- The WRc TR61 cost tool which includes several pre-loaded models e.g., 'Infrastructure models' and 'Water Treatment models'.
- The WRMP19 cost estimation workbook. The WRMP19 pricing workbook was derived using engineering judgement on costs, assumptions, and industry experience at the time of production. Examples of where this was required include new power supply connections and land compensation and purchase.

Optimism bias has been applied as a multiplier to the total project costs to compensate for an inherent tendency for underestimation (optimism) of project pricing compared to the resultant outturn cost. The optimism bias provides a contingency for currently unforeseen scope items and is set at a level appropriate to the stage of the option development. The estimated prices for each option are provided with an optimism bias applied of high, mid, and low estimates reflecting different levels of contingency. The optimism bias for the Grafham Transfer option was produced using guidance from the Cost Consistency Methodology Technical note produced by Mott Macdonald in August 2020, provided for use by South Staffs and Cambridge Water.

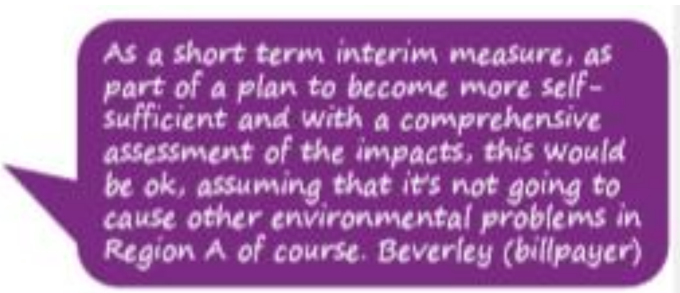
Estimation of fixed Opex costs has been carried out using an approach that is consistent with the SST WRMP24 estimation approach and the WRMP19 methodology. Only staff costs have been included within the fixed operating cost data.

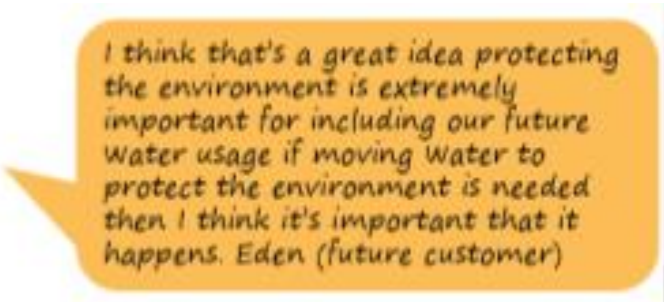
The variable operating costs represent, where applicable to the option: power, chemicals, waste stream and import costs. The import for the Grafham transfer is being received from Anglian Water. In lieu of a commercial agreement between CAM and Anglian Water at the time of option pricing, a review of the Anglian Water trade costings 2022-2023 Wholesale charges schedule has been undertaken to establish assumptions to be prepared representing the expected import costs. The Anglian Water 2022-2023 Wholesale charges schedule provides the Anglian Water fixed charge (per year) and volumetric charge (per m^3).

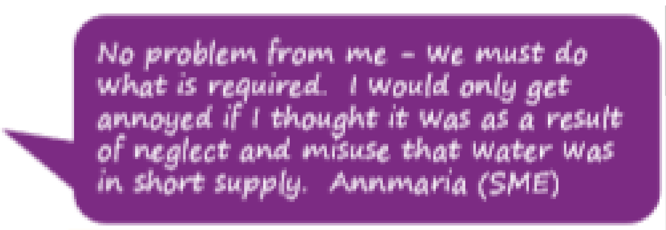
2.1.4 Customer Support

As part of the development of our draft WRMP24 we have shared our plans with customers to understand priorities, affordability, and preferences. As part of this, we have explained our need for new supply options and shared the type of options, as well as our preferred plan. Following our initial customer engagement several customers raised concerns around water transfers, and so we undertook some additional deep dive research into this activity. The outputs of all of customer and stakeholder engagement were published as appendices to our draft WRMP24.

Water Transfers: Most of the customers that we engaged with are in favour of water transfers for environmental reasons (if region A suffers no detrimental environmental impact as a result). However, some questioned the viability of this as a long-term strategy and others wanted further information on the possible adverse environmental impacts of water transfers in terms of carbon. Below are some direct customer quotes:







We also held stakeholder roundtable events as part of the development of our WRMP24 and shared the prospect of water transfers with attendees. Some stakeholders saw them as an essential component of Cambridge Water's WRMP; transfers would boost water supplies faster than a reservoir so would help to fill the deficit in the medium term. However, they did feel that transfers would only be one piece of the overall plan. Given the time for transfers to come online, a range of demand management measures would have to be relied on until then. Also given the size of the deficit, a reservoir would also be needed in the long term.

2.1.5 Best Option for Customers

Our WRMP process identifies potential new supply options, and our process identified over 130 options. These options include:

- New groundwater
- New surface water
- Licence trades
- Water transfers
- Groundwater enhancement
- Water reuse

These options must then be screened to ensure they are feasible and so these have a high-level environment assessment to identify any concerns that cannot be mitigated. Any options that pass this screening process progress as feasible options, and these are shared with key stakeholders and regulators at pre-consultation phase. As a result of feedback at this stage, additional options, predominantly groundwater options and licence trades relating to chalk aquifers, were also screened out. This led to a final feasible options list of just 18 options. These options include:

- Groundwater enhancement
- Water transfers
- New surface water

In order to determine the best plan to meet the deficit, each option is costed. As well as the financial costs, the more indirect costs and benefits are calculated; carbon, flood mitigation, biodiversity, natural capital, tourism and amenity and others. These benefits are all used to compare the options and feed into the multi-criteria analysis tool, known as the simulator. This then selects the best value options to solve the supply demand deficit. This regional modelling consistently selects the Grafham Transfer in all scenarios tested ensuring this is a no regrets option.

In addition to the regional simulator, we also undertake our own options selection process as part of the WMRP to ensure that options that are selected as being best for the region are also the right options for Cambridge Water and our customers. In the past, we have followed the economics of balancing supply and demand (EBSD) approach to develop our preferred plan, which is a well-established framework and traditionally focused on monetisation and developing least cost portfolios to meeting supply and demand challenges. However, for the more challenging complex issues identified through the problem characterisation a more sophisticated approach to analysis is required.

For WRMP24, we needed to ensure we take a Best Value Planning (BVP) approach to developing our preferred plan, as laid out in the Water Resource Planning Guidelines. As such WRW, and the water companies within it, commissioned HR Wallingford, and PJM Economics to develop a multi-criteria analysis tool that would allow companies to assess the value of options, as well as then produce the best value plan to resolve the challenges in each company and the region overall. We have then utilised this tool for our Cambridge Water WRMP to ensure consistency in approach between the two plans.

The UKWIR (2020) framework for best value water resources management plans sets out a multi-criteria decision analysis (MCDA) approach for developing a best value plan, and the tool developed follows this approach.

A full appraisal of capex, life cycle costs and Opex (Totex) for all options ensures we can produce a least cost solution. The details of these for this scheme can be found in Section 6.2 and 6.3. The inclusion of other un-monetised attributes also allows us to optimise on other objectives and understand the value of differences.

The MCDA considers different types of metrics that are important in determining best value:

- Cost
- PWS drought resilience

- Carbon costs
- Flood risk
- Human and social wellbeing
- Sustainable natural resources
- PWS customer supply resilience
- Multi-abstractor benefits

These metrics are then weighted and scores for each area for each option are determined using the Valuestream1 tool following the input of SEA and NCA metrics.

We then use these outputs in the Valuestream2 tool which looks at our supply and demand and determines the best value options to resolve the challenges we face. We have used this, and EBSD modelling, to develop our preferred plan, least cost plan and the plan that is best for the environment. There is additional detail on this process in section 9 of the revised draft Cambridge Water WRMP, see a link to this document in section 6.5.

The Grafham Transfer option is selected consistently in the EBSD modelling, and through Valuestream for the preferred plan and best plan for the environment.

Following the draft plan consultation, significant concerns were raised regarding the original Grafham transfer option that featured in our preferred plan. The Grafham transfer at draft plan stage was reliant on an Anglian Water drought permit which enabled a 15 Ml/d transfer. Following concerns raised by the Environment Agency, this offer was withdrawn by Anglian Water, and we worked together to identify an alternative opportunity to transfer water into the Cambridge Water region. Working jointly with Affinity Water we have linked to the Grand Union Canal scheme – Affinity Water's selection of the 100 Ml/d option in 2030 enables them to reduce their current transfer from Grafham Water. This then enables the opportunity of a transfer of water to Cambridge Water. In addition, this new option enables a larger transfer to be available equal to the maximum spare capacity in the Anglian Water Grafham to Rede pipeline, which equates to 26 Ml/d.

We also commissioned Atkins to undertake a review of the treatment required to bring surface water in our system which is currently 100% groundwater, and to understand any additional treatment that may be required. This demonstrated the most appropriate approach based on quality, risk, cost, and carbon impact. A summary of the outputs of this work are included in Section 6.3 The full report can be found in Appendix U to the Cambridge Water revised draft WRMP.

2.1.6 Cost Efficiency

All pipeline costs have been calculated using the WRC TR61 method and tool. For elements such as land compensation, flowmeters and pressure reducing valves which cannot be represented in TR61, the cost method has been applied from Atkins costing reports using our WRMP19 pricing workbook. This information is then translated into the CAPEX/OPEX workbook which merges all of the data from the costing methods mentioned and is used for uplifts and optimism bias. The options and capex workbook is then converted to NPV and AIC in a separate workbook. Summary outputs from these detailed workbooks have been provided as evidence of the above costing estimation, in Section 6.2 of this appendix.

2.1.7 Customer Protection

This scheme will apply a price control deliverable (PCD) relating to delivery of security of supply. More information and a full list of our PCD's can be found in Section 1.5.

The scheme will be constructed in AMP8 to be ready for the water when it becomes available from Grafham Water in 2032. This water availability is reliant on the Grand Union Canal completion, which is currently forecast for 2032 however, should this be completed earlier by 2030, the water would be available then for use. As such, we need to have undertaken all the necessary construction and connection work by the end of AMP8 so that we are ready for the water as soon as it is available. There will not be a recognised water available for use (WAFU) benefit in AMP8. As such, the PCD will look at delivery of the scheme and ensuring it will be built and ready for use by the end of AMP8.

Table 14 - WRMP PCD

WRMP PCD						
Description	Installation of a 26 Ml/d capacity pipeline for use when water is available.					
Output measurement and reporting	The output of the Grafham import will be measured Ml/d capacity pipeline for use when water is available. Delivery will be reported and monitored through the control period following the existing APR process. Reported at the end of the financial reporting year. Forecasted deliverables are set out in the table below.					
Assurance	Independent third-party assurance to confirm completed milestones					
Conditions on scheme	Grafham Transfer – a 26 Ml/d transfer of water from Anglian Water's Grafham Reservoir. This scheme is dependent upon the construction of Anglian Water's Grafham to Rede pipeline which has approximately 26 Ml/d of spare capacity until 2040. This 26 Ml/d will be available upon completion of the Grand Union Canal (GUC) option under development by Affinity Water that will enable them to reduce their current take from Grafham Water. This is currently scheduled to be completed by 2032. We don't propose any late delivery penalties on this PCD due to variables which are out of our control.					
PCD payment rate	Non-delivery by the end of the control period will be applied where the project hasn't been started within the control period. We will return the full enhancement funded amount for the specific scheme **plus** the time value of money back to our customers. The time value of money will apply the appropriate rates for the period required.					
Deliverables	**Unit**	**Forecast deliverables**				
		2025-26	2026-27	2027-28	2028-29	2029-30
Grafham import	Ml/d					26

2.1.8 Delivery

This section should be read in conjunction with Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.

The notional solution proposal for Grafham Transfer requires construction of either a deviation in the shortest distance optimal solution Grafham Rede pipeline route to achieve close proximity to the Cambridge Water network and a 750m of 500mm pipeline of final / cross connection pipeline or a tee off of 8000m of 1000mm diameter pipeline with Cambridge Water network connection. The pipelines will include access chambers, flowmeters, PRVs, chlorination and water quality monitoring instrumentation.

Although a relatively large project in terms of project delivery by Cambridge Water both historically and with regard to the AMP8 capital programme, the scale of the pipeline is within the markets capacity to deliver, and it should be considered in the context of a transition from AMP7 to AMP8 with the expected increase in investment in pipeline delivery. Although delivery is phased for AMP8 years 3 onwards, it is intended to work collaboratively with Anglian Water to commence the process of identifying and securing commitment from a delivery contractor in AMP8 year 1.

Pipeline construction by its nature faces a number of key challenges;

- Conflicts with existing underground and overground assets
- Varying challenging ground conditions
- Weather impacts creating inefficiency in construction methods, both dry hot and wet cold.

The total cost of the project is estimated at > £12m, which includes a 44% optimism bias estimate to account for challenges such as those above.

The pipeline construction will require detailed site investigation, feasibility, constructability and route optioneering prior to a tender process to ensure the challenges noted above that manifest as programme and cost risks are known and understood. These risks can then be accounted for and mitigated in design and construction phasing and method, and the balance of risk proposed by the contract.

Procurement and delivery would be under a standalone contract. Delivery under the Infrastructure Assets Delivery Framework Contract would not be appropriate given the scale of work and interdependency with the Grafham to Rede strategic main AMP8 project. Works procured under the Assets Delivery Framework Contract would typically be smaller pipe sizes, <500mm and for shorter lengths.

A standalone contract also enables a 2 phased contract commission approach, to carry out a feasibility and reference design development commission prior to the main construction contract commission award giving improved certainty of delivery and cost outturn.

We will work with Anglian Water and their delivery partners to deliver the infrastructure required to transfer water from Grafham reservoir to the Cambridge Water network.

The delivery of the Grafham transfer infrastructure will be in parallel with the Grafham to Rede strategic main. This presents opportunities for co-delivery with Anglian Water which will have a number of advantages;

- Cost efficiency through economies of scale
- Direct management by a single contractor of the physical interface design and construction
- Direct management by a single contractor of the timing of interface construction

Opportunities to deliver as a joint client or with separate client contracts utilising the same contractor will be further explored with Anglian Water during the feasibility phase.

The delivery contract is likely to be SSWs amended NEC4 contract or similar Anglian Water contract if a joint procurement is utilised. Appropriate options will be Option A (fixed price with activity schedule), Option B fixed price with bill of quantities) or Option C (target cost), subject to outstanding risk profile following site investigation and development of the reference design.

2.2 Case 2: WRMP Water Efficiency

2.2.1 Summary

In 2022, the Government published the targets for aiding the delivery of the Environment Act 2021. Three targets relate to water efficiency by seeking reduction in household and non-household consumption as well as delivering an overall reduction in the amount of water put into supply per capita. As part of developing the latest round of Water Resource Management plans, the water resource planning guidelines stated that companies should plan to deliver these targets as part of their WRMP.

Our WRMP24 for Cambridge Water and for South Staffs Water includes delivery of these targets. We have identified a range of options for delivering the required outcomes, and then undertaken multi-criteria analysis by working with Artesia and their demand management optimisation tool in order to determine the best value plan for delivering this. We have undertaken benchmarking across the industry to ensure accuracy in our costs and benefit assumptions, as well as our understanding of risk and delivery.

The optimisation of the options has looked at cost, deliverability and risk when determining the preferred plan. Our best value plan in the WRMP is also the same as our least cost plan. Our proposed profile of activities also deliver additional benefits which include a reduction in our greenhouse gas emissions as a company, as well as enabling us to deliver future abstraction reductions to preserve and protect our environment through delivering the needs identified in the Environment Agency’s Natural Framework for Water Resources.

We are proposing to spend £13.02m TOTEX in AMP8 to deliver 3.38 Ml/d of demand reduction, as well as a reduction of 394.5 tCO_2 per year our greenhouse gas emissions. Our performance will be measured and assessed through annual review submissions to the Environment Agency (through the WRMP annual review) and Ofwat (through the Annual Return process). This activity enables delivery of our PCC performance commitment.

We have shared our ambition and the details of how we’ll deliver this with our customers as part of our WRMP24 customer engagement work. Our customers support our activities and encourage further education and communication to all customers to highlight the reasons behind the need to reduce consumption and encourage behavioural change.

The table below summarises our planned expenditure.

Table 15 - Investment Summary

Investment	Enhancement Investment	AMP 8 TOTEX £k	AMP 8 Enhancement OPEX £k	AMP 8 Base CAPEX £K	AMP 8 enhancement CAPEX £k
Household water efficiency	Water efficiency activity including household water audits and housing association partnerships	12,057	7,400	0	4,657
Non household water efficiency	Water efficiency audits	960	960	0	0
	Totals	**13,017**	**8,360**	**0**	**4,657**

2.2.2 Background Information

In 2022, the Government published the targets associated with the Environment Act 2021. These include targets for the reduction of both household and non-household consumption as detailed below:

- Reduce household consumption to 122 l/p/d by 2038 and 110 l/p/d by 2050.
- Reduce non-household consumption by 9% by 2038 and 15% by 2050.
- Reduce distribution per capita by 20% by 2038.

The most recent water resource management plans (WRMP24) for both Cambridge Water and South Staffs Water outline the options for delivery of these statutory targets, as defined in the water resource planning guidelines (WRPG). The WRMPs identify a range of options for achieving each of these targets and then use a best value multicriteria assessment approach to determining the preferred set of options to form the plan.

The WRMPs have selected the following activities in order to achieve the water efficiency targets:

- Household water efficiency audits.
- Partnerships with Housing Associations to deliver water efficiency improvements.
- Non-household water efficiency audits.

- Our multicriteria analysis has selected these items due to the benefit that can be recognised when compared to the cost, and due to their deliverability. This is supported by work of other water companies in AMP7, such as Thames Water who have an extensive non-household water efficiency audit programme. We have liaised with these companies to understand the outputs of their activities which means we have more certainty on these options for cost, deliverability and benefits that can be recognised. We have based our assumptions and costs for these activities on this real data from other companies.

- We have also worked with retailers to understand how best to deliver reductions to consumption in the non-household market. We took part in a club engagement project with other water companies within Water Resources East (WRE) to work with retailers on developing options for reducing non-household consumption and identifying the best mechanisms for delivery of these. We have been exploring an incentivisation mechanism for retailers to share and promote water efficiency messages and support. In 2022 Southern undertook an incentive scheme with non-householders in order to reduce demand during the drought period. They found that the scheme did not deliver a high level of success and whilst there are many learnings from this, there is obviously still much work to do to understand how this approach may be utilised in order to deliver tangible benefit. As such, we have not included this option in our preferred plan, but we will continue to work with retailers to continue developing this and other options further.

- We are proposing for this work to start in 2025 and continue throughout AMP8. We will also continue these activities post AMP8, as detailed in both the WRMPs and the LTDS, in order to deliver those longer-term Environment Act targets. Our demand optimisation work has shown that work must start in 2025 for both household and non-households if we are to achieve the interim target of 122 l/p/d in 2038.

- As well as delivering the Environment Act targets, these activities deliver our Performance Commitment (PC) for PCC, along with our proposed household and non-household metering programme, which is covered in a separate enhancement business case document.

In our area, we have nearly 42,500 non household properties and they constitute just over 20% of the overall demand for water. As such, there is an important role for these customers in helping us to drive down demand through reducing consumption, wastage, and leakage. We are conscious that retailers own the relationship with non-households since the market opening in 2017, but we see a key role for water companies to play to support demand reduction in this area.

As such, following the introduction of the new Environment Act and the proposed targets within, we have included the reduction to non-household consumption by 9% by 2038 and 15% by 2050 in our preferred WRMP plans. During AMP7 we have not undertaken any proactive work to reduce demand among our non-household population, but we believe there is significant opportunity here that can be explored through collaborative working.

We have undertaken some engagement with retailers throughout the WRMP process, and continue to do so, in order to understand how we can better work with them to support and incentivise water efficiency proposals to non-household customers. This could be supporting with on-site audits for non-households, providing leakage detection and water efficiency advice. We will continue to work with other water companies and retailers to agree the best way to help deliver support and incentives in this area.

We undertook a club retailer engagement Club project with the other WRE companies to identify the best mechanisms to increase water efficiency and how best to engage with retailers and non-householders in order to deliver our plan. We believe this is important so that retailers can expect a consistent approach from the various Wholesalers with whom they work. This will lead to the most efficient way of engaging and operating with both retailers and non-household customers in order to deliver the maximum benefits.

2.2.3 Need for Investment

The drivers for this investment are the targets outlined in the Environment Act relating to reducing both household and non-household consumption, and therefore contributing to reducing the overall amount of water we put into supply per capita.

The Covid-19 pandemic led to a rise in household consumption as we saw increased hygiene practices and more customers working from home. Hybrid working is now commonplace, and this also leads to more household consumption. Our WRMP24s, as per the WRPG, assume we will achieve our in-year target position for PCC by the end of AMP7 and therefore our planning for AMP8 starts from this point. This means we are not seeking additional funding at AMP8 to deliver our AMP7 commitments. Our extensive PCC improvement plans in AMP7 have seen notable reductions to PCC levels, and in 2022/23 the PCC in South Staffs Water region dropped 6 l/p/d compared to the previous year, despite the heatwaves and drought of 2022. In Cambridge, 2022/23 PCC position is just 1 l/p/d above our WRMP19 target position for the year and therefore we are on track for recovering our forecasted progress. Our PCC improvement plan in years 4 and 5 of AMP7 will deliver an additional step change in activity and spend to deliver these target positions.

The Environment Act targets relate to 2038 and 2050 but our demand management optimisation work, that we have undertaken as part of developing the WRMP24s, shows that we need to commence this work in AMP8 if we are to achieve these targets. This long-term pathway for delivery is outlined in the WRMP24s as well as the LTDS and is summarised as follows:

Table 16 - Benefits of our proposed water efficiency programme

Activity	ID	Year activity starts	Total benefit by 2050 Ml/d	Cumulative benefit by AMP				
				AMP 8	AMP 9	AMP 10	AMP 11	AMP 12
Household water efficiency programme (partnering approach, home visit)	2021-012	2025	1.35	1.52	2.85	2.25	1.35	1.35
Innovative tariffs	2021-048	2035	2.30	0	0	2.03	2.03	2.30
Housing associations - targeted programme	2021-036	2025	0	0.71	0.28	0	0	0
Non-household water efficiency programme (partnering approach, site visit)	2021-015	2025	2.30	1.15	2.30	2.30	2.30	2.30
		Total		**3.38**	**5.43**	**6.58**	**5.68**	**5.95**

After AMP10 the cumulative benefit reduces slightly as we replace our household water efficiency programme with our innovative tariff approach. We believe this mechanism will deliver more sustainable results and at a lower cost and is therefore a better value approach. We are undertaking tariff trials in year 5 of AMP7 which will help us to shape and develop this option, identify ways to maximise its outputs and potentially increase the benefits delivered by this option.

As outlined in our Universal Metering enhancement business case, the installation of smart meters enables us to utilise more cost-efficient options. Our universal metering programme looks to have these installed by 2035 and at this stage we can introduce innovative tariffs as well as use the data from these meters to target our water efficiency activity more effectively. As a result, the cost for delivering these efficiency measures reduces from AMP10 onwards.

Through our WRMP24 customer engagement programme, our customers have stated that they want us to do more to educate customers in their water usage and the ways to save water. As well, they want us to share more information to all of our customers of why this is so important; so, to share more on our water stress status, the future challenges and the link between demand and the environment.

2.2.4 Customer Support

As part of the WRMP process, we undertook extensive engagement with both household (including future customers) and non-household customers to understand their views on water efficiency activity. A wide range of research studies, including our local engagement, continues to indicate that a gap remains for many customers between considering the impact on the water environment when they turn on the taps. Many customers are not aware of rainfall levels, the scale of population growth and the low proportion of water habitats which are rated as in good health. A significant proportion are also unaware that they live in a water stressed area.

The core of our local customer engagement programme is our Water Resources Advisory Panel (WRAP). This was carefully recruited in July 2021 to ensure it represented as many consumer voices as possible on an online Forum. At its heart, the WRAP is a group of household (HH) and business (NHH) customers (and future customers) who are convened (multiple times) to feed into an organisation's thinking on their priorities, business plans, service or policy developments or strategic direction. This allows for a continuous, ongoing two-way dialogue with gradually more informed customers. This engenders trust on both sides and allows consumers to input into complex issues and ongoing debates within organisations. The Forum ran for 13 months, covering four specific engagement points to allow on-going discussions.

On our WRAP Forum the national target for reducing customer demand for water (PCC) was largely acceptable to customers. However, the stretch targets to 80 l/h/d seemed too difficult to achieve at this point when informed around what this means in terms of daily water use. However, environmental stakeholders would prefer to see a stretched level of ambition achieved as quickly as possible. The 110 l/h/d target is achievable as long as:

- Customers are educated and incentivised to change behaviours.
- There is investment in changing infrastructure (water recycling, water efficient appliances) and developers are encouraged to build houses which help consumers use less water.
- Businesses are also set targets to reduce consumption.
- The impacts of the pandemic in terms of increasing PCC are not long term.

Many of our WRAP Forum say that the aspiration should be for the PCC target to be 'the sooner the better' – there is a need for action; 30 years is too long to wait we should be ambitious. However, some are more cautious and mentioned that behaviours can be slow to change.

There is appetite from stakeholders in the building sector and wider sectors (e.g., environmental) and customers for building in water recycling into new builds. Customers remain keen to have education on water efficiency strategies, whether via schools, directly to their homes or information on water saving strategies for large businesses.

Behaviour change is an area that overlaps with other demand and supply side options, but in general customers say they need to have a full understanding or any particular issue before any change is likely e.g., the amount of leakage that takes place on customer properties, or the benefits of smart metering versus the costs of installation. For the most part, customers agree they could save more water than they do at present (but need motivation to do so and barriers removed). Education and advice was the second most popular option (behind leakage) when customers were asked to rank 10 options in our WRMP24 Theme 2 quantitative survey, attracting 15 points on a 0-100 priority preference scale.

From reviewing all the available NHH research studies into demand management, these indicates that the biggest barriers to the market engaging in water efficiency are:

- The lack of accurate and accessible meter data.
- A lack of skills and knowledge to understand how to be more water efficient.
- The lack of return on investment of becoming more water efficient and/or when they should become more water efficient.
- There was also an overall lack of knowledge around water scarcity and the fact that at this time water restrictions are not seen as a business threat.
- There were no obvious incentives to drive them to save water and no consequences in place for not becoming more water efficient.

Our collaborative non-household customer engagement has also shown that in-person audits and carefully designed leakage allowance policies can engage them effectively in water efficiency. Larger water users also fed back that more partnership working between energy and water around data and developing solutions to help the NHH customer meet sustainability targets is key and they expressed a greater interest in being engaged with water recycling initiatives through targeted support from wholesalers to help them with business cases and case studies.

Our H2Online community members have been vocal in telling us that we need a multi-channel approach to educating customers to encourage water conservation – from TV, radio, digital, print, and face-to-face engagement.

From the start of our WRAP Forum there were spontaneous calls from some for water companies to bring in new tariffs to encourage water saving behaviours, particularly for use in periods of drought. Our early engagement around new tariff options suggests that tariffs which benefit the individual household are preferred over community-based ones. This call was still being echoed in our first 'Your water, your say' session in June 2023. We will continue to engage customers on this area to develop our plans and are planning to launch a trial in 2024.

2.2.5 Best Option for Customers

As part of the WRMP24 process, we identified a range of options for both household and non-household consumption reduction, in addition to metering which is covered in a separate business case document. For non-household, these are:

- **Non-household water efficiency programme (company led, self-install)** - An analysis of business and water use would be undertaken, then depending on business type and volume of water used per annum a range of options could be promoted. This programme initially proposes provision of cistern displacement device or dual flush retrofit devices and taps inserts and provision of saving your business water use information and is installed by the non-household company themselves.
- **Non-household water efficiency programme (company led, site visit with install)** – as above, but South Staffs Water to undertake the installation work on site.
- **Retailer Incentive Mechanism** - This option encourages retailers to promote water efficiency for non-household customers. An analysis of non-household use would be undertaken. Retailers are incentivised to encourage with payments relating to volume saved.
- **Water audits retail** – South Staffs Water intervention to carry out audits on non-household properties, based on water use and business type where we can then recommend appropriate options for reducing consumption.
- **Rainwater harvesting for new NHH properties** - Using estimates of costs and water savings for rainwater harvesting in new builds from the Waterwise report for small and medium collection areas and low demand the saving is 592 l/prop/day (equivalent to 216 m^3 per property per year). Assume South Staffs Water provide £5k grant to encourage this for 10 new non-households per WRZ per year (CAPEX). All other costs will be met by the developer/owner of the property.

For household consumption reduction, we developed and assessed the following options:

- **Community rainwater harvesting** - an intervention for new developments where water collected through roof runoff and a sustainable drainage system is collected in a lake on the development. This water then undergoes basic treatment before being supplied through a separate supply system for toilet flushing, outside use and potentially clothes washing.
- **Water neutrality** - the additional demand from new development is minimised as far as possible and then offset by reducing demand in the surrounding area. Offsetting could also be done by reducing leakage and/or non-household demand.
- **Household water efficiency programme (partnering approach, home visit) -** provision of water saving kits, plumber installed retrofits, and encouraging behaviour change.
- **Housing associations, targeted programme** - direct company liaison with housing associations to promote water efficiency to residents. An initial audit or communication is followed up with regular communications as new water saving techniques and devices enter the market. The most efficient delivery would be for housing associations to use existing contractors to carry out the installations and so a partnership approach with the housing authority would result in a lower cost to deliver this option.

- **Innovative tariffs** - This intervention assumes smart metering as a pre-requisite and therefore can only be delivered within Smart Network programme. New tariffs are developed and introduced to encourage water saving behaviours through incentives. Tariffs can be targeted to deliver reductions in consumption based on individual household consumption patterns. The framework for tariffs for water services are determined by Ofwat. This intervention would therefore also require input from this regulator.
- **Home retrofit rainwater harvesting/greywater reuse** - This intervention would require a widespread programme to encourage the retrofitting of rainwater or greywater systems to existing housing stock. Rainwater systems are likely to be more successful at present due to the maturity of the technology and lower maintenance requirements. Retrofit options for greywater recycling products are less popular, more complex and require more maintenance.
- **Increased media campaigns and school education** - This intervention would build on the baseline activity and pilot studies that South Staffs Water is already undertaking, but would be higher profile, more consistent and co-ordinated at a regional level. The effectiveness of this campaign would vary depending on whether it was part of a co-ordinated programme, underpinned by smart metering. There are therefore two variants of this intervention, with and without smart networks.
- **New homes standards, voluntary** - At present, all new homes in England must meet the mandatory national standard set out in the Building Regulations, of 125 litres/person/day. Where there is a clear local need, local planning authorities can set out Local Plan policies requiring new dwellings to meet the tighter Building Regulations optional requirement of 110 litres/person/day. This option would be applied at a development scale through consultation and agreement with stakeholders, particularly the local authority, developers and main contractors. The target would be to achieve a new home standard below the current baseline forecast for new households.
- **Targeting properties for leak repairs or efficiency audits -** Home water efficiency visits can result in useful reductions in water use through the provision of water saving kits, plumber installed retrofits, and by encouraging behaviour change. Implementing this option after smart meter installation, as part of a Smart Network programme means that specific properties with the highest rates of consumption can be targeted for engagement, to determine the reason for the high-water use. Repairs to internal leaks, e.g., from leaky loos can be made and advice given if water use is much higher than it should be. The savings associated with this option are based on reported losses from leaky loos. There are also two variants of this intervention, with and without smart networks.
- **Community Water Efficiency Scheme** - This option is based on the results of the St Albans pilot study of the 'Save 10 a Day' campaign, focusing on the benefits estimated from the households engaged most with the programme, by ordering water saving devices through the GetWaterFit app. We would deliver campaigns to encourage households to adjust their water use behaviours and practices. The incentives could be either individual or community based. Individual schemes could be incentivised with a loyalty scheme where customers receive a reward if they achieve a certain percentage reduction in consumption. Community schemes could provide towns, villages or neighbourhoods with a community level reward based on consumption reduction across that area. There are also two variants of this option but where a more modest customer uptake is achieved based on less targeted intervention and communication due to no smart network data availability.

For the draft WRMPs, we considered three PCC pathways which reflect on low, medium, and high levels of ambition for PCC reduction by 2050. The medium pathway is based on the national framework for water resources target of 110 litres/person/day. The high and low pathways represent lower / higher ambitions for PCC targets and are shown in the table below. For the revised draft WRMP, we have assessed another scenario based on the newly introduced Environment Act targets. These scenarios are represented in the table below.

Table 17 - PCC reduction scenarios assessed

Scenario Ref	Name	Description
PCC_01	PCC_LOW	120 l/h/d by 2050
PCC_02	PCC_MED	110 l/h/d by 2050
PCC_03	PCC_HIGH	90 l/h/d by 2050
PCC_04	PCC Environment Act	122 l/h/d by 2038, 110 l/h/d by 2050

As part of our optimisation activity to determine the preferred plan, we included the Government led initiative of water labelling as an enabler. Three scenarios of water labelling were also tested – no water labelling, water labelling with minimum standards, and water labelling with no minimum standards. This has shown that water labelling is required in order to achieve the 110 l/h/d. Without this government intervention we are unable to achieve the Environment Act targets for water efficiency. As agreed at Water Resources West (WRW) and WRE, we have agreed to include water labelling with no minimum standards as our option in the WRMP, which was proposed by the Government in its water labelling consultation in 2022 and have taken the lower savings estimate for this.

As the Environment Act targets are statutory targets, our core pathway looks to deliver these, and we have used the outputs from the scenario PCC_04 above in both our WRMP24s and our PR24 business plan. Our optimisation has chosen both the activities and the profiling of these based on cost and deliverability.

Several of the options for both household and non-household consumption reduction involves the behavioural change of our customers. These options carry a higher level of risk because here we are working to influence and support change, but it is not wholly within our control, nor can we guarantee the sustainability the behavioural change of our customers. These options carry a higher level of risk because here we are working to influence and support change, but it is not wholly within our control, nor can we guarantee the sustainability of the benefits. Our plan incorporates activities that we, and other companies, have undertaken previously and have known and verified benefits and costs. This ensures less risk of delivering the desired outcomes. However, we recognise that there are potentially large benefits to be achieved through other activities, including the introduction of innovative tariffs. We will be undertaking trials in AMP7 and AMP8 on these in order to inform future discussions and plans.

Our WRMPs selected the following options from the above list to make up our preferred plan:

- Household water efficiency programme (partnering approach, home visit) (option ID 2021-012)
- Housing associations, targeted programme (option ID 2021-036)
- Innovative tariffs (option ID 2021-048)
- Non-household water efficiency programme (company led, site visit with install) (option ID 2021-015)

Figure 6 below shows the benefits that will be delivered by our water efficiency work, including the government led intervention water labelling (WL_02).

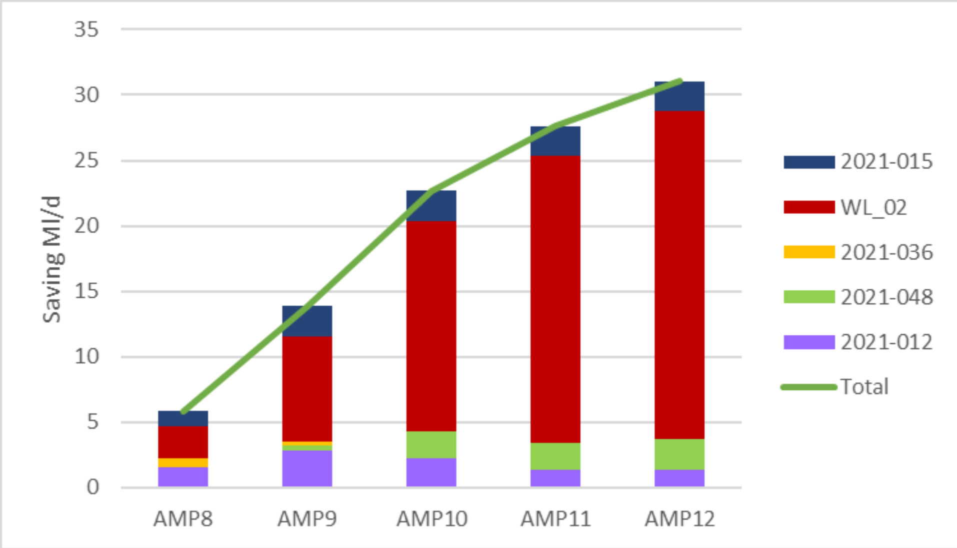


Figure 6 - Water efficiency profile

Reducing PCC and non-household consumption will directly impact the volume of water we need to produce and put into supply, and therefore leads to a direct reduction in our greenhouse gas emissions. The impact of the household and non-household water efficiency programmes is detailed in table 4 below. This is calculated using the UK government cost of carbon table and the Defra intensity metrics, which then enables us to calculate the number of kilograms of CO2e per megalitre of water treated. For every megalitre saved through universal metering, we are able therefore to calculate the associated saving in greenhouse gas emissions.

Table 18 - Estimated greenhouse gas emission reductions from our selected final plan options

tCO2e saved (cumulative)	Year 5	Year 10	Year 15	Year 20	Year 25
	2029/30	2034/35	2039/40	2044/45	2049/50
Water efficiency commitment	260.3	365.3	500.0	394.5	426.0
Non-household consumption reduction	134.2	268.5	268.5	268.5	268.5

We undertook this optimisation with the support of Artesia who have benchmarked costs and benefits against data from other water companies. Our WRMP approach and methodology has been assured by Jacobs prior to submission.

The costs to deliver the programme are outlined in the table below.

Table 19 - Cost of our proposed water efficiency programme

	Option ID	AMP8 (£m)	CAPEX (£m)	OPEX (£m)
Household water efficiency programme (partnering approach, home visit)	2021-012	8.62	3.33	5.29
Housing associations - targeted programme	2021-036	3.44	1.33	2.11
Non-household water efficiency programme (partnering approach, site visit)	2021-015	0.96	0	0.96
	Total	**13.02**	**4.66**	**8.36**

2.2.6 Cost Efficiency

Our options for both household and non-household consumption reduction was developed with Artesia. Artesia have benchmarked costs and benefits against data from other water companies.

Throughout AMP7, Thames Water have undertaken a substantial programme to fit NHH enhanced meter technology and deliver water efficiency visits to NHH customers to identify potential water savings and leakage. They have seen significant success through this approach, finding approximately 3000 l/prop/day average savings for 3000 visits per year with an average cost of £250k per Ml/d saving. We have reviewed this and adapted it for our modelling. We have far fewer NHH customers, and therefore much fewer larger users in our area. Therefore, we believe it is more appropriate to assume a reduced saving of 500 l/prop/day. This is because our average NHH consumption is 1,630 l/prop/day. Obviously therefore the level of average savings that Thames Water achieved is not possible in our area. Whilst there will be obviously some very large users where the savings potential is much greater, we are keen to ensure we look at all NHH customers with specifically tailored programmes based on the size of the customer. We also believe that our costs will be higher as we start up a new activity and develop the programme, and it is likely we will need to make more site visits to achieve the required outcome due to the proportionate scale of savings that would be recognised in smaller businesses. Therefore, we have modelled a cost of £750k per Ml/d saving.

We have worked with retailers to identify the highest consumers for water efficiency reviews and leakage detection. We will look to prioritise our support to the highest water users initially. We believe this will enable to us to identify the largest savings first. As the programme progresses, we will move to medium users.

Many of our large multi-site customers have sustainability leads who have a strong focus on energy and water and therefore we will work with these teams to provide advice and support. In reality, there may be few gains to be had here, and we will focus on large single site users who may not have the internal support for this activity already.

We will look to incorporate the smaller NHH customers with our household water efficiency audits as the requirements are similar e.g., leaky loos, and it will be more efficient to address these on a geographical basis, prioritised by reviewing DMAs of high usage. Likewise, we will also align our metering programmes for NHH and household in order to maximise the efficiencies and enable clearer communication for our customers and more successful water saving education and advice that will be undertake at the point of rollout.

Thames Water have also seen significant success from undertaking a review of continuous flow. Continuous flow is classified as a minimum of one litre per hour registered on the meter every hour for 14 consecutive days, indicating that if there may be a leak or wastage event on the premises. Twenty-five per cent of all water used by businesses is classed as continuous flow, and MOSL's report estimates that 10% of this would be reduced through self-fixes if the information was shared with businesses. This is something we propose to incorporate into the water efficiency audit programme as the smart meters are rolled out and can provide us with this data, so will likely start this work in earnest at the end of AMP8 and start of AMP9. We plan to continue our work with retailers and other stakeholders to determine how we most efficiently enable the delivery of these programmes, and whether retailers may be best placed to undertake some of this activity.

Our WRMP approach and methodology has been assured by Jacobs prior to submission.

2.2.7 Customer Protection

Our activities and delivery plan is outlined in both the WRMP24s and the PR24 business plan. As such, we will need to report annually to both the Environment Agency and Ofwat on progress against our delivery and outline any improvement plans should our delivery be off track.

Our performance will directly relate to delivery of our PCC performance commitment.

2.2.8 Delivery

This section should be read in conjunction with Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.

Management and planning of this programme will be supported by our supply chain partners through our AMP8 Professional Services Delivery Framework. This contract will be retendered for AMP8 and will be aggregation of a number of existing AMP7 framework and standalone contracts. These existing contracts have supported supplier arrangements which are well established and through which we have procured professional services in AMP7, such as Artesia, who have been instrumental in the programmes design.

Delivery of the audit and remedials and enhancement activity will be through direct labour as we employ additional resources to undertake the household water efficiency audits, identify any remedial works and efficiency activity to be delivered. This resource will be supplemented by our Infrastructure Asset Delivery Framework to ensure deliverability.

Water efficiency components will be sourced through our existing supply contracts being extended into AMP8; supplies being held in our internal stores facilities for deployment.

We will continue to work directly with non-household water retailers to determine the best mechanism for undertaking non-household water efficiency audits and remedial efficiency works and determine whether it is ourselves or the retailer who would be best placed to do this. We will continue our discussions on other elements such as incentivisation in order to ensure a successful working partnership that delivers benefits to all parties.

We will work closely with Housing Associations in AMP7 to build relationships that we can take forward into AMP8 to ensure the successful delivery of this work. This direct working relationship activity will also be delivered by South Staffs employees.

2.3 Case 3: WRMP Smart Metering

2.3.1 Summary

In 2021, both the South Staffs Water and Cambridge Water regions were declared as areas of serious water stress by the Environment Agency. As such, we have explored the option of introducing compulsory metering to all of our customers as part of the development of our WRMP24 for each region.

In AMP7, several water companies have undertaken large scale metering programmes and have undertaken thorough analysis on the benefits that this provides. Data from Thames Water and Anglian Water shows that installing a meter into a previously unmetered property can lead to between 13-15% reduced consumption. In addition to this, the additional data provided also enables companies to deliver more effective water efficiency services e.g., identifying households for water audits and tailoring communications. The meter data also helps to identify customer side leakage quickly and accurately and therefore provides leakage benefits too.

At PR19 we explored compulsory metering with our customers, but they did not support it. Through our extensive WRMP24 customer engagement programme we have tested the principle again, and we have seen a shift in customer perception, and we have overall support for this activity. However, particularly in our South Staffs region, customers have raised concerns regarding larger or vulnerable families and were keen that we included sufficient support in our plans. We have reviewed our current support mechanisms and will be expanding on this for AMP8 accordingly.

As part of the WRMP process, we included several options for metering that were assessed against other demand management options. These included the scale of metering we would be looking to achieve as well as the timescale over which we would deliver it. Working with Artesia, we ran various scenarios to identify the preferred optimised programme of activities in each situation. Our preferred pathway achieves all of the Environment Act targets as set out by the Government in 2022, and our analysis shows that universal metering is a key enabler to meeting these targets. This is because universal metering provides data that make existing water efficiency and leakage activities more efficient and unlocks new options that have potential to deliver large benefits, such as the development and introduction of green tariffs that incentivise customers to use less water.

We have also explored metering options for our non-household customers. Approximately 90% of our non-household customers already have a meter, but the majority of these are basic meters and offer little insight to use. Non-household properties constitute just over 20% of the total demand for water in our regions, and therefore there is an important role for these customers in helping us to drive down demand through reducing consumption, wastage, and leakage. We are conscious that retailers own the relationship with non-households since the market opening in 2017, but we see a key role for water companies to play to support demand reduction in this area.

As such, following the introduction of the new Environment Act and the proposed targets within, we have included the reduction to non-household consumption by 9% by 2038 and 15% by 2050 in our preferred WRMP24 plan. During AMP7 we have not undertaken any proactive work to reduce demand among our non-household population, but we believe there is significant opportunity here that can be explored through collaborative working.

We worked with Artesia in the development of our NHH options for our draft WRMP and have included the enhanced metering technology for all NHH as one of these options using the benefits identified in their report for MOSL delivered in 2022. The optimisation work by Artesia showed that significant savings could be achieved through fitting Enhanced Meter Technology to all of our existing non-household customer base. These meters will provide enhanced levels of information and data that we can use to target our engagement with retailers and non-households to help deliver reductions in demand and wastage. It will enable us to identify continuous use which can often be a sign of leakage, and therefore this option will enable us to deliver much greater benefit to our non-household customers as well as direct water savings.

As a result, our preferred plan in WRMP24 includes deployment of universal smart metering across households and non-households in both regions by 2035. This represents a total investment of £70.38m (£36.34m in AMP8) and will deliver 23.51 Ml/d reduction in demand (12.76 Ml/d by the end of AMP8). This investment includes the cost of the meters and their fitting, as well as support cost such as management system upgrades and additional resources to deliver the programme.

We will prioritise the highest usage DMAs first for installation. This will enable us to deliver the maximum benefits quickly and provide useful information to further explore customer side leakage and provide bespoke water efficiency advice to customers. We will also deliver our programme geographically to ensure it is as efficient and cost effective as possible. For non-household installations, we will prioritise those properties with no existing meter and will look to combine our NHH and household rollout programmes, where appropriate, to deliver a more efficient rollout programme.

Our plan assumes these smart meters will all be AMI capable, although not AMI active, in AMP8. This is because the infrastructure in our area of operation is not currently in place to support full AMI capability readily, and therefore the increased costs for installing this means the costs outweigh the benefits. We do expect this to change over the lifetime of our plan, and hence why we are proposing to install AMI capable meters. We expect this shift to occur during AMP9 and beyond, and this is reflected in the split of meter installs we're proposing from then, with an assumption of 50% of each from AMP9.

In order to prepare for this, we are proposing to carry out the installation of three AMI networks across the SSC network. The networks are based upon on a mix of property types and age. Three DMAs will have AMI meters installed that will include household and non-household type properties. We will work with our incumbent meter supplier and other network providers to identify networks for the meters to be connected to. Following installation, data analysis will be carried out to identify the full benefits being seen from the AMI areas. Without carrying out these assessments and trial work on AMI we cannot fully appreciate the benefits and installation requirements of AMI technology. Data reviews will be carried out against the benefits detailed below. The data will then provide any changes to our metering strategy leading into AMP9 in respect of AMR and AMI installations. Full details of this proposal are covered in the PR24 Smart Operations Enhancement Business Case, as this forms part of our overall Smart Networks philosophy and proposals.

We currently read all meters via manpower (meter readers) however, in order to improve our leakage, PCC, C-MeX and revenue performance, we will be reading the majority of our meters by either drive-by (AMR) or remote read (AMI) as we progress to 2035. We believe by 2035 we will have 199,000 legacy smart meters that have to be read by meter readers, and so we are proposing investing in a universal metering solution that will provide a way of reading these legacy smart meters in a smart way. This investment would equate to £750k.

This enhancement case refers solely to the enhancement spend for metering. General replacement of existing assets and reading and processing of these is covered by base expenditure. The following table summarises the planned expenditure.

Table 20 - Investment Summary

Investment	Enhancement Investment	AMP 8 TOTEX £k	AMP 8 Enhancement OPEX £k	AMP 8 Base CAPEX £K	AMP 8 enhancement CAPEX £k
Non-household enhanced metering	AMR to AMI meters	787	0	0	787
Non-household enhanced metering	Basic meters to AMI meters	1,617	0	0	1,617
Non-household metering	New meters for business	1,813	0	0	1,813
Household meters - optants	Optant meter programme	12,600	0	0	12,600
Household meters - universal	Universal metering programme	18,510	0	0	18,510
Smart metering software	Software	875	0	0	875
Smart Infrastructure	Reading equipment	134	0	0	134
	Totals	**36,337**	**0**	**0**	**36,337**

2.3.2 Background Information

In 2021, the Environment Agency declared that both the South Staffs Water and Cambridge Water operating regions are now classified as areas of serious water stress. As a result, we have explored the option of compulsory metering, and engaged with our customers for their views on this as part of our development of the latest round of water resource management plans (WRMP24).

At PR19 our customers were not supportive of compulsory metering and so our approach for AMP7 has focused on optants to increase our metering penetration. However, other companies such as Anglian Water, SES and Thames Water have undertaken large scale smart meter rollout programmes in AMP7. Through our engagement with these companies, we have identified that installing a meter to a household delivers a 13% saving on the amount of water used by that household. These companies have also seen that upgrading a basic meter (requires a manual read by a person) to a smart meter saves 2% of water consumption in that household.

In the Cambridge region, we have approximately 73% meter penetration, but this is much lower in the South Staffs region at 43%. For the South Staffs Water region, our 2022/23 annual return data shows there is a significant gap between the water usage in measured and unmeasured households. Unmeasured households use 158 l/p/d on average, whereas those in a measured household use 120 l/p/d. In addition, the low metering penetration means it is more difficult to identify areas of high usage. By installing universal metering across our South Staffs customers, we will deliver significant savings and also gain better information to help us target additional water efficiency activities and customer supply side leakage which currently forms approximately 30% of all of our leakage.

In the Cambridge area we have a sizeable challenge with short and mid-term water resource availability as we face significant caps to our licences in 2030 and higher than average population and non-household growth projections. Therefore, we believe that installing meters across the remaining households can support this by delivering a reduction in demand. Just the same as for the South Staffs region, this enhanced meter penetration will also give us more information which will help us target water efficiency and customer supply side leakage activities to reduce demand further still. In this way, metering not only delivers direct benefits but also is an enabler for additional beneficial activities.

These reductions are critical in enabling our delivery of the Environment Act 2021 targets that were published by the Government in 2022. These outlines expected reductions to both household and non-household consumption as follows:

- PCC to reduce to 122 l/p/d by 2038 and 110 l/p/d by 2050
- NHH consumption to reduce by 9% by 2038 and 15% by 2050
- Distribution input (DI) per capita to reduce by 20% by 2038

As part of the development of the WRMP24 for both regions, we have assessed the need for household universal metering and the benefits that smart metering across our non-household population could bring. We have looked at a range of potential timelines for delivery, and we discuss the detail of this process later in this document. We also asked our customers for their views and incorporated those into our plans.

As part of our demand management optimisation we have assessed not only the direct benefits that metering may bring, but also the indirect benefits. These include, as mentioned above, the ability to better target water efficiency advice (to both households and non-households) and support and identify customer supply side leakage. We believe that metering will help make existing leakage and water efficiency activities more efficient due to this, but we also believe it opens up additional opportunities to reduce demand. A key example of this would be innovative tariffs for household customers – by having smart meters across all of our customers, we could develop an incentive-based charging mechanism that encourages and rewards customers who use less water. This is a low-cost option that could deliver significant benefits, and this forms part of our long-term strategy in both our WRMP and LTDS once we have smart meters installed.

We are proposing to install smart meters in both regions to our household customers to achieve universal metering (noting 100% penetration will not be possible due to constraints such as shared supplies) by 2035 at a total cost of £62.2m. The installation of the meters will save 14.88 Ml/d as a direct benefit and will then enable additional options that become cheaper to undertake (e.g., active leakage control, customer supply side leakage detection and resolution) as well as new options i.e., innovative tariffs. Our WRMP outlines that innovative tariffs will lead to a 2.3 Ml/d reduction in water across both regions upon implementation.

In addition, we are proposing to fit enhanced meter technology to all of our non-household properties in both regions. The total cost for this activity will be £7.39m in total (including base expenditure) and will deliver 8.63 Ml/d of demand reduction. Similar to our household meter installations, it will also enable more effective and efficient identification of high consumption, through reviews of continuous use for example, as well as customer side leakage. This will therefore enable the delivery of additional demand reductions and therefore cost and carbon savings.

When assessing the benefits of smart metering, we have identified the following additional benefits to those already described:

- Reduced consumption and leakage means reduced abstraction and treatment of water. This saves energy due to less pumping and treatment requirements, as well as a reduction in chemical costs.
- This reduction in energy and chemicals also leads to a reduction in our greenhouse gas emissions and reduces our carbon footprint.
- Environmental benefits of leaving more water in the environment through reduced abstraction needs, helping to achieve Water Framework Directive objectives relating to flow.

- Improved resilience during peak demand.

In order to maximise the benefits outlined above, we are proposing to invest in a universal metering solution. This is driven by:

- The need for a way of reading legacy smart meters in a smart way and mitigating outdated reading equipment.
- Our current capability means we would only be able to retrieve basic data from c75% of our network which limits our ability to recognise the benefits of meter reading for PCC, leakage and C-MeX.

- Greater assurance for future meter supply and cost efficiency as this would mean we are not dependent upon a single meter supplier.
- Requirement to transfer data and provide analysis opportunities to all of our meters.
- Future adaptability as technology advances and the need to have a flexible system to allow us to adapt.
- More efficient meter reading routes by planning geographically.

A new universal metering solution would enable us to address the above which not only future proofs our metering activity but also delivers cost efficiencies and ensures we are able to recognise the PCC and leakage benefits we have outlined.

The timing of the Environment Act targets is a key consideration in the timing of our proposed rollout programme. Our demand optimisation work identifies that metering also plays a key role in our ability to achieve the leakage targets that are also identified in the Environment Act. There are multiple interim targets for leakage as detailed below, as taken from the 2017/18 baseline position:

- 20% by 2027
- 30% by 2032
- 37% by 2038
- 50% by 2050

Our demand management optimisation therefore looked at the relationship between universal metering and having a smart network in place and the delivery of all of these Environment Act targets. The optimiser showed that we need a smart network (including smart metering) to be in place for all of the interim targets to be achieved. During AMP7 we have been delivering our smart network programme of activity which we are building on further for AMP8. The full details of this are contained in the Smart Operations enhancement business case. The activity in that case is required to deliver the full smart network required in order to realise the benefits detailed here.

Through our customer engagement work, our customers have been very clear on their preferences regarding levels of leakage.

- Reducing our leakage levels emerges as a clear and consistent priority among most customers.
- There is a strong and consistent view that we need to do more to reduce leakage from current levels.

As such, we have chosen to adopt the scenario that ensures we meet all the interim targets as well as the 2050 target, assuming we have a smart network in place by 2035. Some activities feature heavily at the start of the planning period – these are more “traditional” leakage reduction methods that we must utilise until we have a smart network in place. As a result, these tend to be more expensive than some of their later equivalents.

Our scenarios show that the quicker we can introduce smart metering to all of customers then the lower the overall cost of the leakage reduction programme. However, we have to assess the deliverability, financeability and affordability of this. Through our discussions with Anglian Water and Thames Water, both of whom have ambitious meter installation programmes in AMP7, we believe that delivery of universal metering is five years is not achievable, and this view is supported by our supply chain. As such, our proposed programme looks to deliver universal metering in 10 years.

The benefits generated by this investment are reported against two performance commitments – PCC and leakage. We will also need to report on progress annually to the Environment Agency as part of our WRMP annual review process.

2.3.3 Need for Investment

Universal Metering

The drivers for this investment are the targets outlined in the Environment Act relating to reducing household and non-household consumption and leakage reduction, and therefore contributing to reducing the overall amount of water we put into supply per capita.

The Environment Act targets relating to household and non-household consumption relate to 2038 and 2050 but our demand management optimisation work, that we have undertaken as part of developing the WRMP24s, shows that we need to commence this work in AMP8 if we are to achieve these targets. It also showed that this profile is required to achieve the interim targets for leakage as set out in the Environment Act. This long-term pathway for delivery is outlined in the WRMP24s as well as the LTDS.

As part of exploring compulsory metering, we have to evidence support from our customers, and at PR19 our customers did not support this approach. However, it is important to understand the background changes since our last round of customer engagement at WRMP19. Energy smart meters are now commonplace in homes as technology over the last five years has increased. With the recent energy price rises, customers are turning more and more to smart meters to have better information and take control of their usage. Having access to this level of data is now seen by customers as necessary, rather than a nice to have. Throughout our surveys, those customers with smart meters acknowledged that they had changed their behaviours as a result to reduce their usage and save money.

As a result, we saw a change in attitude to compulsory metering among our customers at WRMP24. It should be noted that we have used the term “universal metering” to customers, although we have explained the link to compulsory metering. This is because our aim would be to achieve universal metering over a set period in order to better inform our own activities and to help customers change their behaviours.

Our research shows that customers viewed increased metering as a necessary and important approach for us to undertake. They believe it to be a fair way for all and we did receive majority support from our customers for universal metering. However, they did raise concerns around affordability especially in the most recent customer engagement completed in the summer of 2022 as the cost-of-living crisis intensified and wanted us to ensure they made provisions to support vulnerable and large families, particularly in the South Staffs region where we have a higher than national average level of deprivation. We discuss our approach to delivering this in the customer protection section below.

At PR19 customers did not support us progressing with compulsory metering. Our current approach in AMP7 focuses on optants, with a forecast of circa 9000 optants per year. Delivery of our universal metering programme requires a step change in our metering approach, and we have worked closely with our supply chain in developing the programme to ensure deliverability.

This programme of work is deemed as enhancement spend because:

- It has resulted from implementation of new statutory targets i.e., the Environment Act targets
- Customers have supported this enhanced approach

The rollout programme will take place, for both household and non-household metering, between 2025 and 2035 with even profiling of meter installations each year.

In October 2022 we applied to Defra for funding to enable us to start several of our AMP8 proposals early, including to start the delivery of our universal smart metering programme ahead of AMP8. The proposal included the fitting of household and non-household meters. In March 2023 we were informed we had been successful in this bid.

The proposal covered metering for both regions. Due to our proposals in our Cambridge Water draft WRMP relating to the development of a new reservoir called the Fens Reservoir, this has led to costs in AMP7 that were not budgeted for in PR19. We submitted our Gate 2 submission for this in November 2022, where we identified a significant cost increase for the rest of AMP7 as a result of now having a preferred site and concept design, as costs can be more accurately forecast. As a result, we have had to balance the additional funding required from Fens with this accelerated spend and manage these within our financial constraints as a business.

In addition, we have not achieved our existing AMP7 plan for household meter installations to date. This is because the number of customers requesting a meter (optants) has significantly fallen due to the Covid-19 pandemic, where we were also unable to fit new meters during lockdowns, and due to the cost-of-living crisis as customers are reluctant to make changes that could impact on their bills. Therefore, we propose to undertake an extensive programme in 2023/24 to catch up this backlog of meter installations by fitting “ghost” meters – this is where we install meters but do not immediately charge the customer based on the meter consumption.

As a result of this, and the need to identify in period funding for the development of Fens Reservoir (unfunded at PR19), we have been unable to accelerate our metering programme into AMP7.

- Universal Metering System Solution

We expect to have c480k Diehl smart meters by 2035 which are compatible with all reading methodologies. Equally, we will have fitted Diehl smart meters at all properties which currently have no meter (c339k) and hope to replace a proportion of our basic meters too. This leaves 199k legacy smart meters which have to be read by meter readers (after an assumed 6k are replaced as they reach the end of their shelf-life).

There are a series of key drivers for investing in a universal meter reading solution (such as Temetra):

- Providing a way of reading the legacy smart meters in a smart way and mitigating outdated reading equipment
- We have carried two strategic risks in recent years; aging meter reading equipment for legacy smart meters and unsupported software which produces meter reading ‘rounds’ and enables Echo to then input the read data through to the billing system.

Our legacy meter portfolio includes Actaris, ABB, Pontamousson Schlumberger, Smartmeter, Severn, Fusion, Sensus, Kent but the greater majority are Elster and Itron. We use a plethora of reading ‘guns’ to read these meters, the most commonly used are Itron FC300s, Versaprobes and Honeywells which have all been discontinued by their suppliers. Echo typically expect that three guns per year will reach the end of their shelf life. In recent years we have sourced replacements by buying from Ebay, buying from other water companies and most recently we have sourced a supplier in the US who can purpose-build Versaprobes which provides some risk mitigation. However, we have uncertainty in how to source Itron FC300’s and we have exhausted our options for Honeywells and therefore have no way of mitigating the risk here. We are currently not experiencing the effects of this issue partly due to the software issue described below and partly due to being sufficiently stocked with Itron guns as it stands.

Echo has historically used a legacy in-house software solution to produce the read schedules (‘rounds’) and input the read data ready for billing. This solution is no longer functional and has meant that they have had to manually eye-ball read meters (as the reading gun hardware has no software to interact with) and manually input read data for a prolonged period causing significant issues to the operation which has risked productivity, revenue recovery timeliness and data accuracy (human error risk). This is a group-wide strategic risk reportable at Board level.

ODI performance

Following the points outlined in the previous section, we will be limited to realising the smart benefits of meter reading for PCC, leakage and C-MeX if we do not opt for a universal meter reading solution. Without this solution, we will only be able to retrieve basic data from c75% of our network and, depending on the scattered locations of the legacy smart meters, this may prove to give us significant blind spots when trying to analyse leakage or customer consumption in a given DMA for example.

Providing greater assurance regarding future meter supply

We are confident that Diehl can provide the quantity of meters that we require in the coming AMPs however supply chains are susceptible to turbulence and having a universal reading solution does give resilience if Diehl's supply chain does experience issues.

Providing data transfer, repository, and analysis opportunities to all of our meters.

We currently use the Diehl portal to receive meter read data, analyse and pass through to our billing system. This is capable of storing other meter type data however does not have the functionality to transport it and is very expensive. We will, irrespective of this proposal, need to review the alternatives in the market for the Diehl portal in AMP8 due to the cost.

Future adaptability

The water industry is currently setting metering strategies for the coming AMPs in the knowledge that technology will change considerably over this period. Opting for a universal solution provides flexibility for us to adapt as those options naturally appear over time.

Planning our meter reading routes more efficient routes by geography

Our current software does not have geographic planning capacity, constraining our ability to be efficient on daily route. Although we analyse routing via spreadsheets activity, to support considerations around reading meters more frequently for leakage and PCC, we need to obtain a solution to support the creation of more efficient routes. As part of a new software, meter coordinates could be stored in the cloud environment, allowing routes to be created and assigned based on the locations of both meters and meter readers.

Due to the increase in meter installations, we will also need to invest in additional meter reading equipment.

2.3.4 Customer Support

In terms of the investment case, we put forward to shifting from basic to modern metering technology (AMR/AMI) we have engaged extensively with our customers at a local level and with other water companies at a Water Resources East and Water Resources West regional level. The key insights are summarised below which highlight, on balance, that shifting to smart meter technology is supported by our household and non-household customers:

- Majority of customers continue to say that metering is the fairest way to charge for water and as a tool to help customers save money on their water and energy bills. This finding is consistent through all local and regional engagement, including the on-going discussion on our H2Online household Community.
- There is evidence that support for universal and/or smart metering increases when customers understand the future challenges around water supply, highlighting how important engagement and education is to help overcome any customer concerns around metering. Other top benefits attached to metering by customers include:
  - More control and awareness over usage
  - Helps protect the environment as can help reduce wastage
  - Improved leakage detection to reduce wastage

- Automatically submits readings at the desired frequency, without relying on customers to submit their own readings in between company readings. Most customers are comfortable with smart devices and relaxed about data sharing, if the right reassurances, technology and clear communication of this is in place
- More accurate billing, removing the need for estimated reads appearing on bills
- Customers prefer fully smart meters (to semi-smart or non-smart meters) because of the data visibility and consumption data they would bring
- In particular, NHHs view modern meters as the simplest way to become more water efficient – but raised the caveat that water companies support and investment is needed to enable this.

- The benefits of modern meter technology are summarised concisely by our informed and engaged customers who took part in our deliberative sessions as part of our Water Resources Advisory Panel (WRAP) *(Community Research, February 2022).* It is clear across the engagement that the word "smart" has the potential to mean different things to customers (e.g., receiving an in-home display, frequency of reads, how the reads are taken) so clear communication of the benefits using language customers use is important.
- In our quantitative WRMP24 study (Feb-Mar 2022, Accent) there was strong support for universal metering among households who are already metered, **71% in Cambridge region and 65% in SSW**. Over the whole customer sample, which was robust and representative, in the Cambridge region **58%** of customers supported universal metering, with 25% being neutral and only 12% against (5% said don't know). However, in SSW these figures were 44%, 28%, and 22% (7% don't know) respectively. These findings, highlight the need for a robust engagement programme around metering given over 1 in 5 are against the policy change in the SSW region.
- There were consistent calls for new tariffs to be developed to enable customers to have choice and the ability to have more control over their usage and bills, as well as the need to have a robust package of support in place to help customers transition onto a smart meter, particularly those moving from unmetered fixed charges.
- Among those concerned about universal metering, particularly among unmetered customers, key reasons include:
    - Those who reject *water* smart meters tend to also reject *energy* smart meters – mainly as they don't see the benefit and doubt the savings.
    - Customers have the same concerns about smart meters as for metering in general - they worry about increased bills, especially larger or households with vulnerable customers, either from a financial perspective or from a medical perspective – such as conditions that are dependent of water for effective treatment – e.g., dialysis, Chrohn's. A small number of customers also pointed to smart meters having the potential to drive into unwanted behaviours, such as water rationing which can compromise health routines, such as bathing.
    - Meters might not always result in water usage behaviour change. Considered risky to rely on customers to monitor their own usage proactively, so clear advice and support mechanisms would be needed to ensure best outcomes.
    - Resistance to being forced to have a meter and taking away customer choice.
    - Some point to it not being acceptable to transfer any costs around smart meters to customers.
- Customers also expressed mixed views about how we should roll-out metering investments. In our quantitative WRMP24 study (Feb-Mar 2022, Accent) **38%** of customers wanted any roll-out of metering technology to be done in a way that minimises costs, with 27% saying it should be undertaken in a way that has the biggest impact on reducing water consumption quickly.

Whilst there is broad support for universal smart metering, there are mixed views over how much customers are willing to pay (WTP) for investment:

- The PR24 SSC NERA WTP for water services (October 2022) did not observe a positive WTP for installing smart meters, which seems to imply that many customers do not prioritise having a smart meter in their home, and/or that they do not want to pay extra to have one. Conversely, the Water Resources West (2023) synthesis report found most customers do support smart metering, including the universal roll-out. This was especially apparent when customers understood the future challenges around water supply. However, this review noted that there is a lack of WTP data for smart metering, which is in line with the NERA results. These insights showed that customers in both regions were more mindful of price in relation to this attribute compared to most other attributes tested in the study. The lack of informed engagement allowed in a WTP survey may also mean that the full benefits would not have been communicated to customers as they are during deliberative discussions or more focused quantitative studies.

- This is evidenced to a degree, in a stand-alone test in our quantitative WRMP24 study (Feb-Mar 2022, Accent) where **37%** of household customers said they would not be willing to pay more to roll-out universal smart metering, but **54%** said they would pay more. There were varying levels of appetite in terms of paying more to complete the roll-out quicker, with most favouring a balance between cost and speed of roll-out.
- A level of conflict was also seen when customers almost universally told us that the current meter read frequencies we offer are not fit for purpose. As can be seen in the chart below, a meter read frequency of once a year in the SSW and twice a year in the Cambridge region, does not align with customers' preferences. However, when asked in the same study, **65%** said they would not be prepared to may more on their bill to enable more regular readings. However, **26%** said they would pay £2.50 a year more to have monthly/bi-monthly readings and only **11%** saying they would pay £2.90 a year more to enable weekly/daily readings.
- When turning to preferences for metering technology, our deliberative sessions with our Water Resources Advisory customers *(Community Research, February 2022)* found that customers were surprised that there was only a small price differential between roll out of Automatic Meter Reading (AMR) and roll out of AMI metering by 2040. Cost was a prevalent consideration, but once they were aware of the small additional costs of AMI as opposed to AMR, there was a strong preference for AMI. Also, customers felt that it made sense to introduce the most advanced technology and future proof the system and that the functionality and diverse benefits of AMI strongly appealed – participants spontaneously identify numerous benefits.
- Customer did raise concerns about AMI technology which we will need to address as part of our roll-out. The main themes were:
    1. Will the technology work (for individuals and rural communities)? and what happens if it goes wrong?
    2. Will consumers be able to switch back to basic meters if they are not happy?
    3. What data will be collected and are there ulterior motives for its introduction i.e. will prices increase?
    4. Will being able to see use in real-time be stressful for those who are struggling with costs?
    5. Will staff lose their jobs if manual readings are no longer required?

2.3.5 Best Option for Customers

Universal Metering

As part of our demand management plan development for the WRMP24 we have considered Smart Network scenarios, which represent an integrated approach to demand management built on the foundation of installing smart meters on all households. Our view of smart networks is represented below and details the key elements for smart networks, the dependencies, and interfaces and how that drives activities that support and enable demand management.

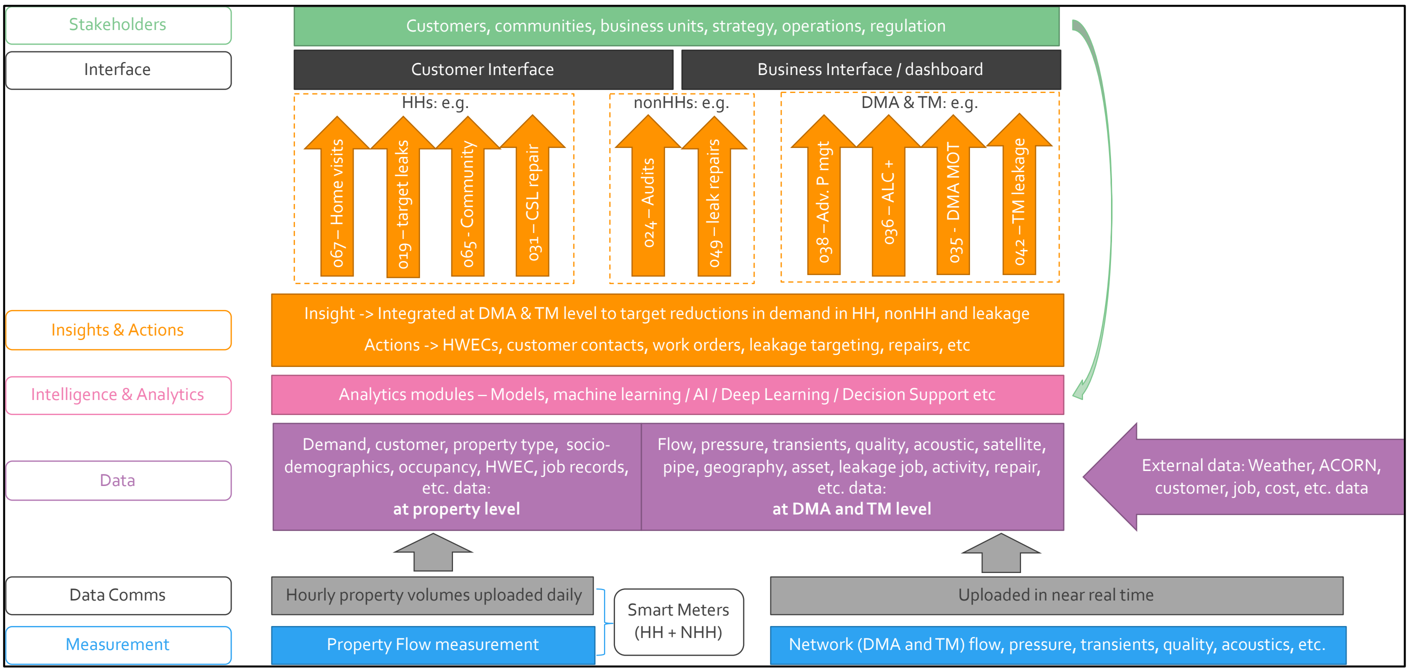


Figure 7 - Smart Networks Overview

During AMP7 we have been progressing our smart network programme and this is set to continue through AMP8. The diagram clearly shows the important stream of data that metering provides, and so we now need to look at how we support this smart network further with more smart data from meters. As a result, we have assessed multiple different scenarios for household metering:

- Universal metering by 2030
- Universal metering by 2035
- Universal metering by 2040
- Current optant level of metering across planning period
- Optants in AMP8 and then commence universal metering in 2030 in SST, complete by 2040, start universal metering in CAM in 2025

For non-household, we assessed the following options

- Metering leftover commercial properties
- Installation of enhanced smart meter technology by 2030
- Installation of enhanced smart meter technology by 2035
- Installation of enhanced smart meter technology by 2040

During AMP7, several companies are undertaking extensive household smart metering programmes, including Anglian Water, SES and Thames Water. Through discussion with these companies and a detailed review of the results they have achieved through AMP7, we are proposing to adopt a 13% saving due to behavioural change upon installation of a meter to an unmetered property with the customer switching to being charged based upon measured volume. We have also assumed a behavioural change demand reduction of 2% when replacing a basic meter with a smart meter. These estimates are based on the results seen by both Anglian Water and Thames Water and are in line with the experience in the energy sector.

As part of the scenario testing, we have assessed the deliverability of the metering schemes, again taking information and lessons learned from Anglian Water and SES in particular. We have also looked at the impact the metering programme has on delivering the leakage targets as well as the PCC targets, and what timescales we need to have metering in place within in order to achieve these. Importantly, we have also assessed the full range of benefits of each of these scenarios, particularly when compared to the cost e.g., installing a smart meter where there is currently no meter will provide a 13% saving in demand for that household. However, there is a very similar cost for upgrading a basic meter to a smart meter, but it only provides 2% demand saving.

Another key element that factors into our decision making relates to the balance of requirements in the two WRMPs as both regions are facing different challenges. We look to balance the needs identified in the WRMPs of both companies alongside affordability and financeability, hence why we looked at a scenario where we delay the start of universal metering until 2030 in South Staffs Water. This option would couple with the acceleration of Cambridge Water's universal metering programme so that is delivered in AMP8, as Cambridge Water faces a larger short term supply challenge.

The optimiser showed that we need a smart network (including smart metering) to be in place for all the interim targets to be achieved. Smart metering enables additional options to help reduce leakage after AMP9, which helps us to meet the long-term targets, and a key option here is the introduction of innovative tariffs.

Our plan assumes these smart meters will all be AMR meters that have AMI capability in AMP8. This is because the infrastructure in our area of operation is not currently in place to support the full utilisation of AMI meters readily, and therefore the increased costs for installing the supporting infrastructure mean the costs outweigh the benefits. We do expect this to change over the lifetime of our plan, and hence why we are proposing to install AMR meters that are easily, and cheaply, converted to AMI meters. We expect this shift to occur during AMP9 and beyond, and this is reflected in the split of meter installs we're proposing from then, with an assumption of 50% of each from AMP9, and 100% AMI from AMP10 onwards.

Our costs have been calculated based on our current contract arrangements and costs. We have assumed that we will have approximately 9000 optants a year and that the remaining profile will be delivered through the universal metering programme. As such, there is a difference in the costs of these different installation activities, as our universal metering programme will be more cost efficient as detailed in the table below. Similarly, we anticipate that non-household meters will be more costly to install due to the location and the potential disruption to business, and therefore the cost for this programme reflects this.

The total household meter installation cost takes the remaining properties and applies the split of external locations where we only need to screw in a meter, internal locations where some internal plumbing is required to be cut and where we need to gain entry and external locations where excavations, reinstatement and pipe cutting is required. Each of these work types has a specific unit rate based on current optant unit rates and applying an assumed efficiency. The volume of each work type is then multiplied by the respective unit rate before all costs are totalled.

Therefore, we have assumed the following costs for meter installations.

Table 21 - Meter installation costs

Installation	Cost per meter installation
Optant	£280
Universal Metering	£162
Non-household	£175

The below table shows the overall costs of our programmes to deliver.

Table 22 - Metering cost programme

	AMP8	AMP9
Household meters	£31.10m	£31.10m
Non-household meters	£4.22m	£2.94m

Reducing PCC, non-household consumption and leakage will directly impact the volume of water we need to produce and put into supply, and therefore leads to a direct reduction in our greenhouse gas emissions. The impact of the metering programmes is detailed in table 4 below. This is calculated using the UK government cost of carbon table and the Defra intensity metrics, which then enables us to calculate the number of kilograms of CO2e per megalitre of water treated. For every megalitre saved through universal metering, we are able therefore to calculate the associated saving in greenhouse gas emissions.162

Table 23 - Estimated greenhouse gas emission reductions from our metering plan

tCO2e saved (cumulative)	**Year 5**	**Year 10**	**Year 15**	**Year 20**	**Year 25**
	2029/30	2034/35	2039/40	2044/45	2049/50
Household & NHH customer metering	1,628	2,732	2,732	2,732	2,732

The key risk to this programme is the deliverability, especially in light of current world affairs which are impacting on meter stock availability and long lead times, but also noting that many water companies also have similarly ambitious metering programmes proposed over AMP8 and AMP9 and this may further impact on stock availability and resources to deliver. However, we have developed this programme in conjunction with our supply chain to ensure that is it deliverable and to mitigate the above risk.

Our cost per meter fitting detailed above is based on current costs and therefore takes into account different meter fit condition e.g., easier fits where there is already a boundary box in place as well as more complex full excavation fits. Therefore, the costs provided are based on the current known profile of remaining meter fits and our existing costs to fit these. Cost profiles may change if we have more or less customers opting for a meter through our optant programme, as these installations are more expensive as there is limited opportunity to recognise efficiencies through geographical planning and working in conjunction with rehab and leakage schemes.

Universal Metering System Solution

We know that customers are asking for more data and ways to reduce it. We recognise the significant benefit that a universal reading solution would provide in terms of supporting the increased data demands of some customers.

In addition, a universal solution is also imperative to supporting the current internal challenges in reading hardware and software which the business (via our supply chain partner Echo) has mitigated for many years.

The current retail plan is based upon continuing to have working reading guns and software; however as aforementioned we carry a significant risk with these items and, should the current software issues continue, or should we not be able to source reading guns, the productivity of the meter reading teams will drop. Echo have previously referenced that manual reads take six times longer to complete vs radio reads which could impact up to 50% of our reads from 2025. A universal reading solution will provide a number of opportunities to improve our customer journey, including:

- Increased revenue security from more effective and timely meter reading reducing debt levels which allows bills across all customers to reduce
- Improved leakage and PCC performance through access to timely meter read data across all of our meters

Improved C-MeX performance as a result of interaction with a customer portal and the functionality to push read data to customers in a timely fashion.

2.3.6 Cost Efficiency

Universal Metering

We worked with Artesia in the development of our NHH options for our draft WRMP and have included the enhanced metering technology for all NHH as one of these options using the benefits identified in their report for MOSL delivered in 2022.

The optimisation work by Artesia showed that fitting Enhanced Meter Technology to all of our existing non-household customer base would deliver the majority of the Environment Act target for NHH reduction in the South Staffs region and provided the largest benefit of any options for the Cambridge region.

We will ensure that we engage with both retailers and non-household customers to communicate the detailed rollout plan. We will prioritise those NHH properties with no existing meter. For household meter installations we will prioritise the highest usage DMAs first. This will enable us to deliver the maximum benefits quickly and provide useful information to further explore customer side leakage and provide bespoke water efficiency advice to customers. We will also deliver our programme geographically to ensure it is as efficient and cost effective as possible. To this end, we also propose to combine the household and non-household meter rollout to deliver both programmes as efficiently as possible. Many of our non-household customers are very close to households, for example shops and hairdressers, and it will be more efficient to do both activities in a geographical area at the same time. It will also enable clearer communication to all our customers and a more successful behavioural change campaign associated with the rollout. We will develop the detail of this rollout plan before 2025 and ensure we develop an extensive communications plan to engage with our customers and retailers. We have engaged with the companies already doing this work in AMP7 and will take on board lessons learned to ensure we deliver the best possible customer support and experience through the process.

Our WRMP approach and methodology has been assured by Jacobs prior to submission.

Universal Metering System Solution

We recognise that this is a significant investment and have therefore explored multiple options to address this risk across AMP7. As part of our 2021 meter hardware tender, we also explored the reading software element to align business vision. We met with three suppliers, with costs averaging £50-£150k set up cost plus £100-£125k annual fee (increasing as we install more meters across the AMP). A full tender process would be required upon approval to confirm specific costs. From a third-party assurance perspective, other water companies have been engaged and options compared as part of the UK Metering Network Group, to give assurance around the benefits of this solution.

We also require additional meter reading equipment for the additional meters we will be installing, and these costs have been developed based on current purchase costs as per our supplier frameworks, which have been competitively tendered.

2.3.7 Customer Protection

As stated above, our research shows that customers viewed increased metering as a necessary and important approach for us to undertake but they did raise concerns around affordability especially in the most recent customer engagement completed in the summer of 2022 as the cost-of-living crisis intensified, and wanted us to ensure they made provisions to support vulnerable and large families, particularly in the South Staffs region where we have a higher than national average level of deprivation.

We take the issue of affordability extremely seriously and we have now undertaken further customer research on potential options to do this and have agreed the following approach:

- We aim to have a maximum of 3% of our customers in water poverty by 2035.
- We will expand our existing Assure programme to support nearly twice as many customers in AMP8 as we are supporting in AMP7.
- We will provide a 2 year grace period for meter rollout. Customers will have 2 years from the date of meter installation before we switch to metered billing so we can provide them with regular consumption and proposed bill data. This will enable them to understand the impacts and plan for the potential changes where required.

Whilst the benefits recognised from the installation of meters (e.g. leakage and PCC) are directly related to these respective performance commitments, there is to be a PCD to cover the metering programme which will ensure funding is returned where we do not install the volume of meters specified. In addition, this will also ensure that we deliver an appropriate mix of easy and more difficult meter installations as per the methodology used to determine the costing.

The PCD will report on numbers of meters fitted per year as the deliverable. More information and a full list of our PCD's can be found in section 1.5.

Table 24 - Metering PCD

Metering PCD	
Description	Installation of advanced monitoring infrastructure (AMI) meters which are capable of recording and transmitting data at least once every 24 hours to measure supplies of water to premises. This involves new AMI meter installations and replacement of existing meters with new AMI meters. The new AMI smart meter installation includes both HH and NHH meters. AMI for basic / AMR replacements covers only NHH replacements as per our enhancement case.
Output measurement and reporting	SSC output will be measured in the number of meters installed by the end of the period. We have put forward a flat phased strategy as can be seen in the table below. Delivery of meters will be reported and monitored through the existing APR process.
Assurance	Independent third-party assurance to confirm completed milestones
Conditions on scheme	We are confident in the delivery over the AMP period but recognise there may be a risk of a lower first year as we phase up the start of our universal programme. Therefore, we expect the PCD to relate to whole AMP delivery, rather than in year.
PCD payment rate	A unit rate per meter will be applied at the end of the control period for non-delivery based on the enhancement funded allowance for the schemes. New AMI smart meter installation = 161,455 units. Current unit cost rate of £204 AMI for basic / AMR replacement = 22,135 units. Current unit cost rate of £109 Per capita consumption performance commitment penalty will add additional penalty for late/non delivery of the schemes.

Cumulative forecast of number of meters (flat phased)

Deliverables	Unit	Forecast deliverables				
		2025-26	2026-27	2027-28	2028-29	2029-30
New AMI smart meter install	Number of meters	32,291	64,582	96,873	129,164	161,455
AMI for basic / AMR replacements	Number of meters	4,427	8,854	13,281	17,708	22,135

2.3.8 Delivery

This section should be read in conjunction with Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.

Delivery of the metering activity will take place within our existing supply chain framework providers for both meter delivery and meter installation. These companies have been involved in the development of these plans in order that we can ensure our programme of activity is deliverable.

Our household meter installation programme is summarised below:

Table 25 - HH metering rollout programme

	AMP8					AMP9					Total
	2025/ 26	2026/ 27	2027/ 28	2028/ 29	2029/ 30	2030/ 31	2031/ 32	2032/ 33	2033/ 34	2034/ 35	
Meter no's.	31,845	31,845	31,845	31,845	31,845	31,845	31,845	31,845	31,845	31,845	**318,450**
Benefit Ml/d	7.44					7.44					**14.88**

Our non-household meter installation programme is summarised below:

Table 26 - NHH metering rollout programme

	AMP8					AMP9					Total
	2025/ 26	2026/ 27	2027/ 28	2028/ 29	2029/ 30	2030/ 31	2031/ 32	2032/ 33	2033/ 34	2034/ 35	
Meter no's.	5,102	5,103	5,103	5,103	5,103	3,374	3,374	3,374	3,374	3,374	**42,384**
Benefit Ml/d	5.32					3.31					**8.63**

Universal meter installations will see us fit an additional 20,000-30,000 meters per year which is a significant step change increase.

We are confident in the deliverability of universal metering both in terms meter stock and the resources to plan and fit the meters.

Meter stock and supply

Our supplier for meters is Diehl and we have had a contract in place for three years currently. We are currently working on the extension of our current contract beyond AMP7 to cover AMP8 which provides assurance for Diehl in our commitment to them and provides greater security for both parties in the production and supply of large quantities of meters.

We are pleased with the performance of Diehl so far and their proactivity in the market with regards to the development of their hard and software. We believe Diehl are market leading in this sense and this provides us with further assurance that we are contracted to the best metering solution provider heading into AMP8. We have also engaged with Diehl in the development of our plans to ensure deliverability.

Diehl's customers include Severn Trent, United Utilities, South West Water, Scottish Water, Northern Irish Water, IWNL and ESP (NAVs) which again provides confidence that we are contracted with a well-placed supplier. Extending our contract provides certainty of future orders for Diehl, enabling them to commit to us as a priority customer within their customer base and allocate manufacturing and delivery resources with a degree of certainty to give us confidence in their intention and capability to deliver. Diehl's track record of commitment to their customer base is strong. We have experienced supply challenges as an industry in recent years due to Covid, the Suez canal incident, Brexit import challenges, factory fires and issues with core material shortages and in each of these cases Diehl have kept us informed and continued to provide a supply of meters which has returned to normal levels in a timely fashion.

Diehl are confident that over a circa 9 month period they are able to scale up orders to meet the universal metering quantities. In addition, in response to the anticipated demand increases over the next few years Diehl have recently approved an investment of £10m in their production capacity including doubling the capacity in their plant in Poland and investing in greater amounts of robotic production to improve efficiency.

As we manage our own stores of components utilised across the business, it is intended to carry by policy minimum amounts of stock at all times to enable any shocks in supply chain to be ridden out, ensuring uninterrupted continuation of the install programme.

Resources to install meters

Our AMP7 smart metering programme installs have been delivered by our Infrastructure Asset Delivery Framework contractors, installing issued meters supplied by Diehl. This element of works will be included as a Lot within the retender of this framework contract for AMP8. This Lot will be considerably larger in value than in AMP7.

We have engaged with our current installation providers who are confident that if successful in the re-tender, they can mobilise adequate additional resources to achieve the universal metering install quantities required by the AMP8 programme.

Whilst the scale of meter fitting is significantly increasing the volume of resources intended to be deployed for planning and fitting will be increased to maintain the programme and take account of expected efficiencies. Current meter fitting is completed on a job-by-job basis however universal metering will be delivered in geographic batches allowing for much greater economies of scale within these functions providing better value for customers.

3. Running a Sustainable Business

These enhancement cases have been developed to secure the investment needed for delivery of our sustainability ambitions. This includes environmental sustainability as well as corporate sustainability.

The summary of our proposed Enhancement Totex is in **Table 27** below, presented in £K.

Table 27 – Section 3 Proposed Enhancement

Running a sustainable business

Enhancement Case	Opex	Capex	CW3 lines
Case 4: Our Water Industry National Environment Programme (WINEP)	0	19,911	CW3.1, 3.7,3.10, 3.16, 3.28, 3.31, 3.34
Case 5: Our stretching leakage ambition	2,240	1,236	CW3.47
Case 6: Energy Security and Carbon Emission Reductions	0	7,236	CW3.127
Case 7: Cyber Security	0	2,754	CW3.124
Case 8: Security & Emergency Measures (SEMD)	0	526	CW3.121
Total	2,240	31,663	

3.1 Case 4: Our Water Industry National Environment Programme (WINEP)

3.1.1 Summary

This programme relates to the delivery of our Water Industry National Environment Programme (WINEP) statutory obligations as agreed with the Environment Agency and Natural England. It also includes activity for the Welsh National Environment Programme (NEP) as agreed with Natural Resources Wales.

Table 28 - Summary of expenditure required for the period 2025-2030 (AMP8)

Investment	Enhancement Investment	AMP8 TOTEX £k	AMP8 Enhancement OPEX £k	AMP8 Base CAPEX £k	AMP8 Enhancement CAPEX £k
Chalk stream restoration	Delivering cytomorphological improvements to deliver WFD objectives	13,940	0	0	13,940
Eel Screening	Protection of eels at Chelmarsh Reservoir	2,101	0	0	2,101
Protected Sites investigations	To identify measures to support and improve SSSIs	959	0	0	959
Environmental destination surveys	To determine the required abstraction reductions required to support WFD objectives	1,167	0	0	1,167
INNS, NERC, Biodiversity implementation	Actions to drive species protection and enhancement	721	0	0	721
Water resources	Investigation to determine ongoing need of augmentation schemes	894	0	0	894
Wales NEP	Remedial works to mitigate impact of Clywedog Reservoir on downstream watercourses	129	0	0	129
	Total	19,911	0	0	19,911

The PR24 WINEP has been developed together with the EA and Natural England, following investigations in AMP7 for implementation drivers, and on advice from these regulators on new investigations required or other drivers. Included are the following enhancements;

Table 29 – Enhancement activity/outputs detail

Activity	Outputs	WINEP driver
Chalk stream restoration	Restore habitats and return rivers to natural state. Conserve and enhance biodiversity and improve brown trout habitat.	NERC_IMP (primary) WFD_IMP_Flow (secondary)
Eel screening	Reduce fish entrainment and mitigate the impacts of ecology from physical modifications in artificial or heavily modified water bodies	EE_IMP
Protected sites investigations	Investigations and implementation of measures to maintain or restore sites of special scientific interest (SSSIs) to favourable conditions.	SSSI_INV SSS_IMP

Environmental destination surveys	Identification of required abstraction reductions to meet environmental destination as outlined in WRMPs	EDWRMP_INV
Invasive non-native species, Natural Environment and Rural Communities Act (NERC), biodiversity implementation	Investigations and implementation of actions to conserve and protect biodiversity, achieve improvement objectives, and prevent deterioration	INNS_IMP NERC_INV NERC_IMP
Water resources	Review augmentation schemes to ensure delivery against objectives. Protect and improve abstracted water supply quality	WFD_NDIND-WRFlow WFDGW_INV
Wales National Environment Programme	Implement remedial actions downstream of Clywedog Reservoir to mitigate effects of impoundment	W_WFD_WRHM WB_INV1

The WINEP drivers have been identified through previous AMP investigations and are statutory requirements under Habitats Directive and Water Framework Directive. Water companies must address any damage arising from their activities, and are expected to protect, restore, and enhance the environment. WINEP programmes are developed in line with the guidance issued by the Environment Agency and activities relate to statutory and non-statutory drivers. Our plans have been developed with input and ongoing liaison with the Environment Agency.

We are required to set out the services and improvements we intend to meet these legal obligations in our business plan through inclusion in the WINEP process relating to;

- reducing our impact on the environment
- ensuring environmental compliance
- improving resilience of assets to climate change
- securing the reliability of water supplies to their customers

The Government, EA, and Natural England expectations of water companies for statutory and non-statutory environmental performance standards and obligations are set out in the Water Industry Strategic Environment Requirements (WISER), and associated legislation such as the Environment Act and River Basin Management Plans.

Our plan for AMP8 is our most ambitious yet and builds on the investigations we have undertaken as part of the AMP7 WINEP programme as we look to take forward options identified to implementation. Our plan also looks at supporting key areas such as delivering biodiversity improvements, supporting removal of invasive species such as mink, the protection of species and river restoration work. There are also some investigations, primarily to determine the environmental destination abstraction reductions required in the long term.

As these schemes have all been developed in conjunction with regulatory stakeholders such as the Environment Agency and Natural England and are supported by statutory requirements. Within the WINEP, all scheme drivers are deemed ‘statutory’ and are therefore must do outcomes.

Our NEP programme for Wales has been stipulated by Natural Resources Wales.

Chalk stream restoration

Chalk rivers are a priority habitat for our customers and stakeholders, globally rare and unique to the area, and under stress due to abstraction, morphological modifications, and water quality issues. Restoration measures will support improvement of water body health and resilience to these pressures.

Restoration measures will provide less stress on flows, water quality and accordingly the habitats supporting NERC species brown trout, but the overall ecology and biodiversity of the waterbodies. Through this they will be more resilient to low flows, and these healthier waterbodies will be more able to support the unique chalk river habitats and ecology. Improved habitats will add to the amenity value of watercourses and surrounding areas also.

This will support the key objective to prevent deterioration of water body status of seven waterbodies, improvement in water body status and improvement in ecological status.

Alternative options are to remove the pressures entirely, such as abstractions from the groundwater and WWTW discharges. These cannot be implemented until alternative supplies have been developed, planned in 2032 and 2036 when new supply side options are commissioned, and in isolation would be less effective in returning these waterbodies to a near natural state. Therefore, restoration measures that can be implemented now will provide the earliest benefits possible, further supported in future by abstraction reductions when possible. This also aligns with the Government's chalk stream river restoration strategy which outlines requirements for water companies to undertake chalk stream river restoration in their operating areas.

Eel Screening, Protected Sites Investigations & Environmental destination surveys

These are all requirements of statutory legislation and are supported by regulators, who have been fully consulted through the process to gain sign off approval of inclusion in the WINEP.

Our work here involves the installation of entrainment prevention for eels at Chelmarsh Reservoir to comply with statutory requirements. Alternative options have been considered as part of the investigation process in AMP7 to define the implementation measure, in agreement with the EA. However, the current EA preference is that these measures would not guarantee compliance with the Eel regulations and would not eliminate the risk, and therefore the installation of a screen is the required approach as defined by the Environment Agency. Eel screens are the only option that ensures the risk is mitigated and compliance with the Eels Regulations can be achieved.

Protected Sites Investigations

Investigations will define future actions or implementation measures that contribute to meeting and or maintaining conservation objectives of Habitats sites and contribute to maintaining favourable conditions for Sites of Special Scientific Interest which are dependent on a healthy waterbody regime.

Environmental destination surveys

These investigations will inform future sustainability reductions at the company and regional scale required to improve the status of all waterbodies at a catchment scale. This will be used in future WRMPs as WFD requirements for improvements in ecological status.

INNS, NERC, Biodiversity Implementation

These are all requirements of statutory legislation and are supported by regulators, who have been fully consulted through the process to gain sign off approval of inclusion in the WINEP. Our customers also support biodiversity improvements that enhance the environment as evidenced during our WRMP engagement activity.

We will undertake actions that will support recovery and enhancement of Natural Environment and Rural Communities Act (NERC) Act S.41 priority species and habitats and prevent habitat deterioration by reducing the risk of spreading INNS and reducing the impact of INNS.

Water Resources

Delivery of agreed water resources driver implementations, as agreed with the Environment Agency. These include investigations into existing augmentations to assess value and any longer-term actions required to ensure the waterbodies achieve good status.

Wales NEP

In addition to the English based WINEP, South Staffs Water also has interactions with National Resource Wales due to the joint relationship with the River Severn. As such, we are also proposing to undertake work downstream of Clywedog, at the request of NRW, and this forms part of the Welsh National Environment Programme (NEP) and is also covered in this business case. The requirements of this work, and the costs associated, have been determined by Natural Resources Wales.

3.1.2 Background Information

Chalk stream restoration

This works looks to deliver the implementation of river restoration measures to improve brown trout habitat as identified in AMP7 through seven water bodies: Granta, Milll River, Shep, Mel, Hoffer Brook, Vicars Brook, Cherry Hinton Brook. This work prioritises in-channel and habitat measures and is part of a 10-year programme that will continue through AMP8.

Cambridge Water are working with the Environment Agency (EA) and other stakeholders to ensure that their abstractions are environmentally sustainable. This includes implementing measures to protect water resources for the longer term through the Environment Agency's Water Industry National Environment Programme (WINEP). One of Cambridge Water's regulatory actions under the WINEP (2020 -2025) is to provide investigation and options appraisal to identify river restoration projects on chalk streams to improve habitats and maximise flow for brown trout.

We have evaluated the works required to be undertaken to deliver such investigations on 7 prioritised water bodies, selected where restoration measures could make the most impact prior to water quality and abstraction pressures being removed. This was undertaken by desk study, walkovers and habitat surveys. These surveys identified the current extent of brown trout (Salmo trutta) habitat and/or potential for enhancement/creation of such habitat. The opportunities identified are set out in reports describing the results of geomorphological and fish habitat surveys for each water body.

Identifying river and riparian restoration options is dependent on project aims, objectives, site constraints and there are key steps which should be carried out to enable a successful restoration project to be undertaken. The activities undertaken to identify measures to be included were:

- Setting out restoration aims and objectives
- Review of river type and catchment characteristics
- Review of previously completed catchment/river investigations and channel improvement work
- Site visit to identify existing pressures and opportunities
- Creation of long list of potential options
- Options appraisal matrix to prioritise options and identify economic viability of options

Pressures within each river catchment are split into five key groups: those in the riparian zone; those affecting banks; those affecting the riverbed, those affecting river planform and those affecting flow.

This work has informed the options identification and appraisal for each water body, and this has been incorporated into a catchment plan of measures.

Table 30 below provides an overview of potential interventions which could improve the habitat afforded by the screened water bodies. Together, these provide information on possible intervention measures and where in the catchment they could be implemented. Management intervention plans then provide a more detailed summary of each intervention/option and location proposed.

The table provides information used to calculate option costs. Costs are high level and should be used to provide an indication of the scale of costs only. The majority of cost estimates have been taken from EA (2019), based on costs produced in 2012. Costs have therefore been inflated from their published data based on the Office of National Statistics (ONS) Consumer price inflation (CSI) rates per year (to 2022) to provide a more up to date value (ONS, 2022).

Table 30 – Potential interventions to improve habitat afforded by the screened water bodies

Potential Restoration Solution	Details	Indicative Costs
Channel realignment	Channel width of 5m and depth of 1m. Assuming 0% disposal off-site. Costs inflated based on the Office of National Statistics ONS CSI rates per year (to 2022) since data was published in 2015.	£50,000 (2015) £60,444 (2022)
Gravel augmentation (reinstatement of coarse bed material)	The cost of bed raising varies significantly with the amount of gravel required. For this cost it is assumed that 3.3m3 of gravel are required per metre length. Costs inflated based on the ONS CSI rates per year (to 2022) since data was published in 2012.	£197,000/km (2012) £250,962/km (2022)
In-channel features (narrowing)	Adding current deflectors and other small in stream structures that contribute to channel morphology. Costs will vary depending on the type of deflector used and the width/depth of the river. For the cost above it is assumed that current deflectors will be spaced at 20m intervals along the river. Costs inflated based on the ONS CSI rates per year (to 2022) since data was published in 2012.	£59,000/km (2012) £75,161/km (2022)
Removal/set-back of flood bank	No costs given in report, but it is considered costs will be comparable to bank reprofiling. Costs inflated based on the ONS CSI rates per year (to 2022) since data was published in 2012.	£77,000/km (2012) £98,092/km (2022)
Bank reprofiling	Cross section enhancement, re-profiling and extending banks and creation of 2 stage channels. Costs will principally vary with the extent of narrowing required and the depth of river. It is assumed that the narrowing technique does not require material to be imported for backfilling behind the new bank line. Costs inflated based on the ONS CSI rates per year (to 2022) since data was published in 2012.	£77k/km (2012) £98,092/km (2022)
Riparian tree-planting	Grant rates taken from the woodland grant scheme allow £2k/ha for new planting and £2k/ha for on-going maintenance (over 10 years). Costs inflated based on the ONS CSI rates per year (to 2022) since data was published in 2012.	£4,000/ha (2012) £5,096/ha (2022)
Riparian tree management	Cost estimate of £1k/day for a team of two men and chainsaw or £2k/km of river length for discrete felling and coppicing works. This would increase if felled or coppiced material had to be chipped and removed from the riverbank and assumes reasonable access. Costs inflated based on the ONS CSI rates per year (to 2022) since data was published in 2012.	£2,000/km (2012) £2,548/km (2022)
Riparian buffer	Based on 12m wide buffer strips adjacent to watercourse to reduce sediment and phosphorus losses to water and pesticide spray drift. One-off costs cover use of agricultural advisors to engage landowners and help them access funding for buffer strips (e.g. via Countryside	£353 per ha (2021) £386 per ha (2022)

Eel Screening

Hampton Loade WTW is supplied from Chelmarsh Reservoir under gravity via several offtakes which are visible inside the offtake tower. Based on construction drawings, there appears to be coarse bar screening across each intake which makes it possible for juvenile fish to be entrained into Hampton Loade WTW.

Due to this potential entrainment of fish and the presence of European eel in the adjacent River Severn, both abstractions fall under the remit of The Eels (England and Wales) Regulations 2009. Specifically, Part 4 Regulation 17 of the regulations makes it a legal requirement for any diversion structure capable of abstracting at least 20 cubic metres of water per day to install an eel screen. We undertook investigations in AMP7 relating to the presence of eels at Chelmarsh and these were located during this work. As a result, there is a need to take action in AMP8 to fit an eel screen in order to fulfil our obligations under The Eels (England and Wales) Regulations 2009.

Protected Sites Investigations

Investigations are required to define future actions or implementation measures that contribute to meeting and or maintaining conservation objectives of Habitats sites (e.g. SSSIs) and contribute to maintaining favourable conditions for Sites of Special Scientific Interest which are dependent on a healthy waterbody regime. Specific sites have been identified through engagement with Natural England where this work is required. They include Alder Carr SSI and Wilbraham Fen.

Environmental destination surveys

These investigations will inform future sustainability reductions at the company and regional scale required to improve the status of all waterbodies at a catchment scale. This will be used in future WRMPs as WFD requirements for improvements in ecological status. Full detail of the requirements of these are outlined in our WRMPs. If no investigations are carried out, it could lead to abstraction reductions being made that are not needed or that do not deliver the required benefits. This would impact on the delivery of the Water Framework Directive objectives and could also trigger additional spend on new supply side options that is not required.

INNS, NERC, Biodiversity Implementation

This looks to conserve and enhance biodiversity and achieve water body objectives, as agreed with the Environment Agency following AMP7 investigations. It also includes actions that will support recovery and enhancement of Natural Environment and Rural Communities Act (NERC) Act S.41 priority species and habitats and prevent habitat deterioration by reducing the risk of spreading invasive non-native species (INNS) and reducing the impact of INNS. The actions taken have been identified in our AMP7 investigations and agreed with the Environment Agency.

These are all requirements of statutory legislation and are supported by regulators, who have been fully consulted through the process to gain sign off approval of inclusion in the WINEP. Our customers also support biodiversity improvements that enhance the environment as identified through both our WRMP and PR24 customer engagement work.

Water Resources

This work involves investigations in three catchments consisting of flow monitoring and desk study investigations and modelling to assess requirements for flow support and augmentation in the future.

Broome Lodge and Shaft 20 Licences are operated under section 20 agreements for low flow support in dry weather events. Crane Brook Augmentation is currently a potential option for augmenting the Crane Brook but will not be utilised until CRT and EA licence changes take effect as part of the new authorisations programme. Broome Lodge has not been used in 2018 or 2022 dry weather. When the WFD ND licence caps take effect there will be no Recent Actual volume to support its operation. The shaft 20 licence was used in the 2022 dry weather event but when licence caps take effect there will be no recent actual abstraction level to support its operation. The third investigation is to look into the effectiveness of the existing Nine Wells augmentation scheme in the Cambridge region to understand any changes that may be required in order to support flows in the local waterbodies appropriately.

Wales National Environment Programme (NEP)

South Staffs Water has our largest abstraction on the River Severn. This abstraction is subject to River Severn Regulation which, managed by the Environment Agency, looks to control flows in the Severn during times of low rainfall and reduced flow to ensure protection of the river. During these times, there are limitations and restrictions applied to our licence and we work closely with the Environment Agency and other abstractors on the River Severn to ensure that flows are balanced during these times.

Our River Severn abstraction takes place at our Hampton Loade treatment works. This is a facility that we share with Severn Trent – we operate and maintain the site on behalf of both parties, and Severn Trent are entitled to a third of the water produced by the site and so are responsible for a third of the costs and capital investment.

When the River Severn is experiencing low flows, the Environment Agency can utilise Clywedog Reservoir by making releases from here to top up the level in the River Severn. Clywedog Reservoir is in Wales yet operated by Severn Trent Water. These releases from Clywedog means that South Staffs Water is able to continue abstraction from the Severn, and it is this relationship to the reservoir that means we also have a duty and responsibility to ensure the impacts of this impounding reservoir are mitigated on the local ecology.

Natural Resources Wales have undertaken studies that show that downstream ecosystems suffer as the result of impounding flows. As such, they have requested work be undertaken downstream of Clywedog to repair some of the damage caused by the impounding. The have requested South Staffs Water, Hafren Dyfrdwy and Severn Trent Water undertake some gravel remediation works in AMP8 to mitigate some of this impact. As this is work in Wales under Natural Resource Wales, it does not fall under our WINEP programme, but instead under the National Environment Programme (NEP) that Wales operates. Following discussions with NRW, we are proposing to work with Severn Trent Water, on a cost share basis proportional to the benefit received by each company from Clywedog, in order to undertake gravel remediation. The cost of this work to South Staffs Water is £128,800.

3.1.3 Need for Investment

Chalk stream restoration

Following AMP7 investigations into river restoration measures to protect and enhance brown trout habitat we have identified several morphological measures to improve flows for the ecology until future abstraction reductions can be made. The investigations involved river surveys on prioritised waterbodies. These are Mill River, River Mel, River Shep, Hoffer Brook, River Granta, Vicars brook & Cherry Hinton Brook. This work aligns to the WINEP Statutory NERC driver.

The measures identified for improvements to NERC species habitats are detailed below:

Channel realignment

Channel realignment would involve changing the existing channel planform with the aim of creating a new channel with improved forms and processes and associated habitat. Channel realignment provides an opportunity to raise bed levels and incorporate features associated with a naturally functioning watercourse including gravel substrate, woody features and shallow banks with improved connectivity with the adjacent floodplain.

In-channel improvements - Berms

In-channel berms can create localised sinuosity within the channel and alter flow processes, promoting deposition near to the berm and encouraging a range of flows within the channel. Berms allow for a low flow channel to be created, encouraging faster flows in the drier months whilst maintaining channel cross-sectional area for high flow events. Berms can also provide refuge areas for fish during flood events and provide a platform for native riparian vegetation to establish.

Berms can be created using a variety of methods, including locally won wood to form the outer edge and infilled also using locally won wood and material from riverbanks. Trees can provide a robust platform for berm creation, particularly at the channel edge to prevent erosion during high flow events.

Bank reprofiling

Where riverbanks have been steepened as a result of channel dredging or realignment (i.e., straightening) the variety of marginal habitats provided by the banks will be significantly reduced. This will also result in reduced flow variety and (often by intention) faster velocities flowing through the channel. Banks can be re-profiled to make them less steep, allowing for marginal vegetation to establish and associated improved riparian habitat, refuge, and foraging. Bank re-profiling can also improve channel stability and, similar to berms, be used to narrow over-wide channels and encourage flows during drier months. Re-profiling banks can also promote lateral connectivity with the floodplain.

Removal of hard bank protection

Hard bank protection is often used to prevent erosion and stabilise banks, however there a wide range of techniques that can be used to replace hard materials that remove riparian habitat and geomorphological diversity. These include making space for the river by reprofiling channel banks, replacement with soft engineering techniques such as woody material, planting of native species or creation of buffer strips.

Deflectors and woody material

In-channel flow deflectors can be used to increase the diversity of flow types and attendant sediment processes within uniform sections of the channel. The ends of structures, which are usually constructed using locally won wood, increase mid-channel velocity, projecting flow into the channel, whilst promoting deposition near to the banks. Improving variations in channel processes and the development of areas of erosion and deposition can improve and create habitats and encourage flow resilience through channel narrowing.

Gravel augmentation

Gravel can be introduced to an over-deep channel to raise the bed and improve flow conditions. Gravel can be imported or locally won (if available). The added gravel can also improve habitat and spawning conditions for fish whilst encouraging lateral connectivity with the adjacent floodplain.

Fish passage options at weir

The existing weirs currently acting as a major barrier to fish passage up rivers. Options to improve fish passage at this location could include:

- Weir removal
- Bypass channel – creation of a new channel bypassing the weir, incorporating natural features to allow fish passage.
- Pre-barrage – to raise the water level up within the channel downstream of the weir.
- Pre-fabricated Larinier fish pass – to provide a pathway for fish to travel up the weir via a series of baffles which slow the water down. Passes can be retrofit onto the weir and downstream channel creating a shallower gradient for fish passage.

Scrapes and ponds

Creation of areas of wetland through removal of embankments or constructing scrapes and ponds can help to provide links between aquatic and terrestrial habitats. Wetland areas can also provide water quality benefits and help with sediment management issues through trapping fine silts before entering the river. The creation of ponds can also provide marginal habitat, which can operate as refugia for mobile species (including fish) where the velocity is reduced at high flows.

Buffer strips

Agricultural activities can compact floodplain soils, decrease infiltration, and increase delivery of water to the channel, increasing flood risk during high rainfall events. Arable farming also results in exposed soils for much of the year, increasing delivery of fine sediment and potential pollutants to the watercourse during rainfall. Lack of riparian vegetation or winder die back can also expose channel banks, increasing fluvial erosion and increasing fine sediment to the channel.

Eel Screening

Presence of eels in Chelmarsh Reservoir has been confirmed. Mitigating the impacts on ecology from physical modifications in Artificial or HMWBs is necessary as detailed in the previous section.

Surveys conducted in 2022 confirmed the presence of European Eels in the reservoir. “APEM (2022). Chelmarsh Reservoir eel surveys. Report APEM Scientific Report P00006794. South Staffs Water, October 2022, v1.0 Final, 22 pp.” describes the existing baseline conditions at the site, the survey strategy, and the results of the survey.

The preferred option, agreed with the EA and included in the WINEP is installation of Eels screens at Chelmarsh Reservoir intakes and annual trap and release programme for mature eels.

Protected Sites Investigations

Wetland sites in area of supply have been through RoC process and investigations. Implementation of measures was third party delivery and NE are concerned that in some cases these may not have been effective and resilient to future climate and have requested that some are revisited.

Natural England advise that Cam Washes and Sawston Hall Meadows are sites of concern that may be influenced by Cambridge Water activities. This activity falls under the WINEP Statutory SSSI driver.

Environmental destination surveys

England’s statutory requirements for abstraction and flow under the Water Environment Regulations 2017 are likely to be missed or need to be extended in many places.

Environmental Destination Options Development is a WINEP activity that the EA has asked every water company to undertake in AMP8. This activity is intended to be complementary to other planned water resources investigations but differ by a more strategic and longer-term view. The total package of investigations for each company should enable them to design a plan to achieve environmentally sustainable abstraction as soon as technically feasible.

Each company should develop a package of actions, including investigations and implementation schemes, which are part of their plan to achieve environmentally sustainable abstraction. Investigations under WINEP will typically fall into two categories:

1. Environmental Destination Options Development study under the EDWRMP_INV driver, in collaboration with relevant regional groups
2. Catchment specific or topic specific investigations which may fall under WINEP drivers for Habitats Regulations, Water Framework Directive Regulations or Environmental Destination. These are more detailed investigations into a specific catchment or issue.

The EA expect water companies to develop solutions to environmentally unsustainable abstraction at a Water Resource Zone or catchment scale based on scenario predictions of the likely range of needs. This includes future environmental and legislative requirements (e.g., where climate change is likely to cause a future flow impact on ecology). For these future issues the timing of solutions should be based on when the impact (or change) is likely to occur. Planning using a scenario approach means we can make best-value low-regrets investments now based on our understanding of the likely range of future needs.

In 2027 the EA will create a list of sustainability changes required for inclusion in the WRMP and WINEP. The list will be informed by conclusion of AMP8 investigations.

INNS, NERC, Biodiversity Implementation

Raw water transfer & INNS: Assets and sites with high risk of invasion from invasive non-native species (INNS) are those where we are more likely to find early arrivals of new INNS. For some species, monitoring approaches and techniques need developing. This will allow for better early intervention across GB priority pathways.

Preferred option - Development of the techniques and approaches needed for INNS surveillance will be a cross company project. The project will be coordinated nationally and will include the discussion and prioritisation of appropriate species. The aim is to provide a standardised and costed set of techniques (including eDNA assays where suitable) to create a national surveillance programme at high-risk sites. The project will potentially be hosted by the Non-Native Species Secretariat Aquatic Biosecurity Group–if not, they will have a strong role on the steering group which will also link to the GB programme board. Costs are split across companies' surface water assets, using the UK Water formula.

INNS at operational sites: Programme of monitoring and management at sites with INNS identified, and company awareness programme. The programme is informed by AMP7 investigations, report; P7598 Biodiversity survey and enhancement report Final.pdf

Biodiversity: Informed by AMP7 investigations and site surveys, implement biodiversity improvement measures and where applicable site-specific management plans to enhance habitats and species diversity on land that we own. Subject to PWS operational conditions.

Measures to be included subject to individual site conditions are;

- Woodland management
- Underplanting of woodlands to NVC classification improving ground and shrub layers
- Hedgerow planting to boundaries, underplanting and gapping up, added security to the fence lines
- Traditional Hedge laying and underplanting
- Scrub planting to create edge habitat to woodland
- Rainwater harvesting from building to create rain gardens e.g. Swales and suds planted which is great for many NERC species. Most are near roads and this would help to attenuate and clean water before entering the surface water drainage system.
- Paint yellow fish on surface water drains leading to watercourse
- Green roofs and green walls on smaller pump houses that are appropriate
- Butterfly banks
- Plug planting and grassland management which has been recommend but very generic
- Willow tit habitat creation where near watercourses and appropriate habitat
- Tree planting within existing hedgerow boundaries
- Tree planting and orchard creation
- Marginal habitat improvements on watercourses and pools
- Watercourse enhancement, e.g., management of invasives and plug planting and seeding, gravel addition, woody material placement
- Create Standing dead wood
- Bird box installation for a variety of species, dependant on location and landscape
- Bat roost box installation – doesn't need to be on a building but could be on a post
- Amphibian and reptile hibernacula creation
- Bee and bug habitat creation against pump house buildings and walls, could include fixtures or even rockeries and fake dry stone walls, dare I say it gabions to create areas of landscape
- Change the lighting around the building so that it is low lux and cowled which would be better for bats, ensuring H&S is maintained but is in keeping with bat new guidelines.

In addition, we will undertake analysis to determine BNG scores for all sites to measure and track ecological value.

Blithfield additional scheme -: To map the Blithfield estates veteran trees, identify individual trees of interest and undertake species surveys.   Phase 2 – To develop and implement a management regime for veteran trees to include direct management of immediate tree environment to support tree longevity (root protection, halo thinning) and complimentary habitat improvements to tree surrounds for associated species to include veteran recruitment, veteranisation of trees (tree surgery/ damage), sump stumps and rot boxes.

Water Resources

As agreed at AMP7 for AMP8 delivery, Broome Lodge and Shaft 20 Licences are operated under section 20 agreements for low flow support in dry weather events. Crane Brook Augmentation is currently a potential option for augmenting the Crane Brook but will not be utilised until Canal & River Trust and EA licence changes take effect as part of the new authorisations programme. Broome Lodge has not been used in 2018 or 2022 dry weather. When the WFD no deterioration licence caps take effect there will be no Recent Actual volume to support its operation. The shaft 20 licence was used in the 2022 dry weather event but when licence caps take effect there will be no recent actual to support its operation. Investigations in both catchments required consisting of flow monitoring and desk study investigations and modelling to assess requirements for their use in the future.

NEP Wales

The NEP work downstream of Clywedog will deliver river restoration and ecological improvements. There are two activities of work to undertake:

Table 31 - NEP Activities

Action Description	Description of Outcome
Investigation and appraisal of options to determine the impact of abstraction on achievement of good ecological potential (GEP) in an Artificial or Heavily Modified Water Body (for water resources uses).	Understand flow regime and gravel reinstatement requirements to mitigate for effect of impoundment
Implementation of actions to mitigate impacts of abstraction and achieve GEP in Artificial or Heavily Modified Water Bodies. This usually follows investigation in the previous AMP but not necessarily.	Reinstatement of gravels and correct flow regime to improve ecological and riverine processes in line with mitigation measure requirements

This work is proposed under the HMWB NEP Driver with driver code W_WFD_WRHMWB_INV1. This code Investigation and appraisal of options to determine the impact of abstraction on achievement of good ecological potential (GEP) in an Artificial or Heavily Modified Water Body (for water resources uses). This driver codes is used for the investigations of WR A/HMWB for which the flow and/or morphology pressure on the water body is due to water company assets and/or operations (e.g. abstraction, discharge, reservoir operational management).

For WR A/HMWB to achieve Good Ecologic Potential (GEP), all of the required mitigation measures need to be “in place” in addition to other physico-chemical and relevant biological elements also being at good status. The list of 12 mitigation measures listed as follows.

Table 32 – 12 Mitigation measures

Driver		Mitigation Measure	
1	**Fish migration** (in relation to main impoundment)	1	Effectiveness of fish passes
		2	Volume and timing of flow releases for migration
		3	Fish entrainment
		4	Access to feeder streams for spawning migration
2	**River flow** (hydrological regime)	5	Baseline flow
		6	River engineering where flow cannot be modified
3	**River sediment** (habitats)	7	Sediment management regime – supply
		8	Flows to move sediment downstream
4	**River water quality**	9	Downstream river dissolved oxygen
		10	Downstream river temperature
5	**Lake level**	11	Lake drawdown
		12	Seasonal level management

The work proposed here related to driver 3.

Natural Resources Wales are planning to propose additional activities in AMP9 as work continues to protect and restore the downstream watercourse following further investigations.

3.1.4 Customer Support

We have asked our customers, through our WRMP24 customer engagement programme, for their views on the level of environmental ambition we should adopt in our plans. Many customers did not support us going notbaly above our statutory obligations at this time due to the current cost of living crisis. All of the options proposed in our AMP8 WINEP programme are under statutory drivers – customer support is only required if work proposed falls under a non-statutory driver.

3.1.5 Best Option for Customers

We have worked with the Environment Agency and Natural England to agree the activities through the plan. Where there are options, these have been identified often through our AMP7 investigations and we have assessed these both from a cost perspective and from a value perspective and agreed these through discussions with the Environment Agency. Some options, such as the eel screen, have been pre-determined by the Environment Agency. They have approved our plan, including the options selected, through their confirmation in May 2023.

We commissioned Atkins to undertake an assessment of the wider environmental benefits of our programme and calculate the benefit-cost rations for our options. The WINEP guidance recommends that options are assessed against four wider environmental outcomes (Natural Environment, Net Zero, Catchment Resilience and Access, Amenity and Engagement) which incorporate 11 environmental benefit (ecosystem service) categories:

- Biodiversity
- Climate Regulation
- Hazard Regulation – flood
- Water Quality
- Water Purification
- Water Supply
- Recreation (including angling)
- Food – shellfish
- Air Quality
- Education
- Volunteering

Some activities, such as surveys and investigations, do not deliver these benefits but are key enablers for identifying activities that will do.

We have submitted this full report as an appendix to our PR24 plan, entitled 'SSC39 WINEP Options Assessment.' Summaries from these are included in the sections below.

Chalk stream restoration

Option evaluation

Using a simple scoring assessment based on the options appraisal matrix evaluation, each option was ranked using scores from high to low (high scores indicating best performance based on selected criteria) and provide an overview of the scores and option ranking. Selected criteria included likely costs of and benefits to:

- Ecology – brown trout habitat
- Hydrology – flow processes and flood risk
- Geomorphology – channel morphology, long term sustainability of underlying processes and erosion/stability risk
- WFD status
- Social opportunities – aesthetics and recreation and community access and educational opportunities
- Economics and logistics – cost. fundability, buildability, and maintenance requirements
- Value for money.

Overarching categories also included value for money, environmental sustainability, risk and status of WFD water body. Option scores and ranking can be seen below in **Table 33**.

Table 33 - Option scores and ranking based on selected criteria

Option	Score	Rank
Option 33 - Channel realignment, wetland/flood storage	21	1
Option 8 - Bank reprofiling, riparian buffer, weir removal, removal of hard bank reinforcement	20	2
Option 30 - Channel realignment, wetland	20	2
Option 59 - Channel realignment, wetland	20	2
Option 72 - Channel realignment, wetland/floodplain	20	2
Option 47 - Channel realignment, wetland	19	3

Option 3 - Bank reprofiling and riparian buffer	18	4
Option 27 - Weir removal	18	4
Option 29 - Weir removal	18	4
Option 32 - Weir removal	17	5
Option 67 - Channel realignment, wetland floodplain area	17	5
Option 10 - Bank reprofiling, realignment, planting and gravel augmentation	16	6
Option 11 - Riparian tree planting, realignment, removal bank reinforcement, gravel augmentation, weir removal	16	6
Option 19 - Remove bank reinforcement, weir removal	16	6
Option 24 - In-channel features	16	6
Option 42 - Restore/add in-channel features	16	6
Option 68 - Embankment removal	16	6

The **Table 34** below shows the total change in ecosystem service values as a result of the activities that we will undertake within chalk stream restoration that relate to the NERC driver.

Table 34 – Total change in ecosystem service values

	Climate Regulation	Recreation (Alternative method)	Air Quality Removal	Natural Hazard Management	Water Purification	Water Quality	TOTAL
ID	30yr £PV	30yr £PV	30yr £PV	30yr £PV	30yr £PV	30yr £PV	30 yr Total £PV
08CW100007	£291,131	NA	£20,789	£43,754	£27,352	NA	£383,026
08CW100012	£175,664	£1,290,009	£12,209	£876,828	£624,585	£5,083,004	£8,062,299

Eel Screening

The preferred option ensures that Eels cannot be entrained at Hampton Loade Treatment Works. This is considered the best value option in the absence of other viable alternatives to stop the entrainment of European eels at the treatment works.

Protected Sites Investigations

Investigations will be guided by Natural England and Environment Agency requirements.

Environmental destination surveys

Failure to undertake investigations to EA requirement would risk greater licence constraints – investigations at regional scale best option.

INNS, NERC, Biodiversity Implementation

AMP7 investigations informed the site management reports for own land, these are optimised measures to meet the NERC/INNS objectives.

Our biodiversity activities have been assessed and will deliver the following total change in ecosystem service values.

Table 35 – Total change in ecosystem service values

	Climate Regulation	Recreation (Alternative method)	Air Quality Removal	Natural Hazard Management	Water Purification	Water Quality	TOTAL
ID	30yr £PV	30yr £PV	30yr £PV	30yr £PV	30yr £PV	30yr £PV	30 yr Total £PV
08SS100005	£495,242	£93,080	£42,713	£120,357	£75,232	NA	£826,624

Water Resources

These investigations have been requested by Natural England and the Environment Agency.

The work at Darnford Brook has been assessed to deliver the following change in ecosystem services (30yr £NPV)

Table 36 – Total change in ecosystem service values

Water Quality	Air Quality	Climate Regulation	Natural Hazard Regulation	Recreation (Alt.)	TOTAL
1,330,410	2,045	43,129	4,665	0	1,380,249

NEP Wales

The NEP work has been requested by NRW, with activities required and cost also provided by NRW.

3.1.6 Cost Efficiency

River Restoration

Costs estimates have been taken from Environment Agency (2019) costs of restoration methods, based on costs produced and applied to length/area identified in restoration plans, as per P8285_Cambridge_Water_Restoration Options tables (V0.1).doc.

The river restoration work programme is all based on catchment and natured based solutions I.e., soft engineering. We are proposing activities that will restore natural habitats and chalk stream conditions through natural methods that are catchment based solutions such as improving river beds and banks and re-introducing river meanders.

We have also worked with the Environment Agency and the local councils in AMP7 and been successful in a bid for funding to undertake river restoration work on the River Granta, and we look to build on this approach for AMP8. Our Chalk Stream Delivery Lead role is engaged with third party organisations, key stakeholders and eNGOs to identify additional opportunities for grants, match funding and costs efficiencies through combining programmes.

In addition to this, we have been liaising with several developers in the Cambridge region to identify opportunities for them to fund activities on river restoration as part of mitigation measures for new developments. We have a signed letter of intent with Brookgate Land Ltd stating they are willing to enter into an agreement to pay a financial contribution towards an identified catchment restoration scheme with Cambridge Water. We will be exploring further opportunities for collaboration as we progress over the next few years.

Eel Screening

The delivery of the eel screen will be delivered through agreed competitive frameworks, as detailed in the delivery section below. Through our engagement with the EA, we have assessed alternative solutions such as capture and release – however the Environment Agency have requested a screen to be installed as this is the proven method to prevent entrainment.

Environmental destination surveys

Failure to undertake investigations to EA requirement would risk greater licence constraints – investigations at regional scale best option in order to ensure future investment in new water sources is not over estimated and committed. We propose to undertake these investigations jointly with our neighbouring water companies and regional groups to deliver efficiencies of scale and ensure a consistent process is applied.

INNS, NERC, Biodiversity Implementation

AMP7 investigations informed the site management reports for own land, these are optimised measures to meet the NERC/INNS objectives. Costs derived using standard approaches to habitat management. These actions are nature-based solutions such as woodland management, veteran tree protection and enhancement, land management, habitat creation and

Water Resources

These investigations will be undertaken by our framework providers, the scope agreed with Natural England and the Environment Agency, to ensure we deliver the requirements. By using our framework providers who have been through a competitive tender process, we can ensure we are cost efficient.

NEP Wales

The NEP work has been requested by NRW, with activities required and cost also provided by NRW. As Hafren Dyfrdwy (HD) and Severn Trent Water (SVT) also have dependencies on Clywedog, the total cost for the proposed work will be shared between all three companies, and the cost split relates to the level of benefit each company receives. As a result, and as proposed by NRW, the split will be 40:40:20 SSW:SVT:HD. As the total cost of the activity, as costed by NRW following their review, is £322,000, leading to a split for South Staffs Water of £128,800. This work will be delivered collaboratively between the three organisations.

This activity, like the chalk stream restoration, is using catchment measures to improve the habitat and condition of the river through the re-introduction of the natural gravel into the downstream river system.

3.1.7 Customer Protection

The WINEP programme performance is monitored annually through the Environment Agency for all work in England, and Natural Resources Wales for all activity in Wales. As part of this, we must demonstrate our completion of the activity outlined and delivery of the specified outcomes in order for the Environment Agency to approve completion of the scheme.

Many elements of our WINEP programme contribute to the Biodiversity Performance Commitment, such as the biodiversity, invasive non-native species and river restoration work.

3.1.8 Delivery

This section should be read in conjunction with Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.

Work will primarily be delivered through framework consultants and contractors due to the specialist nature of the work. In AMP7, we have an existing framework in place, which has been competitively tendered, which provides a number of consultants available to undertake any investigation work, and quotes are sought for any activities not covered through this framework. Any engineering work undertaken has been completed by our framework capital investment providers.

Consultancy and survey work will be delivered as a Lot through the retendered AMP8 Professional Services Delivery Framework contract.

For AMP8 we have built a scope for the AMP8 Professional Services Delivery Framework contract that will include the investigation work we need and also the soft engineering scope of work which will form the majority of our WINEP programme through the chalkstream river restoration, and our Wales NEP programme of river restoration. This work will be included as a Lot in the AMP8 Non-Infrastructure Assets Delivery Framework contract.

By having a competitive tender process to develop a framework of suppliers for our WINEP work within a broader scoped framework contract, we can ensure that we deliver value for money and have several companies enabled to deliver the activity, as we are cognisant of the fact that all water companies have increased WINEP programmes for AMP8 and therefore there could be a strain on the supply chain. As we have already started this tendering process, we are confident we will have companies secured and more than one company available for each element to help support this.

The Non-Infrastructure Assets Delivery framework contract will also provide support to capital projects, whereby a requirement to support the delivery of 10% biodiversity net gain will be mandated.

3.2 Case 5: Our stretching leakage ambition

3.2.1 Summary

Our WRMP analysis has shaped our leakage plans, both for this planning period and into the future. Our WRMP24 suggests that we need to reduce leakage by 8% in SST and 18% in CAM in order to maintain our supply demand position and also be on track to achieve the new Environment Act targets. Ofwat views this activity as base maintenance, and we have therefore included the costs to deliver this within our base Totex programme.

However, we know that leakage is a very emotive subject for our customers, when we shared our original planned reduction with them, in both our structure engagement programme and also our YWYS it was clear to see that customer thought we should go further. We have reviewed our WRMP24 analysis, looking at stretch and ambition, affordability and deliverability and are confident we could accelerate the AMP9 WRMP leakage needs and deliver in the next planning period. It is clear that this expenditure does not sit in base maintenance, as it's going above and beyond the needs of our WRMP, we are therefore making and enhancement case to fund this level of stretch that our customers are supportive of.

Table 37 - Summary of expenditure required for the period 2025-2030 (AMP8)

Investment	Enhancement Investment	AMP8 TOTEX £k	AMP8 Enhancement OPEX £k	AMP8 Base CAPEX £k	AMP8 Enhancement CAPEX £k
Leakage	Stretching leakage ambition	3,476	2,240	0	1,236
	Total	3,476	2,240	0	1,236

3.2.2 Background Information

Our customers strongly supported increasing our leakage ambition, and it is critical that we reflect their priorities in the plan. We also recognised that our original SST target was lower than at PR19, which may be considered unambitious by Ofwat considering the current climate. Therefore, we are proposing to pull forward AMP9 spend from the WRMP to extend these leakage targets further.

The sequence below steps through how we went from WRMP to our stretch PR24 targets for both of our regions.

In order to achieve a supply demand balance and meet the EA targets, we needed to deliver the following leakage reductions in AMP8. We are proposing to deliver this reduction within our base Totex programme under our "what base buys" assumptions.

	CAM	SST
2025 Mld	13.20	59.50
2030 Mld	10.80	54.56
Mld reduction	2.40	4.94
% reduction	**-18.2%**	**-8.3%**

The Totex costs to deliver these WRMP stated target reductions through our base programme are in the below table. Note these do not include our base maintenance costs, also included in our base programme.

	CAM	SST
Total costs £m	**3.54**	**2.94**
Unit rate per Mld	*1.475*	*0.595*

Target Rebase:

We rebased our leakage position in 2022-23 so the starting position is lower.

	CAM	SST
2025 Mld	13.20	58.80
2030 Mld	10.80	53.86
Mld reduction	2.40	4.94
% reduction	**-18.2%**	**-8.4%**

The costs to deliver these reductions are unchanged:

	CAM	SST
Total costs £m	**3.54**	**2.94**
Unit rate per Mld	*1.475*	*0.595*

Extending the target – our stretching leakage ambition

Our customers strongly supported increasing our leakage ambition, and it is critical that we reflect their priorities in the plan. We also recognise our SST target is lower than at PR19, which may be considered unambitious by Ofwat considering the current climate. Therefore, we are proposing to pull forward AMP9 spend from the WRMP to extend these leakage targets further to give the following:

	CAM	SST
2025 Mld	13.20	58.80
2030 Mld	10.56	49.98
Mld reduction	2.64	8.82
% reduction	**-20.0%**	**-15.0%**

Additional enhancement Totex costs:

As we are going beyond our statutory WRMP stated requirements with these targets, we are proposing to include the additional costs of to deliver the extra as an enhancement case.

Based on the WRMP these costs would be:

	CAM	SST
Total costs £m	**0.333**	**2.413**
Additional reduction Mld	0.24	3.88
Unit rate per Mld	*1.386*	*0.622*

However, bringing AMP9 plans forward will require an increase in maintenance costs not captured by the base allowance in order to "maintain" the increase throughout AMP8, which under original plans would not have been completed until AMP9. As we reduce leakage further, more work will be required to maintain current position and stay on top of the natural rate of rise of the network. We have assumed these costs will relate to only the CSL and ALC portion of the programme, as pressure management/asset replacement requires far less maintenance and in its nature is already dealing with the natural rate of rise.

Therefore, we are proposing an additional £0.730m in the enhancement scheme. This includes all costs to find/fix and maintain any assets that would previously not have needing maintaining until AMP9 but has now been bought forward to AMP8.

Table 38 – Summary of Costs

	CAM	SST	Additional maintenance	Total Enhancement Totex
Total costs £m	0.333	2.413	0.730	3.476
Additional reduction Mld	0.24	3.88	-	4.12
Unit rate per Mld	***1.386***	***0.622***	-	***0.846***

Therefore, we are proposing to deliver 4.12Mld additional leakage reduction for £3.476m (unit rate of £846k/Mld). This consists of £2.240m Opex and £1.236m Capex as defined in above summary **Table 38**. The value of £3.476m is the Totex amount we require for this enhancement case.

3.2.3 Need for Investment

This investment is driven by customers wanting us to go faster on reducing our leakage levels. We present the customer support for this in the next section. In our Cambridge region, with the challenges that growth and environmental ambition brings, it is important for us to be able to evidence to our customers and stakeholders that we are driving leakage down as quickly as possible. It is also a key enabler for other demand management activities, especially when we are customers to reduce their own consumption.

3.2.4 Customer Support

Leakage is an emotive issue for customers, with the majority believing that ethically, levels must be reduced as much as possible. Furthermore, some feel that leakage must be reduced if customers are to be motivated to play their part with water conservation. In addition, leaks on customer properties are unlikely to be effectively addressed without an education programme to inform customers of the scale of this problem, how to detect leaks and how to reduce them. The national leakage target appears to be broadly in line with customer expectations (once educated) and there is some scope to bring forward the date by which targets are to be achieved. Similar to customers, most stakeholders tend to think that progress on leaks is a prerequisite to talking about water efficiency.

Throughout our customer engagement programmes for both our WRMP and business plan customers regularly express strong support for proposals to drive down leakage and challenge us to demonstrate more ambition. The SSC H2Online Community Feedback from 2019-2022 found that when members were told about SSC's leakage reduction targets for 2020-2025 (15% reduction), 64% wanted South Staffs Water to go further and deliver a 20% reduction or greater, and 47% wanted Cambridge Water to go further and deliver a 20% reduction or greater. In the same research, one customer commented "Cambridge Water should seek not be satisfied with being better than the average water company, they should aim to be leading the pack."

The 2023 LTDS SSC PR24 work also found leakage reduction to be a top-tier priority amongst almost all customer segments, and it came out as the second highest priority in both the qualitative and quantitative phases of work. It is clear, throughout the SSC regions, that leakage is a very important area to customers.

The WRW 2022 updated regional plan customer research in June 2022 looked at going beyond leakage targets and found there was an appetite to go further i.e., 15% reduction by 2025 and 50% by 2050 is seen as not fast enough. The updated synthesis report from WRW in 2023 also found there are still widespread calls to increase leak reduction targets, and this continues to be an emotive topic and top priority for both HH and NHH customers. Across WRW, there is clear appetite for targets to go further. Looking at SSC specifically, customers supported the leakage reduction target of 50% by 2050, but some questioned whether this could be achieved sooner.

Similarly, the LTDS SSC PR24 work also found leakage reduction to be a top-tier priority for customers. As seen in the other research, the majority of customers (96%) in the LTDS research supported the ambition of reducing leakage levels by 50% by 2050 (from the 2017/18 figure). In the qualitative workshops, leakage reduction was viewed as a priority due to participants being concerned by the current level of leakage and they felt as if it was a strong contributor to water shortages and perceived high prices. They felt that SSC should prioritise fixing leaks before asking customers to reduce their water consumption. Participants in both the qualitative and quantitative phases were asked when they wanted this ambition to be achieved by. Over three quarters of the sample wanted this ambition to be achieved in advance of the national 2050 target which SSC is targeting to deliver (84% in workshops and 76% in survey). Both NHH (78%) and Future Customers (77%) are equally likely to want this ambition achieved before 2050, however, a lower proportion of future customers wanted it achieved by 2035.

Alternatively, the SSC NERA WTP for Water Services at PR24 2022 research found that leakage was a priority for customers, and that customers were willing to pay SSC to combat this. Out of multiple attributes tested, water lost to leakage from pipes was one of a handful of attributes that customers were WTP for, and the amount was higher amongst CAM customers compared to SSW customers.

Table 39: HH WTP, from SSC NERA WTP for Water Services at PR24 research,2022)

Attribute		Unit	HH WTP (£ per unit per household)		
			SST	CAM	Total[1]
B	Risk of temporary "do not drink" notice	reduction in number of properties that received "do not drink" notice	£0.74	£0.97	£0.79
D	Hard water supply	increase in the number of properties that benefit from investment (thousands)	£0.00	£0.03	£0.01
F	Water lost to leakage from pipes	reduction in the percentage of water that is lost to leakage	£0.61	£1.40	£0.77
G	Issues with tap water colour, taste, or smell	reduction in the percentage of properties experiencing issues with tap water per year (tenth of a percentage)	-	£0.11	£0.08
H	Chance of property flooding from a burst pipe	reduction in the flooding incidents per year	£0.16	£1.03	£0.34
J	Supporting nature and wildlife	increase in the number of acres protected and enhanced (tens)	£0.03	£0.28	£0.08

We should note that not all customers might be willing to pay for reducing leakage. The WRW 2023 Updated Regional Plan Customer Research found that, while most customers were willing to pay for reducing leaks, there were exceptions in vulnerable and lower income customers.

3.2.5 Best Option for Customers

We are identified a range of leakage options that are capable of delivering the required volumetric outcome. Artesia, working on our behalf, undertook multi-criteria analysis with their sector leading demand management modelling tool to ensure that best value plan was selected. We further expand on this approach in our water resource management plans.

3.2.6 Cost Efficiency

Work carried out by Artesia, in the demand side options appraisal, reviewed all options and prioritised them on the most efficient £/Mld to be delivered. We have also reviewed the costs in other companies published water resource management plans, and believe when compared to those, we are delivering efficiently. All our WRMP schemes were externally assured by Jacobs.

3.2.7 Customer Protection

We do not believe a PCD is required for this programme of work, as the delivery of it will be covered by the PC for leakage for each of our regions. Our PC's for both regions incorporates our stretching leakage ambition target within them. This is a key priority for our customers, so we will continue to share progress, so we are accountable for our delivery.

3.2.8 Delivery

Due to the differences in our water resource zones, we have regionally specific delivery programmes.

South Staffs Water

For AMP8 SST is targeting leakage benefit from 3 activities: Pressure Management, CSL work and intensive DMA work. For the enhancement, the CSL and intensive DMA work are being increased, bringing forward plans that were originally in AMP9. These plans came from our WRMP work to understand what would be needed to reduce leakage to meet the 2050 target in the cheapest and most efficient way possible. The works we have bought forward from our original plan of AMP9, into AMP8, have been deemed the most efficient.

The CSL work involves purchasing, developing, and trialling new equipment to help us find and temporarily/permanently fix CSLs. The enhanced spent on CSL work will enable us to expand this activity further than originally planned, giving us an enhanced benefit of 1.38Mld.

Intensive DMA leakage work involves undertaking intensive surveys and analysis on all our DMAs and firstly determining its main issues and then undertaking work to act on whatever that issue is (referred to as DMA MOT and ALC plus below). For example, we are currently trialling AI/machine learning algorithms that can do this, and the aim is to continue this into the next AMP. Once we have a better understanding of the issues, different equipment can then be installed to help us solve this. The enhanced spent on this work will allow us to buy more equipment and recruit more FTE to be able to do this work, giving us an enhanced benefit of 2.48Mld.

Overall, in SST, the enhanced spend should equal an enhanced leakage benefit of 3.88Mld, on top of the original 8% reduction of 4.94Mld. This leads to a plan targeting 8.8Mld leakage reduction in AMP8 (15% reduction)

Table 40: South Staffs Region Enhancement

South Staffs Water Enhancement			
Activity	**Overall Mld Benefit**	**Enhanced Mld benefit**	**Enhanced Cost £M**
Advanced pressure optimisation	1.35	0	0

Customer Side Leakage work	2.46	1.39	0.362
DMA MOT and ALC plus	4.99	2.49	2.051
Total	**8.8**	**3.88**	2.413

Cambridge Water

For AMP8 CAM is targeting leakage benefit was 4 activities: Proactive Trunk Main leakage reduction, Pressure Management, CSL work and intensive DMA work. For the enhancement, we plan to increase work within each of these activities, bringing forward plans that were originally in AMP9. These plans came from our WRMP work to understand what would be needed to reduce leakage to meet the 2050 target in the cheapest and most efficient way possible. The works we have bought forward from our original plan of AMP9, into AMP8, have been deemed the most efficient.

The CSL and intensive DMA leakage work is the same process as SST and discussed above. With the enhanced costs gaining us a leakage benefit of 0.013Mld (CSL work) and 0.027Mld (Intensive DMA leakage work) respectively. A slight increase in spend on Pressure Management is also planned, which should enable an increased benefit of 0.001Mld.

The Proactive Trunk Main leakage work involves purchasing and deploying different types of sensors on our trunk main network that can alert us to leaks on this part of our network. It also covers the follow up and investigations around these leak alerts. For the enhancement spend on this activity, which will allow us to purchase more equipment and expand our trunk main works across more of our network, we expect an enhanced leakage benefit of 0.198Mld.

Overall, in CAM, the enhanced spend should equal an enhanced leakage benefit of 0.24Mld, on top of the original 18% reduction of 2.4Mld. This leads to a plan targeting 2.64Mld leakage reduction in AMP8 (20% reduction)

Table 41: Cambridge Region Enhancement

Cambridge Enhancement			
Activity	**Overall Mld Benefit**	**Enhanced Mld benefit**	**Enhanced Cost £M**
Proactive trunk mains leakage reduction	0.49	0.198	0.275
Advanced pressure optimisation	0.297	0.001	0.001
Customer Side Leakage work	0.22	0.013	0.018
DMA MOT and ALC plus	1.593	0.027	0.038
Total	**2.6**	**0.239**	**0.333**

The value of £3.476m is the Totex amount we require for this enhancement case as shown in **Table 38**.

3.3 Case 6: Energy Security and Carbon Emission Reductions

3.3.1 Summary

This document provides the justification and evidence required for the enhancement business case that will allow SSC to commence investment in behind the meter renewable energy (electricity) generation as part of our Net Zero journey (2030 and 2050).

Net Zero – this will be delivered through demand reduction, efficiency, stakeholder engagement, small-scale renewables, Corporate Power Purchase Agreements (CPPAs), replacement / decarbonisation of fossil fuels, and nature based in-setting solutions which target our value chain and communities.

This paper sets out the early business, commercial and environmental (carbon) case for investing £7.24m during AMP8 in 'behind the meter' ground mounted Photovoltaic (PV) electricity generating assets, at key sites within the South Staffs Water region. There are four main objectives for this investment:

1. Absolute carbon emissions reduction
2. Affordability – e.g., de-coupling from global volatile markets
3. Cost and budget certainty
4. Increasing resilience and security of supply
5. Carbon emissions reduction hierarchy i.e.

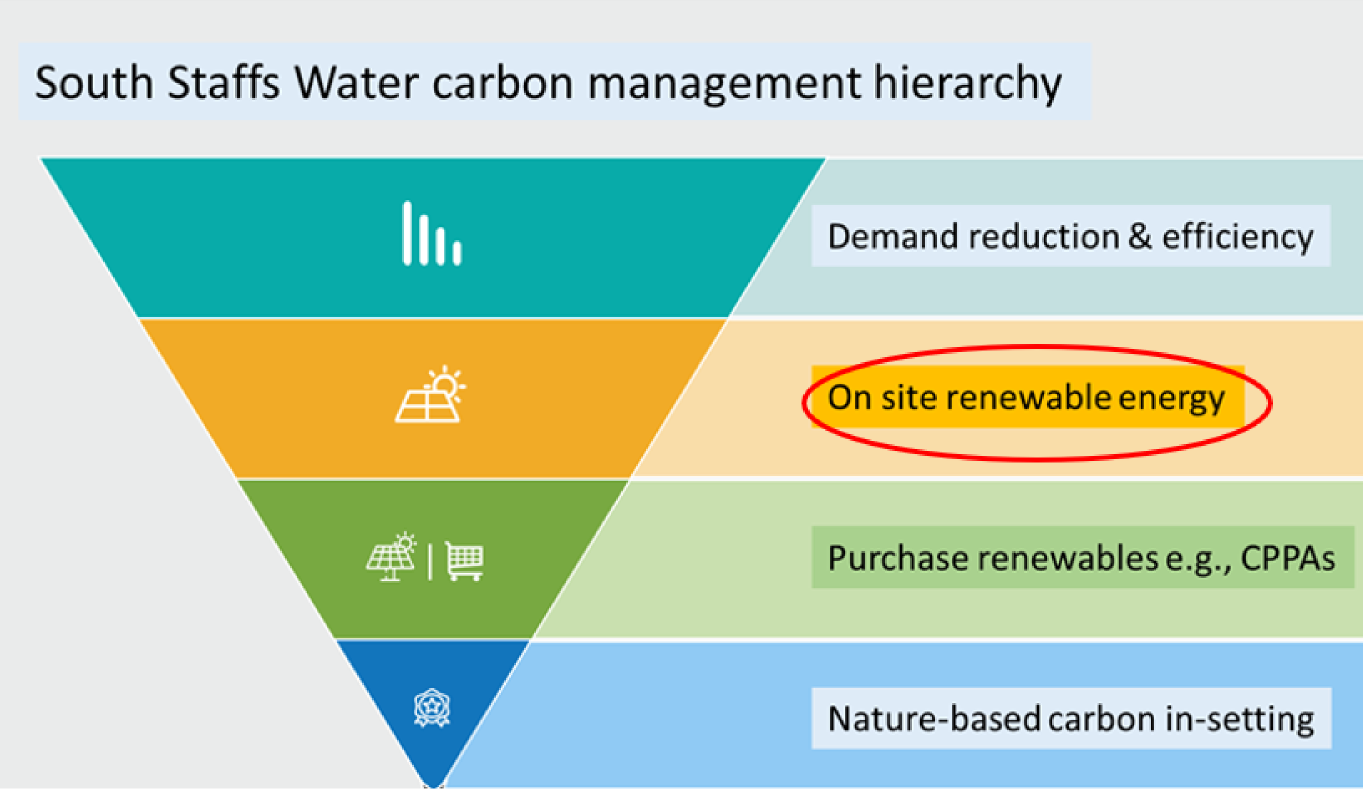


Figure 8 - SSC carbon management hierarchy

The intent of this paper is to gain approval for enhancement funding of £7.24m to support delivery of our NZ roadmap and lay the foundations for the LTDS. This investment is in addition to existing 2030 NZ plans to reduce in absolute terms, on a location-based methodology, our Scope 1 and 2 carbon emissions. These existing plans cover efficiency as well as Corporate Power Purchase Agreements with third party renewable energy asset developers and operators.

This paper will cover the CAPEX enhancement request for our own renewable electricity behind the meter assets – ground mounted Solar PV at four key sites including two water treatment works.

Table 42 - Summary of business case

Investment	Enhancement Investment	AMP 8 TOTEX £k	AMP 8 Enhancement OPEX £k	AMP 8 Base CAPEX £K	AMP 8 enhancement CAPEX £k	NPV £k
Hampton Loade Treatment Works	4,000 KWp ground mounted PV array	3,965	0	0	3,965	
Seedy Mill Treatment Works	2,500 KWp ground mounted PV array	2,478	0	0	2,478	
Fradley Pumping Station	500 KWp ground mounted PV array	496	0	0	496	30,753
Chilcote Pumping Stattion	300 KWp ground mounted PV array	297	0	0	297	
Totals	7.3 MWp	**7,236**	**0**	**0**	**7,236**	

*Source – Copperleaf; carbon benefits in NPV calculation made up of Private, Societal & WTP benefits.

3.3.2 Background Information

This document details the SSC Net Zero strategy and the need for this enhancement in the upcoming AMP8 investment period. This specific investment has been targeted at phase 1 of our overall renewable's strategy out to 2050:

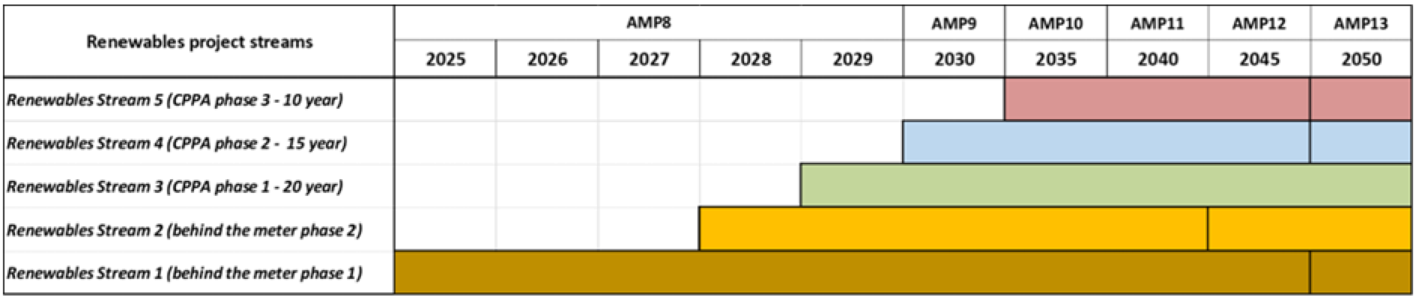


Figure 9 - SSC renewables strategy

The aim of this strategy is to:

- Spread risk (commercial, timeframe, planning, and technology evolvement).
- Have a minimum of 3 suppliers / commercial partners (framework agreement).
- Optimise flexibility (contract length, partner, technology, and commercial funding solutions through multiple AMPS.
- Maximise value to stakeholders through use of assets and leveraging of commercial, funding and technology solutions.

This project meets the Quality and Resilience enhancement criteria as part of our 2050 Net Zero strategy aligned to the UK government's commitments, including:

… Deliver our net zero ambitions and boost nature recovery by increasing tree and woodland cover to 16.5% of total land area in England by 2050…[New legally binding environment targets set out - GOV.UK (www.gov.uk)]

The legally binding Climate Change Act 2008 sets a framework for the UK to reduce GHG emissions and build capacity to adapt and strengthen resilience to climate risks11. The Act originally committed the UK to cut its emissions by at least 80% below the 1990 baseline level by 205012. On 27 June 2019, this target was amended, committing the UK to a legally binding target of net zero emissions by 2050, set on a whole-economy basis…United Kingdom of Great Britain and Northern Ireland's Nationally Determined Contribution (publishing.service.gov.uk)

This investment is critical to enable SSC to deliver its Net Zero plans in both the medium and long term. Outcomes are linked to existing ODI's and PCs including Kg CO2e per connected property. Details of our NZ journey to date and future plans have been shared with our customers via the website and a sample of domestic and business customers via a Net Zero Citizen's Jurey held through May and June this year (2023). This enhancement also delivers:

1. A sustainable and critical first stage in our longer term phased 'whole system' NZ strategy – 'behind the meter' renewables- an established low risk technology.

2. A cost effective 'best use of assets' (land) for our customers; enhancing value of our assets and can run in parallel / compliment nature-based solutions.

3. Cost efficiency and supply security i.e., reducing dependency on energy purchase from volatile and unpredictable global markets.

4. An absolute reduction in carbon emissions – location based, mitigating some risk i.e. that the cost of carbon will increase over time.

5. 'Leaning by doing' for further expansion into community-based programs and collaboration within and outside sector.

6. An adaptive planning approach to emissions reduction, leveraging potential future opportunities as they become feasible e.g. CPPAs, larger scale currently constrained by planning, lead-times and DNO/ESO constraints.

7. Targeted and prudent investment which can be replicated and accelerated as technology, sector, environment and funding innovation progresses.

8. A first step in our transition from fossil fuel generation i.e. eliminating gas at our Hampton Loade Treatment works)

There has also been a fundamental shift in carbon assessment and reporting methodology since PR19 including but not limited to:

- Move to location based where previous actions to achieve Water UK 2030 NZ, such as market-based solutions (purchase of NZ tariffs) are no longer acceptable solutions.

- The transition to a Net Zero economy, and particularly the decarbonisation of heat, removal of fossil fuels and electrification of transport means there is and will continue to be a net increase in energy (electricity) consumption.

- The increasing challenges for DNOs and the ESO (National Grid) to accommodate the Net Zero transition, has resulted in considerable challenges from a capacity, resilience, timeframe and cost perspective. This means that we need to be flexible and nimble in leveraging low carbon opportunities including renewables at every scale; including smaller, targeted behind the meter solutions.

Our latest NZ roadmap and renewable strategy reflects these needs, and we believe accommodates them through a risk-managed and phased approach. The following waterfalls show the evolution of our strategy from PR19, through AMP8 and out to 2050.

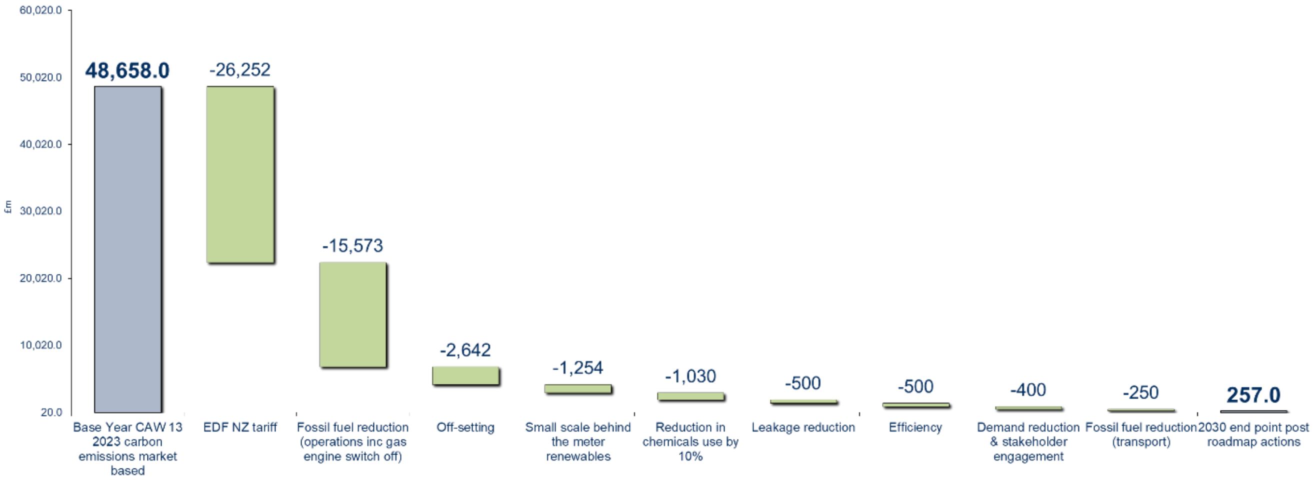


Figure 10 - Carbon reduction waterfall at start of AMP7 (Water UK 2030 NZ roadmap – operational emissions)

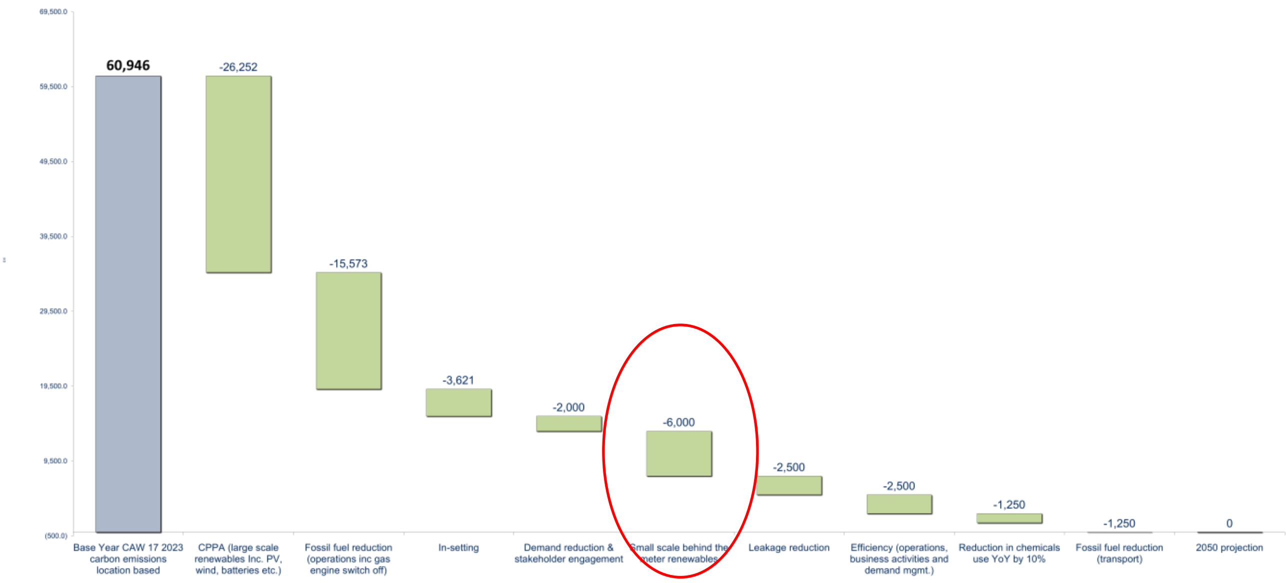


Figure 11 - SSC 2050 NZ carbon emissions reduction waterfall

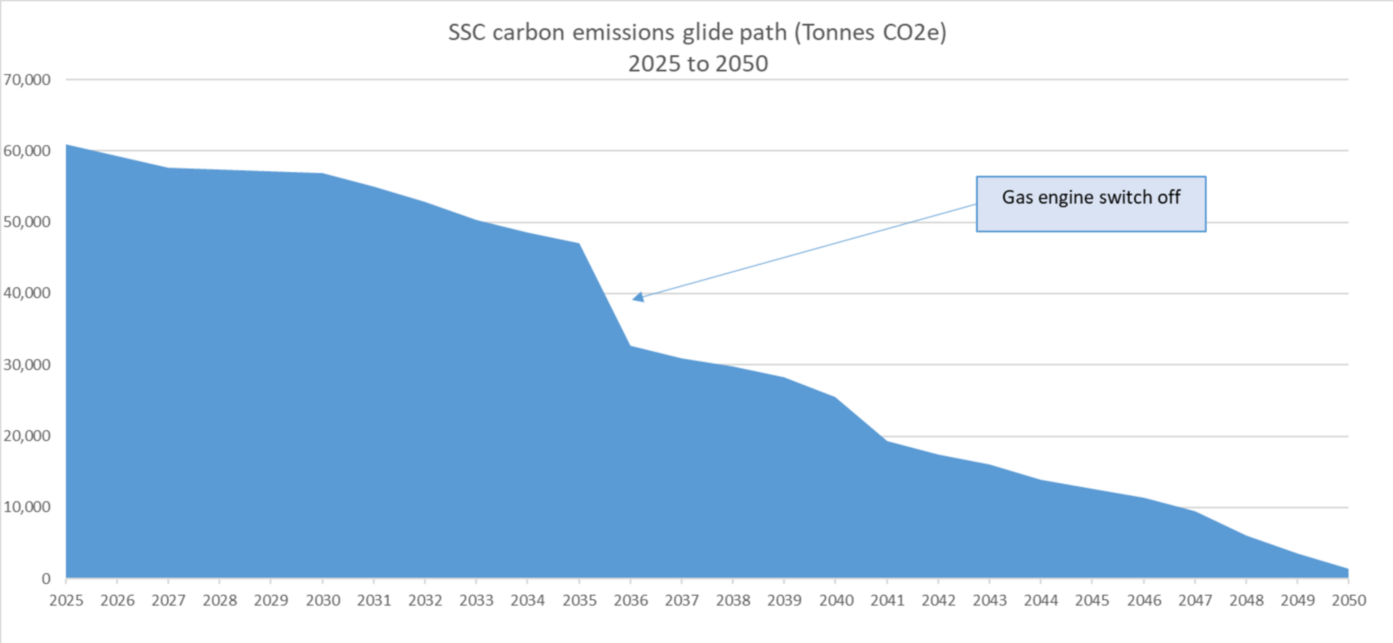


Figure 12 - Carbon reduction glidepath 2025 to 2050

Since 2019 we have purchased electricity through a Net Zero electricity tariff – a market-based mechanism to reduce carbon emissions. From this year (2022/2023 reporting) we can no longer use this and must measure and report our emissions on a location-based methodology. Therefore, beyond absolute reduction in energy consumption and carbon emissions through efficiency (demand reduction etc.); investment in behind the meter, and direct procurement of renewable energy are the only options.

Costs provided in this document have been calculated using a number of resources including inputs and / or data from two consultancies (water sector specialist and PV developer), two existing PV installation at our Seedy Mill treatment works, industry benchmarks e.g. PV GIS, Copperleaf capital & investment planning tool, and internal stakeholders including finance for NPV validation. The SSC energy and carbon team have also assessed the four sites individually using a bespoke assessment tool which takes real life operational and energy consumption profiles from each site and assesses against actual performance of existing PV installations.

Although this enhancement business case has been prepared as a single investment across four sites; cost analysis has been completed for individual installations to enable full interrogation of costs, economies of scales and options for preparing tender against a framework agreement within 4 lots which can be grouped or installed individually to best manage cost efficiency and risk.

Summary of four sites selected for AMP8 PV installations

Circa 17-acre field beside reservoir - 4MWp ground mounted PV (No export)

Figure 13 - Hampton Loade Chelmarsh Reservoir

2 locations (both SSC owned) – totalling 2.5 MWp ground mounted PV (No export)

Figure 14 - Seedy Mill Treatment Works

3-acre plot of land; 0.5 MWp ground mounted PV (No export)

Figure 15 - Fradley Pumping Station

Field alongside pumping station - 0.3 MWp ground mounted PV (No export)

Figure 16 - Chilcote Pumping Station

This section of the document provides a brief overview of the selected solution, subsequent sections of the document will expand on the analysis and decision making that lead to the final option being proposed.

- SSC carbon and energy strategy

SSC are fully committed to delivering our 2030 and 2050 NZ strategy through robust energy and carbon management. Our renewables strategy forms the second layer of this strategy i.e.

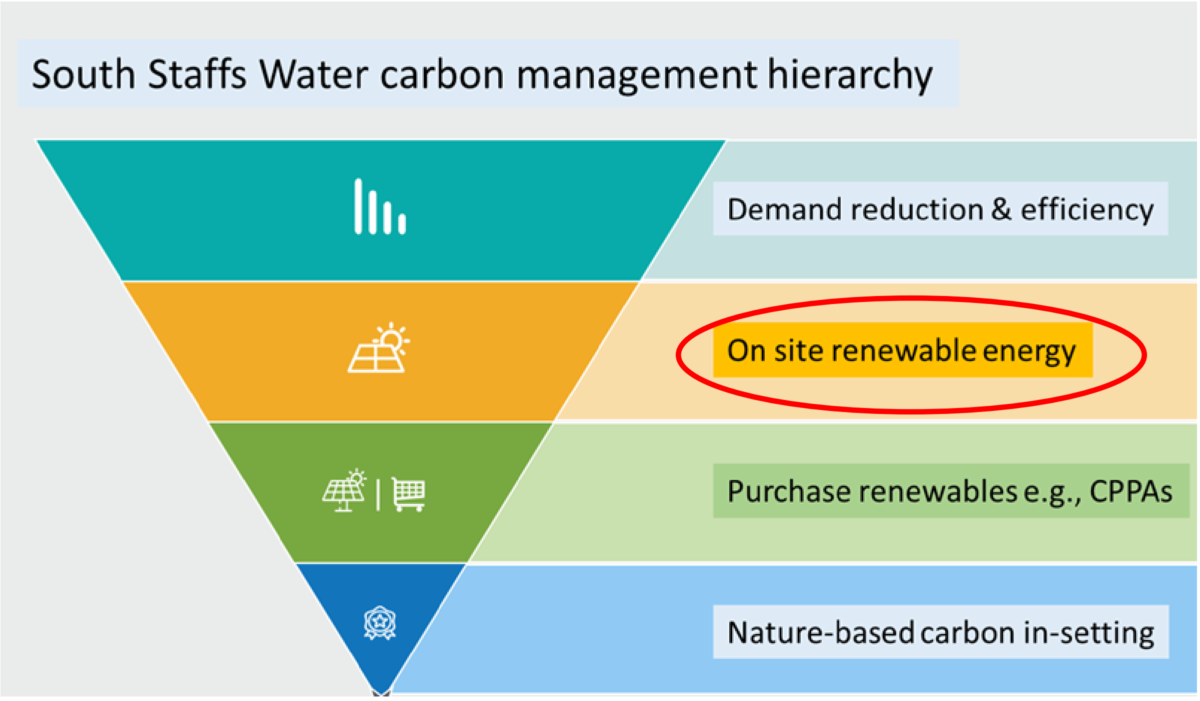


Figure 17 - Carbon management hierarchy

This investment focuses on the upper level of the renewable energy hierarchy i.e., behind the meter renewables located on SSC owned landed, optimising our land assets, value to customer, installed capacity, and risk management.

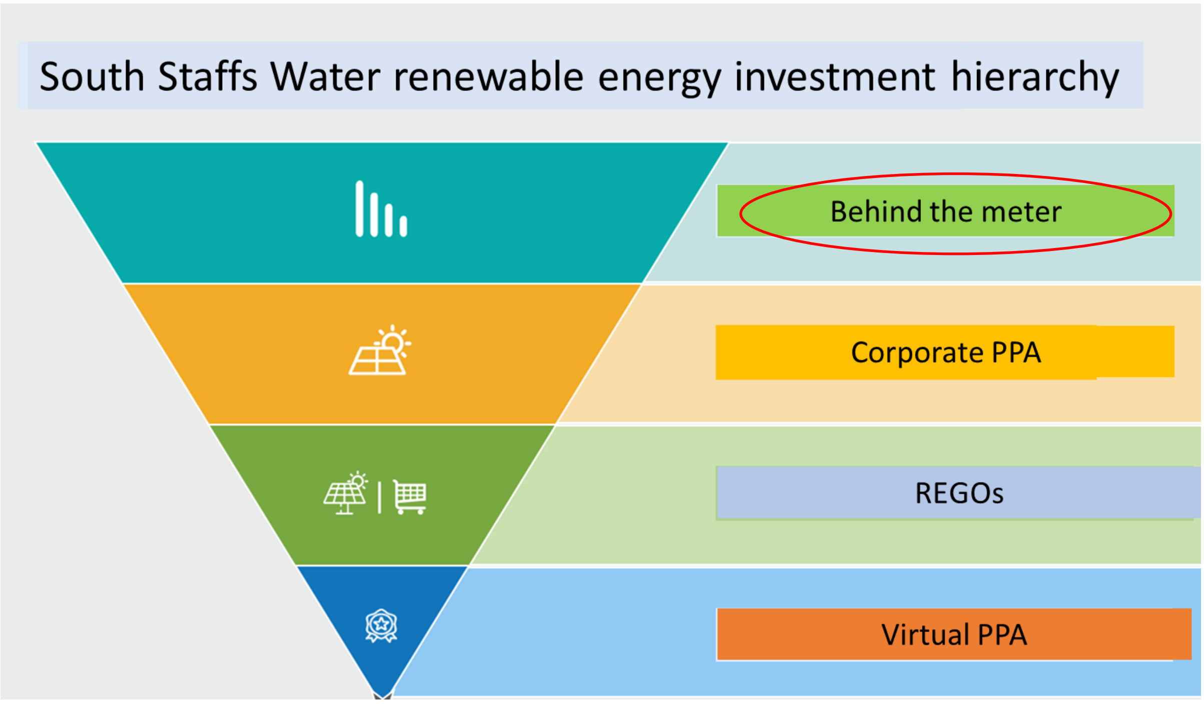


Figure 18 - Renewable energy investment hierarchy

- AMP8 phase 1 renewables

SSC is seeking funding of £7.24m for the installation of behind the meter ground mounted Photovoltaic (PV) electricity generation at four (4) sites, including two water treatment works, within its SST region. This funding will support delivery of our NZ roadmap and lay the foundations for our Long-Term Delivery Strategy (LTDS). More information can be found in our SSC02 South Staffordshire Water - long term delivery strategy.

This investment is in addition to existing 2030 NZ plans to reduce in absolute terms, on a location-based methodology, our Scope 1 and 2 carbon emissions. These existing plans cover efficiency as well as Corporate Power Purchase Agreements with third party renewable energy asset developers and operators.

The high-level business case numbers are summarised below:

Table 43 – Business case numbers

Peak installed capacity (MWp)	**7.30**
Estimated CAPEX (exc. grid connections) £m	**6.24**
Simple payback (years)	**7.00**
Estimated annual carbon savings (Tonnes CO2e)	**1,254**

- AMP 8 carbon reduction

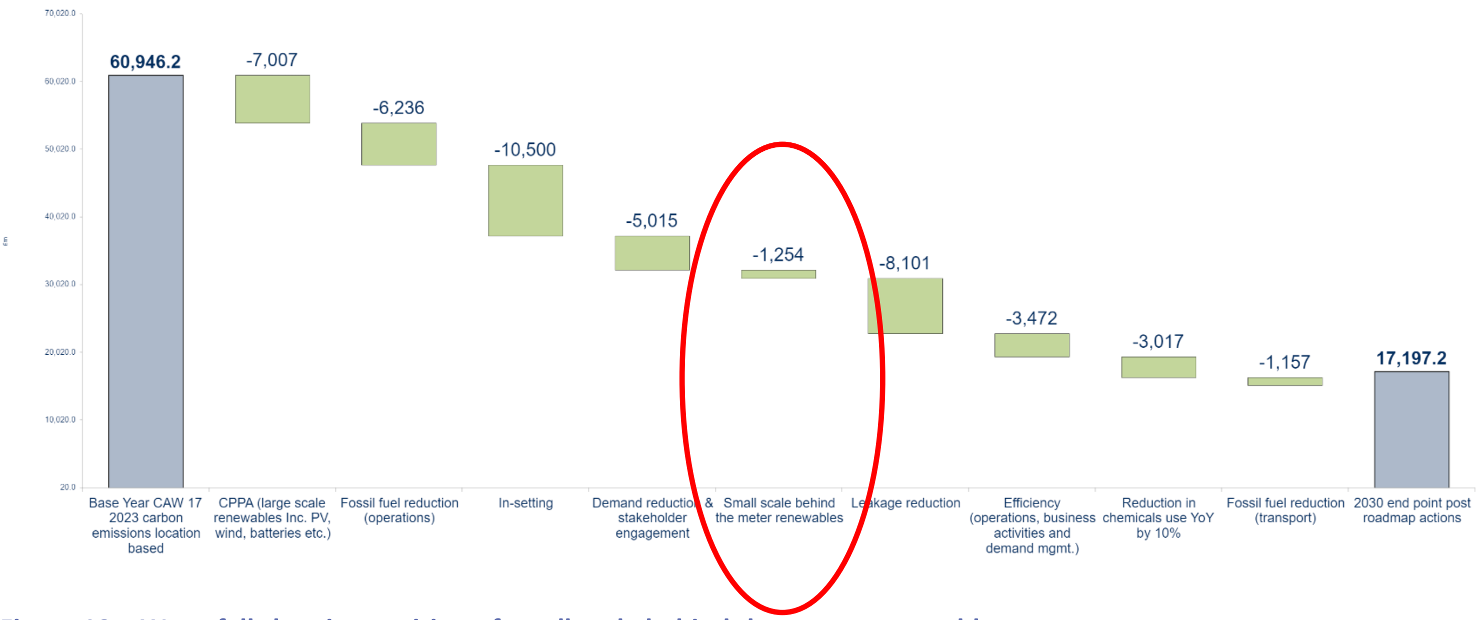


Figure 19 – Waterfall showing position of small scale behind the meter renewables

3.3.3 Need for Investment

We have carried out extensive analysis of all our sites across both regions, including desk top studies, leading to Non-binding Offers (NBOs) from EDF-R. For this first phase of our longer term 'whole system' NZ strategy we have targeted 'behind the meter' renewables - an established low risk technology. This enhancement also delivers:

- A cost effective 'best use of assets' (land) for our customers; enhancing value of our assets and can run in parallel / compliment nature-based solutions.
- Cost efficiency and supply security i.e., reducing dependency on energy purchase from volatile and unpredictable global markets.
- An absolute reduction in carbon emissions – location based, mitigating some risk i.e. that the cost of carbon will increase over time.
- 'Leaning by doing' for further expansion into community-based programs and collaboration within and outside sector.
- An adaptive planning approach to emissions reduction, leveraging potential future opportunities as they become feasible e.g., CPPAs, larger scale currently constrained by planning, lead-times and DNO/ESO constraints
- Targeted and prudent investment which can be replicated and accelerated as technology, sector, environment, and funding innovation progresses.
- A first step in our transition from fossil fuel generation i.e., eliminating gas at our Hampton Loade Treatment works).

There has also been a fundamental shift in carbon assessment and reporting methodology since PR19 including but not limited to:

- Move to location based where previous actions to achieve Water UK 2030 NZ, such as market-based solutions (purchase of NZ tariffs) are no longer acceptable solutions.
- The transition to a Net Zero economy, and particularly the decarbonisation of heat, removal of fossil fuels and electrification of transport means there is and will continue to be a net increase in energy (electricity) consumption.
- The increasing challenges for DNOs and the ESO (National Grid) to accommodate the Net Zero transition, has resulted in constraints from a capacity, resilience, timeframe, and cost perspective. This means that we need to be flexible and nimble in leveraging low carbon opportunities including renewables at every scale; including smaller, targeted behind the meter solutions.

Our latest roadmap and renewable strategy (see section 3.3.2), reflects our adaptive, and pragmatic approach, leveraging opportunity through a risk-managed and phased approach.

The evolving regulatory landscape is also a key driver in our plan including but not limited to:

Ofwat's regulatory framework and net zero e.g.

• *delivering on the government's interim carbon budgets and the Net Zero target for 2050.*

• *identifying the right approaches to net zero, including innovation whilst also leveraging established accreditation standards, initiatives, and frameworks*

Net_Zero_Principles_Position_Paper_Jan_2022.pdf (ofwat.gov.uk)

We have also considered three key areas in Ofwat guidance for net zero planning and delivery, including:

- *net zero target setting.*
- *scope of action on net zero.*
- *prioritising the reduction of Greenhouse Gas (GHG) emissions.*

Water industry strategic environmental requirements (WISER) - GOV.UK (www.gov.uk)

This enhancement paper also considers the issues and opportunities SSC has considered in meeting our environmental obligations and how we will step up our level of ambition including:

- *a thriving natural environment.*
- *resilience for the environment and customers.*
- *expected performance and compliance.*

Building block	Description
Base expenditure	• Base expenditure includes: o routine, year-on-year costs, which companies incur in the normal running of their businesses to provide a base level of good service to customers and the environment; o expenditure on maintaining the long-term capability of assets; o expenditure to improve efficiency; and o expenditure to comply with current legal obligations. • Base expenditure covers wholesale and retail (residential and business) activities, and currently make up around 80% of all costs incurred by water companies.
Enhancement expenditure	• Enhancement expenditure is generally where there is a permanent increase or step change in the current level of service to a new 'base' level and/or the provision to new customers of the current service level. • Enhancement funding can be for environmental improvements required to meet new statutory obligations, improving service quality and resilience, and providing new solutions for water provision in drought conditions.

Figure 20 - OFWAT Table 2.1. PR 24 Enhancement Criteria

- SCC renewables strategy – phased approach

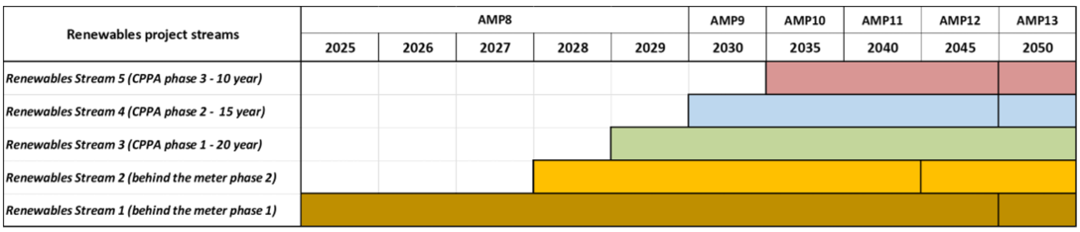


Figure 21 - Renewables Strategy

This strategy aims to:

- Spread risk (commercial, timeframe, planning, and technology evolvement).
- Minimum 3 suppliers / commercial partners.

- Flexibility to adjust contract length, partner, technology, and commercial funding solutions through multiple AMPS.
- Optimum value to stakeholders, use of assets and leveraging of commercial, funding and technology solutions.

This is a project which meets the Quality and Resilience enhancement criteria as part of our 2050 Net Zero strategy aligned to the UK government's following commitments:

Links to Long Term Delivery Strategy (LTDS)

This enhancement request supports our ambitious, long-term vision for our business that aims to demonstrate our value to society and our communities, and our commitment to protecting and enhancing the environment. To deliver this vision, we are focusing our attention on a number of key themes, of which the following are supported by this enhancement:

- *Mitigating the impacts of climate change – for example, by encouraging sustainable practices within our business and our supply chain, using renewable energy sources, switching to a fully electric vehicle fleet, and investing in our network of treatment works, pipes and pumping stations to ensure we are resilient to extreme weather events.*
- *Remaining financeable over the long term – for example, by exploring and taking more advantage of green financing initiatives, while continuing to meet all our regulatory and fiscal obligations.*

At the same time, we will need to take into account the changing expectations of our customers or our regulators over time. This could mean us placing more emphasis on one theme over another, or it could mean adapting our activities to reflect a change in circumstances. Key to this remains the need for us to understand fully our customers' needs and priorities, and to be fully embedded at the heart of all the communities we serve.

Figure 22 - Our vision to 2050

3.3.4 Customer Support

We have carried out our most extensive customer engagement programme ever to ensure our PR24 and WRMP24 plans are underpinned by robust customer and wider stakeholder preferences. Our strategic engagement programme started in early 2020 and has run through to summer 2023, with over 92,500 customers taking part in a wide range of SSC research studies, with their views being compared with those from our robust 'Business as Usual' insight programme and wider industry studies. This programme has been assured by SIA Partners as meeting Ofwat's "high-quality" engagement standards, as outlined in its Customer Engagement Policy paper (February 2022).

A key evidence source is appendix SSC11 which provides a thematic review of the key insights relevant to this investment case. It also highlights the golden threads that have consistently emerged across our engagement. The report also details the project objectives of each study used in the evidence base, when it took place and the numbers and types of customers and stakeholders engaged with. We have made use of our own company-led engagement, club research projects and wider industry studies. Specifically, please refer to section 18 for the key insights related to Net Zero.

Importantly, our programme included a targeted research study focussed on engaging customers on how we should progress our Net Zero plans. This is the first time we have engaged in an in-depth way with our customers on this topic and we view this as the first building block of an on-going deliberative engagement, using a Citizens' Jury programme to allow our customers to challenge our Net Zero plans over time.

Over a three-month period in 2023, we worked closely with our supply chain partner - Explain Research, who facilitated 6 virtual and 2 face to face meetings with a cross section of our non-household (business) and household customers. During these sessions we presented our NZ journey to date, future ambitions and asked for feedback from these customers on their priorities including scale of ambition, timescales and how they wish to be involved in helping us achieve the target.

An example of some of the materials used to engage and inform our customers is show below:

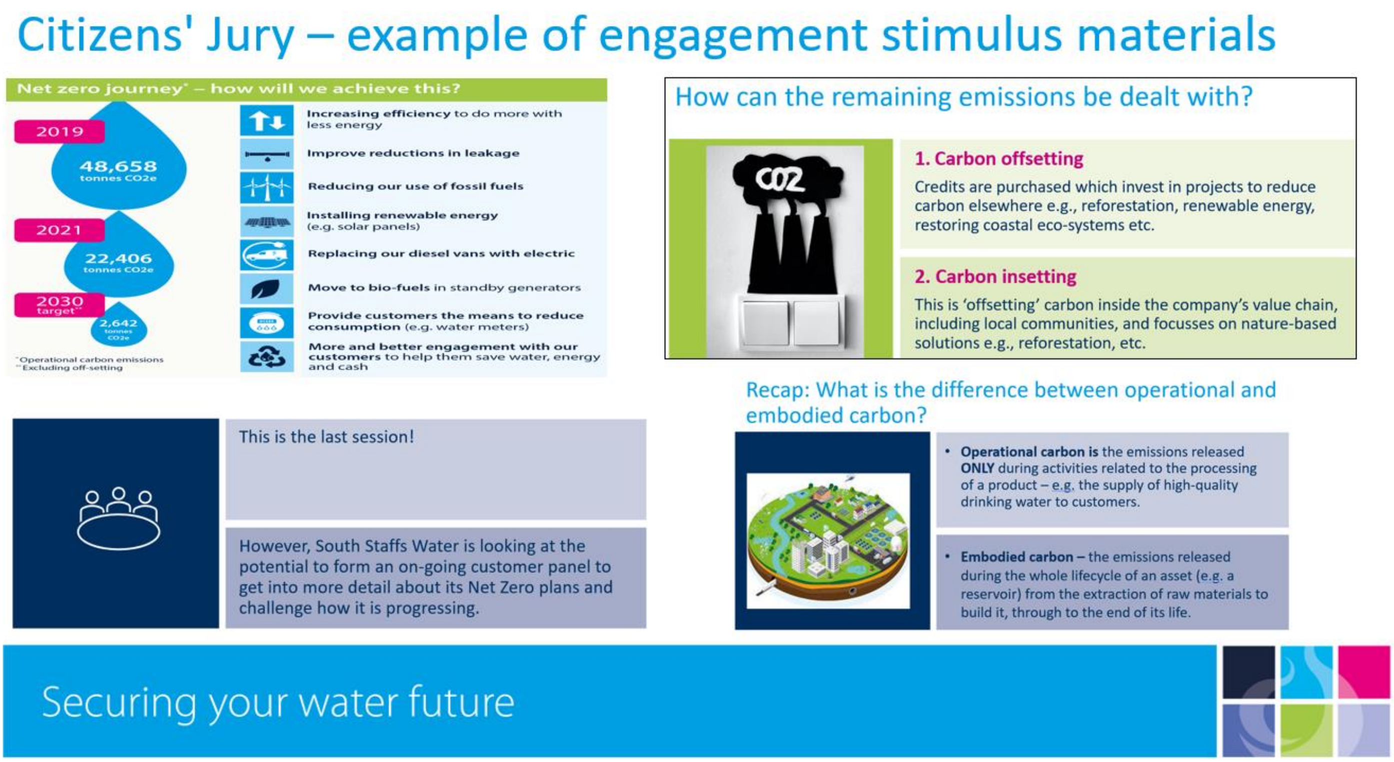


Figure 23 - SSC Net Zero Citizens Jury – example of our customer engagement stimulus materials

Key insights from the SSC Net Zero Citizen's Jury:

- Jurors were in favour of the high-level strategy and pleased about our progress to date towards achieving Net Zero. They expected this to continue.
- Investments to educate customers, and future customers in particular, regarding water efficiency were viewed as the highest priority for customers, followed by the need to reduce leakage levels faster given current leakage performance is almost universally viewed as not acceptable.
- Customers in the online Jury's viewed investments linked to switching to renewable energy solutions as a medium to high-priority, solely due to the fact that it contributes a significant amount of achieving the Net Zero target - "The renewable energy because that's the one that has the most impact… it was explained that that contributed the most to Net Zero".
- When discussing innovation with our Jurors, this trade-off was presented as a choice between making the best use of current technologies to deliver the plan, or to wait until new technologies are developed. Jurors were made aware that there is the risk that, if new technologies do not emerge, then time will be lost. However, if they deliver the plan too soon then SSC may not get the opportunity to benefit from new technologies that could develop. Results of the polls demonstrate that jurors across both regions in the online groups had a slight inclination towards waiting for better solutions, rather than investing more now in current technologies. In contrast, within the F2F sessions there was a strong preference for investing more in current technologies now to deliver the target. - "Trying to reduce the inefficiencies, people duplicating the work, but also choosing what is best practice…. But nothing is going to get better unless there is a push to try something new… to find a new method… innovation is really important, but also doing that with what works and what is known to work".
- On balance, across all the sessions, there was overall support that investments need to be made now to unlock the potential of current technologies to deliver the Net Zero target and that renewable energy should play a role in this given its potential. However, it was clear we need to carefully balance this investment and continually review the plans and adapt as needed to ensure investments deliver the greatest return on investment, whilst keeping bills affordable.
- Transparency is key in terms of setting targets and progress towards delivering these, including being transparent around why bills are increasing and what benefits these investments will deliver for customers and the environment.
- In-setting schemes which targeted local communities were favoured in both our supply regions because of the importance of local benefits to customers, with Cambridge customers also expressing a preference towards collaborative working with other water companies. Doing nothing was rejected as an option.

Balance should be maintained within the trilemma, ensuring progress but also bill affordability, given the pressures on household finances with the rising cost of living. Results in the voting across the groups varied, but within both Cambridge groups and the South Staffs online group there was a preference for a 'middle of the road' approach to the trade-off between investment and bill affordability, with scores around 3 (out of 5). There was some variation within this, with jurors in the Cambridge Water region had a greater preference towards increasing bills where needed (average 3.5 out of 5.0), whilst those in the South Staffs Water region leaned more towards keeping bills lower with an average 2.7 out of 5.0.

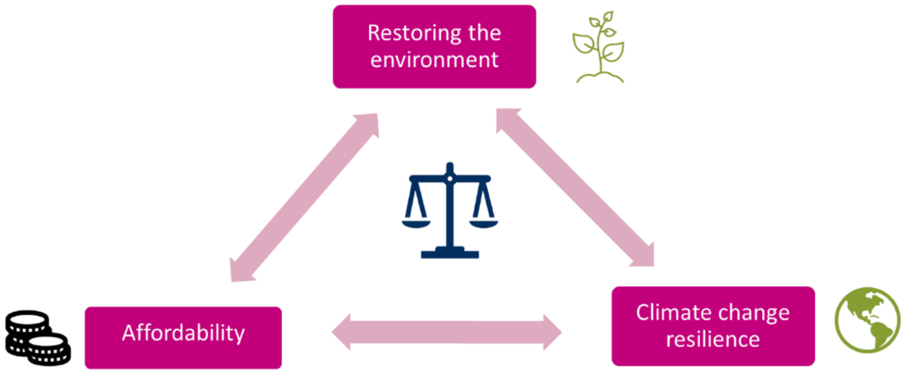


Figure 24 – Stimulus material used to explain the trilemma to customers in our Citizen's Jury

3.3.5 Best Option for Customers

Methodology and approach to identify best value for customer

There are three key processes that have been undertaken to ensure that the business will be delivering the best value options for customers.

Net Zero Citizens Jury and Impact

In April and May of this year, we shared our NZ journey to date and future plans with a selection of domestic and business 'jurors' in our SSW and Cambridge reasons. The structure and content plan for these juries is shown below:

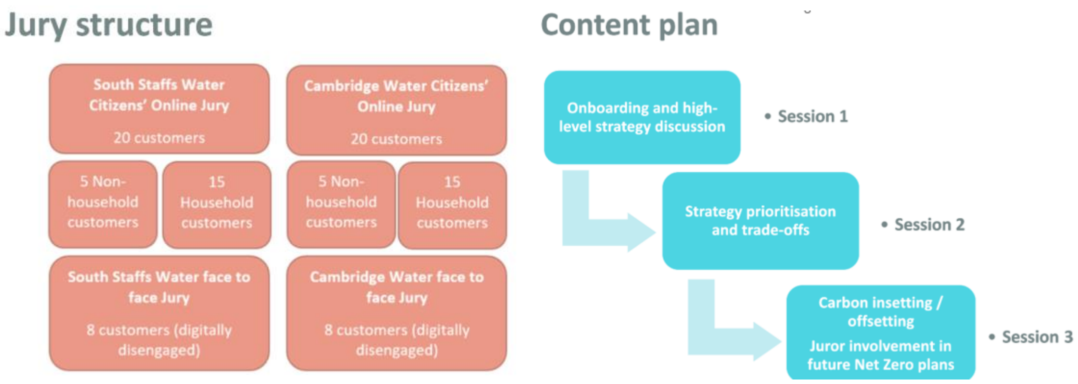


Figure 25 - SSC Net Zero Citizens Jury structure and content plan

A summary of the outputs for session 2 in terms of when targets should be met is shown below:

	Investing more now				Even pattern of distribution
	1	2	3	4	5
CAM Online (average 3.7)	1	0	5	5	4
SSW Online (average 2.6)	5	4	4	4	1
CAM F2F (average 2.1)	1	2	3	1	0
SSW F2F (average 4.0)	1	0	1	1	4

Figure 26 – Customer voting on how we should balance investment and bill affordability, net zero Citizens' Jury

Although there were mixed views across the different sessions (online and Face-to-Face (F2F) and supply regions) there was generally good consensus around 'fairness in terms of affordability and caring for future generations' and 'some level of in climate actions, sooner rather than later'. Some key points were made by our customers including:

- '…I think we should pay for it now and spread cost out…' *SSW F2F Juror*
- '…Fairest way is to spread cost out over next 28 years. Rather than lump all in to next generation…' *Cambridge Water Juror*
- 'Where are we going to be in 20 years'. 'If we do not move on this stuff now, will we never get the chance to really…' *SSW Juror*

Copperleaf analysis

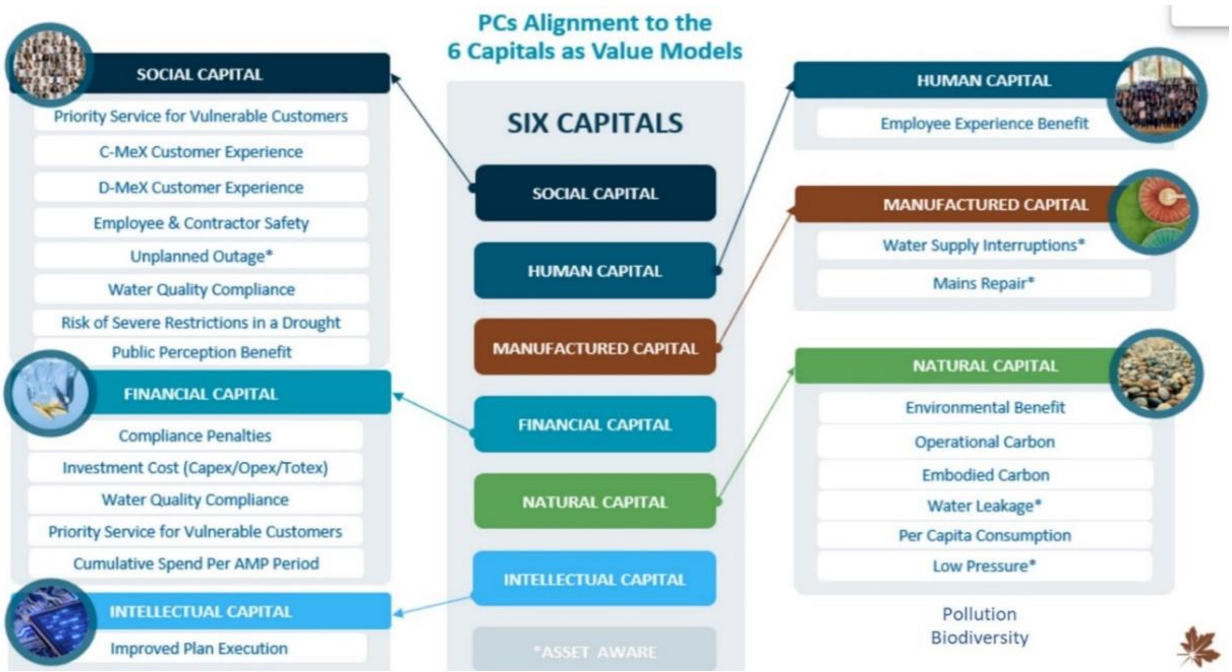
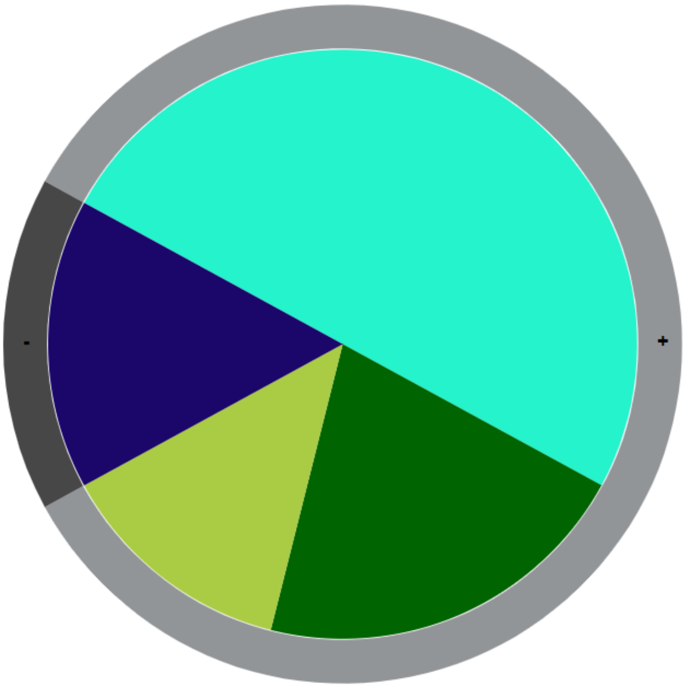


Figure 27 - Copperleaf Six Capitals and Value Framework

Draft Investment Value

Carbon & energy - Small Scale Renewables (PV)



Value Measure	Value
Efficiency Benefit	22,549,783
Operational Carbon Cost - Private	9,467,948
Operational Carbon Cost - Societal	5,916,244
Operational Carbon Cost - WTP	0
Efficiency Benefit - WTP	0
Total Investment Cost	-7,181,139
Total	30,752,836

Figure 28 - Copperleaf NPV / best value assessment for PV enhanced investment project

In conjunction with all other investments in the SSC enhancement plan, this positions project in the upper quartile. Key assumptions and base data for the PV enhancement case assessment are as follows:

- All projects will be delivered in year 1 of the AMP.
- Annual base OPEX cost of 60k
- Repeat installation costs every 20 years
- Annual yield of PV installation from PV GIS and assessment of Seedy mill existing roof mounted PV, and 0.5% per year degradation in yield
- Displaced grid electricity £161 / MWh (16.1p /kWh)
- The Copperleaf system uses a value of £241 per tonne C02e
- Benefit and costs have been calculated over the 40-year planning horizon
- Total Value can be interpreted as the NPV, in this case = £30,752,836

Applicable value models are attached to investments and scored appropriately using standard questionnaire templates to ensure consistency of input across a portfolio. Current and forecasted risk profiles are used to create a baseline risk position that value can be offset against for all solution options within a given investment. All value models (see **Figure 28** above) are attached to a value function that contains up to 3 value sets, Private, Societal and Willingness to Pay. The value sets contain monetised values that align model outputs. Private costs are based on those that we would expect to incur if the risk was realised, Societal costs are based on the expected socio-economic impact of the risk being realised and Willingness to pay costs are based on customer expressed values for areas of service improvement.

The optimisation process takes into account financial and performance constraints that are inputted as parameters to affect its decision-making around the solutions it chooses in context of cost, risk and value in the wider business plan.

When we are looking for the best options for customers, we are taking into consideration affordability as well as cost and value. Final options are selected based on the value that they offer at two levels, the first is the options value at an investment level and the second is the value that they offer at a portfolio level to ensure that we are getting the best value plan across the board based on the portfolio level constraints applied. Operational and Embodied Carbon have formed part of the cost benefit analysis process. See sections 3.2.3 and 4 of the appendix 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond', for full detail on the Copperleaf value model framework and the process of Cost Benefit Analysis within the system.

Why our enhancement case is the only best options:

When developing our Net Zero roadmap, we considered many options to deliver carbon savings within our business. This included a full review of all our sites, and their capacity for renewable generation completed by Aqua Consulting. Our cost benefit analysis concluded that the four sites selected for renewables were the best value solution for our AMP8 ambitions.

Our selection criteria consider the following:

Table 44 – Section criteria considerations

Boundary condition	Notes
Baseline energy use	• Consistent 24/7 365 energy demand is binary for selection criteria. • Renewable capability (MWp) will not exceed energy demand onsite.
Long term appraisal	Energy consumption is not expected to decrease over the life of the renewable asset installed. - Example, forecasted abstraction volume (licence) to remain unchanged
Company owned land	Maximise company owned land adjacent or within feasible proximity to grid connection point.
Complexity	Grid connection already establish and planning obligations likely to be unchallenged.

Upon filtering the final opportunities further analysis to maximise investment were modelled using the following scenarios:

1. SIMPLE - Direct energy displacement (behind the meter) with asset company owned a maximising ROI.
2. COMPLEX – Direct energy displacement (behind the meter) oversized in conjunction with battery storage and alternative financing arrangements.

The financial risk profile associated with National Grid export connections coupled with the uncertainty and longevity of balancing revenue mechanism contract firmly discounted COMPLEX business cases in relation to the SIMPLE installation plans. Therefore, this was the clear best value solution for our business.

Why our other net zero expenditure has not been included:

This does not represent our full net zero ambitions for AMP8. The rest of our carbon reduction activity has not been included, as it does not meet the criteria for the enhancement competition.
In August 2022, Ofwat commissioned a report by Jacobs on the possible technology solutions for delivering carbon reductions in the water industry in AMP8. They only identified 3 scalable options for Water Only Companies:

- **Demand savings**- we have set ambitious leakage, PCC and business demand reductions as part of our AMP8 plans and stretched our leakage target to go beyond our statutory targets. The primary driver is supply-demand balance, and therefore not suitable for the competition.
- **Pump Efficiency**- With the highest average pumping head in the industry, pump efficiency has always been critical to our business. We have been running our Pump Efficiency Programme since 2005. It has delivered both cost savings to ensure we keep bills low for our customers, and environmental benefit by reducing energy use. We will continue to run this programme into AMP8 but consider this base expenditure activity.

- **PPAs**- corporate PPAs are at the centre of our Net Zero strategy. We are already engaging with the market on their implementation across our sites and land near to them. They can deliver significant carbon savings at limited cost to our customers. As we will not buy the assets ourselves, this is also not considered an enhancement investment.

3.3.6 Cost Efficiency

Third party engineering consultants

SSC has been working with a third-party engineering consultancy (AQUA Consultants) who have been undertaking deep dives into solutions that best address the business needs mentioned in the above section. This activity - Towards Net Zero: Renewables Strategy and Energy Efficiency Approach; considered opportunities for renewable energy generation, carbon accounting methodology, and recommendations for next steps.

The outputs are focussed on programmes which prioritise Net Zero 2030 targets (scope 1 and 2 carbon emissions); building scenarios for carbon reduction and 'Net Zero pathways' around renewable energy and energy efficiency.

The methodology used was a high-level independent review of the SSW Net Zero work to date and feedback based on Aqua Consulting's experience. The major findings of this study were around the SSW current position and examined the net zero gaps in the existing plan, as well as initial recommendations for implementing better data capture and reporting; and actions to decarbonise in line with regulation and guidance.

SSW has made good progress in reducing absolute emissions by 18% since 2018. However, these figures currently only include Scope 1 directly combustible fuels, refrigerants, company vehicle fleet; Scope 2 purchased electricity and Scope 3 transmission and distribution.

There are several emissions sources which are not reported within these numbers, and SSW are currently integrating compressive GHG reporting in line with Ofwat guidance; including outsourced activities, embedded carbon, waste, and well-to-tank emissions (associated with extraction, refining and transport of fossil fuels).

SSW are currently reliant on green energy tariffs and offsets to achieve Net-Zero; however, these will not contribute to location-based carbon reduction required by Ofwat. SSW need to adjust their Net-Zero strategy to focus on on-site renewable energy generation and the use of insets. The work carried out by Aqua Consultants considered three scenarios:

Scenario 1 – Technology sizing is proportionately related to the consumption on site, minimising the magnitude of the CAPEX investment for self-funded options.

Scenario 2 –Technology sizing is related to the maximum non-constraint available space of the sites, resulting in maximum CAPEX investment for a third-party developer and maximum CO2e reduction for SSW.

Scenario 3 – Technology sizing is a mixture between scenario 1 and 2 (hybrid); 7 sites were identified for self-funding, due to their high on-site consumption percentage and their low CAPEX values. This scenario also delivers maximum CO2 reduction for SSW.

For AMP8 the top 4 sites, with minimum / no constraints and maximum generation opportunity relevant to base load were selected i.e.

1. Hampton Loade Water Treatment Works
2. Seedy Mill Water Treatment Works
3. Fradley Pumping Station
4. Chilcote Pumping Station

Although the Cambridge region is and will continue to be a key part of our overall energy and carbon strategy, the South Staffs region is an immediate priority based on consumption (>/= 85% of total electricity), carbon, security of supply and resilience.

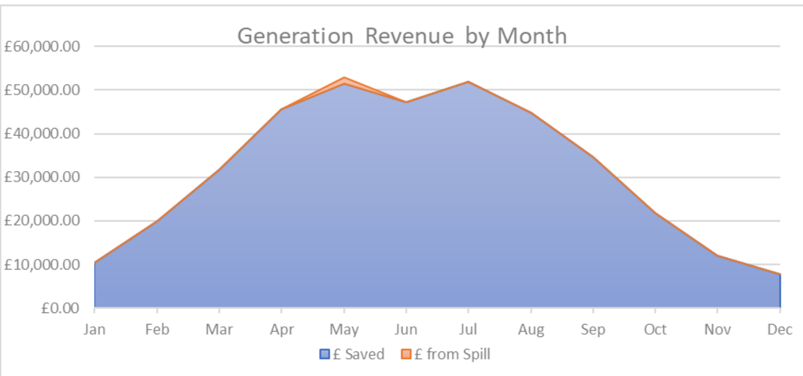
Site	Carbon savings S1	Carbon savings S2	Carbon savings S3	CAPEX S1	CAPEX S2	CAPEX S3	NPV S1	NPV S2	NPV S3	Annual OPEX S1	Annual OPEX S2	Annual OPEX S3	LES S1	LES S2	LES S3
Ashwood	24.00	24.00	24.00	£131,259	£131,259	£131,259	£257,953	£257,953	£257,953	£924	£924	£924	£779,978	£116,996.7	£779,978
Blithfield	15.86	15.86	15.86	£893,618	£3,240,336	£3,240,336	£470,111	£2,980,172	£2,980,172	£31,518	£50,618	£50,618	£515,407	£77,311.1	£77,311
Chilcote	139.87	139.87	139.87	£860,827	£860,827	£860,827	£927,035	£927,035	£927,035	£59,153	£59,153	£59,153	£4,546,515	£681,977.3	£681,977
Churchill	25.47	25.47	25.47	£140,373	£140,373	£140,373	£264,442	£264,442	£264,442	£987	£987	£987	£828,027	£124,204.1	£828,027
Cookley	47.00	47.00	47.00	£308,097	£308,097	£308,097	£452,969	£452,969	£452,969	£2,043	£2,043	£2,043	£1,527,829	£229,174.4	£1,527,829
Crumpwood	246.77	607.61	607.61	£431,030	£3,089,846	£3,089,846	£494,195	£4,869,672	£4,869,672	£34,442	£65,942	£65,942	£4,942,209	£741,331.3	£741,331
Earith	0.00	0.00	0.00	£4,082,002	£4,082,002	£4,082,002	£3,684,067	£3,684,067	£3,684,067	£56,921	£56,921	£56,921	£0	£0.0	£0
Fowlmere	64.85	64.85	64.85	£297,427	£297,427	£297,427	£547,688	£547,688	£547,688	£2,323	£2,323	£2,323	£2,107,855	£316,178.3	£2,107,855
Fradley	253.62	253.62	253.62	£1,017,814	£1,017,814	£1,017,814	£1,567,628	£1,567,628	£1,567,628	£11,236	£11,236	£11,236	£8,243,839	£1,236,575.8	£1,236,576
Green Lane	209.66	248.39	248.39	£1,416,165	£1,821,755	£1,821,755	£1,679,641	£1,524,464	£1,524,464	£8,527	£19,480	£19,480	£6,815,093	£1,211,087.0	£1,211,087
Hampton Loade	213.85	213.85	213.85	£1,063,057	£1,063,057	£1,063,057	£2,369,863	£2,369,863	£2,369,863	£52,879	£52,879	£52,879	£6,951,068	£1,042,660.2	£1,042,660
Linton Rivey Hill	31.08	31.08	31.08	£157,636	£157,636	£157,636	£225,774	£225,774	£225,774	£1,177	£1,177	£1,177	£1,010,316	£151,547.5	£1,010,316
Little Hay	189.47	219.39	189.47	£944,378	£1,089,410	£944,378	£1,276,924	£1,271,392	£1,276,924	£8,283	£9,456	£8,283	£6,158,770	£1,069,716.0	£1,069,716
Madingley	1.79	1.79	1.79	£924,294	£2,338,238	£2,338,238	£387,247	£3,453,648	£3,453,648	£31,300	£42,618	£42,618	£58,238	£8,735.7	£8,736
Maple Brook	160.53	160.53	160.53	£678,929	£678,929	£678,929	£1,321,740	£1,321,740	£1,321,740	£6,230	£6,230	£6,230	£5,217,893	£782,683.9	£782,684
Prestwood	79.68	79.68	79.68	£429,296	£429,296	£429,296	£574,736	£574,736	£574,736	£8,105	£8,105	£8,105	£2,590,035	£388,505.3	£2,590,035
Seedy Mill	88.66	103.59	88.66	£488,888	£548,362	£488,888	£970,734	£832,123	£970,734	£3,588	£13,351	£3,588	£2,881,755	£505,072.1	£2,881,755
Slitting Mill	316.94	661.17	661.17	£1,631,427	£3,271,606	£3,271,606	£3,775,785	£3,139,042	£3,139,042	£37,425	£68,314	£68,314	£8,742,205	£1,311,330.8	£1,311,331
Grid Export	2752.63	3562.82	3562.82												

Figure 29 - Summary of outputs from Aqua Consultants NZ renewables phase 1 report (June 2023)

a. SSW Energy and finance team analysis

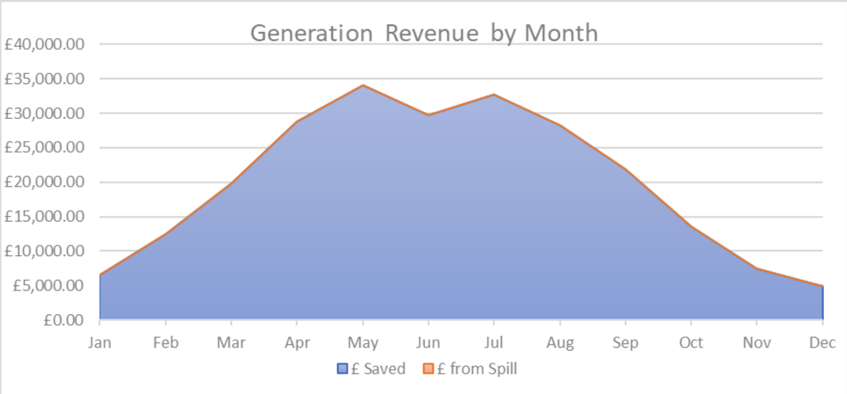
In order to provide maximum confidence in the data and financial analysis, the SSW energy team undertook a number of assessments using industry standards, internal financial expertise and SSW energy and carbon team scenario modelling based on existing on-site, behind the meter PV generation at our Seedy Mill Treatment Works.

Borehole/Site	Hampton Loade TW	
System Rating	4000	kWp
Potential Generation	3,781,279.27	kWh
Installation Price	£850.00	£/kW
Estimated Annual Savings to Bills	£379,439.55	
Total Revenue/Savings	£380,781.57	
Cost of Installation	£3,965k	
Time to Recoup Initial Investment	8.9	Years

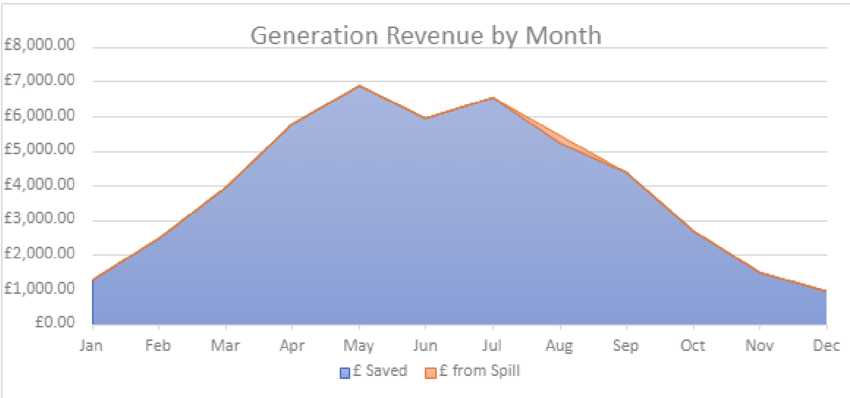


Borehole/Site	Seedy Mill WTW

System Rating	2500	kWp
Potential Generation	2,363,299.55	kWh
Installation Price	£850.00	£/kW
Estimated Annual Savings to Bills	£240,316.34	
Total Revenue/Savings	£240,316.34	
Cost of Installation	£2,478k	
Time to Recoup Initial Investment	8.8	Years



Borehole/Site	**Fradley PS**	
System Rating	500	kWp
Potential Generation	472,659.91	kWh
Installation Price	£850.00	£/kW
Estimated Annual Savings to Bills	£47,677.51	
Total Revenue/Savings	£47,936.79	
Cost of Installation	£496k	
Time to Recoup Initial Investment	8.9	Years



Borehole/Site	**Chilcote PS**	
System Rating	300	kWp
Potential Generation	283,595.95	kWh
Installation Price	£850.00	£/kW
Estimated Annual Savings to Bills	£28,768.19	
Total Revenue/Savings	£28,796.86	
Cost of Installation	£297k	
Time to Recoup Initial Investment	8.9	Years

Figure 30 - PV generation models for four selected sites

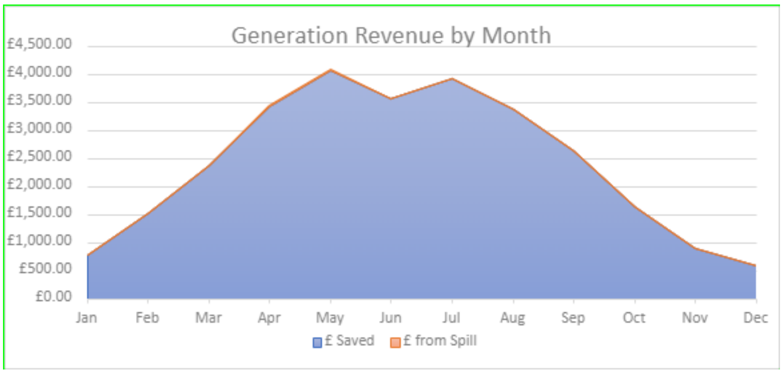


Figure 31 - Finance NPV

Using NPV analysis on a 20-year basis and a weighted average cost of capital (WACC) of 10% the SSC energy team finance partner carried out an Internal rate of Return (IRR) and Net Present Value (NPV) calculation for the combined investment across the four sites.

This produced an output NPV of +2.32m including tax implications. Base assumption for this assessment was that the benefits commence in the same year as installation however, for subsequent analysis we have assumed year 2 of AMP8.

NPV (WACC 10%)	Yr0	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10	Yr11	Yr12	Yr13	Yr14	Yr15	Yr16	Yr17	Yr18	Yr19
Initial Outlay	-6.21																			
O+M	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06
Elec Savings (£m)	0.94	0.93	0.93	0.92	0.92	0.92	0.91	0.91	0.90	0.90	0.89	0.89	0.88	0.88	0.87	0.87	0.87	0.86	0.86	0.85
Carbon Savings (£m)	0.00	0.02	0.05	0.08	0.12	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.31	0.34	0.37	0.41	0.45	0.49	0.53	0.58
Net Cash Flow (£m)	-5.33	0.90	0.92	0.94	0.98	1.02	1.03	1.04	1.06	1.07	1.09	1.11	1.13	1.16	1.19	1.22	1.25	1.29	1.33	1.38
Tax on Additional profit (£m	1.07	-0.18	-0.18	-0.19	-0.20	-0.20	-0.21	-0.21	-0.21	-0.21	-0.22	-0.22	-0.23	-0.23	-0.24	-0.24	-0.25	-0.26	-0.27	-0.28
Net CF After Tax (£m)	-4.27	0.72	0.73	0.76	0.78	0.81	0.83	0.84	0.85	0.86	0.87	0.89	0.91	0.93	0.95	0.97	1.00	1.03	1.07	1.10
DF (WACC 10%)	1.00	0.91	0.83	0.75	0.68	0.56	0.51	0.47	0.42	0.39	0.35	0.32	0.29	0.26	0.24	0.22	0.20	0.18	0.16	0.15
Net CF PV (£m)	-4.27	0.65	0.61	0.57	0.53	0.46	0.42	0.39	0.36	0.33	0.31	0.28	0.26	0.24	0.23	0.21	0.20	0.19	0.17	0.16
NPV	2.32																			

$$IRR = \frac{NPV_1}{NPV_1 - NPV_2}(r_2 - r_1)$$

Figure 32 - SSW Finance NPV and IRR assessment

Internal rate of return = 0.23 =23%

b. EU PVGIS

Photovoltaic Geographical Information System (PVGIS) provides information on solar radiation and photovoltaic system performance for any location in Europe and Africa, as well as a large part of Asia and America. It has a number of features including:

- Free and open access to photovoltaic (PV) electricity generation potential for different technologies and configurations
- No registration
- Extensive supporting documentation
- APIs for fast, automated access need
- Maps of solar resource and PV potential, by country or region, in ready to print files.

JRC Photovoltaic Geographical Information System (PVGIS) - European Commission (europa.eu)

The output for the Hampton Loade TW proposed 4MWp ground mounted PV installation is shown below:

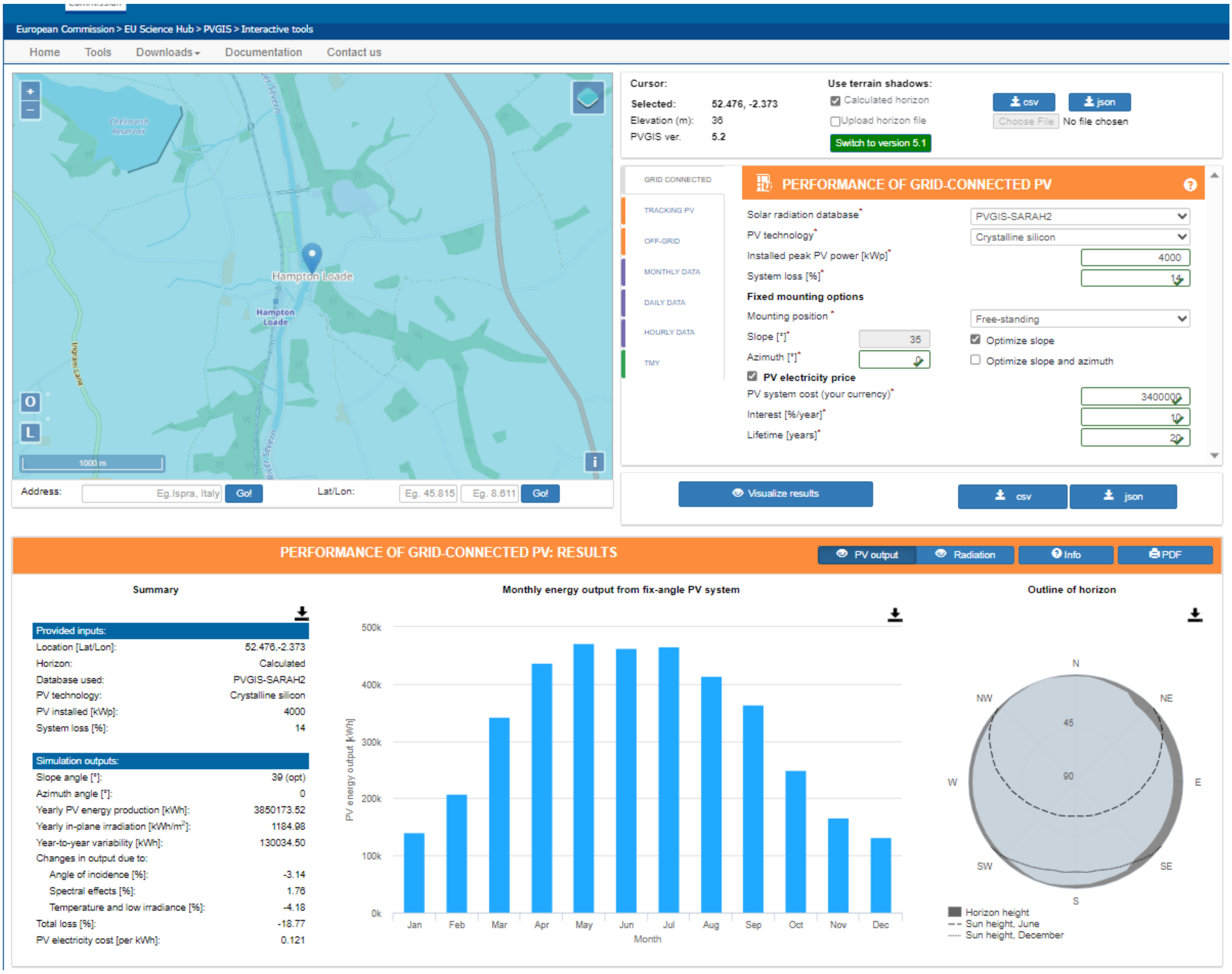


Figure 33 - Output for the Hampton Loade TW proposed 4MWp ground mounted PV installation

3.3.7 Customer Protection

The technical and commercial data for the PV enhancement project, have been prepared and assessed using a multi-layered approach including:

- Existing PV installations (roof mounted at Seedy Mill Treatment works
- EU commission science hub PVGIS tool
- Developers and consultants working in this area inc. Enviromena and Aqua Consulting
- Experience of the energy team who collectively have been involved in delivering PV projects at previous companies totalling > 10MWp over the last 12 years.
- Peer review (finance, PR24, Capital Investment, operations, Water Uk NZ technical working group, Water UK energy managers' forum).
- Cornwall Insight PR24 energy cost projections project (11 participants from across sector inc. SSC).
- Water sector benchmarking.

This approach gives us high confidence alongside the structured approach we will take to all stages of the project including tendering, negotiations, contract award and program delivery.

Third party assurance for the robustness of the cost estimates

- PA Consulting – Energy strategy project Sept 23
- Customers will be protected against non-delivery of these enhancement investments by the Operational greenhouse gas emissions (water) Performance Commitment. At this point we do not know the ODI carbon rate so we cannot confirm whether the scheme needs further protection. Additionally, this scheme falls below the threshold for materiality in the PCD guidance.
- NEC4
- Tender process inc. multiple framework agreements and lots

Ofwat's enhancement model approach…

Table 2.1: Building blocks of our efficient expenditure allowances

Building block	Description
Base expenditure	• Base expenditure includes: o routine, year-on-year costs, which companies incur in the normal running of their businesses to provide a base level of good service to customers and the environment; o expenditure on maintaining the long-term capability of assets; o expenditure to improve efficiency; and o expenditure to comply with current legal obligations. • Base expenditure covers wholesale and retail (residential and business) activities, and currently make up around 80% of all costs incurred by water companies.
Enhancement expenditure	• Enhancement expenditure is generally where there is a permanent increase or step change in the current level of service to a new 'base' level and/or the provision to new customers of the current service level. • Enhancement funding can be for environmental improvements required to meet new statutory obligations, improving service quality and resilience, and providing new solutions for water provision in drought conditions.

Figure 34 - OFWAT Table 2.1. PR24 Enhancement Criteria

3.3.8 Delivery

This section should be read in conjunction with Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.

For the delivery of a ground mounted utility scale Solar PV programme, it is unlikely any of our conventional frameworks with the exception of our ancillary services provided through our main energy supply contract. This is potentially available with our current energy supply contract and most major utilities offer this type of additional service. However, as a consequence of the commercial structure surrounding the conventional procurement of utility scale ground mounted solar PV, best value will be achieved through a competitive tender.

There is a well-established supply chain within the UK for the supply of solar PV panels, transformers, and inverters, with contractors having been installing and commissioning solar farms in the UK since the early 2000's, with almost 10GW installed to date. Modern solar farms can be built up to 50MW and some greater. Given the modest scale of the deployments proposed, it is unlikely that either supply of components or capacity to construct will be an issue for the UK supply chain.

In order to achieve best value, the programme of projects will be competitively tendered. Typically ground mounted utility scale solar PV procurements are tendered on the basis of:

1) Price and;
2) Warranted energy yield and liquidated damages

This enables tenderers to seek competitive advantage by optimising design and utilising the most efficient components.

Typically contract conditions are fixed price Engineer Procure and Construct (EPC) contracts. Contract forms such as ICHemE red book, or similar lump sum contract form. We are more familiar with NEC option A, which could be utilised in an amended form suitable for an EPC.

Given the requirement to carry out performance tests following commissioning for a period of between 12 and 24 months to verify performance against the warranted energy yields, it is usual that alongside and EPC contract the installing contractor is also contracted for O&M services for up to 24 months. These costs would be considered Opex. This enables the contractor to ensure the plant is operated optimally to minimise the commercial risk of being exposed to liquidated damages. It also enables the owner to either secure a long-term O&M contract from an alternate specialist O&M provider or seek training for internal staff to take over at the end of the performance test period.

The intention is to deliver these projects in year 2 of the AMP8, allowing year 1 for tendering.

3.4 Case 7: Cyber Security

3.4.1 Summary

Approval of £2.754m is sought for enhancements to the Security of the organisations Network and Information Systems associated with its Operational Technology (OT)

The enhancements sought align specifically with the 2018 Network and Information Systems (NIS) Directive and the Cyber Assessment Framework (CAF) targets set by the DWI.

These schemes are supported by our water quality regulator, the Drinking Water Inspectorate (DWI), see section 6.1 below for copies of the support notices obtained.

Enhancements target wider monitoring of the OT network, further OT network segmentation, and extended user and device access control across the OT estate.

The enhancements are necessary to:

- provide improved cyber security of OT critical to the safe and secure operation of our production, treatment, distribution, and storage assets, and in doing so,
- consolidate the DWI CAF Sector Specific Profile (SSP) March 2025 compliance target,
- enables us to meet the new DWI enhanced CAF (eCAF) target for March 2028

Table 45 - Summary of expenditure required for the period 2025-2030 (AMP8)

Investment	Enhancement Investment	AMP8 TOTEX £k	AMP8 Enhancement OPEX £k	AMP8 Base CAPEX £k	AMP8 Enhancement CAPEX £k
OT Cyber Security	Enhanced Network Monitoring	1,065	0	0	1,065
OT Cyber Security	Enhanced Network Segmentation	698	0	0	698
OT Cyber Security	PLC Security Framework	410	0	0	410
OT Cyber Security	Local HMI Access Control	582	0	0	582
	Total	2,754	0	0	2,754

3.4.2 Background Information

The Security of Network and Information Systems (NIS) Directive provides legal measures to protect essential services and infrastructure by improving the security of their Network and Information Systems. The UK is implementing the requirements of the NIS Directive through the NIS Regulations 2018, which came into effect on 10 May 2018. As a Water Company, and due to our size, we fall under the designation of an operator of an essential Service (OES) and must comply with the NIS reporting requirements.

Whilst the Secretary of State (for England) and the Welsh Government (for Wales) are the designated competent authorities for the water sector, operational responsibilities of the competent authority function have been conferred to the DWI. They will be provided with technical support via the National Cyber Security Centre (NCSC).

There are two main elements relating to our compliance with the NIS Regulations

• Regulation 11(1) of the Regulations requires us to notify the Competent Authority (in this case the DWI) of an incident that has affected the network and information systems, which has had a significant impact on the continuity of the essential service.

• Self-assessment against a Cyber Assessment Framework (CAF) developed by the NCSC

The aim of the CAF is to provide each company with a framework to assess how cyber security risks are being managed within their business in relation to the production and delivery of wholesome water. It also allows the DWI to assess the extent to which each company is achieving the outcomes specified by the cyber security principles.

The CAF consist of 4 high level objectives and sub principles.

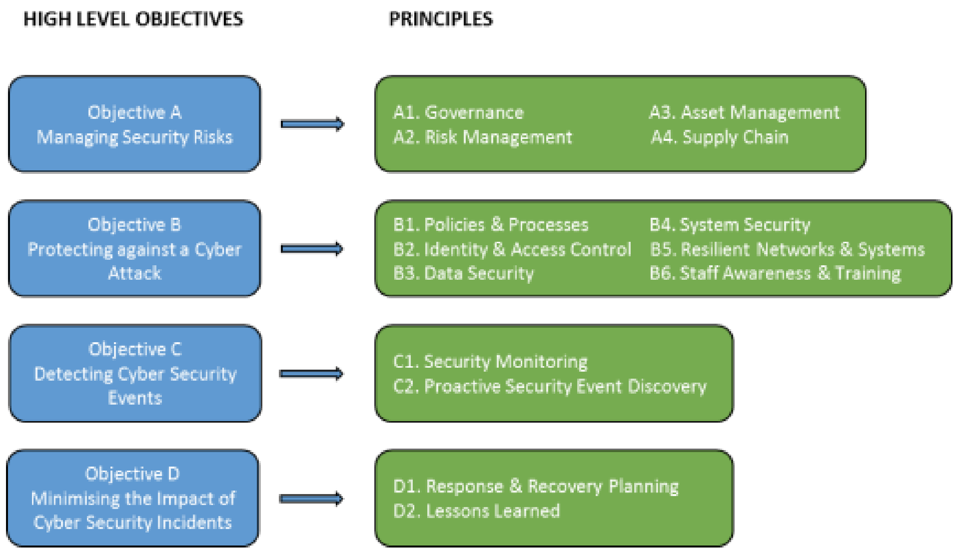


Figure 35 – CAF High Level Objectives and Principles

Each principle is then subdivided into 39 contributing outcomes.

The DWI wrote to UK water companies in AMP7 and set out the Sector Specific Profile (SSP) target. This target informed the sector of the CAF compliance level we were required to meet by March 2025. Progress is reported to the DWI quarterly whilst the CAF is updated and submitted to the DWI annually. We continue to work towards and expect to meet the SSP target by March 2025.

In June 2023, the DWI wrote again to the sector informing of a new enhanced CAF target, the eCAF. On review, the new eCAF target closely aligns to the contributing outcomes identified in this paper for enhancement.

The key enhancements sought under this proposal fall into the following workstreams:

a) Enhanced network monitoring

Whilst a new OT network monitoring solution being implemented in AMP7 can detect remote devices and users connecting to the OT network, it is unable to detect users or devices connecting locally on the automation network. The local automation network connects all PLC, HMI, and SCADA devices at the remote site. It sits on the other side of the wide area OT network router. This blind spot leaves the site vulnerable to an undetected attack instigated physically on site. Attacks of this nature could come from a rogue employee, rogue contractor or anyone who has managed to gain physical access to the site, with the intent to disrupt OT operations.

The proposed solution requires network monitoring devices to be deployed at sites on the local side of the OT network. These devices will detect and transmit all activity on the local OT automation network back to a centralised server where all activity, local and remote will be analysed and inspected. Suspicious and or malicious activity will generate alerts. Alerting will be integrated into the organisations SOC solution where it is the intention to monitor all activity on the OT and automation networks 24/7/365.

b) Enhanced network segmentation

The OT network is separated from the IT network using a firewall. However, once inside the OT network, further segmentation relies on configuration of the site router. Compared to a separate dedicated firewall of different manufacture, router configuration alone is not as secure. Should an attacker gain access to and compromise the site router, in theory, they would be able to travel freely across and within the OT network to access any site on the OT network. This vulnerability leaves the OT network exposed should permitter defences such as the IT or OT network firewall also be compromised.

Guidance from Rockwell Automation and ICS-CERT strongly recommend that all ICS/SCADA networks are properly segmented within the process structure (in our case, this is the wide area OT network) as well as from the Internet and other non-essential networks. The introduction of dedicated firewalls at remote sites would align to this guidance.

https://www.cisa.gov/sites/default/files/2023-01/NCCIC_ICS-CERT_Defense_in_Depth_2016_S508C.pdf

c) PLC security framework

PLC devices are deployed extensively across the OT network. They are critical for the control, safety and processes associated with the production, treatment, storage, and distribution of water. Historically, device level security had been poor to non-existent on PLC devices. However, most modern PLC devices do now have some level of security that can be activated.

To date, we have not implemented device level security, relying instead on permitter defence at the IT and OT network boundaries. Not applying device level security does, however, present a vulnerability should an attacker compromise permitter security controls, they would gain direct access to the PLC where they could conduct a malicious act unchallenged.

A security framework will be developed and deployed across all compatible PLC devices. This security framework will see the activation of manufacturer specific securities at a device level to protect from unauthorised access. Application of the security framework is through configuration of features on the target devices.

d) Local HMI access control

HMIs are used extensively across the OT estate by operators to monitor and make changes to plant operations. Typically, each device is protected by a simple 4-digit code, a code which is repeated at other sites. This simple level of protection was designed primarily as a validation step only, to ensure the operator does not inadvertently modify site operation. It is not, however, a suitable method to control device access or to detect who is accessing the device. This vulnerability means changes can be made to site operation via the HMI locally without any reasonable level of authorisation and with no electronic audit trail, leaving the site vulnerable to malicious activity. Attacks of this nature could come from a rogue employee, rogue contractor or anyone who has managed to gain physical access to the site with the intention of disrupting OT operations.

RFID devices will be retrospectively fitted and configured to work with all compatible HMIs across the OT estate. Where HMI devices are not compatible, these will be upgraded or replaced. These RFID devices will be linked specifically to users enabling electronic verification to take place along with records of users who make changes to control parameters, including water quality setpoint and alarm limits. These records can then be retrospectively compared to manual change logs to ensure all changes have been authorised. By moving to dedicated RFID devices for individual users, common codes for HMI devices can be removed, reducing the risk of uncontrolled change being made locally to HMI settings. Part of this solution may also include replacing HMIs with more up to date HMIs that incorporate access control.

We have submitted our proposals to the DWI for support. The DWI have reviewed, and we have received letters of support for all investments in this case from them. For further information on the response received please see section 6.1 of this Enhancement Case Appendix.

3.4.3 Need for Investment

Programme of works and investment summary

Table 46 - Programme of works and investment summary

Enhancement	Implementation cost	Annual support & maintenance (base OPEX)
Enhanced network monitoring	£1,064,509	£159,791
Enhanced network segmentation	£0,698,000	£0
PLC security framework	£0,410,000	£30,000
Local HMI access control	£0,582,000	£20,000
Totals	**£2,754,509**	**£209,791**

Workstreams

The following summarises the scope, need, evidence, risk before and post investment, the link to CAF outcomes and, an initial view on workstream delivery for each enhancement.

The compensating measures reflect the current position which has been used to calculate the existing risk (based on a 5 by 5 matrix) for each workstream. For further information please see **Figure 39 and 40** at the end of Section 3.4.8.

Table 47 - Enhanced network monitoring

Enhancement	Enhanced network monitoring	
Scope	Deployment of network monitoring devices at the plant/local automation level. Devices will be linked back to the centralised OT network monitoring solution and the 24/7/365 SOC to alert immediately on detection of suspicious network activity.	
Need	Vulnerability	Compensating Measures
	Latency in threat detection	Physical security, including intruder detection in place to protect from unauthorised access to buildings and roadside cubicles.

Enhancement	Enhanced network monitoring			
	Unable to detect users and or devices connecting locally to the automation network. Attacks on the automation system carried out locally cannot be detected. Attacks could come from a rogue employee, rogue contractor or anyone who has managed to gain physical access to the site, legitimately or not, intent to disrupt OT operations.		Security is enhanced at larger more sensitive sites with CCTV. A manual change management process to approve and record changes made to PLC/HMI code.	
Evidence	Supports eCAF March 28 target Supports CAF outcomes: (A3.a) Asset Management, (B2.a) Identification, (B2.b) Device Management, (B4.d) Vulnerability, (C1.a) Coverage, (C1.d) Incidents, (C1.e) Tools, (C2.a) Abnormalities, (C2.b) Attack Discover. Supports Regulation 11(1) of the NIS 2018 Regulations that require us to notify the Competent Authority (in this case the DWI) of an incident that has affected the network and information systems, which has had a significant impact on the continuity of the essential service.			
Risk	Before Solution	15	After Solution	5
Timing	Project Start:	Jun 2025	Project End:	May 2027

Table 48 - Local HMI access control

Enhancement	Local HMI access control	
Scope	RFID devices (or similar technology) will be retrospectively installed and configured to work with all compatible HMIs across the OT estate. RFID devices will be linked specifically to users enabling electronic verification to take place and for logs to be created of users who make changes to operational parameters. Where HMI devices are not compatible, these will be upgraded or replaced under the base capital maintenance programme.	
Need	Vulnerability	Compensating Measures

Enhancement	Local HMI access control			
	Password protection on HMI devices is weak and does not support user authentication and there are no audit trails for users accessing HMI devices. This leaves the site vulnerable to malicious activity. Attacks could come from a rogue employee, rogue contractor or anyone who has managed to gain physical access to the site, legitimately or not, intent to disrupt OT operations.		Physical security, including intruder detection in place to protect from unauthorised access to buildings and roadside cubicles. Security is enhanced at larger more sensitive sites with CCTV. Site logs are used to record changes made to setpoints by the operator.	
Evidence	Supports: eCAF March 28 target Supports CAF outcomes: (B2.a) Identification			
Risk	Before Solution	9	After Solution	3
Timing	Start:	Dec 2025	End:	May 2027

Table 49 - PLC security framework

Enhancement	PLC security framework	
Scope	A new security framework will be developed and enabled across all compatible PLC devices. The security framework will see the activation of manufacturer specific securities at a device level to protect from unauthorised access. Application of the security framework is through configuration of features on the target devices and, the maintenance of firmware. Incompatible PLCs will be replaced under schemes identified in the base capital maintenance plan.	
Need	Vulnerability	Compensating Measures
	Device level security is not enabled on PLC or similar intelligent devices. If an attacker gains access to the PLC device either locally or remotely, they could deploy malware, exploit device vulnerabilities or equipped with appropriate software, modify PLC code to disrupt OT operations.	IT network protected by firewall, malware software and monitored 24/7/365. OT network separated from IT network and the internet (remote access threat)

Enhancement	PLC security framework			
			Physical security, including intruder detection in place to protect from unauthorised access to buildings and roadside cubicles. A change management process is in place to record changes made to PLC/HMI code.	
Evidence	Supports: eCAF March 28 target Supports CAF outcomes: (B2.a) Identification, (B4.b) secure configuration.			
Risk	Before Solution	15	After Solution	5
Timing	Project Start:	June 2025	Project End:	May 2027

Table 50 - Enhanced network segmentation

Enhancement	Enhanced network segmentation	
Scope	Industrial firewalls will be installed at remote sites enabling stronger network segmentation and enhanced security policies to be implemented. Firewalls would likely be managed by a third party and be off different manufacturer to those protecting the IT and OT boundaries.	
Need	Vulnerability	Compensating Measures
	Protection of lateral movement once inside the OT network is managed by rules within the WAN OT router for each site. If the router is compromised, access in theory is possible to all sites within the OT network. With access gained, an attacker could target multiple OT devices including PLCs and SCADA systems.	IT network protected by firewall, malware software and monitored 24/7/365. OT network separated from IT network and the internet (remote access threat) Physical security, including intruder detection in place to protect from unauthorised access to buildings and roadside cubicles. A change management process is in place to record changes made to PLC/HMI code.

Enhancement	Enhanced network segmentation			
Evidence	Supports: eCAF March 28 target Supports CAF outcomes: (B4.a) secure design.			
Risk	Before Solution	15	After Solution	5
Timing	Project Start:	June 2025	Project End:	May 2027

3.4.4 Customer Support

To inform our decision on the significant investments we are proposing to further improve our cyber resilience, we have captured the feedback received from our customers during the impacts they experienced following our business experiencing a cyber-attack in August 2023. This attack compromised the personal and banking details of some of our household customers.

These insights and learnings are captured mainly from social media and customer satisfaction surveys received between 29 November 2022 through to 10 March 2023. It covers the period following the communications, via a postal letter, sent to customers who had been directly impacted to inform them of the situation and to outline the support and advice being offered to help protect themselves from any malicious activity that might have resulted because of the breach. However, we also made use of other contacts, including face-to-face sessions held in the Community to support customers and other contacts, such as letters and e-mails received from customers. Below we outline some of the main sources of insights we have drawn on which support the need to make further investments to ensure another attack does not occur given the impacts experienced by our customers:

- A thematic review of hundreds of social media comments left by customers and wider stakeholders across the channels we operate – such as Facebook, Twitter (now called X), LinkedIn and Instagram. There were captured in real-time though our social media listening software. The social media feedback was received through two main routes:
    - Posts started by the public (often professors, or those working in or who a higher level of working knowledge about cyber security matters, with other people then joining these to express their views on the incident, who were a mix of customers and wider members of the public.
    - Those that were private and/or public messages from customers impacted by the incident aimed at SSC, mainly received following receipt of the letters sent out to customers.
- Using the Qualtrics platform to send customer satisfaction surveys sent following a contact with us. These insights were captured and analysed and during the period covered we received 1,490 surveys across our two supply regions, with 167 of these directly linked to feedback about our service performance about the cyber incident.
- We have also picked up through our Trackers and wider PR24 engagement how customers have felt about the company since the incident happened, such as trust perceptions. It is important that we continue to track these impacts to try and rebuild the lost trust.

From our have analysis we identified common themes. A thematic review of the feedback shows the main reactions about the breach and the communication and support we subsequently offered were, with many customers expressing one or a number of these:

- Anger, rage, and disgust

- Disbelief, disappointment, and shock
- Fear, worry, anxiety, stress, and frustration
- Confusion and uncertainty.

Specifically related to the communication (postal letter) there was clear evidence that we had not landed this effectively when we notified customers of the breach from the 29 November 2022. We will use the learnings to inform our wider communications, particularly during incidents. It highlights how important effective communication is to customers to ensure they can quickly and clearly understand what is required of them and to minimise any confusion, particularly in stressful situations.

- **The main theme on social media and in the surveys was being angry and let down at the level of support provided by us in response to protect people from any unwanted misuse of their personal data.** Customers expressed very strong negative views about perceived failings by the company in protecting their personal data and then why they were being asked to sign up to an online service to protect themselves from any malicious use of their data by others. The lack of a direct apology in a five-page letter and level of perceived "waffle" was also seen as triggered an anger flashpoint for customers. There were also many angry comments about why we had taken so long to inform them about the loss of their personal data.

- Linked to the above, some customers reacted in frustration and anger at being asked to sign up to another online service. There were concerns from some that being asked to register and give over more personal details to another online provider, which was felt to further increase the risk of cyber fraud to them. There were also calls for why customers were being asked to go through the effort of signing up to a service when the company had caused the issue and should register customers on their behalf. There was a lack of understanding around data privacy as to why this was not possible.

- Some customers felt that the **letter sent to them to inform them about the breach was a "fake".** Some customers reported throwing their letter away having been advised by others (including banks) that it looked like a scam. There were calls for people to be very cautious and others convincing each other on social media of reasons why they believed it to be a scam. In these cases, we did not observe people saying they were checking official websites (like our website) to validate facts they might have read or heard about in other places. A common and wider issue seen on social media around fake news driving misinformation. There was also anger that some customers found out about the incident through social or other media before receiving their own letter.

- The incident also triggered a range of **"sarcastic"** responses to point out perceptions of the water company cyber failings on other social posts we continued to promote, such as those related to metering, leakage and our online MyAccount service. Customers also pointed to the fact that this was just another service failure by a water company, with the anger compounded by the fact that they could not switch to supply and were stuck with our company as their supplier. Loss of trust was mentioned frequently.

- There were many calls for compensation **for the inconvenience** the data breach had caused customers. Customers cited the additional efforts and costs they were forced to go through, for example to change bank details or sign up to CIFAs protection and how we should have compensated them for the effort and the stressed caused. There were also calls from a minority to stop paying their water bill. The comments suggested that, given the serious nature of the breach, the perceived lack of concern and support for customers meant they felt entitled to cancel their direct debit payment as a way of gaining compensation directly.

- Some customers used social media **to support others**, such as encouraging others to sign-up to the support offered to protect themselves. This included encouraging others to sign up to Transunion via LinkedIn.

- A minority of feedback pointed to customers **panicking** because they hadn't received a letter" and wondering if this was because their letter had not arrived yet, or if they were not impacted to start with. From the feedback, some customers were not always going to our website to read the FAQs about the incident which were provided about who and who wasn't impacted.
- Customers did not respond well to what was perceived to be the **"corporate and complex"** language used in the letter, in the FAQs we provided and the way our telephone hotline handled queries. It was felt to lack any empathy and often did not help customers resolve their query satisfactorily.
- Some customers did not express any strong emotions about receiving the letter, just commenting on social media that they have received one. This may be driven by lack of knowledge about the potential risks and/or view that data breaches have become a regular occurrence over recent years and so their details are already on the dark web.

These themes led to a significant impact fall in the satisfaction scores received from our customers. An analysis of out point of contact surveys during the period 29/11/12 to the 10/03/23 highlighted how customers rated our overall service. In the year leading up to the 29 November our satisfaction score was 8.03/10.0, but was 2.91/10.0 from customers who contacted as specifically about the incident and 3.27/10.0 for those who contacted us about another query but mentioned the cyber-attack in their feedback on the contact. This high level of dissatisfaction clearly highlights the impact a cyber-attack and the issue outlined above has had on our customers.

An example of a customer comment left in one of our satisfaction surveys is shown below.

"Your company's response to the data breach has been completely inadequate. I telephoned to find if I was affected and was told that if I don't receive a letter from you then I am not at risk. that is absurd. There needs to be a mechanism instituted to tell all customers EITHER they have or have not had their data shared. Had it not been for the fact that newspapers printed an article then many customers would not be informed there was even an issue. There are now advertisements on Facebook for law firms promising assistance to seek redress. I would question whether SSW has properly complied with ICO and GDPR regulations. Certainly, information has not been disseminated in a timely or effective manner. I spoke to your telephone customer service on the day the ironically named leak was announced in the press, and there was an option 1 to enquire regarding that matter. The member of staff I spoke to was completely unprepared to provide any meaningful information and could only parrot that if I did not receive a letter then I was not affected. Nonsense. I felt sorry for the individual concerned that their line management had not prepared them with any other responses. I requested a call back the next day which did not materialise. 24 hours after that I received a call from what turned out to be a third-party internet security firm who had partnered with SSW but could only help if I could provide a reference number off a letter that I had not received. I have not received any post from anybody for over a week as there is a postal strike in progress, it is close to the Christmas holidays when there are delays in the ordinary course of events. There is no information to be easily found on the SSW website. I understand that this is a difficult situation, but I reiterate, the so-called response is woeful to an incident that was recognised as having occurred at least 4 MONTHS ago. I sincerely hope your company can survive this."

However, it was notable from the customers who were satisfied with the way we had handled their quey when contacting us about the incident that common themes emerged:

- Receiving a quick and clear response to their query.
- Receiving a response that answered their quey in full.
- Being treated in an emphatic manner by the person who handed their query.

“The call handler was very kind and sympathetic regarding queries relating to the recent breach on direct debit payments whereby personal details have been released to unknown persons. She gave clear advice to me and answered my queries leaving me feeling more at ease regarding the situation.”

It is also clear from customer feedback that we need to rebuild the lost trust generated by this incident. In our Customer Promises Tracker quarter 4 2022/23 surveys, undertaken between w/c 6 to w/c 27 March 2023, we found that our overall satisfaction and trust scores fell notably quarter-on-quarter. **Figure 36** shows this impact when we exclude any responses that mentioned the cyber-attack, with the overall satisfaction and Trust metrics remaining flat quarter-on-quarter. This provides evidence of the reputational impacts of the incident among our customer base. This trend continued into Q1 2023/24 and is now also shown in the Value for Money metric scores.

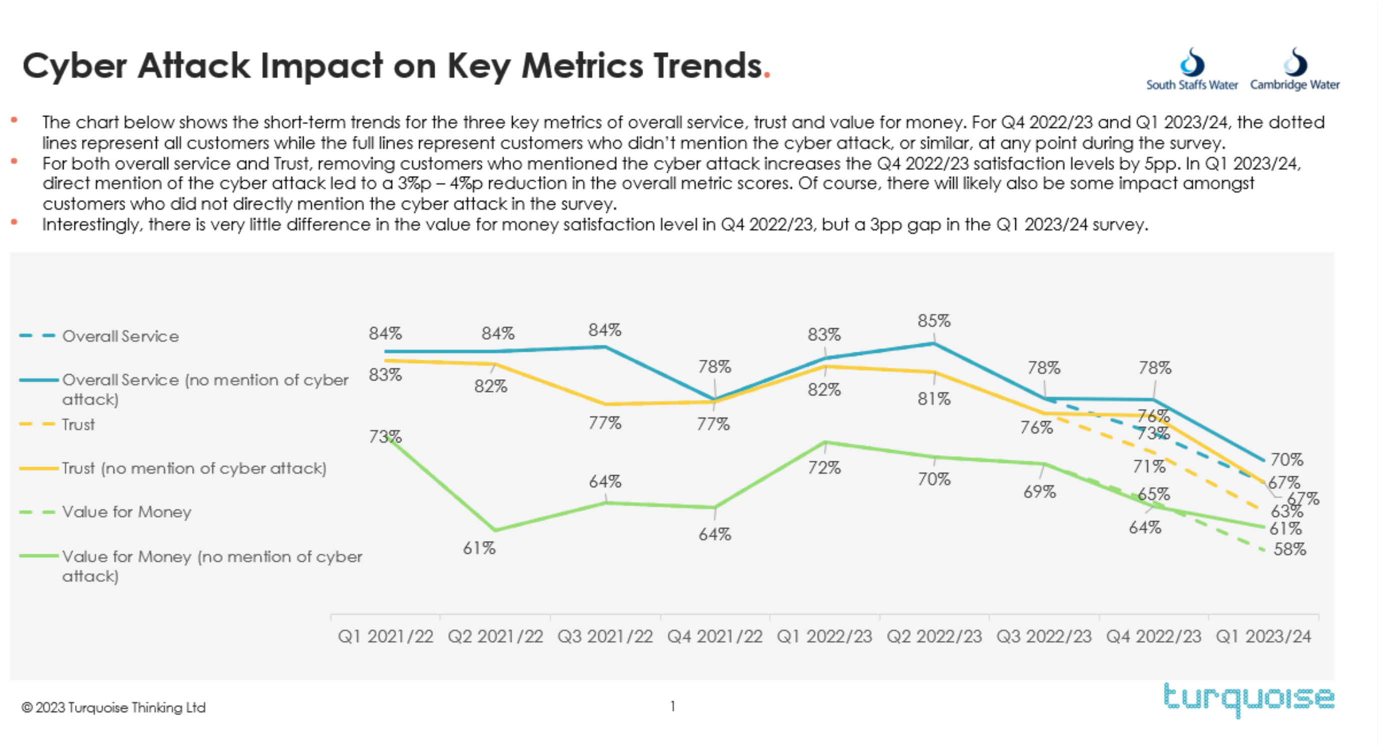


Figure 36 - Impact of the cyber incident on our key household customer metrics

Source: SSC Customer Promises Tracker. Circa 200 surveys a quarter, split 50/50 by phone and online methodology among household bill payers

In our Customer Priorities Tracker surveys, we identify in our 2022/23 quarter 4 wave of surveys that there were calls from customers to make cyber-resilience a priority. In the online survey customers are asked to trade off against 20 priority areas which one is most and least important using a Max-Diff approach. They are then asked following this if there are any areas missing from the 20 shown that they consider to be a priority. **Figure 37** summaries the feedback received from these questions and other points in the survey where customers were calling for us to ensure no more data breaches occurred.

We will continue to track the impacts of the incident to understand if we have rebuilt the lost trust.

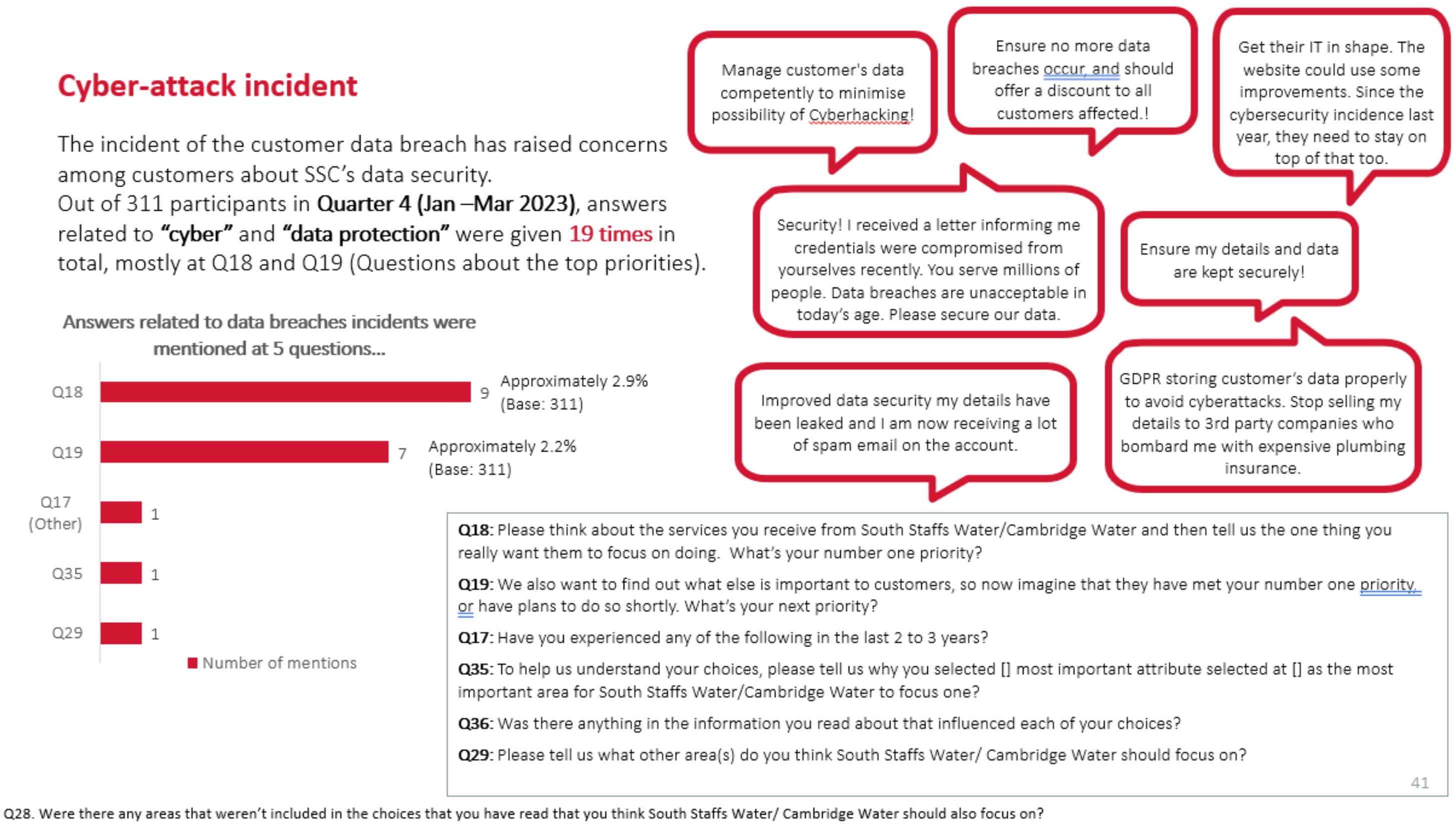


Figure 37 - Impact of the cyber incident on our key metrics

Source: SSC Customer Priorities Tracker. 313 online surveys among SSC household bill payers,

3.4.5 Best Option for Customers

Table 51 - Enhanced network monitoring

Enhanced Network Monitoring				
Options	Description	Strengths	Weaknesses	Decision
Do Nothing	Network monitoring restricted to OT Wide Area Network.	Monitoring solution can detect remote attacks that likely come in via the IT network.	Unable to detect attacks local to the site. It's possible these can come from internal employees or others who have gained physical access to the site.	Considered but does not support cyber strategy or CAF compliance targets.
Least Cost	Install enhanced network monitoring only at sites with water treatment processes.	Sites where an attacker could modify water treatment processes are monitored with alerts raised on detection of suspicious activity.	Non water treatment sites unable to detect anomalous activity.	Considered but not adopted given any successful attack on any part of the OT network is likely to cause public concern,

Enhanced Network Monitoring				
				possibly panic, even if the quality of water cannot be impacted.
Best Cost Option	Extend network monitoring coverage to all remote sites	Attack surface fully monitored meaning inside, or external threat would be detected enabling alerts to be raised.	Increased network complexity	**Adopted.** Supports CAF compliance and reduces overall cyber security risk.
Alternatives	Operate OT sites in island 'fully isolated' mode	Prevents attack from remote locations.	Does not protect from insider or local threats. Unable to remotely operate sites resulting in increased site visits, carbon footprint and cost.	Considered but impractical to implement due to operational impacts.

Table 52 – Local HMI access control

Local HMI access control				
Options	Description	Strengths	Weaknesses	Decision
Do Nothing	Only implement measures to achieve the DWI SSP March 2025 target in AMP7.	None.	Perpetuates inadequate access control on HMI devices.	Considered but does not support cyber strategy or CAF compliance targets.
Least Cost	Retro fit RFID or similar access technologies to existing HMI devices.	User specific access and audit logs available for each HMI device and user. Able to record parameter changes and link to change process.	System maintenance partly manual as no active directory or management type console available. Update could be achieved remotely but overhead in effort.	**Adopted.** Supports CAF compliance and reduces overall cyber security risk.
Best Cost Option	Replace all HMI devices with active directory compatible device for user access controls and manage centrally.	Full user access control achieved with unique user login and full audit capability.	Costly. Each HMI would need to be replaced with a device capable of being integrated with active directory. This also increases the attack surface and cyber risk.	Considered but not adopted. Although it will satisfy the eCAF, the additional complexity, risk and cost is prohibitive.

Local HMI access control				
Alternatives	Implement site specific security codes for HMIs and change the pass code on a frequent basis.	Removes common pass code issue which provides some improvement.	Does not provide an audit function, codes will be shared so no user specific data available. Also requires dedicated resource to update HMI devices on a regular basis.	Considered but not adopted due minimal improvement and increased resource effort required to maintain.

Table 53 – PLC security framework

PLC security framework				
Options	Description	Strengths	Weaknesses	Decision
Do Nothing	Rely on perimeter cyber and physical defences, e.g., firewalls, physical security, to prevent access to PLC devices.	Provides a secure perimeter but should this be compromised, there is no further protection at the device level.	An attacker with access to the PLC device, gained locally or remotely, will acquire full admin level control of the device.	Considered but does not support our cyber strategy or CAF compliance targets.
Least Cost	Only apply PLC level security framework to devices specifically controlling dosing and water quality processes.	Offers additional security for critical water quality processing sites only.	Does not protect non water quality sites and does not mitigate the risk of disruption to supply.	Considered but does not support cyber strategy or CAF compliance targets. A successful attack on any part of the OT network would impact customer confidence irrespective of the actual damage done.
Best Cost Option	Apply PLC level security framework to all devices including boosters, distribution, and storage control systems.	Offers enhanced security for water production, distribution, treatment, and storage sites.	Legacy systems may not be compatible and will therefore require replacing or managing as appropriate.	**Adopted.** Achieves eCAF compliance and reduce overall cyber security risk.
Alternatives	No alternative available.	n/a	n/a	n/a

Table 54 – Enhanced Network Segmentation

Enhanced Network Segmentation				
Options	Description	Strengths	Weaknesses	Decision
Do Nothing	Rely on existing router level network segmentation rules to prevent lateral movement within the OT network.	Logical segmentation for all sites provided by existing routers managed by third party supplier.	Security features associated with routers are inherently weaker than dedicated firewall devices. If the router is compromised or configured incorrectly, the OT network could be accessed.	Considered but not adopted due to inherent weaknesses of routers not performing as well as dedicated firewalls.
Least Cost	Install dedicated firewalls sites controlling dosing and water quality processes only.	Offers additional security for critical water quality processing sites.	Does not protect non water quality sites and does not mitigate the risk of disruption to supply.	Considered but does not support cyber strategy or CAF compliance targets. A successful attack on any part of the OT network would impact customer confidence irrespective of the actual damage done.
Best Cost Option	Install dedicated firewalls at all sites.	Offers enhanced security for all water production, distribution, treatment, and storage sites.	It is essential that the firewalls are correctly configured An additional level of complexity is introduced that will require managing.	**Adopted**. Achieves eCAF compliance and reduce overall cyber security risk.
Alternatives	Operate OT sites in island 'fully isolated' mode	Prevents attack from remote locations.	Does not protect from insider or local threats. Unable to remotely operate sites resulting in an increased site visits, carbon footprint and cost.	Considered but impractical to implement due to operational impacts.

Summarising, whilst our customers are generally aware of the implications of having their personal data stolen, they are not necessarily aware that cyber risk extends to the protection of physical assets that abstract, treat, store, and distribute water. The options presented here for customers target the specific protection of these assets, to ensure the safe and continued supply of water against an increasing threat to the OT landscape. This very much aligns to the UK governments Cyber Security Strategy 2022-2230, specifically the objectives focused on protection and detection, which further align with the NIS Directive and DWI CAF.

3.4.6 Cost Efficiency

Costs have been estimated using information supplied by trusted suppliers with knowledge of our systems, who are familiar with the sector and who are experts in the field of OT cyber security and, who have engaged with us to discuss our proposals.

Detailed design work will be needed going forward to determine all final solutions and ultimately final costs.

A high-level breakdown of the estimated funding needed is shown below:

Qty	Enhanced network monitoring	Cost	CAPEX	OPEX
160	CTD Sensor	1,500	240,000	0
160	Sensor setup/site config/MGT	900	144,000	0
160	Network switches	300	48,000	0
160	Monitoring panel and installation	3,000	480,000	0
3	Claroty Servers	10,000	30,000	0
1	CTD Sensor Licence / year	474		75,840
1	CTD & EMC Server Licence / year	20,356		20,356
1	SOC cinfiguration and tuning	22,509	22,509	
1	SOC monitoring service / year	43,595		43,595
1	IT SOC linked support	20,000		20,000
1	Group IT project resource	50,000	50,000	0
1	OT project resource	50,000	50,000	0
			1,064,509	**159,791**
	Enhanced network segmentation			
160	LAN Firewalls	2,300	368,000	0
1	WAN Firewall (IT/OT)	80,000	80,000	0
1	Network Design (Rockwell)	150,000	150,000	0
1	Group IT project resource	50,000	50,000	0
1	OT project resource	50,000	50,000	0
			698,000	**0**
	PLC security framework			
200	Apply security to PLC devices at site	1,800	360,000	0
1	OT project resource	50,000	50,000	0
1	OT system admin	30,000		30,000
			410,000	**30,000**
	Local HMI access control			
140	Hardware, configuration and Install	3,000	420,000	0
1	OT project resource	50,000	50,000	0
1	SI resource for HMI cofig	112,000	112,000	
1	OT system admin	20,000		20,000
			582,000	**20,000**
	Totals		**2,754,509**	**209,791**

Figure 38 – Cost breakdown

Assumptions:

1. All 160 sites will require firewalls to achieve secure network separation.

2. The number of incompatible HMI devices is low. Any HMI device not capable of integrating with an RFID or similar interface will be replaced under investment in the base capital maintenance for AMP8.

3. The number of incompatible PLC devices is low, Any PLC not capable of adopting the PLC security framework will be replaced under the base capital maintenance plan for AMP8.

4. Cabinets and cubicles housing OT have enough space to accommodate the additional firewalls. Possible to dual purpose network monitoring panel subject to detailed design.

5. Mains power and existing UPS capacity at site is sufficient to accommodate new firewalls and monitoring devices.
6. Supply of specialist devices can meet programme of works.
7. Availability of external specialist and consultants can meet programme of works.

3.4.7 Customer Protection

Whilst not passing the materiality threshold of requiring a PCD, the investment sought is directly linked to achieving eCAF compliance by March 2028.

Failure to meet the deadline for eCAF compliance is likely to attract significant financial penalties enforceable by the DWI. This will ensure customers are protected in the case of non-delivery and failure to deliver the intended benefits.

We append the DWI notice of support in our Annex to this appendix, section 6.1.1.

3.4.8 Delivery

Service requirements and outputs

The enhancements will be delivered under a programme of work governed by a steering group with executive sponsorship.

There will be four primary workstreams:

a) Enhanced network monitoring
b) Enhanced network segmentation
c) PLC security framework
d) HMI local access control

Outputs in each case will be aligned and measured against specific CAF outcomes.

Procurement strategy and route

Under the programme of work, initial design activity associated with workstreams a), b) and c) will be undertaken with suppliers and existing agreements.

Design work for workstream d) will be conducted in-house.

Following confirmation of designs, the installation and implementation work for workstream a) will be conducted with the current solution provider, Rockwell Automation.

All other work including manufacturing of panels, configuration and software coding required for workstreams b), c) and d) will be subject to an RFQ and competitive tender process.

Table 55 - Summary table

Section	Recap of conclusions	Evidence highlights	Section
Introduction	The NIS directive and a legal requirement to comply with DWI CAF targets have required us to review cyber security capability of our OT systems. This has led to the creation of a programme of works aimed at reducing OT cyber security risk.	EU-NIS Directive	3.4.2
Need for Investment	The programme of works specifically targets OT assets critical to the essential service from the developing and ever-changing cyber threats that align to CAF targets set by the DWI, targets that without investment cannot be achieved.	eCAF March 2028 target PA Consulting supportive of programme content	3.4.3
Best options for customer	a) Enhanced OT network monitoring linked to a 24/7/365 Service Operation Centre (SOC) for alert management. b) Enhanced network segmentation to protect from lateral movement in the OT network if permitter cyber defences are compromised. c) Implementation of security framework at the PLC device level to further protect critical OT assets. d) Enhancement of HMI access controls and user specific accounts to protect critical OT operations.	Partial monitoring considered but residual risk unacceptable and unable to meet DWI CAF targets. Partial segmentation considered but residual risk considered high and does not meet DWI CAF targets. Partial implementation considered but residual risk considered high and does not meet DWI CAF targets. Alternative security measures but residual risk considered high and does not meet DWI CAF targets	3.4.5
Cost efficiency	Enhancement programme has been developed with estimated costs provided by an industry leading supplier with considerable expertise in both Cyber and OT.	Expert supplier cost estimates.	3.4.6
Customer protection	Failure to deliver enhancement programme will result in a failure to meet March 2028 eCAF target	Legal undertaking.	3.4.7
Delivery	Programme of works will be delivered through executive sponsored steering Group.	Existing supplier agreements, plus, RFQ and competitive tender process	3.4.8

Section	Recap of conclusions	Evidence highlights	Section
	RFQ and competitive tender process will support supplier selection for outsourced activity.		

LIKELIHOOD						
	Very Likely 5	5	10	15	20	25
	Likely 4	4	8	12	16	20
	Feasible 3	**3**	6	9	12	15
	Slight 2	2	4	6	8	10
	Very unlikely 1	1	2	3	4	5
		Insignificant 1	**Minor** 2	**Significant** 3	**Major** 4	**Critical** 5
	Severity					

Figure 39 - Risk Assessment Scoring Criteria

Device / System								Reference Number	
Unable to detection users and devices connecting localy to the automation network								OTCRA035	
Attack Scenario / Risk									
A threat actor who gains access to the local automation network can not be detected if they access the network on the local side of the site router although the threat actor does need to be present physically at the site to gain access. At present, protection and detection relies on the physical security measures in place which includes security doors and locks and security cameras at critical sites. However, a threat actor who has gained physical access to the site by either authorised or unauthorised methods can then connect to the OT network undetected.									
System(s) at risk									
S1	ICS control system		Multiple ICS system distributed across OT estate						
Risks									
R1	Undetected the threat actor can modify PLC, HMI and SCADA code impacting the sufficiency of water								
R2	Undetected the threat actor can apply malware to the ICS system								
R3									
R4									
R5									
MITIGATION									
M1	Physical security including electronic door locks in place at all sites								
M2	Intruder detection in place at most sites								
M3									
M4									
M5									
Risk Rating with Mitigations Deployed									
Severity	5	Likelihood	2	Score	10	Risk	Medium		
Additional Mitigations Identified									
AM1	Implement network monitoring at local automation network level and network access policy and procedure								
AM2	Implement permit to work procedure on automation network								
AM3	Implement alert detection response process (SOC) for suspicious network activity								
AM4	Add intruder detection devices(door alarm or similar) at sites that do not have it fitted. Access can then be cross referenced to permit to work.								
AM5									
Risk Rating with Recommended Improvements									
Severity	5	Likelihood	1	Score	5	Risk	Low		

Device / System								Reference Number	
User access control to HMI devices								OTCRA036	
Attack Scenario / Risk									
A threat actor with physical access to a HMI is able to modify settings with limited challenge at a the device level at present. The HMI devices installed do not inherently offer effective access control however, by adding additional hardware, a form of access and user identiy control can be achieved. Should an attacker gains access to the HMI device, they would in any case only be able to modify plant settings within the normal parameters of the site however, there would be no indication that anyone has modified site operating parameters which can lead to operation uncertainty and also to potential site/plant outages.									
System(s) at risk									
S1	ICS control system - HMI devices		Multiple ICS system distributed across OT estate						
Risks									
R1	The threat actor can modify HMI setpoints and operating parameters wiithout suitible access control impacting the sufficiency of water								
R2									
R3									
R4									
R5									
MITIGATION									
M1	Physical security including electronic door locks in place at all sites								
M2	Intruder detection in place at most sites								
M3	Simple code required to activate HMI screens associated with WQ parameters								
M4									
M5									
Risk Rating with Mitigations Deployed									
Severity	3	Likelihood	3	Score	9	Risk	Medium		
Additional Mitigations Identified									
AM1	Implement RFID access control with unique user tags								
AM2									
AM3									
AM4									
AM5									
Risk Rating with Recommended Improvements									
Severity	3	Likelihood	1	Score	3	Risk	Low		

Device / System								
Access to PLC devices (remotely or via local network)				**Reference Number** OTCRA023				
Attack Scenario / Risk								
A threat actor with access, either remotely or using a connection local to the PLC could modify the PLC code if they have the proprietary programming application or, exploit vulnerabilities on the PLC to impact the sufficiency of water. At a device level, some basic security features are enabled, for example preventing remote code modifications (compatible devices only) however the primary source of protection is afforded by permitter defences. At a local level, protection is achieved with physical security measures such as secure entry systems, video surveillance and intruder detraction. At the remote level, protection is afforded by firewall and network separation of the IT network and internet from the OT network.								
System(s) at risk								
S1	ICS control system	Multiple ICS system distributed across OT estate						
Risks								
R1	The threat actor can modify PLC code, compromising safety features, modifying dosing and altering operational behaviours.							
R2	The threat actor can exploit device vulnerabilities							
R3								
R4								
R5								
MITIGATION								
M1	Physical security including electronic door locks in place at all sites (protect local access)							
M2	Intruder detection in place at all sites (protect local access)							
M3	OT network separated from the IT network via firewall (protect remote access)							
M4	OT network not connected to the internet (protect remote access)							
M5								
Risk Rating with Mitigations Deployed								
Severity	5	**Likelihood**	3	**Score**	15	**Risk**	High	
Additional Mitigations Identified								
AM1	Apply security framework (manufacturer and device specific) at PLC level to protect from unauthorised access/modification							
AM2								
AM3								
AM4								
AM5								
Risk Rating with Recommended Improvements								
Severity	5	**Likelihood**	1	**Score**	5	**Risk**	Low	

Device / System								
Lateral movement within the OT network				**Reference Number** OTCRA037				
Attack Scenario / Risk								
The OT network is firewalled (separated) from the internet and the IT network. The OT network then consists of some 160 sites which in turn connect to regional SCADA. This network is then segmented at a site level by configuration in the router. There are some exceptions to this where sites need to communicate to other sites in the network for blend schemes and closed loop control type solutions, but the majority are logically segmented. This segmentation is critical to limit lateral movement in the OT network should any of the perimeter defences be compromised and a threat actor gain access to part of the OT network from where they can then move sideways. By using the same vendor and hardware, i.e. router to achieve network segmentation at a site level, some risk is present.								
System(s) at risk								
S1	ICS control system	Multiple ICS system distributed across OT estate						
Risks								
R1	The threat actor compromises the site based router enabling access to other sites on the OT network where devices can be accessed							
R2								
R3								
R4								
R5								
High								
M1	Site to site traffic protected via site router configuration							
M2	OT network separated from the IT network via firewall							
M3	OT network not connected to the internet							
M4								
M5								
Risk Rating with Mitigations Deployed								
Severity	5	**Likelihood**	3	**Score**	15	**Risk**	High	
Additional Mitigations Identified								
AM1	Deploy dedicated firewall solution at remote sites							
AM2								
AM3								
AM4								
AM5								
Risk Rating with Recommended Improvements								
Severity	5	**Likelihood**	1	**Score**	5	**Risk**	Low	

Figure 40 – Example Risk Assessment

3.5 Case 8: Security and Emergency Measures Directives (SEMD)

3.5.1 Summary

This Security and Emergency Measures Directive section sets out the business case for £526k of funding to for enhancements to a number of assets security standards to ensure compliance with the Security and Emergency Measures Directive. The case is supported by the DWI in their letter dated the 25th of August 2023. See section 6.1.2

The ministerial direction sets outcomes water companies must meet in the interest of national security and for the purpose of mitigating the effects of any civil emergency.

These necessary investments have been identified following security surveys of our critical assets associated with supply of water to our customers.

Table 56 - Summary of expenditure required for the period 2025-2030 (AMP8)

[INFORMATION REDACTED]

3.5.2 Background Information

SEMD requires Water and Sewerage companies to comply with the following obligations;

- Planning - companies have to make, keep under review, test and revise plans to ensure the provision of essential water supply and/or sewerage services at all times, including during a civil emergency or any event threatening national security.
- Resourcing – companies have to ensure they have the necessary capability, capacity and facilities to implement their plans.
- Securing – companies have to identify and mitigate against any security risks to the provision of water supply and/or sewerage services. There are additional requirements for companies who have been notified by government they have any Critical National Infrastructure designated sites.
- Responding – companies have to react promptly to incidents, including providing an alternative supply of water (where required).

The enhancement investments proposed in this case are primarily associated with the obligation to 'Secure'.We have submitted our proposals to the DWI for support. The DWI have reviewed, and we have received letters of support for all investments in this case from them. For further information on the response received please see section 6.1.2 of this Enhancement Case Appendix.

3.5.3 Need for Investment

[INFORMATION REDACTED]

[INFORMATION REDACTED]

3.5.4 Customer Support

We have carried out our most extensive customer engagement programme ever to ensure our PR24 plans are underpinned by robust customer and wider stakeholder preferences. Our strategic engagement programme started in early 2020 and has run through to summer 2023, with over 92,500 customers taking part in a wide range of SSC research studies, with their views being compared with those from our robust Business as Usual insight programme and wider industry studies. This programme has been assured by SIA Partners (see appendix SSC14) as meeting Ofwat's "high-quality" engagement standards, as outlined in its Customer Engagement Policy paper (February 2022).

Our strategy put forward is the best option to ensure our systems are not compromised which could result in loss of customer supply, reduction in customer supply, or modification to the quality of water supplied to customers as well as damage to assets, buildings and people. Through our customer engagement we see a clear thread of customers (household and non-household) expecting us to prioritise investments which ensure a reliable high-quality service is maintained 24/7 and they have shown a Willingness to Pay to for us to make investments that deliver on their priorities. Our customers in vulnerable situations, who rely on a consistent water supply to manage medical conditions, have expressed an even stronger preference for us to ensure we deliver a high-quality, reliable supply every day. Our customers' preferences align directly to the benefits that our proposed investment will bring, significantly decreasing the level of risk that customers will experience any service failures.

3.5.5 Best Option for Customers

In all the proposed enhancements cases the proposed investment represents the lowest cost / best value solution as no alternates lower cost solutions which provide compliance with SEMD requirements.

A do-nothing option has been considered, however this was discounted as it would not provide the required SEMD compliance.

3.5.6 Cost Efficiency

Cost estimates have been obtained from a minimum of two suppliers, and the costs quoted represent the lowest cost from those estimates. These works will be carried out as a package of work or opportunistic works carried out when other works are being carried out at the sites in question to ensure customers benefit from economies of scale or minimal mobilisation costs. The total cost estimate of £526k is considered efficient as although the security risks at these locations are low, the consequences are high.

3.5.7 Customer Protection

Whilst not passing the materiality threshold of requiring a PCD, the investment sought is directly linked to the DWI notice of support in our Annex to this appendix, section 6.1.2.

3.5.8 Delivery

This section should be read in conjunction with **Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.**

The SEMD programme of works will be delivered through either our existing term and approved suppliers utilised to support facilities management, ie surveillance equipment such as CCTV, and physical security, controlled access systems gates, fencing doors windows on existing facilities.

We have well established term relationships with our facilities management supply chain for delivery of both capital and repair and maintenance requirements. This supply chain is subject to annual resilience and capability assurance and regular reviews of performance to ensure that it is fit for purpose, resilient and delivers value for money. Where there are requirements to carry out more substantive works to water treatment or delivery assets, then our Infrastructure and Non-Infrastructure Frameworks Contracts will be utilised.

4. Providing High-Quality Drinking Water

These enhancement cases have been developed to secure the investment needed for delivery of our water quality ambition, following engagement with our customers and the Drinking Water Inspectorate.

The summary of our proposed Enhancement Totex is in **Table 57** below, presented in £K.

Table 57 – Section 4 Proposed Enhancement

Providing high-quality drinking water

Enhancement Case	Opex	Capex	CW3 lines
Case 9: Addressing raw water deterioration	0	28,069	CW3.97
Case 10: Reducing lead supplies	0	7,164	CW3.106, 3.109
Total	0	35,233	

4.1 Case 9: Addressing Raw Water Deterioration

4.1.1 Summary

This case sets out the investment we propose to make to continue providing clean, wholesome drinking water to our customers during the next asset management planning period and beyond. We are seeking £28.07m to mitigate deteriorating trends in raw water quality and improve final water quality across sites in the South Staffordshire and Cambridge regions.

These schemes are supported by Customers (see section 4.1.4 below) and our water quality regulator, the Drinking Water Inspectorate (DWI), see section 6.1.3, 6.1.4, 6.1.5 and 6.1.6 below for copies of the support notices obtained.

Within this enhancement case, we have separated the investment we require into four distinct areas of raw water deterioration. These are: Nitrates, Bacteria, Manganese & Antimony.

Table 58 - Summary of expenditure required for the period 2025-2030 (AMP8)

Investment	Enhancement Investment	AMP8 TOTEX £k	AMP8 Enhancement OPEX £k	AMP8 Base CAPEX £k	AMP8 Enhancement CAPEX £k	NPV £k
Morden Grange Pumping Station - Nitrates	Install nitrate removal plant	6,734	0	0	6,734	614,962
Cookley Pumping Station	Install UV plant	3,210	0	0	3,210	474,020
Maple Brook Pumping Station	Install UV plant	1,479	0	0	1,479	252,675
Pipehill Pumping Station	Install UV plant	1,508	0	0	1,508	336,664
Fulbourn Pumping Station	Install UV plant	843	0	0	843	54,141
Great Chishill Pumping Station	Install UV plant	793	0	0	793	38,318
Great Wilbraham Pumping Station	Install UV plant	1,657	0	0	1,657	257,019
Bourne Vale Pumping Station - Manganese	Install Cartridge Filters	2,219	0	0	2,219	129,764
Sutton Coldfield WSZ - Manganese	Ice Pigging 19km of mains	5,534	0	0	5,534	125,752
Fradley Pumping Station - Antimony	Drill additional borehole	4,090	0	0	4,090	1,030,342
	Totals	28,069	0	0	28,069	

As this case will demonstrate, we have taken a holistic, whole-system view of the water quality schemes listed above. Each of these schemes has a specific water quality outcome linked to our 2050 ambition, as well as outcomes that support other areas that are not necessarily water quality related. For example, the investment at Fradley Pumping Station will ensure downtime at the site is reduced, which in turn is critical to improving the level of supply resilience in a zone that is difficult to manage during peak demand periods. Furthermore, these water quality schemes are closely linked to our base capital expenditure programme.

Our base capital expenditure programme (for details on how this was programme please see Section 5.1 of SSC37 Our Asset Management approach to best-value investment planning throughout 2025-2030 and beyond Appendix) has a detailed set of investment requirements for each of these sites, based on a Hazard Review that took place in 2022. In addition to this enhancement expenditure, we will be investing via our base expenditure to ensure the new assets seamlessly integrate with the existing site and deliver the outcomes we have established in this case.

4.1.2 Background Information

This enhancement case looks at specific water quality parameters that we are required to have adequate treatment processes in place for to ensure safe, clean drinking water for our customers. For the sites listed in this enhancement case, we have identified the requirement to upgrade, or install new treatment processes within the AMP8 period. These investments are critical for maintaining a low level of Compliance Risk Index events (<1), which will become more challenging to achieve if raw water deterioration goes unmitigated. Other outcomes including Unplanned Outage, Customer Contacts about Water Quality, and Supply Interruptions will also see long-term benefit from these investments as we invest to mitigate changing conditions outside of management control. Details of the underlying risks and solutions are presented in this after development with the DWI, our colleagues, and customers.

We have submitted our proposals to the DWI for support. The DWI have reviewed, and we have received letters of support for all investments in this case from them. For further information on the response received please section 6.1.3, 6.1.4, 6.1.5 and 6.1.6 of this Enhancement Case Appendix.

Costs provided in this case have been built by a third-party engineering consultant, who worked with stakeholders across our business to understand the likely design and scope of works. For these investments, a unit cost library was utilised by our supporting third party. Further information on our costing methodology can be found in Section 7.1 of SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.

The sources identified below are part of our longer-term supply plan, as referenced in our Water Resources Management Plan (WRMP). We will be continuing to invest in these sites as part of our ongoing base maintenance programme to address risks that have been identified to our existing assets and processes. This is to ensure that the sites remain in supply by mitigating the known risks associated to our asset base.

Table 59 - Key Information

Information criteria	Description/ Unit of measurement
Location of any proposed installations	**Cambridge regions sites:** Morden Grange Pumping Station (Nitrates) Fulbourn Pumping Station (UV treatment) Great Chishill Pumping Station (UV treatment) Great Wilbraham Pumping Station (UV treatment) **South Staffs region sites:** Cookley Pumping Station (UV treatment) Maple Brook Pumping Station (UV treatment) Pipehill Pumping Station (UV treatment) Bourne Vale Pumping Station and Sutton Coldfield WSZ (Manganese) Fradley Pumping Station (Antimony)
Volumes [2]	**Cambridge regions sites:** Morden Grange Pumping Station (1.5 Ml/d) Fulbourn Pumping Station (3.28 Ml/d) Great Chishill Pumping Station (1.06 Ml/d) Great Wilbraham Pumping Station (9.09 Ml/d) **South Staffs region sites:** Cookley Pumping Station (18 Ml/d) Maple Brook Pumping Station (10 Ml/d) Pipehill Pumping Station (12.6 Ml/d) Bourne Vale Pumping Station and Sutton Coldfield WSZ (4.5 Ml/d) Fradley Pumping Station (12 Ml/d)

4.1.2.1 Nitrates – Morden Grange Pumping Station, Cambridge

A key core pathway element in our Long-Term Delivery Strategy (LTDS) is to ensure that all sites remain below the currently allowed Prescribed Concentration or Value (PCV) level for Nitrates, which is currently set at 50mg/l. There is one site where treatment will be required for rising nitrates levels during AMP8. Projections show that on average, nitrate levels at Morden Grange will be consistently over the PCV. If the PCV is exceeded, then the site must be taken out of

[2] These volumes are achievable, with enhanced treatment, within licence limits.

supply until concentrations fall below the threshold. Morden Grange is a pumping station in the Cambridge region. This site is part of the Heydon WSZ and supports the area to the west of Cambridge.

The selected option is to install a full stream Ion Exchange Plant (IEX) at the site for effective removal of nitrates from the raw water. Catchment investigations show that the nitrates are naturally occurring within the ground through historic use of fertiliser. We are seeking funding of £6.73m for installation of the new treatment plant. This investment at Morden Grange will be in conjunction with our base maintenance investment plans. At this site we have identified risks associated to our contact tank, instrumentation, health and safety and security. We plan to address these through base maintenance expenditure in AMP8.

4.1.2.2 Enhanced Disinfection – Various Sites, South Staffordshire

As part of the development of the LTDS component of our PR24 business plan and associated AMP8 core pathway enhancement schemes, we received the outputs of a study commissioned through Atkins that considered climate change and impacts on groundwater quality. This study considered a literature review of a scoping study undertaken by the British Geological Society, commissioned by the Environment Agency in 2022 to improve the understanding of the impacts of climate change on groundwater quality. Specific to our groundwater assets, Atkins have also reviewed case studies for Permo-Triassic Sandstone (located in our South Staffs Region) and Chalk (located in our Cambridge Region) aquifer information. Several conclusions were drawn from this review, the most significant being a high confidence in increased rainfall/recharge seasonality and greater magnitude of extreme winter rainfall and recharge events, which may result in pollutant spikes. As part of our submission of evidence to the DWI, to obtain support for our enhancement investments, we additionally reviewed a link between historical raw water quality failures and the conclusions from the Atkins study, plus the outputs of an internal hydrogeological risk review. A core pathway element of our LTDS is to ensure that we have no sites that are marginally dosed with Chlorine for the treatment of organic matter and bacteria.

We plan to enhance six of our marginally dosed sites with the installation of Ultraviolet (UV) treatment processes across both regions equally. The sites have existing chemical treatment processes, with marginal dosing of chlorine. In line with our LTDS disinfection policy, we are upgrading with UV treatment processes to avoid the significant risk of site outages when microbiological failures are detected. In undertaking this upgrade in a planned manner, we can mitigate operational risks associated with removing the site from supply as a reactive measure to a raw water quality failure. In a reactive event, the source would be out of supply for a prolonged period (likely to be many months) until we can mobilise and deliver the necessary enhanced disinfection solution. Due to the operational criticality of the identified sites, this proactive movement to UV treatment will mitigate the potential risk of raw water quality deterioration, which could impact customers drinking water quality and our water supply interruptions performance commitment. We will spend £9.49m at these six sites to ensure that supplies remain resilient for customers now and in the future. Installation of enhanced disinfection at these sites will complete our long-term programme to upgrade all our marginal dosing sites.

4.1.2.3 Manganese – Bourne Vale Pumping Station and Sutton Coldfield WSZ, South Staffordshire

Our Bourne Vale site has seen increasing concentrations of manganese in the water that goes out into distribution within the Sutton Coldfield WSZ. Whilst Manganese is not a health concern, there are downstream consequences that can affect customers, such as significant discolouration of water supplies. The current levels of manganese are below PCV but over the last fifteen years these lower levels have been accumulating in the downstream WSZ (Sutton Coldfield) which have caused discolouration events at customer properties. The Sutton Coldfield WSZ is currently ranked second highest in the region for customer contacts about water quality. The first-ranked WSZ is Hopwas, however this zone has a smaller population in comparison to Sutton Coldfield. To remove this excess manganese and improve quality of the final product, we are seeking funding of £7.75m for a whole-system solution. First, we are proposing to install a manganese removal process at Bourne Vale PS to ensure that accumulation in the network does not continue. We will then undertake a mains cleaning program within the Sutton Coldfield WSZ to remove the manganese sediment that has been accumulating over time. This will mitigate the risk around introducing further manganese into the WSZ and deal with that deposited historically. The expected output being the mitigation of a long-term deterioration in performance commitment measures, particularly for customer contacts for discolouration. This would be particularly impactful during a major event such as a burst main.

4.1.2.4 Antimony – Fradley Pumping Station, South Staffordshire

Our Fradley Site region currently runs on three Boreholes (BHs), one of which has higher concentrations of antimony (BH2). The water from BH2 is currently blended with BH1 & BH3 to ensure that levels are compliant in the final water. Data trends for the concentration of antimony in the final water shows an increasing trend that will reach unacceptable levels within AMP8, intersecting the current PCV level in year one of AMP9. This site directly supports the Outwoods WSZs and indirectly supports Winshill, Castleway and Hanbury WSZs, with at least 148,000 customers. The site is unable to operate if BH3 is out of supply for any period, as this borehole is critical to blending out the Antimony, which is a single point of failure with the operation of the site. BH1 and BH2 have perpetual abstraction licenses, whereas BH3 has a time expired license, due for renewal in 2027. We require a new borehole as well the refurbishment of the existing ones, to the value of £4.09m. The refurbishment is required to address the raw water deterioration, asset deterioration is not causing the increasing antimony trend. This raw water deterioration is outside of management control which means that the described works to the existing boreholes are necessary. The introduction of a new borehole (with lower antimony levels) will provide blending resilience if other boreholes are out of supply, particularly BH3. This new borehole will also provide resilience to operation of the site as it will allow for the facilitation of work on the other boreholes but is expected to still allow the site to operate to its licensed abstraction requirements.

4.1.3 Need for Investment

The following enhancement needs for investment have had the evidence and justification submitted to the DWI for appraisal. Following their review, we have received support from the DWI for all the investment needs that are set out below. To view the support letters, we have obtained please see section 6.1.3, 6.1.4, 6.1.5 and 6.1.6 of this Enhancement Case Appendix.

4.1.3.1 Nitrates – Morden Grange Pumping Station, Cambridge

This site shows a deterioration in nitrate levels that is forecasted to exceed compliance levels during the next investment period. Morden Grange is a single borehole site, with two further boreholes that are currently out of service and have been for more than five years due to the frequency of nitrate concentrations exceeding the PCV of 50mg/l. Treated water supplies Croydon Service Reservoir which subsequently supplies the Heydon water quality zone (estimated at 32,000 properties). The nitrates hazard at this site is largely down to the historic use of fertiliser on arable land within the catchment. Examining the catchment has showed limited viability for management of nitrate concentration using catchment management techniques. Delay/lag times for land use changes (impacting nitrate concentrations in aquifer) are calculated to be between 50 and over 200 years for the majority of the catchment. Given the large thickness of the unsaturated zone and a high proportion of grassland, much of the catchment is designated as having a low or moderate sensitivity to land use change.

The consequence of not addressing the rising nitrate trends will impact the availability of the source within the Cambridge supply region. Our Cambridge WSZ relies 100% on these groundwater sources, and Heydon zone, which

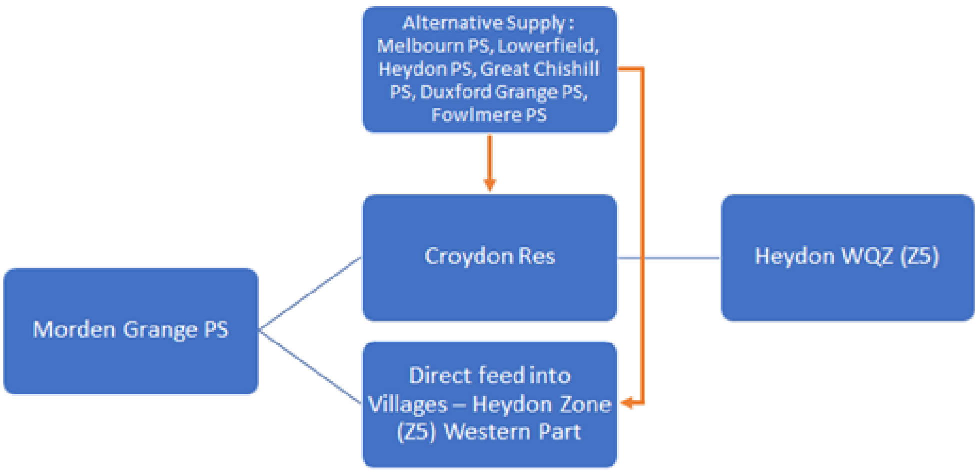


Figure 41 - Morden Grange Supply Schematic

Morden Grange supplies, has heavy reliance on this source being in supply, particularly during peak supply times. Morden Grange is supplies the Heydon WSZ directly, without this source the Heydon zone must have a larger proportion supplied from Heydon Reservoir. The reservoir is supported by pumping stations and transfer from the Cambridge Zone. Without Morden Grange, the zonal transfer becomes more critical, which takes water from other zones, impacting their storage levels. As the levels of nitrates at the site begins to exceed the PCV levels, failsafe at the site will begin to step in more regularly, shutting the site down to ensure that customers do not receive high-nitrate water.

The daily average output is 1.5 Ml/d. The current treatment process comprises of abstraction from the borehole using a submersible pump followed by super chlorination and disinfection in a contact tank and partial de-chlorination for final waters (using chlorine gas, sulphur dioxide). A minimum concentration value (Ct_{10}) of 15 mg/l.min hypochlorous acid as Cl_2 is applied. Treated water is then subjected to dosing with orthophosphoric acid for downstream plumbosolvency control. Nitrate concentrations within both raw water and treated water are sampled on a weekly frequency with no nitrate treatment currently in place. A review of the data shows that in the period of 2017 – 2023 the average nitrate concentration within the treated water (BH1 in use only) was 42.32 mg/l (see **Figure 42**).

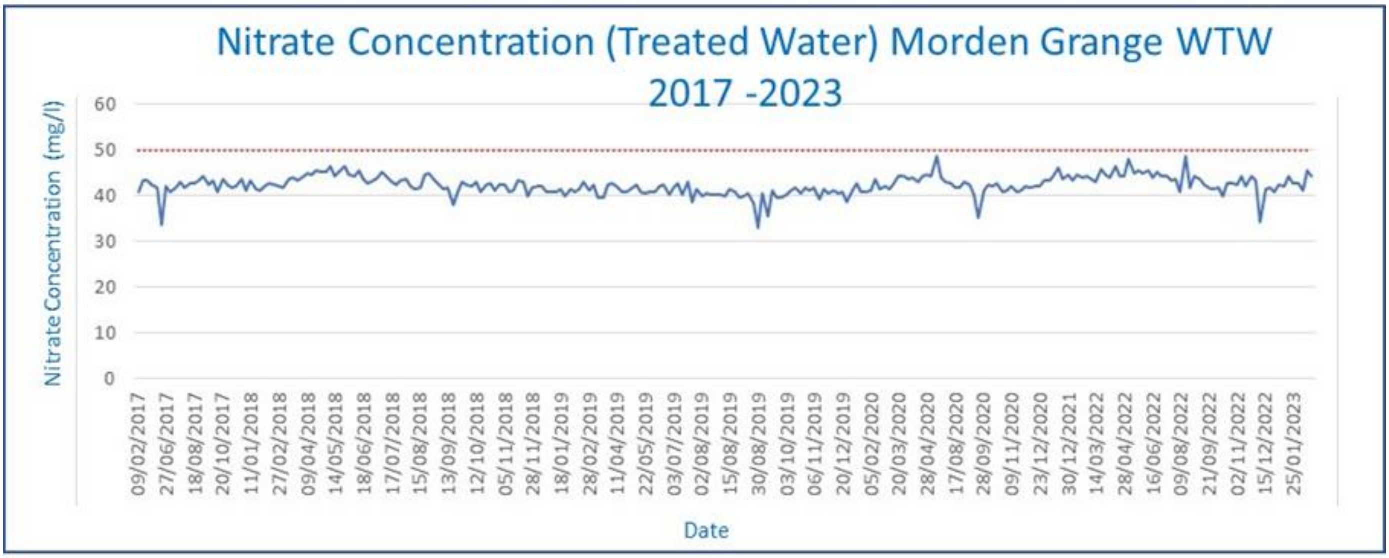


Figure 42 - Historic Monthly Average Nitrate Concentrations at Morden Grange vs PCV limit

Whilst initial examination of the data shows only a marginal increase in nitrate concentrations since 2017, historic analysis (monthly average) shows a more significant increase with the average nitrate concentration during the period of 2007-2011 being 38.99 mg/l. Company modelling forecasts that average nitrate concentrations shall exceed 45 mg/l during the period of 2025-2030. The site currently has online monitoring with shut down arrangements in place to prevent the supply of unwholesome water to customers. Morden Grange has been taken out of supply three times in the last four years with an average duration of 113 days.

2019: 1.4 days

2021: 328.7 days

2022: 9.8 days

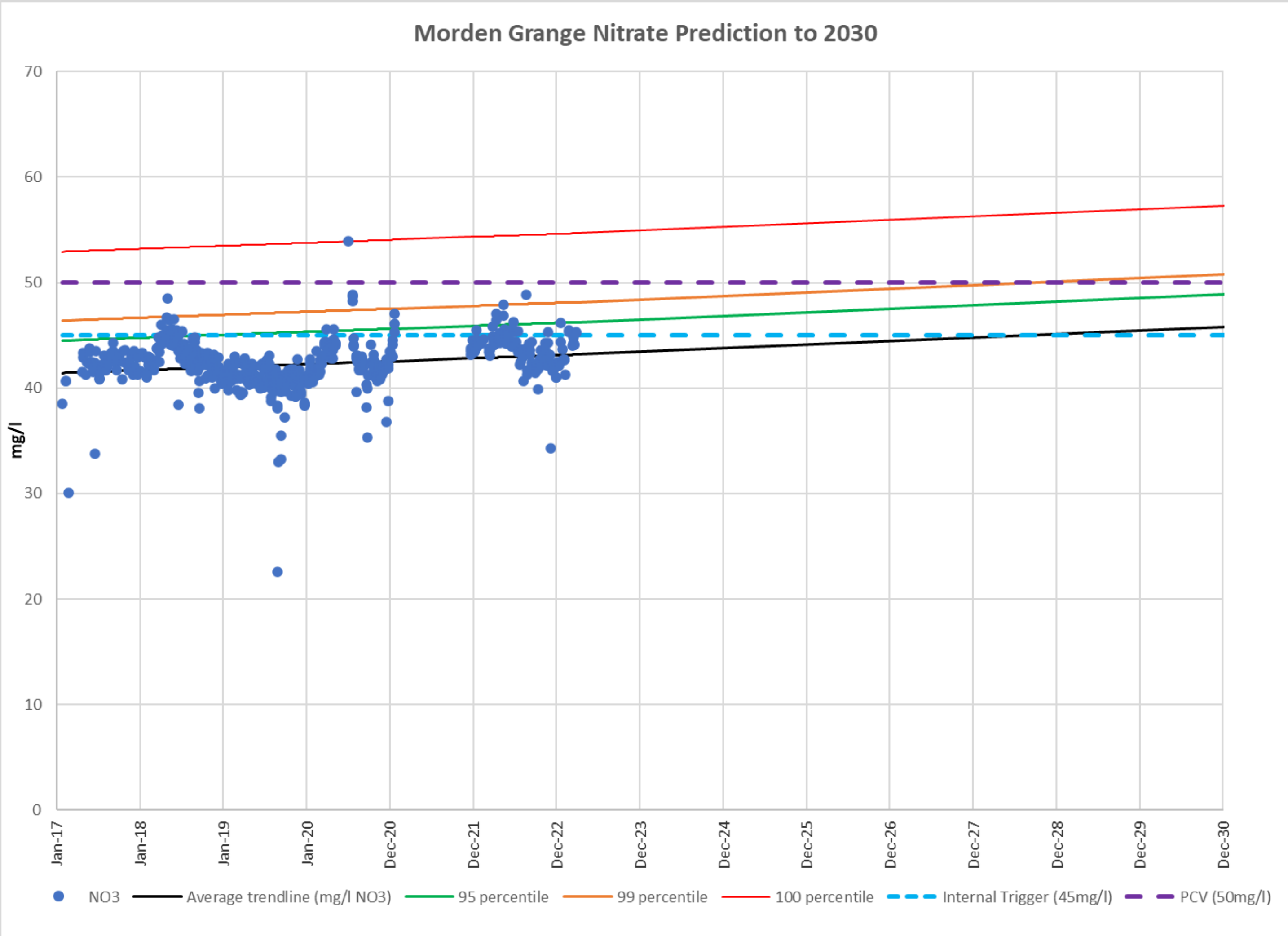


Figure 43 - Forecast Nitrate Concentrations at Morden Grange

Figure 43 above shows the 95th, 99th and 100th percentiles. The data set uses both raw and treated nitrate data from supply samples. The data suggests that on average, by the end of AMP8 we will be sampling above our 45mg/l trigger on the prediction points.

4.1.3.2 Enhanced Disinfection – Various Sites, South Staffordshire

To demonstrate the need for investment in AMP8 to mitigate future deterioration in raw water quality at critical operational sites in our network we have compiled information across 4 key areas to highlight why we are forecasting a deteriorating risk position associated with the following sites identified for this programme of work.

The six sites in scope of this programme are:

- Cookley Pumping Station (SST), water from three boreholes is marginally chlorinated using sodium hypochlorite, followed by orthophosphoric acid and hexafluorosilicic acid dosing. There is a dependency between Cookley pumping and Kinver pumping station, another pumping station in the same WSZ. Cookley water is blended with Kinver so the loss of the Cookley site is compounded by having to take Kinver out of supply.
- Maple Brook Pumping Station (SST), water from four boreholes is marginally chlorinated using sodium hypochlorite, followed by orthophosphoric acid and hexafluorosilicic acid dosing.
- Pipehill Pumping Station (SST), water from four boreholes is treated by ion exchange for nitrate and pesticide (chlorthal) removal, marginally chlorinated using sodium hypochlorite, followed by orthophosphoric acid and hexafluorosilicic acid dosing.
- Fulbourn Pumping Station (CAM), raw water is marginally chlorinated using sodium hypochlorite.
- Great Chishill Pumping station (CAM), raw water is marginally chlorinated using sodium hypochlorite.
- Great Wilbraham Pumping Station (CAM), raw water is marginally chlorinated using chlorine gas. Orthophosphoric acid is also dosed at the site.

Together, these sites supply a population of over one million people with a combined pumping capacity of fifty-three megalitres of water per day, which accounts for 10% of our peak pumping capacity.

The 4 key areas which we have compiled information for are as follows:

1. Commissioning of Atkins engineering consultancy to review climate change impacts on groundwater quality.
2. Detailed review of historical raw water quality failures and potential links to the Atkins study conclusions
3. Water Supply Zone modelling to clearly understand the criticality of each site in terms of our operational supply resilience.
4. Internal hydrogeological risk review through our Water Strategy team to demonstrate potential risks following source – pathway - receptor methodology assessment.

1. Commissioning of Atkins engineering consultancy to review climate change impacts on groundwater quality.

As part of the development of the LTDS component of our PR24 business plan and associated AMP8 core pathway enhancement schemes, we received the outputs of a study commissioned through Atkins that considered climate change and impacts on groundwater quality. We present the key points and conclusions that this study offered as evidence as to why we need enhanced disinfection in AMP8, at the identified sites.

This study considered a literature review of a scoping study undertaken by the British Geological Society, commissioned by the Environment Agency in 2022, to improve the understanding of the impacts of climate change on groundwater quality.

The below are selected processes that are discussed in the literature review.

- Higher temperatures and increased rates of recharge potentially enhancing biogeochemical reactions and transport of point and diffuse source contaminants.
- Wetter years causing groundwater chemistry to vary, especially for major element ratios due to modified groundwater-surface water interaction times.

- Increasing dissolved organic matter due to enhanced degradation of soil organic matter from increasing temperatures.
- Increasing shallow groundwater temperature in line with rising temperatures, hence changing the groundwater quality: decrease in pH and oxygen saturation from increased microbial activity and enhanced organic matter mineralization.

Specific to our groundwater assets, Atkins have also reviewed case studies for Permo-Triassic Sandstone (located in our South Staffs Region) and Chalk (located in our Cambridge Region) aquifer information. The general conclusions from the case studies were:

- High confidence in increased rainfall/recharge seasonality and greater magnitude of extreme winter rainfall and recharge events, which may result in pollutant spikes. May be offset by dilution.
- Increase in temperature could increase degradation rates of contaminants but could be marginal.
- Direction of changes in long term recharge is uncertain.

For further information on the case studies please see the following table which summarises the climate change impacts on ground water quality for the Permo-Triassic Sandstone, taken from the Atkins study (2023).

Table 60 – Atkins Study summary for potential impact on South Staffs Region sandstone boreholes.

Climate change projection	Potential impact and risk for SST P-T sandstone BHs
Increased temperature	Increased reaction rates for degradation of contaminants (nitrate, pesticides & industrial contaminants) but likely to be a small effect.
Increase in extreme winter rainfall	Increased spikes of pollutants from flushing, leaching and mobilization. May be offset by dilution. Surface flooding may mobilize contaminants and increase vulnerability at headworks. Could result in increases in nitrates, pesticides, turbidity and local point source pollutants (e.g. industrial contaminants such as metals, sulphate, chloride and organic compounds).
Drier summers	Increases in summer concentrations of contaminants from reduced dilution but baseline summer recharge is low so unlikely to be a large effect.
Land use change (climate induced)	Change in contaminant sources and recharge pathways. Potential to lead to significant change but highly uncertain.

The following table summarises the climate change impacts on ground water quality for the Chalk, taken from the Atkins study (2023).

Table 61 – Atkins Study summary for potential impact on Cambridge Region chalk boreholes.

Climate change projection	Potential impact and risk for CAM Chalk BHs
Increased temperature	Increased reaction rates for degradation of contaminants but likely to be a small effect.
Increase in extreme winter rainfall	Increased spikes of pollutants from flushing. May be offset by dilution. Surface flooding may mobilize contaminants and increase vulnerability at headworks. Could result in increases in nitrates, pesticides, turbidity and local point source pollutants.
Higher groundwater level maxima from increased winter recharge	Mobilization of agricultural pollutants (nitrate and pesticides) stored in the soils, infill materials and unsaturated zone. However, eFLaG data do not indicate higher winter GWL in this area (but do not show the extreme highs/lows).
Drier summers	Increases in summer concentrations of contaminants from reduced dilution but baseline summer recharge is low so unlikely to be a large effect.
Wetter winters and drier summers	Increase in size of seasonal fluctuations in water levels. Decrease in thickness of unsaturated zone in spring, potentially decreasing the timelag for nitrate to reach the water table. However, eFLaG data do not indicate higher winter GWL in this area (but do not show the extreme highs/lows).
Land use change (climate induced)	Change in contaminant sources and recharge pathways. Potential to lead to significant change but highly uncertain.

In both cases, Atkins have identified that, based on current available information, the risk that has the highest confidence in being realised is extreme weather trigger events such as high rainfall leading to groundwater moving at a different rate because of flushing.

2. Detailed review of historical raw water quality failures and potential links to the Atkins study conclusions

We have extended the review period of our raw water quality data at these 6 sites and reviewed the recorded rainfall in the same period as the historical failures (coliform and E.coli detections). It is evident in most cases that the rainfall in the month prior to detection is significantly higher than the average in that given year.

Table 62 - Review of Raw Water Quality Detections 2010-2021 compared with average annual and monthly rainfall

Site	Detections Month/Year (Raw Water Quality)	Average Annual Rainfall* in year of detection (mm)	Average Rainfall in month prior to detection (mm)
Cookley	None	N/A	N/A
Maple Brook	March 2011 (Running to waste)	39.7	53.7
	June 2011	39.7	62
Pipe Hill	July 2012	76.4	147.5
Fulbourn	February 2017	49.3	82.9
Great Chishill	August 2019	43.1	40.8
Great Wilbraham	None	N/A	N/A

*Average Annual rainfall is based calculated from the monthly mean rainfall values.

Further, in August 2023, we have seen a further detection on Maple Brook BH1, as a result BH1 has been taken out of supply. Reviewing the latest Met Office data published for August. For the central region of England, the data shows rainfall in July at 205% of the long-term average rainfall for 1961-1990.

3. Water Supply Zone modelling to clearly understand the criticality of each site in terms of our operational supply resilience.

In the event of the above risks becoming realised in AMP8, we will need to remove the site from supply until the marginal disinfection process can be replaced with enhanced disinfection treatment. This will have a significant duration to deliver, when undertaken in a reactive way.

We have identified these sites to proactively move to enhanced disinfection and mitigate the potential risk of raw water quality deterioration, which could impact customers drinking water quality and our water supply interruptions performance commitment. These sites are critical to our supply resilience based on the following factors.

Cookley

- A critical source to the Shavers End WSZ. It provides 35% of the production into the zone.
- Shavers End WSZ does currently have a good amount of emergency storage and is classified as an amber risk zone. Shavers End No. 2 Reservoir is approaching end of asset life. It is currently expected that in AMP9 the reservoir will need to be removed from service. This dramatically increases the risk to the WSZ, moving it into a **red risk zone** (<12 hours emergency storage). It is essential that the production sources are resilient when this operational decision occurs.
- Currently Prestwood and Kinver production sites (the other pumping stations in the Shavers Zone) are both installed with enhanced disinfection to support their resilience.

Maple Brook

- In a peak week scenario, the emergency storage in Gentleshaw Reservoir is an average of 8 hours (modelled diurnal demands).
- Maple Brook PS is a critical source to the Cannock High WSZ. It provides **32% of the required production** into the zone. Cannock High WSZ currently has a poor amount of emergency storage and is classified as a **red risk zone**. That is based on no source inputs, but the storage with any one source remaining in supply takes the zone into an amber risk.
- Seedy Mill WTW can supplement the loss of Maple brook, but this does mean changing pumping to other zones to move the required water over to the Cannock High zone. Increased treated flows at Seedy Mill could also be required to make up any deficit. This will also have a negative impact on Blithfield Reservoir conservation.
- A loss of Maple Brook in peak demand can have a negative effect on strategic storage.

Pipehill

- Pipehill PS provides 40% of the Hopwas and Glascote zonal demand. Although Seedy Mill can make up for the loss of water this does put stresses on other WSZs and on Blithfield Reservoir conservation.
- In a peak week scenario, the emergency storage in Hopwas Reservoir has an average of **6 hours.** The emergency storage in Glascote Reservoir has an average of 19 hours (modelled diurnal demands).

Fulbourn

- Fulbourn is 1.6% of the source production for the zone.
- This is a critical source for the Cambridge region as all sources are critical due to the supply demand balance headroom being very narrow. This means that a loss of production in a peak week will mean strategic reservoir losses with no room to recover until demand reduces.
- Peak week demand of 58 Ml/d. Note Cambridge also transfers to other zones which are dependent on Cambridge exports. The peak exports can be up to 40 Ml/d.
- Average demand of 47 Ml/d. Note Cambridge also transfers to other zones which are dependent on Cambridge exports. The average day demand export can be up to 29 Ml/d.

Great Chishill

- Great Chishill produces 21% of the source production for the zone.
- This is a critical source for the Heydon & Croydon zones as all sources are critical due to the supply demand balance headroom being very narrow. The zone already needs to be supplemented from neighbouring zones and is unable to be self-sufficient.
- If there was a loss of Great Chishill in a peak week scenario, there would be a reliance on Cambridge zone to make up for the loss of water.

Great Wilbraham

- Great Wilbraham produces 8% of the source production for the zone.
- This is a critical source for the Cambridge region as all sources are critical due to the supply demand balance headroom being very narrow. This means that a loss in production in a peak week will mean strategic reservoir losses with no room to recover until demand reduces.
- Peak week demand of 58 Ml/d. Note: Cambridge also transfers to other zones which are dependent on Cambridge exports. The peak exports can be up to 40 Ml/d.
- Average demand of 47 Ml/d. Note: Cambridge also transfers to other zones which are dependent on Cambridge exports. The average day demand export can be up to 29 Ml/d.

A significant amount of storage in the Cambridge region is concentrated in the Cambridge, Madingley, Croydon and Heydon zones. Linton in the south-east of the region, and Bluntisham in the north-west appear to be the zones that have the least resilience given the large number of water towers that do not provide any significant amount of storage. The availability of the Cambridge region groundwater sites is critical to both meeting the supply demand balance in the region and to ensure that water transfers between zones – to get the water where it is needed – is available.

Due to the operational criticality of these sites, we cannot afford a raw water quality failure at any of these sites that takes a source out of a supply, for what would be a prolonged period – due to the reactive nature of delivery, until enhanced disinfection is in place. In this event, this will cause significant operational supply resilience impacts and challenge our water supply interruptions performance commitments, particularly when considering peak periods of demand.

4. Internal hydrogeological risk review through our Water Strategy team to demonstrate potential risks following source – pathway - receptor methodology assessment.

Whilst considering the academic reviewed risks associated to climate change and extreme weather events that could trigger changes in raw water quality, we have also undertaken an internal review of sites. This considered the following aspects.

- Geology
- Hydrogeology
- Aquifer vulnerability
- Catchment characteristics
- Potential pollution source
- Pathway
- Receptors

We feel this review further substantiates the risks of marginal disinfection no longer being appropriate by the end of AMP8. The review highlights the aquifer vulnerabilities and the potential pollution sources that have a pathway though the unconfined fractured/fissured aquifer to the borehole. Please see the following table for the outputs of this review.

Site	Geology	Hydrogeology	Aquifer vulnerability	Ground Water Assets	Catchment Characteristics	Drainage	potential pollution source	pathway	receptor	Commentary
Cookley	Unconfined chester formation of Sherwood Sandstone Group	Flows within the aquifer are predominantly through fissure flow. Where sandstones are well cemented, they can be considered to be partial barrier to downward flow but fracturing and fissuring will bypass that barrier where present	There are no overlying clay rich soils or units at the site and the aquifer is assessed as unconfined and highly vulnerable	3No Boreholes	Largely rural wider catchment but the site is located within the smaller village of Caunsall.	Foul drainage at the site and adjacent properties is connected to public sewer. Other standalone properties, some residential and agricultural are serviced by private sewage treatment plants.	yes - STP's, agricultural processes - pits, slurry applications	Unconfined fractured/fissured aquifer	Yes - Borehole	Following the Source - Pathway - Receptor Methodology. The site is classified as "at risk" of bacteriological contamination due to presence of all three factors required to create a pollution linkage.
Maple Brook	located at boundary with confining MMG, however predominantly unconfined SSG	Flows within the aquifer are predominantly through fissure flow. Where sandstones are well cemented, they can be considered to be partial barrier to downward flow but fracturing and fissuring will bypass that barrier where present	Some minor superficial deposits and near boundary with MMG however considered vulnerable to extent of unconfined strata	6No Boreholes	largely rural area with sporadic farmhouses and associated agricultural buildings	The site uses on-site Sewage treatment plant which also services adjacent single property. Integrated drainage largely constrained to areas of developed residential. Standalone properties are typically serviced by own standalone sewage treatment plant or septic tank.	yes - STP's, agricultural processes - pits, slurry applications	Unconfined fractured/fissured aquifer	Yes - Borehole	Following the Source - Pathway - Receptor Methodology. The site qualifies as "at risk" of bacteriological contamination due to presence of all three factors required to create a pollution linkage.
Pipe Hill	The main aquifer at the site is the Wildmoor Sandstone and Kidderminster Formation of the Permo - Triassic Sherwood Sandstone Group. The Wildmoor consists of well sorted, poorly cemented sandstone mudstone horizons. The Kidderminster consists of conglomerates and reddish-brown sandstones. The sandstones are cross bedded and pebbly. The conglomerates have a reddish-brown sandy matrix and consist mainly of pebbles of brown or purple quartzite.	The thickness of Wildmoor and Kidderminster is approximately 85m and 70m respectively. The full thickness of the Kidderminster is proved in onsite borehole by presence of Enville beds at base. Yields are predominantly within fracture zones between 25mbgl and 100mbgl. Yields drop progressively with depth within the well. Whilst none observed at the site superficial deposits locally are described as alluvium and till.	There are no overlying clay rich soils or units at the site and the aquifer is assessed as unconfined and highly vulnerable	4No Boreholes	largely rural area with sporadic farmhouses and associated agricultural buildings	The site uses on-site Sewage treatment plant which also services adjacent single property. Integrated drainage largely constrained to areas of developed residential. Standalone properties are typically serviced by own standalone sewage treatment plant or septic tank.	yes - STP's, agricultural processes - pits, slurry applications	Unconfined fractured/fissured aquifer	Yes - Borehole	Following the Source - Pathway - Receptor Methodology. The site qualifies as "at risk" of bacteriological contamination due to presence of all three factors required to create a pollution linkage.
Fulbourn	Mostly firm, pale grey to off-white blocky chalk with a lower part characterised by rhythmic alternations of marls and marly chalks with firm white chalk. Thin gritty, silty chalk beds act as markers in the sequence	Flow is predominantly through fissure flow, often rapid	No overlying superficial or confining layers, as such classified as vulnerable	1No Borehole	largely rural area with sporadic farmhouses and associated agricultural buildings	The site uses on-site Sewage treatment plant which also services adjacent single property. Integrated drainage largely constrained to areas of developed residential. Standalone properties are typically serviced by own standalone sewage treatment plant or septic tank.	yes - STP's, agricultural processes - pits, slurry applications	Unconfined fractured/fissured aquifer	Yes - Borehole	Following the Source - Pathway - Receptor Methodology. The site qualifies as "at risk" of bacteriological contamination due to presence of all three factors required to create a pollution linkage.
Great Chishill	Lowestoft formation overlying Chalk with subsidiary calcareous mudstone and flint.	Flow is predominantly through fissure flow, often rapid	Overlying lowestoft formation forms an impermeable barrier at surface to the south of the site. Site is still assessed as vulnerable as no cover present north of the site.	1No Borehole	largely rural area with sporadic farmhouses and associated agricultural buildings	The site uses on-site Sewage treatment plant which also services adjacent single property. Integrated drainage largely constrained to areas of developed residential. Standalone properties are typically serviced by own standalone sewage treatment plant or septic tank.	yes - STP's, agricultural processes - pits, slurry applications	Unconfined fractured/fissured aquifer	Yes - Borehole	Following the Source - Pathway - Receptor Methodology. The site qualifies as "at risk" of bacteriological contamination due to presence of all three factors required to create a pollution linkage.
Great Wilbraham	Generally hard nodular chalks with thin flaser marls and significant proportions of shell debris in part	Flow is predominantly through fissure flow, often rapid	No overlying superficial or confining layers, as such classified as vulnerable	3No Boreholes	largely rural area with sporadic farmhouses and associated agricultural buildings	The site uses on-site Sewage treatment plant which also services adjacent single property. Integrated drainage largely constrained to areas of developed residential. Standalone properties are typically serviced by own standalone sewage treatment plant or septic tank.	yes - STP's, agricultural processes - pits, slurry applications	Unconfined fractured/fissured aquifer	Yes - Borehole	Following the Source - Pathway - Receptor Methodology. The site qualifies as "at risk" of bacteriological contamination due to presence of all three factors required to create a pollution linkage.

Table 63 – Internal Hydrogeological Review Outputs

4.1.3.3 Manganese – Bourne Vale Pumping Station and Sutton Coldfield WSZ, South Staffordshire

This investment is in two parts but both parts have a dependency on each other. The first part of the investment is for removal of manganese at the Bourne Vale source to prevent accumulation within the downstream network of the WSZ that this source feeds. The second part is the removal of sediment that has accumulated over the years within the downstream pipework to reduce the risk of discolouration events at customer supplies. For customers to realise the full benefit, both investments need to be completed.

Bourne Vale is a groundwater site located in the central region of the SSW operational area. The site extracts water from one borehole. Water is treated then blended to supply water to the Sutton Coldfield Water Quality Zone. Bourne Vale blends with Seedy Mill WTW source water. The current monitoring and treatment process is shown in **Figure 44**:

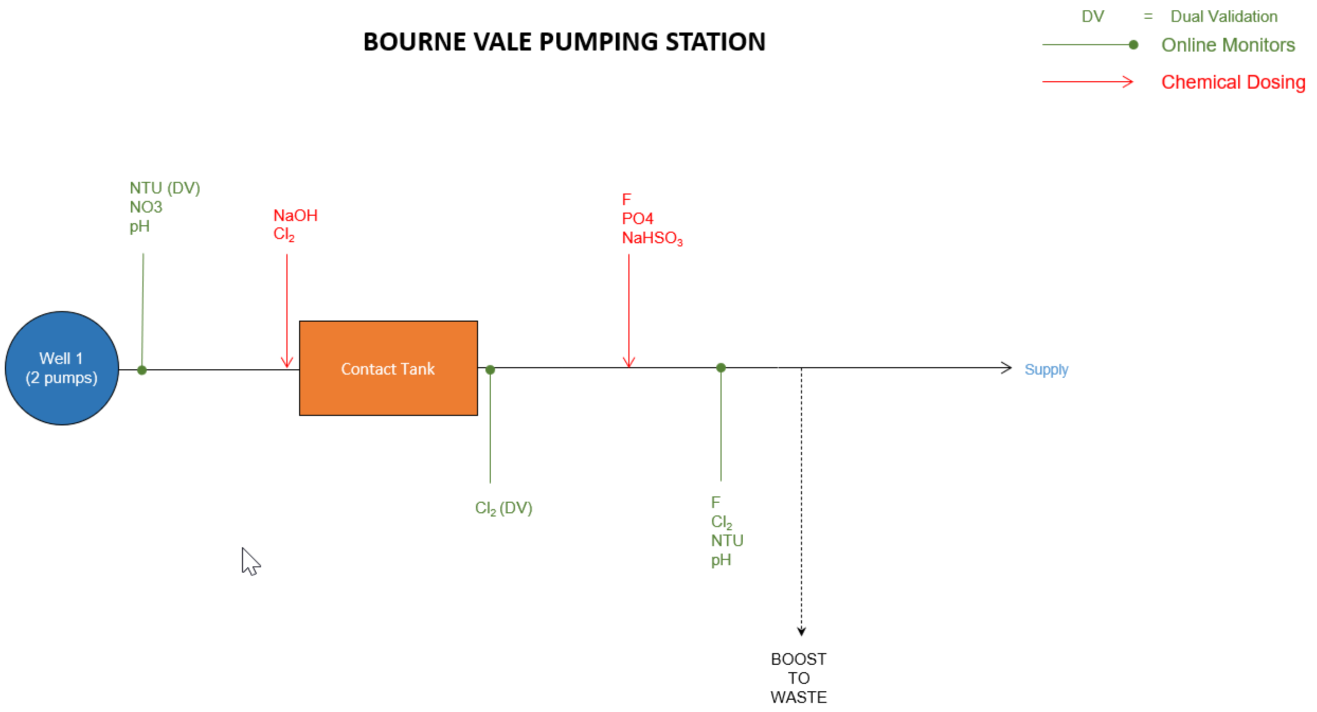


Figure 44 - Bourne Vale treatment process

Bourne Vale abstracts water from a single well via two pumps in a duty/standby arrangement, before entering a contact tank for disinfection. Sodium hydroxide solution is also dosed prior to the contact tank to increase the low natural pH of the water from site. Super-chlorination disinfection into a contact tank using sodium hypochlorite is used to achieve a minimum Ct value of 15 mg/l.min. To reduce plumbo-solvency, the water is conditioned with orthophosphoric acid (PO4) and fluoride is dosed on behalf of the health authorities to improve dental health. Dosing systems for Cl2, PO4 and fluoride are controlled by automated dosing systems which constantly monitor the dosing to achieve the required target. Dosing for PO4 and fluoride occurs after the contact tank. Turbidity is monitored after the contact tanks prior to going into supply. The regulatory level of turbidity which must be achieved before disinfection is <1NTU. After leaving the site water is blended with Seedy Mill water to achieve compliance with the iscolitrate standard (<50mg/l).

Examination of data below shows the manganese levels leaving Bourne Vale. The PCV is 50ug/l. This scheme is to improve treatment (manganese removal) at Bourne Vale and explore a viable solution to clean the mains in the Sutton Coldfield Zone (ZSU) to improve customer acceptability contacts for discolouration and mitigate the risk of pollution in the event of a mains failure causing an unplanned discharge event.

The following tables show the levels of iron and manganese, in the raw water and final water samples, over a 5-year period. The tables show the levels of manganese and iron in the raw water and final water at Bourne Vale. Previous manganese investigations have showed that there is an increased risk of iron discolouration if manganese levels exceed 2ug/l.

Table 64 - Bourne Vale raw water – Manganese (ug/l)

Year	Count of Mn	Average Mn	Max of Mn
2018	14	10.98	12.90
2019	8	11.20	12.80
2020	34	12.37	17.00
2021	48	12.30	15.80

2022	48	11.40	14.00

Table 65 - Bourne Vale final water – Manganese (ug/l)

Year	Count of Mn	Average Mn	Max of Mn
2018	54	15.50	381.00
2019	39	22.00	448.00
2020	51	11.68	18.80
2021	48	11.71	64.30
2022	48	16.23	250.00

Table 66 - Bourne Vale raw water (ABVB1) – Iron (ug/l)

Year	Count of Fe	Average Fe	Max of Fe
2018	14	5.59	33.90
2019	8	3.78	5.50
2020	11	4.31	8.10
2021	11	4.25	4.40
2022	10	7.01	7.30

Table 67 - Bourne Vale final water (BVPW) – Iron (ug/l)

Year	Count of Fe	Average Fe	Max of Fe
2018	1.00	9.30	9.30
2019	1.00	3.00	3.00
2020	1.00	4.00	4.00
2021	*	*	*
2022	2.00	7.30	7.30

During the review period 2018 to 2022 there have been 4 occasions when the levels in the final water have exceeded the PCV (50ug/l). Elevated levels of manganese in these samples were related to accumulated deposits in the sample line.

Table 68 – Final water manganese results (> 50ug/l)

Year	Sampled	Site	Operational Sample Mn Result	Compliance NTU Sample Result
2018	03-08-18	BV PW	381	0.25
2019	15-05-19	BV PW	448	0.1
2021	22-03-21	BV PW	64.3	0.1
2022	06-01-22	BV PW	250	0.61

As a mitigation to reduce the build-up of manganese in the sample line actions taken have included hard flush exercises to scour and remove accumulated deposits and increased frequency of sample line replacement. **Table 69** details the sample results from hard flush sampling following the reported elevated result in the final water on the 8th of January 2022.

Table 69 - Bourne Vale final water sample line hard flush exercise sample results

Date	Final Water	NTU	Mn	Comments
08-01-22	BV QCN	< 0.10	10.6	Pre hard Flush
08-01-22	BV QCN	19.3	2910	High Velocity flow for 10 Seconds
08-01-22	BV QCN	0.64	386	High Velocity flush post 3 minutes
08-01-22	BV QCN	45.7	14900	Post 5 minutes flush hard shocking
08-01-22	BV QCN	<0.10	11.1	Post hard flush 5 minutes normal flow

Figure 45 shows samples taken during the sample line flushing exercise. Discoloured samples have high levels of manganese present which have been removed from the sample line during the high velocity flushing.

Figure 45 - Samples collected from hard flushing exercises

We carry out regular hard flush (high velocity) operational exercises at Bourne Vale final water sample point to remove any accumulated deposits associated with manganese. Contact tank inspection shows the presence of sediments and staining of manganese, see **Figure 46**.

Figure 46 – Sediments in Bourne Vale Contact tank

Bourne Vale hydrogeology confirms that the source of manganese is naturally derived in the transition from the pebble bed layer and penetration of coal measures within the strata. The summary tables detail average and maximum levels of turbidity, manganese and iron of samples collected in the Sutton Coldfield WQZ during the period of 2018 - 2022.

Table 70 - Sutton Coldfield zone sample results Turbidity (NTU)

Year	Count of Turbidity	Average of Turbidity	Max of Turbidity
2018	55	0.10	0.30
2019	54	0.10	0.20
2020	56	0.10	0.20
2021	56	0.10	0.30
2022	54	0.10	0.30

Table 71 - Sutton Coldfield zone sample results Iron (Fe)

Year	Count of Fe	Average Fe	Max of Fe
2018	55	10.90	54.1
2019	54	9.2	31.6
2020	56	10.2	51.2
2021	56	8.8	42
2022	54	9.8	58.7

Table 72 - Sutton Coldfield zone sample results Manganese (Mn)

Year	Count of Mn	Average Mn	Max of Mn
2018	55	2.4	5.8
2019	54	2.3	6.9
2020	56	3.6	17.1
2021	56	2.6	12.5
2022	54	2.5	9.5

Figure 47 details the Manganese levels in the zone which are typically 3ug/l.

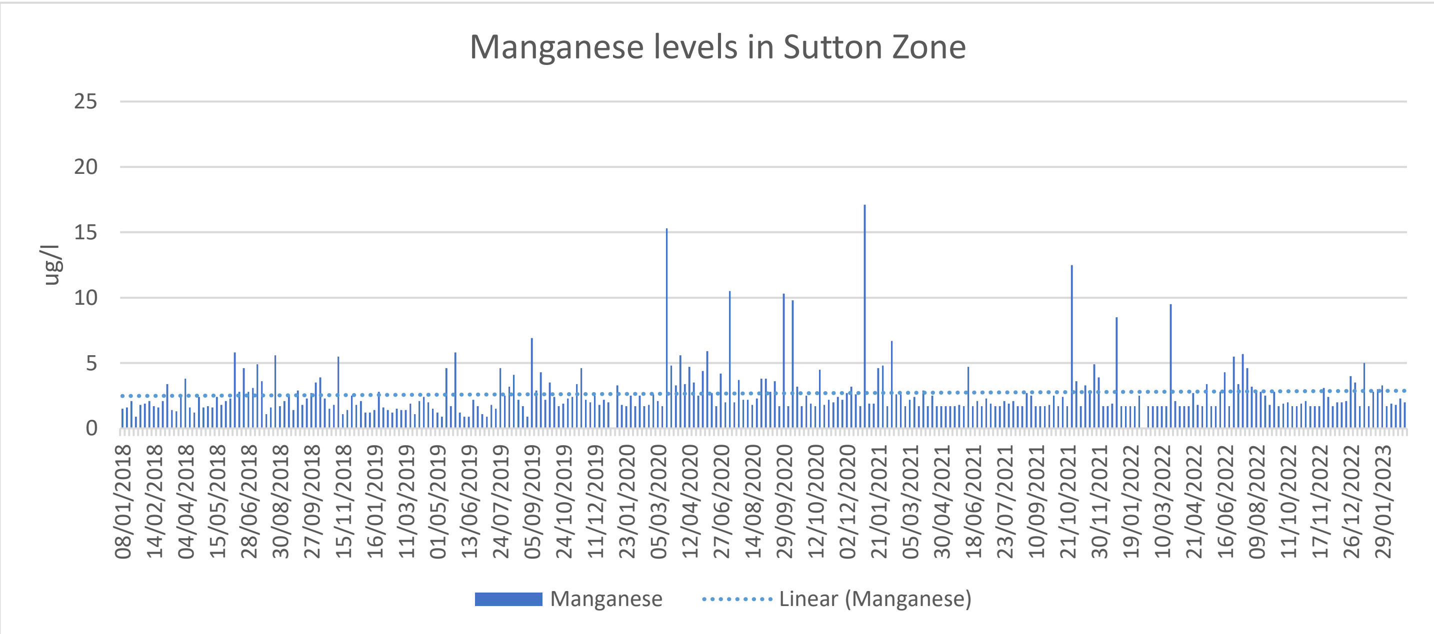


Figure 47 - Sutton Coldfield Zone manganese levels

Previous manganese investigations have showed that there is an increased risk of iron discolouration if manganese levels exceed 2µg/l. There were 284 samples taken from random properties in the Sutton Coldfield Water Quality zone between January 2018 and March 2023 where both the iron and manganese concentration were analysed.

- The average iron concentration was 10.0µg/l
- 16 samples above 20µg/l
- 3 samples above 50µg/l

12 samples were reviewed and the analysis of the manganese concentrations in these samples has shown a clear association between the manganese and iron concentrations, see **Figure 48**. Further analysis has shown that 50% of samples are above 2ug/l of manganese.

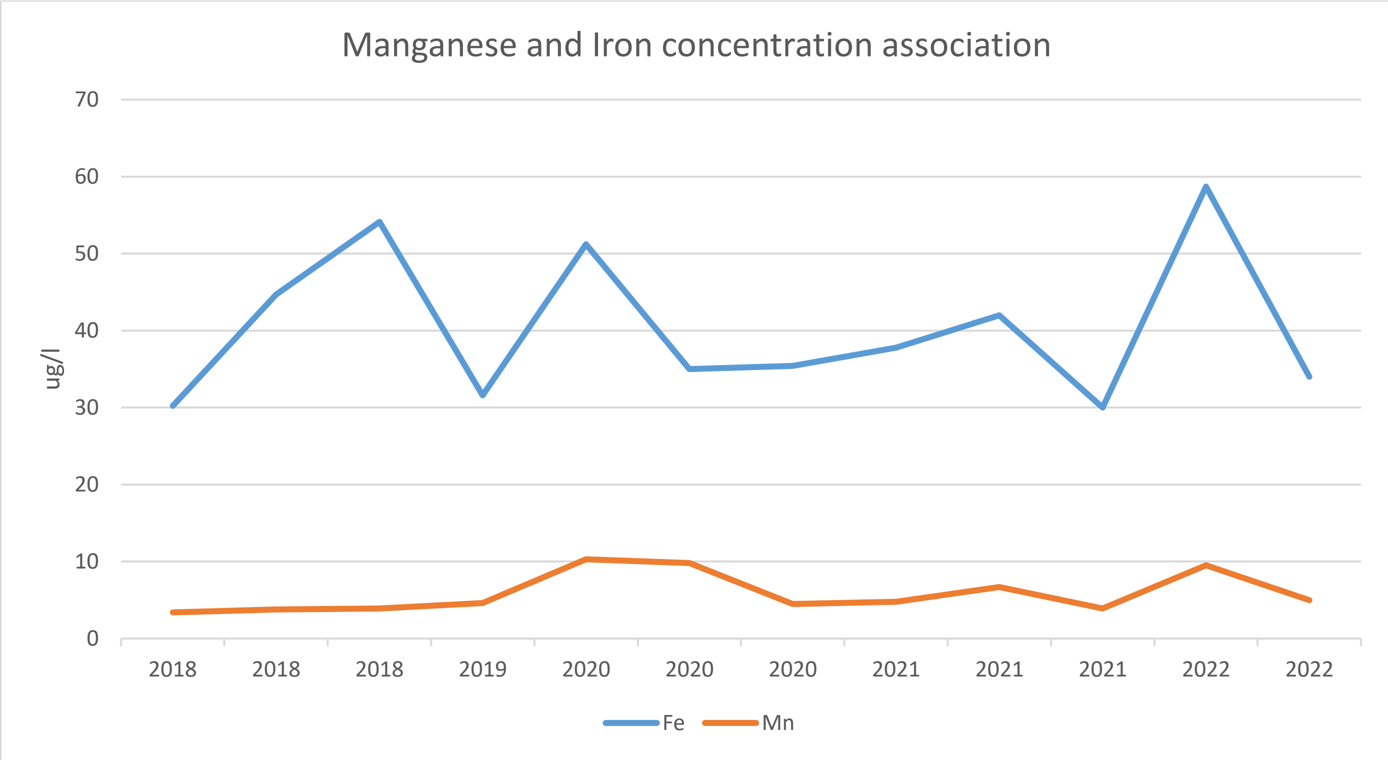


Figure 48 – Correlation between Manganese and Iron concentration

Figure 49 shows that the Sutton Coldfield WQZ exhibits discolouration contacts on a regular basis. Large peaks in contact rates in the Sutton Coldfield WQZ are shown in October 2018 and January 2021. The peak observed in Sutton Coldfield WQZ in October 2018 was related to a burst main, and the peak in January 2021 was related to the operation of a shut-valve which caused a disturbance which resulted in discolouration. Increased discolouration contacts are usually generated by changes in flow often associated with burst mains and maintenance works. As a comparison the Sutton Coldfield WQZ discolouration rate has been compared to Cannock High 1 zone which is similar in population and receives water from a groundwater source and Seedy Mill WTW.

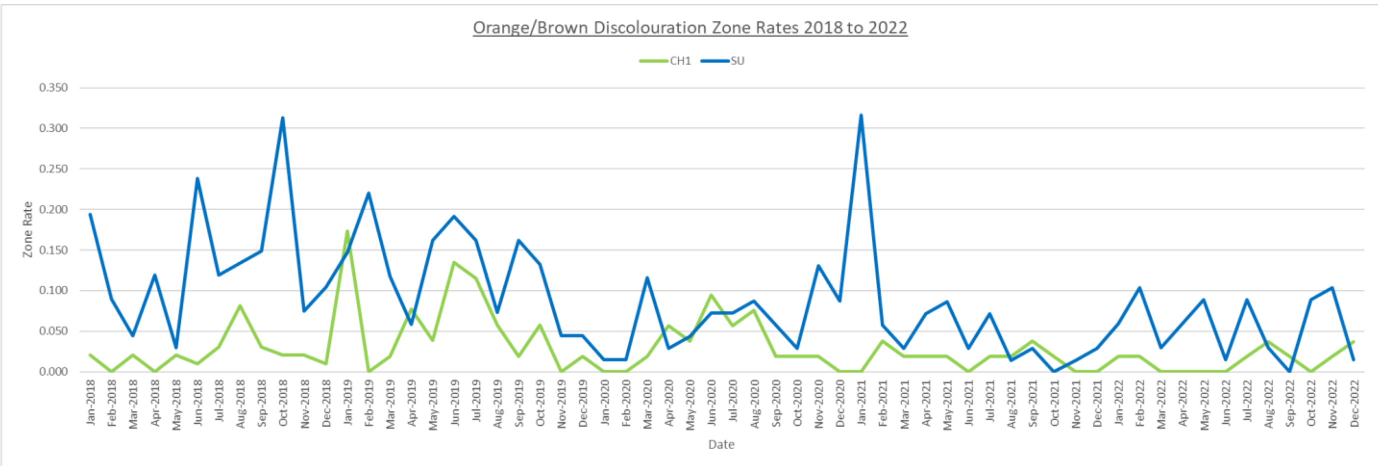


Figure 49 – Orange/Brown discolouration rates Sutton Coldfield Zone (SU) vs Cannock High 1 (CH1)

The SU WQZ is ranked at No 2 within the Company - discolouration contact rate. See **Figure 50**.

WQ Zone	Total ZR 2018-2022
HW	5.904
SU	5.302
BBN	4.996
CH2	4.448
BUR1	4.383
BUR2	3.782
SGY	3.772
WED	3.737
WAS	3.640
WIN	3.607
WAN	3.425
BBSW	3.021
RCL	2.908
WAC	2.763
WBN	2.737
HG	2.544
SPW	2.451
CW	2.373
BBSE	2.214
WBS	2.096
GLAW	1.821
CH1	1.729
GLAE	1.515
SPE	1.364
SVE	1.026
UTT	1.010
SVC	0.878
SVW	0.283

Figure 50 – Ranking of Discolouration contact data.

We have had several burst main events which have resulted in widespread discolouration in the Sutton Coldfield zone. As with most burst main events we would expect reports of no water and discolouration. However, events in the Sutton Coldfield zone have resulted in widespread discolouration across the water quality zone. DWI Reportable event- (Burst Water Main Sutton Coldfield 2018-6478) resulted in widespread discolouration. A systematic flushing plan was implemented to remove discoloured water from the network. See **Figure 51** below taken from the 3-day report to the DWI showing widespread discolouration contacts in the Sutton Coldfield Water Quality Zone.

From the available data the manganese levels in the borehole and final water have been consistent for the last 15 years. We are aware that the manganese leaving Bourne Vale for the last 15 years has travelled into the Sutton Coldfield water quality zone, which has accumulated and seeded the network over time and presents a higher risk of discolouration and ranked no 2 across all our regions. As the site has no current means of removing manganese from the water, we need to install a solution that does this and then remove any sediment build up from the distribution mains within the downstream WSZ.

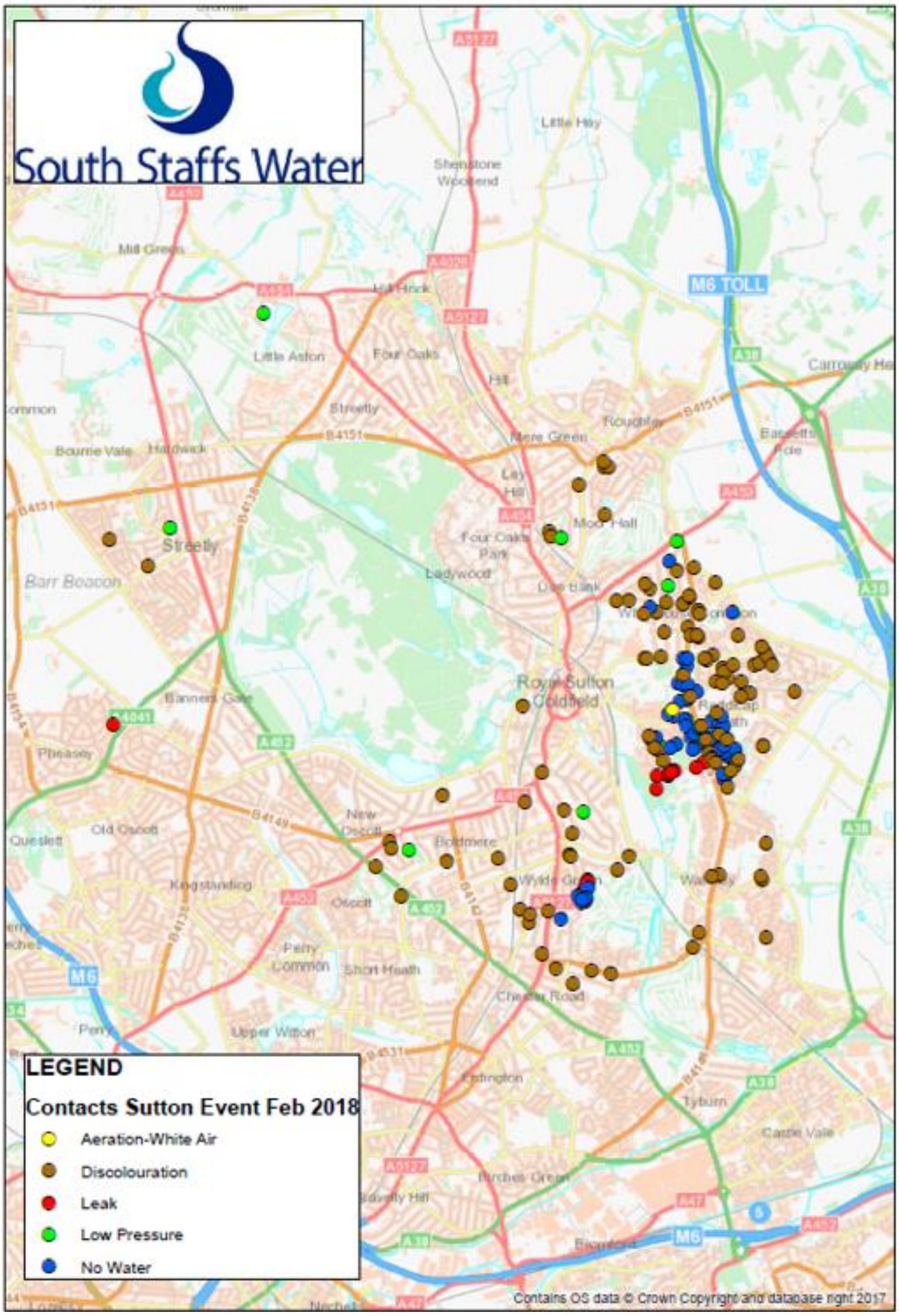


Figure 51 - Customer contacts of discolouration in Sutton Coldfield Zone

Other examples of non-reportable events (below the reporting trigger) include:

- 20 orange/brown discolouration contacts reported in the Sutton Coldfield zone between the 15th - 22nd October 2018 related to a burst main.
- 14 orange/brown discolouration contacts received in the Sutton Coldfield Zone between the 3rd and 4th February 2019.
- 8 orange/brown discolouration contacts reported in the Sutton Coldfield zone in January 2021 due to a disturbance related to flushing in the area.

4.1.3.4 Antimony – Fradley Pumping Station, South Staffordshire

Fradley PS requires investment to improve operational supply resilience to one of our largest areas. There are currently three boreholes on the site and one of these (BH2) contains high concentrations of antimony in the raw water. BHs 1 & 3 have low concentrations of antimony and are used to blend with the water from BH2. When water from BH 1 or 3 is unavailable, the whole site must be taken out of supply.

Fradley is a key water source within the northern part of our distribution network and supports the supply of water to northern WSZs (Outwoods and Winshill directly. Hanbury and Castleway indirectly). The design capacity of the site is 12 Ml/d with an average output of 9.4 Ml/d. The Outwoods WSZ contains three reservoirs, located at the same site, which provide the storage for the Outwoods zone. They have a total capacity of 28.09Ml. The zone's main supply is from Seedy Mill WTW and a borehole pumped supply from Fradley. There is an emergency resilience import into the zone called the Outwoods Infusion Valve Scheme from Barr Beacon Reservoir via the Seedy Mill WTW.

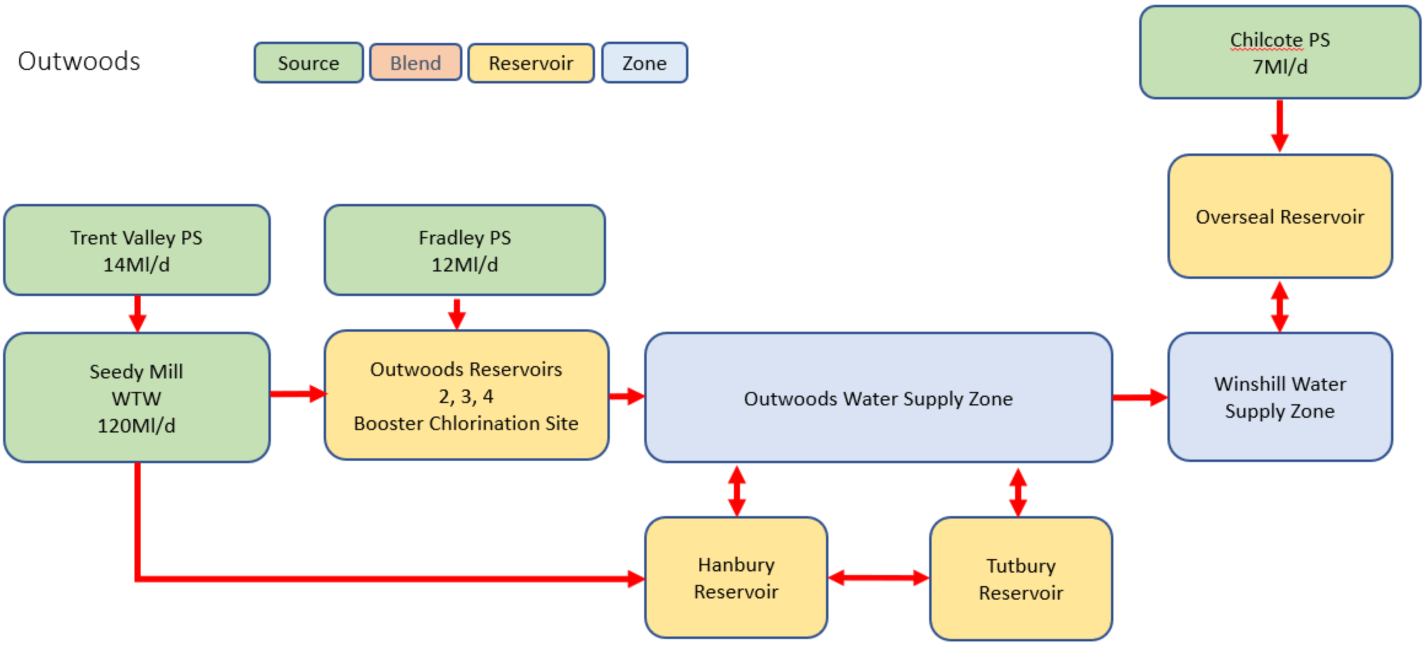


Figure 52 - Schematic of supply from Fradley PS.

There are existing treatment processes on site which include UV disinfection and chlorination using sodium hypochlorite, ferric sulphate coagulant and chlorine, all dosed prior to filtration through pressure vessels and sand filters. Orthophosphoric acid and fluoride are also dosed at the site. It is noted the current treatment process, oxidation, coagulation with ferric based coagulant and filtration is recommended for both antimony and arsenic removal, however the oxidation of arsenic from a soluble state to insoluble is faster than antimony (similar to faster oxidation of iron than manganese) (American Water Works Association, 2005) (Faust & Osman, 2000).

Historical monitoring data for antimony at Fradley BH2 shows an elevated level, above PCV, that requires blending with BHs 1 & 3 to maintain compliance. The trend is rising on BH2 and loss of BH3 threatens the operability of the site as it would need to be shutdown to prevent PCV breach. A scheme to secure ongoing compliance and maintain site resilience is therefore required. Forward forecast modelling of the rising trend and breach of blend capacity has been undertaken.

Table 73 - Fradley BH1 Antimony

Year	No. of Samples	Average Antimony (ug/l)
2018	42	0.10
2019	24	0.10
2020	64	0.20
2021	50	0.20
2022	48	0.20

Table 74 - Fradley BH2 Antimony

Year	No. of Samples	Average Antimony (ug/l)
2018	38	6.08
2019	26	6.73
2020	66	6.59
2021	46	7.63
2022	49	8.05

Table 75 – Fradley BH3 Antimony

Year	No. of Samples	Average Antimony (ug/l)
2018	N/A	N/A
2019	21	0.10
2020	72	0.20
2021	50	0.20
2022	50	0.20

Table 76 – Fradley Pumped Water Antimony

Year	No. of Samples	Average Antimony (ug/l)
2018	58	4.38
2019	120	1.37
2020	73	2.46
2021	49	2.88
2022	51	3.05

As **Figure 52**, Outwoods Zone schematic, above shows Fradley PS is critical to the Outwoods zone as it supports Outwoods Reservoir, along with water from Seedy Mill. This criticality is further amplified by the Hanbury and Winshill WSZs that rely on the Outwoods zone for supply of water.

Antimony is above the PCV in BH2 and on a rising trend. BHs 1 & 3 have low antimony and blend with BH 3 to maintain levels below PCV in water leaving the site. Under current blend arrangements at the rate of antimony increase in BH2 the blend is forecast to be non-compliant by 2031. Final water data collated since 2019, when BH3 was introduced to supply, has been forward forecast and shows breach of PCV at average levels by 2031 – see trend below in **Figure 53**.

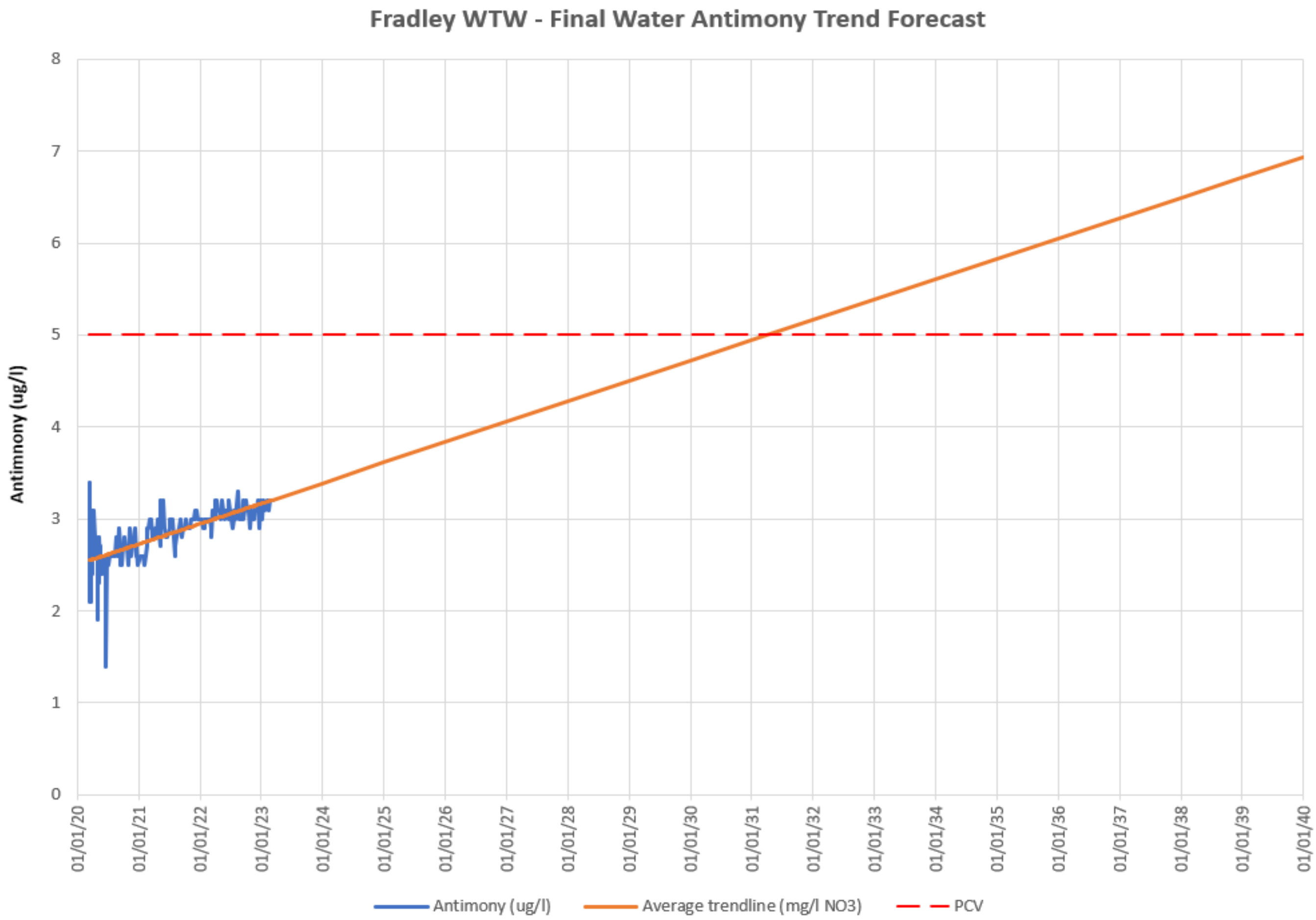


Figure 53 - Final Water Antimony trend forecast

4.1.4 Customer Support

A series of customer engagement sessions were held in June 2023, which tested investments within our enhancement plan to understand whether customers would support our plans. The quality of the water that customers receive was classified as being of "High importance" based on this qualitative study.

We have carried out our most extensive customer engagement programme ever to ensure our PR24 and WRMP24 plans are underpinned by robust customer and wider stakeholder preferences. Our strategic engagement programme started in early 2020 and has run through to summer 2023, with over 92,500 customers taking part in a wide range of SSC research studies, with their views being compared with those from our robust Business-As-Usual insight programme and wider industry studies. This programme has been assured by SIA Partners as meeting Ofwat's "high-quality" engagement standards, as outlined in its Customer Engagement Policy paper (February 2022). See appendix SSC14.

A key evidence source is appendix SSC11, which provides a thematic review of the key areas relevant to this investment case. It also highlights the golden threads that have consistently emerged across our engagement. The report also details the project objectives of each study used in the evidence base, when it took place and the numbers and types of customers and stakeholders engaged with. Specifically, please refer to section 15 for Water Quality.

Specifically related to water quality, we see a clear thread from our engagement towards customers (household and non-household) and stakeholders expecting to see investment to ensure a reliable high-quality, affordable service is maintained 24/7. Customers also expect further investment and innovation in infrastructure schemes to detect and predict problems to quickly fix and prevent any failures before their impacts are experienced, such as discoloured water.

Key customer evidence points to support this enhancement case include:

- A "reliable, high-quality supply" continues to be the number one priority for investment among our household and non-household customers – as evidenced in our Customer Priorities Tracker, which is a qualitative and quantitative study that has been running since 2020.
    - Our research shows that a reliable, high-quality supply, is one of two "super hygiene" areas, alongside bill affordability, highlighting the need for on-going targeted investment to deliver a high-quality service.
    - The chart below evidences the priority customers place on this area, and when making their trade-offs in the max-diff stated preference exercise, with **58%** selecting it as the more important area for investment and only **6%** stating it was the least important area of the service attributes shown. There were no significant differences between our two supply regions of note, or within any customer segments for this attribute highlighting the consistent response.
    - Importantly, customers priorities are now becoming more balanced over the 20 services areas tracked in the study, with social and environmental areas becoming increasingly more important over time. However, customers still view having a reliable supply as a basic service which SSC should be delivering to a high standard so that daily activities, such as drinking tap water, washing and cleaning, are not impacted.

Figure 54 – Year 3: Quantitative ranking of customer priorities for investment

Source: SSC Customer Priorities Tracker, year 3 report, April 2023. Representative sample of 1,072 household customers (including 62 future customers).

The insights from our Customer Priorities Tracker for water quality and supply reliability were also seen in our Long-Term Delivery Strategy (LTDS) customer engagement, which involved a multi-stage research programme of qualitative and quantitative research. The charts below show a summary of the research findings and highlight the strong and consistent level of support among all customer segments for SSC to deliver stretched ambitions for improving water quality. There is also evidence that many customers are expressing a preference for the company to deliver the targets put forward before 2050, although bill impacts to achieve this were not shown to them.

Customers want a balanced approach between investment into water treatment processes and activities which protect water sources used of human supply from becoming polluted.

Figure 55 – LTDS research outputs on our water quality improvement ambition

Source: SSC LTDS Research, July 2023 report. Representative sample of 1,080 household and non-household customers (including 82 future customers).

Moving on from the priorities customers have expressed, free from the constraints of bill impacts, the PR24 valuation studies undertaken highlight clearly a theme that both household and non-household customers are willing to pay (WTP) for investments to improve water quality and/or avoid service failures. Specifically:

- In Ofwat's Collaborative ODI Research (Summer 2022) an analysis of the results from SSC's customer base who took part shows that 3 of the top 6 service scenario attributes in terms of Willingness to Accept £m valuations were related to water quality and supply interruptions, with unplanned interruptions of up to 24hrs attracting the highest valuation.

- In SSC's PR24 Willingness to Pay Study (Autumn 2022) customers gave the highest WTP valuations for investments to reduce the risk of a "do not drink notice" occurring.

- The table below highlights the range of valuations that were developed from our technical triangulation framework, which was developed to triangulate WTP values to set central, upper, and lower values for use in Cost Benefit Analysis (CBA). This framework was academic peer reviewed end-to-end, and the valuations data sources challenged by our Delphi panel of expert stakeholders to help provide confidence in the WTP valuations used in Copperleaf. The framework was also given a Green (highest level) rating by SIA partners in its independent assurance of the technical triangulation approach developed for us to inform PR24 investment decisions by our partners Impact.

- As shown in the table, for attributes expressed in per property WTP values, the highest triangulated valuation is for ensuring water is safe to drink. See report SSC09 for full details of our technical triangulation approach and the valuation sets provided to us for use in Copperleaf to enable a range of sensitivity tests of customer preferences within Copperleaf.

This is a consistent thread through from customer priorities through to WTP valuations that provides robust evidence that customers support investments which ensure a high-quality water supply.

Table 5.2: Values (per unit) to be tested in Copperleaf (High RAG ratings, HH and NHH combined, total SSC)

COMBINED SSC	ALL - HIGHEST Central value	LOW NERA AND ODI - ALL OTHERS HIGHEST Central value	NO NERA - HIGHEST Central value	PRE PR24 Central value	ALL - HIGHEST Lower value	ALL - HIGHEST Higher value
Water not safe to drink (per property affected)	£73,592	£27,985	£5,983	£1,510	£14,779	£303,914
Flooding from a burst pipe (per property affected)	£23,775	£10,102	£2,090	£1,064	£4,983	£85,550
Unexpected temporary loss of water supply (per property affected)	£3,369	£1,832	£4,573	£506	£674	£14,259
Water hardness (per property affected)	£484	£437	£404	£381	£98	£1,762
Taste and smell of water (per property affected)	£2,116	£1,166	£2,876	£520	£423	£7,030
Low water pressure (per property affected)	£1,185	£582	£1,612	£74	£237	£3,991
Lead pipes (per property affected)	£39	£40	£50	£42	£8	£89
Water metering (per customer)	£8	£10	£8	£10	£3	£20

Figure 56 – WTP valuations sets used for sensitivity testing in Copperleaf

In terms of use of business-as-usual insights, a key driver's analysis (Shapely regression) of the 800 survey responses in our 2023 Customer Promises Tracker highlights that "tap water is safe to drink" is a key driver of overall service and that household customers who have not had to contact the company to report a service failure are significantly more satisfied with the overall service than those who have. This evidences that to deliver an overall positive experience to customers that this promise must be delivered on by us. This attribute has become a notably stronger driver of overall service since 2019/20.

This preference towards the need for on-going water quality investments was further evidenced in our qualitative acceptability and affordability business plan research (June 2023). Within this study we followed the official guidance and tested our proposed and least cost plans so customers could comment on their acceptability and affordability. The image below is taken from the qualitative report and highlights that most household and non-household customers expressed a strong preference to ensure water quality improvements, including tackling lead pipes. Customers are clearly concerned and increasingly aware of the impact that increasing level of pollution are having on water sources and the need to ensure any risks and removed trough the treatment process.

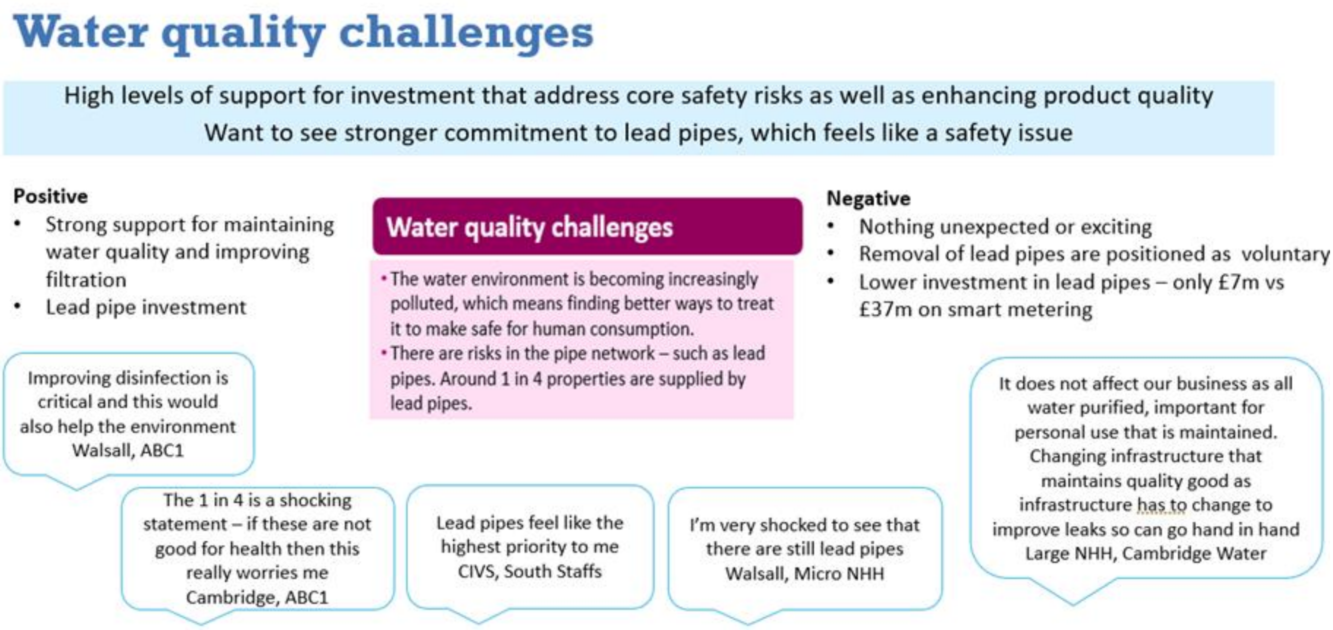


Figure 57 – feedback from customers in our PR24 AAT qualitative research on our proposed water quality enhancements.

4.1.5 Best Option for Customers

4.1.5.1 Nitrates – Morden Grange Pumping Station, Cambridge

Solutions with the catchment were discounted at early stage in the long-listing process when investigations showed limited viability for the management of nitrate concentrations using catchment management techniques. The likely time required for land use changes (which would impacting nitrate concentrations in aquifer) are calculated to be between 50 and over 200 years for most of the catchment. Therefore, given the depth of the unsaturated zone and high proportion of grassland, much of the catchment is designated as having a low or moderate sensitivity to land use changes.

Table 77 Morden Grange – outputs from long-listing stage

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Do not address rising nitrate trend, site will become unavailable	No capital expenditure	Ability to address project drivers and meet regulatory compliance. Technical feasibility. Deliverability.	Discarded	Availability of the source will continue to be impacted. The Cambridge WSZ relies 100% on groundwater sources, and the zone that Morden grange supplies, has heavy reliance on this source being in supply, particularly during peak supply times.
Full Stream IEX Process	Install a full Ion exchange process at site within current process.	Ability to address project drivers and meet regulatory compliance. Long term solution for customers.	Cost. Environmental Impact	Adopted	Costly solution that does meet the project drivers and should be considered as a shortlist option based on other options having lower uncertainty around efficacy.
Borehole Studies & Relining	Geohydrology study & Borehole assessment.	Technical Feasibility. Cost.	Potential to provide a long-term solution to customers.	Adopted	This could be a low-cost solution without building new assets but without confirmation that this is viable.
Network Blending	Create blend point with water from Affinity Water.	Technical feasibility. Cost. Ability to meet project drivers and regulatory compliance.	Ability to meet project drivers and regulatory compliance, based on WQ from Affinity Water.	Discarded	This could provide a long-term solution to help nitrates but is not within SSC control as the water source is from Affinity water. Affinity confirmed that nitrate levels from their bulk supply are between 40-42. This would not be viable for blending with water from the site.
Partial Ion Exchange Process	Install a side stream ion exchange process at site, treating partial flow	Technical feasibility. Provide a long-term solution for customers.	Environmental Impact	Discarded	Full stream with bypass taken forward following MCA scoring application and greater confidence in problem resolution using full stream IEX

Table 78 - Nitrate Treatment Options for Morden Grange Short list options

Options	Description	NPV (£k)	Cost (£k)	Decision
Full Stream IEX Process	Install a full Ion exchange process at site within current process.	614,962	6,734	Recommended alternative
Borehole Studies & Relining	Geohydrology study & Borehole assessment.	162,093	675	

The recommended alternative is the option that offers the most efficacy for reducing the risk around nitrates and station outage time compared with the other options that carry uncertainty around efficacy. This is the best option for customers to ensure that Morden grange is more resilient during peak demand periods despite rising nitrate trends in the raw water as described earlier in this document. There is no current evidence to support that borehole studies and relining will solely mitigate the levels of nitrates at the site so uncertainty around this option is reflected through the likelihood if this option being successful.

The appraised advantage of this solution is that these systems, for nitrate removal, are an established technology with a high removal efficacy. Additionally, there is sufficient space on site to accommodate new infrastructure and building, plus the tie-in points are readily accessible. We recognise that this option comes with additional waste and power requirements and is a more CAPEX and OPEX intensive solution.

The recommended alternative considered the following items as part of the option.

- A 1.5 Ml/d Ion-exchange (IEX) process unit to be incorporated within the existing process.
- System to include of secure kiosk and blind tank for wash collection with tanker collection point that will be tankered on a weekly basis.

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 79 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	Sufficient space to include the proposed solution near the anticipated tie-in point. Sufficient road access for a tanker to enter, withdraw, turn, and exit site. Sufficient power to meet increased needs to be established.
Climate Change	Constant tankering of brine solution not ideal, alternatives to be explored at detailed design.
Regulatory Shifts	Most resilient option if regulation nitrate concentrations decrease.
Demand	Option will improve supply and quality to end users.
Technology	Latest ion exchange technology to be utilised.
Unique Regional Factors	Conditions and variables unique to the South Staffordshire have been taken onto consideration. SSW familiarity with ion exchange for nitrate removal beneficial.

4.1.5.2 Enhanced Disinfection – Various Sites, South Staffordshire

Table 80 - Longlist options for marginal disinfection sites

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Continue to operate with marginal chlorine dosing	No capital expenditure	Ability to address project drivers and meet regulatory compliance.	Discarded	Does not meet the driver for addressing risks associated with the potential for raw water deterioration
New Duty/Standby low-pressure UV	Duty/standby, low-pressure UV system to the treatment process. New contact tank/main.	Ability to address project drivers and meet regulatory compliance. Provide a long-term solution for customers.	Solution scored low for carbon capture potential	Adopted	Meets the driver, lower opex cost than other solutions, can fit in current site.
New Duty/Standby medium pressure UV	Duty/standby, medium-pressure UV system to the treatment process. New contact tank/main.	Ability to address project drivers and meet regulatory compliance. Provide a long-term solution for customers.	Solution scored low for carbon capture potential	Adopted	Has a higher disinfection efficacy than lower pressure UV.
New Duty/Standby LED pressure UV	Duty/standby, LED UV system to the treatment process. New contact tank/main.	Ability to address project drivers and meet regulatory compliance. Provide a long-term solution for customers.	Solution scored low for carbon capture potential	Discarded	LED UV is currently in early stages of development and no suppliers with validated units available, difficult to cost
New Duty/Standby Ozone System	Duty/standby, ozone dosing system. Including, ozone generation system, dosing systems, inline static mixers, new 150m^3 contact tank. New contact tank/main.	Ability to address project drivers and meet regulatory compliance. Provide a long-term solution for customers.	Solution scored low for carbon capture potential	Discarded	High opex costs and required higher level of operator input which is not viable as these are predominantly unmanned sites

Table 81 - Enhanced disinfection summary of benefit values at all six sites

Options	Description	NPV (£k)	Cost (£k)	Decision
UV treatment at Cookley Pumping Station	Duty/Standby low pressure UV treatment solution	474,020	3,210	Recommended alternative at this site
UV treatment at Maple Brook Pumping Station	Duty/Standby low pressure UV treatment solution	252,675	1,479	Recommended alternative at this site
UV treatment at Pipehill Pumping Station	Duty/Standby low pressure UV treatment solution	336,664	1,508	Recommended alternative at this site
UV treatment at Fulbourn Pumping Station	Duty/Standby low pressure UV treatment solution	54,141	843	Recommended alternative at this site
UV treatment at Great Chishill Pumping Station	Duty/Standby low pressure UV treatment solution	38,318	793	Recommended alternative at this site
UV treatment at Great Wilbraham Pumping Station	Duty/Standby low pressure UV treatment solution	257,019	1,657	Recommended alternative at this site

The chosen solution is for the installation of UV disinfection across all six sites. This is in line with the business' disinfection policy and will provide site resilience in the future to ensure customers have the most reliable supply of wholesome drinking water.

Low Pressure UV systems were also selected as the preferred solution as they offer lower OPEX cost, less frequent bulb replacements and the installation footprint was not deemed a concern when reviewed at this desktop stage. Medium pressure UV systems were considered as they have higher disinfection efficacy and a smaller footprint, however the bulbs have a shorter lifespan, operate at higher temperatures, and has higher CAPEX and OPEX costs (inclusive of carbon and energy impacts) compared to low pressure systems.

We also considered newer technologies such as LED UV however after discussion with suppliers and industry, it was determined that despite the technology being promising there are no validated systems on the market currently, or likely to be in the immediate future. This option was therefore discarded; however, we will continue to monitor LED advancement and acceptability for any future projects.

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 82 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	Construction can be planned in such a way to significantly reduce shutdown duration and frequency for tying in new infrastructure. Both available power, and site power quality will require assessment to assess feasibility of adding UV.
Climate Change	Considered but no issues for future use.
Regulatory Shifts	Regulations may shift in future and be more onerous, if shifts are foreseen that would lend preference to medium pressure UV units and their high disinfection efficacy these must be considered.
Demand	Improved disinfection resilience will improve overall supply and quality to customers.
Technology	Latest low pressure technologies to be used. LED technology was considered; however, it is still very much in its infancy and not appropriate for the required time frames.
Unique Regional Factors	Conditions and variables unique to the South Staffordshire have been taken onto consideration.

4.1.5.3 Manganese – Bourne Vale Pumping Station and Sutton Coldfield WSZ, South Staffordshire

Table 83 - Longlist options - Bourne Vale WQ Enhancement (Manganese)

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Manganese deposits downstream will continue to accumulate	No capital expenditure	Ability to address project drivers and meet regulatory compliance.	Discarded	Does not meet the drivers or mitigate the risks
New Manganese removal filter system	4No. Pressurised manganese removal filtration system (with catalysed media) with backwash tanks and air scour.	Ability to address project drivers and meet regulatory compliance. Provide a long-term solution for customers. Technical Feasibility.	Solution scored low for carbon capture potential	Adopted	improve treated water quality and site resilience.
New Oxidisation, Precipitation and cartridge filter system with disinfection	New cartridge filter system to remove precipitated manganese.	Ability to address project drivers and meet regulatory compliance. Provide a long-term solution for customers. Technical Feasibility.	Solution scored low for carbon capture potential	Adopted	improve treated water quality and site resilience.
New Ion Exchange system	Ion Exchange unit downstream of the boreholes and upstream of chlorine dosing. Flow split proportional to incoming raw water quality.	Ability to address project drivers and meet regulatory compliance. Provide a long-term solution for customers. Technical Feasibility.	Solution scored low for carbon capture potential	Discarded	Currently no manganese removal resin within regulation 31 materials. SSW preference is to avoid Ion Exchange where possible.

Table 84 - Short list options - Bourne Vale WQ Enhancement (Manganese)

Options	Description	NPV (£k)	Cost (£k)	Decision
Install Pressure Filters for Manganese Removal	4No. Pressurised manganese removal filtration system (with catalysed media) with backwash tanks and air scour.	124,015	5,738	
Install Cartridge Filters for Manganese Removal	New cartridge filter system to remove precipitated manganese.	129,764	2,219	Recommended Alternative

The recommended alternative is to install cartridge filters for manganese removal. This option involves the following aspects.

- Utilisation (and conversion) of existing chlorine dosing and contact tanks at Bourne Vale PS into oxidation and precipitation stages. These treatment steps will allow the manganese to be precipitated into a form that can be removed by filtration.
- Filtration will involve cartridge filters, downstream of the contact tank to remove previously precipitated manganese. The cartridge filtration system may require a coagulant dose, but this will be determined at detailed design.
- Additional disinfection will also be required in the form of a new contact tank downstream of the filtration step to ensure disinfection is the last process step. No additional chlorine dosage is anticipated, but residual monitored downstream of filters.
- The solution will include a flow ratio bypass arrangement that can be used to control proportioning flow through the cartridge filter system.

This option was chosen as it offers a high degree of confidence in the ability of the solution to mitigate the risk. There are Reg 31 approved systems in place. This solution is well established and understood technology that is largely familiar to operational teams. It has a lower CAPEX cost than other shortlisted solutions. The solution does not have a liquid waste stream which would require disposal, which is a significant advantage. The solution does have OPEX costs but these will be dependent on the frequency of changing the cartridge filters. This will vary depending on the incoming concentrations of manganese. Additional to this, more monitoring and operational input is required to control the oxidation, precipitation process in comparison to direct filtration options.

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 85 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	Desktop studies indicate sufficient space for new infrastructure. Disposal of cartridges should be simple to meet compliance.
Climate Change	Considered but no issues for future use.
Regulatory Shifts	PCV limit and SSW target for manganese my reduce further in future. This option should sufficiently meet any further changes.
Demand	Option will significantly improve supply and water quality to the end user.
Technology	Latest technology in cartridge filtration.
Unique Regional Factors	Conditions and variables unique to the South Staffordshire have been taken onto consideration.

Table 86 - Long list options – Removal of sediment from mains in the Sutton Coldfield WSZ

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Do not clean mains and leave deposits within them	No capital expenditure	Ability to address project drivers and meet regulatory compliance	Discarded	Does not meet the drivers or mitigate the risks associated with manganese build up in the mains network
Ice Pigging	Clean approx. 19.2 km of water mains	Provide a long-term solution for customers Technical Feasibility	Cost	Adopted	Give thorough clean of all mains
Flushing	Clean approx. 19.2 km of water mains	Technical Feasibility Cost	Ability to address project drivers and meet regulatory compliance	Discarded	Aggressive flushing all the mains as a single solution would not clean the mains fully and could have a detrimental effect of damaging the existing Cast Iron water mains
Ice Pigging and Flushing Hybrid	Clean approx. 2.3km of PE and 4.6km of DI by flushing and clean 12.3km of CI by ICE pigging	Provide a long-term solution for customers. Technical Feasibility	Cost	Adopted	flushes the HPPE and DI water mains and ICE Pigging the CI making a small saving on cost but sacrifices a full clean on the HPPE and DI pipes

Table 87 - Short list options – Removal of sediment from mains in the Sutton Coldfield WSZ

Options	Description	NPV (£k)	Cost (£k)	Decision
Ice Pigging	Clean approx. 19.2 km of water mains	125,752	5,534	Recommended Alternative
Ice Pigging and Flushing Hybrid	Clean approx. 2.3km of PE and 4.6km of DI by flushing and clean 12.3km of CI by ICE pigging	98,545	4,161	

The recommended option is Option 1 Ice pigging of 19.2km of various size and material water mains. This option is chosen for the following reasons.

- A single cleaning method is more cost effective.
- It is a proven cleaning method which is fast and efficient compared to other cleaning methods, which will reduce the impact to customers.
- Once the enabling works have been completed no further excavations are required for the cleaning and tinkering, making it the safest cleaning method.
- Alternative cleaning methods such as swabbing could damage the existing pipework, especially older Cast Iron pipes, and have an increased risk of discolouration to the area.
- The discharge can be controlled, using tankers to remove away, so that it does not outfall into the existing sewer system which could cause an overload leading to flooding.
- The installed fittings, used for cleaning, will allow improved control of the network for any future use.
- Works to be carried out at night to limit disruption to the network, customers, and residents.

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 88 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	Enabling works must be carried out prior to cleaning. Large area for ICE pigging tanker and at exit point for waste tanker
Climate Change	Considered but no issues for future use.
Regulatory Shifts	Considered but no issues for future use
Demand	Considered but no issues for future use.
Technology	Most advanced technology for cleaning, ICE pigging, will be used for this scheme.
Unique Regional Factors	Conditions and variables unique to the South Staffordshire have been taken onto consideration

4.1.5.4 Antimony – Fradley Pumping Station, South Staffordshire

Table 89 - Longlist options

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Manage operations using existing borehole stock and do not address Antimony issue	No capital expenditure	Ability to address project drivers and meet regulatory compliance.	Discarded	Does not meet the driver or mitigate the risks associated with Antimony at this site
Borehole Condition and Antimony removal investigations	Investigate borehole conditions and investigate relining as refurbishment option. Process trials investigating Antimony removal efficacy and minor optimisation	Technical Feasibility. Deliverability. Cost.	Ability to address project drivers and meet regulatory compliance.	Adopted	Possible that investigations can improve the raw water quality and antimony removal efficacy with minor modifications and additions.
Borehole construction, refurbishment and decommissioning	Construction of new borehole (BH4) along with relining refurbishment of BH1 and decommissioning of BH2	Technical Feasibility. Ability to address project drivers and meet regulatory compliance.	Providing green solutions	Discarded	Similar delivery to options 1 & 2. No preference to decommission borehole 2 unless absolutely necessary.
Borehole construction and refurbishment of existing	Construction of a new additional borehole along with relining refurbishment of BHs 1 & 2	Ability to address project drivers and meet regulatory compliance. Technical Feasibility.	Cost	Adopted	Improve raw Water quality and site resilience.
Ion Exchange Treatment Process	Add IEX process to the existing PS treatment solution	Ability to address project drivers and meet regulatory compliance. Technical Feasibility.	Cost Providing green solutions	Discarded	Currently no Antimony removal resin within Regulation 31 materials. Preference against IEX if can be avoided due to operation and brine stream disposal.

Table 90 - Short list options

Options	Description	NPV (£k)	Cost (£k)	Decision
Borehole Condition and Antimony removal investigations	Investigate borehole conditions and investigate relining as refurbishment option. Process trials investigating Antimony removal efficacy and minor optimisation	1,000,849	2,085	
Borehole construction and refurbishment of existing	Construction of a new additional borehole along with relining refurbishment of boreholes 1 & 2	1,030,342	4,090	Recommended Alternative

The recommended alternative for the removal of antimony has been selected based on the best NPV for shortlisted options. Lower NPV for the borehole condition investigations based on uncertainty around efficacy of borehole refurbishment as a solution for reducing the concentration of Antimony in the raw water.

The selected option provides the following benefits.

- Removal of reliance on BH2, which is the only borehole with increased antimony concentrations, so meets the driver for this scheme.
- Improves resilience of the operation of the site. Site is a critical support for the Outwoods WSZ. This option will ensure increased availability of the site.

The selected option also provides resilience during the construction of the solution as the new borehole can be introduced with minimal interruptions to site output and will be available to support the site whilst the existing boreholes are being refurbished.

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 91 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	Demand management (shutdowns) will need to be implemented whilst BH investigations and remediations are implemented. Process investigations less likely to impact typical operation. All required work for new BH (Site investigations, construction etc) can be completed without interfering with existing TW until tie-in and commissioning.
Climate Change	Considered but no issues for future use.
Regulatory Shifts	Abstraction licences of BH 3 and new BH to be reviewed, as there is a high potential, they are not perpetual licences like BH 1&2.
Demand	Addition of a new BH with non-detectable antimony concentrations will significantly improve supply and quality for the customer.
Technology	Latest technologies in borehole investigations and refurbishments to be used. Similarly new BH to align with best current practices.
Unique Regional Factors	Conditions and variables unique to South Staffordshire have been taken onto consideration

4.1.6 Cost Efficiency

To demonstrate efficiency on cost, various costing exercises have been undertaken. As discussed previously in this document third-party consultants have supported the PR24 submission by leading the development of long list options for potential solutions that address the identified business risks/needs.

These business needs were established to have a driver that satisfied the OFWAT enhancement criteria. Drivers were quantified and confirmed within a series of internal Problem Statement documents. These documents formed the basis for a series of options included within the longlisting stage. Longlisting consisted of initial stakeholder engagement which also included confirmation of the need as well as high level potential solutions that would satisfy the requirements of the business and its customers.

At the long listing optioneering stage, the identified solutions at that point were provided with an estimated cost, based on industry cost models to inform decision making at that stage. This formed part of the criteria used to score solutions ahead of promotion of solutions through to short listing and feasibility appraisal. Additionally, the MCA assessment was used within a series of stakeholder engagement sessions to help determine appropriate shortlist options. Top level categories included:

- Ability to meet project drivers and regulatory compliance.
- Provide a long-term solution to the company.
- Providing Green solutions.
- Technical Feasibility.
- Deliverability.
- Cost.

Schemes that scored highly in these areas were selected for the shortlisting stage. Further stakeholder sessions were then undertaken to ensure detailed scopes were developed prior to costing. To develop the scopes further the consultants elicited information specific to sites. This included current processes and schematics to help inform where new solutions could be accommodated into the current layout sites.

Utilising the detailed scoping the shortlisted options were put through a detailed cost breakdown by the consultants. This was undertaken using.

- Cost modelling data
- Industry benchmarking
- Engineering experience
- Supply chain relationships.

The cost estimation considers civil, mechanical, electrical and automation requirements across the solution to provide cost confidence to support the value and appraisal of the proposals. This is achieved through models that contains actual outturn costs from similar solutions across the water industry. This appraisal identified the recommended solution for the investment need when considering capex costs, Opex costs, whole life cost and net present value.

Following completion of the above process we engaged with Gardiner & Theobold to undertake a review of our costing process. An output from this was to benchmark the accuracy and reliability of a representative sample of the cost estimates that our consultants had compiled.

For further detail on the above process that we undertook to develop, challenge, and continually refine our cost estimates please refer to Section 3 and 4 of SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.

4.1.7 Customer Protection

Customers will be protected against non-delivery of investment as the cases within this Section 4.1 have all received support from the DWI. This supports requires the submission of deliverables and milestones, as well as providing regular progress updates to this other regulatory body. Failure to deliver these investments will result in enforcement action from the DWI. For further information on the DWI response and support for our proposed investments please see below references.

4.1.7.1 Nitrates – Morden Grange Pumping Station, Cambridge

We append the DWI notice of support in our Annex to this appendix, section 6.1.3.

4.1.7.2 Enhanced Disinfection – Various Sites, South Staffordshire

We append the DWI notice of support in our Annex to this appendix, section 6.1.4.

4.1.7.3 Manganese – Bourne Vale Pumping Station and Sutton Coldfield WSZ, South Staffordshire

We append the DWI notice of support in our Annex to this appendix, section 6.1.5.

4.1.7.4 Antimony – Fradley Pumping Station, South Staffordshire

We append the DWI notice of support in our Annex to this appendix, section 6.1.6.

4.1.8 Delivery

This section should be read in conjunction with Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.

As the scale of these programmes are relatively modest it is not expected that delivery will prove challenging for our existing or retendered AMP8 framework contractor supply chain.

4.1.8.1 Nitrates – Morden Grange Pumping Station, Cambridge

The proposal is for a nitrate removal plant delivered as a standalone project costed at > £6m. These works will be delivered under the Non-Infrastructure Assets Delivery Framework contract which will be retendered for AMP8. The nature of the works and expected risk profile are such that the works will be contracted as NEC4 Option A (fixed price with activity schedule). Given the value of the works the intention would be to tender the works as a mini competition to ensure best value for money.

4.1.8.2 Enhanced Disinfection – Various Sites, South Staffordshire

The proposal is for the installation of UV disinfection plants at Cookley, Maple Brook and Pipehill in South Staffs and Fulbourn, Great Chishill and Great Wilbraham in Cambridge.

These works will be delivered under the Non-Infrastructure Assets Delivery Framework which will be retendered for AMP8. The UV projects will be combined into a batch expected to be valued at >£9m. This will enable economies of scale, and efficiency of delivery to be secured for the UV programme. It also provides for certainty of workload for the supply chain, enabling the successful contractor to resource up and plan procurement to ensure timely delivery of components. Given the value of the works, a mini tender competition will be held to ensure value for money. The risk profile and scope of these projects will enable the use of an NEC4 Option A (fixed price with activity schedule).

4.1.8.3 Manganese – Bourne Vale Pumping Station and Sutton Coldfield WSZ, South Staffordshire

We will invest in 19km of mains ice pigging which will be delivered under the Infrastructure Assets Delivery Framework or alternately a standalone contract given the specialist nature of the works. The estimated cost of the programme of works is >£3m, as such would be subject to mini competition. The works would be delivered as a programme or programmes of work under an Option B contract.

We will invest in new cartridge filters at Bourne Vale PS. The estimated cost is > £1.3m. These works will be delivered under the Non-Infrastructure Assets Delivery Framework as a standalone project. A mini tender competition would be held to ensure value for money. The works will be let as either direct allocation with price verification or mini tender competition depending on supply chain programme workloads and capacity. The risk profile and scope of these projects will enable the use of an NEC4 Option A (fixed price with activity schedule).

4.1.8.4 Antimony – Fradley Pumping Station, South Staffordshire

Also proposed is the drilling of an additional borehole and the refurbishments of boreholes 1 and 2 at Fradley. The estimated costs of these works are >£2m. These works could be batched with the borehole works proposed under the Non-Infrastructure Resilience programme to form a batch costed at >£3m. These works will be delivered under the Non-Infrastructure Assets Delivery Framework. The projects will be either direct allocation with price verification or mini tender competition depending on supply chain programme workloads and capacity. The risk profile and scope of these projects will enable the use of an NEC4 Option A (fixed price with activity schedule).

4.2 Case 10: Reducing Lead Supplies

4.2.1 Summary

The provision of clean, safe water that our customers can trust is our absolute priority as a business, and our customers regularly support this vision through our engagement programmes. While the sector, and our business, has done a good job of mitigating risks of lead adsorption into drinking water via chemical dosing at treatment works, it is clear that we need to continue to remove lead pipework from the drinking water system.

The Drinking Water Inspectorate (DWI) are firmly of the view that the sector must continue to focus on lead compliance and are championing the view that chemical dosing of orthophosphoric acid at treatment works is an interim mitigation strategy rather than a final solution. We support this stance, and are committed to the removal of lead pipework from both our assets and those of our customers, however we do propose to deliver this at a rate that remains affordable for our customers.

Continuation of efficient replacement strategy

We will continue our efficient existing AMP7 strategies of opportunistic communication pipe replacement during mains rehabilitation work and lead replacement associated with elevated sample results at the customers tap we will also deliver two new projects in AMP8. This will see us invest £0.9m enhancement in communication pipe replacements.

We are also going to go beyond our AMP7 delivery by launching two new strategies in the next AMP, namely;

Lead free supplies to the most vulnerable

Across both of our operating regions we have 373 Primary Schools and Nurseries which we believe have lead pipework in part of their connection to our network. The evidence is clear that developing brains are the most at risk to lead in drinking water, so we are committing to replace the whole connection, from the main to the tap, at these properties. This will cost approximately £2.7m and will be delivered before 2030.

Reconnecting a DMA – pilot trial to inform long-term strategy

Lead pipework is not the only challenge when it comes to the connection between our network and our customers taps, we also see challenges due to shared supplies which can cause pressure challenges and also make metering challenging. We are proposing to invest an additional £3.5m in the next AMP to lay new, dedicated supplies to a representative DMA of approximately 1,200 customers, replacing the whole connection from main to tap. We will approach this work as a trial to inform not only our future direction, but will share the learning with the sector as it is inevitable that the challenges we see will be challenges elsewhere.

In total we will invest £7.16m across these three areas of replacement activity in the next AMP, which will see 1943 lead connections (of which 1600 will be replacement of the whole connection from main to tap) replaced with newer materials. We will ensure our customers are protected via both the creation of a PCD based on the number of connections replaced, and also via the existing common CRI performance commitment which includes lead analysis.

Table 92 - Summary of expenditure required for the period 2025-2030 (AMP8)

Investment	Enhancement Investment	AMP8 TOTEX £k	AMP8 Enhancement OPEX £k	AMP8 Base CAPEX £k	AMP8 Enhancement CAPEX £k	NPV £k
Reducing Lead Supplies	Continuation of efficient replacement strategy	875	0	0	875	1,289
Reducing Lead Supplies	Targeted lead pipe replacement of the most vulnerable	2,700	0	0	2,700	3,795,706
Reducing Lead Supplies	Reconnecting a DMA – pilot trial to inform long-term strategy	3,589	0	0	3,589	51,086
	Total	7,164	0	0	7,164	

4.2.2 Background Information

Based on analysis of mounting stock and water main data we estimate that we have approximately 300,000 connections across our operating regions that are likely to contain lead in either the communication or supply pipework. In recent years we have opportunistically replaced communication pipes when we have undertaken mains rehabilitation work, which has reduced the estimated number of lead communication pipes to approximately 130,000, leaving approximately 190,000 customer owned supply pipes.

Our existing policies see us replace approximately 5,500 lead communication pipes a year.

To ensure we safeguard drinking water quality, all of the water we supply in both of our operating regions is dosed with orthophosphoric acid at 26 treatment processes. These processes operate continuously, and our drinking water compliance for lead is good.

4.2.3 Need for Investment

It is clear that, as a sector, we must move to remove all lead from drinking water systems. Strategies of orthophosphoric dosing, targeted lead pipework replacement and opportunistic replacement have materially increased lead compliance across the sector in recent AMPs, however this doesn't change the fundamental reality that all lead pipework must be removed. More information can be found in **section 5.5** of our **'SSC02 South Staffordshire Water – long term delivery strategy.'**

The Drinking Water Inspectorate (DWI) are very clear that the sector needs to act to remove lead pipework, and we support them in this direction. In addition, there are concerns regarding the long term viability of orthophosphoric dosing as chemical supply is likely to become more volatile in the future as other industrial uses for orthophosphate become more lucrative and may challenge the supply to the water sector.

The current view of zonal lead risk is derived from property age (lead indicator), property use (vulnerable location or not) and proportion of lead failures in recent sample data. This is in line with research from the WRC study but does need to include upstream plumbosolvency dosing. The future for this analysis and visualisation (pre delivery) is for it to align with the industry research on how to assess lead compliance risk. This will allow us to ensure we are prioritising the right locations for future replacement programs.

Figure 58 - Example of our lead GIS dashboard visualisation, supporting prioritisation and strategy for replacement

In the coming AMP period, we will increase our level of investment to remove more lead communication pipes than we have previously, however we are also proposing to be proportional in our expenditure to balance the impact on customer bills. Our current plans see us replace approximately 1,000 communication pipes a year, which with 130,000 across our network leaves us with 130 years of delivery to remove them all. This isn't appropriate in the longer term, so from AMP9 onwards we are proposing to treble the rate of investment in lead communication pipes to move towards a substantially reduced position by 2070. We expect factors such as failure of aging lead pipework and potentially changes to asset ownership may allow us to deliver this sooner, but we are clear on the need to tackle lead pipework more aggressively in future AMPs.

4.2.4 Customer Support

We have carried out our most extensive customer engagement programme ever to ensure our PR24 and WRMP24 plans are underpinned by robust customer and wider stakeholder preferences. Our strategic engagement programme started in early 2020 and has run through to summer 2023, with over 92,500 customers taking part in a wide range of SSC research studies, with their views being compared with those from our robust Business as Usual insight programme and wider industry studies. This programme has been assured by SIA Partners as meeting Ofwat's "high-quality" engagement standards, as outlined in its Customer Engagement Policy paper (February 2022).

A key evidence source is appendix SSC11 which provides a thematic review of the key areas relevant to this investment case. This report was compiled independently by our triangulation partners Impact. The report also highlights the golden threads that have consistently emerged across our engagement and also details the project objectives of each study used in the evidence base, when it took place and the numbers and types of customers and stakeholders engaged with. Specifically, please refer to section 15 for a review of Water Quality insights related to lead pipes.

Specifically related to lead pipes, we see a clear thread from our engagement towards customers (household and non-household) expecting us to prioritise investment to ensure a reliable, high-quality water supply is maintained 24/7. A water supply that is free of any pollutants that removes any risks to human length, in the short and long-term. The comments below neatly summarise the consistent feedback we get from our all segments of our customers and future customers, about their number one priority.

"Water is essential to everything we do in life, our health is the most important thing and without water or poor quality water life deteriorates. It's important that people have complete faith in their water supply."

"Safety is everything, including for households. Water is instrumental to a family's state of mind and everyday lives. It's taken for granted, but that's because it's a great service."

"What you drink affects your health, so water needs to be safe to drink."

Key customer evidence points to support this enhancement case include:

- A "reliable, high-quality supply" continues to be the number one priority for investment among our household and non-household customers – as evidenced in our Customer Priorities Tracker, which is a qualitative and quantitative study that has been running since October 2020. This study asks customers to express their preferences for the areas they want to see investment in, using a Max-Diff trade off approach free from any information about bill impacts.

- In the tracker, for every attribute they are asked to trade off we inform customers with context about the current performance and provide wider context. When customers are shown the high-quality water service attribute when making their trade-offs we inform them we inform customers about a number of points about water quality issues, including the risks around lead pipes and how the water is currently treated. The outputs of the tracker highlights that a reliable, high-quality supply, is one of two "super hygiene" attributes, with the other being ensuring that water bills remain affordable for all. This highlights the need for on-going targeted investment to deliver a high-quality water supply. It is important to highlight that "affordable bills" does not mean the majority of customer are expressing the view that they want cheaper water bills at the expense of a deteriorating service, but that water should be affordable given its an essential public service and essential for everyday life.

- The chart below evidences the priority household customers place on the high-quality water supply attribute when making their trade-offs in the max-diff stated preference exercise. We find 58**%** selecting a "reliable, high-quality supply" as the most important area for investment and only **6%** stating it was the least important area of the service attributes shown. There were no significant differences between our two supply regions of note, or within any customer segments for this attribute, highlighting the consistent customer response.

Importantly, customers priorities are now becoming more balanced over the 20 services areas tracked in the study, with social and environmental areas becoming increasingly more important over time. However, customers still view having a reliable supply as a basic core service which SSC should be delivering to a high standard so that daily activities, such as drinking safe tap water, washing, and cleaning, are not impacted.

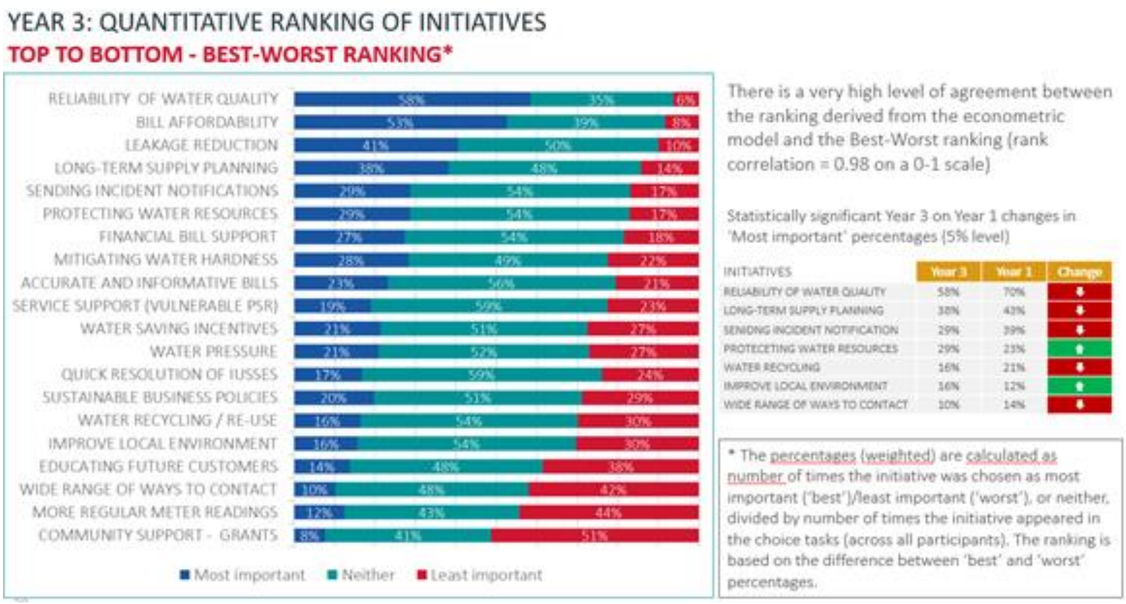


Figure 59 – Year 3: Quantitative ranking of customer priorities for investment

Source: SSC Customer Priorities Tracker, year 3 report, April 2023. Representative sample of 1,072 household customers (including 62 future customers.

- The insights from our Customer Priorities Tracker for water quality were also seen in our Long-term delivery strategy (LTDS) customer engagement, which involved a multi-stage research programme of qualitative and quantitative research. One of the 10 long-term ambition areas engaged on covered lead-pipe replacement The charts below show a summary of the research findings and highlight the strong and consistent level of support among all customer segments for SSC to remove all lead pipes by 2050. 96% of customers supported this ambition. There was also strong evidence that many customers are expressing a preference for the company to deliver the targets put forward before 2050, although bill impacts to achieve this were not shown to them. Our LTDS research found:
  - 70% of household customers wanted a lead-free pipe network delivered before 2050 but they were concerned about the potential bill impacts of what that might mean for their bills and particularly those that are struggling more with their water bills. Customers did however recognise that removing the need to treat the water in the long-term would eventually remove that cost from the water treatment process;
  - There was universal support for the strategy to target the highest risk properties first, but customers do support the principle of allowing any customer, at any time to be able to request to us that a lead pipe can be replaced if that is their preference;
  - Future customers ranked lead pipe replacement as the lowest priority in the points allocation exercise, highlight that whilst important, other areas of the service are more important to them to invest in long-term.
  - Household and future customers' majority view was that the cost of replacing lead pipes should be spread across all customers, although NHH customers had a majority view that those with lead pipes should pay the majority of the cost to have their supply pipe replaced; and
  - There was recognition of the disruption that a large-scale lead pipe replacement programme rolled out very quickly could have on their local community and the need to carefully manage the impacts through careful planning.

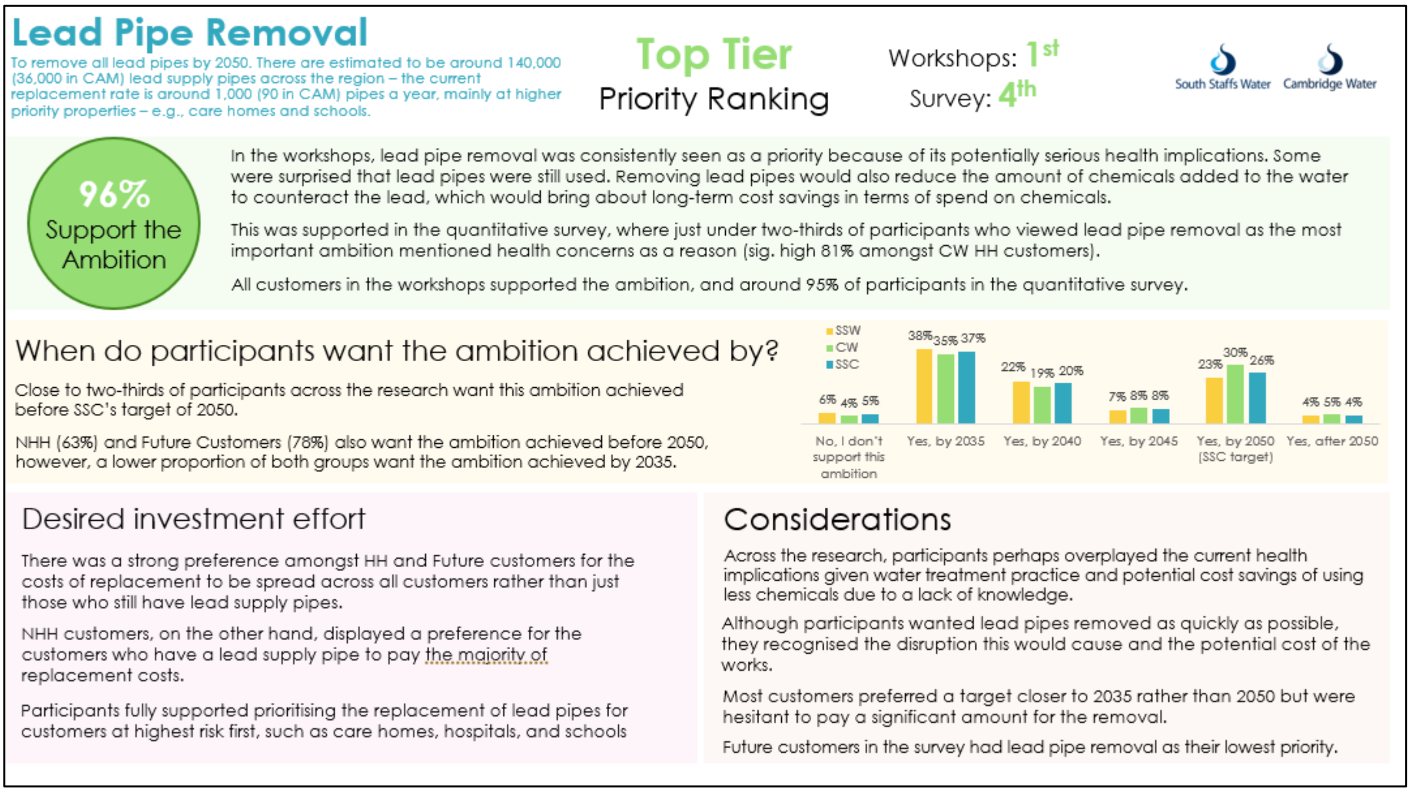


Figure 60 – LTDS research outputs on our lead pipe removal ambition

Source: SSC LTDS Research, July 2023 report. Representative sample of 1,080 household and non-household customers (including 82 future customers).

Moving on from the priorities customers have expressed, the robust PR24 valuation studies undertaken highlight clearly a theme that both household and non-household customers are willing to pay for investments to avoid service failures, when presented with bill impacts.

In our Willingness-to-Pay (WtP) Research in 2018 we observed a relatively high WTP values for lead pipe removal, with participants citing a higher level of expected service offered for customers' money when compared to other factors. This study used a tried and tested WTP methodology regularly used in valuations research, with some improvements to improve comprehension for customers made to build on the learnings at PR19. As shown in the chart below, lead pipes attracted the highest WtP amount of all the attributes tested and was the third highest rated service attribute in the Max-Diff priorities trade off exercise in the same study.

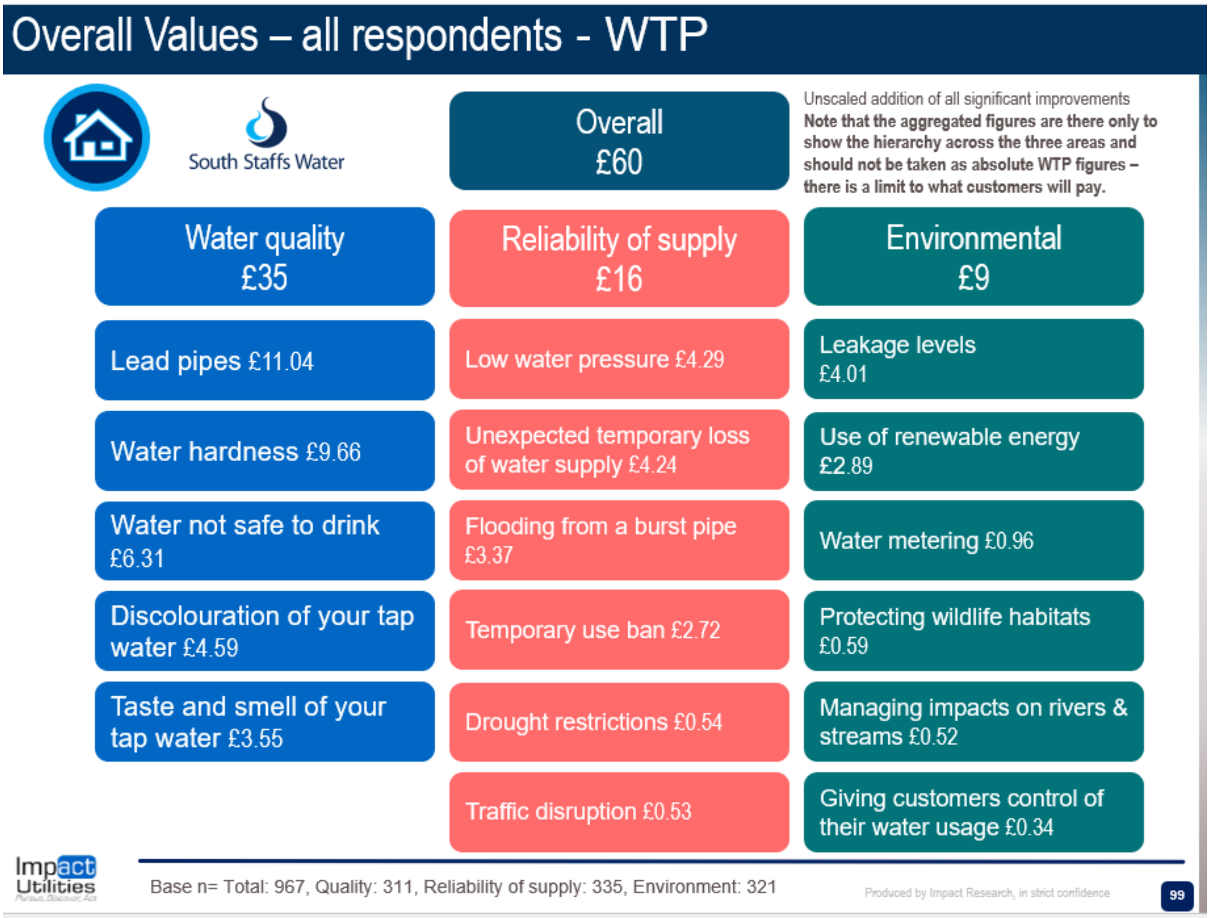


Figure 61 – WTP overall values from all respondents

In contrast, our recent SSC PR24 work (Nera 2022), lead piping did not attract a strong WTP (a modest amount in our CAM region and none in SSW region), despite improvements to removing lead pipes being selected by half of customers. We find that WtP for lead pipe replacement is found among higher affluence households and when removing protest voters from the survey, those who feel that the company should fund service improvement and not customers.

We put forward that the lack of a positive WTP response in the NERA study, particularly in the SSW region, was partially due to an unwillingness to pay for things considered to be the customers' responsibility (as many of the lead supply pipes in the network are customer owned). This is supported by the fact that in our LTDS research study almost all customers in both regions are very supportive in the ambition for lead pipe removal by 2050 (96%) and almost two thirds (60%) a decade before that. This suggests that when customers are asked to infer WTP for lead pipe removal as part of a bundle of measures (as per the 2018 PR19 work), they express a positive value, but when asked to directly pay for it, they are less supportive (the NERA study), even though it is an important objective for them.

Building on these valuations summaries, we triangulated WTP valuation and wider insight sources to set central, upper and lower valuations for use in Cost Benefit Analysis (CBA). This technical triangulation framework was subject to a rigorous academic peer reviewed end-to-end, and the valuations data sources challenged by our Delphi panel of expert stakeholders to help provide confidence in the WTP valuations used in Copperleaf. The framework was also given a Green (highest level) rating by SIA partners in its independent assurance of the technical triangulation approach developed for us by our partners Impact to inform PR24 investment decisions.

As shown in the image for attributes expressed in per property WTP values, the highest valuations are for services attributes related to water quality and supply interruptions, with lead pipes values being notbaly lower. The report details the technical triangulation approach and the valuation sets provided to us for use in Copperleaf to enable a range of sensitivity tests of customer preferences within the model. The data sources used in the triangulation include customer contact data related to these services attributes.

Table 5.2: Values (per unit) to be tested in Copperleaf (High RAG ratings, HH and NHH combined, total SSC)

COMBINED SSC	ALL - HIGHEST Central value	LOW NERA AND ODI - ALL OTHERS HIGHEST Central value	NO NERA - HIGHEST Central value	PRE PR24 Central value	ALL - HIGHEST Lower value	ALL - HIGHEST Higher value
Water not safe to drink (per property affected)	£73,592	£27,985	£5,983	£1,510	£14,779	£303,914
Flooding from a burst pipe (per property affected)	£23,775	£10,102	£2,090	£1,064	£4,983	£85,550
Unexpected temporary loss of water supply (per property affected)	£3,369	£1,832	£4,573	£506	£674	£14,259
Water hardness (per property affected)	£484	£437	£404	£381	£98	£1,762
Taste and smell of water (per property affected)	£2,116	£1,166	£2,876	£520	£423	£7,030
Low water pressure (per property affected)	£1,185	£582	£1,612	£74	£237	£3,991
Lead pipes (per property affected)	£39	£40	£50	£42	£8	£89
Water metering (per customer)	£8	£10	£8	£10	£3	£20

Figure 62 – WTP valuations sets used for sensitivity testing in Copperleaf

This preference towards resilience investment was further evidenced in our qualitative acceptability and affordability (AAT) PR24 business plan research (June 2023, Accent Research). During the qualitative testing we followed the official guidance provided by Ofwat and CCW and tested our proposed (best value) and Must do (least cost) plans so customers could comment on their acceptability and affordability.

The image below is taken from the qualitative report and highlights that most household and non-household customers wanted increased spend beyond the mandatory/least cost plan to ensure investment into resilience schemes as they perceive that this will ultimately feed through into lower bills over time. As part of the stimulus materials for the proposed plan enhancement spend to address water quality challenges, customers were informed that the plan would include a £7m investment to increase the rate at which lead pipes are removed from properties, including targeting vulnerable groups as a priroity.

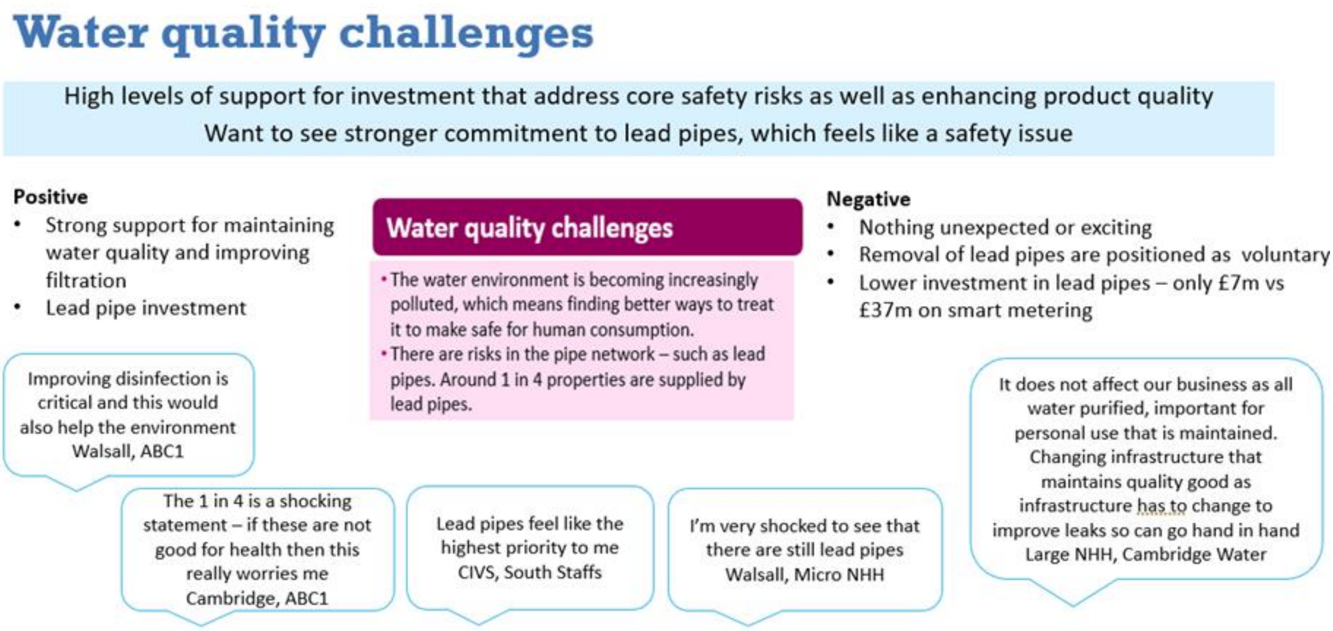


Figure 63 – Customer views on lead pipe removal from our qualitative PR24 AAT research

Again, following the Ofwat and CCW guidance in our quantitative testing of our proposed plan we found that 70% of customers found the investments and the associated bills to deliver them acceptable. Specifically, when asking customers to rate the three enhancement areas put forward in our business plan, improving water quality (which included £7m of lead-pipe removal investment) was selected by 31% of the participants. There were significantly more South Staffs customers selecting this option than in our Cambridge Water region highlighting the importance of water quality investment to the South Staffs region. Overall, this feedback shows that our plan is targeting the right areas and highlights how important is it to keep improving water quality for our customers.

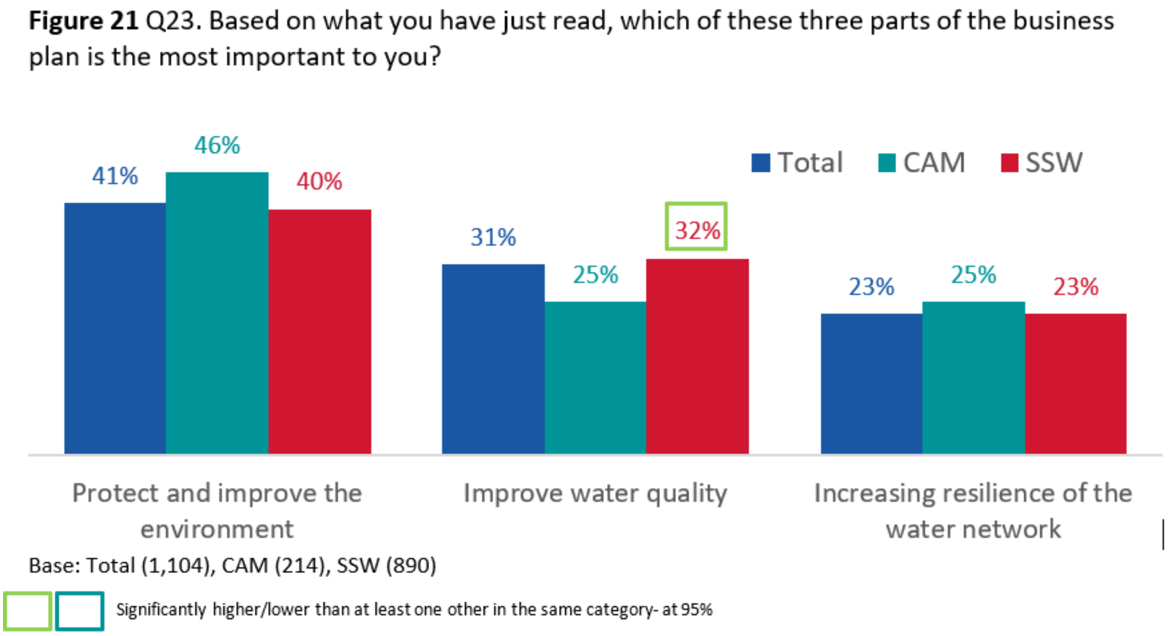


Figure 64 – How customers rated the importance of three enhancement areas in our quantitative PR24 AAT research

Our business plan acceptability testing research highlights that customers are clearly concerned and increasingly aware of the need to invest in water services infrastructure and have expressed a clear priority that important investments that provide resilience to any threats and that these should not be further delayed, including issues related to water quality. However, given that over a third of customers indicated that they would find it difficult to afford our AMP8 bills, it is very important for us to protect those customers who are struggling with paying their bills from the increases that will be required to deliver long-term investments to ensure a safe, reliable drinking supply is maintained 24/7.

4.2.5 Best Option for Customers

While it is clear that all of the lead supplies must be removed in the fullness of time, affordability must be considered, particularly against the backdrop of existing mitigation being successful in managing the risk to customers.

Based on our current unit costs, we are able to replace a lead communication pipes for approximately £1500. Multiplied by the approximated 130,000 communication pipes across our two operating regions we estimate it would cost approximately £195m to replace them all in today's prices. Consequently, such a level of investment to replace all these would be beyond funding capabilities during a single five year planning period – this would incur significant expenditure and in turn, impact significantly on customer bills.

In context of our two newly developed proactive replacement strategies, we define the following efficient replacement rates;

1. **Targeted lead pipe replacement of the most vulnerable** – we are committed to the replacement of 373 lead supplies (main to tap) to nurseries and primary schools across both of our regions. We estimate that these replacements will cost approximately £7,200 each, so approximately £2.7m.

2. **Reconnecting a DMA – pilot trial to inform long-term strategy** – Lead pipework is not the only challenge posed by customer supply pipes; we also see challenges from shared supply pipes in terms of flow and pressure, but also that they can make customer metering challenging. As a result, we propose to target the multiple challenges associated with supply pipes in a single DMA and replace around 1,200 total service pipes, main to tap, to achieve the multiple benefits that new, dedicated, metered supply pipes. We anticipate this will cost approximately £3.5m.

For further information around how we have developed our lead strategy ambition for the long term (to be further informed by the outputs of the DMA trial in AMP8), see **section 5.5** of our **'SSC02 South Staffordshire Water – long term delivery strategy.'**

4.2.6 Cost Efficiency

All aspects of our lead enhancement investment in the next AMP will be delivered via our Infrastructure Asset Delivery Framework contract which delivers all aspects of our below ground spend, including burst repairs, new connections, customer metering, strategic mains diversions and other maintenance across both of our operating regions. This is the largest framework we operate within the business and will be retendered in early AMP8 when the existing framework reaches renewal. Competitively tendering the framework allows us to demonstrate best value, and combining of a number of workstreams into a single framework gives additional efficiency from an overhead perspective.

See **section 6** in '**SSC01 Securing your water future – South Staffordshire Water's business plan 2025-2030,'** for further detail around how we developed our delivery approach to support AMP8 investment plans.

In addition, the plans for the next AMP are designed with cost efficiency at their core, as summarised below:

- Replacing lead communication pipework when we are already mobilised at a location to deliver mains rehabilitation schemes significantly reduces the unit cost of a replacement as we are already excavating the connection as per for the mains replacement scheme. While the connection to the water main is exposed for the mains work, we simply extend the excavation slightly to allow us to replace the communication pipework to the customers boundary. This efficiency allows us to replace multiple communication pipes in a day, with zero additional travel, mobilisation or customer communication costs as these are required for the mains rehabilitation scheme.
- Targeting a whole DMA's service pipework for replacement as part of our DMA trial will allow us to work efficiently as all of the connections will be in the same geographical area. The delivery vehicle will be similar to a mains rehabilitation scheme, with a single site establishment being required, allowing us to work far quicker and more efficiently than if we were doing individual connections across a wider geographical area.
- The schools and nurseries that we are going to replace connections for cover fourteen local authorities across both of our operating regions. We already have working relationships with these organisations across multiple touch points in our business, and will project manage our delivery and build relationships with the education maintenance teams within the authorities to allow us to deliver efficiencies into our work while ensuring that they are able to continue to provide for children throughout our works.
- Our existing Bounty framework is structured around the identification and embedding of innovation into the delivery of our essential works across our below ground asset base. We are currently re-tendering the framework and this will only increase the value we place on innovation, customer service and financial efficiency. We hope that a further iteration of this mindset through a full market tender will result in us embedding additional innovative approaches to further enhance our deliver for our customers.

4.2.7 Customer Protection

We are proposing the creation of a bespoke Price Control deliverable (PCD) to ensure that the interests of customers are protected throughout the delivery of our lead pilot scheme and Lead replacement programme through the next control period.

Quality PCD – This PCD covers our lead pilot scheme and Lead replacement programme enhancement investments. We don't propose any later delivery penalties as these schemes don't meet the materiality threshold. We do want to apply a PCD to protect our customers from non-delivery. We want to provide an open data report on our lead pilot scheme to encourage shared learning and benefits with the industry. We hope this will provide insights into the benefits and provide a platform for the industry to make informed decision looking to the future. More information and a full list of our PCD's can be found in section 1.5.

Table 93 - Quality PCD

Quality PCD	
Description	Lead pilot scheme and a lead replacement program for vulnerable customers.
Output measurement and reporting	The output of the lead pilot scheme will be through the mechanism of an open data report. The outcome of the lead replacement program will be based on 373 vulnerable customers lead replacements. Forecasted deliverables are set out in the table below. Delivery of the open data report should be published in the first quarter of year 4 of AMP 8 (June 2028). Reporting of the lead replacement programme will be reported at the end of the control period through the existing APR process.
Assurance	Independent third-party assurance to confirm completed milestones
Conditions on scheme	We don't propose any late delivery penalties on this PCD has it does not meet the materiality threshold. We do however want to apply a PCD as we are confident, we can deliver the project and feel the shared open data report will provide insights for the water industry to make informed decisions on the benefits of lead replacements to reduce the risk of lead failure to customers for future price control periods.
PCD payment rate	Non-delivery of the open data report for the lead pilot scheme will be applied where the project hasn't been started within the control period. We will return the full enhancement funded amount for the specific scheme **plus** the time value of money back to our customers. Non-delivery of lead replacement programme will apply a unit rate per replacement not delivered by the end of the control period. The unit rate will be based of the enhancement funded amount. A time value of money cost of capital will also be applied to the applicable value amount. The time value of money will apply the appropriate rates for the period required.

Deliverables	Unit	Forecast deliverables				
		2025-26	2026-27	2027-28	2028-29	2029-30
Lead pilot scheme	Open data report				Open data report	
Lead replacements	Number					373

In addition, customers are already protected from a water quality compliance perspective by the common Compliance Risk Index (CRI) ODI that will penalise the business should our water quality compliance fall below acceptable levels. Compliance lead sampling from customers properties forms part of the sampling programme that influences CRI.

4.2.8 Delivery

This section should be read in conjunction with **Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.**

Replacement of lead supplies will be carried out by our by our contractors under our Infrastructure Asset Delivery Framework contract, both for lead replacements carried out opportunistically during our Infrastructure Renewal Expenditure programme, where lead is replaced reactively to customer requests or elevated lead results in customer properties and our replacement programme for supplies to the most vulnerable.

It is envisaged that the lead replacement programme will treble with regard to replacement of communication pipes, with a target remove all by 2070, however further to discussions with our supply chain, this is thought to be well within their resource capacity and along with the trial DMA works is not expected to be challenging for the supply chain to mobilise additional resource to deliver. Certainty of ambition and programme timing will allow our supply chain to confidently mobilise resources, and the increased level of activity should bring economies of scale.

5. Delivering Water at the Right Pressure

These enhancement cases have been developed to secure the investment needed to improve levels of resilience and continue delivering resilient water supplies in the face of a changing climate.

The summary of our proposed Enhancement Totex is in **Table 94** below, presented in £K.

Table 94 – Section 5 Proposed Enhancement

Delivering water at the right pressure			
Enhancement Case	**Opex**	**Capex**	**CW3 lines**
Case 11: Distribution Network Resilience	0	8,285	CW3.118
Case 12: Production Resilience	0	7,337	CW3.118
Case 13: Smart Water System Trials	0	3,557	CW3.118
Total	0	19,179	

5.1 Case 11: Distribution Network Resilience

5.1.1 Summary

This case sets out the distribution network resilience investments we need to deliver in AMP 8 to improve our strategic network resilience. We are proposing two distribution network resilience schemes (Burntwood resilience & Hanbury resilience) and one reservoir storage investment (Langley Reservoir) across our South Staffordshire region. This case aims to improve our strategic network to mitigate against customer supply impact. We want to proactively mitigate against our supply interruption risks to customers. The enhancement investments will help us provide a more resilient and continuous supply of wholesome water for customers.

We are one of the leading companies in the industry in supply interruptions. We want to ensure we remain in the upper quartile in terms of our performance to ensure we maintain our excellent service to customers, by investing in AMP8 (2025-2030). We are asking for approval of £8.29m of enhancement spend to deliver three schemes. We can confirm that none of these schemes have been previously funded.

Distribution network resilience investments are supported by our customers (Customer Support section 5.1.4) and important to us as they help us deliver an improvement in network versatility by reducing the risk of, and frequency or duration of, supply interruptions when there is an unexpected network event because of asset failure or by external influences outside of management control.

All the distribution network resilience schemes in this case form part of our long-term delivery strategy (LTDS). The three schemes being Burntwood and Hanbury resilience, plus Langley storage resilience. As part of our LTDS we created a decision tree to identify our core pathway enhancement investments. The decision tree aims to test the investments to ensure they are a low or no regrets and, whether it should be base or enhancement investments. **Figure 65** below shows the decision tree template used. More information can be found in the operational resilience section 5.4 of our SSC02 South Staffordshire Water - long term delivery strategy.

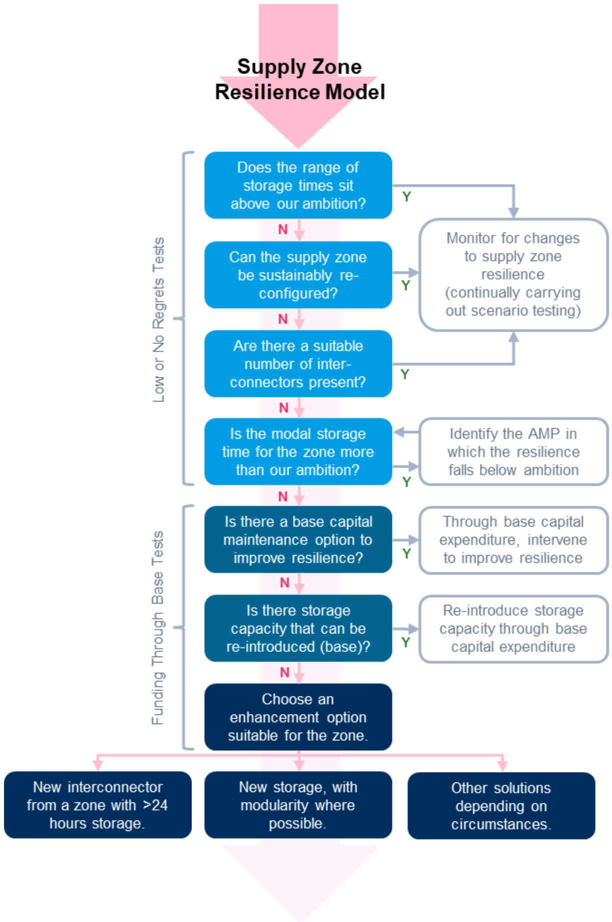


Figure 65 - Decision tree for investment testing

In the below summary table (**Table 95**), you will see a monetised NPV (net present value) for the schemes. The NPV is measured within our Asset Management tool called Copperleaf. Copperleaf uses our six capitals framework with associated value models to where a current baseline risk is inputted. An outcome is then valued based on the expected benefits of a solution. This then provides a monetised NPV of the solution. More information on our Copperleaf system and six capitals framework can be found in our appendix, 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond' (Section 1.2 Our value framework).

The AMP8 capex costs within the summary table are made up of direct, indirect, and overhead costs. More details around the cost build-ups can be found in our appendix, 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond' (section 3 and 7.1 Costing estimation evidence).

Table 95 - Summary of expenditure required for the period 2025-2030 (AMP8)

Investment	Enhancement Investment	AMP 8 TOTEX £k	AMP 8 Enhancement OPEX £k	AMP 8 Base CAPEX £K	AMP 8 Enhancement CAPEX £k	NPV £k
Burntwood resilience	New 400mm resilience link main	396	0	0	396	109,802
Hanbury resilience	6.1km of new resilience mains	2,911	0	0	2,911	114,420
Langley Reservoir	Build a new upsized Langley reservoir to replace existing asset	8,290	0	3,312	4,978	160,502
	Totals	**11,597**	**0**	**3,312**	**8,285**	

As this case will demonstrate, we have taken a holistic approach of our distribution network resilience enhancement investments listed above. Each of these schemes have a dependency with additional base expenditure on our non-infrastructure assets that feed into these specific investments. For example, to assist with the Burntwood resilience enhancement investment there will be significant base expenditure at Maple Brook PS. We are aware that there are transient pressures within the trunk main system when the station trips. Within our base programme at Maple Brook, surge protection is part of our planned base investment. This will ensure that our new assets which will provide supply resilience, also have a resilient non-infrastructure base behind them to ensure system resilience.

5.1.2 Background Information

This enhancement case looks specifically at network resilience risks that can have big impacts to our customers in the event of a failure. For the schemes identified in this enhancement case, we are proposing to install new assets in AMP 8 to ensure our distribution network systems are resilient to failures, so we can maintain a consistent service to our customers. These investments are critical for mitigating against large supply impact risks to our customers. The investments are designed to avoid big one-off events which would have great consequences to customers as well as avoiding performance commitment failures, such as water supply interruptions.

Costs provided in this case have been developed by an independent engineering consultant, who worked with stakeholders across our business to understand the likely design and scope of works. For these investments, a unit cost library was utilised by the independent, which draws on outturn costs for similar projects across the industry which were fed into cost models. Further information on our costing methodology can be found in our appendix 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond' (sections 3 and 7.1 Costing estimation evidence).

5.1.2.1 Burntwood resilience

Burntwood resilience scheme is a localised resilience investment within the Cannock High WSZ, to secure the supplies to our customers who reside in the Burntwood area.

Below are some facts about our Cannock High WSZ:

- Serves approximately 45,100 properties.
- Seedy Mill WTW pumps to the zone along a single 600mm trunk main
- Three borehole sources within the zone: Slitting Mill, Moors Gorse, Maple Brook.
- There are 6 booster stations within the zone.
- There are 4 exports from the zone: Bulk supply to STW, Uttoxeter transfer, Moors Gorse transfer control valve, and Hill top transfer valve.
- One reservoir (Gentleshaw 22.58Ml capacity) and one water tower (Pye Green 0.27Ml capacity).

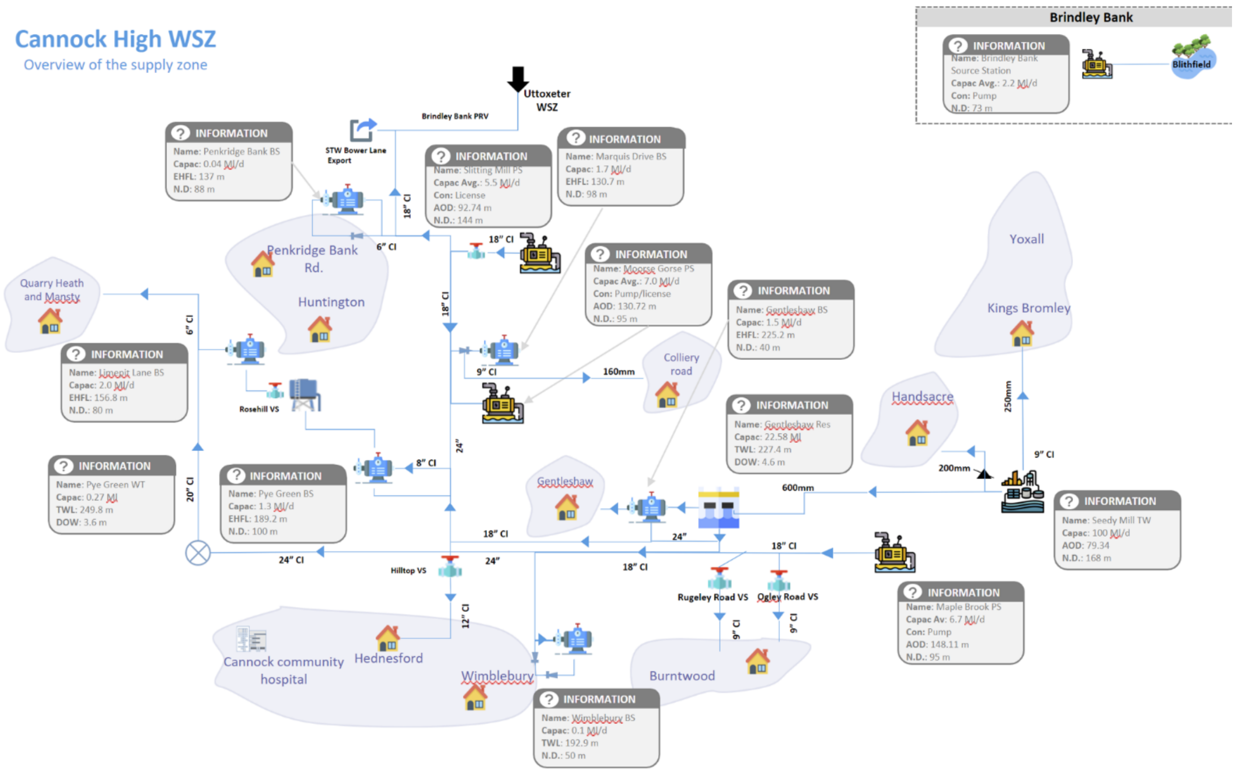


Figure 66 - Cannock High WSZ schematic

In the above **(Figure 66)** you will find Maple Brook PS to the southeast of the illustration along with the single 18” CI delivery main and, the two control valves that provide the wholesome drinking water to the Burntwood area.

Table 96 - Burntwood resilience investment information

Information criteria	Description/ Unit of measurement
Location of proposed installations	A new main to run through private land and connect at either end into the existing trunk main network. Connect into the existing 18” CI main on Chorley Road, lay new 400mm DI through private land to Rugeley Road. Connect into the existing 18” CI on Rugeley Road. Installation of new trunk main valve setups at either end of the new link main. A new trunk main valve setup to be installed to the supply of the Rugeley Road control valve.
Volumes	A total of 770 metres of 400mm main to be laid in soft ground through private land. A unit rate of £514 per metre has been used for the scheme. When compared to previous works carried out in soft ground in 2022 in private land for a 400mm DI main which worked out to an actual rate of £514 per metre, over 3.9km, we feel this is a representative unit rate.
Condition/maintenance/ other data	The existing 18” CI main is 111 years old. The condition of the main is unknown but is believed to be satisfactory. Our infrastructure asset management systems have 27 years of asset history. Within this data set the 18” trunk main has no failures recorded to date. As with trunk mains in general the likelihood of failure is low, but the consequences are high. We are aware of transient pressures when Maple Brook source station trips or is taken out of supply, and there are investments within our base programme at Maple Brook to address these issues which will have a dependency to this enhancement scheme.
Assumptions on external pressures/cost drivers	Assumed private land entry and easement agreement. No SSSI sites identified on proposed route.

5.1.2.2 Hanbury Resilience

For PR24 we built a new resilience model for each of our WSZs. We developed the model to help us to assess the supply resilience in each WSZ using varying factors such as climate change, demand, operating environment, and reservoir levels. The model calculates a supply-demand position (in hours of storage available) for each WSZ using unique scenarios specific to the areas. Each WSZ has an emergency storage run which demonstrates the time in hours before a reservoir is depleted.

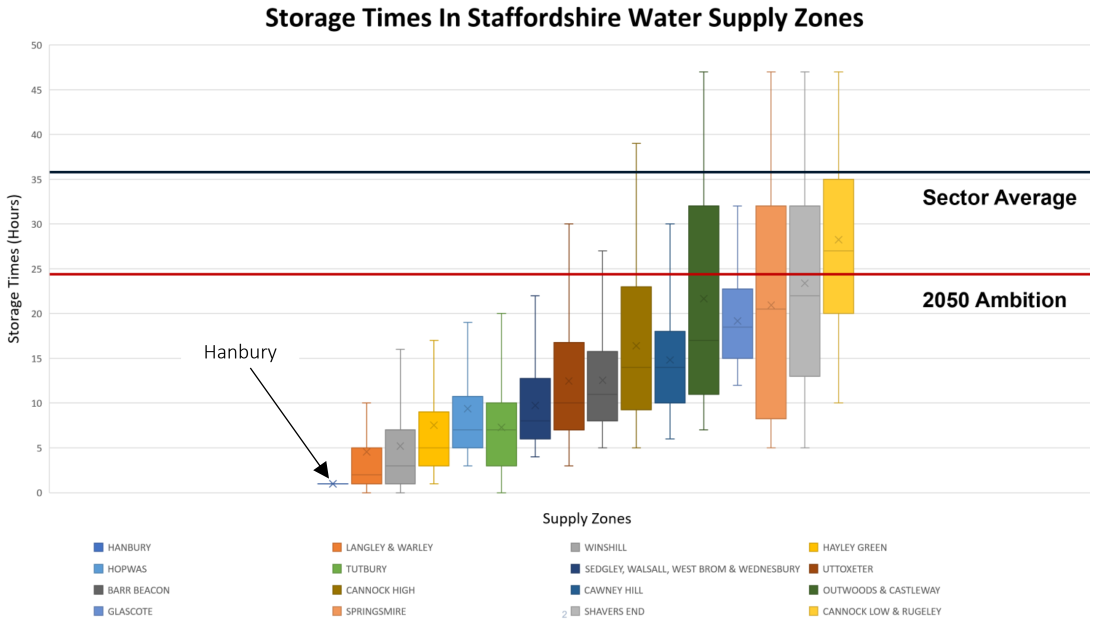


Figure 67 – Storage times in Staffordshire Water Supply Zones with position of 'Hanbury WSZ' shown

Figure 67 above shows the South Staffordshire WSZs [3] in a box and whisker plot. The box shows the median of the storage time data. The whiskers show the variability in storage times outside of the median box. This takes all storage times, under all storage scenarios over a 25-year period to show the current and likely storage times in the future. As shown in the plot, Hanbury WSZ is our least resilient in terms of storage, so is therefore heavily reliant on the Outwoods and Yoxall Booster stations remaining in supply. Outwoods Booster is the primary feed to the Hanbury WSZ. If there is a loss of Outwoods Booster or a need to carry out an intervention on the single 300mm delivery main, there would be customer impact to approximately 76% of properties in the zone.

Hanbury WSZ is dependent on Outwoods WSZ. Below are some facts about our Hanbury WSZ:

- Serves approximately 7,700 properties.
- There are two boosters that provide the bulk of the supply to Hanbury WSZ (Outwoods and Yoxall Boosters).
- Hanbury WSZ receives virtually of all its water from Outwoods WSZ
- There are two storage assets within the zone. Hanbury Tower (0.28Ml capacity) and Tutbury Reservoir (0.34Ml capacity).
- There are three boosters within the zone. Tutbury Booster, Newborough Booster, and Heatley Green Booster.
- Peak demand of 7.8 Ml/d.

[3] In this context, Langley / Warley is a sub-zone of Cawney Hill WSZ and Tutbury is a sub-zone of Hanbury WSZ. Barr Beacon includes Barr Beacon WSZ and Sutton Coldfield WSZ

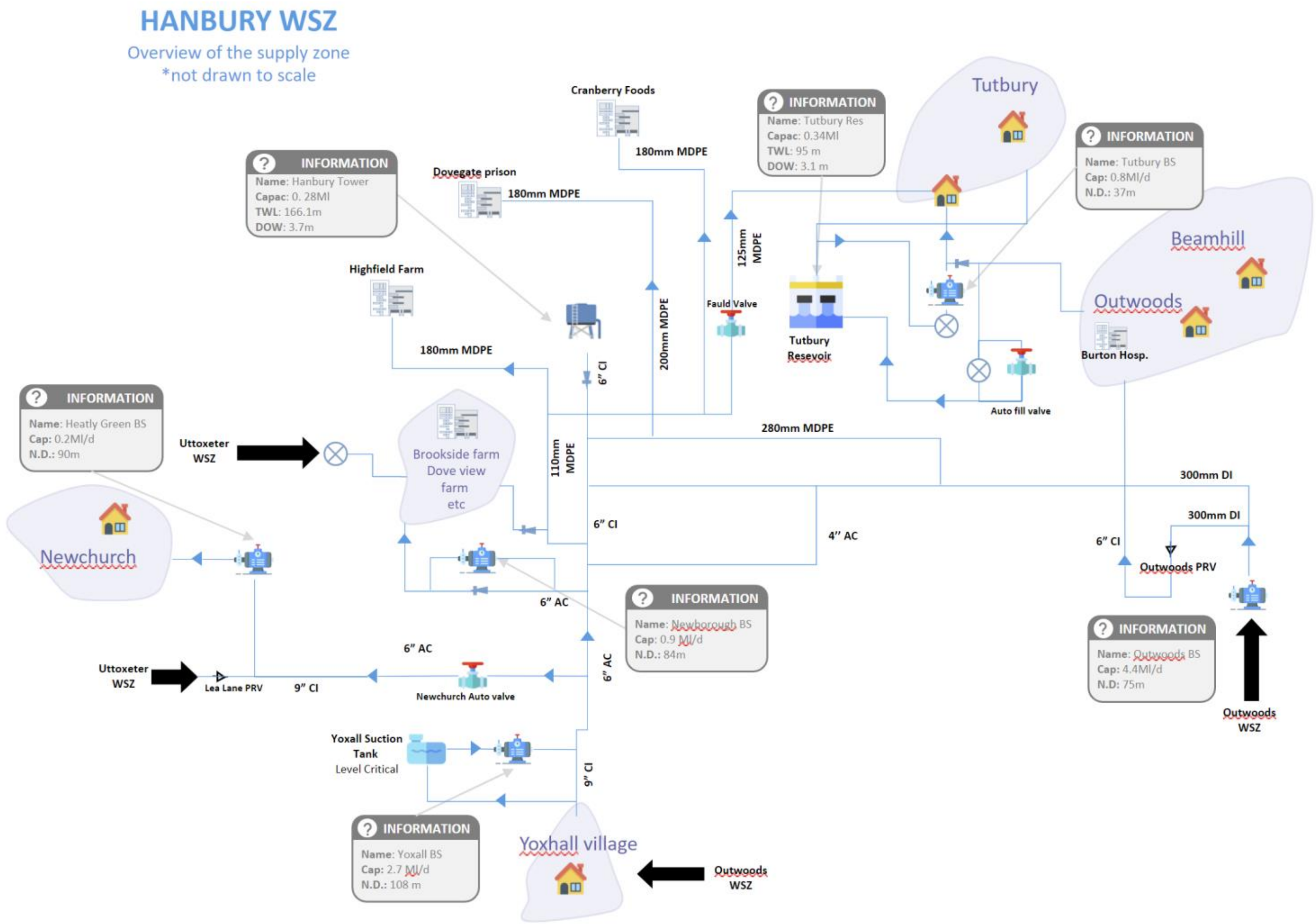


Figure 68 - Hanbury WSZ schematic

In **Figure 68** above you will find to the east side of the illustration Outwoods Booster. This provides most of the water into the Hanbury zone from Outwoods No.2 Reservoir. To the south of the illustration, you will find Yoxall Booster. Yoxall Booster is fed from the Outwoods trunk main system. Central of the illustration you will see some 6" pipework. The 6" pipework does not have sufficient capacity to allow Outwoods Booster to provide full resilience to the Hanbury WSZ if there is a loss of Yoxall Booster. You will find further information on the hydraulic restriction within this document in section 5.1.3.

Table 97 - Reservoir capacities for the Hanbury zone.

Reservoir	Capacity (Ml)	Maximum operating level %	Minimum operating level %	Usable storage %	Usable storage Ml
Hanbury Tower	0.28	99%	10%	89%	0.249
Tutbury Reservoir	0.34	95%	35%	60%	0.204
Total	**0.62**			**73%**	**0.453**

Table 98 - Investment information

Information criteria	Description/ Unit of measurement
Location of proposed installations	From Outwoods Booster we propose to duplicate the 300mm delivery main to the junction of Beamhill. Further mains reinforcement is then needed within the zone. We propose 160mm from Anslow Road to Mitre Cottage to remove the hydraulic restriction between the two boosters.
Volumes	A total of 6.1km of new mains. 2.5km of 300mm from Outwoods Booster to Beamhill. A further 3.6km of 160mm from Anslow Road to Mitre Cottage. An all-in unit rate of **£477** has been used for the Hanbury resilience scheme. Compared to a previous investment where a unit rate cost of **£316** was provided for an out turn cost laying a 280mm for 2.3km, we accept the unit rates provided by the engineering consultant to be fair as this investment does have some unknowns through private land where archaeology or environment factors could substantially increase costs during the scheme.
Condition/maintenance/ other data	Storage model assessments have highlighted the Hanbury zone is SST's **highest risk** WSZ in terms of emergency storage. In a RAG matrix it is rated as a **red zone.** The 9" PVC / CI main that provides the suction and part of the delivery of Yoxall Booster Station, has a history of failure (7 bursts in the last 10 years 0.7 bursts per year). Rehab of this main is in our AMP 8 plan as part of a dependency to the enhancement investment.
Assumptions on external pressures/cost drivers	2km of the 300mm route is through private land, Assumed land entry and easement agreement. No SMAS or SSSI sites identified on proposed route.
Impact on performance commitments	PC benefits are expected to be delivered through our base programme. This enhancement investment is to mitigate against one-off events which could severely impact on Supply interruptions and Water Quality contacts. Benefits will arise by enhancing the resilience of the network to maintain supplies to customers in the Hanbury WSZ. Being able to maintain supplies and pressures within the zone will mitigate against the risk water of quality contacts, which can be caused by de-watering and recharging of mains.
Benefit not captured by performance commitment that requires PCDs	Hanbury resilience will be measured and monitored under the Supply resilience PCD and reported through our APR process.

5.1.2.3 Langley Storage

For PR24 we built a new resilience model for each of our WSZs. We developed the model to help us assess the supply resilience in each WSZ using varying factors such as climate change, demand, operating environment, and reservoir levels. The model calculates a supply-demand position (in hours of storage available) for each WSZ using unique scenarios specific to the areas. Each WSZ has an emergency storage run which demonstrates the time in hours before a reservoir is depleted.

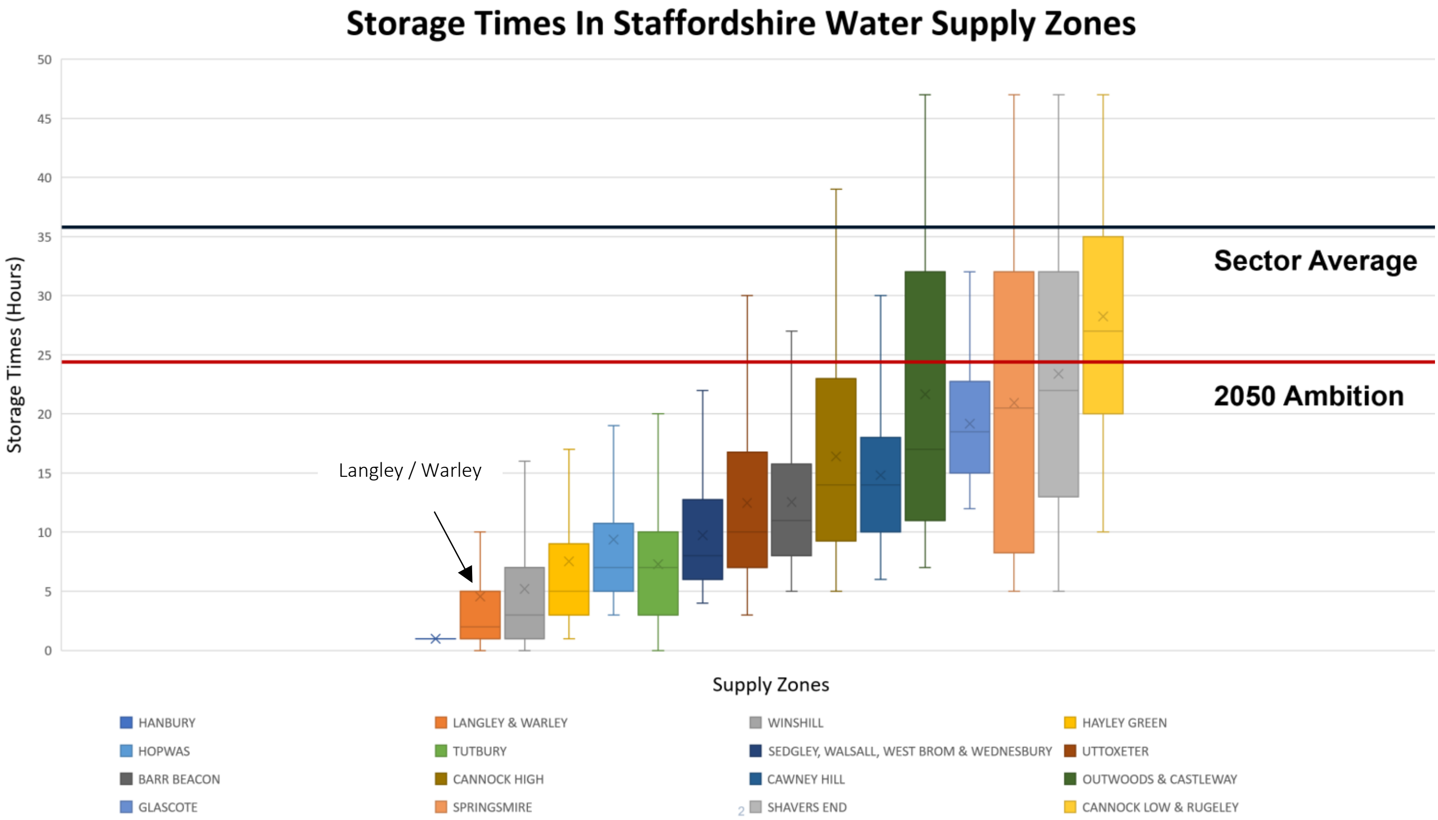


Figure 69 – Storage times in Staffordshire Water Supply Zones with position of 'Langley WSZ' shown

Figure 69 shows the South Staffordshire WSZs in a box and whisker plot. The box shows the median of the storage time data. The whiskers show the variability in storage times outside of the median measures. This takes all storage times, under all scenarios over a 25-year period to show the current and likely storage times in the future. As shown in the plot, Langley / Warley zone is one of the least resilient, in terms of storage. The zone is heavily reliant on Langley Booster, which is fed solely by Langley Reservoir.

Langley / Warley zone:

- Serves approximately 11,800 properties.
- Primary Input – Langley Booster (suction received from Langley Reservoir).
- Secondary inputs – Pound Road and Wolverhampton Road NRV's (from the Cawney Hill WSZ).
- Storage assets – Langley Reservoir and Warley Tower.
- Peak demand of 8.78Ml (2021)

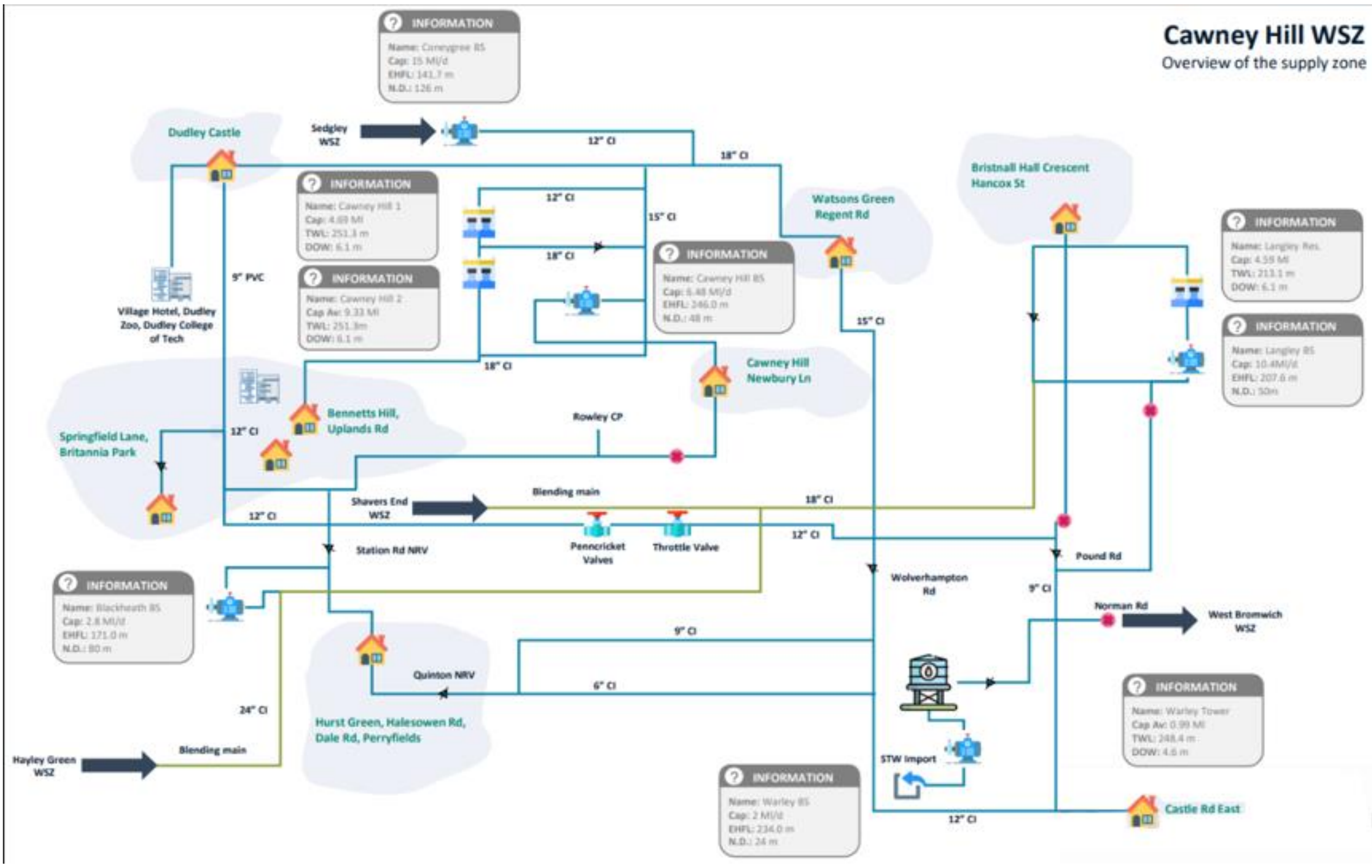


Figure 70 - Cawney Hill WSZ

Figure 70 above illustrates the Cawney Hill WSZ which incorporates the Langley / Warley area on the east side of the schematic.

Table 99 - Reservoir capacities for the Langley / Warley zone.

Reservoir	Capacity (Ml)	Maximum operating level %	Minimum operating level %	Usable storage %	Usable storage Ml
Langley Reservoir	4.49	89%	30%	59%	2.7
Warley Tower	0.99	99%	10%	89%	0.88
Total	**5.58**			**64%**	**3.58**

Table 100 - Proposed solution information Langley Reservoir

Information criteria	Description/ Unit of measurement
Location of any proposed installations	Bristnall Hall Road, Oldbury B68 9TS. Land adjacent to the existing reservoir which is owned by South Staffs Water.
Volumes	Increased reservoir capacity at Langley from 4.59 Ml to 10 Ml.
Condition/maintenance/ other data	Current storage asset is 109 years old. Deterioration in asset health which requires frequent remedial works which are increasing in costs. Poor outlet and drain design can and has caused water quality incidents. Single cell which offers no resilience if there is a sample failure from the reservoir meaning loss of storage to Langley Booster which is primary feed for the Langley / Warley zone.
Assumptions on external pressures/cost drivers	Vegetation clearance - Undertake appropriate ecology surveys and follow recommendations e.g., if nesting birds are present ensure timing of project and meetings as necessary are undertaken to mitigate risk. Ground conditions - Undertake GI and design foundations based on GI results.
Impact on performance commitments	PC benefits are expected to be delivered through our base programme. This enhancement investment is to mitigate against one-off events which could severely impact on supply interruptions and Water Quality compliance (CRI). The case sets out below how climate change and a small increase in demand to the Langley / Warley area could have a significant impact to customers. This solution will mitigate against those risks now and for the future. There have been previous failures (2018) in water quality compliance due to the design of the existing reservoir. The outlet main is also utilised as the drain main to waste. The outlet within the reservoir is in the sump in the middle of the reservoir at the lowest point. Post cleaning operations it is difficult (through original design) to ensure the main is clear and no debris from the clean / maintenance remain. In 2018 a large discolouration event occurred post re introduction of Langley Reservoir into supply. This will be designed out in a new reservoir build.
Benefit not captured by performance commitment that requires PCDs	A price control deliverable will be implemented against this scheme. The PCD will measure Ml available for use. 5.41Ml of additional storage will be delivered within AMP 8 or enhancement funding will be returned to customers.

5.1.3 Need for Investment

We continuously develop and proactively look to improve the resilience of our supply networks in our South Staffs and Cambridge regions. Engaging with stakeholders through risk elicitation sessions, has identified areas where we can do more to improve our networks resilience. Areas have been identified where we have a high risk to customers' services. By investing in these areas, it will help to maintain the service we provide to our customers. The two network resilience schemes have a low likelihood of asset failure as with many strategic trunk mains, but both schemes have high consequences in terms of customer impact, with little to no alternative feeds from interconnecting networks. The network storage investment has a greater likelihood of failure due to climate change causing dryer, hotter weather with more frequent prolonged spells of high demand. Langley Reservoir currently has very little emergency storage (average of 3 hours in peak demand) as demonstrated within this section in more detail.

The three schemes chosen, have been identified as our biggest risk items in terms of maintaining a continuous supply to customers in the event of an unexpected failure.

In **Table 101** below, it shows our network resilience schemes and their baseline monetised risk value, which is produced from our asset management decision making tool called Copperleaf. The greater the monetised baseline risk value is, the greater the existing risk to customers. Copperleaf uses a six capitals framework and value models (more information on our Six Capitals framework can be found in our appendix, 'SSC37 Our asset management approach to best-value investment planning through 2025-2030 and beyond' (section 1.2 Our value framework). You will see in **Table 101**, the three schemes chosen for enhancement investment in AMP 8 have the greatest annualised baseline (current) risk values. Meaning the risk value is calculated as the product of the likelihood and consequence of an event.

Table 101 - Network resilience schemes within Copperleaf enhancement portfolio

Network resilience investments	Annualised baseline risk value £k
Langley Reservoir – Langley/Warley resilience	6,628.5
Hanbury Resilience	1,338.5
Burntwood resilience	1,280.1
Network Shudy Tower outlet mains resilience	511.2
Network - Croydon mains resilience	141.8
Network - Warboys mains resilience	38.6
Network - Bluntisham Zone mains resilience	5.0
Network - Fleam Dyke 12" Booster main resilience	1.9
Network - Dullingham to Westley mains resilience	1.9
Network - ST Ives Reservoir main resilience	0.43

5.1.3.1 Burntwood resilience

Currently there is little to no resilience in place to maintain supplies to the Burntwood area which serves approximately **13,800 properties**. The current main serving the area is an 18” CI main laid in 1912 (111 years old). The condition of the main is unknown but is believed to be in satisfactory condition based on no recorded failure history over the last 27 years (our infrastructure asset management systems have 27 years of asset history). As with many trunk mains in general the likelihood of failure is low, but the consequences are high. The main is a single point of failure for the customers within the Burntwood area. We are aware of transient pressures (up to 11 bar transient pressure) when Maple Brook PS trips or is taken out of supply, and there **are investments within our base programme at Maple Brook** to mitigate the transient issues with surge protection, which will have a dependency to this enhancement scheme. In AMP 8 it is expected that the transient pressure will be reduced through the base investments prolonging the life of our infrastructure assets. Although there is no recorded burst history on the trunk main that delivers treated water from Maple Brook PS to the Burntwood control valves, we want to be proactive by addressing the risk to avoid measures out of our control causing supply interruptions to customers. This could be driven by climate change. In recent years we have seen long dry spells of sunny weather which puts stress on infrastructure assets. This is not driven just through increased prolonged demands but through ground movement, which does have a significant impact on burst mains failures. This means that for areas identified like the Burntwood area it is more likely in the future for a service interruption to occur. This enhancement investment is to ensure **local resilience** to a vulnerable area where no alternatives to supply our customers are available from surrounding networks.

The distribution network resilience schemes in this case form part of our long-term delivery strategy (LTDS). As part of our LTDS we created a decision tree to identify our core pathway enhancement investments. The decision tree aims to test the investments to ensure it is a low or no regrets and, whether it should be base or enhancement.

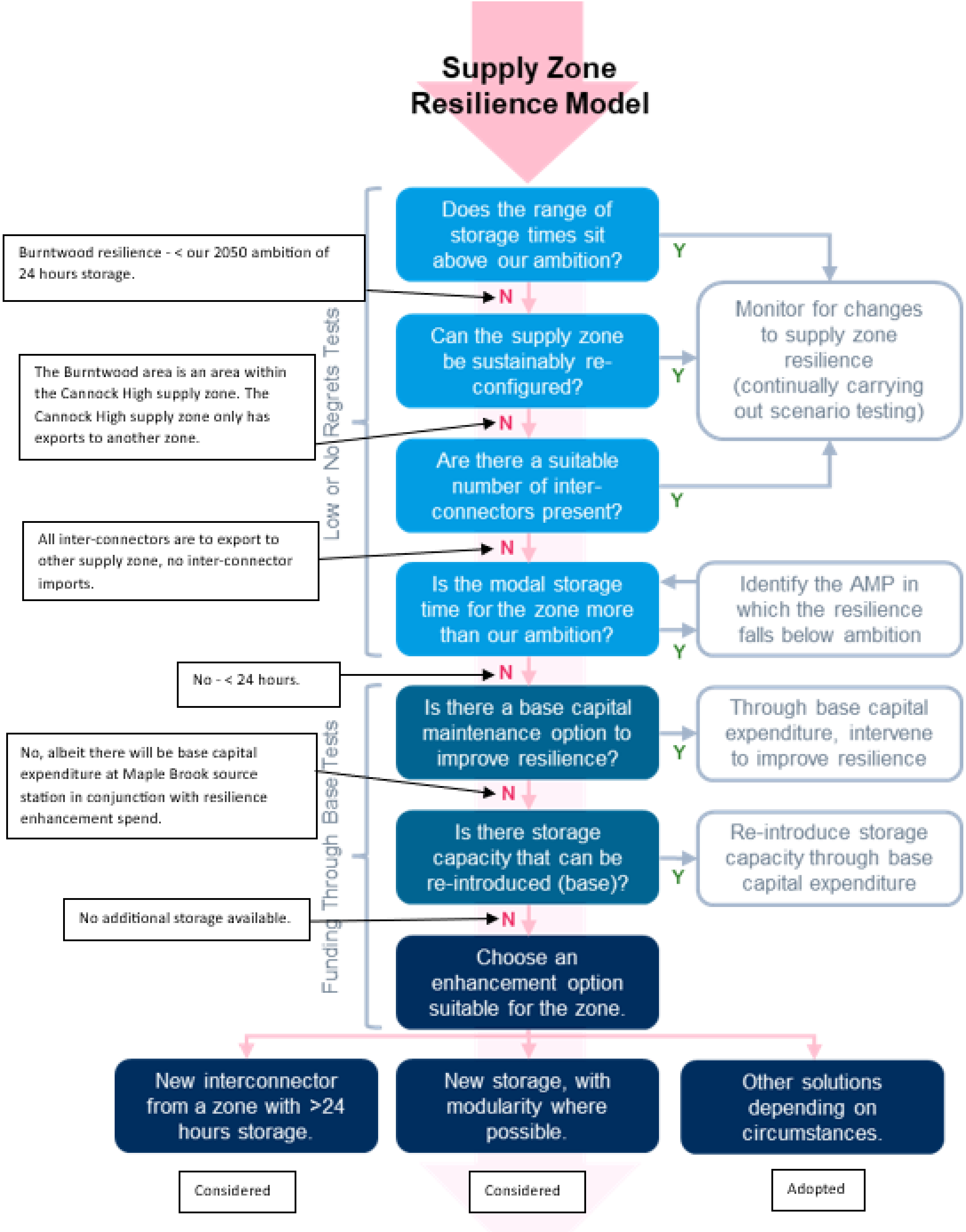


Figure 71 - Decision tree for investment testing

Figure 71 above shows the step-by-step process with annotations for each, for the Burntwood resilience scheme. Although the Burntwood area isn't a WSZ the potential customers that could be impacted **(13,800)** is greater than the other schemes in this case which are WSZ resilience. Burntwood resilience scheme fits into our decision tree model criteria and because of the potential consequence of disruption to customers' supplies we feel this needs to be addressed in AMP 8.

Consequences of asset failure or by external influences:

- Hydraulic model shows that approximately **13,800 properties affected if a loss of supply to both control valves.**
- Loss of supply to one control valve would result in half of the properties without water **(approximately 7,000 post mitigation valve operations).**

- Maple Brook PS would need to be removed from supply **(Unplanned Outage)**
- Potential for **Water Quality contacts** due to de-watering and recharging mains. From previous experiences on trunk main failures, we know upon recharge there is a risk to the aesthetics of the water quality (discolouration / aeration).
- Water supply interruption to customers could be between **6-12 hours** based on a typical trunk main repair time. In some cases, it can be longer than **12 hours** if there are further technical difficulties to deal with (inoperable / faulty valves, other utilities, access / safety requirements). Potential for a one-off event to have an ODI impact of **6 minutes and 45 seconds** based on all properties off for 6 hours.

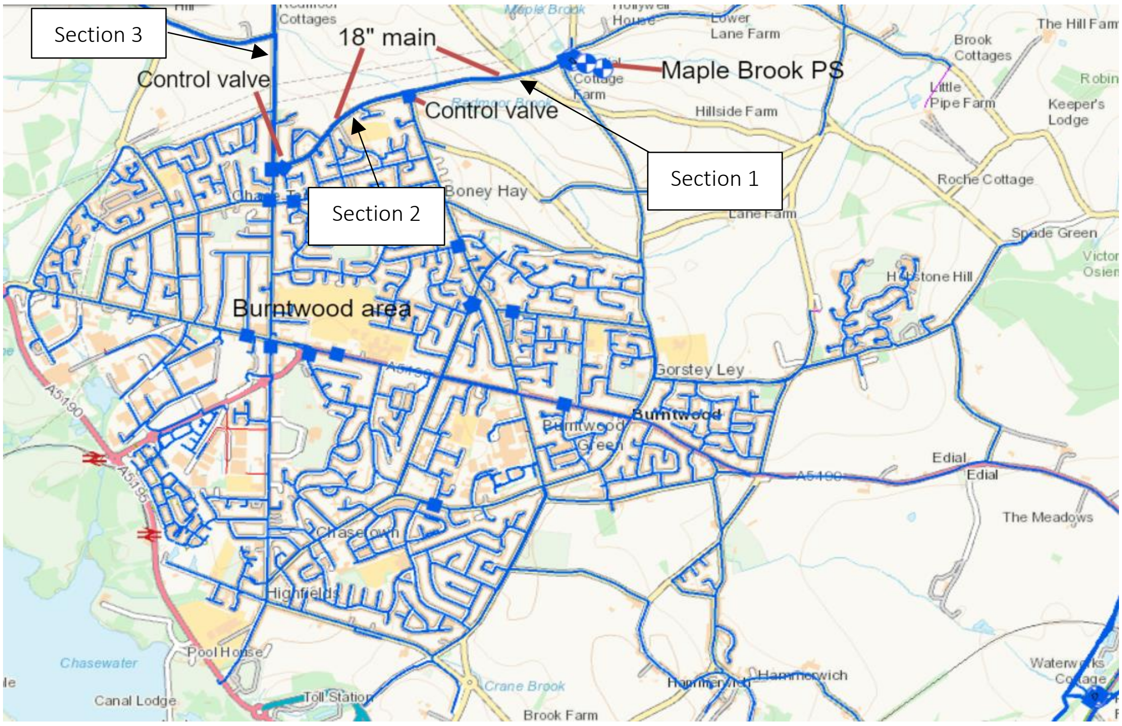


Figure 72 – Burntwood area GIS mapping

Figure 72 shows a GIS picture of the Burntwood area. The connectivity to the north via the trunk main system links into the Cannock High WSZ where Gentleshaw Reservoir can feed the area of Burntwood if there is a loss of Maple Brook PS. I've broken the 1.5km of 18" main into 3 sections. If section 1 is isolated both control valves can currently remain fed from Gentleshaw Reservoir. If section 2 is isolated, due to valve locations the supply to both control valves will be lost and the same applies to section 3 as this is the same isolation.

There are no interconnectors to the south of the Burntwood area. Although there are some connections to the east and west, neither of these interconnectors have the pressure or the mains capacity (one is 90mm the other 4") to offer an alternative supply to the area.

5.1.3.2 Hanbury Resilience

Hanbury WSZ has little resilience to maintain supplies in the area. If there was a scenario where we were unable to boost water into the zone from Outwoods Booster, this would result in most of the zone having no supply. The Outwoods booster pumps have a duty / standby arrangement and do have a generator to provide backup power when required. The booster pumps take their suction from Outwoods No. 2 Reservoir. There is a single 300mm delivery main which constitutes a single point of failure, and it would lead to customer impact if there was a need to carry out an intervention. The storage and zonal assessments that have been carried out with third parties (including a reservoir panel engineer) show that Hanbury Tower is insufficient and offers little to no emergency storage to the area. There is also a hydraulic restriction on the outflow from the Tower due to mains capacity, such that even if Yoxall Booster is operating as normal, the combination of Yoxall Booster and Hanbury Tower cannot sustain pressures without Outwoods Booster also being in supply.

Hanbury WSZ does not have sufficient emergency storage (less than 1 hour) and has low resilience to maintain service to customers. Our long-term delivery strategy sets out to address the high-risk areas where there is poor emergency storage within our South Staffs and Cambridge regions. This resilience scheme for Hanbury is part of the core pathway to achieve our long-term goal. It is envisaged that Hanbury Tower in the future will be discontinued making the zone a boosted only zone. Ensuring Outwoods Booster and delivery mains are resilient is our focus in AMP 8 as this is the critical feed into the Hanbury zone. Enhancing one part of the resilience in AMP 8 will create potential to address the second part in AMP 9 by upsizing and improving the capability of the second booster into the zone (Yoxall).

The distribution network resilience schemes in this case form part of our long-term delivery strategy (LTDS). As part of our LTDS we created a decision tree to identify our core pathway enhancement investments. The decision tree aims to test the investments to ensure it is a low or no regrets and, whether it should be base or enhancement.

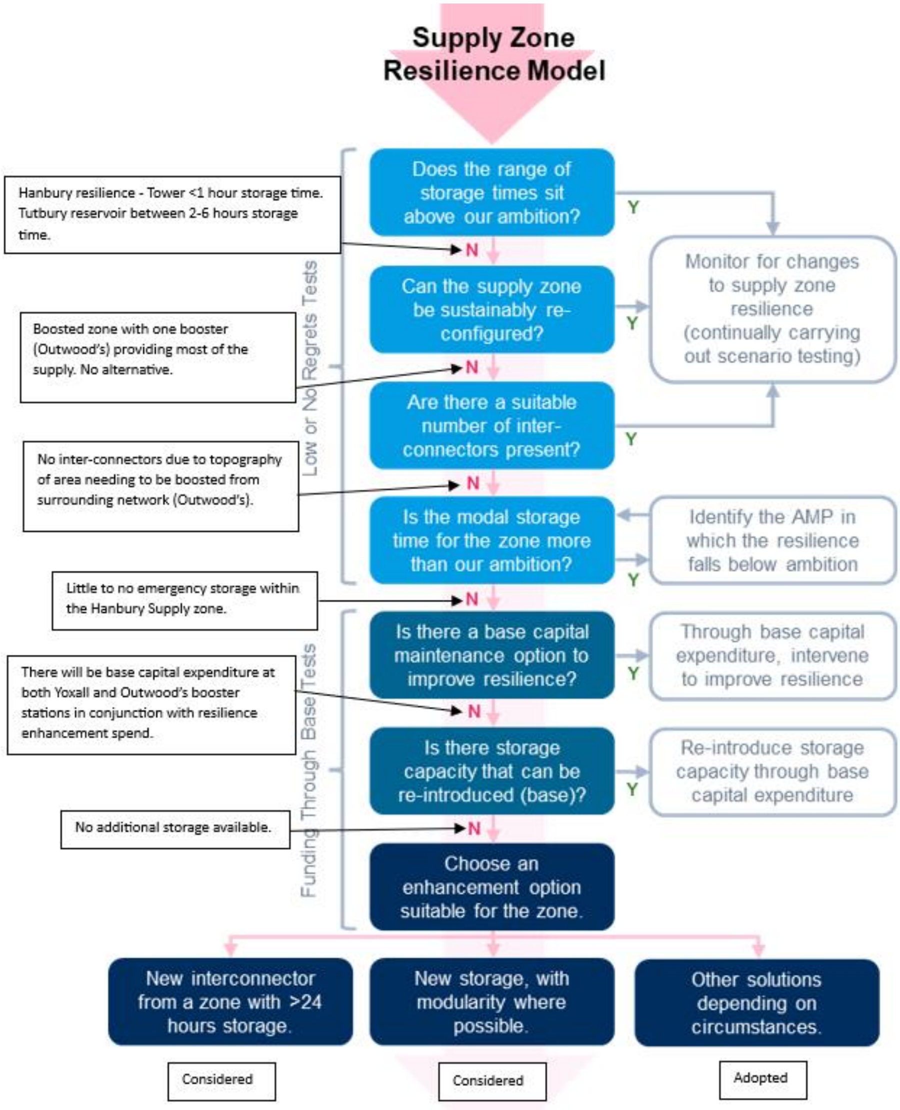


Figure 73 - Decision tree for investment testing

Figure 73 above shows the step-by-step process with annotations for each, for the Hanbury resilience scheme. Hanbury WSZ is our greatest supply resilience risk as shown in **Figure 67** (Box and Whisker) plot. The Hanbury resilience scheme fits into our decision tree model criteria and because of the potential consequence of disruption to customers supplies we feel this needs to be addressed in AMP 8.

The single 300mm delivery main (2.5km) from Outwoods Booster was laid in 1992 and to date has 1 recorded burst which occurred in 2001. The need for resilience is a forward-looking investment as the likelihood of failure is low but the consequence is high with no alternative feeds from interconnecting networks and, with little to no emergency storage due to storage assets being undersized for many decades for the population served, means there would be customer impact within a short time frame. With the storage assets approaching end of asset life and not being fit for purpose with limited scope to increase capacity due to location constraints, it is envisaged that as part of our LTDS Hanbury Tower will be discontinued in the future. Therefore, mains and booster resilience will be critical, and this will form part of the improved resilience to the Hanbury zone with a future resilience investment expected to be in AMP 9 or 10 to build a new increased capacity Yoxall Booster station.

Asset failure either through asset health or external influences on the single 300mm delivery main would have the following consequences:

- Loss of Outwoods Booster delivery into the Hanbury zone, based on our hydraulic models would impact approximately **5,850 properties.**
- Loss of Yoxall Booster delivery into the Hanbury zone, based on our hydraulic models would impact approximately **1,850 properties.** This is mainly due to the hydraulic restriction (head loss) within the zone not allowing Outwoods Booster to reach the Newborough / Yoxall areas.
- Less than **1** hour emergency storage in Hanbury Tower (average and peak demands).
- Tutbury Reservoir has between **2-6 hours emergency storage** (2 hours peak, 6 hours average).
- Risk of emptying Hanbury Tower in an event meaning inspection and cleaning operations would be required before returning to supply. There have been instances within the last 2 years where a 4" burst main has required an event team to manage due to Hanbury Tower falling rapidly to critical levels due to the inadequate storage volume.
- Potential for **Water Quality contacts** due to de-watering and recharging of mains (or a loss of reservoir storage). From previous experiences on trunk main failures, we know upon recharge there is a risk to the aesthetics of the water quality (discolouration / aeration). There is also a risk to emptying Hanbury Tower, which if not isolated before emptying is highly likely to lead to discolouration from debris that usually settle at the bottom of storage tanks.
- Water supply interruption to customers could be between **6-12 hours** based on a typical trunk main repair time. In some cases, it can be **greater than 12 hours** if there are further technical difficulties to deal with (inoperable / faulty valves, other utilities, access / safety requirements).

There is currently a hydraulic restriction within the zone which doesn't allow Outwoods Booster to provide whole WSZ resilience if there is a loss of Yoxall Booster. Outwoods is a larger booster site with suction from Outwoods Reservoirs and has power generation backup. This makes Outwoods Booster the more resilient site out of the two booster inputs and the only booster that has capacity to feed the whole zone.

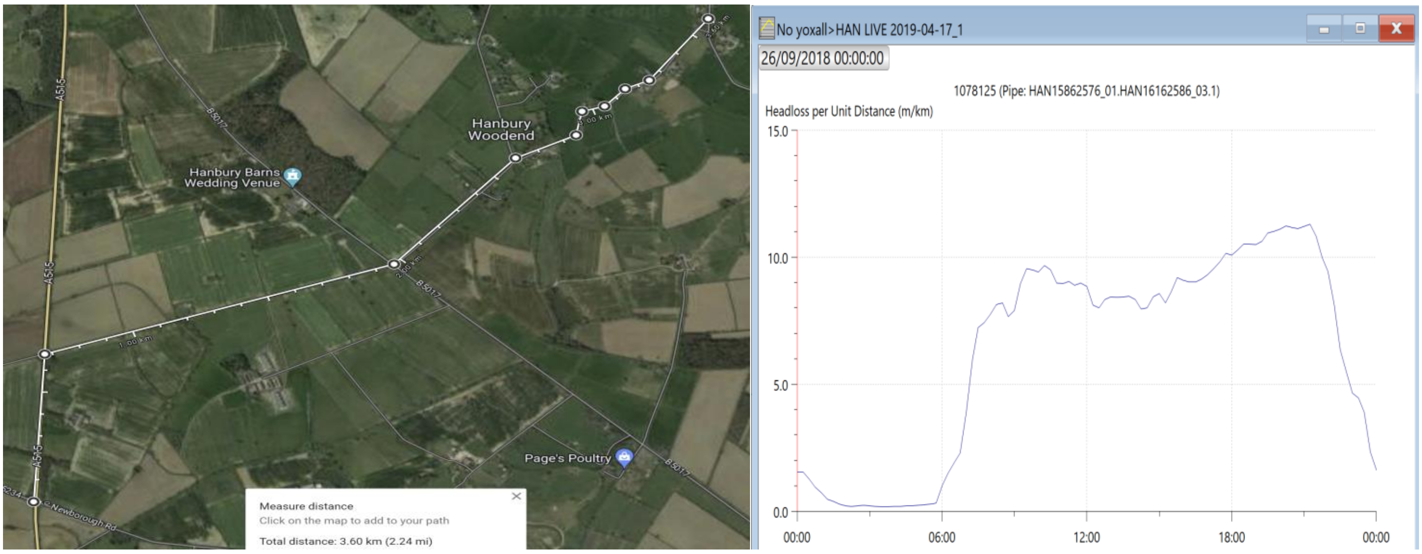


Figure 74 - Route of 3.6 km hydraulic restriction and model evidence of head loss per km

Our models show:

- 0.8 m/s velocity
- Head loss of 1 bar per km = 3.5 bar pressure loss over this length.
- Results in 0 – 1 bar pressure in and around the Yoxall area.

Table 102 below shows the storage capacity of Hanbury Tower and Tutbury Reservoir along with their upper and lower limits. The final column shows you the usable storage volume available for each asset.

Table 102 - Hanbury WSZ reservoir operating levels and capacities.

Reservoirs	Capacity Ml	Maximum operating level	Minimum operating level	Usable storage Ml
Hanbury Tower	0.28	99% High high alarm	10% Low low alarm	0.249
Tutbury Reservoir	0.34	95% Ball valve	35% Low alarm / booster suction	0.204
Totals	0.62			0.453

Table 103 below shows the outputs from our storage modelling assessments for the Hanbury WSZ. The storage times have been given a RAG status. Red illustrates there is **less than 12 hours storage time (Red Risk).** Amber illustrates there is between **12 and 24 hours (Amber Risk)** and, green illustrates there **is greater than 24 hours storage (Green Risk).**

Has you can see in the table below Hanbury is a red risk zone in all scenarios. Tutbury is slightly better but is still within the red risk zone.

Table 103 - Storage assets draw down times in hours.

	Average day demand			Peak day demand		
Scenarios	present day	10-year horizon (10% demand increase)	20-year horizon (20% demand increase)	present day	10-year horizon (10% demand increase)	20-year horizon (20% demand increase
Hanbury Tower emergency storage	<1	<1	<1	<1	<1	<1
Tutbury Reservoir emergency storage	6	6	5	2	2	2

The recommendations from storage and zonal reviews are:

1.Hanbury WSZ effectively has no emergency storage and is reliant on Outwoods Booster. It is recommended there is an in-depth review of the resilience of the zone which should review the resilience of Outwoods and Yoxall Boosters or increase of storage at Hanbury Tower.

2.Tutbury is only marginally better than Hanbury but because Tutbury is dependent upon Hanbury, an in-depth review of the resilience of the zone is recommended.

5.1.3.3 Langley Storage

We continually develop and proactively look to improve the resilience of our supply networks in our South Staffs and Cambridge regions. Engaging with stakeholders through risk elicitation sessions has identified areas where we can do more to improve our resilience. Areas have been identified where we have significant emergency storge risks, through storage and zonal analysis with third-party consultants and an All-reservoir panel engineer. By investing in these areas, we can improve our service to customers. The one non-infrastructure reservoir resilience scheme below has been identified as our biggest risk in terms of emergency storage to maintain a continuous supply to our customers, in the event of an asset failure or through greater prolonged customer demand periods due to climate change.

Langley Reservoir was built in 1914 as a brick lined mass concrete reservoir. The reservoir is 109 years old and is at the end of the asset life expectancy.

- Wall and floor lining is breaking down, signs of corrosion of beams and wall arches.
- Settlement on slab (previous cracking).
- Other identified work following two external surveys; grass cut and vegetation clearance required.

Langley Reservoir has a storage volume of 4.59Ml and is 6.1m deep. The reservoir is a mass concrete structure with blue brick lining to the walls and floor. The mass concrete barrel arch roof is supported on steel UB (universal beams), with blue brick supporting aches and columns. The walls and floor have a puddle clay lining. In 1990 a new membrane was installed to the roof; the blue brick floor was screeded over with a polymer modified render and the walls coated with gunite. A cementitious paint system was applied to the walls, floor, and columns. In November 2000 new high security LPC Grade 4 access and ventilation covers were fitted along with a new ball valve on the inlet. In 2016 a new roof membrane was applied “live” over the entire roof.

The **outlet main is also the drain main** which is a cause for concern and has resulted in water quality incidents in the past (2018) when returning the reservoir to supply from an inspection and cleaning maintenance programme.

The Langley / Warley zone currently serves approximately 11,800 properties. Langley / Warley zone is deemed as a **red risk** zone (less than 12 hours emergency storage) as highlighted through our storage and zonal analysis, meaning due to inadequate emergency storage compared to diurnal demand profiles our customers in this area are at a significant risk of supply interruptions. Hanbury WSZ is our greatest risk as shown in **Figure 67** (section 5.1.2 Background information), with Langley/ Warley zone being our second greatest risk which is why the two investments to improve resilience to these two zones are part of our core pathway in our LTDS.

The distribution network resilience schemes in this case form part of our long-term delivery strategy (LTDS). As part of our LTDS we created a decision tree to identify our core pathway enhancement investments. The decision tree aims to test the investments to ensure it is a low or no regrets and, whether it should be base or enhancement.

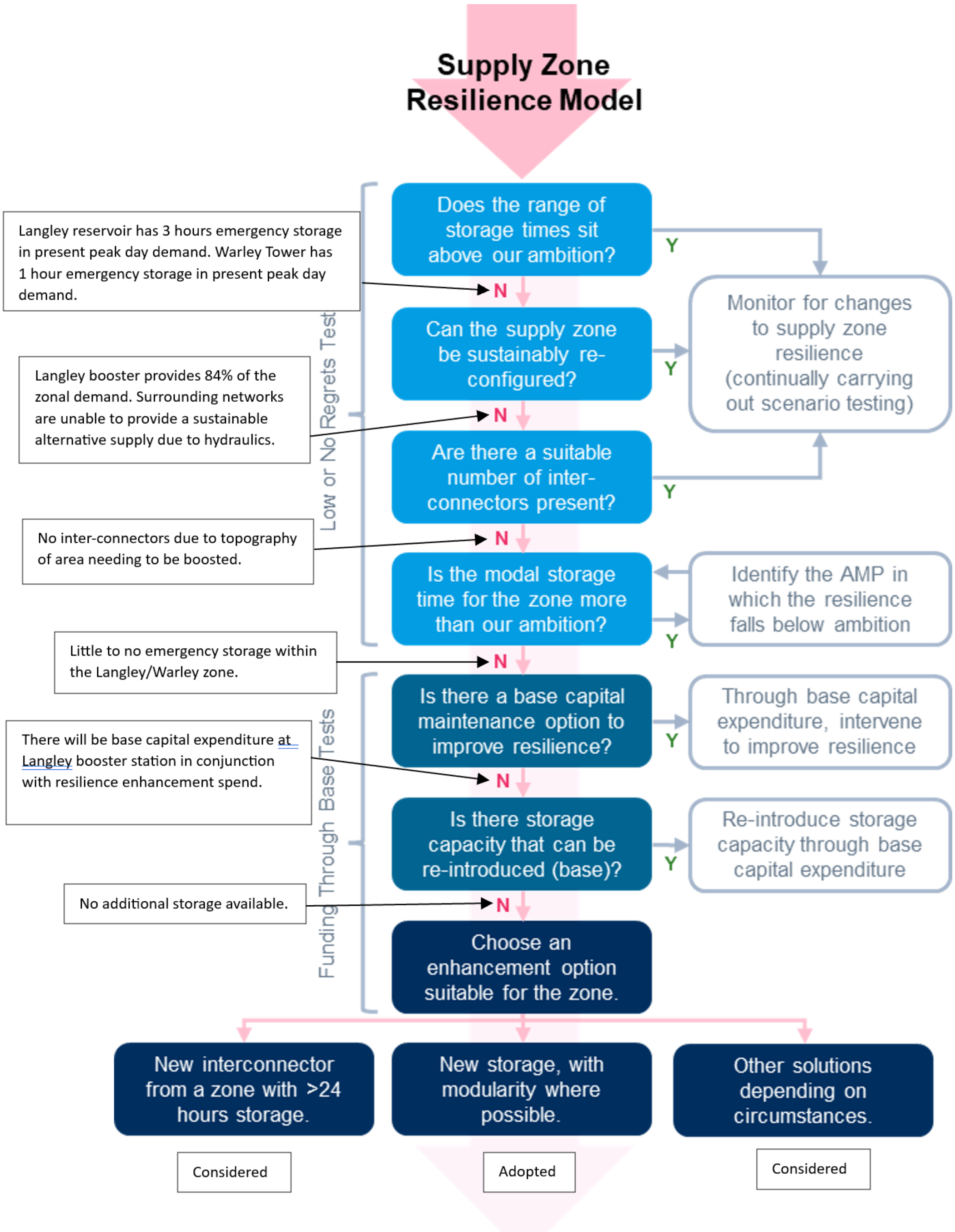


Figure 75 - Decision tree for investment testing

Figure 75 above shows the step-by-step process with annotations for each, for the Langley storage scheme. Langley/Warley zone is our second greatest supply resilience risk as shown in **Figure 69** (section 5.1.2 Background information, Box and Whisker plot). The Langley storage scheme fits into our decision tree model criteria and because of the potential consequence of disruption to customers supplies we feel this needs to be addressed in AMP 8.

Analysis has been carried out for Langley Reservoir level profile for peak week demand, with varying assumptions for demand.

Figure 76 below is as existing, but with flows into Langley maximised overnight to target 90% each morning. Daytime flows are already “maximised”, while seeking to support Hayley Green (balance of transfer from Hayley Green to Langley) at the same time and to avoid low pressure at Rowley Regis by limiting use of Penncricket Valve 2 (Cawney Hill transfer).

Note: Langley Reservoir in peak demand often draws down to 40%, and if overnight refill does not reach 90% it may draw down to 30% and lower on occasions providing a significant risk to customers supplies.

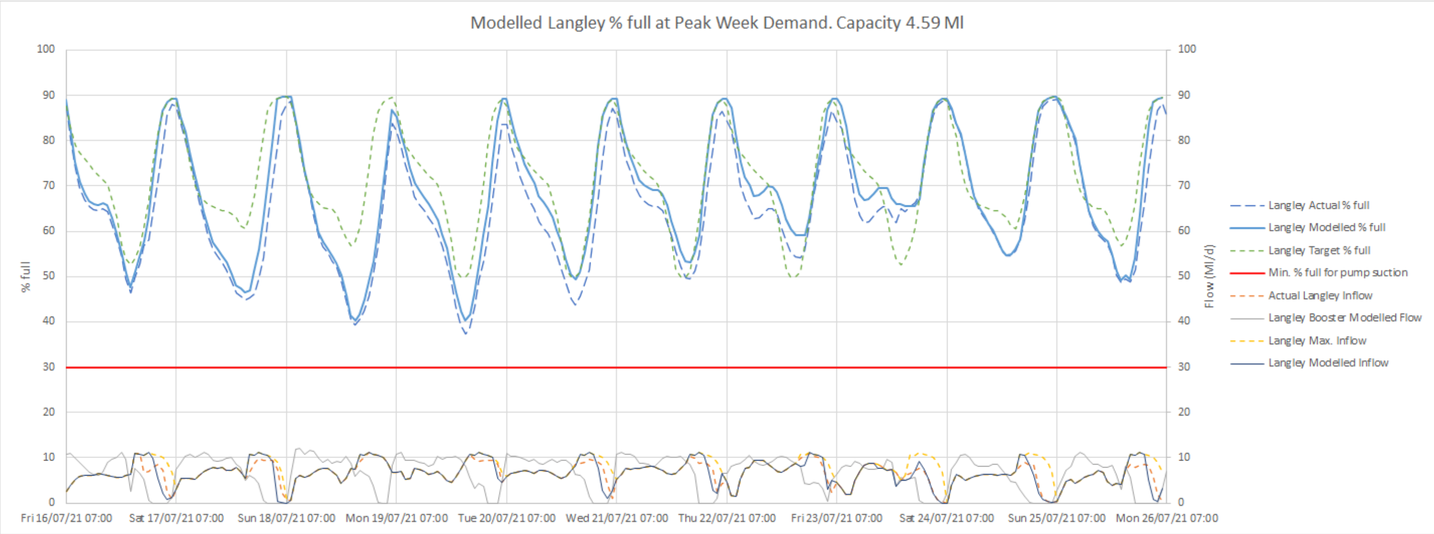


Figure 76 - Current Langley Reservoir profile in peak week.

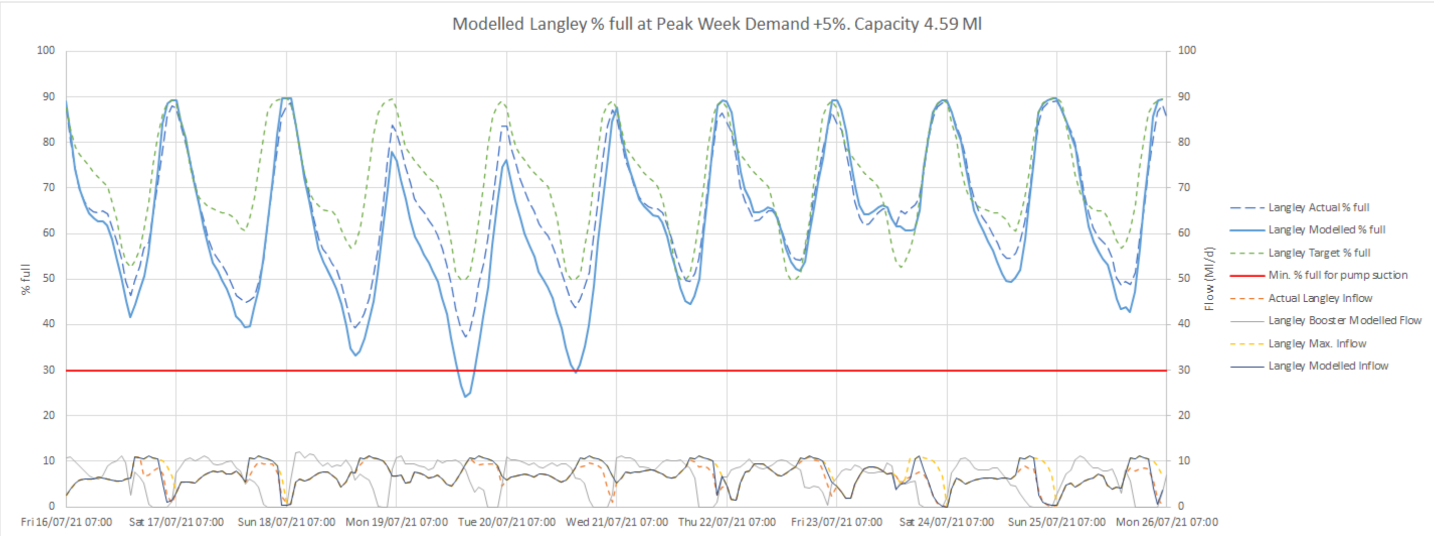


Figure 77 - Langley Reservoir profile in peak week with a 5% demand increase.

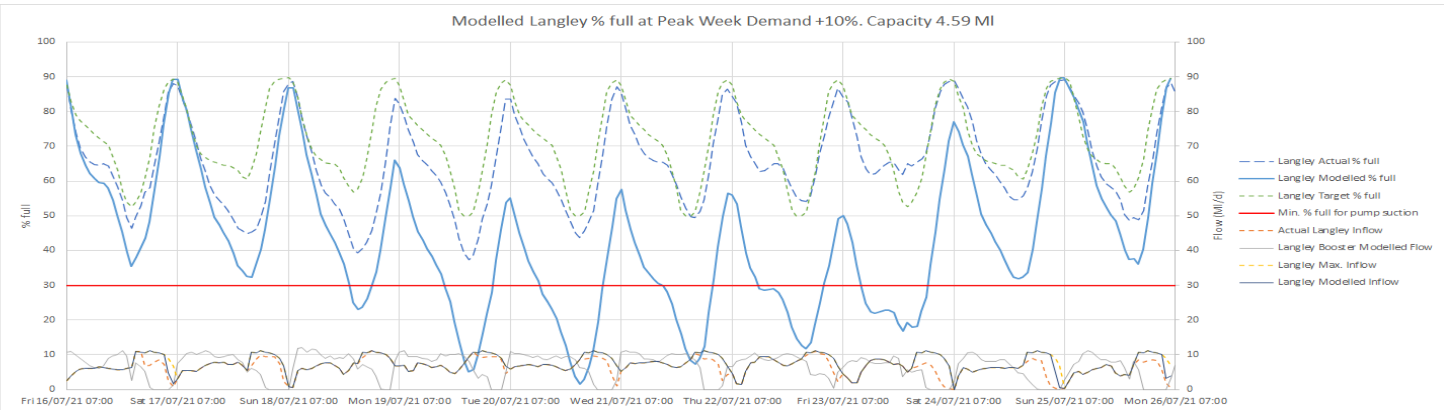


Figure 78 - Langley Reservoir profile in peak week with a 10% demand increase.

- Currently, the reservoir is at risk during peak demand weeks in terms of drawdown under normal operating conditions.
- Currently little to no emergency storage through evening demand.
- Single 18" CI inlet main – one asset failure recorded within the last 27-year period in 2018. Main laid in 1913 (110 years old).
- No allowance for climate change or extra demand during an event.

Storage analysis has been carried out on all South Staffs Water assets to highlight our most at risks zones in terms of emergency storage available. Langley / Warley zone is **a red risk** for emergency storage, and it also puts stress onto the zones that provide its water. Increasing its storage capacity will relieve those stresses particularly on the Hayley Green zone which is part of the LTDS.

The below **Figure 79** shows Langley Reservoir emergency storage in hours for present peak day demand.

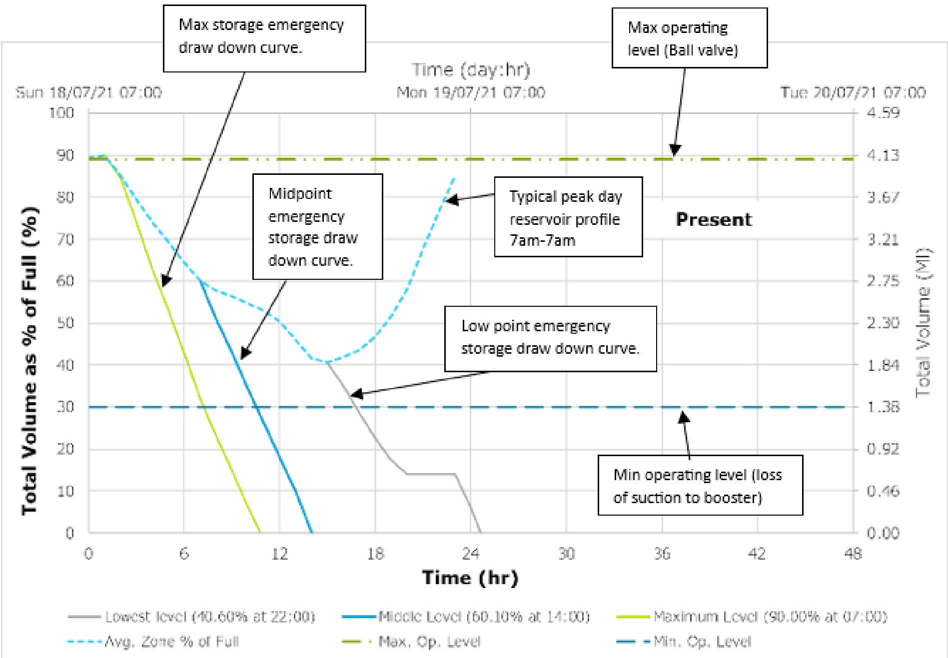


Figure 79 - Current Langley Reservoir peak day emergency storage drawdown curves.

Table 104 below shows the **Langley and Warley emergency storage times in hours for both average and peak day demands.** As you can see in peak demand there is only 2 hours of emergency storage in Warley Tower and 5 hours in Langley.

Table 104 – Langley & Warley storage times averages in hours.

	Average day demand			Peak day demand		
Scenarios	present day	10-year horizon (10% demand increase)	20-year horizon (20% demand increase)	present day	10-year horizon (10% demand increase)	20-year horizon (20% demand increase
Warley Tower emergency storage	3	3	3	2	1	1
Langley Reservoir emergency storage	7	6	5	5	4	3

5.1.4 Customer Support

We have carried out our most extensive customer engagement programme ever to ensure our PR24 and WRMP24 plans are underpinned by robust customer and wider stakeholder preferences. Our strategic engagement programme started in early 2020 and has run through to summer 2023, with over 92,500 customers taking part in a wide range of SSC research studies, with their views being compared with those from our robust Business As Usual insight programme and wider industry studies. This programme has been assured by SIA Partners as meeting Ofwat's "high-quality" engagement standards, as outlined in its Customer Engagement Policy paper (February 2022) – see appendix SSC14.

A key evidence source is appendix SSC11, which provides a thematic review of the key areas relevant to this investment case. This report was compiled independently by our triangulation partners Impact. The report also highlights the golden threads that have consistently emerged across our engagement and details the project objectives of each study used in the evidence base, when it took place and the numbers and types of customers and stakeholders engaged with. Specifically, please refer to:

- section 15 for a review of Water Quality insights
- section 16 for a review of Supply Interruptions insights

Specifically related to resilience, we see a clear thread from our engagement towards customers (household and non-household) expecting us to prioritise investment to ensure a reliable high-quality, affordable service is maintained 24/7 and showing a Willingness to Pay to make these investments. Customers also expect further investment and innovation in infrastructure schemes to detect and predict problems, in order to quickly fix and prevent any failures before their impacts are experienced, such as unexpected supply interruptions and the chance of property flooding due to a burst pipe.

Key customer evidence points to support this enhancement case include:

- A "reliable, high-quality supply" continues to be the number one priority for investment among our household and non-household customers – as evidenced in our Customer Priorities Tracker, which is a qualitative and quantitative study that has been running since October 2020. This study asks customers to express their preferences for the areas they want to see investment in, using a Max-Diff trade-off approach free from any information about bill impacts.
- This study shows that a reliable, high-quality supply, is one of two "super hygiene" areas, whilst ensuring that water bills remain affordable for all, highlighting the need for on-going targeted investment to deliver a high-quality service. It is important to highlight that "affordable bills" does not mean the majority of customers are

expressing the view that they want cheaper water bills at the expense of a deteriorating service, but that water should be affordable given it is an essential public service.

- The chart below evidences the priority customers place on this area, and when making their trade-offs in the max-diff stated preference exercise, with **58%** selecting a "reliable, high-quality supply" as the most important area for investment and only **6%** stating it was the least important area of the service attributes shown. There were no significant differences between our two supply regions of note, or within any customer segments for this attribute, highlighting the consistent response.

Importantly, customers' priorities are now becoming more balanced over the 20 services areas tracked in the study, with social and environmental areas becoming increasingly more important over time. However, customers still view having a reliable supply as a basic core service which SSC should be delivering to a high standard so that daily activities, such as drinking tap water, washing and cleaning are not impacted.

There is also evidence that non-household customers, particularly those whose operations rely on a water supply, value this service area even higher given the impacts that a loss of supply can have on day-to-day business operations.

Figure 80 – Year 3: Quantitative ranking of customer priorities for investment

Source: SSC Customer Priorities Tracker, year 3 report, April 2023. Representative sample of 1,072 household customers (including 62 future customers.

- The insights from our Customer Priorities Tracker for water quality and supply reliability were also seen in our Long-term delivery strategy (LTDS) customer engagement, which involved a multi-stage research programme of qualitative and quantitative research. The charts below show a summary of the research findings and highlight the strong and consistent level of support among all customer segments for SSC to deliver stretched ambitions for improving water quality and reducing supply interruptions. There is also evidence that many customers are expressing a preference for the company to deliver the targets put forward before 2050, although bill impacts to achieve this were not shown to them.

Figure 81 – LTDS research outputs on our water quality improvement ambition

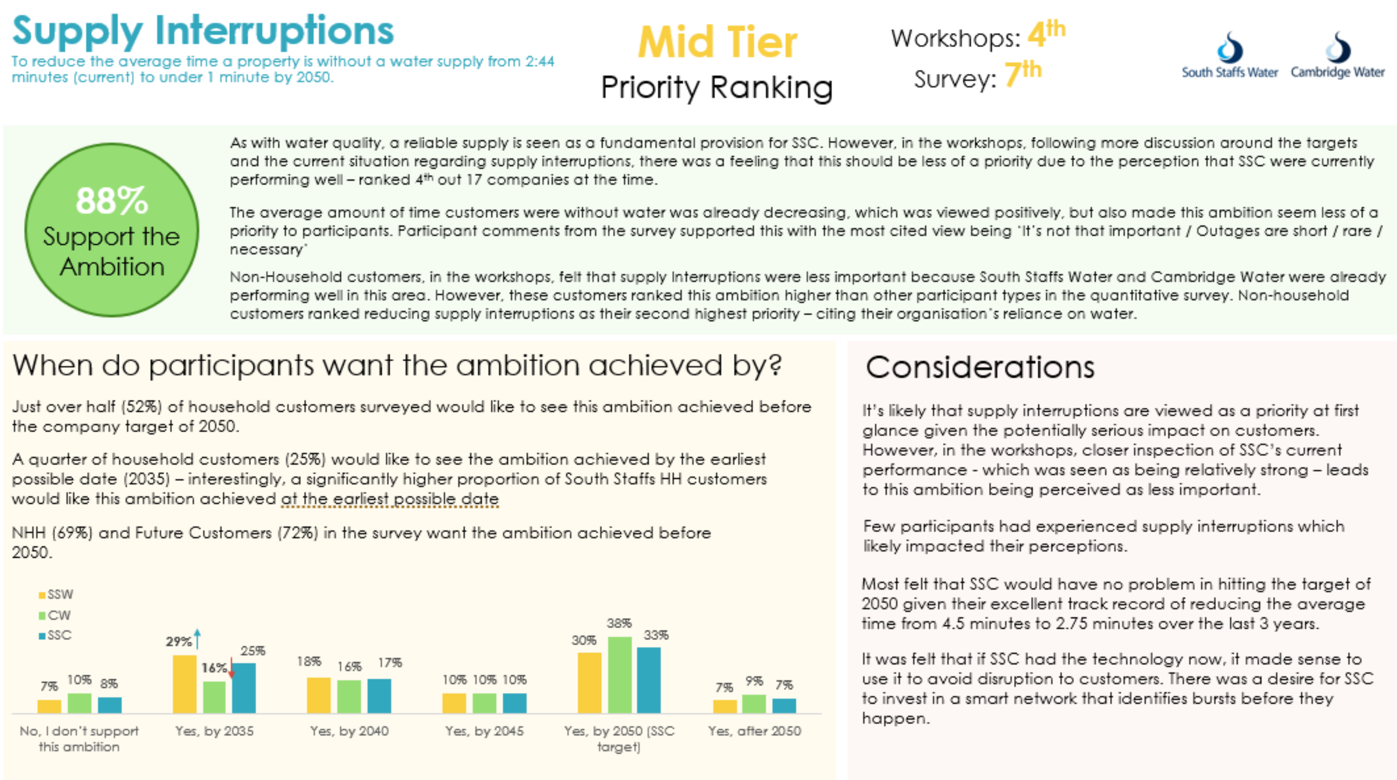


Figure 82 – LTDS research outputs on our supply interruptions ambition

Source: SSC LTDS Research, July 2023 report. Representative sample of 1,080 household and non-household customers (including 82 future customers).

Moving on from the priorities customers have expressed, the robust PR24 valuation studies undertaken highlight clearly a theme that both household and non-household customers are willing to pay for investments to avoid service failures, when presented with bill impacts. This is true in both stated preference studies whose methodology focused on a Willingness to Accept (WTA) and Willingness to Pay (WTP) approach. Specifically:

- In Ofwat's Collaborative ODI Research (Summer 2022) an analysis of the results by PJM Economics from SSC's customer base who took part shows that 5 of the top 6 service scenario attributes in terms of Willingness to Accept £m valuations (Compensation Stated preference exercise) were related to water quality and supply interruptions, with unplanned interruptions of up to 24hrs attracting the highest valuation. This highlights that customers were placing a greater emphasis on paying for service failures to not happen for these areas. We also saw a trend of customers who had medical, communications, or life-stage vulnerabilities giving higher valuations compared to the wider customer base.

- In SSC's PR24 Willingness to Pay Study (Autumn 2022) there was again a consistent theme of customers expressing higher WTP valuations for service attributes relating to resilience, namely avoiding burst pipes and do not drink notices. The table below highlights the range of valuations that were developed from our technical triangulation framework, which was developed to triangulate WTP values and wider insight sources to set central, upper, and lower valuations for use in Cost Benefit Analysis (CBA). This framework was subject to a rigorous academic peer review end-to-end, and the valuations data sources challenged by our Delphi panel of expert stakeholders to help provide confidence in the WTP valuations used in Copperleaf. The framework was also given a Green (highest level) rating by SIA partners in its independent assurance of the technical triangulation approach developed for us by our partners Impact to inform PR24 investment decisions. As shown in the image (table 5.2 from the WTP report, Nera and Qa Research), for attributes expressed in per property WTP values, the highest valuations are for services attributes related to water quality and supply interruptions, namely damage from burst pipes and unplanned supply interruptions. See appendix SSC09 for full details of our technical triangulation approach and the valuation sets provided to us for use in Copperleaf to enable a range of sensitivity tests of customer preferences within Copperleaf.

- This is a consistent thread through from customer priorities through to valuations that provides robust evidence that customers support investments which deliver on improving water quality and reducing failures that can lead to service failure such as unexpected supply interruption and water quality issues.

Table 5.2: Values (per unit) to be tested in Copperleaf (High RAG ratings, HH and NHH combined, total SSC)

COMBINED SSC	ALL - HIGHEST Central value	LOW NERA AND ODI - ALL OTHERS HIGHEST Central value	NO NERA - HIGHEST Central value	PRE PR24 Central value	ALL - HIGHEST Lower value	ALL - HIGHEST Higher value
Water not safe to drink (per property affected)	£73,592	£27,985	£5,983	£1,510	£14,779	£303,914
Flooding from a burst pipe (per property affected)	£23,775	£10,102	£2,090	£1,064	£4,983	£85,550
Unexpected temporary loss of water supply (per property affected)	£3,369	£1,832	£4,573	£506	£674	£14,259
Water hardness (per property affected)	£484	£437	£404	£381	£98	£1,762
Taste and smell of water (per property affected)	£2,116	£1,166	£2,876	£520	£423	£7,030
Low water pressure (per property affected)	£1,185	£582	£1,612	£74	£237	£3,991
Lead pipes (per property affected)	£39	£40	£50	£42	£8	£89
Water metering (per customer)	£8	£10	£8	£10	£3	£20

Figure 83 – Valuation sets from our WTP triangulation approach used to sensitivity test customer preferences in Copperleaf

In terms of use of business-as-usual insights, a key drivers analysis (Shapely regression) of the 800 survey responses in our 2023 Customer Promises Tracker highlights that "reliability of water supply" is a key driver of overall service and that household customers who have not had to contact the company to report a service failure are significantly more satisfied with the overall service than those who have. This evidences that to deliver an overall positive experience to customers that this promise must be delivered on by us. This attribute has become a notably stronger driver of overall service since 2019/20, in part linked to the impact of the COVID pandemic when customers were spending longer periods at home due to lockdowns. Although lock downs have passed, there is an on-going impact due to the change of working habits with more people spending time working at home.

This preference towards resilience investment was further evidenced in our qualitative acceptability and affordability business plan research (June 2023, Accent Research). During the qualitative testing we followed the official guidance provided by Ofwat and CCW and tested our proposed and least cost plans so customers could comment on their acceptability and affordability. The image below is taken from the qualitative report and highlights that most household and non-household customers wanted increased spend beyond the mandatory/least cost plan to ensure investment into resilience schemes as they perceive that this will ultimately feed through into lower bills. Customers were informed the bill impact would be £22m during 2025-2030 with it clearly stated this would add £2.30 to the typical household bill per year, with non-household customers given a % figure.

Customers are clearly concerned and increasingly aware of the impact that our changing climate is having on water services infrastructure and have expressed a clear priority that important investments that provide resilience to these threats should not be delayed, but that it is very important for SSC to protect those customers who are struggling with paying their bills from the increases that will be required to deliver resilience investments.

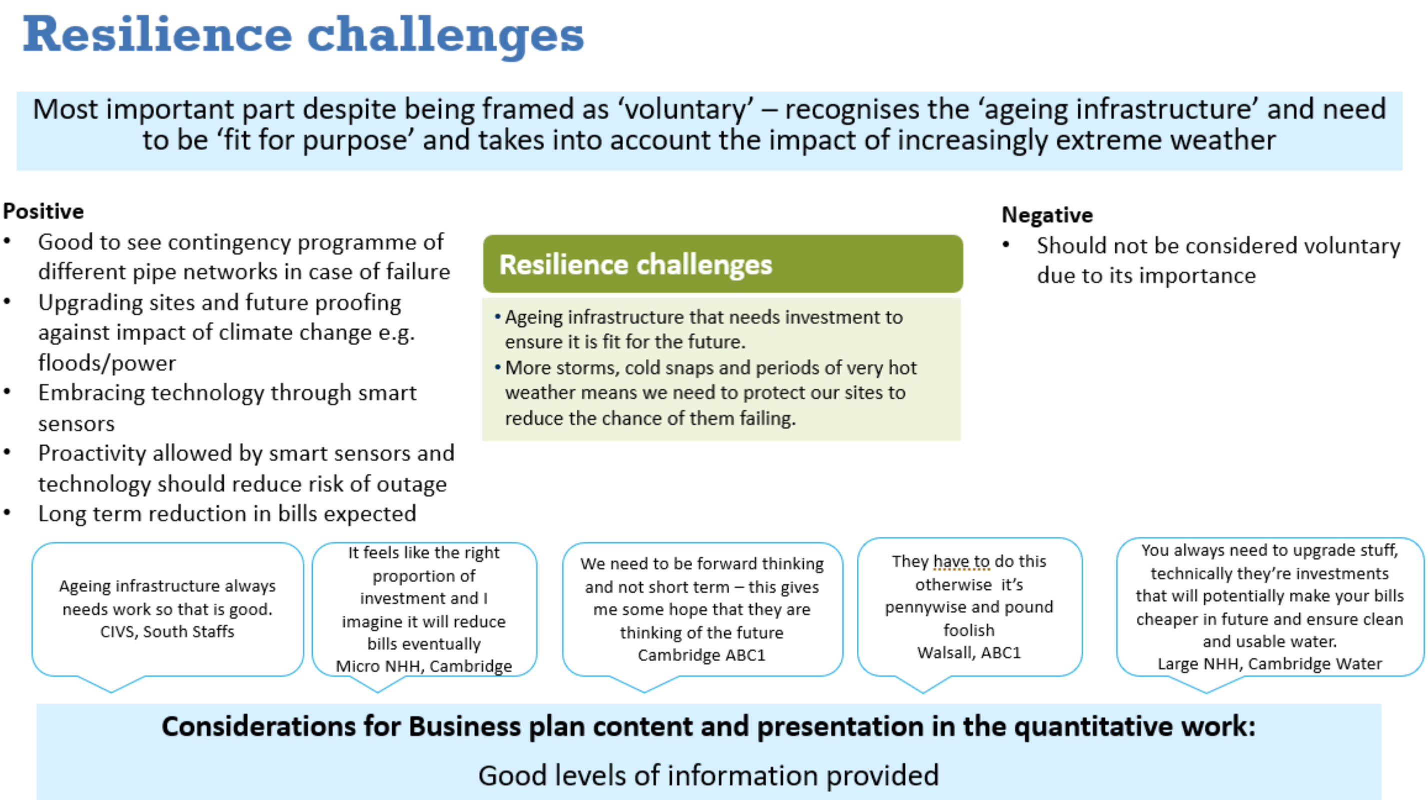


Figure 84 – feedback from customers in our PR24 AAT qualitative research on our proposed resilience enhancements.

5.1.5 Best Option for Customers

We have undertaken an in-depth bottom-up build of our risks across our business. The bullet points below provide a brief overview of the process undertaken:

- Bottom-up risk capture with stakeholders across the business scored on a traditional 5x5 risk matrix.

- Appropriate high-risk schemes were then taken forward for longlist optioneering.
- Further analysis through a multi criteria assessment (MCA) took place to form a shortlist from the longlist solutions.
- Further value appraisals (CBA) were then undertaken.
- Optimisation of the AMP 8 portfolio was then undertaken to provide a set of schemes that will offer a best value plan for the financial constraints applied.
- The three schemes in this enhancement case are part of our best value plan.
- A more detailed description of our methodology can be found in section 3 of our appendix, 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.'

Performance commitments are delivered through our base programme however, we have identified key resilience investments required to mitigate long term deterioration in these performance measures. This is due to changing conditions outside management control such as climate change, that additional investment is needed to maintain current PC's. We have tested this approach with customers, who strongly support investing in climate change resilience now to mitigate future risks to service, rather than waiting for deterioration to materialise and causing bill shocks for future generations as we recover our position. We are pushing for a fair and modelled level of resilience investment now, and through our LTDS proposals, to manage the intergenerational spend profile for resilience. More information can be found in our appendix, 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond', section 3.2.3.7.

5.1.5.1 Burntwood resilience

Optioneering

Table 105 below shows the longlisted options developed through stakeholder engagement, along with the engineering consultants (Aqua). The solutions were appraised through a multi criteria assessment (MCA) with high level cost estimations provided through Aqua's cost estimation team. It looked at a scheme's strengths and weaknesses and whether the drivers are meet with a rationale for the decisions made.

Table 105 - Solutions

Options	Description	Strengths	Weaknesses	Decision	Capex Cost (£k)	Rationale for decision
Do Nothing	Continue to operate with a single point of failure risk	No capital expenditure	No resilience achieved and risk to water supply interruptions remains the same	Discarded	£0	Resilience essential to mitigate water supply interruptions and meet customer feedback showing desire for increased operational resilience
Least Cost Option	Install strategic valves and upsize bypass	Allows shorter sections of trunk main to be isolated	Doesn't achieve full resilience to maintain supplies	Discarded	£268.9	Resilience essential to mitigate water supply interruptions and meet customer feedback showing desire for increased operational resilience
Best value option	Install new resilience link main through private land (770 metres)	Meets resilience driver. Can be built offline	Private land access and easements required	**Shortlisted**	£395.78	Meets enhancement driver of providing resilience to customers supplies. Mitigates the risk of supply interruptions
Other Alternatives	Duplicate the 18" main 1.5km	Meets resilience driver. Can be built offline	Pipeline construction risks, laying new main next to live existing trunk main. Open cut in carriageway. Greater carbon impact compared to the best value option.	**Shortlisted**	£2,907	Meets enhancement driver of providing resilience to customers supplies. Mitigates the risk of supply interruptions
Other Alternatives	Replace the 18" main 1.5km	Provides a new asset	Doesn't achieve resilience in the event of asset failure	Discarded	£1,873.5	Resilience essential to mitigate water supply interruptions and meet customer feedback showing desire for increased operational resilience

More options were also discussed during the stakeholder engagement sessions but were discarded at that stage due to either the feasibility of the scheme or through hydraulic analysis ruling them out. For example – a new link main from a neighbouring WSZ (Walsall). A quick analysis of total heads soon highlighted that there is insufficient driving head to meet service levels for up to half of the Burntwood area. This implied that the new link main would need to be boosted, which would not be a cost-efficient solution.

Shortlisted solutions

Through the above optioneering process, the two options selected for shortlisting are shown below. At shortlisting stage, scopes were reviewed and defined to allow for a more accurate cost estimation.

1. **Lay new 400mm alternative route through private land (£395,780).**
2. **Duplicate 18" with 400mm (£1,261,208).**

Table 106 below shows the two shortlisted options which have been entered into our asset management decision-making tool called Copperleaf. In Copperleaf these solutions have been valued against our six-capital framework which provides a monetised net present value (NPV). The NPV considers the cost of the investment as well as the carbon impact to deliver and values the solution against the benefits.
Further information on our value framework can be found in our appendix 'SSC37 Our Asset management approach to best-value investment planning through 2025-2030 and beyond,' in section 1.2 for our value framework and section 4 for our optimisation approach.

Table 106 - Shortlisted options

Options	Description	NPV (£k)	Cost (£k)	Decision
1	Install new resilience link main through private land (770 metres)	109,802	£395.8	Recommended alternative (best value)
2	Duplicate the 18" main 1.5km	109,032	£1,261.2	

The recommended alternative offers the best value option for customers. The NPV's for both shortlisted solutions are similar, this is because both solutions offer the same in terms of meeting the resilience drivers. The difference between the two is that the link main through private land is a more environmentally friendly solution which produces less carbon impact to deliver and is less in terms of length of main required and cost.

Burntwood resilience solution

Lay 770 metres of 400mm main through private land to link the existing 18" CI main serving the Burntwood area to the existing trunk main system within the Cannock High WSZ. The investment will also include three trunk main valve setups to provide flexibility in the network. This allows for full resilience to maintain pressure and flows to both control valves which serve the Burntwood area.

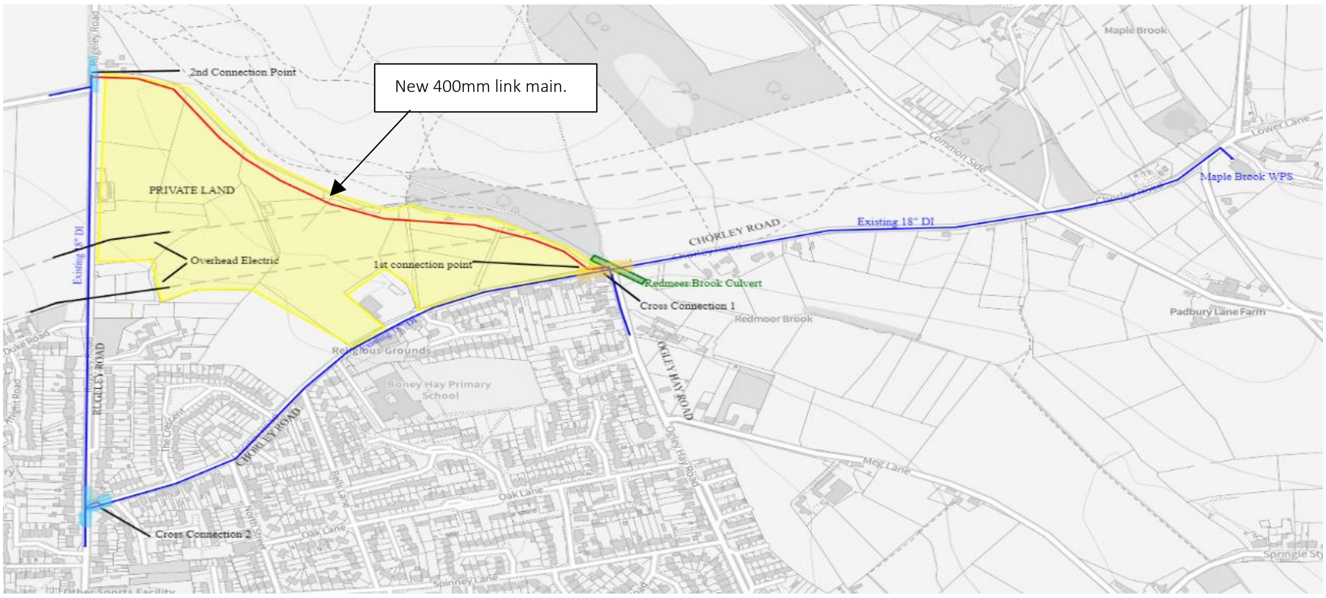


Figure 85 - Solution diagram

Figure 85 above shows the proposed new 400mm link main in red. The new main will cross through the private land area to provide the enhanced connectivity within the trunk main system improving the resilience to maintain supplies in the event of a failure. The solution ensures that the two control valves feeding the Burntwood area can maintain their feeds no matter what section of the main is required to be isolated.

Due to the main crossing private land, there is an opportunity to use Directional Drilling techniques to reduce costs and excavations, allowing for a shorter and more sustainable construction programme.

Implementation of 770 metres of 400mm resilience main through private land along with associated trunk main valve setups will provide the following benefits to our customers:

- Our customers in the Burntwood area **(approximately 13,700 properties)** will have a robust and resilient service, long-term.
- Reduction in the risk of supply interruptions of customers supplies from high to low risk.
- Existing ODI impact for supply interruptions is a minimum of **6 minutes and 45 seconds**. Outcome risk is no impact to supply interruptions ODI (**less than 3 hours**).
- Reduction in the risk of increased **water quality contacts** from an asset failure from high to low risk.
- Customers are receiving the most cost-effective solution which will have a bill impact of **£0.04p** or a **0.02%** per year.

The bill impact is calculated using the investment CAPEX cost multiplied by the weighted average cost of capital (WACC of 3.69%). Then using a run-off rate of 4.5% to calculate the depreciation impact. The WACC impact is added to the depreciation impact to provide a total. The total is then split based on 80% household properties and divided by the number of households to provide a bill impact per year. The bill impact percentage is then based off our average bill rate of £170 per year.

5.1.5.2 Hanbury Resilience

Optioneering

Table 107 below shows the longlisted options developed through stakeholder engagement, along with the engineering consultants (Aqua). The solutions were appraised through a multi criteria assessment (MCA) with high level cost estimations provided through Aqua's cost estimation team. **Table 107** summarises the scheme's strengths and weakness and whether the drivers are meet with a rationale for the decisions made. Further information on our value framework can be found in our appendix, 'SSC37 Our Asset management approach to best-value investment planning through 2025-2030 and beyond,' in section 1.2 for our value framework and section 4 for our optimisation approach.

Table 107 - Solutions

Options	Description	Strengths	Weaknesses	Decision	Capex Cost (£k)	Rationale for decision
Do Nothing	Continue to operate a red risk WSZ with no resilience	No capital expenditure	No resilience achieved and risk to water supply interruptions remains the same	Discarded	£0	Resilience essential to mitigate water supply interruptions and meet customer feedback showing desire for increased operational resilience
Least Cost Option	Duplicate 2.5km of 300mm from Outwoods Booster to the junction of Beamhill	Provides a percentage of resilience to the zone by removing the single point of failure of Outwoods delivery main	Doesn't achieve full resilience to maintain supplies to the whole WSZ	Discarded	£1,035.6	Resilience essential to mitigate water supply interruptions and meet customer feedback showing desire for increased operational resilience
Best value option	Duplicate 2.5km of 300mm from Outwoods Booster to the junction of Beamhill plus, install 3.6km of 160mm across from Hanbury to Yoxall area	Meets full zone resilience driver. Reduced carbon impact to deliver compared to alternative options.	Private land access and easements required. Zonal resilience still reliant on one booster site	**Shortlisted**	£2,484.2	Meets enhancement driver of providing resilience to customers supplies. Mitigates the risk of supply interruptions
Other Alternatives	New greater capacity Yoxall Booster site located near the Outwoods trunk main to ensure no suction pressure issues. 10 km of new delivery mains to allow greater volume capacity from new booster site.	Meets resilience driver. Can be built offline. Removes current suction pressure issues	Pipeline construction risks, laying new main next to live existing trunk main. Opencut in carriageway. Greater carbon impact compared to the best value option.	**Shortlisted**	£7,708.6	Meets enhancement driver of providing resilience to customers supplies. Mitigates the risk of supply interruptions
Other Alternatives	We looked at the above alternative (new Yoxall Booster) with varying lengths of new mains (5.2 & 6.7 km)	Can be built offline. Removes current suction pressure issues	Doesn't achieve full resilience to maintain supplies to the whole WSZ	**Discarded**	5.2km £5,757,784 6.7km £6,367,284	Resilience essential to mitigate water supply interruptions and meet customer feedback showing

						desire for increased operational resilience

More options were also discussed during the stakeholder engagement sessions but were discarded at that stage due to either the feasibility of the scheme or through hydraulic analysis ruling them out. For example – refurbishment and upsizing of the current Yoxall Booster site. The issue here is maintaining the suction pressure to the site when increasing the output. Currently suction pressure in peak demand drops to 0.5 bar. This is why we have suction tanks on site. If we were to upsize and increase capacity, hydraulic modelling showed that the suction to the site could not be maintained. Therefore, the only feasible option to increase capacity of the site is to move the booster location close to the trunk main that provides the suction.

Shortlisting options:

1. New Yoxall Booster with 10km of new mains.
2. Resilience to the 300mm single delivery main from Outwoods Booster to Beamhill plus, 3.6km of reinforcement to the 6” main within the Hanbury zone.

The above two options were entered into our asset management decision making tool called Copperleaf. The alternatives were assessed against the six capitals and their associated value models to provide a NPV (Net Present value) for each scheme. Both schemes achieve similar outcomes, providing a resilient supply to the Hanbury WSZ so, the real analysis is around which one is most cost beneficial and most efficient to deliver.

Further information on our value framework can be found in our appendix, ‘SSC37 Our Asset management approach to best-value investment planning through 2025-2030 and beyond,’ in section 1.2 for our value framework and section 4 for our optimisation approach.

New booster plus 10km of new mains

Advantages	Disadvantages
Meets resilience driver to supply Hanbury WSZ from Yoxall	Land purchase required rather than building on SSW owned land
Addresses issues of ageing and inefficient equipment	Two sites will need to be run until Yoxall can be decommissioned and Brown’s Lane can start
The new location would avoid approximately 3km of suction pipework to the booster pumps and minimise air entrainment into pumps	Potential delays with land negotiation and purchase
Potential to offset some costs by selling existing Yoxall site and/or reuse equipment	Building on greenfield site, loss of green space and environmental impact
The site can largely be built offline minimising disruption up until the tie in point	

300mm and 6” mains resilience

Advantages	Disadvantages
Meets resilience driver to supply Hanbury WSZ	Reliance to feed the zone still on Outwood’s booster
Least cost option that fulfils resilience driver	First 600 meters of the route will need to be open cut and traffic management requirements
Less carbon impact to deliver this scheme, with no ongoing operational carbon impact compared to other scheme.	Connections will need to be done under pressure
Mains can be laid offline with under pressure connections to tie in.	1.9Km is through fields, so land access will be required.
Supports base investments programme into Outwood’s booster.	May need new or updated easements.
Helps support any future growth in the zone	Notice to landowners will be required.
Helps to support the long-term delivery strategy around Hanbury storage / resilience	
Supports the drive to rehab the 9” PVC main which also improve zonal resilience.	

Table 108 below shows the two shortlisted solutions that have been appraised in Copperleaf with the net present value outcomes of the investments showing which once offers the best value for money for our customers.

Table 108 Shortlisted solutions

Options	Description	NPV (£k)	CAPEX Cost (£k)	Decision
1	New booster site with 10km of mains upsizing	111,068	£7,708.6	
2	Duplicate 2.5KM of 300mm main plus reinforcement of 3.6 KM of 6" main	114,420	£2,911	Recommended alternative (best value)

Hanbury resilience solution.

The best value solution we propose to implement is duplication of the existing 300mm Outwoods Booster delivery main alongside its existing route for 2.5km plus, 3.6km of new greater capacity mains within the Hanbury WSZ to allow zonal resilience from east to west (Outwoods to Yoxall).

Figure 86 – Proposed route for resilience solution

Figure 86 above shows the proposed route from Outwoods Booster along 0.5km of carriageway, then 2 km through soft ground to the junction of Beamhill where the main splits into three.

The second part of the scheme is improved mains capacity within the zone that links the two boosters together. Our models show this is a hydraulic restriction preventing Outwoods Booster from providing full resilience to the zone in a scenario where there is a loss of Yoxall Booster. This links the spine mains in the zone and is under capacity to allow the required pressure to be transferred.

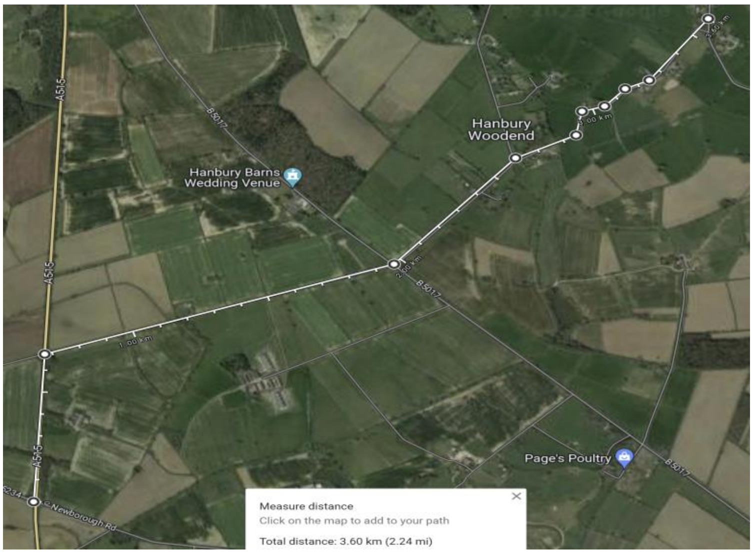


Figure 87 – Route of 3.6km of existing network

Figure 87 above shows the route of the 3.6 km restriction with need of improved mains capacity that will be delivered through this investment.

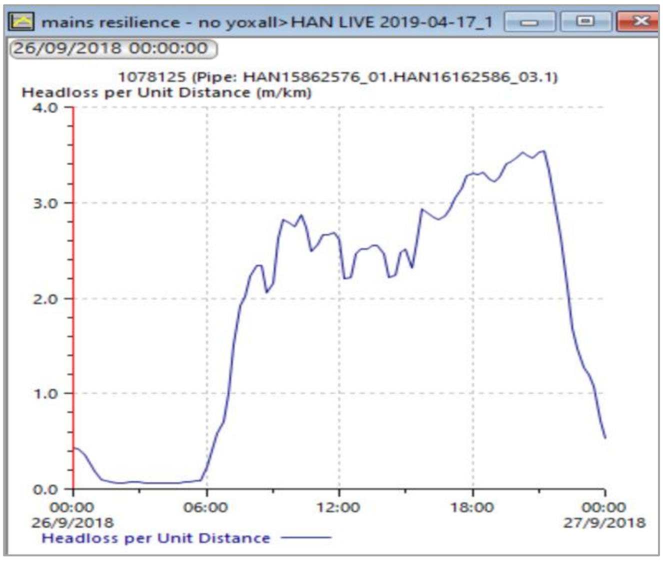


Figure 88 – Hydraulic model output of reduced head loss

Figure 88 shows the hydraulic model output of the reduced head loss in metres per km (m/km) The main has a peak head loss in peak evening demand of 3.5 metres (0.35 bar) per km compared to 10 metres (1 bar) per km in its current state. This enables the high point at Newchurch to maintain a pressure between 37 – 26 metres (3.7 – 2.6 bar) which is satisfactory.

Outwoods Booster is the critical asset to maintain supplies to the Hanbury WSZ. This is why we propose to improve the resilience of the mains from Outwoods Booster to ensure the critical assets are robust to maintain supplies to customers. The benefits will include:

- Resilient infrastructure to maintain supplies to the whole WSZ **(7,700 properties)**
- Removing the hydraulic restriction that prevents zonal resilience where there is a loss of Yoxall Booster.
- The best value solution to provide resilience to customers supplies.
- Proactively reducing the risk to customers supplies by reducing the impact of a one-off event which could see interruptions between 6-12 hours.

- One-off event impact avoidance of **3 minutes and 46 seconds ODI impact to supply interruptions.**
- The above outcomes can be achieved for an **added £0.26p / 0.15% impact** to customer bills.

The bill impact is calculated using the investment CAPEX cost multiplied by the weighted average cost of capital **(WACC of 3.69%)**. Then using a run-off rate of **4.5%** to calculate the depreciation impact. The WACC impact is added to the depreciation impact to provide a total. The total is then split based on **80%** household properties and divided by the number of households to provide a bill impact per year. The bill impact percentage is then based off our average bill rate of **£170** per year.

We are aligning our base programme with this enhancement investment by ensuring we invest a significant amount of base expenditure on Outwoods Booster. This will look to install a new booster pump to replace one of the existing booster pumps which is now at end of asset life and inefficient. We also have a dependency to mains rehabilitation on the 9" PVC / CI main that provides the suction and part of the delivery to Yoxall Booster station, as this main does have a history of failure **(7 bursts in the last 10 years 0.7 bursts per year).**

It is believed that at some point in the future, we may still need to complete the solution of a new Yoxall Booster site with significant investments in new upsized mains when the reservoir assets are at end of life. This is part of our LTDS resilience core pathway, where it is proposed that the Hanbury WSZ will become a boosted zone. The proposed investment forms part of the long-term vision for the WSZ giving us and our customers confidence that the investment is a no regrets investment.

5.1.5.3 Langley Storage

Optioneering

Table 109 below shows the longlisted options developed through stakeholder engagement, along with the engineering consultants (Aqua). The solutions were appraised through a multi criteria assessment (MCA) with high level cost estimations provided through the Aqua's cost estimation team. It looked at scheme's strengths and weakness and whether the drivers are meet with a rationale for the decisions made.

Table 109 solutions

Options	Description	Strengths	Weaknesses	Decision	Capex Cost (£k)	Rationale for decision
Do Nothing	Continue to operate a red risk zone with little storage resilience	No capital expenditure	No resilience achieved and risk to water supply interruptions remains the same	Discarded	£0	Resilience essential to mitigate water supply interruptions and meet customer feedback showing desire for increased operational resilience
Least Cost Option	Base maintenance on existing 4.59Ml capacity reservoir	Low capital expenditure	No improvements, still operating with supply and water quality risks	Discarded	£1,147	Resilience essential to mitigate water supply interruptions and meet customer feedback showing desire for increased operational resilience
Best value option	Build new reservoir asset with increased capacity 10 Ml.	Provides approximately 22 hours of emergency storage. Will remove the current Water Quality risk with outlet and drain main. Replaces old deteriorating asset.	Vegetation clearance required.	**Shortlisted**	£4,978.2 this figure is the enhance-ment proportion of the TOTEX	Meets enhancement driver of providing resilience to customers supplies. Mitigates the risk of Water Quality incidents.
Other Alternatives	Rebuild reservoir same size 4.59Ml	New reservoir asset. Reduced capital cost compared to upsizing. Will remove the Water Quality risk.	Current supply risk will remain the same as demonstrated in the need section of this case.	**Shortlisted**	£5,976	Mitigates the risk of Water Quality events but does not address supply issues.
Other Alternatives	Drill a new outlet main through side wall of existing reservoir	Removes the Water Quality risk with the drain main / sump.	Due to internal walls already been lined previously, condition of the blue brick is unknown and may not be possible to drill through. Would require the reservoir to be out of supply which puts supplies at risk.	**Discarded**	£1,497	Mitigates the risk of Water Quality events but does not address supply issues.

More options were also discussed during the stakeholder engagement sessions but were discarded at that stage due to either the feasibility of the scheme or through hydraulic analysis ruling them out. For example – Rebuilding and upsizing Warley Tower. There isn't room on the current site to expand the existing tower capacity and due to the storage required a tower isn't a feasible option from a hydraulic position. This means this solution would need a suitable location, new land purchase, new main laying, possible localised booster zone if top water level isn't able to be built up high enough, which would not be a cost-efficient solution.

Shortlisting:

The two options selected for shortlisting were:

1. **Rebuild reservoir to same size 4.59Ml (£5,976k).**
2. **Rebuild reservoir increased capacity 10Ml (TOTEX of £8,290k of which £4,978k is enhancement spend).**

The above two options were entered into our asset management decision making tool called Copperleaf. The alternatives were assessed against the six capitals and their associated value models to provide a NPV (net present value) for each scheme. The great the net present value the greater the benefits are of that investment.
Further information on our value framework can be found in our appendix, 'SSC37 Our Asset management approach to best-value investment planning through 2025-2030 and beyond,' in section 1.2 for our value framework and section 4 for our optimisation approach.

Table 110 - Shortlist solutions NPV outputs

Options	Description	NPV (£k)	TOTEX Cost (£k)	Decision
1	Rebuild reservoir same size (4.59Ml)	32,265	£5,976	
2	Build a new 10Ml capacity asset and decommission existing	160,502	£8,290	Recommended alternative (best value)

Langley storage solution

Based on the above process and analysis our proposed solution is to build a new twin cell reservoir of 10Ml capacity. The reservoir has been sized by South Staffs Water subject matter experts alongside an All-reservoir panel engineer to meet 22-24 hours emergency storage. This also considers the potential to discontinue Warley Tower in the future once the tower is deemed no longer fit for use. Please also refer to our long-term delivery strategy to support this.

This option involves:

- Site clearance of heavily overgrown land
- Upgrade of access road around site.
- Remove earth embankments and roof coverings.
- Build new 10Ml twin celled concrete box structure reservoir.
- Construct related pipework modifications including new valve chambers.

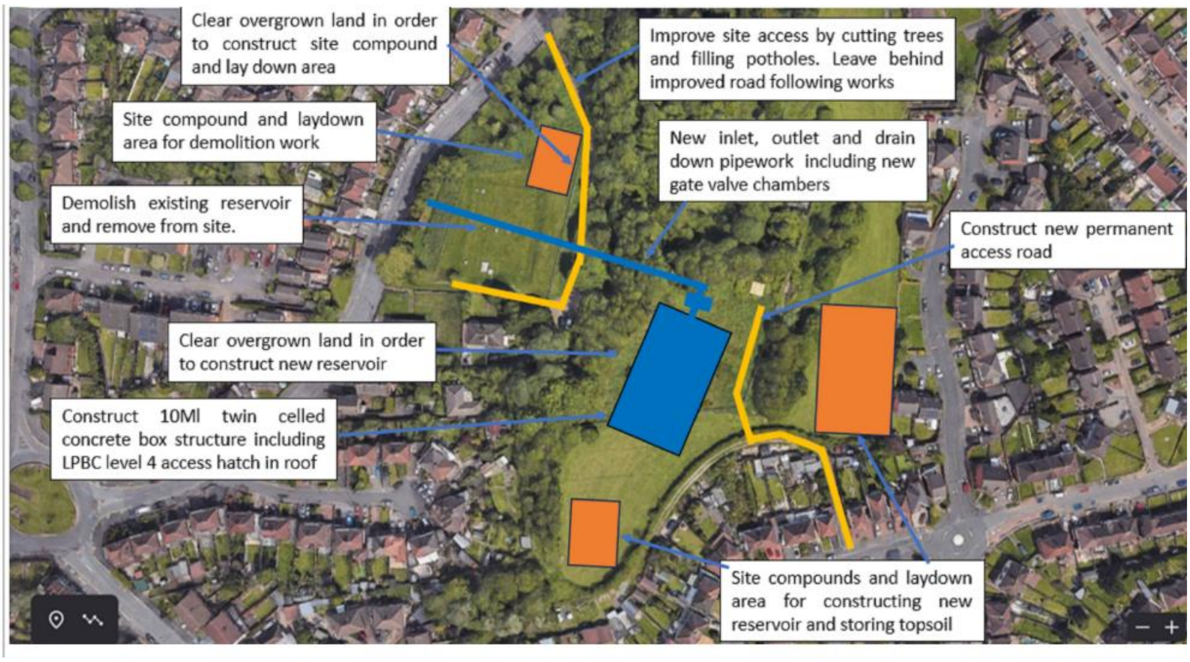


Figure 89 - High level view proposal of new 10Ml reservoir

Figure 89 above shows a high-level view of where the new reservoir could be built while the existing reservoir remains in supply. It shows where site compounds can be located and access roads. Upon commissioning into supply the existing reservoir would then be demolished.

As evidenced in section 5.1.5 of this case above in shortlisting, there are benefits to rebuilding the reservoir (positive NPV) to the same size by, mitigating the water quality risk issue and asset life but has no value against supply resilience. Building a new 10Ml cell has a much greater value (NPV) due to the investment meeting all drivers of:

- Water Quality improvements
- Deteriorating asset exceeding asset life expectancy
- Supply resilience

Below are the modelled outputs of peak demand weeks with a 10 Ml capacity reservoir.

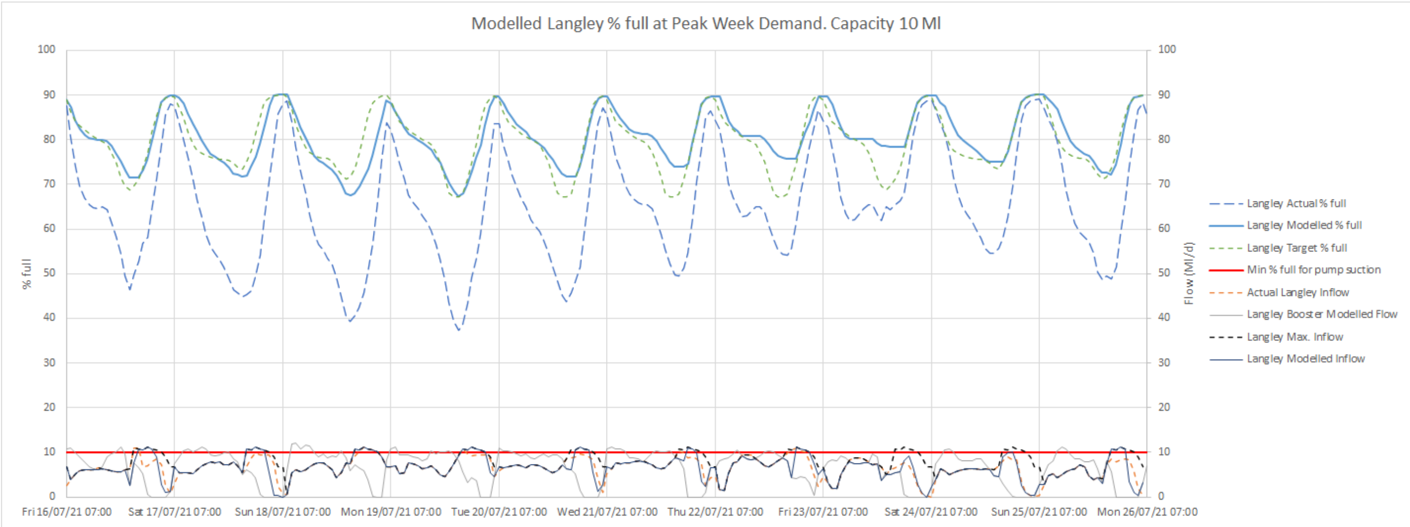


Figure 90 - Langley Reservoir with 10Ml capacity - profile in peak week demand

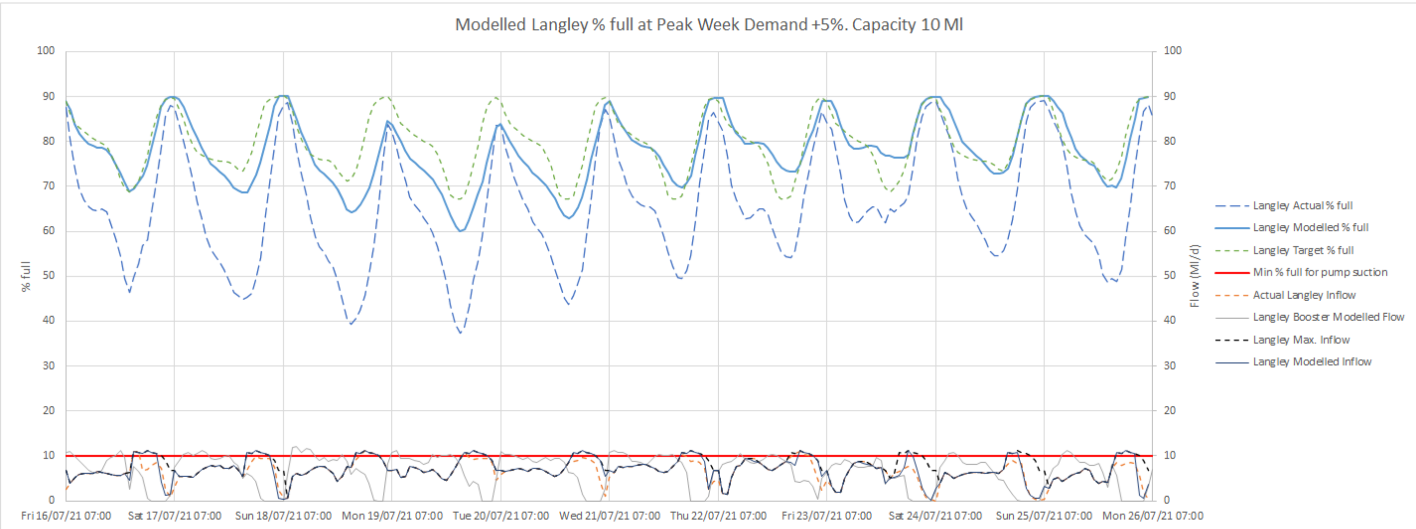


Figure 91 - Langley Reservoir with 10Ml capacity - profile in peak week demand plus 5% increase

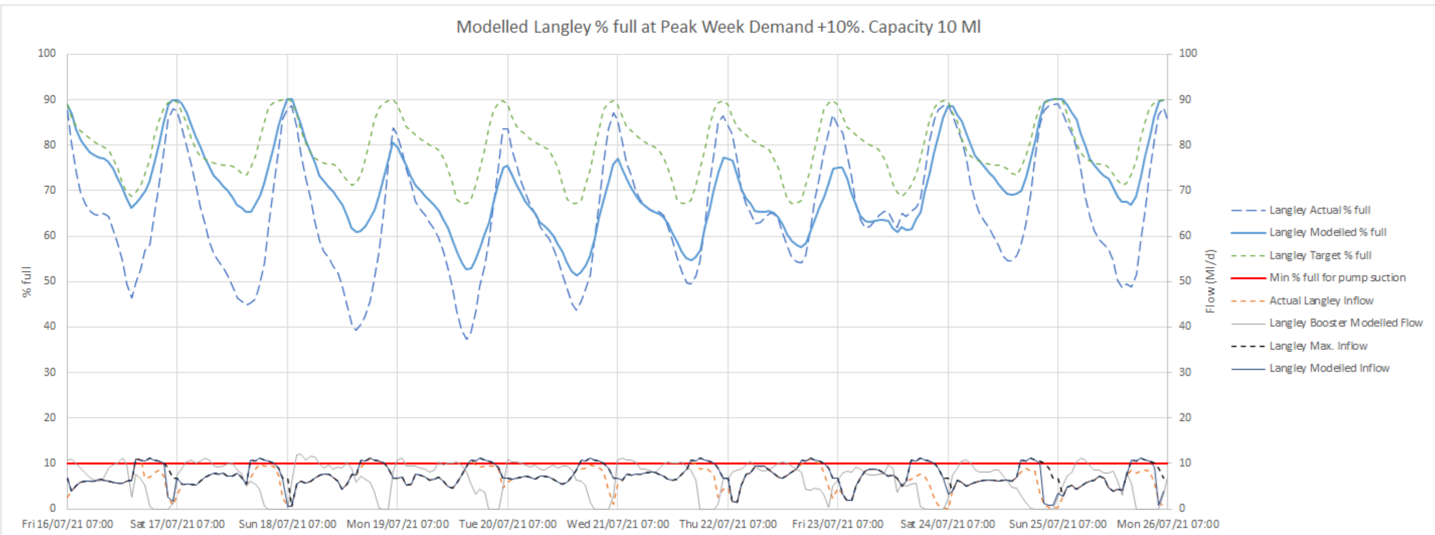


Figure 92 - Langley Reservoir with 10Ml capacity - profile in peak week demand plus 10% increase

Figure 92 above shows by increasing the reservoir capacity, it will provide much greater supply resilience when compared to the current existing position which is demonstrated in section 5.1.3 of this case. Currently we operate on the limit in terms of storage in this reservoir with very little resilience if there is an increase in demand or a prolonged period of demand which is becoming more common with climate change.

Increasing capacity will give our customers security of supply and will also benefit other strategic storage reservoirs upstream of Langley that provide its input. One of the beneficiaries being Hayley Green which is a vulnerable reservoir also classed as a red risk WSZ and is part of our core pathway in our LTDS for AMP 9.

The enhancement CAPEX spend will deliver:

- Increase in storage capacity by 5.41Ml on top of the existing 4.59Ml.
- New reservoir storage asset with a life expectancy of 100 years.
- Supply security to approximately 11,800 properties
- A long-term investment which will allow various options with Warley Tower storage asset when at end of life.
- The scheme would have a customer bill impact of £0.45p or 0.26% per year.

The bill impact is calculated using the investment CAPEX cost multiplied by the weighted average cost of capital **(WACC of 3.69%)**. Then using a run-off rate of **4.5%** to calculate the depreciation impact. The WACC impact is added to the depreciation impact to provide a total. The total is then split based on **80%** household properties and divided by the number of households to provide a bill impact per year. The bill impact percentage is then based off our average bill rate of **£170** per year.

5.1.6 Cost Efficiency

For this case (Distribution Network resilience) we decided to engage directly with an engineering consultancy to ensure options and costs could be developed robustly and efficiently with the objective to satisfy OFWAT's enhancement criteria in mind at all stages along the way. Further information on our costing process can be found in our SSC37 Our Asset management approach to best-value investment planning through 2025-2030 and beyond section 3.2.2.

Upon receipt of the completed estimates we have completed our own internal benchmarking to ensure that assumptions in the make-up of the estimates were efficient for us. Below you can find the internal benchmarking comparisons for each scheme in this case.

5.1.6.1 Burntwood resilience

The costs provided for the **Burntwood resilience** solution were provided by an engineering consultant who have used their own cost models, which take information from industry-wide data sets and the engineering consultant's own expertise, as they have worked with many of the UK's water industry companies.

The consultant's cost estimates were compared against two schemes that were delivered in 2022 and 2023. **Table 111** below shows the comparison between the schemes on costs and all-in unit rates.

Table 111 - Cost benchmark comparison.

Scheme	Cost £s	Length of pipeline (m)	unit rate £s per metre	Comments	Included in cost
Burntwood Resilience Aqua consultant estimation	£1,119,506	770m	£1,454	The unit rate appears high for the South Staffs region as this is 90% through private land.	Direct, Indirect & overheads
Waterbeach A10 scheme Actual cost data installed in 2022	Actual cost £1,931,612	3,758m	£514	This scheme was 90% through private land of 400mm main. The same as the proposed investment accept this was over a much greater length.	Direct, Indirect & overheads
Cemex scheme installed in 2022/23. Actual costs	£1,196,850	3,950m	£303	This scheme was 250mm pipework through 70% private land and 30% roadways.	Direct, Indirect & overheads
Burntwood resilience cost we feel are representative post benchmarking	£395,780	770m	£514	Similar cost per metre as the Waterbeach A10 works seems representative as it's the same size pipework through similar ground conditions	Direct, Indirect & overheads

The CAPEX cost provided for the Burntwood resilience scheme from the engineering consultants we feel is very high compared to other schemes delivered in the table above. The Waterbeach scheme in the table is very similar to the Burntwood resilience scheme in terms of main size and ground conditions. Based on this we have decided to apply an efficiency reduction in the scheme costing using a run rate unit of **£514** per metre. This means we have reduced the initial CAPEX estimation from **£1,119,506 to £395,780.**

5.1.6.2 Hanbury resilience

The costs provided for the **Hanbury resilience** solution were provided by an engineering consultant who have used their own cost models, which take information from industry-wide data sets and the engineering consultant's own expertise, as they have worked with many of the UK's water industry companies.

The consultant's cost estimates were compared against one developed by our internal Developer Services team and against actual delivered schemes. Our internal cost estimation sheets use our current AMP7 framework Bounty rates. **Table 112** below shows the comparison between the schemes and the all-in unit rates. We feel the estimation provided by the engineering consultant which we have adopted, is a fair cost with a fair unit rate applied. There are unknown risks when laying through private land such as compensation rates, archaeological factors and environment factors which can cause a significant increase in costs and duration of the scheme.

Table 112 - Cost benchmark comparison.

Scheme	CAPEX cost £s	Length of pipeline (m)	unit rate £s per metre	Comments	Included in cost estimation
Hanbury resilience – 2.5km of 300mm plus 3.6km 160mm. Total of 6.1km with 2km in soft ground and 4.1 km in carriageway Engineering consultant Aqua	£2,911,049	6.1	£477	Estimation from engineering consultants (adopted)	Direct, Indirect & overheads
Hanbury resilience – 2.5km of 300mm plus 3.6km 160mm. Total of 6.1km with 2km in soft ground and 4.1 km in carriageway SST internal Developer Services estimation team.	£2,534,844	6.1	£416	Estimation sheet using AMP 7 framework costs	Direct, Indirect & overheads
Beamhill - 2.3km of 280mm near the proposed Hanbury resilience solution	£727,000	2.3	£316	Actual out turn costs from delivery framework contractor	Direct, Indirect & overheads
Cemex scheme installed in 2022/23. This scheme was 250mm pipework through 70% private land and 30% roadways. Length of main laid 3,950m	£1,196,850	3,950	£303	Actual out turn costs from delivery framework contractor	Direct, Indirect & overheads

5.1.6.3 Langley Reservoir

The costs provided for the new Langley Reservoir of 10Ml capacity was provided by an engineering consultant (Aqua) who have used their own cost models, which take information from industry-wide data sets and the engineering consultant's own expertise, as they have worked with many of the UK's water industry companies.

The percentage proportion split between enhancement and base costs are 60:40. This was assessed through the engineering consultant's estimation cost breakdowns. Through each item reference the cost was split by either enhancement spend, base spend or a proportion split. For example, the cost of a 10Ml storage reservoir box applied a 54% enhancement cost and 46% base cost. The existing reservoir is 4.59 Ml capacity so this equates to 46% of the cost to build the new structure. Additional costs for new pipework and drainage pipes is allocated to enhancement expenditure. Demolishing the existing reservoir is allocated to the base expenditure.

The consultant's estimates were compared against previous reservoir build costs. As seen in **Table 113** below, costs have increased compared to the Outwoods Reservoir build completed in 2017. It is clear to see that from 2017 (Outwoods 3 & 4 build) to 2023 (Bourn Res build) there is a proportional increase of £289k per Ml of storage. There is a similar proportional increase for the proposed new Langley build in AMP 8 (£307k per Ml of storage increase from Bourn Res build). There is more work involved in the Langley Reservoir build compared to the recent Bourn Reservoir. Bourn Reservoir included demolition of the existing reservoir and rebuild on the same footprint. This means there was minimal pipework and drainage works required. Langley is to build a new reservoir offline on the opposite side of the site. This requires a new access road, pipework and drainage installations to run across the site from existing reservoir location, and a heavily vegetated area to be cleared. It will include demolition of the old reservoir once the new one is commissioned and reinstatement of the land.

Based on the above information we feel the estimation provided by the engineering consultant (Aqua) which we have adopted, is a fair cost with a fair unit rate applied.

Table 113 - Cost benchmark comparison

Source	Scheme	Estimated TOTEX cost £k	unit rate £k per Ml of storage	Included in cost estimation
Engineering consultant Aqua	New 10Ml twin cell reservoir with associated pipework and land clearance	£8,290	£829	Direct, Indirect & overheads
Actual outturn costs of a new reservoir build completed in January 2023	New Bourn Reservoir 8Ml capacity single cell. Demolish existing reservoir and replace asset in same location.	£4,178	£522	Direct, Indirect & overheads
Actual outturn costs of a new reservoir build completed in 2017	Outwoods 3 & 4 Reservoirs each 5 Ml capacity	£2,328	£233	Direct, Indirect & overheads

5.1.7 Customer Protection

Distribution Network resilience schemes aim to provide avoidance of large one-off events having big impacts to our service to customers by ensuring isolated or problematic areas have a resilient system in place to allow movement of water around our network to maintain a continued supply of wholesome water.

Customers will be protected against non-delivery of the Distribution Network resilience enhancement investments by committing to Price Control Deliverables (PCD). The PCDs that we are proposing are to be grouped based on our enhancement case themes. The proposed enhancement investments within this case will come under the supply resilience and storage resilience PCD groups. More information and a full list of our PCD's can be found in Section 1.5.

5.1.7.1 Burntwood and Hanbury resilience enhancement PCD

These schemes will be protected under the Supply resilience PCD. Within this PCD it covers 3 different penalty options to protect customers.

Table 114 – Supply resilience PCD

<table>
<tr><th colspan="5">Supply resilience PCD</th></tr>
<tr><td>Description</td><td colspan="4">Power, supply and, network improvements to deliver water Ml/d improved resilience capacity.</td></tr>
<tr><td>Output or Outcome measurement and reporting</td><td colspan="4">The outputs of this PCD will be measured in Ml/d improved resilience capacity. The forecasted Ml/d deliverables are set out in the table below.
Delivery of Ml/d improved resilience capacity will be reported and monitored through the control period following the existing APR process.
Reported at the end of the financial reporting year.</td></tr>
<tr><td>Assurance</td><td colspan="4">Independent third-party assurance to confirm completed milestones</td></tr>
<tr><td rowspan="10">Conditions on schemes</td><td colspan="4">Due to the variance in schemes included within this PCD, we feel the unit rates don’t provide a fair price control for our customers. Therefore, we propose to measure deliverables in Ml/d improved resilience capacity but will apply penalties based on individual scheme enhancement funded allowance.</td></tr>
<tr><td>Scheme</td><td>Forecast delivery</td><td>Cost £s</td><td>Ml/d</td></tr>
<tr><td>Fleam Dyke station – Power resilience</td><td>2028/29</td><td>£312,685</td><td>2.4</td></tr>
<tr><td>Grantchester road station - Power resilience</td><td>2029/30</td><td>£541,270</td><td>40.8</td></tr>
<tr><td>West Bromwich station - Power resilience</td><td>2026-27</td><td>£1,362,994</td><td>104.0</td></tr>
<tr><td>Euston borehole – Supply resilience</td><td>2028/29</td><td>£1,920,016</td><td>10.0</td></tr>
<tr><td>Heydon borehole - Supply resilience</td><td>2029/30</td><td>£2,095,749</td><td>1.1</td></tr>
<tr><td>Gentleshaw relift pump – Network resilience</td><td>2028/29</td><td>£1,104,698</td><td>10.0</td></tr>
<tr><td>Hanbury resilience - Network resilience</td><td>2029/30</td><td>£2,911,049</td><td>7.8</td></tr>
<tr><td>Burntwood resilience - Network resilience</td><td>2029/30</td><td>£395,780</td><td>8.1</td></tr>
<tr><td>PCD payment rate</td><td colspan="4">Option A - Late delivery for in-AMP phasing, will apply a time value of money penalty to the enhancement funded amount applied for the individual scheme which will be returned to our customers. The time value of money will be applied at the appropriate rate for the period required.
Option B – Late delivery where the project has started but isn’t delivered by the end of the control period will apply, the time value of money on late delivery (This will apply a cut off period to the end of year 1 of AMP 9 (2030/31). If by the end of year 1 AMP 9 the project is still incomplete, we will return the enhancement amount funded not spent on that scheme back to the customer.
Non-delivery of Ml/d improved resilience capacity will be applied where the project hasn’t been started within the control period. We will return the full enhancement funded amount for that specific scheme plus the time value of money back to our customers.
The time value of money will apply the appropriate rates for the period required.</td></tr>
</table>

Deliverables	Unit	Forecast deliverables				
		2025-26	2026-27	2027-28	2028-29	2029-30
Ml/d improved resilience capacity	Ml/d		104		22.4	57.86

5.1.7.2 Langley storage enhancement scheme PCD

Customers will be protected under the storage resilience PCD. Within this PCD it covers two different penalty options to protect customers.

Table 115 - Our storage resilience PCD

Storage resilience PCD	
Description	Storage improvement - to deliver a storage improved resilience capacity.
Output measurement and reporting	The outputs of this PCD will be measured in megalitres improved resilience capacity. The forecasted Ml deliverable is set out in the table below. Delivery of storage improved resilience capacity will be reported and monitored through the control period following the existing APR process. Reported at the end of the financial reporting year.
Assurance	Independent third-party assurance to confirm completed milestones
Conditions on scheme	This PCD is to provide customer protection against non and late delivery of Langley Reservoir enhancement funding. The below PCD payment rates will apply to the enhancement funded allowance. There is a significant amount of base allowance to complete this project which will not be subject to a price control deliverable.
PCD payment rate	**Option A –** Late delivery where the project has started but isn't delivered by the end of the control period will apply, the time value of money on late delivery (This will apply a cut off period to the end of year 1 of AMP 9 (2030/31). If by the end of year 1 AMP 9 the project is still incomplete, we will return the enhancement amount funded **not spent** on that scheme back to the customer. **Non-delivery -** of storage improved resilience capacity will be applied where the project hasn't been started within the control period. We will return the full enhancement funded amount for the specific scheme **plus** the time value of money back to our customers. The time value of money will apply the appropriate rates for the period required.

Deliverables	Unit	Forecast deliverables					
		2025-26	2026-27	2027-28	2028-29	2029-30	Total
Storage available for use	Ml					5.41	5.41

5.1.8 Delivery

This section should be read in conjunction with Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.

5.1.8.1 Distribution Network Resilience

The proposal for Burntwood resilience scheme is a new trunk main to provide an alternate means of supply for the Burntwood area, alternate to the existing 18" main which is a single point of failure.

The proposal for the Hanbury resilience scheme is a new trunk main to provide resilience from a single point of failure at Outwoods delivery main and, reinforcement of an existing strategic main to enable the supply from Outwoods Booster to supply Yoxall in the event of a failure at Yoxall Booster.

The nature of these infrastructure works is such that they will be delivered under the Infrastructure Assets Delivery Framework Contract, the terms are SSW's amended NEC contract. Given the value of the works, at > £3m, the approach would involve a mini competitive tender process, with either contract Options A (fixed price with activity schedule) or B (fixed price with bill of quantities) depending on the perceived risk profile following site investigation and detailed design. Through a mini tender process value for money can be tested.

Phasing of the projects' delivery in AMP8 will be subject to optimisation through the Copperleaf investment planning tool which was deployed during AMP7 to improve asset management maturity and has been utilised to optimise the AMP8 capital programme.

5.1.8.2 Langley Reservoir

The proposal for Langley Reservoir is to construct a new 10 Ml storage reservoir to replace the existing 4.59 Ml reservoir, increasing the in-zone storage from circa 5 hours to circa 22 hours.

Constructability at the site is considered challenging due to access and topography. Site investigation, feasibility, constructability and optioneering prior to a tender process will be carried out to ensure that the challenges noted, which will manifest as programme and cost risks, are known and can be accounted for and mitigated in a reference design and construction phasing and method, and the balance of risk proposed by the contract.

Procurement and delivery will be under a standalone contract. Delivery under the Framework Contracts would not be appropriate given the scale of the project.

A standalone contract enables a two-phased contract commission approach, to carry out the feasibility and reference design development commission prior to the main construction contract tender and commission award, thus giving improved certainty of delivery and cost.

The delivery contract will be SSW's amended NEC4 contract, under either Option A (fixed price) or Option C (target cost), subject to outstanding risk profile following feasibility and development of the reference design.

The total cost of the project is estimated at > £8m, partially Base and partially Enhancement, and as such it would be proposed to deliver this project through a stand-alone contract. The project can be batched with the Barr Beacon Service Reservoir replacement project in the Base programme which would provide for an overall contract value from the two reservoirs of >£35m, attracting greater interest from the supply chain and benefiting from economies of scale.

The procurement would be through a shortlisted tender process of pre-qualification, followed by full tender.

Phasing of the project's delivery in AMP8 will be subject to optimisation through the Copperleaf investment planning tool which was deployed during AMP7 to improve asset management maturity and has been utilised to optimise the AMP8 capital programme.

5.2 Case 12: Production Resilience

5.2.1 Summary

This enhancement case is seeking to address a key customer priority for us in AMP8. This priority is to ensure we continue to implement resilience against the long-term deterioration in water supply interruptions and unplanned outage performance commitments (PC) by further investing at our critical production sites. This is due to changing conditions outside of management control such as population growth and climate change. These resilience investments will address single points of failure within the operation of these sites and provide mitigation against the realisation of the risks we are currently exposed to on our non-infrastructure assets. This approach has been developed and verified with our customers, who strongly support investing in resilience now to mitigate future risks to service. This is supported on the basis that we invest now instead of waiting for deterioration to materialise and causing significant bill impacts for future generations as we recover from such an impact.

As a result of making these enhancement investments we expect to mitigate the water supply interruption, unplanned outage, and climate change impact risk by enabling our key production sites, assets, and processes to continue to be operational when impacted by uncontrollable influences such as power grid failure, raw water quality events and climate change impacting water demand patterns.

Table 116 - Production Resilience Risks

Investment Location	Impact	Risk
Euston Pumping Station, Cambridge Region	Supply Interruptions / Unplanned Outage	Single Borehole operation
Heydon Pumping Station, Cambridge Region	Supply Interruptions / Unplanned Outage	Single Borehole operation
Fleam Dyke Booster Station, Cambridge Region	Supply Interruptions	No permanent generator
Grantchester Road Booster Station, Cambridge Region	Supply Interruptions	No permanent generator
West Bromwich Booster Station, South Staffs Region	Supply Interruptions	No permanent generator
Seedy Mill Treatment Works, South Staffs Region	Supply Interruptions / Unplanned Outage	No pumping resilience to all supplied zones

We have seen strong performance, so far in AMP7, on the supply interruptions and unplanned outage PC's. According to OFWAT water company performance reports we are a top performer in the industry for supply interruptions in Year 1 and Year 2 of this AMP. Additionally, for unplanned outage, we are achieving at or better than the target set. The above enhancement investments are promoted to ensure that over the long-term, we are protected from low probability high consequence major events so we can sustain leading performance in the sector on these commitments.

Through the detailed customer engagement work we have undertaken to support our whole business plan, customers have told us that they strongly support investment, wanting us to do more investment in resilience to ensure we are amongst the leading companies in the industry on these commitments in AMP8 and beyond. Further details on this can be found in Section 5.2.4 Customer Support below.

To derive a robust and comprehensive quantifiable risk and need understanding we have refreshed our processes. This commenced with the wide-reaching review of all our asset risks and needs, using a Central Risk Team (CRT). This team reviewed, with the relevant stakeholders, to elicit information on various risks such as environment, health and safety, security of supply, compliance etc. In each of these categories there are multiple risks that were appraised and quantified the likelihood and impact, this considered the unmitigated and mitigated risk score to arrive at the residual risk. This allowed the team to start to identify potential future controls for this residual risk.

From the completion of the CRT's work, these assessed risks were consolidated and translated through onto zonal masterplans. These plans were then workshopped through with key stakeholders to validate the CRT outputs, close any gaps, and identify and further potential solutions. These zonal study workshops generated a validated list of risks, whole system solutions that consider investment dependencies, efficiencies, and impacts with risks and proposed solutions linked to long-term outcomes as part of this methodology. These outputs were supplemented with the development of zonal storage models that examined the inputs and exports to the zone alongside the storage volumes. This was used to determine the impact to duration of emergency storage across a number of scenarios where inputs and exports were configured. These impacts were applied to the average and peak day demand at present day and on 10- and 20-year horizons. The zonal models identified and substantiated the developed risk profiles to support and enhance the potential solutions for addressing high risks around low emergency storage in AMP8 and beyond, feeding into our long-term delivery strategy (LTDS).

These investments are aligned with our LTDS core pathway for resilience. Our ambition for Production Resilience focuses on ensuring our water treatment works and pumping stations can continue to supply water reliably. Although reliability can be measured in different ways, it aligns closest with the Unplanned Outage Performance Commitment (PC), defined by Ofwat. More information can be found in the operational resilience section 5.4 of our SSC02 South Staffordshire Water - long term delivery strategy.

The above processes led to validated risks and potential solutions which were now ready for further appraisal using our investment decision making support tool, Copperleaf. This system uses multiple components to achieve a deliverable and affordable business plan through a process called Optimisation, further information on this process can be found in Section 3 and 4 of our appendix, 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond'.

The optimisation process generated a best value plan of enhancement investments that have then undergone further validation and development through creation of a suite of documents which define the 'problem' in problem statements, provides longlisting and shortlist of potential solutions using multi-criteria assessments and feasibility studies that have reviewed the risks, costs, and benefits of shortlisted potential solutions at an investment level. Further detail can be found on the recommended and alternative solutions in further sections of this case as well as in the supporting appendices.

The output of this process, for non-infrastructure asset enhancement investments is listed in the below **Table 117**.

Table 117 - Summary of expenditure required for the period 2025-2030 (AMP8)

Investment Location	Enhancement Investment	AMP8 TOTEX (£k)	AMP8 Enhancement OPEX (£k)	AMP8 Base CAPEX (£k)	AMP8 Enhancement CAPEX (£k)	NPV (£k)
Euston Pumping Station, Cambridge Region	Drill 2nd borehole	1,920	0	0	1,920	34,977
Heydon Pumping Station, Cambridge Region	Drill 2nd borehole	2,096	0	0	2,096	4,784
Grantchester Road Booster Station, Cambridge Region	Install generator and fuel tank	541	0	0	541	179,579
Fleam Dyke Pumping/Booster Station, Cambridge Region	Install generator and fuel tank	313	0	0	313	5,982
West Bromwich Booster Station, South Staffs Region	Install generator and fuel tank	1,363	0	0	1,363	190,264
Seedy Mill Treatment Works, South Staffs Region.	Install re-lift pump and pipework	1,105	0	0	1,105	17,521
	Total	7,337	0	0	7,337	

5.2.2 Background Information

With a focus on the resilience requirements of our non-infrastructure assets, this document is the evidential culmination of a bottom-up build of asset and process risks. This has been supported by engagement with stakeholders across the business to refresh the portfolio of asset risks and needs. The risks that were captured during this elicitation process were scored based on likelihood and impact drawing out high, medium, and low scoring risks for further development into needs and investment options. These investment options are promoted to ensure we continue to provide high levels of service to customers, as evidenced through our top performance in supply interruptions performance commitment this AMP.

This process was used to identify priority solutions which have been developed into cost efficient and well-examined investments. The pathway illustrated in the following design process details the flow which we have followed.

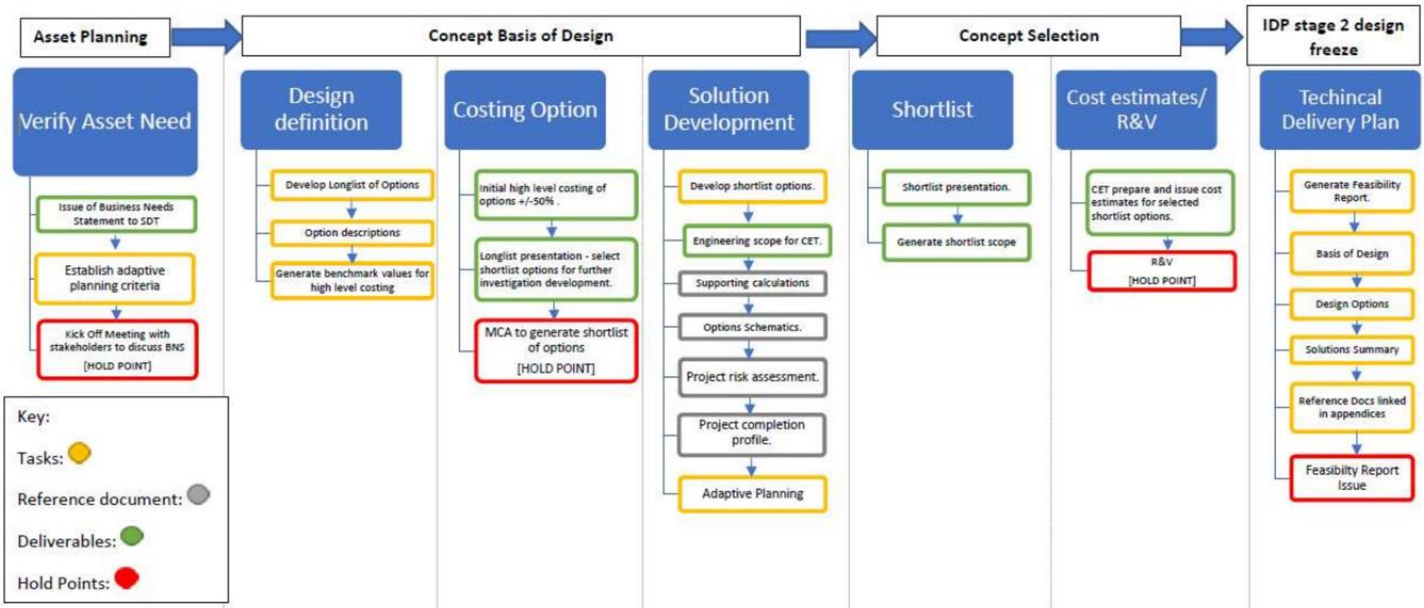


Figure 93 – Design Process Flowchart

Using this process, the shortlisted investment options were loaded into our investment risk management and optimisation tool, Copperleaf. This tool sees each investment passed through a valuation framework to monetise the baseline risk associated with the investment. This is then used to value solutions that mitigate against the identified risks to the framework. Further details on this process and the how the Copperleaf platform has been used please see Section 3 and 4 of our appendix, 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.'

As such, we are now seeking to deliver mitigation against several of the identified risks through the mechanism of enhancement funding. The required investment in resilience on these assets should also be read and understood in conjunction with our infrastructure resilience enhancement cases and overall AMP8 base maintenance investment plan, as they are seeking to address similar drivers and provide similar operational benefits by improving our overall resilience position.

The target, by increasing our operational resilience position, is to improve service to customers by mitigating the risks of low probability high consequence events, outside of management control, in AMP8 and beyond which could impact our long-term performance on water supply interruptions and unplanned outages. This reduction in risk to customers will lead to improvement in service and is why we consider these investments to be enhancements.

Please see the below table that provides background information for each of the investment location and associated assets.

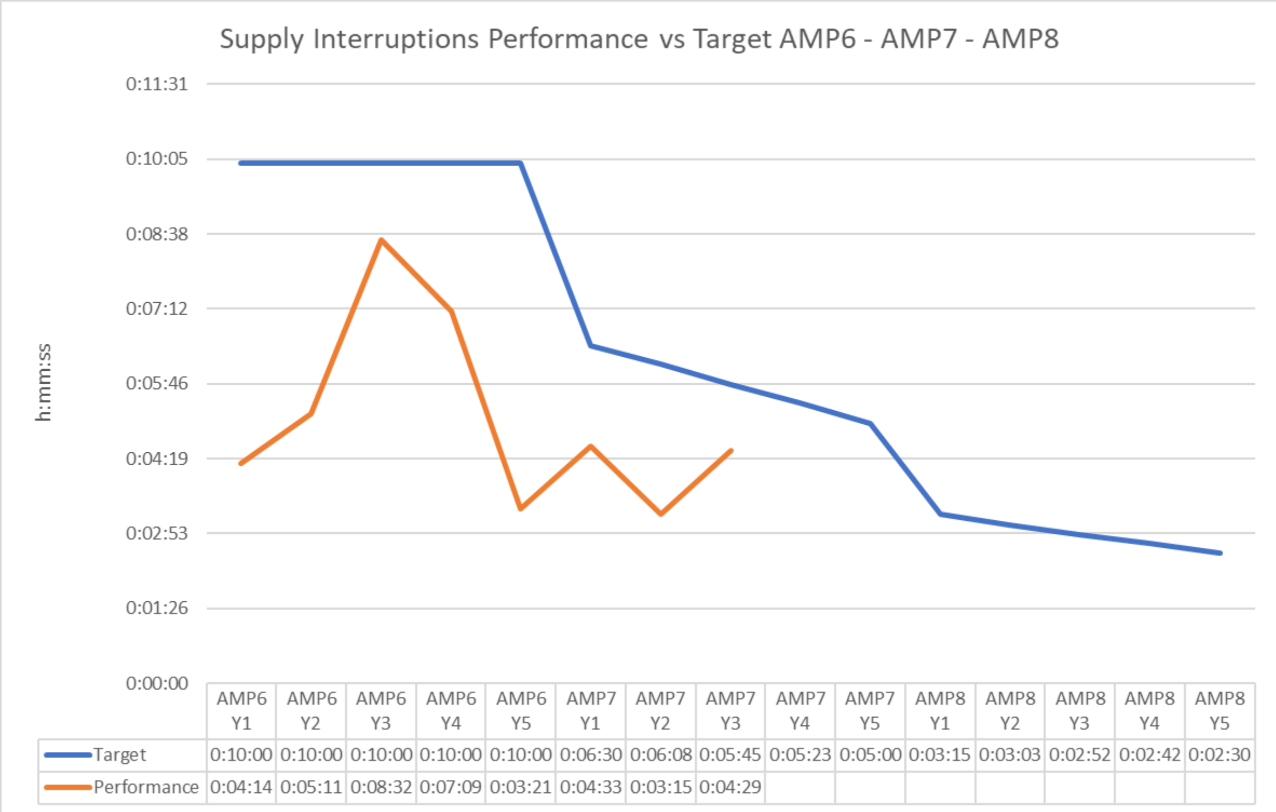
Table 118 – Key Background Information

Information criteria	Description/ Unit of measurement
Location of any proposed installations	**Cambridge regions sites:** Euston Pumping Station (Borehole Resilience) Heydon Pumping Station (Borehole Resilience) Grantchester Road Booster (Power Resilience) Fleam Dyke 12" Booster (Power Resilience) **South Staffs region sites:** West Bromwich Booster (Power Resilience) Seedy Mill Water Treatment Works (Zonal Pumping Resilience)
Volumes	**Cambridge regions sites:** Euston Pumping Station (Aggregated license of 16.25 Ml/d average and 25 Ml/d peak when combined with adjacent Brettenham PS). Heydon Pumping Station (Aggregated license of 1.13 Ml/d average and 2.27 Ml/d peak) Grantchester Road Booster (transfer up to 40.8 Ml/d) Fleam Dyke 12" Booster (transfer up to 2.4 Ml/d) **South Staffs region sites:** West Bromwich Booster (transfer up to 104 Ml/d when including booster and control valve flows at the site) Seedy Mill Water Treatment Works (water production up to 125Ml/d)

5.2.3 Need for Investment

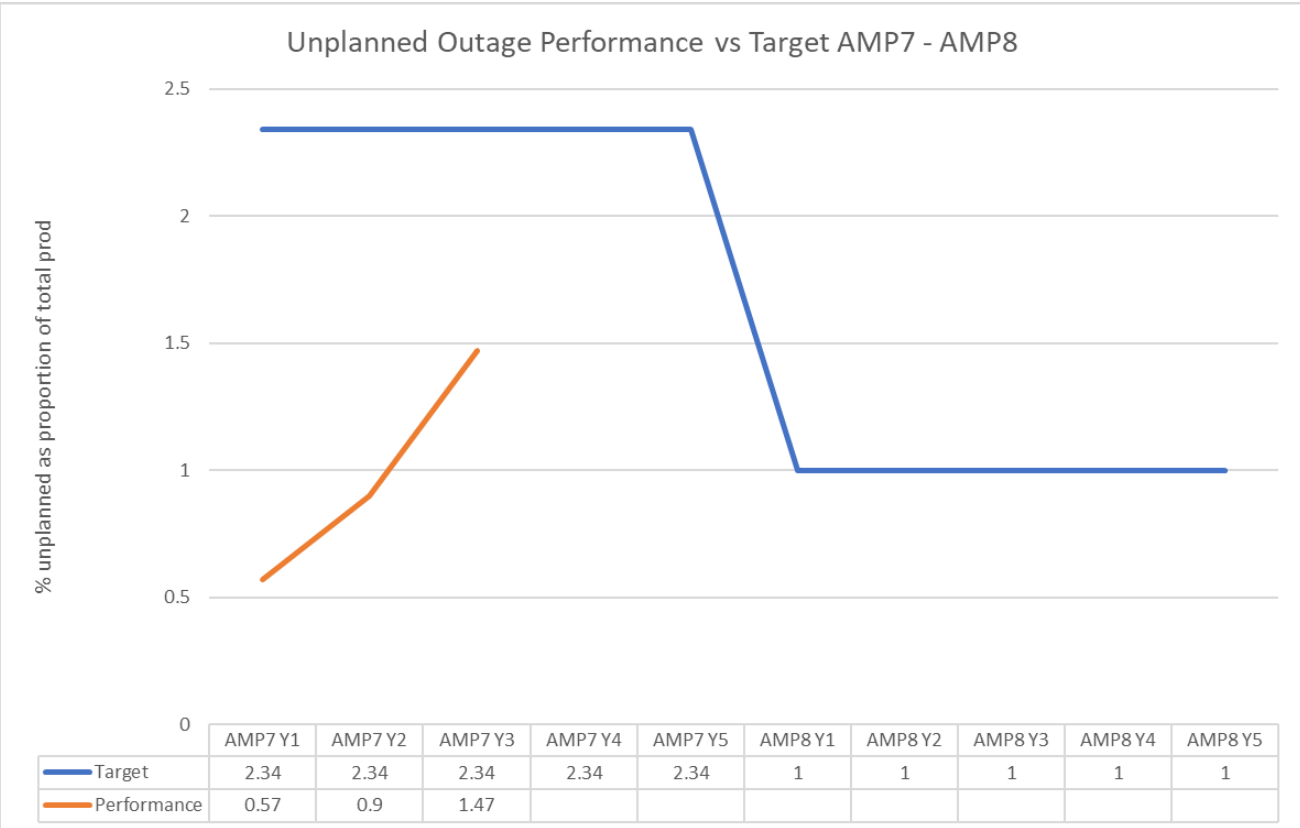
We have seen strong performance, so far in AMP7, on our supply interruptions and unplanned outage PC's. According to OFWAT water company performance reports we are a top performer in the industry for supply interruptions in Year 1 and Year 2. Additionally, for unplanned outage, we are achieving at or better than the target set. The above enhancement investments are promoted to ensure that into AMP8 and beyond, we mitigate the risk of a long-term deterioration in these PC measures. Changing conditions that are outside of management control can result in low probability high consequence events which can impact customers and PC measures. These conditions are those such as power grid failure, raw water quality events and climate change. Climate change will be particularly impactful as it changes water demand patterns by extending peak demand periods. Temperature increases will drive these changes in demand patterns, also likely are greater magnitudes of events such as extreme winter rainfall.

The below graphs show our performance against these PCs in AMP6, AMP7 and the target for AMP8.



	AMP6 Y1	AMP6 Y2	AMP6 Y3	AMP6 Y4	AMP6 Y5	AMP7 Y1	AMP7 Y2	AMP7 Y3	AMP7 Y4	AMP7 Y5	AMP8 Y1	AMP8 Y2	AMP8 Y3	AMP8 Y4	AMP8 Y5
Target	0:10:00	0:10:00	0:10:00	0:10:00	0:10:00	0:06:30	0:06:08	0:05:45	0:05:23	0:05:00	0:03:15	0:03:03	0:02:52	0:02:42	0:02:30
Performance	0:04:14	0:05:11	0:08:32	0:07:09	0:03:21	0:04:33	0:03:15	0:04:29							

Figure 94 – Supply Interruptions performance in AMP6 and AMP7 compared to target for AMP8



	AMP7 Y1	AMP7 Y2	AMP7 Y3	AMP7 Y4	AMP7 Y5	AMP8 Y1	AMP8 Y2	AMP8 Y3	AMP8 Y4	AMP8 Y5
Target	2.34	2.34	2.34	2.34	2.34	1	1	1	1	1
Performance	0.57	0.9	1.47							

Figure 95 – Unplanned Outage performance in AMP7 compared to target for AMP8

Please note that the numbers shown are the PR19 definition of Unplanned Outage, not the altered PR24 definition.

These graphs are provided to show how our current and previous AMP target is changing into AMP8. This generates increased risk around the impact of a low probability high consequence event that results in significant customer impacts and a consequential likelihood of failure against our PC targets. These identified investments are proposed to mitigate the risk associated with these major events, to protect customers and avoid deterioration of our performance.

Without investment in this non-infrastructure resilience, our current high-level of performance is at risk when considering external factors out of our control that may impact our performance.

Furthermore, as part of the PR24 business plan development we have undertaken customer engagement workshops that examined the acceptability of our proposals, with household and non-household customers. The headlines of these workshops, in relation to these investments, were from both our South Staffs region-based and Cambridge region-based customers, a consensus that resilience challenges were well supported and seen as essential measures to guarantee future supply, with a desire to invest further where possible. The detailed information on customer feedback can be found Section 5.2.4 in this document as well as in Section 4.4 of SSC01 Securing your water future – business plan 2025 to 2030.

We will now consider the differing investment types within these cases, commencing with those listed in the following table.

5.2.3.1 – Borehole Resilience

Investment Type	Investment Location
Boreholes	Euston Pumping Station, Cambridge Region
	Heydon Pumping Station, Cambridge Region

Within the Cambridge Region we supply water to customers using 100% groundwater, as a result the availability of our boreholes is critical to managing the supply demand balance and mitigating against water supply interruptions and unplanned outages, particularly during periods of peak demand. To meet these challenges, it is essential to have borehole availability. Within this borehole asset range there are several sites where we currently operate at significant risk due to the presence of a single borehole only on the site. Aligned with this is that a number of these sites provide a high proportion of the region's deployable output.

We need to invest in the above sites to address single points of failure within their operation. This is to provide mitigation against low probability, high consequence events. Events that outside of management control, such as the impacts of climate change, causes rising temperatures, and more weather events such as extreme winter rainfall. These events influence the way in which customers use water. This is likely to create increasingly higher peak demand periods, with a longer duration. We have identified these investments as key resilience required to mitigate long-term deterioration in PCs. These events are likely to be very impactful to water supply interruptions and unplanned outage performance commitments, which in turn have the potential to cause significant customer impact.

A significant amount of storage in the Cambridge region is concentrated in the Cambridge, Maddingley, Croydon and Heydon zones. Other zones, often due to lower amounts of storage time, rely on zonal transfers out of the Cambridge Zone. For instance, Linton in the south-east of the region, and Bluntisham in the north-west appear to be the zones that have the least resilience given the large number of water towers that do not provide any significant amount of storage. Critical boreholes such as Euston and Heydon are essential in the supply of water to our storage assets, as detailed below, so that they can support other areas of the region with lesser amounts of storage.

Additionally, abstraction license restrictions are due to be imposed which will see our average daily yield decrease, into AMP8 and beyond. As previously stated, the continued availability of borehole sources is critical to meet water supply demand balance and to address the water supply interruptions risk to customers. As these abstraction licences reduce and our supply headroom decreases, consequently we need increased resilience on these assets critical to supply, to ensure their continued operation, when considering the risks associated with low probability high consequence events and the below sites having single points of failure within their operation. As an example, the future combined licences at Euston PS and Brettenham PS would be 12-15% of our total deployable output, presently this is 16%.

As part of our Water Resource Management Plan (WRMP) submitted as part of PR24, we are seeking to defer the abstraction license restrictions until the end of AMP8, but this is not guaranteed.

Enhancement Investment at Euston PS

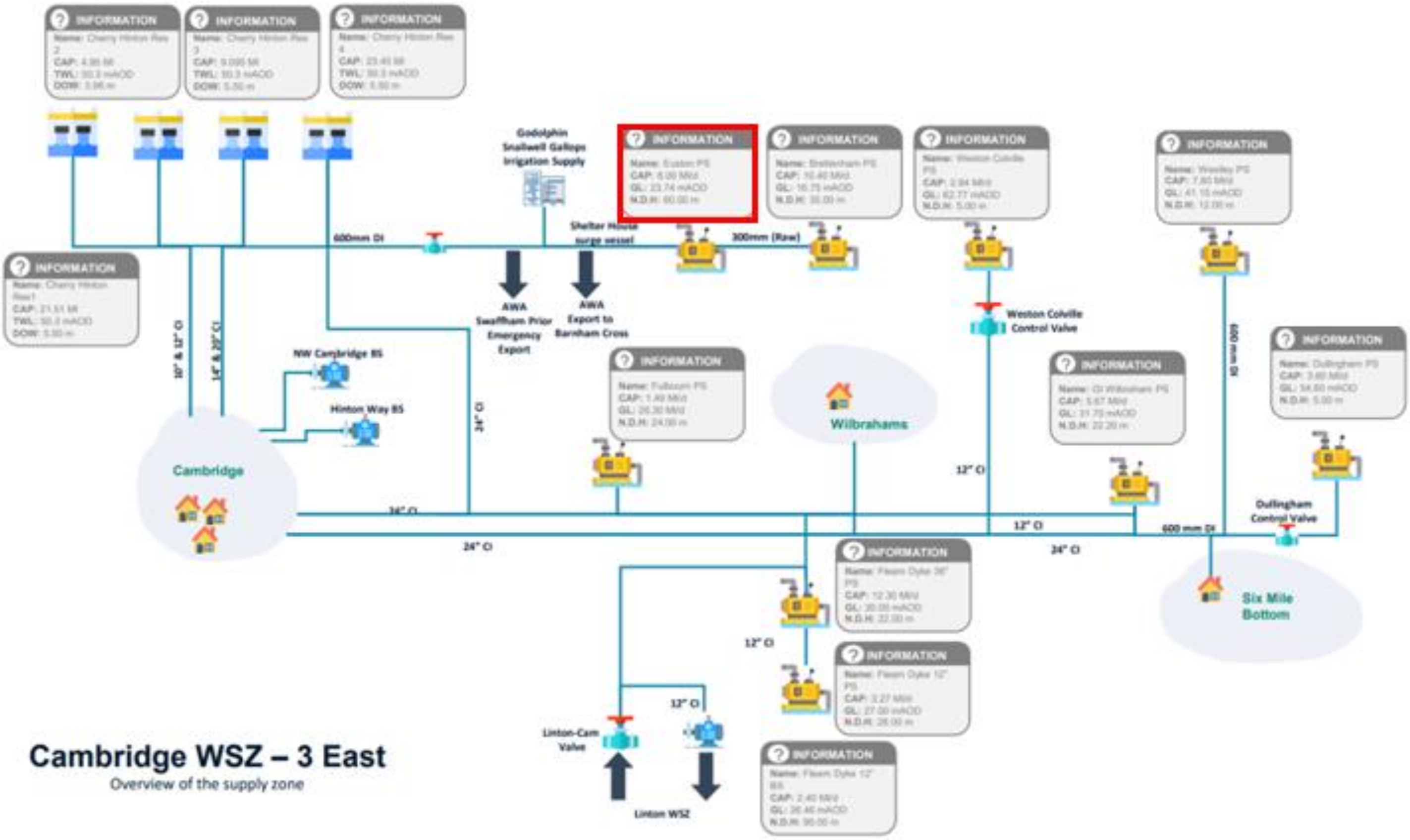


Figure 96 – Cambridge WSZ (East) – showing position of Euston PS

Euston Pumping Station (PS) and Brettenham PS are located to the east of our area of supply and have an aggregated abstraction license of an annual average at 16.25 million litres per day (Ml/d), and a peak of 25 Ml/d. Brettenham PS is a single borehole site that is licensed to transfer, an average of 10.4 Ml/d and peak 15 Ml/d, raw water through to Euston PS for treatment. This raw water is joined by the water abstracted from the single borehole at Euston PS. Euston PS is licensed to abstract an average of 8 Ml/d and peak of 10 Ml/d. The combined flow is then treated at Euston PS before being pumped into our WSZ and reservoirs for distribution and consumption. This process is essential in the regional supply of treated water and contributes c.20% of the overall potable supply for the Cambridge region. An asset failure leading to an unplanned outage, particularly for the long term, would have a catastrophic impact on meeting water supply demand. This would be most severe at Cherry Hinton Reservoirs, which receive the treated water from Euston PS. This has a direct knock-on impact at Coton Reservoirs which take their feed from Cherry Hinton. These strategic storage assets are key to maintaining potable supply and consequently avoiding water supply interruptions in the Cambridge region.

Please see below for information regarding the impact to our Cherry Hinton Reservoirs (capacity c.59Ml), when we lose Euston PS and Brettenham PS.

Table 119 – Outage impacts to strategic reservoir storage, in peak demand period

Date	Euston & Brettenham output (Ml/d)	Total Water into Supply (Ml/d)	Euston and Brettenham as % of Total Supply	CAM Region Total Demand (Ml/d)	Cherry Hinton Total Storage (Ml)	Change in Storage (Ml)	Change in Storage (%)
05-08-20	18.18	94.96	19.14	97.21	41.52	-1.47	-4
06-08-20	15.37	96.54	15.92	101.78	38.20	-3.31	-9
07-08-20	11.78	92.86	12.69	105.57	28.69	-9.51	-33
08-08-20	19.09	105.13	18.16	98.23	32.21	3.52	11

- The above example is following an unplanned outage during a peak demand period. An operational emergency occurred on the 6th of August 2020 and the repair was affected on the 7th of August.

Table 120 – Outage impacts to strategic reservoir storage in 2023

Date	Euston & Brettenham output (Ml/d)	Total Water into Supply (Ml/d)	Euston and Brettenham as % of Total Supply	CAM Region Total Demand (Ml/d)	Cherry Hinton Total Storage (Ml)	Change in Storage (Ml)	Change in Storage (%)
07-07-23	13.27	90.97	15	93.12	50.52	-1.68	-3
08-07-23	0.05	72.91	0	86.34	45.28	-5.24	-12
09-07-23	0.00	75.62	0	88.83	30.13	-15.15	-50
10-07-23	7.65	84.88	9	90.78	17.88	-12.25	-68
11-07-23	13.75	95.85	14	87.10	27.46	9.58	35
12-07-23	15.59	91.74	17	88.79	34.03	6.57	19

- The above example for a recent operational emergency. Despite water demand not being as high as the previous example, this still indicates the risk to water supply interruptions for a prolonged unplanned outage, even outside of peak demand periods.
- If the above unplanned outage had continued for longer, it is likely that there would have been significant water supply interruptions.

Additionally, along the treated water pumped main from Euston PS to Cherry Hinton Reservoir, there are several key commercial customers which are supplied from this main and are directly impacted if Euston PS experiences an outage; these are Anglian Water and Godolphin (Horse racing trainers).

- Godolphin (Snailwell Gallops)
  - The supply agreement states "Quantity: 1600 cubic metres per day to irrigate five grass gallops during the 214-day horse training season (April to October) totalling around 290,000 cubic metres per year in years of very little rainfall and around 230,000 cubic metres per year in years of average rainfall." If Euston PS is not pumping, we can (and do) backfeed the main from Cambridge Zone to maintain the supply.

- Anglian Water Barnham Cross
  - Maximum rate of flow 0.25 Ml/d, average rate of flow 0.25 Ml/d. This supply is in regular use. Its location means that it cannot be backfed from Cambridge Zone. This commercial customer has a supply agreement.

- Anglian Water Swaffham Prior
  - Maximum rate of flow 2.5 Ml/d, average rate of flow 2.5 Ml/d.
  - This is a drought mitigation supply which Anglian Water can call upon. Historically this has often not been utilised as a result of Anglian Water reinforcing their strategic network elsewhere. Previous use of this supply has been due to problems operating their nearby source at Southfields. The supply could be maintained by backfeeding from Cambridge Zone, if required. This commercial customer has a supply agreement.
  - Whilst several of these key commercial supplies can be backfed when needed, due to an outage at Euston PS, doing so detrimentally affects the levels of water storage within the Cambridge Zone.

As Euston is one of the most critical supplies to us, outages at the site require urgent attention especially during periods of high demand. Given the geographical location of this site, to the east of Cambridge and outside of our area of supply boundary, it can take additional time for technicians to attend site to deal with any unplanned outage experienced. This further increases the consequence and duration of an unplanned outage.

To support this statement, the loss of Euston PS has been modelled, and during peak demand week, this loss would have severe consequences in terms of customer impact. The Reservoirs at Coton, Madingley and Bourn would be empty within 48hrs and Cherry Hinton Reservoirs within 72 hrs. It is estimated c.1000 properties would lose their supply within 48 hrs, with over 10,000 receiving low pressure.

During periods of normal demand, the operational pressures and reliance on the deployable output available from Euston PS and Brettenham PS, should derive less criticality around the availability of this water, however in the event of an operational event, planned (planned outage at other pumping station to deliver essential maintenance and asset investments) or unplanned (pumping station outage or significant burst main) we would be vulnerable to water supply interruptions even during normal periods of demand. Given the criticality of these boreholes, we must ensure that any planned maintenance and inspections are undertaken during expected periods of lower demand, and not when other planned operational maintenance or asset upgrades are taking place and have the minimum duration possible to undertake.

In the case of enhancement investment at Brettenham PS and/or Euston PS the appraised best value solution recommended is to drill a new borehole, of the same diameter, depth, and pumping capacity, as the existing borehole at Euston PS. The reasons for this, and other options also considered can be found in Section 5.2.5 Best Option for Customers of this document.

Enhancement Investment at Heydon PS

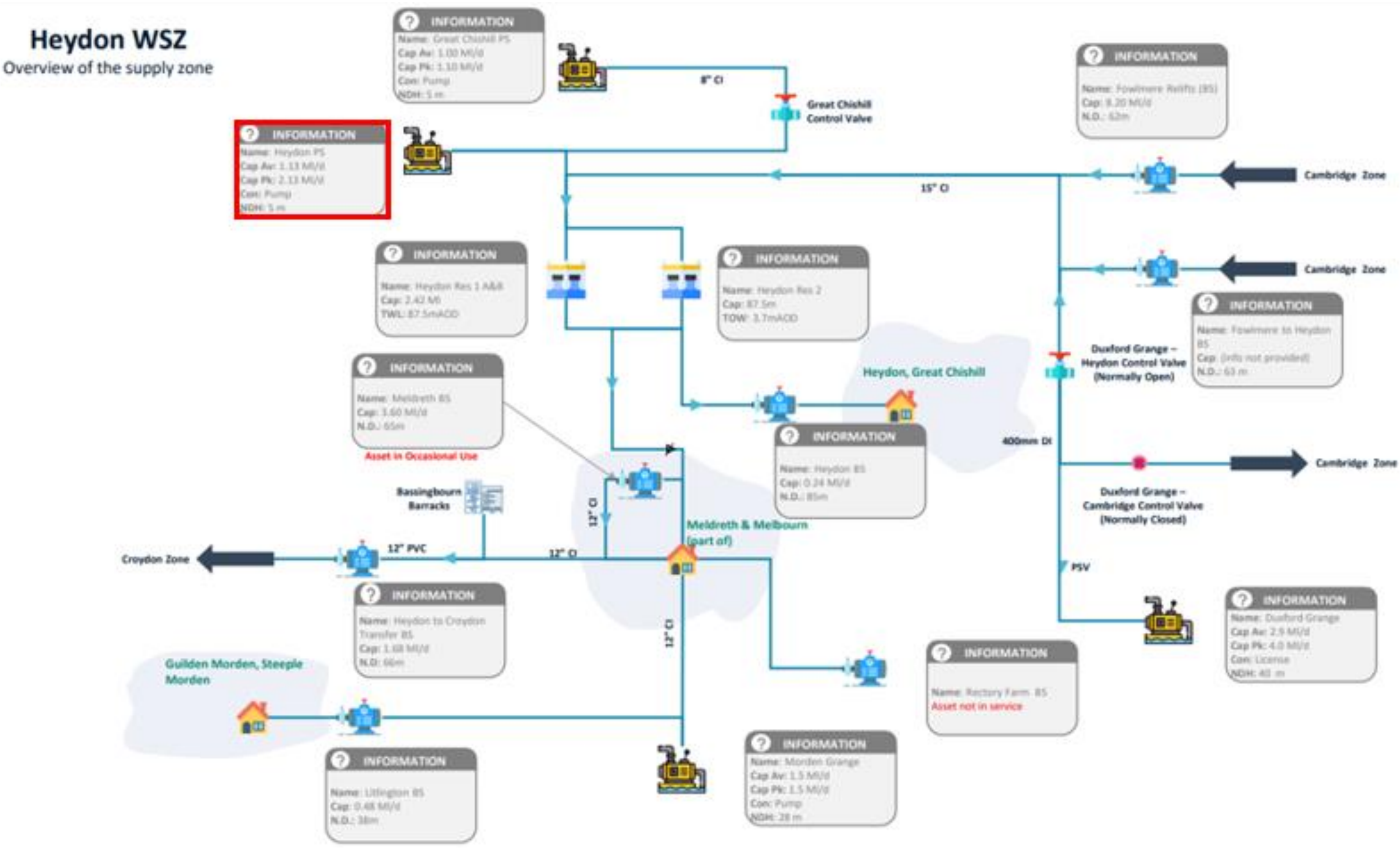


Figure 97 – Heydon WSZ – showing position of Heydon PS

Heydon PS borehole is located to the south of our Cambridge Region area of supply and has an abstraction license that has thresholds for the annual average at 1.13 Ml/d, and a peak of 2.27 Ml/d. The raw water is abstracted from a single borehole and treated before it is stored in Heydon Service Reservoir. The borehole and the reservoir are located on the same site. In the reservoir the treated abstracted water is blended with treated water from Fowlmere PS, Duxford Grange PS and Great Chishill PS. Heydon PS borehole provides c.25% of supply to the adjacent reservoir storage.

At Heydon PS, unplanned outages have an impact on the level at the adjacent Heydon Service Reservoir. During periods where the borehole is not in supply, the reservoir level is maintained by transfer from other pumping stations and zonal transfers, however the availability of this transfer is more limited during peak demand periods.

To provide resilience against water supply interruption and unplanned outage risks, investment at these sites has been promoted. As part of the third-party consultant led optioneering process and stakeholder engagement, a consideration has been made for several options. Further detail around these options is provided below, as well as confirmation why other alternative investments have not been taken forward. We are looking to mitigate the above risks by installing a second borehole at these critical sites, to ensure that supply can be maintained in the event of an unplanned outage on the original borehole and so that customers see no impact to their levels of service.

In the case of enhancement investment at Heydon PS, the best value solution recommended to mitigate this risk to supply interruptions and unplanned outage is to drill a new borehole, of the same diameter, depth, and pumping capacity, as the existing borehole at Heydon PS.

5.2.3.2 – Booster Resilience

Investment Type	Investment Location
Booster	Grantchester Road Booster Station, Cambridge Region
	Fleam Dyke Pumping/Booster Station, Cambridge Region
	West Bromwich Booster Station, South Staffs Region

The availability of our booster stations to either transfer water across zones and between reservoirs or directly provide customers with water supply is a key part of our operational configurations. To ensure that these stations are always in use when needed, we have reviewed the external influences that could impact this availability.

The National Risk Register 2023 has identified that a regional failure of the electricity network could impact large numbers of the population and be the result of extreme weather which damages local infrastructure. Examples of this would be where localised flooding affects power substations or severe winds damaging overhead cabling. The Risk Register references examples where regional electricity failures left thousands of homes were left without power following storms Arwen and Eunice in winter 2021/22. This risk register considers a scenario of a significant failure on the electricity network resulting in the loss of power across regions. These failures are noted as causing disruption to public services due to failures across utilities. The assumption made for this scenario is that the failures are caused by extreme weather events. Whilst forecasting, in the case of weather events, can help to put mitigation measures in place such as authorities and industries making alternative power supply measures, and having additional standby workforce as response teams to act. For recovery from an electricity network failure event, the risk register advises that customers would be reconnected within hours, but for widespread or remotely located damage it could take several weeks to restore all customers. This delay is due to access and repair time factors.

Instances and risk such as these, outside of management control, are the driver behind ensuring we invest in making our booster stations, which are seeing their operational criticality increasing, more resilient to such power failure events. This is achieved by addressing the current lack of alternative power supplies at the named sites. During a widespread power outage, transferring water around our network and getting it to where it is needed to supply customers would likely not be possible in some instances. We have identified critical sites where we need to invest to implement power resilience to mitigate this risk.

Enhancement Investment at Grantchester Road Booster

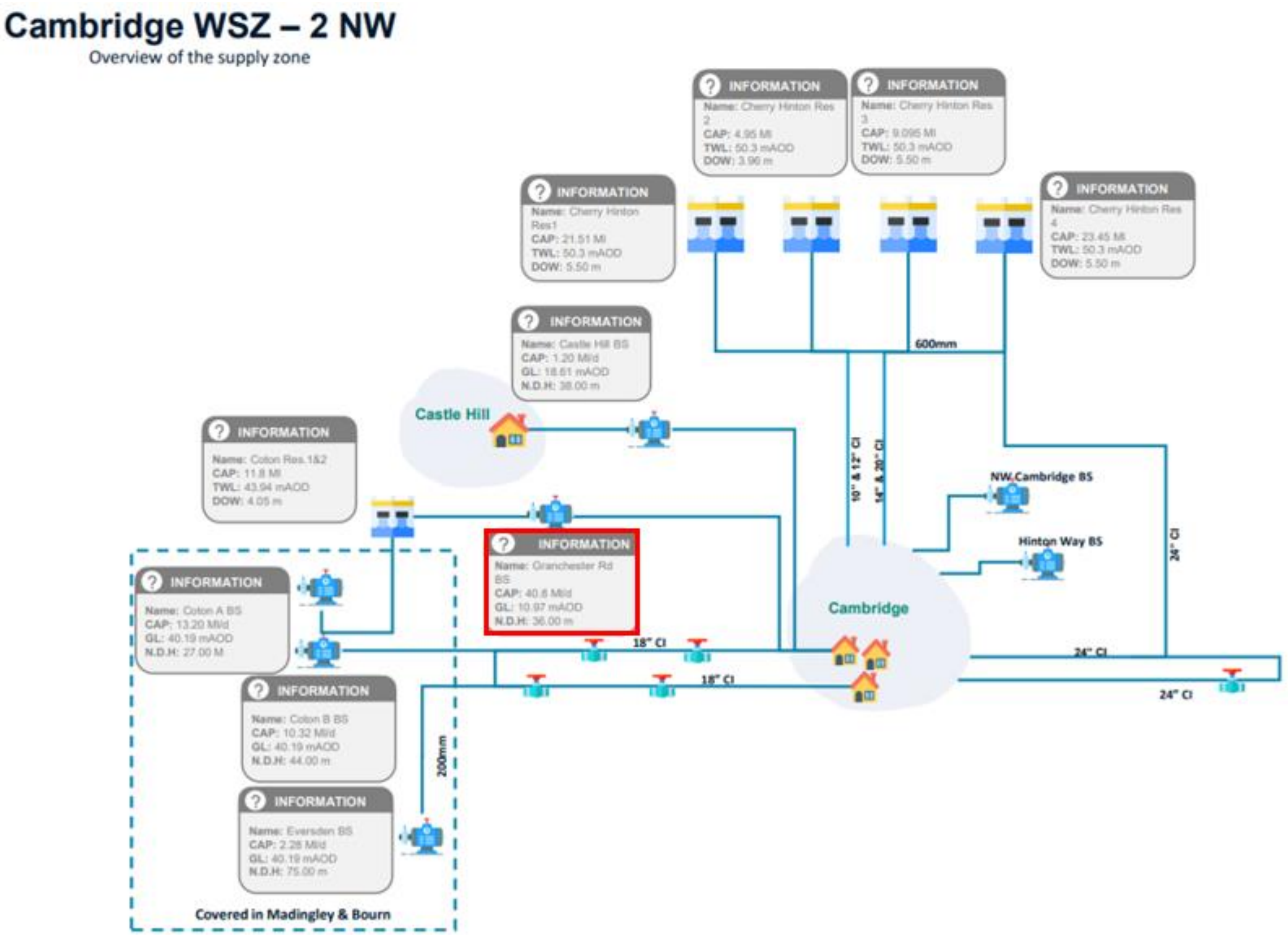


Figure 98 – Cambridge WSZ (Northwest) – showing position of Grantchester Booster

In periods of average demand, when our reservoir at Cherry Hinton is at a healthy level, we can transfer a maximum of around 24 Ml/d of water from Cherry Hinton Reservoir to Coton Reservoir via gravity. From Coton Reservoir it is then pumped further downstream to supply c.45,000 properties.

When demands increase, or when the level at Cherry Hinton Reservoir is low, the gravity transfer becomes inadequate. When this happens, Grantchester Road Booster is used to transfer water to Coton Reservoir at whatever rate is required.

Grantchester Road Booster does not have a generator on site. When an unplanned outage occurs, notably because of a power failure on the electricity network, we must hire a generator from one of our suppliers as part of our emergency response. The availability of Grantchester Road Booster to transfer water and manage distribution challenges is essential. Both upstream and downstream of Grantchester Booster is seeing challenges in how we manage our strategic storage. Upstream, population and demand increases mean that reservoir levels are more depleted than historically acceptable, and there is therefore less available water to transfer to other zones as needed. Downstream, the same population and demand increases mean that reservoir levels are also more depleted than historically acceptable, so the need for water to be transferred to address this is much greater.

By comparing the daily quantity pumped by Grantchester Road Booster with the amount which could have been transferred by gravity, it is possible to estimate what the deficit would have been if the booster station had not been available.

Analysis of the daily totals pumped during the period May 2022 to March 2023 shows that there were 184 days when there would have been a deficit in the transfer to Coton Reservoir if Grantchester Road Booster had not been available. The maximum daily deficit would have been 9.5Ml.

Any deficit in transfer results in water being taken out of storage further downstream. Downstream storage can be taken to mean the reservoirs at Madingley, Bourn, Eversden and Bluntisham (plus some smaller reservoirs and towers).

The maximum theoretical volume of storage is c.49Ml. However, during times of high demand it is common for the downstream reservoirs to be operating in the range 50% - 70% of maximum. There are also water quality constraints on how low the reservoir levels can be allowed to go (typically the last 15% is not allowed to be put into supply due to potential water quality concerns). It is therefore possible that only about 50% of the theoretical maximum is available (say 25Ml). Widespread loss of supply to customers would therefore occur after any period where the accumulated deficit exceeds 25Ml. During 2022-23 there were three 3-day periods and twelve 4-day periods when this would have happened. These periods occurred during June to August 2022 and are shown on the below graph.

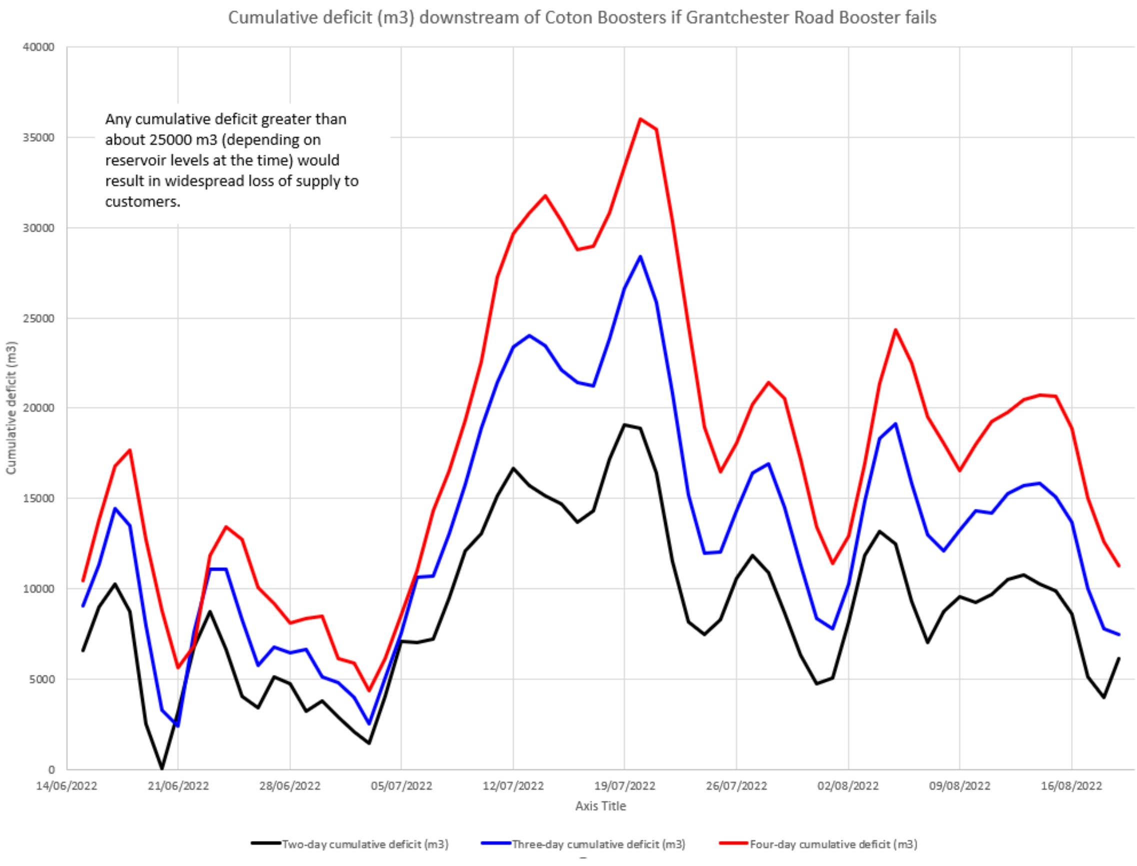


Figure 99 – Cumulative deficit (m^3) downstream of Coton Boosters if Grantchester Road Booster fails

As referenced above the criticality of this site is increasing so power supply reliability is required to mitigate the risk of an issue with the existing power supply, which is a single point of failure. We cannot afford a failure of the booster due to power failures on the electrical network. Investment at this site is required to provide power resilience so that it can remain in operation when required to mitigate the risk to water supply interruptions, when an unplanned major event such as power failure occurs, particularly if it is for a prolonged period. The availability of Grantchester Road in supporting these challenges and zonal water balance is critical. The proposed mitigation is the installation of a generator and fuel tank at the site.

Enhancement Investment at Fleam Dyke 12” Booster

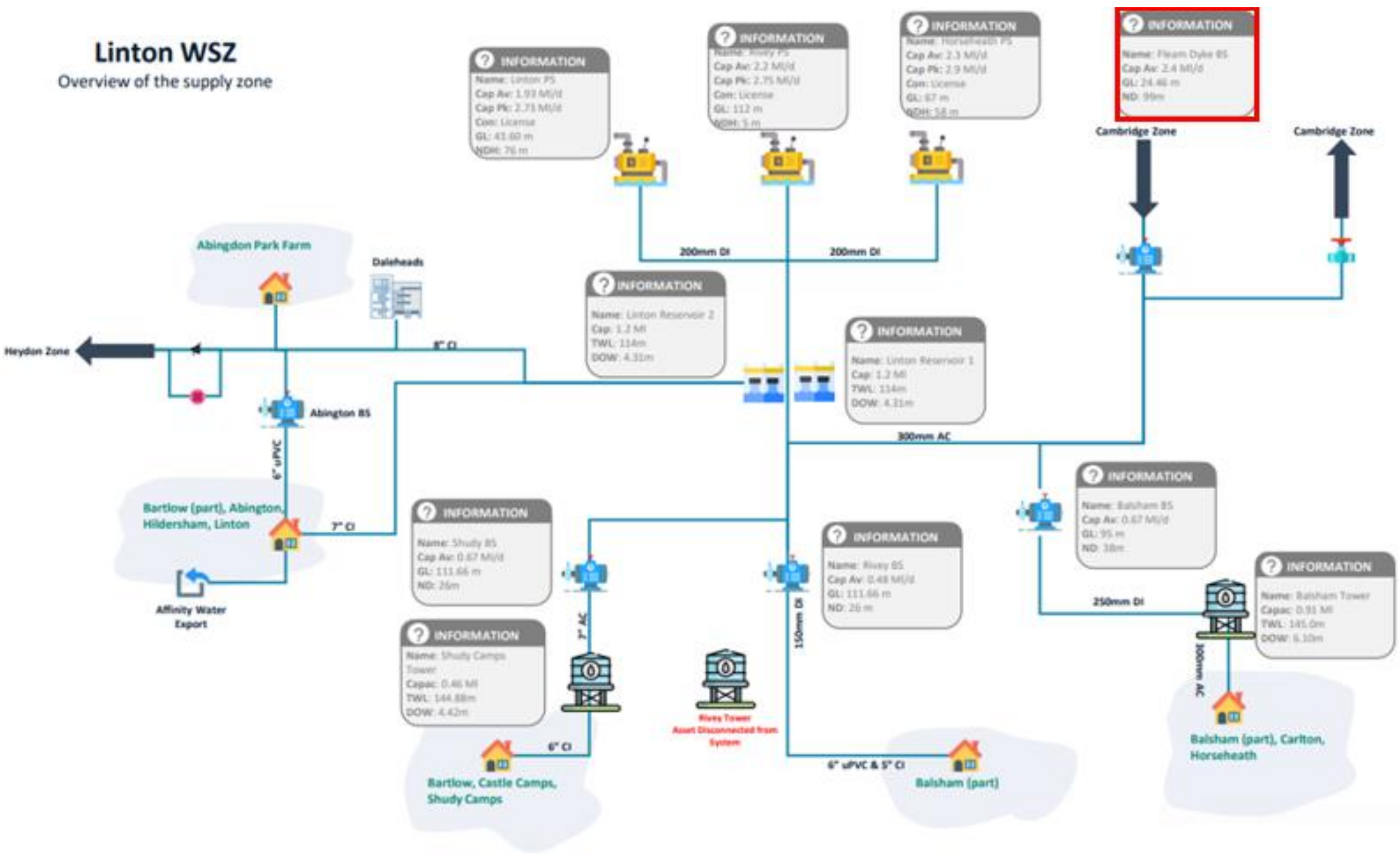


Figure 100 – Linton WSZ – showing position of Fleam Dyke 12” Booster

Within the southeast of our Cambridge Region, we have a WSZ called Linton. This zone supplies c.5100 properties and has an Average Day Peak Week demand of 4.5Ml/d. Zonal demand is not expected to increase much in the coming years as the scope for housing development is limited. Within this zone there are 3 ground water abstraction pumping stations – Linton, Horseheath and Rivey B. All three of these pump into Linton Reservoirs. The abstraction from these sources, under normal abstraction license conditions, can create a surplus within the Linton zone. This surplus can be exported to the Cambridge zone using the Linton-Cambridge transfer. This transfer is essential in supporting the Cambridge and other interlinked zones.

However, in this zone the abstraction licences at all the pumping stations are subject to restrictions when the flow in the adjacent River Granta at Babraham drops (the so-called Hands-Off-Flow or HOF restrictions). The restrictions are applied in increasingly severe steps as the flow in the watercourse reduces.

These restrictions from the EA, were first implemented on 1st April 2016 at Linton and Rivey, and then on 1st April 2020 at Horseheath. Since this was put in place the following HOF levels have been recorded, as shown in the below table.

Table 121 – Count of Normal and HOF flows at river monitoring point, impacting abstraction availability.

	Normal	*HOF Step 1*	*HOF Step 2*	*HOF Step 3*
	Count Flow Above 36 l/s	Count Flow Between 30 and 36 l/s	Count Flow Between 26 and 30 l/s	Count Flow Below 26 l/s
2016	338	22	6	0
2017	320	40	5	0
2018	316	43	5	1
2019	105	62	39	159
2020	286	35	22	23
2021	365	0	0	0
2022	253	34	35	43
2023	182	0	0	0

Please note the above table shows 2023 data to the start of July.

When the HOF restrictions come into force, there can be a water deficit in the Linton Zone. When this occurs, water is pumped from Cambridge Zone into Linton Zone via the Fleam Dyke 12" Booster.

The table below shows the contribution required from Fleam Dyke 12" Booster under the different licence restrictions, and the estimated length of time that Linton Reservoirs could maintain supplies for if the booster was not available. The maximum theoretical volume of storage is about 2.4Ml. However, during times of high demand it is common for the reservoirs to be operating in the range 50% - 70% of maximum. There are also water quality constraints on how low the reservoir levels can be allowed to go (typically the last 15% is not allowed to be put into supply for fear of being non-compliant with strict water quality parameters). It is therefore possible that only about 50% of the theoretical maximum is available (say 1.2Ml).

Table 122 – Contribution required from Fleam Dyke Booster 12" under differing license scenarios

Licence Scenarios	Linton Max Output (Ml/d)	Rivey Max Output (Ml/d)	Horseheath Max Output (Ml/d)	Available resource in zone (Ml/day)	Anticipated demand ADPW (Ml/d)	Contribution required from Fleam Dyke 12" Booster (Ml/d)	Days' storage if booster not available
Normal	1.9	2.7	2.5	7.1	4.5		
HOF conditions step 1	2	2	1.7	5.7	4.5		
HOF conditions step 2	1	1	1.7	3.7	4.5	0.8	1.6
HOF conditions step 3	0	1	1.7	2.7	4.5	1.8	0.7
HOF step 3 more severe by 2030 at latest	0	1	0.4	1.4	4.5	3.1	0.4

This table shows that at HOF step 2 we have less than 2 days storage in Linton zone, if Fleam Dyke 12" Booster is not available. At HOF step 3, this is less than 1 day's storage.

It is important to note that HOF step 3 is expected to become more severe by 2030 at the latest, and that step 3 is likely to become the "business as usual" operation.

The contribution which Fleam Dyke 12" Booster makes to Linton Zone is extremely important, and this will only increase. It is likely that it will eventually need to run 24 hours per day to keep up with demand.

Fleam Dyke 12” Booster relies on its power supply from the existing electrical distribution network and does not have any other form of back-up power supply on site. When an unplanned outage occurs, notably as a result of a power failure on the electricity network, we hire an emergency generator from one of our suppliers.

As referenced above the criticality of this site is increasing so power supply reliability is required to mitigate the risk of an issue with the existing power supply, which is a single point of failure. We cannot afford a failure of the booster due to power failures on the electrical network. Investment at this site is required to provide power resilience so that it can be always available for operation. This is to address the impact of HOF restrictions causing a deficit in the Linton zone which, if the booster is not available due to a power supply issue, potentially will impact customers via the risk to water supply interruptions. Particularly if not available for a prolonged period. The availability of Fleam Dyke 12” Booster in supporting these challenges and zonal water balance is critical. The proposed mitigation is the installation of a power generator and fuel tank at the site.

Enhancement Investment at West Bromwich Booster

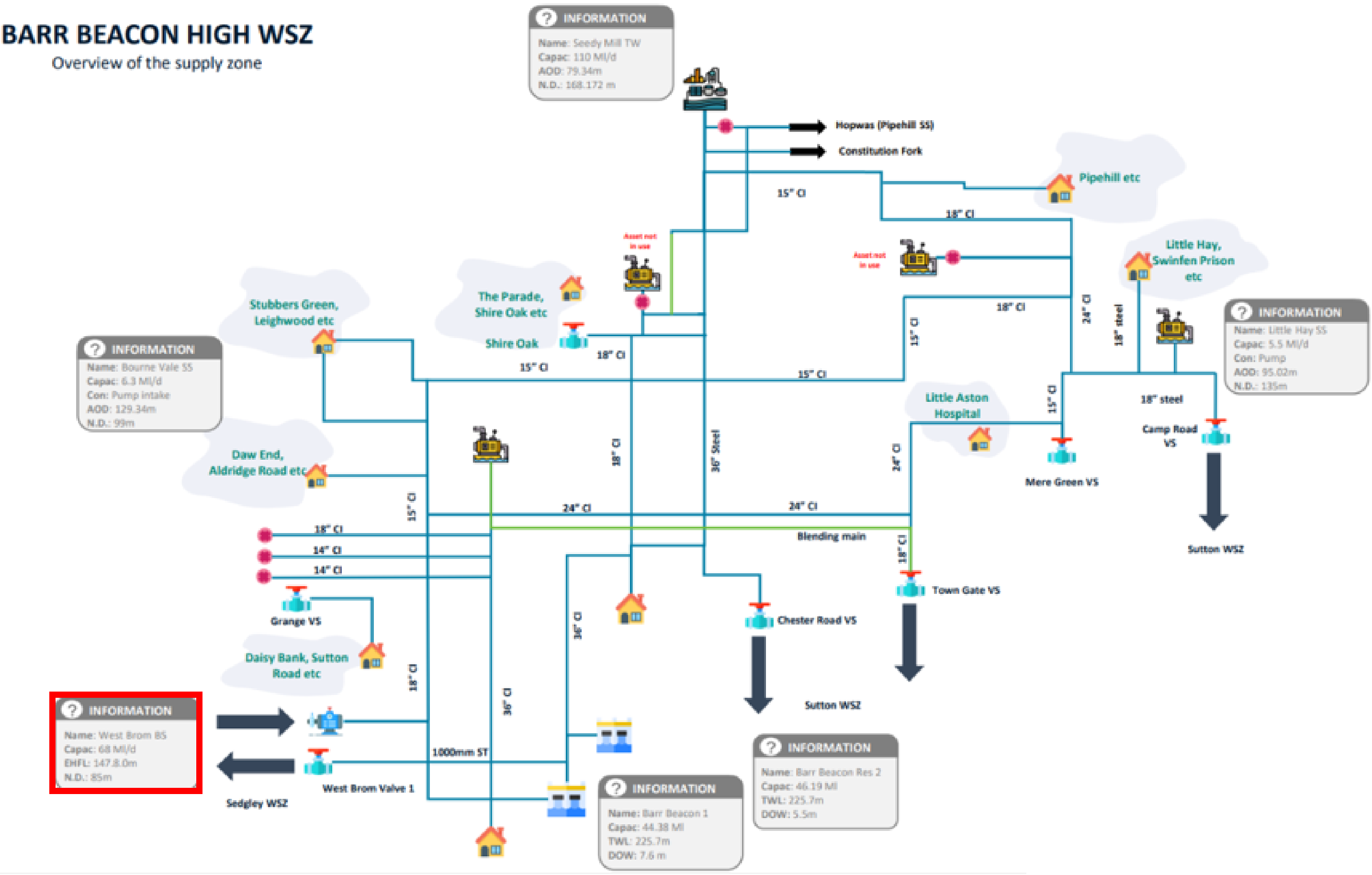


Figure 101 – Barr Beacon WSZ – showing position of West Brom Booster

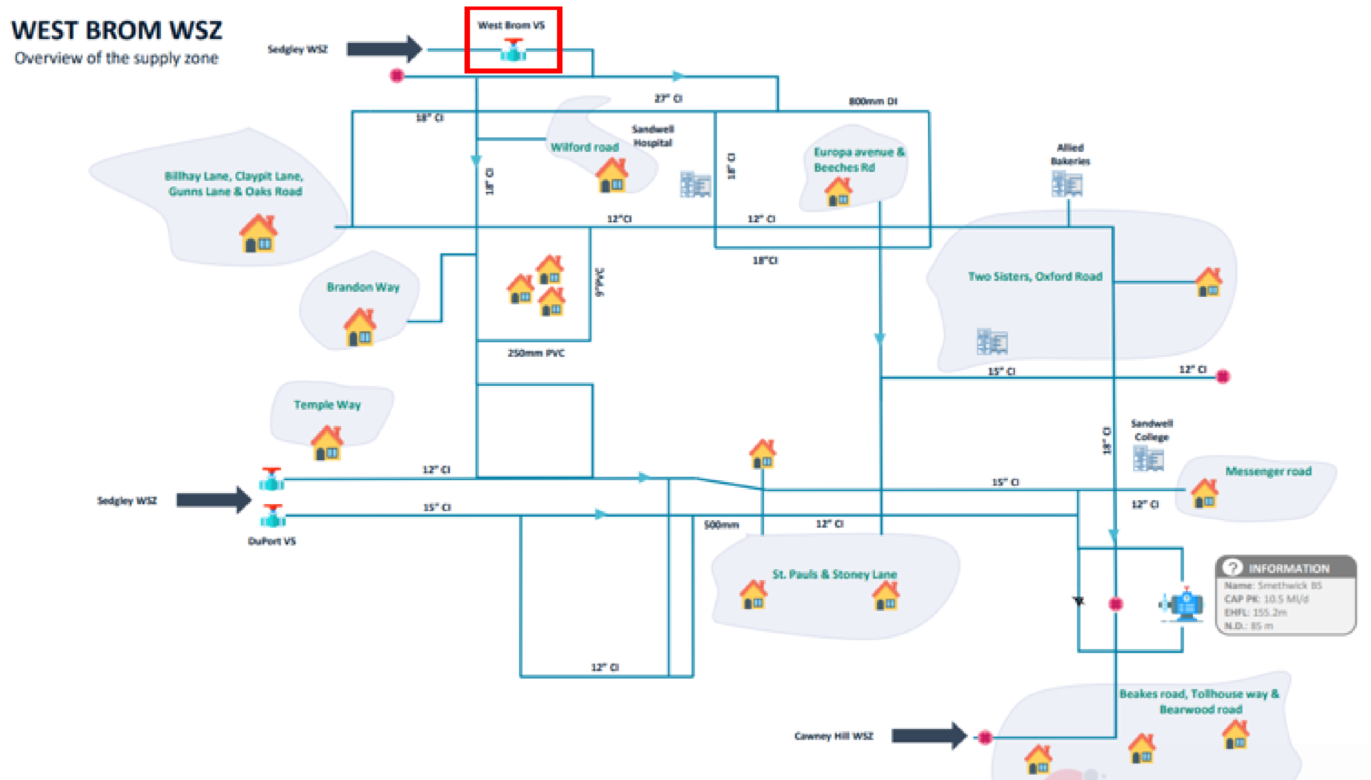


Figure 102 – West Brom WSZ – showing position of West Brom Valve Scheme

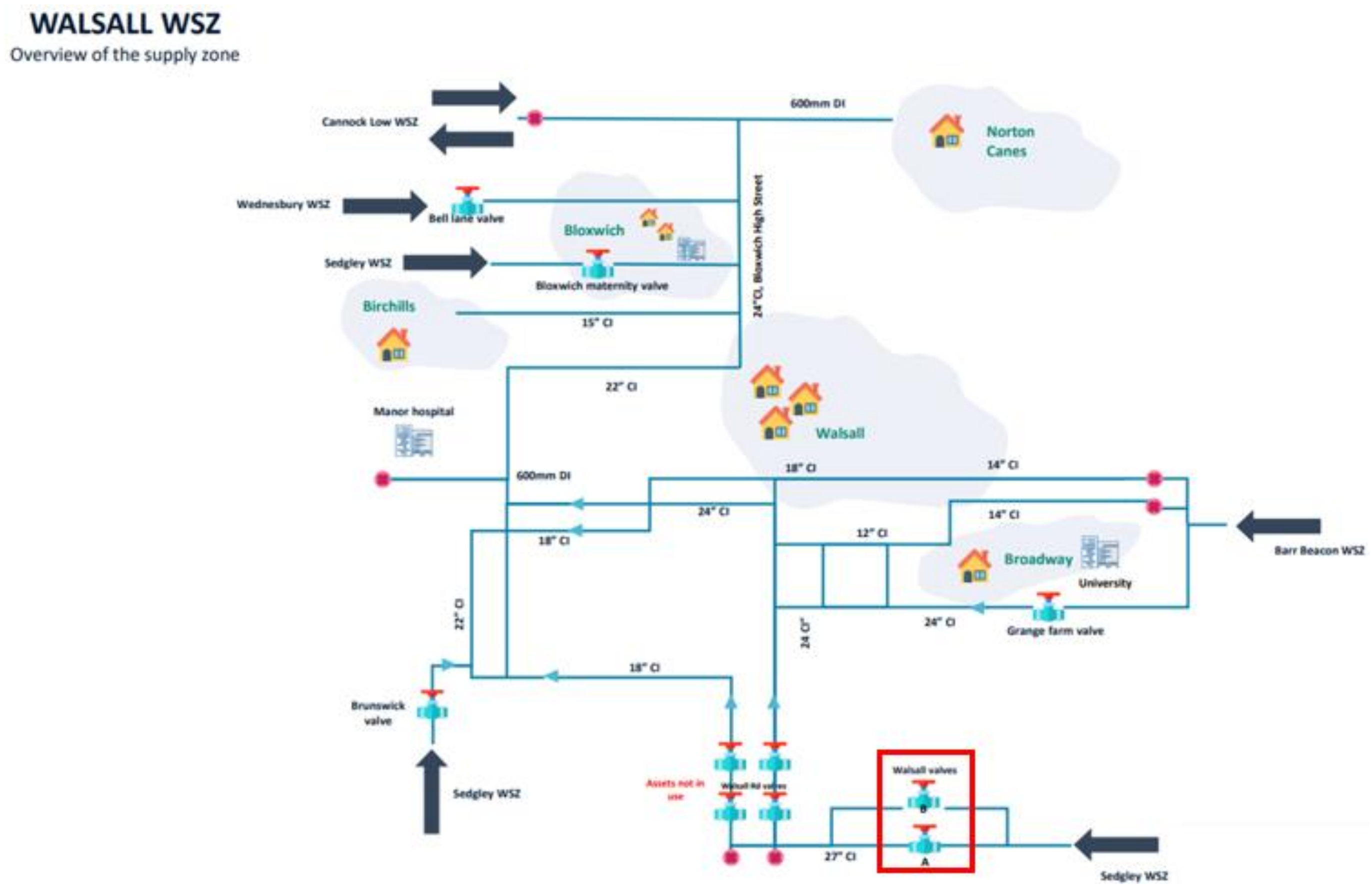


Figure 103 – Walsall WSZ – showing position of Walsall Valve Scheme

West Bromwich Booster, located within our South Staffs region, is one of the main transfer boosters within this region to support the management of strategic storage and the balancing of water availability across the various WSZs. This site is centrally located and can transfer water between the northern and southern parts of the region. The booster is used for the pumped transfer of water from our Sedgley WSZ to our Barr Beacon WSZ. West Bromwich Booster can transfer up to 104 Ml/d when including booster and control valve flows at the site so is a very significant operational tool that is utilised regularly. It is particularly important in periods when we are operating to conserve the water level at Blithfield Reservoir, located in our northern region, which is an impounding reservoir that supplies water to Seedy Mill WTW in the northern part of the region.

Conservation of Blithfield Reservoir allows for the water level to recover from periods of high demand and provide security of the resource required to treat and distribute therefore supporting our mitigation measures against supply interruptions. In such periods we reduce the drawdown from Blithfield by producing less water at Seedy Mill. To do this we have to operate West Bromwich Booster to transfer water from Sedgley WSZ and support our strategic reservoir at Barr Beacon. This ensures that the reduced outputs, from Seedy Mill in this period can be directed to the strategic storage in other zones. To allow this process, we need to ensure any shortfall is made up with an increased output from our southern treatment works at Hampton Loade. This can then by transferred northwards using West Bromwich Booster. The impact of climate change on the rate of recovery of Blithfield in AMP8 and beyond will probably increase the criticality of operational availability for West Bromwich Booster.

At the same site in West Bromwich we have an electronically controlled and remotely operated trunk main valve, known as Valve 1, that can move water in the opposite direction (from Barr Beacon to Sedgley), however this transfer is currently only available via gravity. Significant use of Valve 1 is made when Blithfield Reservoir is full, usually in winter and early spring, when we wish to treat and distribute high volumes of water from Seedy Mill. Typically, during the same period we see operational challenges at Hampton Loade, most commonly due to water quality constraints associated with the River Severn abstraction, which cause the works output to be reduced. In this scenario we rely on using Valve 1 to transfer from north to south and support Sedgley.

Furthermore, at this site we have additional electronically controlled and remotely operated trunk main valves called the Walsall and West Bromwich control valves. The Walsall control valves provides pressure control to the Walsall WSZ, a zone which supplies c.72,300 properties. The West Bromwich control valves provide pressure control to the West Bromwich WSZ, a zone which supplies c.42,200 properties. Without this control both zones would either over-pressure the network, resulting in mains bursts and water supply interruptions or under-pressure the network, resulting in low pressure customer contacts and water supply interruptions.

West Bromwich Booster, Valve 1, Walsall control valves and West Bromwich control valves are all assets within the same site. The site does not have a generator and in the event of a power failure, these critical assets become unavailable, which we cannot allow to happen. In this event this creates a significant operational risk for water supply interruptions, for which we would need to hire an emergency generator from one of our suppliers. This lack of power resilience is a single point of failure that needs to be addressed as part of this enhancement investment. The proposed mitigation is the installation of a generator and fuel tank at the site.

5.2.3.3 Treatment Works Resilience

Investment Type	Investment Location
Treatment Works	Seedy Mill Treatment Works, South Staffs Region

Enhancement Investment at Seedy Mill Treatment Works – Gentleshaw Re-lift Pumps

At Seedy Mill Treatment Works we pump into four WSZs (which in turn support other downstream WSZs). These zones are Barr Beacon, Hopwas/Glascote, Outwoods and Cannock High. Barr Beacon and Cannock High are high pressure (high lift) pumped zones, with the remaining zones having a lower pressure (low lift) pumped flow. This is dictated by the elevation to which the water is required to be pumped for storage.

In the event of operational issues that prevent pumping to one or any of the zones then the following take place to mitigate against risk of water supply interruptions due to reduced strategic storage in the affected zones.

Both Hopwas/Glascote and Outwoods have a dedicated process whereby water from Barr Beacon Reservoir can be fed back to Seedy Mill via gravity outflow and then diverted via an infusion valve, to send water to these zones. Gravity transfer is possible due to the elevation differences between the strategic reservoirs in these zones. To support this process, the water level in Barr Beacon Reservoir can be supplemented by a boosted transfer from Sedgley Reservoir in the southern part of the region. Sedgley is fed from Hampton Loade treatment works. The boosted transfer, along with pumping station inputs within the Barr Beacon WSZ assists in slowing the rate of fall, maintaining, or increasing the reservoir level in Barr Beacon, Hopwas/Glascote and Outwoods strategic reservoirs, in the event of an unplanned operational issue at Seedy Mill.

For the Cannock High zone, whose main strategic reservoir is located at Gentleshaw, the gravity transfer from Barr Beacon is not possible as the elevations of both reservoirs are similar, generating no pressure differential to move the water. In addition, there is no pipework connectivity at the treatment works to facilitate this transfer.

Please see below figure for illustration of this.

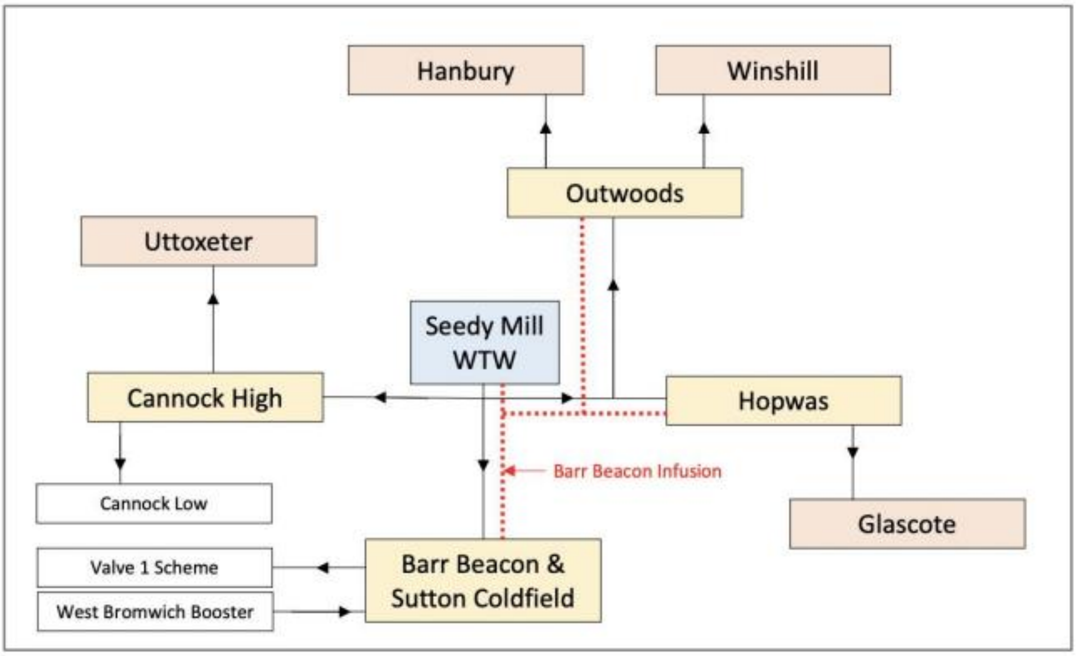


Figure 104 – Seedy Mill Treatment Works zonal schematic, with infusion connectivity shown

The Cannock High WSZ is served by Gentleshaw Reservoir, which is the only reservoir within the zone. This zone supports surrounding WSZs, namely Cannock Low and Uttoxeter. Within these supported zones there are several storage reservoirs. Gentleshaw Reservoir is made up of two cells (East and West) and the usable storage is significantly reduced due to the need to provide booster suction. The properties that the Cannock High zone served approximately 45,000 properties.

Please see below table for a summary of the reservoir operating levels.

Table 123 – Gentleshaw Reservoir Operating Levels

Reservoir	Capacity (Ml)	Maximum Operating Level	Minimum Operating Level	Usable Storage (Ml)
Gentleshaw East	11.29	96% @ High Alarm	30% @ Low Alarm, booster suction	7.45 @ 66%
Gentleshaw West	11.29	96% @ High Alarm	30% @ Low Alarm, booster suction	7.45 @ 66%
Totals	22.58	-	-	14.9 @ 66%

The main imports and exports to this zone are shown in the below table

Table 124 – Imports and Exports into Cannock High zone

Source	Flows (Ml/d)
Import: Seedy Mill WTW	25
Import: Slitting Mill & Moors Gorse	10.5
Import: Maple Brook	8.5
Export: Moors Gorse Valve scheme (remotely operable when required)	0 - 6Ml/d
Export: Uttoxeter Valve scheme (remotely operable when required)	0 - 6Ml/d
Export: STW export (Operated by STW normally only overnight)	50l/s for 8 hrs

Flows shown in above table are typical operating limits.

Slitting Mill pumping groundwater for treatment at Moors Gorse. Moors Gorse and Maple Brook Pumping Stations deliver water into Cannock High WSZ. The Moors Gorse Valve scheme is an export to Cannock Low WSZ, and the Uttoxeter Valve scheme is an export to Uttoxeter WSZ. This Uttoxeter valve scheme is the main source of resilience to the Uttoxeter WSZ, and together both zones supply around 55,000 properties. The valve scheme is reliant on the Cannock High zone and Gentleshaw Reservoir level to support customers in the Uttoxeter zone, when needed.

Historically several of the unplanned operational issues at Seedy Mill have been caused by power failures. Whilst the treatment works has a power generator to mitigate any power losses experienced, the consequence of a power dip or outage on the treatment processes can mean that whilst power can often be returned to the works relatively quickly, the treatment output can take several hours to return to its previous level. It is in this period where it is crucial to be able to support the other zones with Barr Beacon Reservoir water.

The Cannock High zone cannot be supported from Barr Beacon under current operations. This issue is further compounded if the power failures are widespread across the region and impact our pumping stations. In this scenario, the Cannock High zone could experience no input from a pumping station or treatment works, and with no support via an transfer from Barr Beacon, the zone is solely supported by the stored water volume in Gentleshaw Reservoir. If these events occur in a period of high demand or when the reservoir is at a lower level, in line with managed diurnal profile the risk of water supply interruptions is very prevalent. It is these low probability, high consequence events such as third-party power asset failures that have been identified as part of our LTDS operational resilience pathway, as we consider grid reliability in extreme weather associated to the predicted climate changes such as reduced rainfall and increasing temperatures, as well as extreme weather events.

To further understand and demonstrate this risk position, we have engaged with third-party consultants to provide zonal modelling looking at various scenarios linked to demand and storage time. The modelling exercise examines the storage time using the usable storage for average and peak day demand. This examination is looking at present day, 2032 and 2042 demand scenarios.

Table 125 – Modelled Scenarios

Scenarios	Description
1	All imports on zero to establish emergency storage.
2	Maple Brook in on 8.5Ml/d rate, all other sources out.
3	Slitting Mill and Moors Gorse in on 10.5Ml/d rate, all other sources out.
4	Seedy Mill TW in on 25Ml/d rate, all other sources out.
5	Slitting Mill, Moors Gorse and Maple Brook in on a combined supply of 19Ml/d, all other sources out.

The data used is based on daily, weekly and seasonal demands and looked at the average and peak demand scenarios within this.

Please see below summary table for the scenarios modelled and the emergency storage available.

Table 126 – Average and Peak day emergency storage by scenario

Scen.	Average day demand (Av Hrs)			Peak day demand (Av Hrs)		
	Present	10 year (10%)	20 year (20%)	Present	10 year (10%)	20 year (20%)
1	14	13	12	8	7	6
2	23	20	17	13	9	8
3	26	23	20	15	13	9
4	>26	N/A	N/A	39	39	28
5	>26	N/A	N/A	27	23	18

Risk designation: High Risk (Red) – Less than 12 Hours emergency Storage: Medium Risk (Amber) – Between 12- and 24-hours emergency storage: Low Risk (Green) – Greater than 24 hours emergency storage:

The conclusion of the modelling exercise is that the emergency storage with zero inflow (Scenario 1) for the present and future is insufficient for peak demand and considered to be high-risk. The risk reduces marginally with a single borehole source (Scenario 2). The risk only reduces to low risk for present day peak demand either with Seedy Mill in supply and all boreholes out (Scenario 4) or with only all boreholes in supply and Seedy Mill out (Scenario 5).

This conclusion further demonstrates how providing a facility to support the Cannock High zone with a re-lift pump connected off the Barr Beacon pipework would help to mitigate supply interruptions by supporting Gentleshaw Reservoir and extending the hours of emergency storage.

Additionally, associated with this investment, is the requirement for conservation of Blithfield Reservoir. This impounding reservoir and primary source of raw water to Seedy Mill requires ongoing conservation to manage the water level to ensure that we have enough water to treat and supply to customers.

As part of our LTDS core pathway we have considered the predicted climate changes around reduced rainfall, increasing temperatures, and extreme weather events, and accordingly the management of abstractions from the reservoir becomes increasingly crucial. This management is needed to maintain water levels above drought curves and ensure temporary use bans for customers are avoided. To recover Blithfield we often reduce the levels of abstraction and treatment with reliance on the transfer of treated water from south (Hampton Loade) to north and then infusion from Barr Beacon to support the zones where infusion is available.

As the criticality to conserve Blithfield Reservoir increases into forthcoming and future AMPs, due to climate change impacts, it is possible we will see lower than usual treated flow from Seedy Mill, for longer periods. In these scenarios we will be more reliant on using Barr Beacon infusion transfer to support our northern WSZs. Without availability to use Barr Beacon re-lift transfer to support Cannock WSZ, we would have to maintain a higher treated water output and abstraction from Blithfield in order to maintain storage at Gentleshaw Reservoir.

Clearly becoming more reliant on Barr Beacon Reservoir to provide an supporting transfer to other zones also brings risks around maintaining the level at this reservoir, given how much usable storage is available. To address these risks, and wider risks around the need for increased strategic storage, particularly in the Barr Beacon zone, we are promoting a base investment for the re-build of Barr Beacon Reservoir number 1, which is currently out of supply due to structural issues. This 46Ml asset, when returned to supply, will allow for greater volumes of water to be stored and utilised as needed, including supporting flows to other northern WSZs. This also links to the enhancement power resilience promoted at West Bromwich Booster, which is the asset used to transfer water into Barr Beacon currently, please see section 5.2.3.2 for further detail on this investment need and how this booster asset is critical in supporting Barr Beacon during the scenario described above.

To ensure that we mitigate against the above risks on water supply interruptions, we have appraised the best value solution as being to install cross connection pipework between the Barr Beacon and Gentleshaw mains network at Seedy Mill and to install a re-lift pump to allow for a gravity transfer not being possible.

To provide the right cost beneficial investment to address the lack of resilience at these sites, a thorough risk elicitation exercise has been undertaken. This exercise, along with the support of our business leaders and operational teams, reviewed and captured extensive detail around assets, risks, and associated investment opportunities. To build on this risk elicitation programme, a comprehensive optioneering exercise has subsequently been undertaken by third-party consultants, again, with the support of our business through subject matter expert stakeholders. This work has seen development of a clear understanding of the problems associated and the risks assigned to each proposed enhancement investment.

The development of long list options for potential solutions and application of a multi-criteria assessment (MCA) has generated shortlisted options for the undertaking of a feasibility appraisal. The outputs of this process and feasibility appraisal can provide a confidence around the selection of the most cost beneficial, best value option that addresses the need and mitigates the risks, plus identifying residual risks to be rectified in detailed design and delivery. For more detail on this process and the approach taken please see Section 3 of our appendix, 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.'

These production resilience investments are proposed in AMP8 to ensure that our critical non-infrastructure assets have the resilience to address increasing abstraction pressures around future license caps, an increasing customer base – both in household and non-household population rises and predicted climate change challenges that require investment in assets that demonstrate the best value for customers in mitigating water supply interruptions risk.

Investments on these assets can be considered low or no regrets as these investments resolve issues we recognise today, as the sites each have a single point of failure and when not operational have the potential to have a significant customer impact because of water supply interruptions and unplanned outage performance commitment.

5.2.4 Customer Support

We have carried out our most extensive customer engagement programme ever to ensure our PR24 and WRMP24 plans are underpinned by robust customer and wider stakeholder preferences. Our strategic engagement programme started in early 2020 and has run through to summer 2023, with over 92,500 customers taking part in a wide range of SSC research studies, with their views being compared with those from our robust business-as-usual insight programme and wider industry studies. This programme has been assured by SIA Partners as meeting Ofwat's "high-quality" engagement standards, as outlined in its Customer Engagement Policy paper (February 2022) – see appendix SSC14.

A key evidence source is appendix SSC11, which provides a thematic review of the key areas relevant to this investment case. It also highlights the golden threads that have consistently emerged across our engagement. The report also details the project objectives of each study used in the evidence base, when it took place and the numbers and types of customers and stakeholders engaged with. Specifically, please refer to **section 16** for Supply interruptions and low pressure.

Specifically related to water quality, we see a clear thread from our engagement towards customers (household and non-household) and stakeholders expecting to see investment to ensure a reliable high-quality, affordable service is maintained 24/7. Customers also expect further investment and innovation in infrastructure schemes to detect and predict problems to quickly fix and prevent any failures before their impacts are experienced, such as discoloured water.

- Key customer evidence points to support this enhancement case include:
    - A "reliable, high-quality supply" continues to be the number one priority for investment among our household and non-household customers – as evidenced in our Customer Priorities Tracker, which is a qualitative and quantitative study that has been running since 2020.
        - Our research shows that a reliable, high-quality supply, is one of two "super hygiene" areas, alongside bill affordability, highlighting the need for on-going targeted investment to deliver a high-quality service.
        - The chart below evidences the priority customers place on this area, and when making their trade-offs in the max-diff stated preference exercise, with **58%** selecting it as the more important area for investment and only **6%** stating it was the least important area of the service attributes shown. There were no significant differences between our two supply regions of note, or within any customer segments for this attribute highlighting the consistent response.
        - Having good water pressure was a mid-tier ranked priority, with **21%** of customers selecting this attribute as the "most important" when making their trade-offs. Customer living in higher-income houses gave a significantly higher priority to ensuring they have good water pressure.
        - Importantly, customers priorities are now becoming more balanced over the 20 services areas tracked in the study, with social and environmental areas becoming increasingly more important over time. However, customers still view having a reliable supply as a basic service which SSC should be delivering to a high standard so that daily activities, such as drinking tap water, washing and cleaning, are not impacted by unexpected supply interruptions and/or pressure issues.

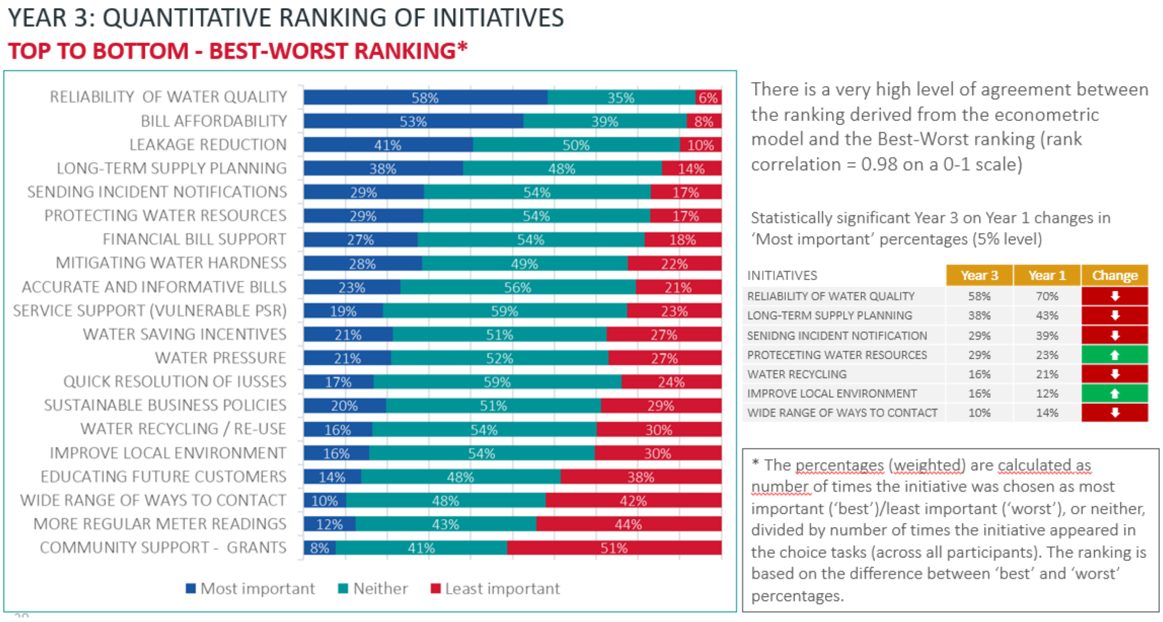


Figure 105 – Year 3: Quantitative ranking of customer priorities for investment

- Source: SSC Customer Priorities Tracker, year 3 report, April 2023. Representative sample of 1,072 household customers (including 62 future customers.

- The insights from our Customer Priorities Tracker supply reliability did show some subtle differences in our LTDS customer engagement, which involved a multi-stage research programme of qualitative and quantitative research. The charts below show a summary of the research findings and highlight the strong and consistent level of support among all customer segments for SSC to deliver stretched ambitions for reducing supply interruptions. 88% supported the ambition to drive supply average supply interruption performance to under 1 minute by 2050.
- However, this ambition viewed as a mid-tiered priority for investment against the 10 areas covered, but the qualitative workshops highlighted that this was mainly due to us already have a strong performance and that most customers have not experienced the issue and so did not consider it as important as other areas.
- It is still viewed as important to keep improving performance and it is clear that NHH place a higher priority on this area given the reliance many businesses have on a reliable water supply in the context of their day-to-day operations. The impacts for water reliant businesses are more serious and customers cited this could lead to needing to close, or halted production leading to loss of sales.

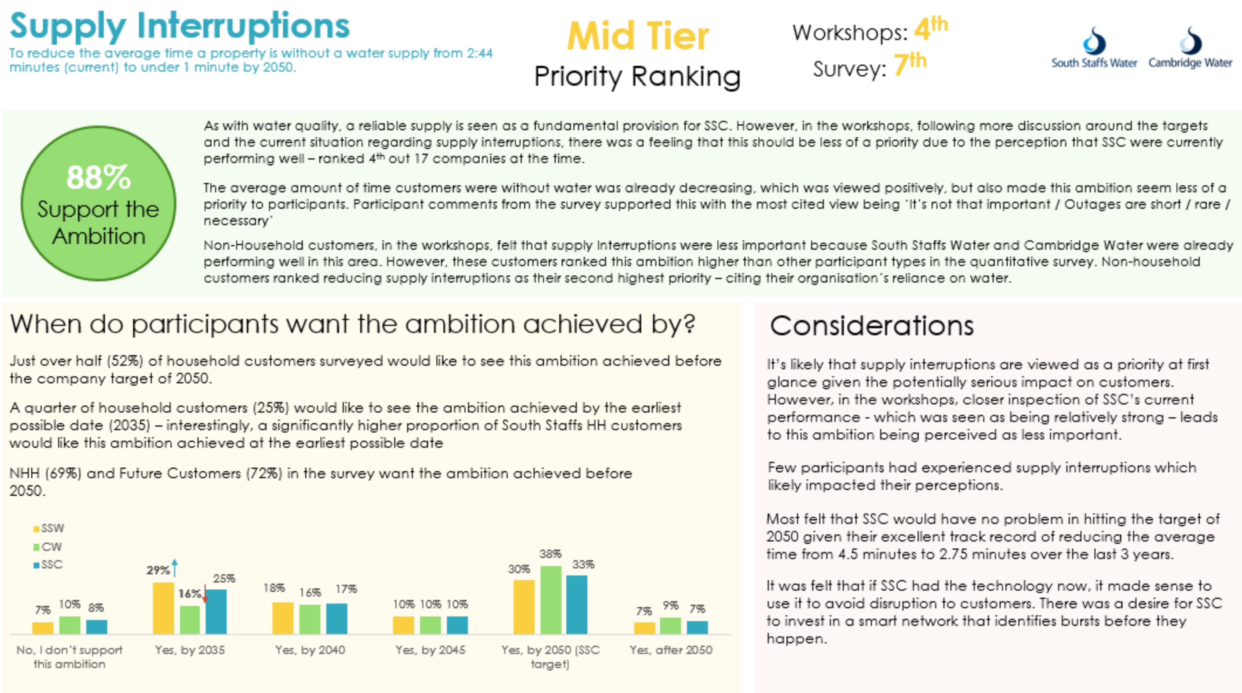


Figure 106 – LTDS research outputs on our supply interruptions ambition

Source: SSC LTDS Research, July 2023 report. Representative sample of 1,080 household and non-household customers (including 82 future customers).

Moving on from the priorities customers have expressed, free from the constraints of bill impacts, the PR24 valuation studies undertaken highlight clearly a theme that both household and non-household customers are willing to pay (WTP) for investments to avoid service failures linked to water supply reliability. Specifically:

- In Ofwat's Collaborative ODI Research (Summer 2022) an analysis by PJM Economics of the results from SSC's customer base who took part in the study, shows that "unplanned interruptions of up to 24hrs" attracting the highest Willingness To Accept (WTA) £ valuation. NHH gave notably higher WTA valuations highlighting again the importance of a reliable supply. Customers with vulnerabilities, such as medical conditions or who struggle with communicating also gave notable higher WTA valuations for this service attribute. This is in in keeping with feedback from qualitative research where service failures tend to have a great impact on the lives of those who have conditions that relies on having access to a reliable water supply.

- In SSC's PR24 Willingness to Pay Study (Autumn 2022) there was again a consistent theme of customers expressing higher WTP valuations for service attributes relating to resilience, namely avoiding burst pipes.

- The table below highlights the range of valuations that were developed from our technical triangulation framework, which was developed to triangulate WTP values to set central, upper, and lower values for use in Cost Benefit Analysis (CBA). This framework was academic peer reviewed end-to-end, and the valuations data sources challenged by our Delphi panel of expert stakeholders to help provide confidence in the WTP valuations used in Copperleaf. The framework was also given a Green (highest level) rating by SIA partners in its independent assurance of the technical triangulation approach developed for us to inform PR24 investment decisions by our partners Impact.

- As shown in the table, for attributes expressed in per property WTP values, two of the highest valuations are for the services attributes related to supply interruptions, namely damage from burst pipes and unplanned interruptions. See report SSC09 for full details of our technical triangulation approach and the valuation sets provided to us for use in Copperleaf to enable a range of sensitivity tests of customer preferences within Copperleaf.

- This is a consistent thread through from customer priorities through to WTP valuations that provides robust evidence that customers support investments which can reduce service failures, such as unexpected supply interruption.
- When turning to water pressure, WTA valuations in Ofwat's Collaborative ODI Research (Summer 2022) for an "unexpected 6-hour period of low water pressure" were notably lower when compared to unexpected supply interruptions and there was no significant Willingness to pay for the same service issue in our NERA study. In fact, close to 40% of customers in the NERA study selected their choice for this service area as they were looking for the "cheapest option". However, this should not be taken to mean they would expect a lower service level of increasing instances of unexpected low pressure, as our research shows that almost 1 in 5 customers has experience low pressure in the last two to 3 years. Our current strong performance is likely a key reason why many customers were not WTP for service improvements related to pressure and the fact that a 6-hour low pressure issue can be worked around by customers or happen when they are out/asleep. However, the table below shows that across the valuation studies there is customer WTP for improvements to reduce low pressure, but is notably lower than unexpected supply interruptions.

Table 5.2: Values (per unit) to be tested in Copperleaf (High RAG ratings, HH and NHH combined, total SSC)

COMBINED SSC	ALL - HIGHEST Central value	LOW NERA AND ODI - ALL OTHERS HIGHEST Central value	NO NERA - HIGHEST Central value	PRE PR24 Central value	ALL - HIGHEST Lower value	ALL - HIGHEST Higher value
Water not safe to drink (per property affected)	£73,592	£27,985	£5,983	£1,510	£14,779	£303,914
Flooding from a burst pipe (per property affected)	£23,775	£10,102	£2,090	£1,064	£4,983	£85,550
Unexpected temporary loss of water supply (per property affected)	£3,369	£1,832	£4,573	£506	£674	£14,259
Water hardness (per property affected)	£484	£437	£404	£381	£98	£1,762
Taste and smell of water (per property affected)	£2,116	£1,166	£2,876	£520	£423	£7,030
Low water pressure (per property affected)	£1,185	£582	£1,612	£74	£237	£3,991
Lead pipes (per property affected)	£39	£40	£50	£42	£8	£89
Water metering (per customer)	£8	£10	£8	£10	£3	£20

Figure 107 – Valuation sets from our WTP triangulation approach used to sensitivity test customer preferences in Cooperleaf

In terms of use of business-as-usual insights, a key drivers analysis (Shapely regression) of the 800 survey responses in our 2023 Customer Promises Tracker highlights that "reliability of water supply" is a key driver of overall service and that household customers who have not had to contact the company to report a service failure are significantly more satisfied with the overall service than those who have. This evidences that to deliver an overall positive experience to customers that this promise must be delivered on by us. This attribute has become a notably stronger driver of overall service since 2019/20. "Water pressure" appears as a weaker influencer of overall customer service but has gained slightly in importance since 2019/20. CCW water household "Water matters" tracker research highlights that low pressure is a key reason why some customers "suffer in silence" with 37% of customers who has experienced a low-pressure issue not contacting their company for help. The figures were 26% for supply interruptions. This means that investments that can help prevent customers from living with service issues is important to ensuring positive experiences.

This preference towards resilience investment was further evidenced in our qualitative acceptability and affordability business plan research (June 2023). Within this study we followed the official guidance and tested our proposed and least cost plans to customers could comment on their acceptability and affordability. The image below is taken from the qualitative report and highlights that most household and non-household customers wanted increased spend beyond the mandatory/least cost plan to ensure investment into resilience schemes. Customers are clearly concerned and increasingly aware of the impact that our changing climate is having on infrastructure and have expressed a clear priority that important investments should not be delayed, but that it is very important for SSC to protect those customers who are struggling with paying their bills from the increases that will be required to deliver investments.

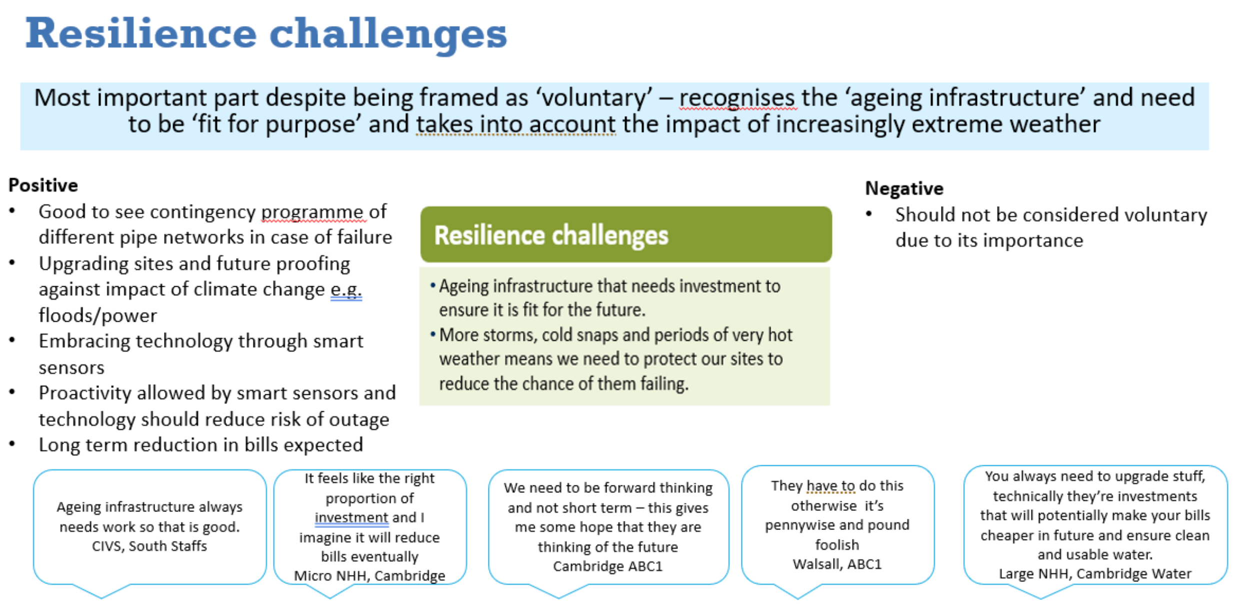


Figure 108 – feedback from customers in our PR24 AAT qualitative research on our proposed resilience enhancements.

5.2.5 Best Option for Customers

We have undertaken a detailed bottom-up build of our risks across our business. The following stages provide a brief overview of the process undertaken:

- Bottom-up risk capture with stakeholders across the business scored on a traditional 5x5 risk matrix.
- Appropriate high-risk schemes were then taken forward for longlist optioneering.
- Further analysis through a multi criteria assessment (MCA) took place to form a shortlist from the longlist solutions.
- Feasibility assessments and cost estimation stage were undertaken to allow for value appraisals (CBA) to be compiled.
- Optimisation of the AMP 8 portfolio was then undertaken to provide a set of schemes that will offer a best value plan for the financial constraints applied.

This optimisation of the AMP8 portfolio, to arrive at the best option and value for customers, the company uses a decision-making system to store investments and turn them into a deliverable and affordable business plan for our customers. This system, Copperleaf, uses multiple components to optimise. The system uses a value framework made up of more than 20+ value models that allow us to capture risk and value against categories that are pertinent to our operations and our customers.

A more detailed description of our methodology can be found in Sections 3 and 4 of our appendix, 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.'

5.2.5.1 Borehole Resilience

Investment Type	Investment Location
Boreholes	Euston Pumping Station, Cambridge Region
	Heydon Pumping Station, Cambridge Region

The following tables provide summary information for each investment and the spectrum of potential options considered at long listing stage. The summaries show the associated strengths and weaknesses for the options, with decisions on if these options were to be taken forward to shortlisting for feasibility appraisal.

Table 127 - Brettenham PS and Euston PS Borehole Resilience Long Listing options

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Continue operation with single borehole and no resilience	No capital expenditure	No resilience achieved and risk to water supply interruptions remains the same	Discarded	Resilience essential to mitigate water supply interruptions and meet customer feedback showing desire for increased operational resilience
Least Cost Option	Investigation into Pumping issues at Brettenham PS	Potential additional output to reach abstraction license could be achieved	No additional resilience achieved and risk to water supply interruptions remains the same	Discarded	Resilience essential to mitigate water supply interruptions and meet customer feedback showing desire for increased operational resilience
Best value option	Drill new Borehole at Euston PS	Meets resilience driver	Additional operational maintenance required on 2nd borehole	Adopted	Meets enhancement driver of providing resilience to water supply interruptions risk
Other Alternatives	Upsize pipeline between Brettenham PS and Euston PS plus new borehole at Brettenham PS	Provides additional resilience at Brettenham PS	Pipeline construction risks given river, oil and SSSI challenges	Discarded	Estimated capital expenditure, is much higher than alternative options

For details on the Longlisting, MCA scoring and shortlisting process that was undertaken please see Section 3 of our appendix, ‘SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.’

The output of the MCA assessment was that the shortlisted option is:

- Drill a new borehole at Euston PS

Please see below table for summary on the cost, benefit, and value of this option.

Table 128 – Brettenham PS and Euston PS Borehole Resilience Short Listed options

Option	Description	NPV (£k)	AMP8 Capex Cost (£k)	Decision
Option 2- Drill new BH	Drill new Borehole at Euston PS	34,977	1,920	Recommended Alternative

The recommended alternative was the above selected option as this offers the best value for customers, and it also meets the driver of providing resilience at the site. The option requires no land purchase and as a result of being located on the existing site, has reduced operational requirements, compared to a satellite borehole.

The proposed borehole is to match existing borehole diameter, depth and pumping capacity.

The scope for this option includes:

- New Borehole
- New Borehole Pump
- Valve chamber, valves connections and tap into pipe to combine new rising main into existing pipework
- NRV valve
- Flow meter
- Telemetry upgrade
- Rising main in BH
- Rising main connection to existing
- MCC
- Hardstanding area

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 129 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	Vehicle access will be required to the proposed borehole and so an additional hard standing area has been included in scope. Pipework for the proposed borehole has been shown to connect into the pipework adjacent to the IEX treatment vessels; similar to the existing arrangement.
Climate Change	Separate investigation required to assess the effects of climate change upon water resources, geographical conditions, and potential site output.
Regulatory Shifts	Many abstraction licenses are likely to be reduced in the future by the Environment Agency (across all WASC areas) that could have an impact on this abstraction site. This additional borehole is a resilience measure rather than an increase in max capacity.
Demand	Network demand is expected to continue. Increasing the resilience of the boreholes means an improved service for the customer by reducing the risk of interruption to supply.
Technology	The technology of construction and installation equipment is expected to be current. New pumps are expected to be more efficient than existing assets. Modern construction methods may have all-round improvements in comparison to existing boreholes
Unique Regional Factors	There are no water treatment facilities in the Cambridge Water supply zone. There is only water abstraction which supplies the entire region.

Table 130 - Heydon PS Borehole Resilience Long Listing options

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Continue operation with single borehole and no resilience	No capital expenditure	No resilience achieved and risk to water supply interruptions remains the same	Discarded	Resilience essential to mitigate water supply interruptions and meet customer feedback showing desire for increased operational resilience
Least Cost Option // Best Value Option	Drill new Borehole at Heydon PS	Meets resilience driver. Reduced operational requirement as all on one site.	Site congested with existing infrastructure. Additional operational maintenance required on 2nd borehole	Adopted	Meets enhancement driver of providing resilience to water supply interruptions risk
Other Alternatives	Develop observational borehole into operational borehole	Utilisation of existing assets on a congested site footprint	Suitability for existing borehole to become operational instead of observational unknown. Understood to be located outside of site boundary, requiring land purchases and infrastructure installs.	Discarded	Risk associated with observational borehole not being suitable for conversion into operational borehole.
Other Alternatives	Drill a new borehole at a satellite location	Provides additional resilience at Heydon PS	Purchase of third-party land required; additional infrastructure assets required between two sites	Discarded	Estimated capital expenditure, is much higher than alternative options

For details on the Longlisting, MCA scoring and shortlisting process that was undertaken please see Section 3 of our appendix, ‘SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.’

The output of the MCA assessment was that the shortlisted option is:

- Drill a new borehole at Heydon PS

Please see below for summary on the cost, benefit, and value of this option.

Table 131 – Heydon PS Borehole Resilience Short Listed options

Option	Description	NPV (£k)	Cost (£k)	Decision
Option 2- Drill new BH	Drill new Borehole at Heydon PS	4,784	2,096	Recommended Alternative

The recommended alternative was the above selected option as this offers the best value for customers, and it also meets the driver of providing resilience at the site. The option requires no land purchase and as a result of being located on the existing site, has reduced operational requirements, compared to a satellite borehole.

The proposed borehole is to match existing borehole diameter, depth and pumping capacity.

The scope for this option includes:

- New Borehole
- New Borehole Pump
- Valve chamber, valves connections and tap into pipe to combine new rising main into existing pipework
- NRV valve
- Flow meter
- Telemetry upgrade
- Rising main in BH
- Rising main connection to existing
- MCC
- Hardstanding area

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 132 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	Vehicle access will be required to the proposed borehole and so an additional hard standing area has been included in scope.
Climate Change	Separate investigation required to assess the effects of climate change upon water resources, geographical conditions, and potential site output.
Regulatory Shifts	Many abstraction licenses are likely to be reduced in the future by the Environment Agency (across all WASC areas) that could have an impact on this abstraction site. This additional borehole is a resilience measure rather than an increase in max capacity.
Demand	Network demand is expected to continue. Increasing the resilience of the boreholes means an improved service for the customer by reducing the risk of interruption to supply.
Technology	The technology of construction and installation equipment is expected to be current. New pumps are expected to be more efficient than existing assets. Modern construction methods may have all-round improvements in comparison to existing boreholes
Unique Regional Factors	There is no water treatment facility in the Cambridge zone. There is only water abstraction which supplies the entire region.

The value to customers, of resilience, is highlighted by the outputs from the customer acceptability workshops that have been undertaken. These outputs from these workshops and the associated feedback and value apportioned to resilience can be further found in Section 5.2.4 Customer Support above.

In delivering the best option for customers, we understand that we need to address the residual risks associated with the recommended solutions for resilience on these critical single borehole sites. We also understand the sensitivity of ground water abstraction and chalk stream ecological/community amenity values. To this end engagement will continue with relevant stakeholders, notably the EA, to undertake this work in a way reflective of these sensitivities and requirements. The availability of these sites, particularly Euston PS and Brettenham PS is critical in meetings regional water supply requirements.

5.2.5.2 Booster Resilience

Investment Type	Investment Location
Booster	Grantchester Road Booster Station, Cambridge Region
	Fleam Dyke Pumping/Booster Station, Cambridge Region
	West Bromwich Booster Station, South Staffs Region

The following tables provide summary information for each investment and the spectrum of potential options considered at long listing stage. The summaries show the associated strengths and weaknesses for the options, with decisions on if these options were taken forward to shortlisting for feasibility appraisal.

Table 133 - Grantchester Road Booster Resilience Long Listing Options

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Operate site with no power resilience in the event of a power failure	No capital expenditure	No resilience achieved and risk to water supply interruptions remains the same	Discarded	Resilience essential to mitigate water supply interruptions and meet customer feedback on criticality of resilience
Least Cost Option // Best Value Option	Power Resilience by installing generator and fuel tank	Provides back up power to site in the event of an electrical outage	Large amount of fuel to be stored, risk of theft, life expiration and contamination	Adopted	Meets enhancement driver of providing resilience to water supply interruptions risk
Other Alternatives	Install second incomer power feed to site	Provides resilience against failure on existing incomer	Still reliant on the electric grid and not a cost-efficient solution	Discarded	Discounted mainly due to the small size of the site, the additional equipment/complexity required to enable a secondary incomer power feed would increase the solution cost and would require external liaison with the DNO which may impact delivery timescales
Other Alternatives	Back up batteries to power site	No fuel storage	Not feasible solution	Discarded	Discounted as it is not feasible to power the site using batteries due to the loads and varying currents

For details on the Longlisting, MCA scoring and shortlisting process that was undertaken please see Section 3 of our appendix, ‘SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.’

Please see below for summary on the cost, benefit, and value of this option.

Table 134 – Grantchester Road Booster Resilience Short Listed options

Option	Description	NPV (£k)	Cost (£k)	Decision
Option 1 – new generator	Install new generator with fuel tank	17,579	541	Recommended Alternative

The recommended alternative was the above selected option as this offers the best value for customers. This solution also meets the driver for power resilience. The site can continue to run for up to 10 days using the proposed generator and fuel tank. The use of generators for power resilience is a proven solution used already throughout our company.

The scope for this option includes:

- New land purchase
- Installation of a new SR4 kiosk to house a new 350kVA generator and control panel. The size of the generator was scaled down from the long listing phase following clarification.
- Installation of associated electrical and control cabling and pipework
- Installation of a new 17000l fuel tank and bund with security fencing

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 135 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	Existing site access road will need to be modified to enable fuel tanker deliveries. New kiosk and fuel storage ages to be established
Climate Change	Considered but no issues for future use.
Regulatory Shifts	Potential change to future generator emissions regulations.
Demand	New generator will ensure a robust power supply in the event of main power loss.
Technology	Latest generator technology will be used for this scheme.
Unique Regional Factors	Conditions and variables unique to the South Staffordshire have been taken onto consideration.

Table 136 - Fleam Dyke 12" Booster Resilience Long Listing options

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Operate site with no power resilience in the event of a power failure	No capital expenditure	No resilience achieved and risk to water supply interruptions remains the same	Discarded	Resilience essential to mitigate water supply interruptions and meet customer feedback on criticality of resilience
Least Cost Option // Best Value Option	Power Resilience by installing generator and fuel tank	Provides back up power to site in the event of an electrical outage	Large amount of fuel to be stored, risk of theft, life expiration and contamination	Adopted	Meets enhancement driver of providing resilience to water supply interruptions risk
Other Alternatives	Install second incomer power feed to site	Provides resilience against failure on existing incomer	Still reliant on the electric grid and not a cost-efficient solution	Discarded	Discounted mainly due to the small size of the site, the additional equipment/complexity required to enable a secondary incomer power feed would increase the solution cost and would require external liaison with the DNO which may impact delivery timescales
Other Alternatives	Back up batteries to power site	No fuel storage	Not feasible solution	Discarded	Discounted as it is not feasible to power the site using batteries due to the loads and varying currents

For details on the Longlisting, MCA scoring and shortlisting process that was undertaken please see Section 3 of our appendix 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.'

Please see below for summary on the cost, benefit, and value of this option.

Table 137 – Fleam Dyke 12" Booster Resilience Short Listed options

Option	Description	NPV (£k)	Cost (£k)	Decision
Option 1 – new generator	Install new generator with fuel tank	5,982	313	Recommended Alternative

The recommended alternative was the above selected option as this offers the best value for customers. This solution also meets the driver for power resilience. The site can continue to run for up to 10 days using the proposed generator and fuel tank. The use of generators for power resilience is a proven solution used already throughout our company.

The scope for this option includes:

- Installation of a new SR4 kiosk to house a new 125 kVA generator and control panel.
- Installation of associated electrical and control cabling and pipework.
- Installation of a new 7000l fuel tank and bund (capable of 10 days fuel storage) with security fencing.

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 138 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	Existing site access road will need to be modified to enable fuel tanker deliveries. New kiosk and fuel storage ages to be established
Climate Change	Considered but no issues for future use.
Regulatory Shifts	Potential change to future generator emissions regulations
Demand	New generator will ensure a robust power supply in the event of main power loss.
Technology	Latest generator technology will be used for this scheme
Unique Regional Factors	Conditions and variables unique to the South Staffordshire have been taken onto consideration.

Table 139 - West Bromwich Booster Resilience Long Listing options

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Operate site with no power resilience in the event of a power failure	No capital expenditure	No resilience achieved and risk to water supply interruptions remains the same	Discarded	Resilience essential to mitigate water supply interruptions and meet customer feedback on criticality of resilience
Least Cost Option // Best Value Option	Power Resilience by installing generator and fuel tank	Meets the driver to provide resilience in the event of a power outage	Increased risk of theft due to 10 days fuel storage on site	Adopted	Meets enhancement driver of providing resilience to water supply interruptions risk
Other Alternative	Power resilience by installing generator and fuel tank. Additionally install surge vessel	Meets the driver to provide resilience in the event of a power outage but also provides a new surge vessel to allow for resilience against failure of existing surge vessel	Increased risk of theft due to 10 days fuel storage on site. Additional capital expenditure without evidence of enhancement benefit	Discarded	Additional capital expenditure that was not possible to justify as enhancement

For details on the Longlisting, MCA scoring and shortlisting process that was undertaken please see Section 3 of our appendix ‘SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.’

Please see below for summary on the cost, benefit, and value of this option.

Table 140 – West Bromwich Booster Resilience Short Listed options

Option	Description	NPV (£k)	Cost (£k)	Decision
Option 1 – new generator	Install new generator with fuel tank	190,264	1,363	Recommended Alternative

The recommended alternative was the above selected option as this offers the best value for customers. This solution also meets the driver for power resilience. The site can continue to run for up to 10 days using the proposed generator and fuel tank. The use of generators for power resilience is a proven solution used already throughout our company.

The scope for this option includes:

- Installation of a new SR4 kiosk to house a new 800kVA generator and control panel.
- Installation of associated electrical and control cabling and pipework.
- Installation of a new 40000l fuel tank and bund with security fencing.

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 141 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	Existing site access road will need to be modified to enable fuel tanker deliveries. New kiosk and fuel storage areas to be established. Access is through a residential estate. Entrance gateway may need removing and reinstating and traffic management introduced.
Climate Change	Blithfield conservation is envisaged to increase with growing demand and climate change
Regulatory Shifts	Potential change to future generator emissions regulations.
Demand	New generator will ensure a robust power supply in the event of main power loss.
Technology	Latest generator technology will be used for this scheme.
Unique Regional Factors	Conditions and variables unique to the South Staffordshire have been taken onto consideration.

5.2.5.3 Treatment Works Resilience

Investment Type	Investment Location
Treatment Works	Seedy Mill Treatment Works, South Staffs Region

The following tables provide summary information for each investment and the spectrum of potential options considered at long listing stage. The summaries show the associated strengths and weaknesses for the options, with decisions on if these options were taken forward to shortlisting for feasibility appraisal.

Table 142 - Seedy Mill Treatment Works – Gentleshaw Re-Lift Pumping Long Listing options

Options	Description	Strengths	Weaknesses	Decision	Rationale for decision
Do Nothing	Make no changes to the current operation of the treatment works	No capital expenditure	No resilience achieved and risk to water supply interruptions remains the same	Discarded	Resilience essential to mitigate water supply interruptions and meet customer feedback on criticality of resilience
Least Cost Option/Best Value	Install a single re-lift pump for Gentleshaw in car park at works	Meets the driver to provide resilience by being able to re-lift Barr Beacon flow into Cannock High zone	Congested working area as multiple underground services and space constraints in car park	Adopted	Meets enhancement driver of providing resilience to water supply interruptions risk
Other alternative	Install a single re-lift pump for Gentleshaw next to surge vessel building at works	Meets the driver to provide resilience by being able to re-lift Barr Beacon flow into Cannock High zone	Congested working area as multiple underground services	Considered	Space constraints thought to be less risk than installing in car park but more expensive cost estimate

For details on the Longlisting, MCA scoring and shortlisting process that was undertaken please see Section 3 of our appendix 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.'

Please see below for summary on the cost, benefit, and value of this option.

Table 143 – Seedy Mill Treatment Works – Gentleshaw Re-Lift Pumping Short Listed options

Option	Description	NPV (£k)	Cost (£k)	Decision
Option 1 – Install re-lift pump for Gentleshaw in car park at works	Install single re-lift pump	17,521	1,105	Recommended Alternative
Option 2 – Install re-lift pump for Gentleshaw next to surge vessel building at works	Install single re-lift pump	17,423	1,176	

The recommended alternative was the above selected option as this offers the best value for customers. This option meets the project resilience driver.

The scope for this option includes:

- A pump capable of a flow of 10 Ml/d with a max head of 20m.
- An estimation calculation was performed to obtain an approximate pumps size which was calculated at ~35kW.
- Power was determined for the 35kW pump MCC with a 10kW allowance for building services in the kiosk (45kW total).
- An upsize of the existing Barr Beacon to Gentleshaw cross connection was also allowed for (to 350mm) as the velocity of 10 Ml/d going through the 9” pipework would otherwise be significant around 2.92m/s.

A number of adaptive planning considerations were identified during the feasibility stage of the design process. These are shown in the below table.

Table 144 – Adaptive Planning Considerations for Recommended Alternative

Category	Description
General Site Requirements	The area is in the site car park so additional arrangements will be required to minimise disruption. As the site is active, traffic management will be required. Flow from Barr Beacon is reportedly high pressure so appropriate safety precautions to be made.
Climate Change	Considered but minimal impact on this scheme
Regulatory Shifts	Considered but minimal impact on this scheme
Demand	New pump it will be able to maintain supply of approx. 10MLD to the affected area provided infusion can supply the water
Technology	Appropriate pump to be selected for efficiency and power consumption for the required duty
Unique Regional Factors	Conditions and variables unique to the South Staffordshire Water have been factored in.

5.2.6 Cost Efficiency

To demonstrate efficiency on cost, various costing exercises have been undertaken. As discussed previously in this document third-party consultants have supported the PR24 submission by leading the development of long list options for potential solutions that address the identified business risks/needs.

These business needs were established to have a driver that satisfied the OFWAT enhancement criteria. Drivers were quantified and confirmed within a series of internal Problem Statement documents. These documents formed the basis for a series of options included within the longlisting stage. Longlisting consisted of initial stakeholder engagement which also included confirmation of the need as well as high level potential solutions that would satisfy the requirements of the business and its customers.

At the long listing optioneering stage, the identified solutions at that point were provided with an estimated cost, based on industry cost models to inform decision making at that stage. This formed part of the criteria used score solutions ahead of promotion of solutions through to short listing and feasibility appraisal. Additionally, the MCA assessment was used within a series of stakeholder engagement sessions to help determine appropriate shortlist options. Top level categories included:

- Ability to meet project drivers and regulatory compliance.
- Provide a long-term solution to the company.
- Providing Green solutions.
- Technical Feasibility.
- Deliverability.
- Cost.

Schemes that scored highly in these areas were selected for the shortlisting stage. Further stakeholder sessions were then undertaken to ensure detailed scopes were developed prior to costing. To develop the scopes further the consultants elicited information specific to sites. This included current processes and schematics to help inform where new solutions could be accommodated into the current layout sites.

Utilising the detailed scoping the shortlisted options were put through a detailed cost breakdown by the consultants. This was undertaken using.

- Cost modelling data
- Industry benchmarking
- Engineering experience
- Supply chain relationships.

The cost estimation considers civil, mechanical, electrical and automation requirements across the solution to provide cost confidence to support the value and appraisal of the proposals. This is achieved through models that contains actual outturn costs from similar solutions across the water industry. This appraisal identified the recommended solution for the investment need when considering capex costs, opex costs, whole life cost and net present value.

Following completion of the above process we engaged with Gardiner & Theobold to undertake a review and apply benchmarking of our costing process. An output from this was to benchmark the accuracy and reliability of a representative sample of the cost estimates that our consultants had compiled.

For further detail on the above process that we undertook to develop, challenge, and continually refine our cost estimates please refer to Section 3 and 4 of our appendix, 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond.'

5.2.7 Customer Protection

Within our Production resilience schemes we are seeking enhancement funding to mitigate risks to low probability high consequence events that have the potential to significantly impact customers. These impacts will be seen through our water supply interruptions and unplanned outages performance commitments. As such, we feel that an activity-based driver is most appropriate so that we can monitor and report performance against a unit of Ml/d improved resilience capacity with phased milestones for deliver within the control period.

Customers will be protected against non-delivery of these enhancement investments by committing to Price Control Deliverable (PCD). The PCDs that we are proposing for these enhancement investments are grouped in the supply resilience PCD. More information and a full list of our PCD's can be found in Section 1.5.

These schemes will be protected under the Supply resilience PCD. Within this PCD it covers 3 different penalty options to protect customers.

Table 145 – Supply resilience PCD

<table>
<tr><th colspan="7">Supply resilience PCD</th></tr>
<tr><td>Description</td><td colspan="6">Power, supply and, network improvements to deliver water Ml/d improved resilience capacity.</td></tr>
<tr><td>Output or Outcome measurement and reporting</td><td colspan="6">The outputs of this PCD will be measured in Ml/d improved resilience capacity. The forecasted Ml/d deliverables are set out in the table below.
Delivery of Ml/d improved resilience capacity will be reported and monitored through the control period following the existing APR process.
Reported at the end of the financial reporting year.</td></tr>
<tr><td>Assurance</td><td colspan="6">Independent third-party assurance to confirm completed milestones</td></tr>
<tr><td rowspan="10">Conditions on schemes</td><td colspan="6">Due to the variance in schemes included within this PCD, we feel the unit rates don't provide a fair price control for our customers. Therefore, we propose to measure deliverables in Ml/d improved resilience capacity but, will apply penalties based on individual scheme enhancement funded allowance.</td></tr>
<tr><td colspan="3">Scheme</td><td>Forecast delivery</td><td>Cost £s</td><td>Ml/d</td></tr>
<tr><td colspan="3">Fleam Dyke station – Power resilience</td><td>2028/29</td><td>£312,685</td><td>2.4</td></tr>
<tr><td colspan="3">Grantchester road station - Power resilience</td><td>2029/30</td><td>£541,270</td><td>40.8</td></tr>
<tr><td colspan="3">West Bromwich station - Power resilience</td><td>2026-27</td><td>£1,362,994</td><td>104.0</td></tr>
<tr><td colspan="3">Euston borehole – Supply resilience</td><td>2028/29</td><td>£1,920,016</td><td>10.0</td></tr>
<tr><td colspan="3">Heydon borehole - Supply resilience</td><td>2029/30</td><td>£2,095,749</td><td>1.1</td></tr>
<tr><td colspan="3">Gentleshaw relift pump – Network resilience</td><td>2028/29</td><td>£1,104,698</td><td>10.0</td></tr>
<tr><td colspan="3">Hanbury resilience - Network resilience</td><td>2029/30</td><td>£2,911,049</td><td>7.8</td></tr>
<tr><td colspan="3">Burntwood resilience - Network resilience</td><td>2029/30</td><td>£395,780</td><td>8.1</td></tr>
<tr><td>PCD payment rate</td><td colspan="6">Option A - Late delivery for in-AMP phasing, will apply a time value of money penalty to the enhancement funded amount applied for the individual scheme which will be returned to our customers. The time value of money will be applied at the appropriate rate for the period required.
Option B – Late delivery where the project has started but isn't delivered by the end of the control period will apply, the time value of money on late delivery (This will apply a cut off period to the end of year 1 of AMP 9 (2030/31). If by the end of year 1 AMP 9 the project is still incomplete, we will return the enhancement amount funded not spent on that scheme back to the customer.
Non-delivery of Ml/d improved resilience capacity will be applied where the project hasn't been started within the control period. We will return the full enhancement funded amount for that specific scheme plus the time value of money back to our customers.
The time value of money will apply the appropriate rates for the period required.</td></tr>
<tr><th>Deliverables</th><th>Unit</th><th colspan="5">Forecast deliverables</th></tr>
<tr><td></td><td></td><td>2025-26</td><td>2026-27</td><td>2027-28</td><td>2028-29</td><td>2029-30</td></tr>
</table>

Ml/d improved resilience capacity	Ml/d		104		22.4	57.86

5.2.8 Delivery

This section should be read in conjunction with Section 6.4 ‘Delivering a high quality and ambitious business plan’ of SSC01 Securing your water future – business plan 2025-2030.

The proposal is to drill second boreholes at two locations in the Cambridge area, Euston and Heydon, provide generators and fuel tanks at Fleam Dyke Booster and Grantchester Rd Booster in the Cambridge area and at West Bromwich Booster in the South Staffs area and install a re-lift pump and pipework at Seedy Mill Treatment Works in the South Staffs area.

These works will be delivered under the Non-Infrastructure Assets Delivery Framework. These types of works would be considered core scope under this framework contract. It is not envisaged that the scale of the works would be a challenge for the supply chain.

The borehole works would form a batch costed at >£4m and the generator works another batch costed at >£2.2m to benefit from economies of scale. The re-lift pump and pipework would be a single project delivery at circa £1.1m.

The projects would be either direct allocation with price verification or mini tender competition depending on supply chain programme workloads and capacity. By verifying the price against cost models or a mini tender value for money can be tested.

The risk profile being low and scope of these projects being non-complex, will enable the use of an Option A fixed price contract.

Phasing of the projects delivery in AMP8 will be subject to optimisation through the Copperleaf investment planning tool which was deployed during AMP7 to improve asset management maturity and has been utilised to optimise the AMP8 capital programme.

5.3 Case 13: Smart Water System Trials

5.3.1 Summary

We are embarking on an integrated smart water trial of activity to create a step change for us to improve our leading level of service to our customers. We have not attempted to implement a complete WSZ smart water system before, so we want to carry this out as a trial, to gain learning to help us appraise the benefits for potential whole system smart water system in future AMP's. Our long-term delivery strategy (LTDS) core pathway includes a faster technology scenario which looks to complete a Smart water supply network by 2035. For further information please see our SSC02 South Staffordshire Water - long term delivery strategy. To support this and the water industry in general, we want to implement a full smart water system trial in our Outwoods WSZ to provide a proof of concept along with quantified outcome benefits. We propose to share these learning with an open data report to allow insights into benefits to provide the industry to make informed decisions going into PR29 on Smart water. We believe there will be great benefits for our customers through a smart water system.

> *"A Smart Water System is defined as an integrated set of data and digital capabilities (processes, products, and assets) designed to enhance operational performance, manage risk, and uncover new opportunities through intelligent decision making, learning and innovation."*

Smart water systems improve the efficiency, longevity, and reliability of physical assets by better measuring, collecting, analysing, and acting upon a wide range of network events. This impacts all aspects including customer interactions through pro-active messaging, reducing the impact on customers whilst carrying out daily operations, maintenance and changing the way customer assets interact with our distribution system. The ability to:

- Improve network planning is provided by allowing data from sensors and the network to identify key areas for prioritised works where customers supplies could be affected. With this knowledge, targets can be set accurately, investments planned, and challenges addressed in customer service, leakage, energy efficiency and regulatory compliance.
- Improve both customer and company assets to reduce the risk of causing network failure through how they operate i.e., causing pressures surges and transients

Smart Water Systems incorporate several works to allow the assets to be monitored and operated on a near real time basis to enable the business to make informed decisions around changes that maybe happening and provide a pro-active approach to customer service. Artificial Intelligence (AI) and Management Information (MI) will form a key part of decision making. The AI software is based on a set of human defined objectives that generate outputs such as content, predictions, recommendations, or decisions influencing the areas with which it is interacting with. Smart water systems connect different sources of data and include the areas detailed below.

Table 146 - Summary of expenditure required for the period 2025-2030 (AMP8)

Investment	Enhancement Investment	AMP 8 TOTEX £k	AMP 8 Enhancement OPEX £k	AMP 8 Base CAPEX £K	AMP 8 Enhancement CAPEX £k	NPV £k
Smart Water Trial	System Calming Including Customer Asset, Intelligent Control and AMI	£7,786	£0	£4,229	£3,557	£32,545

Our smart water trial will include both infrastructure and non-infrastructure assets, as well as assets of non-household customers that directly interact with the water network. This trial will be conducted in the Outwoods WSZ in the South Staffs Water Area. The trial will also examine the interaction of the Outwoods zone with the surrounding Castleway, Hanbury, and Winshill WSZs. It is expected that this trial will bring significant improvements to approximately 33,000 properties in the Outwoods area by providing:

- Improved interactions with customers through AI technology.
- Improve mains failures caused by pressure related events by 30-50%
- Improve interruptions to customers supply.
- PCC benefit (to be quantified during the trial)
- Carbon reduction by 6 – 8% by reduction in vehicle mileage and water production.

We are proposing to conduct a smart water trial to provide a step change to customer service. The smart water trial will provide proactive information to customers and enhance non-infrastructure, infrastructure, and non-household customer assets in the Outwoods zone. The trial will implement proposed enhancements based on an analysis of the zone conducted in 2022:

- Intelligent control systems on non-infrastructure and infrastructure
- Advanced meter infrastructure (AMI)
- Reduction in PCC
- Advanced trunk main metering and sensors
- Installing new enhanced system controls on non-Household users
- Artificial Intelligence linked to visualisation.

We will have a significant base expenditure to complete the trial in the Outwoods WSZ which is proposed to provide the following benefits. The trial will determine the full benefits:

- Reduction in energy costs by 6-12%,
- Surge protection
- Optimise and calm DMAs through new advanced Pressure Management Controls.
- Trunk main air valve replacement
- PCC data

Figure 109 – Smart Operations functions

5.3.2 Background Information

The strategic system is managed at individual WSZ level and the operation of water movement is carried out by "Control Room Assistants" (personnel managing the water network 24/7/365) who use subject matter experts for support.

The smart water trial will incorporate intelligent control systems and monitoring, whole system calming and AMI trials across the Outwoods Zone to provide a step change to customer service. A significant part of the trial is how we interact with NHH customer assets to manage the impact on our distribution network. The trial will impact the operation of the Castleway, Hanbury and Winshill WSZs. The delivery of the smart water trial in Outwoods will include several areas funded through base.

Following trunk mains bursts along the A38 dual carriageway between Birmingham and Derby that have occurred every two years on average, a study with a final report has been carried out to identify key issues. The trunk mains bursts have caused major traffic delays due to road closures along with Interruptions to Supply prior to isolation of the bursts. Options throughout the report have included replacement of existing trunk mains in comparison to network calming and intelligent systems. Pump controls and interaction of Customers assets against our assets have been reviewed as part of the report. It has been identified that to replace the trunk mains along the A38 would cost in excess of £9million based on a quote in 2013.

The study that was carried out in 2022 focussed on changing the way in which the system is operated from our assets through to customer owned assets. The study identifies a significant step change in several of ours and customer operations. The study has also identified where existing systems can be enhanced or expanded and this would be carried out as part of base. Combining the changes in both enhance and base will provide a change in the way the Outwoods zone operates and how we interact with customers. Benefits to customers that are being identified include:

- Pro-active customer communication through use of enhanced systems
- Reduction in interruptions to supply through system calming.
- Customers not seeing changes in water pressure during changes in demand.

- Reduction in transients occurring thus resulting in a reduction in burst occurrence.

The purpose of the smart water system trial is to determine the return on the investment to allow us to understand if this type of whole zone smart water systems can be rolled out across the whole of the company zones and provide maximum benefit to customers. The focus of the trial will be based on delivery outputs relating to the installation of these systems, including the benefits to customers allowing for a smart water trial report to be issued across the industry to provide shared learning. This will form part of our price control deliverable for this enhancement case.

An in-depth assessment has been carried out in 2022 on the Outwoods WSZ, engaging with third-party consultants PA Consulting (summary report findings can be found in section 6.4). In addition, intelligent system providers have been consulted to gain an insight into potential benefits through an integrated smart system. The objective of the analysis was to highlight base risks, needs and recommendations to improve the performance of our trunk main network, particularly the dual 18” CI trunk mains that run within the A38 dual carriageway. These critical dual trunk mains have had 12 failures since 1998, averaging out as a failure every other year, with the most recent failure in 2022. Outputs from this assessment have led to clear and substantial risks being confirmed. These risks have been translated into a baseline and have been loaded into our investment decision-making tool called Copperleaf. The investment goes through a valuing exercise to monetise the baseline risk associated with the investment. The recommendations and expected outcomes from the report has then been used to value a smart water trial in the Outwoods zone to mitigate against the baseline risks. Further information on our value framework can be found in our appendix, ‘SSC37 Our Asset management approach to best-value investment planning through 2025-2030 and beyond,’ sections 1.2 for our value framework and section 4 for our optimisation approach.

Outcome benefits are predicted to reduce mains failures by 30-50% which will have the added benefits to help reduce leakage, business demand, improve CRI, and supply interruptions. Most importantly our customers will receive a calm sustained service for the long term.

Outwoods zonal overview

The Outwoods WSZ is primarily supplied with surface water from the Seedy Mill treatment works (predominantly surface water treatment) and borehole water from the Fradley PS (Borehole source). There is an infusion valve that can provide water from the Barr Beacon WSZ if needed. All water inputs for the Outwoods zone come from the south. The water flows into a ring main system that extends from Lichfield to Burton-On-Trent and Outwoods Reservoirs. The Outwoods WSZ directly supplies two other zones, Castleway to the North, Hanbury to the West, and supports Winshill to the East.

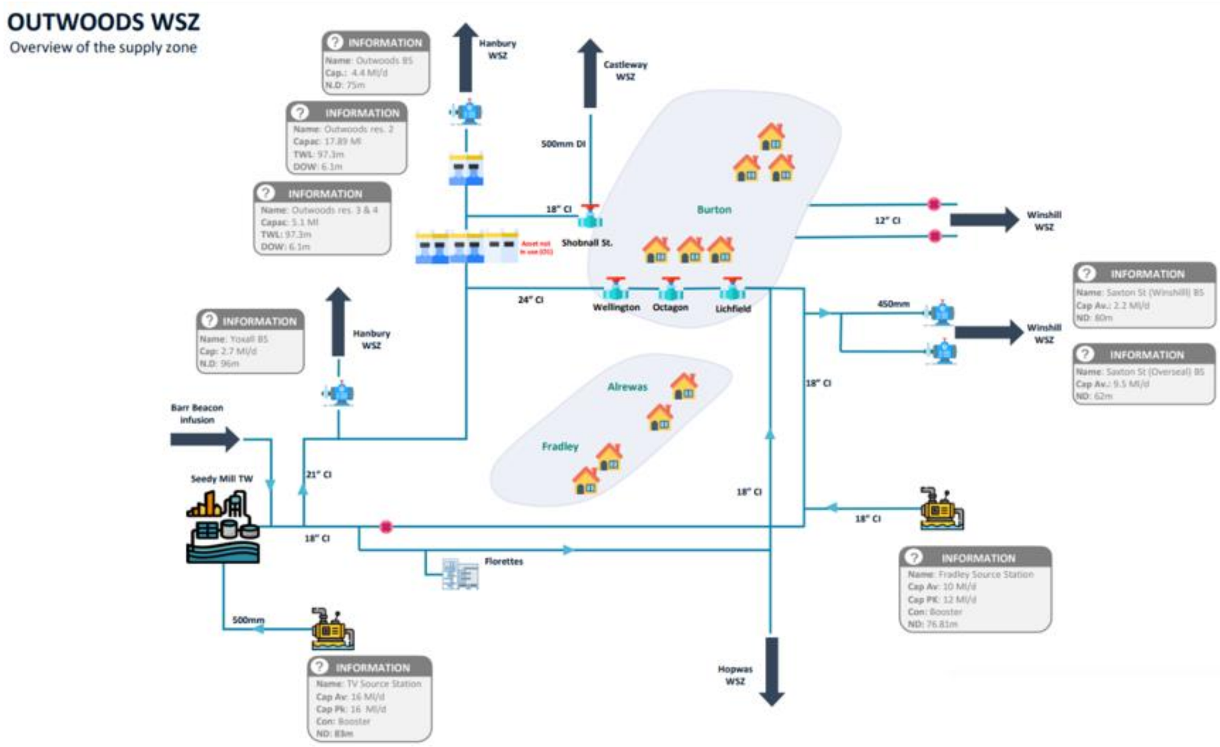


Figure 110 – Outwoods WSZ schematic

During **AMP 7** the business has commenced Smart Water System integration into the business. Areas of works that have been carried out during AMP 7 are:

Increased Sensor Penetration

During AMP 7 the business has installed WQ sensors to record turbidity, chlorine, and water temperature sensors at the inlet to 100 District Metered Areas (DMAs) to provide a signature of WQ. The outputs and benefits from the sensor show where water temperature changes the impact on assets from failure through to chlorine degradation. The effect on turbidity will be monitored from the trunk mains system and inlets to DMAs during seasonal demand changes during high and extremely low ambient temperatures to provide a more detailed insight into how the distribution system is reacting. Data from the sensors will flow into the Near Real time Network Models that we have begun developing during AMP7.

40% of our DMAs now have greater than 3 data loggers installed recording pressure, flow (where applicable) at 10-second and 15-minute intervals and water temperature at 15-minute intervals. This is an additional 1100 data loggers with various sensors attached. These are in addition to previously installed 2500 loggers across the company DMAS.

Acoustic data loggers are being installed monitored and moved as part of our current smart project. Outcomes from the loggers are showing leakage points of interest and pressure and flow variation because of a leakage sound. In the first 30 weeks of the 52-week trial 30l/s of calculated leakage has been identified with an average of 0.75 l/s per week. The forecasted savings was estimated to be at 16.7l/s over 52 weeks from the loggers that were installed as part of Lift and shift studies. From the permanently installed acoustic loggers 0.73l/s per week has been identified in a 39-week period.

The above data is being transferred using an application programming interface (API) which allow software to be integrated between each other into a Central Data Repository to ensure there is one version of the truth. From the Central Repository, links have been created to show all data loggers onto a Visualisation system.

Smart Networks has used intelligent data streams to help us and SME (a company who combine their extensive subject knowledge of water distribution network management with modern analysis and data science techniques and work across the UK water industry to deliver complex projects), United Utilities, Anglian and Severn Trent) identify potential leakage within District Meter Areas (DMAs)) in a new way. SME input data on consumption, pressure, and flow changes in

DMAs into their systems, along with information on Non-Household (NHH) businesses, types and number of households, religious festivals, bank holidays, school holidays, etc. These models are then trained and developed with more data from the companies in the project. The outcome of this process will identify potential leakage, potential genuine consumption that is not being accounted for in billing systems, and instances where the acorn classification (a demographic segmentation system) is incorrect for establishing demand profiles.

Visualisation

Following installation of the additional sensors we have commenced installing a single visual product to show all sensors in one single mapping function that is linked to the corporate GIS system. The visualisation system is proposed to allow all sensor data to be shown as a layer that is incorporated with customer contact data to enable a risk matrix against the response to an alarm to be developed. The visualisation system is planned to be viewable by both office and field worker staff to improve customer engagement when investigating potential problems on site.

Large display screens are being developed to show Outcome Delivery Incentives (ODI's) and other key performance indicators at our head office. The screens allow our Customer Operations Team and the Incident Team to interact directly and change what can be seen.

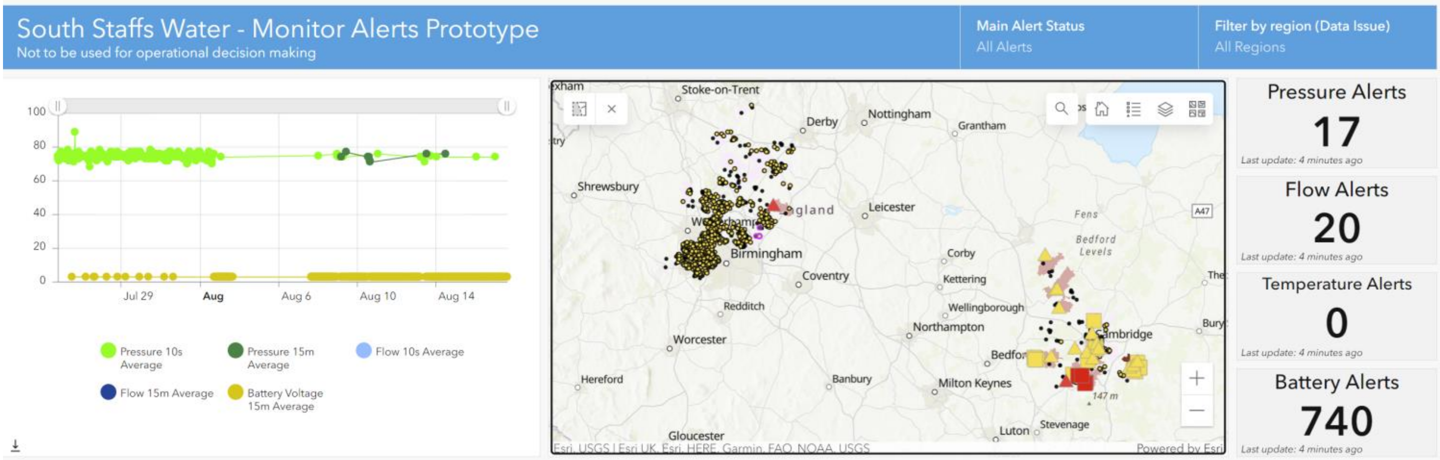


Figure 111 – Monitor Alerts Dashboard

5.3.3 Need for Investment

In AMP 8, we propose a smart water system trial to allow us to:

- Enhance our engagement with customers.
- Understand the benefits of zonal smart water system with a view to Companywide Smart Water System as part of the LTDS core pathway.

Outwoods WSZ has been identified for the trial smart water system due to:

- Impact of frequent bursts on A38 – financial, reputation and customer. Burst mains occurring in the A38 which is major route between Birmingham and Derby result in large traffic restriction. Burton On Trent has a large number of distribution hubs with employees travelling into the town and thus closures of the A38 affects local industry.
- The trunk mains have had non-destructive tests carried out and they have been identified as having a minimum of 40 years life remaining although have a high burst rate caused by transients.
- Large number of transient surge sources impacting on trunk mains captured by sensor data.
- Although Outwoods does not have the highest number of transient related bursts, the impact within the Outwoods Zone is impact is significant due to the criticality of the trunk mains and their location within the A38. They additionally feed into three other WSZs.

PA consultants “A38 Mains Investigation report” (Report summary can be found in section 6.4) has identified the risks, needs, and solutions. As such, we are now seeking to deliver a Smart water system trial to mitigation against these risks through the mechanism of enhancement and base funding of £7,786k.

The above required analysis of mains failure data, hydraulic data, and zonal level review of operations. This was done in collaboration with PA consultants and SSW subject matter experts. This has led to the successful conclusion of the investigation with a well evidenced root cause, clear findings and a series of actionable recommendations and solutions along with projected costs.

The following findings were made:

- The mains failure modes, data from recent non-destructive testing, hydraulic data and sensor data indicate that pressure transients are the most likely root cause.
- The Outwoods Zone has many potential surge sources / points of origin, which includes:
    - 27 Major Users (of which at least 8 have significant volumetric demands with on/off demand profiles).
    - Several SSW sites which appear to cause significant pressure events on stop/start on the network.
    - Several Non-Return Valves which are of unknown condition and function on the strategic trunk mains network.
    - Large PRV’s in differential modes of control.

None of the above in isolation is unusual in a distribution zone. However, what is unusual is the number of potential large transient surge sources (29 in total between the categories mentioned above). Therefore, to mitigate the risk of failure of the A38 trunk mains and improve performance, the zone will benefit from a smart water system approach.

Ambition

Our ambition is to a fully integrated and automated supply and distribution system at both strategic and DMA level. The system will use AI data alongside MSE data to provide a calm, cost effective, environmentally sustainable system.

Customer Asset Improvement

The Outwoods WSZ is experiencing an erratic oscillating demand from non-household (NHH) users. This demand is causing an unstable network, as observed through data sensors that record high accuracy and transients resulting in the control philosophy in the zone being problematic. In addition, there is no surge protection in place. As a result, burst mains occur, particularly on the A38 trunk mains, which burst on average every two years. The burst data suggests that these bursts are caused by transient pressure bursts. This instability and burst mains have a negative impact on customers, leading to a poor company reputation. These issues are partially caused by measures out of our control, specifically the actions of industrial users.

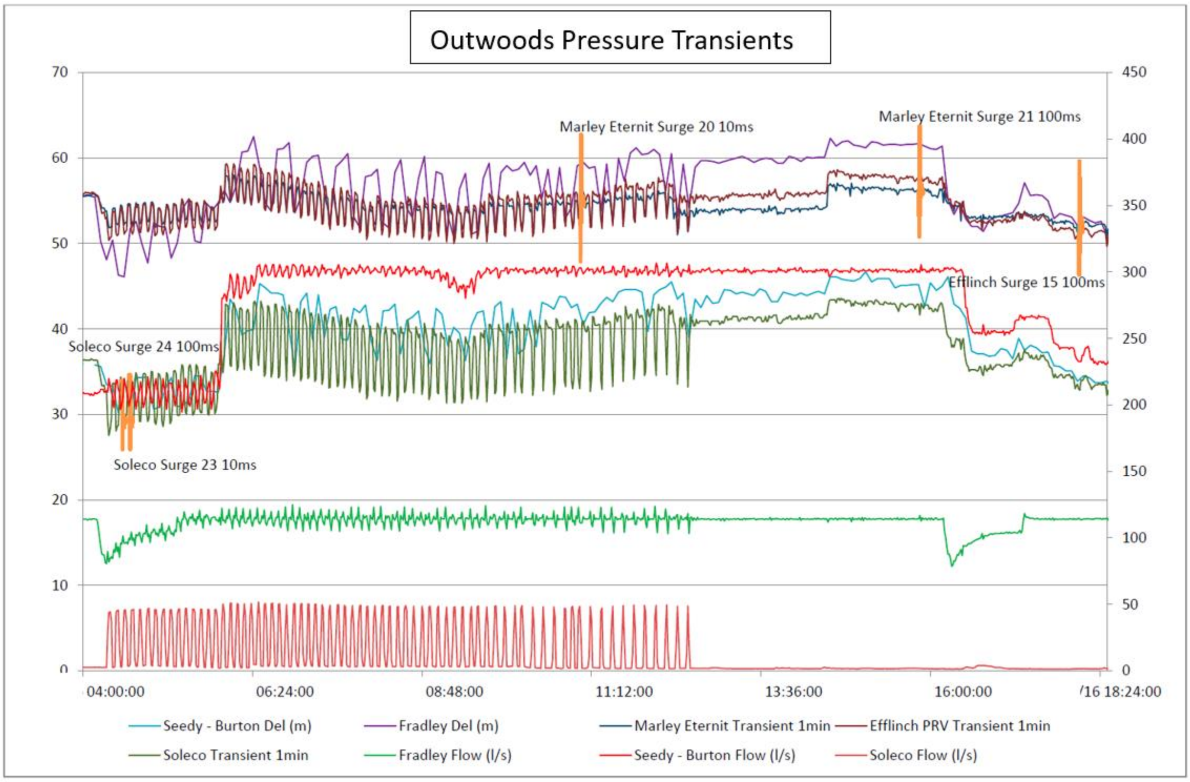


Figure 112 - Flow and pressure data

Figure 112 above shows various flows and pressure data where potential transient pressures are being produced. The red and green flows are our Seedy Mill WTW (red) and Fradley PS (green). You can see the flow is spikey along ¾ of the graph. The last quarter is somewhat smoother until Fradley PS trips. One large user in the area (soleco – illustrated with maroon colour, bottom line on graph) seems to have the overall impact on all flows and pressure sensors within the graph. When Soleco draw rapidly and stop rapidly it has a knock-on effect to the delivery pumps at our Seedy Mill WTW and Fradley PS pump controls. The pressure sensors downstream (Efflinch PRV and Marley Eternit) show a direct coloration with the spikey draw off from Soleco.

You can also see the impact Fradley PS has when it trips. There is a large pressure drop before the system then recovers. There is no surge protection at our sources within this zone with only the reservoir acting as a surge release.

Major stress on storage within the Outwood WSZ which also serves two other WSZs and supplements 1 other.

Burst mains are often because of a pressure transient caused by customer usage, operation of non-infrastructure and infrastructure assets within a zone and the area reacting to changes in pressure and resulting in large pressure variations in a very short time. Early trials have shown the calming of a network and maintaining a steady pressure state reduces the risk of bursts and damage to fittings, thus reducing customer contact. Low pressure contacts are the highest type of customer contact received by us and are often received during periods of increased demand.

There have been 12 failures over the last 25 years on the dual 18” CI mains that run under the A38 dual carriageway. This averages out as a failure every other year since 1998. Six of which were identified to joint failures and six to long fractures. Significantly there are no records of pin holes or circular fractures. All the failures since 2016 have been long fractures with most occurring on the southern section of the 18” mains along the A38 between Lichfield and Barton.

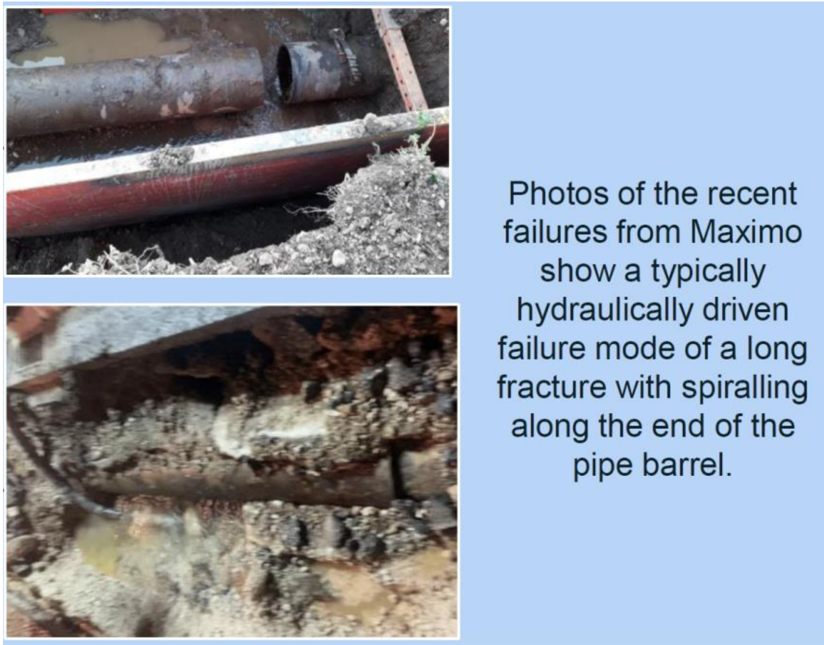


Figure 113 - 18" trunk main failures within the A38

Failure modes observed since 2016 (from records and photographs) are all long fractures consistent with positive and negative pressure events. There have also been recorded transient surges from loggers already installed on the network. Some of these transient events have been recorded as generating negative surge pressures which potentially explain some of the more catastrophic (end to end) failures.

A review of recent transient logger data has revealed numerous transient events occurring daily (magnitude not possible to discern 50hz logging required to verify).

Numerous sources identified from review of telemetry data undertaken on 16h March 2022:

- Out of the 27 large users in the Outwood zone, 8 have been identified which have significant rates of flow change daily.
- Interplay of Seedy Mill and Fradley seems to cause pressure instabilities along with one of the large non household users with no wider control interlocks across the network.
- Control valves (e.g., Outwood Res) are relatively quick open/close and not modulated.
- Numerous NRV reflux valves in unknown state, Air valve status uncertain

Failure of one of the 18" CI assets within the A38 dual carriageway in 2019 had the following impacts to customers:

- Approximately 6,000 properties with impacted service until the isolation was carried out within the 3-hour period.
- Major traffic impacts due to the A38 having to be closed due to flooding and to carry out repair.
- Danger to public with cars having to be abandoned on major dual carriageway.
- Flooding to properties.
- Major stress on storage within the Outwood WSZ which also serves two other WSZs and supplements 1 other.

5.3.4 Customer Support

Customer support

We have carried out our most extensive customer engagement programme ever to ensure our PR24 and WRMP24 plans are underpinned by robust customer and wider stakeholder preferences. Our strategic engagement programme started in early 2020 and has run through to summer 2023, with over 92,500 customers taking part in a wide range of SSC research studies, with their views being compared with those from our robust business-as-usual insight programme and wider industry studies. This programme has been assured by SIA Partners as meeting Ofwat's "high-quality" engagement standards, as outlined in its Customer Engagement Policy paper (February 2022) – see appendix SSC14.

A key evidence source is appendix SSC11, which provides a thematic review of the key areas relevant to this investment case. This report was compiled independently by our triangulation partner, Impact, drawing on a wide range of our and wider sector reports. The thematic review report also highlights the golden threads that have consistently emerged across our engagement and details the project objectives of each study used in the evidence base, when it took place and the numbers and types of customers and stakeholders engaged with.

When looking at the broader landscape and the areas customers prioritise that are delivered against by the investments outlined in this report, we see water quality, leakage, environmental and pressure management all feature as key priorities. There is a clear thread from our engagement towards customers (household and non-household) expecting us to prioritise investment to ensure a reliable high-quality, affordable service is maintained 24/7 and showing a Willingness to Pay to make these investments. Customers also expect further investment and innovation in infrastructure schemes to detect and predict problems to quickly fix and prevent any failures before their impacts are experienced, such as unexpected supply interruptions and the chance of property flooding due to a burst pipe.

Key customer evidence points to support this enhancement case include:

- A "reliable, high-quality supply" continues to be the number one priority for investment among our household and non-household customers – as evidenced in our Customer Priorities Tracker, which is a qualitative and quantitative study been running since October 2020. This study asks customers to express their preferences for the areas they want to see investment in, using a Max-Diff trade off approach free from information about bill impacts.
- This study shows that a reliable, high-quality supply, is one of two "super hygiene" areas, whilst ensuring that water bills remain affordable for all, highlighting the need for on-going targeted investment to deliver a high-quality service. It is important to highlight that "affordable bills" does not mean the majority of customer are expressing the view that they want cheaper water bills at the expense of a deteriorating service, but that water should be affordable given its an essential public service.
- The chart below evidences the priority customers place on this area, and when making their trade-offs in the max-diff stated preference exercise, with **58%** selecting a "reliable, high-quality supply" as the most important area for investment and only **6%** stating it was the least important area of the service attributes shown. There were no significant differences between our two supply regions of note, or within any customer segments for this attribute, highlighting the consistent response.
- Reducing leakage is ranked as the third most important area to tackle, with water pressure and sustainability issues rated with relatively less priority. However, all the 20 service areas tracked are viewed as important to customers in both the waves of qualitative research undertaken as part of this on-going engagement.

Importantly, customers priorities are now becoming more balanced over the 20 services areas tracked in the quantitative study, with environmental areas gradually becoming more important over time. However, customers still view having a reliable supply as a basic core service which SSC should be delivering to a high standard so that daily activities, such as drinking tap water, washing and cleaning, are not impacted.
There is also evidence that non-household customers, particularly those whose operations rely on a water supply, value this service area even higher given the impacts that a loss of supply or pressure can have on day-to-day business operations.

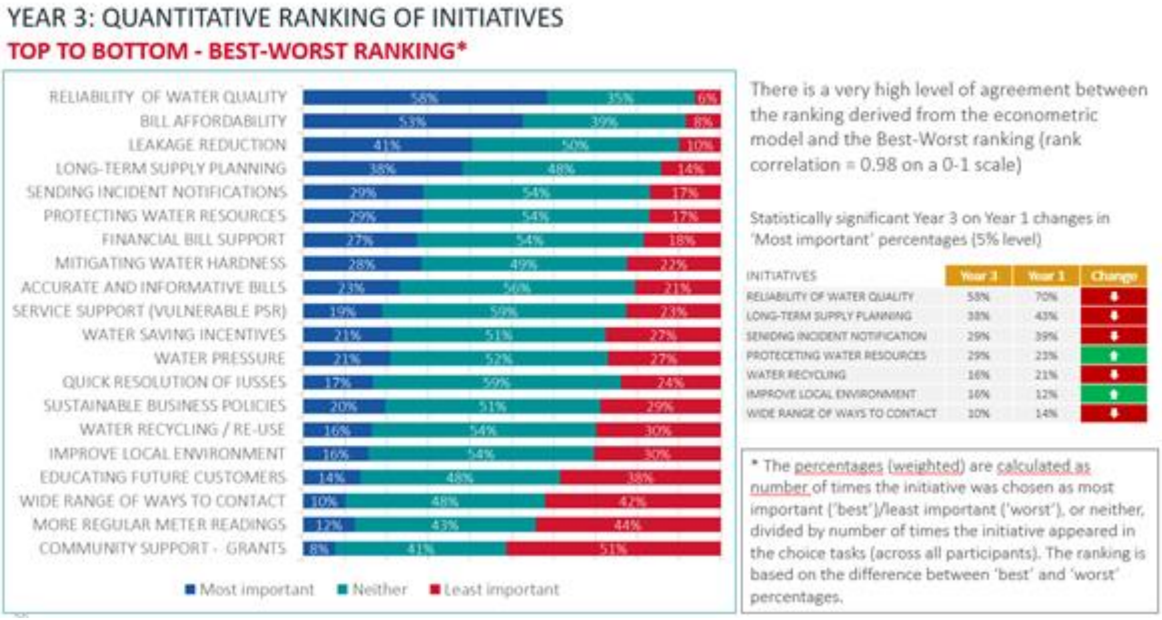


Figure 114 – Year 3: Quantitative ranking of customer priorities for investment

Source: SSC Customer Priorities Tracker, year 3 report, April 2023. Representative sample of 1,072 household customers (including 62 future customers.

The insights from our Customer Priorities Tracker for water quality and supply reliability were also seen in our Long-term delivery strategy (LTDS) customer engagement (*Turquoise, July 2023*), which involved a multi-stage research programme of qualitative and quantitative research. The chart below shows a summary of the research findings and highlight the strong and consistent level of support among all customer segments for SSC to deliver stretched ambitions for improving water quality and reducing supply interruptions. There is also evidence that many customers are expressing a preference for the company to deliver the targets put forward before 2050, although bill impacts to achieve this were not shown to them.

Figure 115 – LTDS research outputs on our water quality improvement ambition

Source: SSC LTDS Research, July 2023 report. Representative sample of 1,080 household and non-household customers (including 82 future customers).

We have also engaged with customers about their preferences for investment in smart technology up to 2050. This forms part of our wider engagement focused on underpinning decision in our Long-term Delivery Strategy (LTDS).
The latest round of qualitative engagement in our Customer Promises Tracker (Accent, May 2022) engaged household and business customers in focus groups, with a section introducing them to our 'Looking to the Future' visual to draw out views on our emerging long-term plan to 2050. Participants were asked to select areas they were most interested in for further discussion.

The image below summaries the feedback from customers on the technology vision in our 'Looking to the Future' document. It highlights the positive views customers expressed on the need for us to harness technology to help address their main concerns, such as reducing leakage, and spotting issues before they happen to reduce customer impacts and any wastage. Future customers, given they have grown up with mobile technology, were particularly drawn to this area of the plan, alongside the environmental areas.

There was also a clear difference between discussing short-term priorities (next 2-3 years) and long-term to 2050. This focused on the fact that customers were expecting to see much more use of imaginative, technological solutions such as predictable usage apps and real time/instant service support over time. The types of investments outlined in this report and the real-time insights they generate can then be made accessible to customers in a relevant and user-friendly way, so delivering on their expectations.

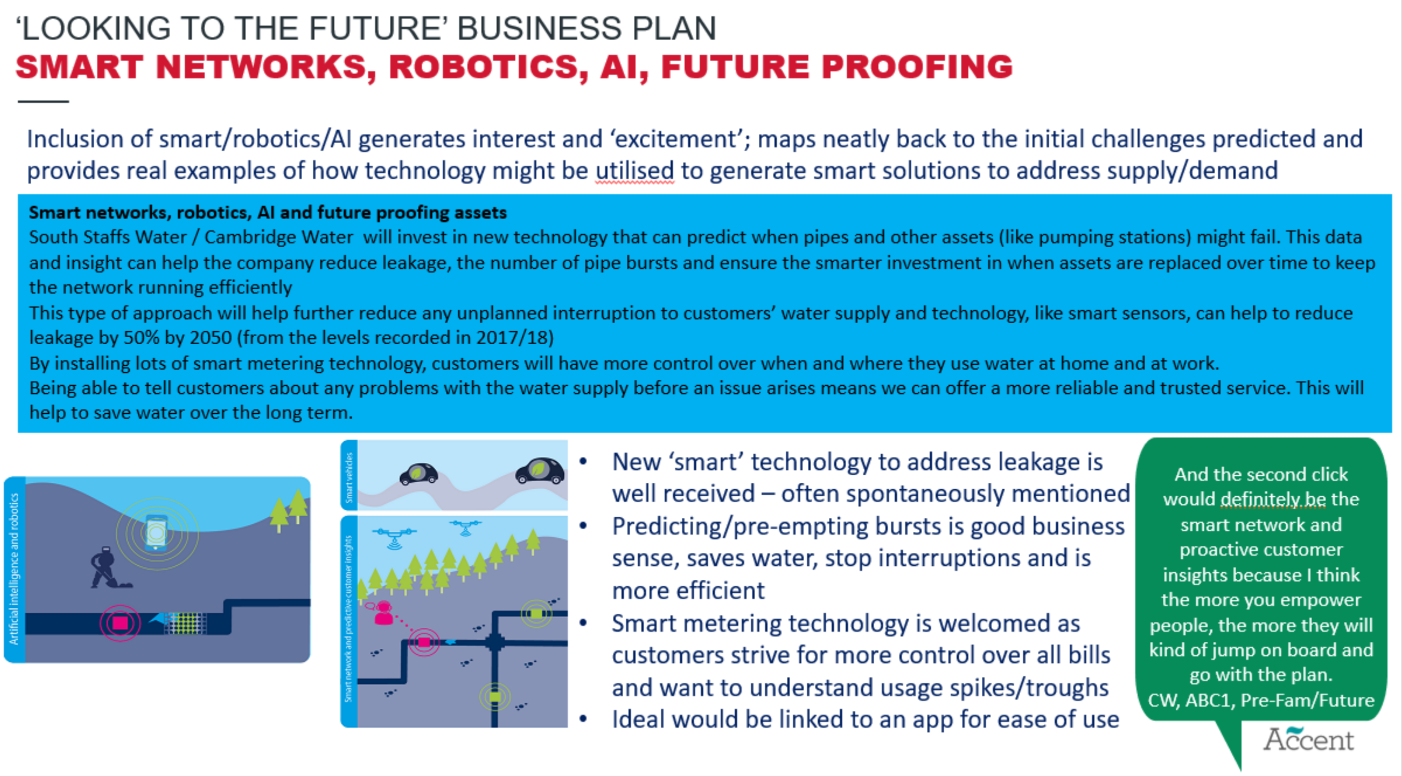


Figure 116 – Feedback on our Looking to the Future Strategy ambitions in our Priorities Tracker
Source: SSC Customer Priorities Tracker, qualitative wave 2 research, May 2022 report. Mixed sample of 27 current and future HH consumers and seven NHH SME) customers took part. Five depth interviews to reach elderly (75+) and financially vulnerable (social grade E) customers and five depth interviews with larger (50+ employees) NHH customers.

In our Long-term delivery strategy (LTDS) customer engagement (*Turquoise, July 2023*) we tested a pro-active service ambition with customers. Despite this being ranked towards the bottom of the list of the 10 ambition areas covered, the targets put forward attracted majority support across all customer segments – 75% for 2030 and 77% by 2050. For the reasons detailed in the image below, customers had mixed views over how far and fast we should invest to achieve being best in class in the context of the challenges the company faces. However, there was consistent support that investments need to be made to deliver a pro-active service. Again we saw future customers (18-24, non-bill payers) expressing a preference for faster investment in these areas, when compared to bill paying household and non-household customers.

Pro-Active Customer Service

To be the best performing company in the water sector for customer service by 2030.

To be the best performing company in the utilities sector (energy, broadband, etc) by 2050.

Bottom Tier
Priority Ranking

Workshops: 10th
Survey: 9th

South Staffs Water Cambridge Water

WATER SECTOR — 75%* Support the Ambition**

UTILITIES SECTOR — 77%* Support the Ambition

*Note that the 75% and 77% support figures used here is only from the workshops as this was not one of the five ambitions explored in depth in the survey.

The pro-active customers service ambitions were of low priority across the research. Participants felt that being ranked 4th out of 17 water companies (at the time) for customer service was impressive.

Unlike the Net Zero Carbon ambitions, this ambition was seen as a low priority across all three participant types.

For participants who saw pro-active customer service as a priority, the key reasons were: 'good customer service is essential', and that it leads to higher 'customer satisfaction / trust'.

*When do participants want the ambition achieved by?

TO BE THE BEST COMPANY IN THE WATER SECTOR FOR CUSTOMER SERVICE BY 2030

The 2030 target for this ambition was only supported by 27% of HH customers, 40% of future customers and 30% of NHH customers.

48% of HH customers want the ambition achieved between 2035 and 2050: 60% Future customers and 40% NHH customers.

TO BE THE BEST PERFORMING COMPANY IN THE UTILITIES SECTOR BY 2050

41% of HH customers want SSC to achieve this ambition before 2050. A similar proportion want (34%) SSC to achieve the ambition on target at 2050.

All Future Customers wanted SSC to achieve this ambition before 2050.

30% of NHH customers want SSC to achieve this ambition before 2050; 40% at 2050.

Considerations

Some participants felt that it was not necessary to be a leader or early adopter of new technology as it can be expensive at first, but the cost often decreases as it becomes more widespread. Therefore, it may not always be wise to be the first to embrace new technology.

Some participants also felt that 'it was easy' to improve customer service and they could do that before 2030 without investment in technology.

Low Income and vulnerable customers felt that Pro-active Customer Service should be more of a priority compared with other customer types.

Figure 117 – LTDS research outputs on our pro-active customer service ambition

Source: SSC LTDS Research, July 2023 report. Qualitive findings from eight workshop groups assembled in the water regions of South Staffs Water and Cambridge Water, each meeting twice, and covering a range of demographic groups – 52 household, future and NHH customers.

Moving on from the priorities customers have expressed, the robust PR24 valuation studies undertaken highlight clearly a theme that both household and non-household customers are willing to pay for investments to avoid service failures, when presented with bill impacts. This is true in both stated preference studies whose methodology focused on a Willingness to Accept (WTA) and Willingness to Pay (WTP) approach. Specifically:

- In Ofwat's Collaborative ODI Research (Summer 2022) an analysis of the results by PJM Economics from SSC's customer base who took part shows that 5 of the top 6 service scenario attributes in terms of Willingness to Accept £m valuations (Compensation Stated preference exercise) were related to water quality and supply interruptions, with unplanned interruptions of up to 24hrs attracting the highest valuation. This highlights that customers were placing a greater emphasis on paying for service failures to not happen for these areas.
- In SSC's PR24 Willingness to Pay Study (Autumn 2022) there was again a consistent theme of customers expressing higher WTP valuations for service attributes relating to resilience, namely avoiding burst pipes and do not drink notices. The table below highlights the range of valuations that were developed from our technical triangulation framework, which was developed to triangulate WTP values and wider insight sources to set central, upper and lower valuations for use in Cost Benefit Analysis (CBA). This framework was subject to a rigorous academic peer reviewed end-to-end and the valuations data sources challenged by our Delphi panel of expert stakeholders to help provide confidence in the WTP valuations used in Copperleaf. The framework was also given a Green (highest level) rating by SIA partners in its independent assurance of the technical triangulation approach developed for us by our partners Impact to inform PR24 investment decisions. As shown in the image (table 5.2 from the WTP report, Nera and Qa Research), for attributes expressed in per property WTP values, the highest valuations are for services attributes related to water quality and supply interruptions, namely damage from burst pipes and unplanned supply interruptions. See appendix SSC09 for full details of our technical triangulation approach and the valuation sets provided to us for use in Copperleaf to enable a range of sensitivity tests of customer preferences within Copperleaf.
- This is a consistent thread through from customer priorities through to valuations that provides robust evidence that customers support investments which deliver on improving water quality and reducing failures that can lead to service failure such as unexpected supply interruption and water quality issues. Ensuring no low pressure issues also attracted a notable set of triangulated WTP valuation.

Table 5.2: Values (per unit) to be tested in Copperleaf (High RAG ratings, HH and NHH combined, total SSC)

COMBINED SSC	ALL - HIGHEST Central value	LOW NERA AND ODI - ALL OTHERS HIGHEST Central value	NO NERA - HIGHEST Central value	PRE PR24 Central value	ALL - HIGHEST Lower value	ALL - HIGHEST Higher value
Water not safe to drink (per property affected)	£73,592	£27,985	£5,983	£1,510	£14,779	£303,914
Flooding from a burst pipe (per property affected)	£23,775	£10,102	£2,090	£1,064	£4,983	£85,550
Unexpected temporary loss of water supply (per property affected)	£3,369	£1,832	£4,573	£506	£674	£14,259
Water hardness (per property affected)	£484	£437	£404	£381	£98	£1,762
Taste and smell of water (per property affected)	£2,116	£1,166	£2,876	£520	£423	£7,030
Low water pressure (per property affected)	£1,185	£582	£1,612	£74	£237	£3,991
Lead pipes (per property affected)	£39	£40	£50	£42	£8	£89
Water metering (per customer)	£8	£10	£8	£10	£3	£20

Figure 118 – Valuation sets from our WTP triangulation approach used to sensitivity test customer preferences in Cooperleaf

In terms of use of business-as-usual insights, a key driver's analysis (Shapely regression) of the 800 survey responses in our 2023 Customer Promises Tracker highlights that "reliability of water supply" is a key driver of overall service and that household's customers who have not had to contact the company to report a service failure are significantly more satisfied with the overall service than those who have. This evidences that to deliver an overall positive experience to customers that this promise must be delivered on by us. This attribute has become a notably stronger driver of overall service since 2019/20, in part linked to the impact of the COVID pandemic when customers were spending longer periods at home due to lockdowns and impact and on-going in terms of the change of working habits.

This preference towards investment into reliability of service was further evidenced in our qualitative acceptability and affordability business plan research (June 2023, Accent Research). During the qualitative testing we followed the official guidance provided by Ofwat and CCW and tested our proposed and least cost plans to customers could comment on their acceptability and affordability. The image below is taken from the qualitative report and highlights that most household and non-household customers wanted increased spend beyond the mandatory/least cost plan to ensure investment into resilience schemes as they perceive that this will ultimately feed through into lower bills. Customers were informed the bill impact would be £22m during 2025-2030 with it clearly stated this would add £2.30 to the typical household bill per year, with non-household customers given a % figure.

Customers are clearly concerned and increasingly aware of the impact that our changing climate is having on water services infrastructure and have expressed a clear priority that important investments that provide resilience to these threats should not be delayed, but that it is very important for SSC to protect those customers who are struggling with paying their bills from the increases that will be required to deliver resilience investments.

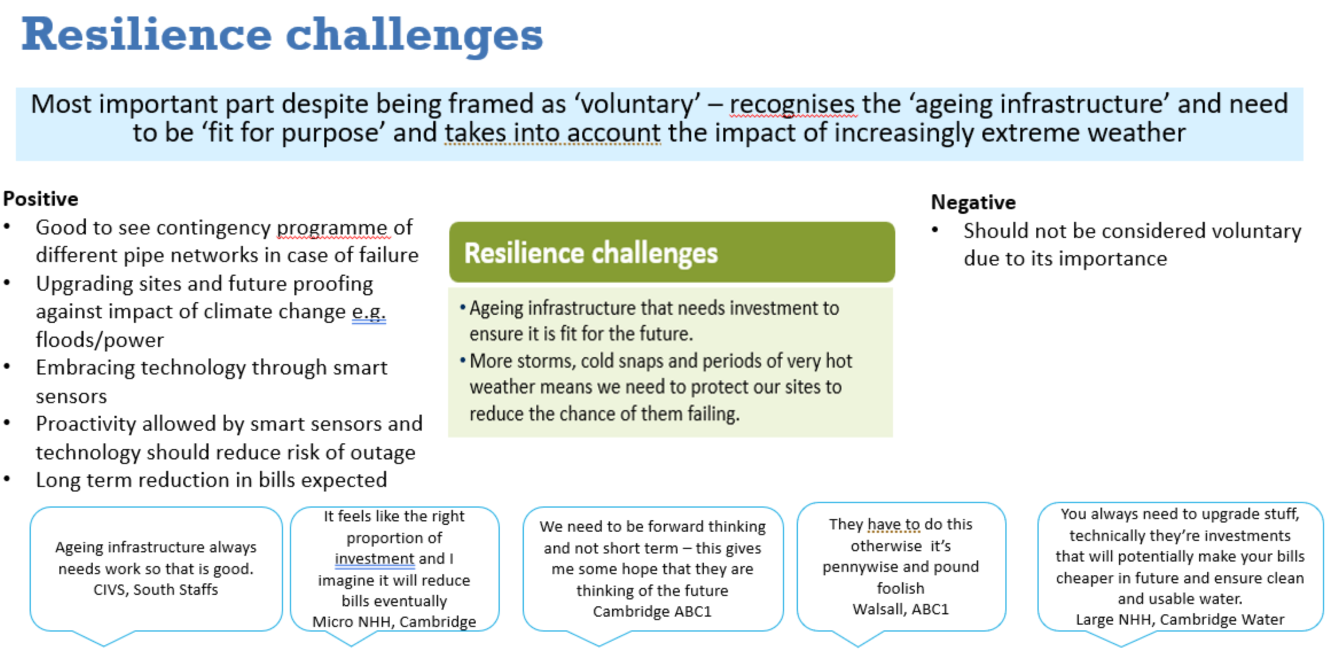


Figure 119 – Title needed and figure updated without red/blue lines

Again, following the Ofwat and CCW guidance in our quantitative testing of our proposed plan we found that 70% of customers found the investments and the associated bills to deliver them acceptable. Specifically, when asking customers to rate the three enhancement areas put forward in our business plan we find that reducing leakage attracts the highest proportion of votes when asked to select the most important. Overall, this feedback shows that our plan is targeting the right areas and highlights how important is it to ensure water is reduced any service failures minimised.

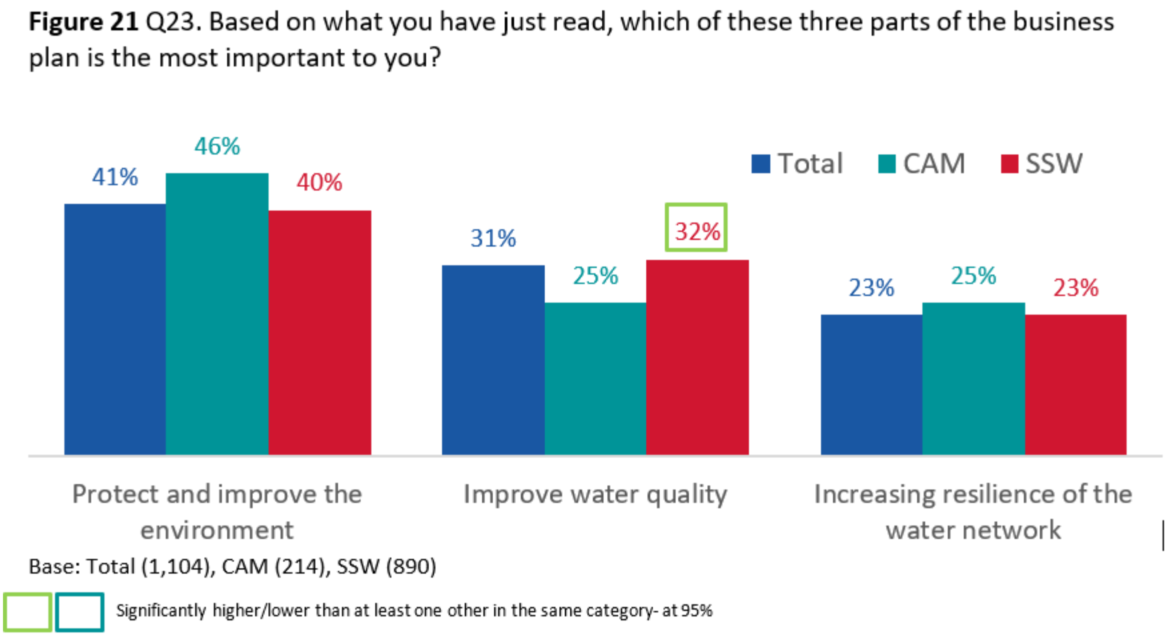


Figure 120 – How customers rated the importance of three enhancement areas in our quantitative PR24 AAT research

Metering customer insights

In terms of the investment case we put forward to shifting from basic to modern metering technology (AMR/AMI) we have engaged extensively with our customers at a local level and also with other water companies at a Water Resources East and Water Resources West regional level.

The key insights are summarised below which highlight, on balance, that shifting to smart meter technology is supported by our household and non-household customers:

- Majority of customers continue to say that metering is the fairest way to charge for water and as a tool to help customers save money on their water, and energy bills. This finding is consistent through all local and regional engagement, including the on-going discussion on our H2Online household Community.
- There is evidence that support for universal and/or smart metering increases when customers understand the future challenges around water supply, highlighting how important engagement and education is to help overcome any customer concerns around metering. Other top benefits attached to metering by customers include:
    - More control and awareness over usage
    - Helps protect the environment as can help reduce wastage.
    - Improved leakage detection to reduce wastage.
    - Automatically submits readings, rather than customers needing to take more readings than the frequency the water company takes readings. Most customers are comfortable with smart devices and relaxed about data sharing, if the right re-assurances, technology and clear communication of this is in place.
    - More accurate billing, removing the need for estimated reads appearing on bills.
    - Customers prefer fully smart meters (to semi-smart or non-smart meters) because of the data visibility and consumption data they would bring.
    - In particular, NHHs view modern meters as simplest way to become more water efficient – but raised the caveat that water companies support investment to enable this.
    - The benefits of modern meter technology are summarised concisely by our informed and engaged customers who took part in our deliberative sessions with our Water resources Advisory customers *(Community Research, February 2022).* It is clear across the engagement that the word “smart” has the potential to mean different things to customers (e.g. receiving an in-home display, frequency of reads, how the reads are taken) so clear communication of the benefits using language customers use is important.

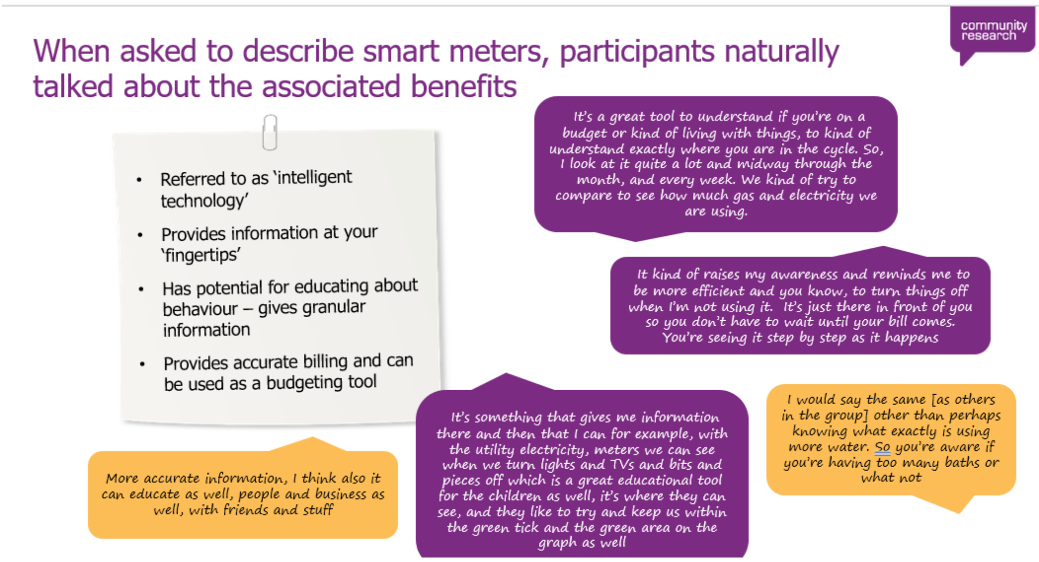


Figure 121 – Feedback about metering technology from our WRMP24 WRAP forum, focus groups

- In our quantitative WRMP24 study (Feb-Mar 2022, Accent) there was strong support for universal metering among households who are already metered, **71% in Cambridge region and 65% in SSW**. Over the whole customer sample, which was robust and representative, in the Cambridge region **59%** of customers supported universal metering, with 25% being neutral and only 13% against (5% said don't know). However, in SSW these figures were 44%, 28%, and 22% (7% don't' know) respectively. These findings, highlight the need for a robust engagement programme around metering given over 1 in 5 are against the policy change in the SSW region.
- There were consistent calls for new tariffs to be developed to enable customers to have choice and the ability to have more control over their usage and bills, as well as the need to have a robust package of support in place to help customers transition onto a smart meter, particularly those moving from unmetered fixed charges.
- Among those concerned about universal metering, particularly among unmetered customers, key reasons include:
    - Those who reject *water* smart meters tend to also reject *energy* smart meters – mainly as they don't see the benefit and doubt the savings.
    - Customers have the same concerns about smart meters as for metering in general - they worry about increased bills, especially larger or households with vulnerable customers, either from a financial perspective or from a medical perspective – such as conditions that are dependent of water for effective treatment – e.g. dialysis, Chrons. A small number of customers also pointed to smart meters having the potential to drive into unwanted behaviours, such as water rationing which can compromise health routines, such as bathing.
    - Meters might not always result in water usage behaviour change. Considered risky to rely on customers to monitor their own usage proactively, so clear advice and support mechanisms would be needed to ensure best outcomes.
    - Resistance to being forced to have a meter and taking away customer choice.
    - Some point to it not being acceptable to transfer any costs around smart meters to customers.
- Customers also expressed mixed views about how we should roll-out metering investments. In our quantitative WRMP24 study (Feb-Mar 2022, Accent) **38%** of customers wanted any roll-out of metering technology to be done in a way that minimises costs, with 27% saying it should be undertaken in a way that has the biggest impact on reducing water consumption quickly.
- Whilst there is broad support for universal smart metering, there are mixed views over how much customers are willing to pay for investment:

- The PR24 SSC NERA WTP for water services (October 2022) did not observe a positive WTP for installing smart meters, which seems to imply that many customers do not prioritise having a smart meter in their home, and/or that they do not want to pay extra to have one. Conversely, the Water Resources West (2023) synthesis report found most customers do support smart metering, including the universal roll-out. This was especially apparent when customers understood the future challenges around the water supply. However, this review noted that there is a lack of WTP data for smart metering, which is in line with the NERA results. These insights showed that customers in both regions were more mindful of price in relation to this attribute compared to most other attributes tested in the study. The lack of informed engagement allowed in a WTP survey may also mean that the full benefits would not have been communicated to customers as they are during deliberative discussions or more focused quantitative studies.
- This is evidenced to a degree, in a stand-alone test in our quantitative WRMP24 study (Feb-Mar 2022, Accent) where **37%** of household customers said they would not be willing to pay more to roll-out universal smart metering, but **54%** said they would pay more. There were varying levels of appetite in terms of paying more to complete the roll-out quicker, with most favouring a balance between cost and speed of roll-out.
- A level of conflict was also seen when customers almost universally told us that the current meter read frequencies we offer are not fit for purpose. As can be seen in the chart below, a meter read frequency of once a year in the SSW and twice a year in the Cambridge region, does not align with customers' preferences. However, when asked in the same study, **65%** said they would not be prepared to may more on their bill to enable more regular readings. However, **26%** said they would pay £2.50 a year more to have monthly/bi-monthly readings and only **11%** said they would pay £2.90 a year more to enable weekly/daily readings.

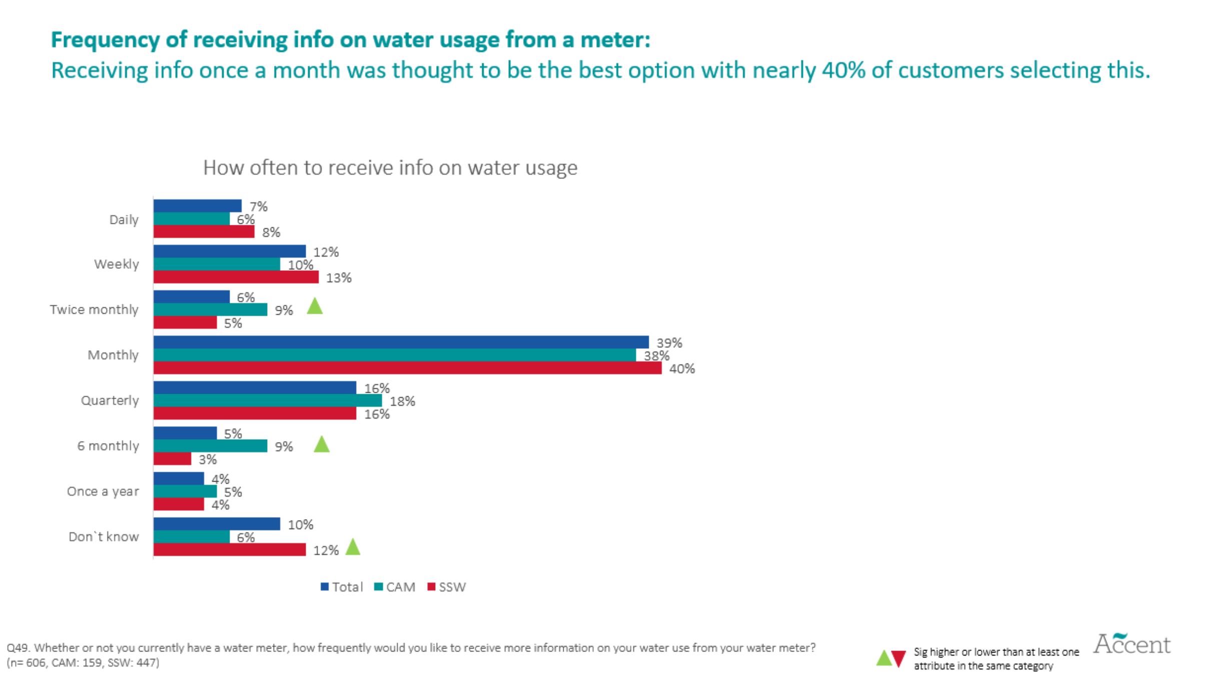


Figure 122 – customer feedback on preferred water meter read frequency, Themes 1 and 3 quantitative research

- When turning to preferences for metering technology, our deliberative sessions with our Water resources Advisory customers *(Community Research, February 2022)* found that customers were surprised that there was only a small price differential between roll out of Automatic Meter Reading (AMR) and roll out of AMI metering by 2040. Cost was a prevalent consideration, but once they were aware of the small additional costs of AMI as opposed to AMR, there was a strong preference for AMI. Also, customers felt that it made sense to introduce the most advanced technology and future proof the system and that the functionality and diverse benefits of AMI strongly appealed – participants spontaneously identify numerous benefits.

- Customer did raise concerns about AMI technology which we will need to address as part of our roll-out. The main themes were:
- Will the technology work (for individuals and rural communities)? and what happens if it goes wrong?
- Will consumers be able to switch back to basic meters if they are not happy?
- What data will be collected and are there ulterior motives for its introduction i.e., will prices increase?
- Will being able to see use in real-time be stressful for those who are struggling with costs?
- Will staff lose their jobs if manual readings are no longer required?

5.3.5 Best Option for Customers

We have undertaken an in-depth bottom-up build of our risks across our business. The bullet points below provide a brief overview of the process undertaken:

- Bottom-up risk capture with stakeholders across the business scored on a traditional 5x5 risk matrix.

- Appropriate high-risk schemes were then taken forward for longlist optioneering.
- Further analysis through a multi criteria assessment (MCA) took place to form a shortlist from the longlist solutions.
- Further value appraisals (CBA) were then undertaken.
- Optimisation of the AMP 8 portfolio was then undertaken to provide a set of schemes that will offer a best value plan for the financial constraints applied.
- Smart water system trial was picked during the optimisation process as part of our best value plan.
- A more detailed description of our methodology can be found in our appendix, 'SSC37 Our Asset Management approach to best-value investment planning through 2025-2030 and beyond, sections 3 and 4.

Enhancement CAPEX

The section below shows the Enhanced CAPEX and provides the predicted benefits what will be achieved upon delivery of the Smart Water System. We have reviewed several options as of part this enhancement case to identify the best option for customers. These include:

Table 147 - Solutions

Solution	Strengths	Weaknesses	Decisions	Rationale
Do Nothing	No Capex Costs	• Continued risk of Asset Failure • Continued risk of Increased customer impact • Highways Impact • Financial and reputational Impact • Customer and public perception	Discarded	If we do nothing it is expected that we will continue to have failures on the A38 every other year affecting the following ODI's Supply interruptions, Mains bursts, Financial, Legal, and Reputational Risk, Water Leakage, CRI, Increased Water Quality Contacts, Unplanned Outage.
Replace dual Trunk mains within A38 corridor	• New assets • Short Term gains in reduction of bursts	• Highway Impact • High Cost • Short Term investment	Discarded	The zone will still have current risk s that will reduce impact in the short term due to new assets, Long tern will still see failures
Install Smart Water System	• Extending current life assets • Improving customer engagement • Reduction on supply impact to customers • Information for future business planning • Full understand of how a system is operating from source to tap. • Understand full benefits prior to being locked into fill zonal installation. • Reduction in Energy Consumption	• Impact on NHH whilst installing new assets (full design unknown) • Impact on Non-infrastructure assets during changes to controls • Unknown quantifiable benefits	Adopted	• Long term solution to extend the life of assets. • Improved pro-active customer engagement. • Understanding customer behaviours • PCC calculation improvements • Smart water system intelligence

As identified in **Table 147** above the smart water system approach has greater benefits and provides a long-term approach to asset management and customer engagement. It is anticipated it would significantly reduce the likelihood of any further strategic failure in the zone at a cost of approximately £3,557,199 (Enhancement Capex) by the end of AMP8. When compared to the option of full or partial replacement of the 18" trunk mains that is within the A38 (2013 quote of £9,000,000) this is lower in terms of capex and with more and greater benefits.

In addition, we have been able to map a series of secondary benefits from broader system calming on the rest of the Outwoods Zone. This suggests there is a wider case for applying system calming across all zones (PR29). This is integrated in a broader smart water system strategy (inclusive of water quality monitoring and smart metering). This aligns with our long-term Delivery Strategy (LTDS).

In AMP 8 we are looking to quantify the benefits from the trial to allow informed decisions on the cost-benefit analysis of extrapolating smart water system across both of our Company regions in future AMPs.

The smart water system will have several trials taking place within the Enhancement case spend and these include the following:

- Customer Asset improvement – Working with NNH customers to install new smart system controls on their supplies.
- Intelligent systems controls – Installing intelligent systems control at both distribution level and strategic level including non-infrastructure assets will provide a step change for us and our customers. Intelligent control systems will do this using AI technology taking in data from several sources (weather, customer demand, PCC) and will provide a single visual overview with automatic changes taking place and will allow the network to operate in a calm manner avoiding large fluctuation in pressure eths enhancing the customer experience.
- Enhanced Strategic Network Monitoring – To provide data to allow the intelligent systems to be most effective and enhance our data set, an enhanced program of work within the Outwoods Strategic Network as part of this trial is proposed throughout AMP 8. This will provide enhanced data and decision making from the strategic network to improve how to operate and reduce risk when operating the strategic system. There will be specialist data logging systems not used by us previously installed to understand how the strategic network is performing. Examples of the specialist trunk mains system that we have engaged with are Syrinix and ATMOS. These companies specialize in trunk mains monitoring, AI data and providing insight into how trunk mains are performing. Linking this with the Variable Condition Discolouration Model (VCDM) provides a holistic view of trunk main operation By installing specialist sensors alongside trunk mains metering and linked to the near real time network models we aim to achieve a number of goals including:
    - The creation of a system to identify trunk mains that have not achieved the maximum potential flow velocity. Identifying operation at maximum velocity in turn allows for mains conditioning to be carried out using the work that has been developed with University of Sheffield and their Variable Condition Discolouration Model (VCDM) in an automated way. This would then reduce the risk of discolouration during times of peak demand.
    - Auto detection of potential leakage breakouts
    - Auto transient detection within the strategic trunks mains system.
- Advanced Metering Infrastructure (AMI) - During AMP 8 our WRMP focusses on increases our meter penetration and providing the opportunity to carry out remote reading. The WRMP program is to install AMI ready meters but read using AMR technology. AMI is an integrated system of equipment, communications, and information management systems to remotely collect customer water usage data in near real time and will send data as a minimum on a daily data transfer. Unlike AMR, AMI doesn't require personnel to collect the data.

  We are proposing to install up to 7500 AMI meters across discreet DMA areas of mixed type housing. The AMI meters will ingest data remotely and more frequently. The trials will provide a step change for us as we have not previously trialled full AMI metering. The AMI meter trials will enable us to focus on our metering strategy going forward by understanding:

- Customer behaviours in both HH and NHH and how their behaviours affect the operation of the distribution system and the intelligent network.
- Frequency of data exchange
- Ability to transfer data into our core billing systems.
- Ability to transfer data and use alongside leakage management data.
- Insight into customer behaviour to support in managing customer use i.e. PCC, debt provision,
- Vulnerable customer management
- Using Smart meters, Anglian Water identified 167000 customers leaks of which 138000 had been resolved equating to around 38 Ml/d.

Table 148 - Predicted benefits of Enhanced Smart Water System

Task	Enhanced CAPEX Costs	Benefits
System Calming including customer assets	£1,379,000	• Reduction in risk of A38 trunk mains failures • Reduction in customer impact within the Outwoods Zone • Reduction in transient pressure asset failures up to 30 – 50%
Intelligent System Control within Outwoods, incorporating exports from zone	£1,963,499	• Calm Network Operation • Enables better operational decisions. • Reduces pipe bursts. • Reduces capital investment costs of infrastructure. • Increases equipment lifecycle
AMI	£214,700	• PCC calculation improvements alongside leakage – 15-minute data from AMI indicates 6.2 % of population show continuous use of water indicating leakage whereas in 1 hour dial up (AMR) shows 12.9% of props have continuous flow indicating usage rather than leakage. • Ability to link to pressure and flow data to allow more accurate leak detection within DMAs. • Pro-active customer contact more quickly following detection of change in usage patterns. • Link to debt management • Future development on linking with energy bills and also feed through to wastewater company for calculating changes in demand patterns.
Total	£3,557,199	

Proposed Systems

To support in the smart water system a trial in which Intelligent System Control will be implemented using the SUEZ Aqauadvanced Energy Optimisation System and Royal HaskoningDHV Digital Aquasuite system. The enhanced benefits of us using these systems is to:

- Calm Network Operation – Using AI technology the system assets will maintain a constant pressure this reducing the risk of transients and providing a consistent pressure to customer properties.
- Enables better operational decisions – using AI technology will provide a step change in communication with customers and internal stakeholders.
- Reduces pipe bursts – Through mechanism of AI and installing new technology on NHH assets and Company Non-Infrastructure and Infrastructure assets.

- Reduces capital investment costs of infrastructure – In changing how assets operates is proposed to reduce fatigue on assets and reduce potential failures caused by transients.
- Increase equipment lifestyle – Through the use of AI technology, asset management of equipment will be carried out based on data provided and using the data allows for informed decision making and action based on plant performance.

High level benefits supplied by SUEZ regarding their system is shown below. This does include both enhanced and base benefits. The trial will provide further evidence into the full benefits of an intelligent system prior to AMP9 rollout across our remaining WSZs.

SUEZ - Aquadvanced

- Environmental Carbon Emissions / Energy Savings - Typically, SUEZ expect energy savings to be in the range of 6% to 12% with energy efficiency saving of some 6% to 8% based on the very consistent outcome from 32 previous implementations. SUEZ also note that energy costs have risen considerably since 2021 and continue to do so, leading to even greater cost benefits from load shifting and energy efficiency improvements. Consequently, the net CO2 “footprint” of the utility is correspondingly reduced.
- Water Quality Turnover - Aquadvanced Energy manages water quality in a number of ways. Turnover of water is generally desirable from both a water quality point of view and to maximise energy savings. The Aquadvanced Energy ‘target cycler’ module is designed to change the targeted fill level of each reservoir throughout the week (or any given number of days). Different storage tank strategies can be applied throughout the year to achieve operational requirements without sacrificing energy cost savings.
- Pressure Management - Aquadvanced Energy can adhere to pressure constraints by using its integrated hydraulic model to determine network pressures in a feedback loop.
- System Calming - Aquadvanced Energy uses its integrated hydraulic model to determine the effects of its scheduling on system pressure and will adjust its schedules in response to the feedback from the hydraulic model. This means the software can be configured to remain within specified pressure limits and/or maintain critical pressure points within the water network.

Intelligent System Control Operation is as per below:

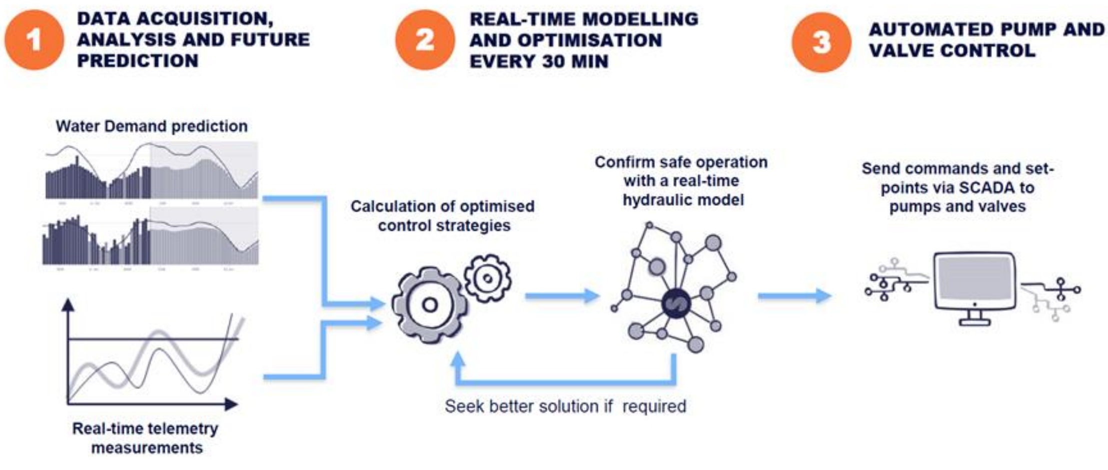


Figure 123 – Intelligent System Control Operation

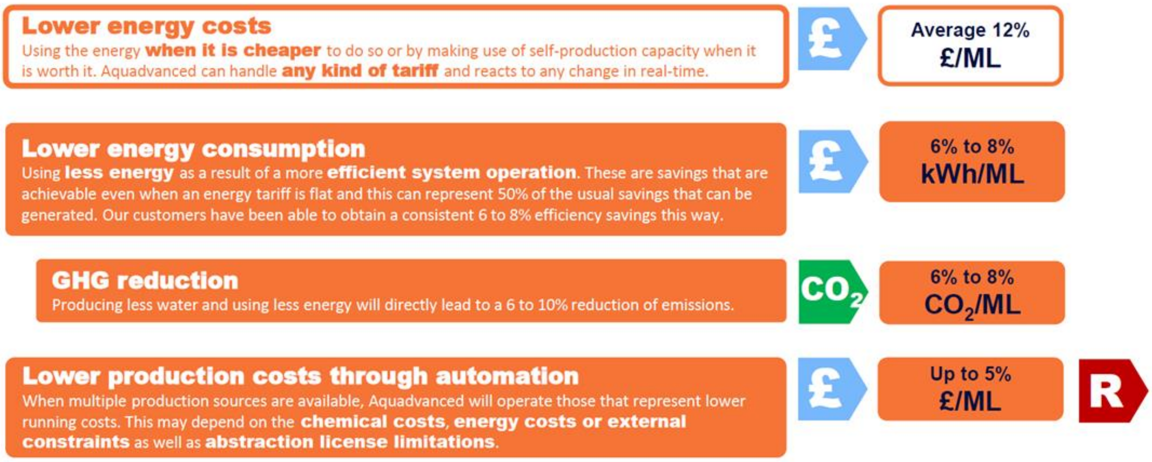


Figure 124 – Energy Impacts

Table 149 - Base Expenditure

As part of the Smart water System there are key areas that will be funded through base.

Task	Base Costs	Benefits
System Calming including customer assets	£1,337,500	• Forecast 26% reduction in average pressures where it is installed • Night to Day pressure savings • Data provided by i20 and is based on average data from other company data
Intelligent System Control within Outwoods, incorporating exports from zone	£2,891,210	• 6 – 8% Energy Savings forecasted by Suez – to be confirmed as part of trial • Improves produced water quality • Minimizes operational effort • Enables better operational decisions • Reduces pipe bursts • Reduces capital investment costs of infrastructure • Increases equipment lifecycle
AMI	£56,250	• Linking AMI data through to billing system direct from Diehl Portal where it is used • Further enhanced use of Diehl Portal for reporting
Total	**£4,228,710**	

Proposed Systems

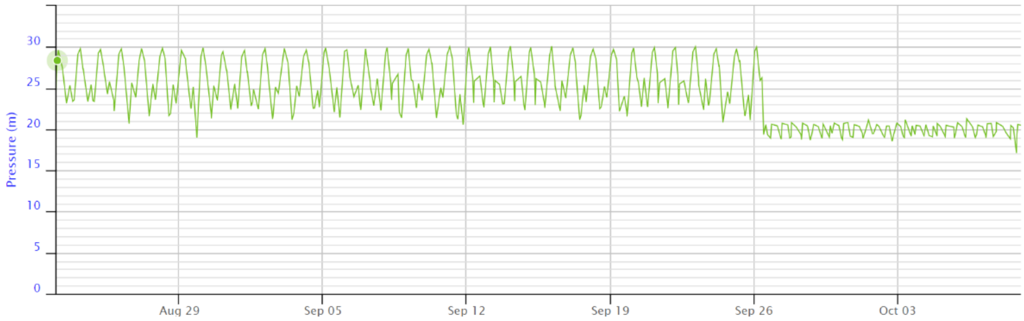


Figure 125 – Energy Impacts

Figure 125 above shows before and after an **i20 intelligent controller** was installed. The increased pressure variation to the left of the graph is what was seen prior to the intelligent controller being installed. The pressure is calmer with less fluctuations following installation.

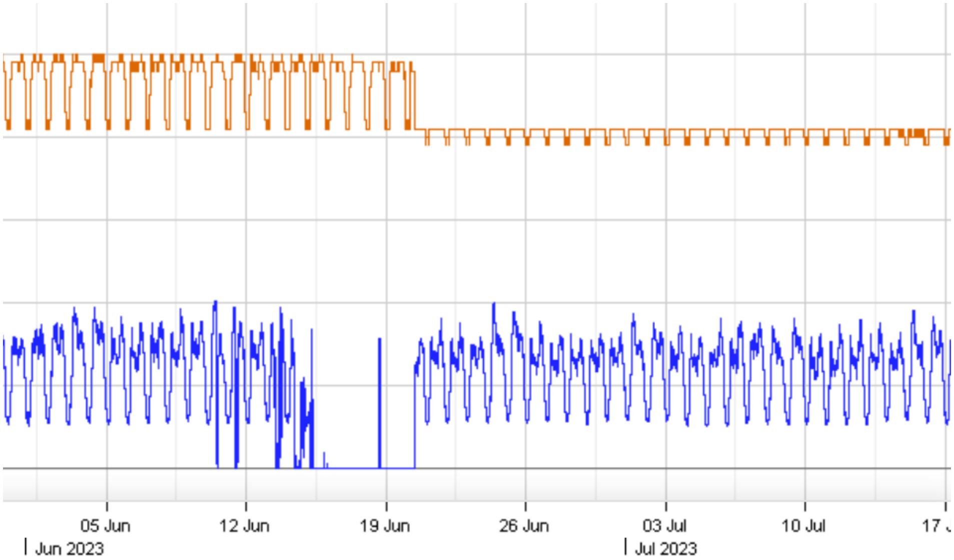


Figure 126 - Regulo pressure control

Figure 126 above shows where a **Regulo pressure control** was installed on a DMA that previously received direct booster pump pressure. The upstream pressure was controlled at a pump. Variation in pressure was around 15mhd and with a basic control was reduced to 2mhd. The graph does not show a significant reduction in the nightline for flow as the minimum pressure was not reduced.

As part of the smart water system across the Outwoods Supply System, calibrated network models are used to identify trunk mains flows using DI and DMA data. However, the models are calibrated at a point in time and not near real time. Using near real time modelling and Digital twins the ability to understand and see changes in patterns within the network can be seen more quickly. To enhance the models requires increased near real time and specialist data from the trunk mains system and additional sensors.

Benefits of a Smart Water System funded through Base and Enhancement

SSC is using an investment decision making support tool called Copperleaf to house investments and ultimately turn them into a deliverable and affordable plan for customers. The system itself uses multiple components to achieve this through a process called optimisation. The system uses a value framework made up of more than 20+ value models that allow the business to capture risk and value against categories that are pertinent to the business and its customers. Further information on our value framework can be found in our appendix, ‘ SSC37 Our Asset management approach to best-value investment planning through 2025-2030 and beyond,' sections 1.2 for our value framework and section 4 for our optimisation approach.

It is predicted that a smart water system trial in the Outwoods zone would reduce between 30 – 50% of transient driven bursts based on the analysis and report. This would be a 15% reduction in overall bursts for this WSZ. This would have predicted benefits to Supply interruptions, Mains Bursts, Financial, Legal, and Reputational Risk, Water Leakage, CRI, Increased Water Quality Contacts, Unplanned Outage, Operational Carbon, Embodied Carbon and Environmental.

Table 150 below provides the net present value for a smart water system trial produced from our Copperleaf system based on the predicted benefits from the PA consultants A38 report.

Table 150 NPV

Options	Description	NPV (£k)	Enhancement CAPEX Cost (£k)
1	Smart water system trial	£32,545	£3,557

Using a conservative approach to reducing transient related failures, a 30% to 50% reduction in these failures would achieve a 9% to 15% in overall burst rate with add benefit of reduced totex and ended network asset life. In addition, there are number of secondary benefits such as reduced leakage, improved CRI and interruptions to supply performance.

As an example, the 2019, 2021 and 2022 events combined (all long fractures) resulted in a total impact of over 2 minutes per property with a service impact. The innovative solutions would look to mitigate against these risks in a very diverse zone.

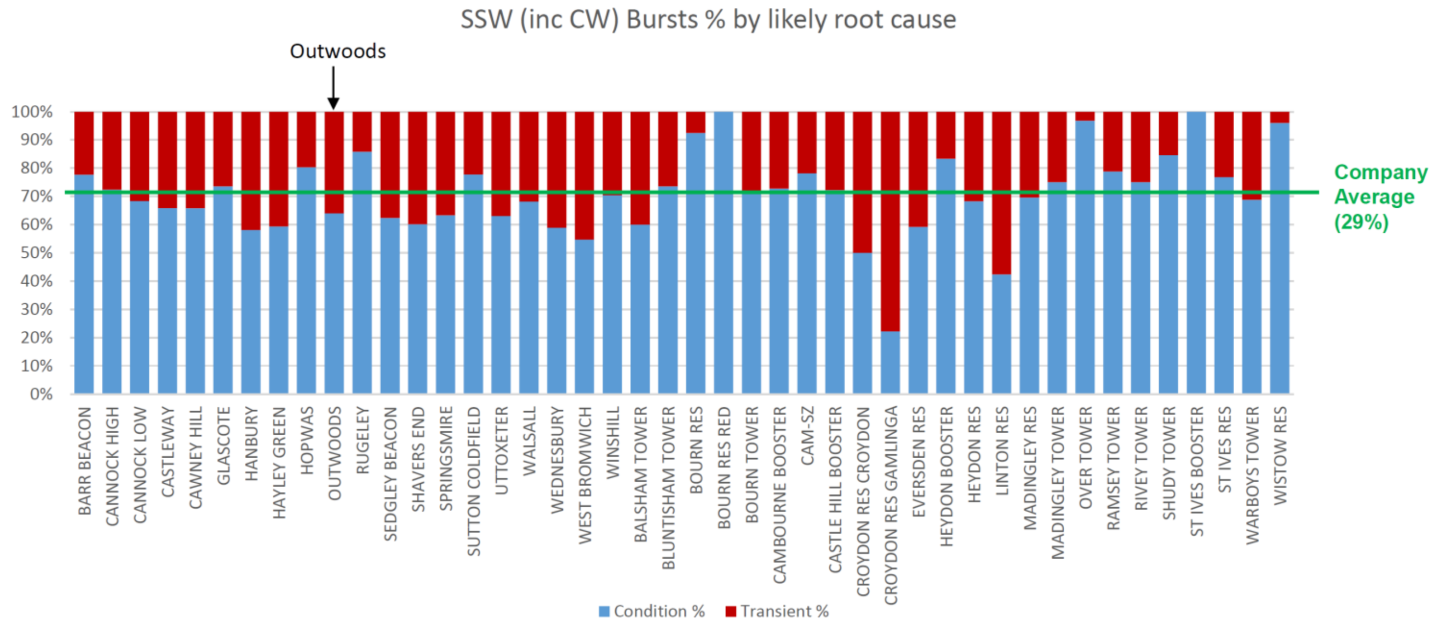


Figure 127 - Burst mains by WSZ's

Figure 127 above shows the mains burst percentage split between transient related and condition related asset failures across South Staffs and Cambridge region WSZs. You can see that Outwood is above the average but is not our most affected zone. The big difference is the impact incurred to our customers when there is an asset failure on our trunk mains in the A38 corridor in the Outwood zone. This is why we want to address the issue in AMP 8.

Table 151 - below shows the overview of Enhanced Capex and Base spend forecast for AMP 8 to implement a Smart Water System trial in Outwoods Zone.

Table 151 – Enhancement Expenditure

Investment	Enhancement Investment	AMP 8 TOTEX £k	AMP 8 enhancement OPEX £k	AMP 8 Base CAPEX £K	AMP 8 enhancement CAPEX £k
Smart Water System	System Calming Including Customer Assets	£2,716,500		£1,337,500	£1,379,000
	Intelligent Control, trunk mains intelligence, design, install and Project Implementation	£4,854,709		£2,891,210	£1,963,499
	AMI	£214,700		£0	£214,700
Total		£7,785,909	£0	£4,228,710	£3,557,199

5.3.6 Cost Efficiency

Where costs are available for carrying out the work these have been stated within the tables. Costs are based on quotes received when proposing the works, extrapolation of quotes, framework agreement costs and actual current costs.

Some assumptions have been made based not being able to gain full costs for some areas and some costs are based on knowledge from previous projects from SMEs.

Quotes received: create table for unit costs.

SUEZ – Quote received from SUEZ for installation and 1 year of support and licence as parr of installation. The quote was for a similar area and operation in CAM region and therefore costs have been used from this quote.

Royal HaskonivinDV – Quote received from Royal HaskonvinDV as part of a proposal for both CAM and SST regions. As we are carrying out a trial within SST region and not the whole of the region the cost to install and operate from the CAM area has been used as this will have similar make up as Outwoods Trial Area

Both above costs will be confirmed by framework agreements with both companies.

Specialist monitoring for trunk mains - Quotes received from Syrinix, previous costs from Flexim for clamp on meters =x and costs have been extrapolated from the quotes to provide calculations for building into the enhancement paper

Frameworks costs

Technolog – We currently hold framework agreements with Diehl, Technolog and Hydrosave. All purchase and install costs will be as per the framework agreements.

Cost for the overall PMO office have been calculated across the areas to ensure the Smart Water System is fully managed during installation. Costs are:

PM based on current market rates – £65,000 per annum for 1135 working days over 5 years.

Data Analyst - £30,000 per annum for 454 working days for 2 years

Business Analyst - £45,000 per annum for 454 working days for 2 years

Enhancement Costs

Table 152 - Total scheme cost (Enhancement)

Enhancement Capex £	AMP 8 enhancement Opex £	Total AMP 8 enhancement Totex
£3,557,199	£0	£3,557,199

5.3.7 Customer Protection

Customers will be protected against non-delivery of the Smart water system trial enhancement investment by committing to a Price Control Deliverables (PCD). The PCDs that we are proposing are to be grouped based on our enhancement case themes. The proposed enhancement investments within this case will come under the Smart Water system trial PCD. More information on our PCD's can be found in section 1.5.

Smart water system trial PCD – The Smart Water system trial PCD requires the deliverable of an open data report on a full smart water system. The scheme doesn't meet the materiality threshold for a PCD, but we want to apply a PCD as we believe it will provide a platform for which informed decisions can be made within the water industry for the future. The report will provide insights into a Smart water system and the quantified benefits for customers.

Table 153 - Smart water system trial PCD

Smart water system trial PCD	
Description	Smart water system trial in the Outwood's supply zone to quantify the benefits of a smart water system.
Output measurement and reporting	The output of this PCD will be through the mechanism of an open data report on the quantifiable benefits of a smart water system. The forecasted deliverable is set out in the table below. Delivery of the open data report should be published in the first quarter of year 4 of the control period (June 2028).
Assurance	Independent third-party assurance to confirm completed milestones
Conditions on scheme	We don't propose any late delivery penalties on this scheme as it does not meet the materiality threshold for a PCD. We do however want to apply a PCD as we are confident, we can deliver the project and feel it will deliver insights for the water industry to make informed decisions on the benefits of a Smart water system looking into future price control periods.
PCD payment rate	Non-delivery by the end of the control period will be applied where the project hasn't been started within the control period. We will return the full enhancement funded amount for the specific scheme **plus** the time value of money back to our customers. The time value of money will apply the appropriate rates for the period required.

Deliverables	Unit	Forecast deliverables				
		2025-26	2026-27	2027-28	2028-29	2029-30
Smart water system trial	Open data report				Open data report	

5.3.8 Delivery

This section should be read in conjunction with Section 6.4 'Delivering a high quality and ambitious business plan' of SSC01 Securing your water future – business plan 2025-2030.

1. Smart water system trial
    a. These works will be delivered partially under the Non-Infrastructure Assets Delivery Framework with installation and programme changes to non-infrastructure sites carried out under this framework. The works will also partially be partially under the infrastructure asset Delivery Framework where there are changes required to infrastructure to allow connectivity to the intelligent systems. In addition, standalone contracts will be put in place for providers of the intelligent control system. Existing Framework agreements are in place for logger providers.
    b. The projects covered under existing frameworks would be either direct allocation with price verification or mini tender competition depending on supply chain programme workloads and capacity.
    c. Clear guidelines on ROI to be set out in contract and will include.

   i. Delivery of energy savings or penalty clauses
   ii. Delivery of a calm / sustainable network

d. Setting up relationships through retail market for NHH customer to upgrade their systems to reduce transient impact.
e. Use of existing framework agreements with IWS for upgrades of pump where required.
f. OT to deliver on SCADA changes using direct staff or pre-arranged contractors using framework agreements.

2. Advanced Metering infrastructure (AMI)
   a. Use of existing DIEHL contract to enable additional infrastructure to be brought online in line with Section 2.3 Smart Metering
   b. Areas to be chosen to be developed internally by Leakage Strategy, Customer Delivery and Metering Strategy alongside data provider.
   c. Standalone contracts will be used where through trials it is identified there is opportunity to use different providers for communications.

6. Annex – Supporting Information

6.1 DWI Support notices

We append in this section the formal notices of support received from the DWI. This has been received following submission of our evidenced risk and proposed investment solutions through the sector wide engagement process carried out by the DWI at PR24.

Set out in the same order as the enhancement cases in this appendix, the following schemes have received the support:

6.1.1 Cyber Security – DWI REF SST01 – OT Network and System Security

Drinking Water Inspectorate
Area 1A, Nobel House
17 Smith Square
London SW1P 3JR
Enquiries: 0330 041 6501
E-mail: DWI.Enforcement@defra.gov.uk
DWI Website: www.dwi.gov.uk

DWI reference: NIS SST_01 V2

20 September 2023

Andy Willicott
Managing Director
South Staffordshire Water Plc
Green Lane
Walsall
West Midlands
WS2 7PD

Dear Mr Willicott

Periodic Review 2024: South Staffordshire Water Plc

DWI Scheme reference: NIS SST_01 - OT (Operational Technology) Network and System Security Enhancements

Final Decision Letter – Support Proposed Scheme

The Inspectorate has completed its detailed assessment of the schemes proposed by South Staffordshire Water Plc to achieve 'green' for all Contributing Outcomes in AMP8. The proposed schemes include deployment of network monitoring devices; implementation of access controls to HMI devices; user authentication and access controls at the PLC level; and installation of data diodes to prevent lateral movement within the OT network. The schemes are proposed to secure or facilitate compliance with the Network and Information Systems Regulations 2018 at all drinking water assets. A summary of the outcome of our assessment of this scheme is attached.

Based on the information submitted by the company, the Inspectorate **supports** the need for this scheme, and the supported scheme shall be included by the company in its Final Business Plan, subject to the caveats listed in the attachment.

6.1.2 Security and Emergency Measures Directives (SEMD)– DWI REF SST01 Physical Security

Drinking Water Inspectorate
Area 1A, Nobel House
17 Smith Square
London SW1P 3JR
Enquiries: 0330 041 6501
E-mail: DWI.Enforcement@defra.gov.uk
DWI Website: www.dwi.gov.uk

DWI reference: SEMD_SST_01

25 August 2023

Mr Andy Willicott
Managing Director
South Staffordshire Water Plc
Green Lane
Walsall
West Midlands
WS2 7PD

Dear Mr Willicott

Periodic Review 2024: South Staffordshire Water Plc

DWI Scheme reference: SEMD_SST_01 - Physical Security - Risk Review

Final Decision Letter – Support Proposed Scheme

The Inspectorate has completed its detailed assessment of the scheme proposed by South Staffordshire Water Plc to ensure compliance with the security standards within the Security and Emergency Measures Direction 2022 at various sites listed in submission (and associated assets as applicable). A summary of the outcome of our assessment of this scheme is attached.

Based on the information submitted by the company, the Inspectorate **supports** the need for this scheme, and the supported scheme shall be included by the company in its Final Business Plan, subject to the caveats listed in the attachment.

Consequently, a blank section 19 Undertaking schedule template has been attached to this letter for the company's review. I would be grateful if the company could add measures as appropriate, to this template and send the completed template back to DWI.Enforcement@defra.gov.uk by 30 November 2023.

6.1.3 Nitrates – Morden Grange Pumping Station, Cambridge – DWI REF SST8

Drinking Water Inspectorate
Area 1A, Nobel House
17 Smith Square
London SW1P 3JR
Enquiries: 0330 041 6501
E-mail: DWI.Enforcement@defra.gov.uk
DWI Website: www.dwi.gov.uk

DWI reference: SST8

31 August 2023

Mr Andy Willicott
Managing Director
South Staffordshire Water Plc
Green Lane
Walsall
West Midlands
WS2 7PD

Dear Mr Willicott

Periodic Review 2024: South Staffordshire Water Plc

DWI Scheme reference: SST8 - Morden Grange Nitrate - Nitrate

Final Decision Letter – Support Proposed Scheme

The Inspectorate has completed its detailed assessment of the scheme proposed by South Staffordshire Water Plc to install ion exchange treatment to secure or facilitate compliance with the nitrate standard for drinking water quality reasons at Morden Grange WTW (and associated assets as applicable). A summary of the outcome of our assessment of this scheme is attached.

The detailed assessment considered the outcome of the risk assessment report(s) dated 01 March 2023, that was submitted to the Inspectorate as required by regulation 28(1) of the Water Supply (Water Quality) Regulations 2016 (as amended) for Morden Grange WTW (and associated assets as applicable).

Based on the information submitted by the company, the Inspectorate **supports** the need for this scheme, for water quality reasons, and the supported scheme shall be included by the company in its Final Business Plan, subject to the caveats listed in the attachment.

6.1.4 Enhanced Disinfection – Various Sites, South Staffordshire – DWI REF SST9

Drinking Water Inspectorate
Area 1A, Nobel House
17 Smith Square
London SW1P 3JR
Enquiries: 0330 041 6501
E-mail: DWI.Enforcement@defra.gov.uk
DWI Website: www.dwi.gov.uk

DWI reference: SST9 – letter 2

13 September 2023

Mr Andy Willicott
Managing Director
South Staffordshire Water Plc
Green Lane
Walsall
West Midlands
WS2 7PD

Dear Mr Willicott

Periodic Review 2024: South Staffordshire Water Plc

DWI Scheme reference: SST9 - Disinfection Resilience - Resilience

Final Decision Letter – Commend for Support

The Inspectorate has completed its detailed reassessment of the scheme proposed by South Staffordshire Water Plc, following the submission of additional information and evidence. The scheme is to provide upgrades to the disinfection at 6 water treatment works, by the installation of ultraviolet disinfection to secure or facilitate compliance with the wholesomeness standard for drinking water quality reasons at Cookley, Maple Brook, Pipe Hill, Fulbourn, Great Chishill and Great Wilbraham water treatment works (and associated assets as applicable). A summary of the outcome of our assessment of this scheme is attached.

The detailed assessment considered the outcome of the risk assessment report, that was submitted to the Inspectorate as required by regulation 28(1) of the Water Supply (Water Quality) Regulations 2016 (as amended) for Cookley, Maple Brook, Pipe Hill, Fulbourn, Great Chishill and Great Wilbraham water treatment works (and associated assets as applicable).

This was the second submission of this scheme, following additional information that was sent by the company to the Inspectorate on 11 September 2023.

Based on the new information submitted by the Company, the Inspectorate now **commends for support** the proposals to Upgrades to the disinfection at 6 water treatment works by the installation of ultraviolet disinfection and we agree that the proposals should be included by the Company in its Final Business Plan. We consider that formal enforcement action and putting in place a legal instrument is inappropriate at this stage.

6.1.5 Manganese – Bourne Vale Pumping Station and Sutton Coldfield WSZ, South Staffordshire – DWI REF SST2

Drinking Water Inspectorate
Area 1A, Nobel House
17 Smith Square
London SW1P 3JR
Enquiries: 0330 041 6501
E-mail: DWI.Enforcement@defra.gov.uk
DWI Website: www.dwi.gov.uk

DWI reference: SST2

31 August 2023

Mr Andy Willicott
Managing Director
South Staffordshire Water Plc
Green Lane
Walsall
West Midlands
WS2 7PD

Dear Mr Willicott

Periodic Review 2024: South Staffordshire Water Plc

DWI Scheme reference: SST2 - Sutton WQZ Manganese - Manganese

Final Decision Letter – Support Proposed Scheme

The Inspectorate has completed its detailed assessment of the scheme proposed by South Staffordshire Water Plc to install manganese removal treatment and carry out downstream network cleaning to secure or facilitate compliance with the manganese standard for drinking water quality reasons at Bourne Vale WTW and Sutton Coldfield WQZ (and associated assets as applicable). A summary of the outcome of our assessment of this scheme is attached.

The detailed assessment considered the outcome of the risk assessment report(s) dated 01 February 2023, that was submitted to the Inspectorate as required by regulation 28(1) of the Water Supply (Water Quality) Regulations 2016 (as amended) for Bourne Vale WTW and Sutton Coldfield WQZ (and associated assets as applicable).

Based on the information submitted by the company, the Inspectorate **supports** the need for this scheme, for water quality reasons, and the supported scheme shall be included by the company in its Final Business Plan, subject to the caveats listed in the attachment.

6.1.6 Antimony – Fradley Pumping Station, South Staffordshire – DWI REF SST3

Drinking Water Inspectorate
Area 1A, Nobel House
17 Smith Square
London SW1P 3JR
Enquiries: 0330 041 6501
E-mail: DWI.Enforcement@defra.gov.uk
DWI Website: www.dwi.gov.uk

DWI reference: SST3

31 August 2023

Mr Andy Willicott
Managing Director
South Staffordshire Water Plc
Green Lane
Walsall
West Midlands
WS2 7PD

Dear Mr Willicott

Periodic Review 2024: South Staffordshire Water Plc

DWI Scheme reference: SST3 - Fradley works antimony - Antimony

Final Decision Letter – Support Proposed Scheme

The Inspectorate has completed its detailed assessment of the scheme proposed by South Staffordshire Water Plc to provide a new borehole source to secure or facilitate compliance with the antimony standard for drinking water quality reasons at Fradley WTW (and associated assets as applicable). A summary of the outcome of our assessment of this scheme is attached.

The detailed assessment considered the outcome of the risk assessment report(s) dated 01 February 2023, that was submitted to the Inspectorate as required by regulation 28(1) of the Water Supply (Water Quality) Regulations 2016 (as amended) for Fradley WTW (and associated assets as applicable).

Based on the information submitted by the company, the Inspectorate **supports** the need for this scheme, for water quality reasons, and the supported scheme shall be included by the company in its Final Business Plan, subject to the caveats listed in the attachment.

6.2 Atkins cost estimation for Grafham Pipeline

Member of the SNC-Lavalin Group

Option Information

Option name	**Third party potable water transfer: AWS grid main crossing West to East through CAM area of supply (26Ml/d) with AWS main cost included and blending WTW plant.**		
Option ref	CW24-75D Opt 2	**Previous ref**	None
Scheme Type	External import of potable water bulk supply/transfer		
Concept	Cross-connection from AWS new strategic pipeline to Cambridge network north of Longstanton with a supply of 26Ml/d, inclusive of AWS main cost and a blending plant.		
Links to other options	Dependencies: None Exclusivities: CW24-75A, CW24-75B and CW24-75Ci. Each sub-option represents the same water source just at different DO sizes; therefore, these options are exclusive.		

Screening decision	Peak option	Drought option	Resilience option
Constrained list	N/A	N/A	N/A

DO BENEFITS	Low	Best	Extreme
DYAA Ml/d	-	26 Ml/d	-
NYAA Ml/d	-	26 Ml/d	-
DYCP Ml/d	-	26 Ml/d	-
Reasoning behind DO (Ml/d) selection	AWS advised a provision of available surplus DO from the new proposed strategic main – 3 sub options have been progressed at this stage while AWS undertakes detailed modelling which will advise CAM on the final DO output available and which sub-option to progress to design stage.		

Background	AWS are understood to be considering construction of a new strategic pipeline running from their existing Grafham WTW to a new strategic reservoir at Rede, that is being constructed adjacent to an existing distribution reservoir at Rede. This main is expected to run through the north of Cambridge and will therefore intersect existing CAM supply mains.
Option description	A cross-connection will be constructed where the new AWS strategic main from Grafham to Rede (west to east) intersects the existing CAM supply mains; this will notionally be located approximately 2km north of Longstanton (538850, 267802). The infrastructure required for this option includes: - 750m of 700mm diameter cross-connection pipework has been included in this option for variable allowance and costing purposes due to the uncertainty of the final AWS strategic main location. - 8000m of 1000mm diameter cross-connection pipework to the AWS strategic main. - The pipework will be equipped with a flowmeter and pressure reducing valve (PRV) - Land compensation for the pipelines Work is ongoing to assess indicative requirements and will be priced separately. Further work, including review of customer research outputs, will determine whether this additional treatment element will be included at a later stage of the option's development. A review of water quality of the receiving network, and of the bulk import of potable water has indicated that additional treatment, in the form of breakpoint chlorination, is required on the imported potable water from AWS, prior to mixing with the existing CAM network to make the two treated waters compatible. To read the full water quality assessment, please refer to document 5211472-ATK-RP-7.14.2-112. The infrastructure required for breakpoint chlorination includes: - Chlorine contact tank (516 m^3) - Sodium Hypochlorite dosing rig and storage (26 Ml/d) - Land requirement (600 m^2)

Asset Pricing

The below data has been used to input into the costing methods for this option:

	Assets required for pricing	Method for pricing assets applied
Raw water source	N/A *Potable water is being provided by AWS.*	
Treatment	- Chlorine contact tank (516 m^3) - Sodium Hypochlorite dosing rig and storage (26 Ml/d) - Chemical Dosing and storage kiosk building (75 m^2)	WRC TR61 method and tool applied.
Distribution	- 750m 650mm pipeline (costed at 700mm) - 8000m 1000mm AWS pipeline contribution - Flowmeter - Pressure reducing valve (PRV)	WRC TR61 method and tool applied. Unable to represent in TR61, cost method applied from costing report (5211472-ATK-RP-7.9-074)
Land	Linear land compensation for: - 12,750m^2 of pipeline - Land requirement for treatment site (600 m^2)	Unable to represent in TR61, cost method applied from costing report (5211472-ATK-RP-7.9-074)
Power	- Assumed connection to local power connection.	

6.3 Atkins treatment optioneering for Grafham Pipeline

The Water Resource Management Planning 2024 (WRMP24) identified a preferred plan of importing surface water as soon as 2028 to maintain the Supply Demand Balance (SDB) within the Cambridge region. This import is expected to come from Anglian Water's (AWS) new trunk main from Grafham Water Treatment Works (WTW) to Rede service reservoir. This report investigates the potential water quality risks associated with a surface water import of 15 Ml/d produced at Grafham WTW into the existing CAM ground water supply area, and suggests potential control measures to manage compliance and customer acceptability risks.

To assess water quality risks associated with the proposed bulk import to CAM, water quality data from Grafham WTW and two of Cambridge Water's supply zones has been reviewed. The UKWIR Blending tool was used to identify risks associated with substituting or blending this surface water into the CAM network.

- The water quality analysis indicates that both sources are moderately hard and potentially scale forming according to corrosion indices. However, a corrosion index (Larson ratio) suggests the Grafham water could be more corrosive to ferrous pipes.
- The residual disinfectant in the Grafham import is chloramine whereas the CAM network uses free chlorine. It is not industry good practice to blend these two residual disinfectants and chemical conditioning is normally required to make them compatible.
- Substituting surface water for a ground water source carries a risk of customer contacts due to the aesthetic change (taste & odour) associated with the higher organics concentration in surface waters.

Two blending scenarios were agreed for the import of Grafham water to CAM - a surface to ground blend ratio of 81:19 and 71:29 – which will depend upon the infrastructure arrangement to bring the water into the CAM network, together with a complete substitution. Following a review of water quality risks associated with these two blend scenarios, it has been identified that the risks are similar.

Three potential solutions to manage water quality risks have been evaluated against technical and financial criteria:

1. No chemical conditioning when introducing the surface water into the CAM network. Two sub-options were assessed for this approach:
    a. Blending surface water with ground water in the existing CAM network.
    b. Introducing surface water into either a new discrete supply zone or to an existing discrete supply zone so that the two sources do not blend.
2. Chemical conditioning to make the two water sources compatible in terms of residual disinfectant (either breakpoint chlorination of Grafham water or ammonia dosing of CAM water).
3. Intensive treatment to demineralise Grafham water and then remineralise (and add free chlorine) to broadly match the CAM water quality.

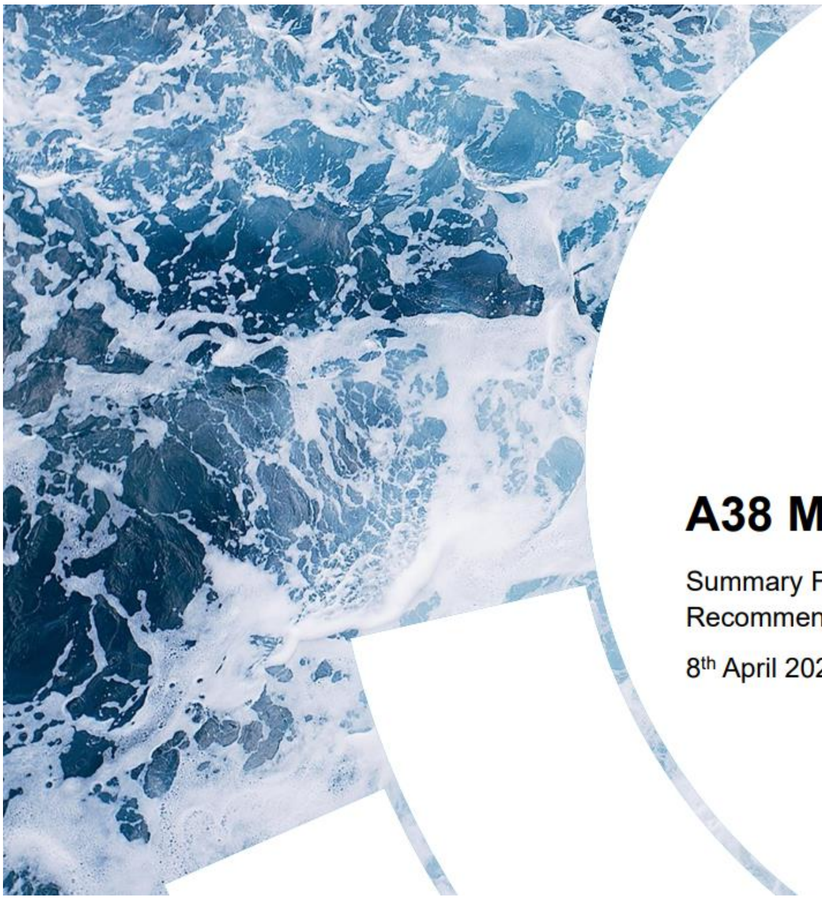
The table below summarises the assessment carried out in this report against the possible solutions for 15 Ml/d.

Option	CAPEX (£k)	OPEX (£k/year)	Embodied Carbon (tonne)	Operational Carbon (tonne)	Recommendation
1a	-	-	-	-	Not recommended due to the risk of customer contacts caused by dichloramine and trichloramine formation through uncontrolled blending in the network.
1b	-	-	-	-	Not recommended due to reduced resilience and unlikely that zone demand utilises the available 15 Ml/d.
2	1,646	38	56	5	Recommended if sufficient funds aren't available for Option 3 as it offers the best balance of cost and water quality risk.
3	9,808	1,600	178	454	Should offer lowest water quality risk but at very high cost and carbon.

Option 2 is recommended as it offers the best balance of cost and water quality risk, whilst maintaining network resilience and flexibility. For all options, pro-active customer engagement and a management plan for the introduction of surface water into the existing CAM ground water network would be required to minimise any customer acceptability risks. The following are considered next steps to progress:

- Undertake water safety planning to capture risks and control measures;
- Develop the preferred connection configuration to determine treatment solution location;
- Liaise with AWS regarding possibility of receiving un-ammoniated water from Grafham WTW;
- Begin customer engagement;
- Undertake corrosivity trials;
- Undertake chlorine decay and breakpoint chlorination trials.

6.4 PA A38 Mains investigation report



A38 Mains Investigation

Summary Findings and Recommendations

8th April 2022

Bringing Ingenuity to Life
paconsulting.com

Executive Summary: Background and Findings

PA Consulting were commissioned by South Staffordshire Water to undertake an assessment of the root causes of a series of repeat failures of a trunk main on the A38. Importantly, this assessment also included reviewing the potential enhancement cases for replacement of the main or an alternative solution at PR24 or beyond. In order to achieve the above within a 4-week timescale, the following activities were undertaken:

- Activity 1: Independent review of historical failures/incidents of the asset
- Activity 2: Independent review of recent incident (chronology and response)
- Activity 3: Review the diagnostics of failures observed (identify likely root cause)
- Activity 4: Review options to remedy / reduce risk based on root cause
- Activity 5: Identify other similar assets/risks on the rest of the network
- Activity 6: Provide outline recommendations on:
  - Potential enhancement case (long term solution if required, otherwise management of the risk within base allowances)
  - Outline of operational improvements and low-cost risk mitigation (short to medium term solutions)

The above required analysis of mains failure data, hydraulic data and zonal level review of operations. This was done in collaboration with SSW Subject Matters Experts (SMEs) at bi-weekly meetings. This has lead to the successful conclusion of the investigation with a well evidenced root cause, clear findings and a series of actionable recommendations.

The following findings were made:

1. The root cause of mains failures is highly likely to be transient surge pressures and is unlikely to be asset condition driven. The mains failure modes, data from recent non-destructive testing and hydraulic data all suggest transience is the most likely root cause.
2. The Outwoods Zone has a large number of potential surge sources / points of origin, which includes:
   - 27 Major Users (of which at least 8 have significant volumetric demands with on/off demand profiles).
   - A number of SSW sites which appear to cause significant pressure events on stop/start on the network.
   - A number of Non-Return Valves which are of unknown condition and function on the strategic trunk mains network.
   - Large PRV's in differential modes of control.
   - In addition to the above, there appears no overall control philosophy for all the assets within the zone.
3. None of the above in isolation is unusual in a distribution zone. However what is unusual is the number of potential large transient surge sources (29 in total between the categories mentioned above). Therefore to mitigate the risk of failure of the A38 trunk mains and improve performance, the zone is likely to benefit from a Complete System Calming (CSC) approach.
4. The CSC approach would significantly reduce the likehood of any further failure on the 18" main in the zone at a cost of approx. £2.8m, by the end of AMP7. When compared to the option of full or partial replacement of the 18" main, this is order of magnitudes lower in terms of totex and with more immediate benefit.
5. In addition we have been able to map a series of secondary benefits from broader system calming on the rest of the Outwoods Zone. This suggests there is wider PR24 business case for applying system calming across all zones. This could be easily integrated in a broader smart networks strategy (perhaps inclusive of water quality monitoring and smart metering). This would also align with the Technology common reference scenario described by Ofwat in their Long term Delivery Strategy guidance publication.

For the above findings there are **3 recommendations**.

Executive Summary: Recommendations

Recommendation 1: Detailed System Calming Study for Outwoods Zone

Develop the short, medium and long-term calming interventions as described in this report. This should include developing an overall zonal control philosophy and a costed execution plan and programme to deliver the interventions and benefits highlighted. This has the potential to significantly reduce the short term risk of mains failure and remove the risk in the medium to long term. In addition it will have significant network performance benefits across multiple performance commitments both in AMP7 and AMP8. Based on this observation we also make Recommendation 2.

Recommendation 2: Develop Business Case for System Calming across all Zones for PR24

The initial assessment of the benefits of System Calming on the Outwoods Zone indicates there are potentially significant benefits to undertaking the same approach across all other zones. By undertaking a similar top-down assessment it would be possible to develop an outline business case for consideration in PR24 (either as an enhancement business case or as a key pillar for increasing network botex efficiency). This could be easily integrated with the existing smart networks programme. We recommend this is undertaken by September-22 to ensure embedment within the Long Term Delivery Strategy (LTDS) development.

Recommendation 3: Undertake a Zonal Master Planning approach

Observations from our review of the Outwoods Zone would indicate a Zonal Master Planning approach would be useful to create a common thread from source to tap, to consider all bottom up and top down risks and form a single investment plan (25 years) for each zone, aligning to the Long Term Delivery Strategy (LTDS).

6.5 WRMP links

South Staffs Water revised draft WRMP, associated appendices and data tables:

Our Water Resources Plan | South Staffs Water (south-staffs-water.co.uk)

Cambridge Water revised draft WRMP, associated appendices and data tables:

Our Water Resources Plan | Cambridge Water (cambridge-water.co.uk)

6.6 Glossary of Abbreviations

ALC	Advanced Leakage Control
APR	Annual Performance Report
AMI	Advanced Metering Infrastructure
AMR	Automatic Meter Reading
BCM	Base Capital Maintenance
BVP	Best Value Planning
CAF	Cyber Assessment Framework
CAM	Cambridge Water region
CBA	Cost Benefit Analysis
CEMAR	Contract Event Management and Reporting (software)
COPI	Construction Output Price Inflation
CPI	Consumer Price Index
CPPA	Corporate Power Purchase Agreement
CRI	Compliance Risk Index
CRT	Central Risk Team
CSL	Customer Side Leakage
DEFRA	Department for Environment, Food and Rural Affairs
DHLUC	Department for Levelling Up, Housing and Communities
DMA	District Metered Area
EBSD	Economics of Balancing Supply and Demand
EPC	Engineer Procure and Construct (contract)
GHG	Greenhouse Gas
GIS	Geographical Information System
HH	Household
HMI	Human Machine Interface
HOF	Hands Off Flow
IEX	Ion Exchange (plant)

INNS	Invasive and Non-Native Species
LTDS	Long Term Delivery Strategy
LTF	Looking to the future
MCA	Multi Criteria Assessment
MOSL	Market Operator of England's Non Household Water Market
NCSC	National Cyber Security Centre
NEC	New Engineering Contract
NEP	National Environment Programme
NERC	Natural Environment and Rural Communities Act
NBO	Non-Binding Offer
NHH	Non Household
NIS	Network and Information Systems (directive)
NPV	Net Present Value
NVC	National Vegetation Classification
NZ	Net Zero
ODI	Outcome Delivery Incentive
OES	Operator of an Essential Service
ONS	Office for National Statistics
OT	Operational Technology
PC	Performance Commitment
PCC	Per Capita Consumption
PCD	Price Control Deliverable
PCV	Prescribed Concentration or Value
PLC	Programmable Logic Controller
PS	Pumping Station (a groundwater source station)
PV	Photovoltaic
RAPID	Regulators' Alliance for Progressing Infrastructure Development
SEMD	Security and Emergency Measures Directive

6 Annex – Supporting Information

SME SME Water Ltd

SME Subject matter expert

SOC Service Operation Centre

SSC OFWAT term for South Staffs Water (incorporating Cambridge Water)

SST South Staffs Water region

SSSI Site of Special Scientific Interest

SSW South Staffs Water (company)

WACC Weighted Average Cost of Capital

WAFU Water Available For Use

WFD Water Framework Directive

WINEP Water Industry National Environment Programme

WISER Water Industry Strategic Environment Requirements

WRAP Water Resources Advisory Panel

WRMP Water Resources Management Plan

WSZ Water Supply Zone

WRPG Water Resources Planning Guideline

WRW Water Resources West

WRZ Water Resource Zone

WTA Willingness to Accept

WTP Willingness to Pay

WTW Water Treatment Works