

SRN-DDR-037: Water Network Resilience and Disinfection Enhancement Cost Evidence Case

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from
**Southern
Water** 

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1. Introduction and Background

Southern Water are submitting this additional enhancement business case to deal with operational resilience and process safety risks within our business which we now consider will need to be addressed during AMP8. In this document we set out the rationale for this investment and articulate how it will deliver enhanced levels of operational resilience and safety, which are valued by our customers. This level of expenditure cannot be accommodated through base funding (for reasons described in detail in our representation SRN-DDR-004 Base Expenditure). Furthermore, given the drivers and intended purpose of this investment we consider that the nature of our resilience cases are similar to the resilience enhancement cases submitted by Severn Trent at PR14 (Birmingham Resilience) and Thames Water at PR19 (North East London Resilience), both of which were supported by Ofwat. The amounts requested are intended to allow Southern Water to address these risks.

- Improving the resilience of our Hastings Water Supply System
- Improving resilience of water supplies to the Isle of Sheppey
- Reducing the health and safety risk in relation to the use of chlorine gas as the basis for disinfection of treated water

In the case of Hastings and the Isle of Sheppey, there have been major interruption to supply incidents in 2024 and 2022 affecting over 50,000 customers in total. The most recent and most significant event, the interruption of 26,800 customers in Hastings, occurred after the submission of our PR24 business plan and has influenced our risk appetite in this regard.

With regards to chlorine gas systems, we experienced a gas leak at one of our key works in Winchester in early 2024. Although there was no impact on public safety, and the site complies with regulations, this triggered the company to review its risk appetite in the context of the water sector drive to move away from chlorine gas and initiated a review of all sites or stores containing chlorine gas.

The common denominator for these individual cases is the fact that the potential risks in these areas have already crystallised in terms of actual incidents, which we consider legitimately increases the urgency with which we need to address them, and base allocations are not appropriate to support this resilience and risk investment.

There remains scope to optimise the identification of best value options required to address these issues and work will be ongoing up to and beyond the PR24 final determination in relation to these areas and our wider, long-term resilience plans. Our initial identification of high-risk assets within the Hastings and Isle of Sheppey systems and potential interventions to improve the reliability of the system with respect to known vulnerabilities has enabled us to identify an initial set of interventions and high-level cost estimates. We consider that further optimisation will be possible in the run up to AMP8, which would allow us to deliver greater level of resilience improvements through the requested funding, particularly where we will be working to improve redundancy as well as reliability within these systems. However, Southern Water considers that it would not be appropriate to defer addressing these issues until PR29 and leave customers exposed to a risk of repeat service interruptions or safety risks.

We are therefore requesting that Ofwat considers these additional cases under the special Delivery Mechanism which currently is proposed by Ofwat to cover certain aspects of our AMP8 environmental programme (continuous water quality monitoring, CSO's, phosphorous and nitrate removal).

Actual funding, bill profile and RCV adjustments would therefore be subject to the annual funding request and approval process mandated under that mechanism which provides protection for customers in the event of any subsequent changes to the proposed scope and level of investment set out in this document. For the three areas of investment highlighted in this document, we will support the annual funding request with evidence that we have completed a comprehensive needs assessment and optioneering process before putting forward the specific schemes for delivery in the subsequent period.

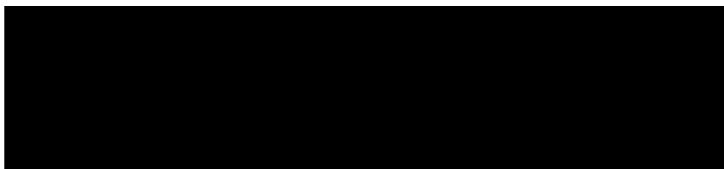
These schemes do not form part of our base activities as they are to address non-standard risks on key strategic assets that will deliver an enhancement in our supply resilience as expected by our customers. Consequently, we need the additional funding summarised below to deliver these improvements. Based on Southern Water’s current assessment of the risks in these areas and outline solutions, we estimate that the AMP8 enhancement capex required will be **£ 71.2 m** as set out in the table below.

Table 1: AMP8 enhancement capex required

System	Intervention	Rationale	Cost
Hastings	Improving resilience of critical mains and enhancing connectivity and redundancy	[REDACTED]	£35.0 m
Isle of Sheppey	Improving resilience of critical mains and storage	[REDACTED]	£15.0 m
Chlorine gas disinfection systems	Transition from chlorine gas to liquid at our most critical sites	Chlorine gas was once the mainstay of disinfection of treated water; however it poses health and safety risks, and we wish to transition away from its use, particularly where in close proximity to customers.	£21.2 m*
Total			£71.2 m

Note: *Please note that our resubmitted table CW3 contains an error in relation to the chlorine gas disinfection case. The stated cost of £10.057 m was the direct works cost only, excluding on-costs and overheads. The above table shows the actual value.

In the subsequent sections of this document, we set out additional detail on the basis for the additional funding requested.



2. Needs Case for Enhancement

2.1. Island System Resilience Cases

Managing the risk associated with high impact but low likelihood (HILL) risks is a key challenge for water companies. With so many demands on limited investment funds, it is always challenging to divert investment from issues that are currently impacting on service, to those which, by definition, may not do so in the next investment period. However, when such risks do materialise, with significant impact on service, customers inevitably ask why they were not better protected against such eventualities.

'Island Systems' that is those which are dependent solely on local water supply infrastructure, with limited or no available support from other areas or supply systems are common to many water companies and as an industry we have begun to address the lack of resilience of such systems, notably in recent AMPs with the significant investment to address such issues in respect of the water supply to Birmingham (Severn Trent's AMP7 Frankley alternative supply scheme) and North East London (Thames Water's PR19 conditional allowance). In both these recent cases Ofwat recognised that the drivers and intended outcomes of the investment made it appropriate to treat these as enhancement cases.

In principle, those same issues apply in the case of Southern Water's Hastings Water Supply System and supplies to the Isle of Sheppey (literally an island system). A key difference for Southern Water is that some of the potential risks affecting our systems have already materialised, causing major disruption to customers within the last two years and they remain exposed to significant residual risk.

Our ongoing review of our systems' resilience has highlighted a number of areas where we have critical assets that our current operating and maintenance regimes will not provide the required level of supply resilience our customers expect. We have prioritised these two schemes for investment as customers have told us we should prevent a repeat of these incidents, however, we would propose that further resilience enhancements are considered under the annual review process proposed for this case.

Southern Water customers on the Isle of Sheppey and in the Hastings water supply area suffered unacceptable service failures in 2022 and 2024 respectively. The scale of these incidents is summarised below: -

- **Isle of Sheppey** – up to 24,000 homes and 12 schools losing supply for up to 2 days
- **Hastings** – Initially over 26,800 customers lost supply, with 6,500 customers still affected after 5 days

The company aspires to deliver levels of resilience that would ensure that no Southern Water customers suffer such catastrophic service failures in future, and we are in the process of developing a "system / zonal" risk and resilience methodology which will identify strategic asset resilience and enhancement improvement programmes. This approach will be fully rolled out across all our water supply systems during AMP8 and will inform our PR29 investment plans and long-term delivery strategy.

Delivering full resilience in these and other water supply systems will be a multi-AMP process, but the interventions proposed in this submission for AMP8 will provide the foundation for that longer-term process and ensure that customers are not exposed to unacceptable risk of further supply interruptions in the near term. Prioritising investment in these areas would mean that service impacts of a similar scale to those experienced by the customers in Hastings and the Isle of Sheppey would not be experienced twice in those customer's lifetimes.

Hastings System Issues

The May 2024 supply interruption issue which impacted over 26,800 of our customers resulted from a loss of raw water supply to Beauport WSW due to a burst on the 800 mm diameter raw water main from Darwell. The Hastings system is dependent on two WSW's Beauport and Brede and neither works can supply the entire system.

The incident revealed that accessing the main for repair could be challenging and that the failure mode leading to the burst was likely to be present elsewhere on the main.

As part of our developing approach to understanding the relative resilience of our water supply systems, we have developed resilience scorecards which indicate that Hastings is our least resilient system, the potential loss of raw water supply to Beauport WSW is a significant contribution to the resilience risks in this system as illustrated by the figure below: -

Table 2: Resilience scores by water resource zone

Water Resource Zone	Resilience Score
Brighton	0.85
Sussex Worthing	0.77
IOW	0.74
Hampshire Winchester	0.58
Thanet	0.57
Kingsclere	0.56
Medway East	0.53
Medway West	0.45
Sussex North	0.44
Hampshire South West	0.43
Andover	0.36
Hampshire South East	0.28
Hampshire South Rural	0.24
Hastings	0.11
Average	0.49

Addressing the risk of a further failure of the Darwell to Beauport raw water supply has been identified as a key priority for the short-term mitigation of further supply interruption risk in this system, but other strategic network reinforcements are envisaged for both raw and treated water assets. We summarise below, the overall scale of our anticipated interventions in the Hastings system as part of our proposed AMP8 resilience improvements.

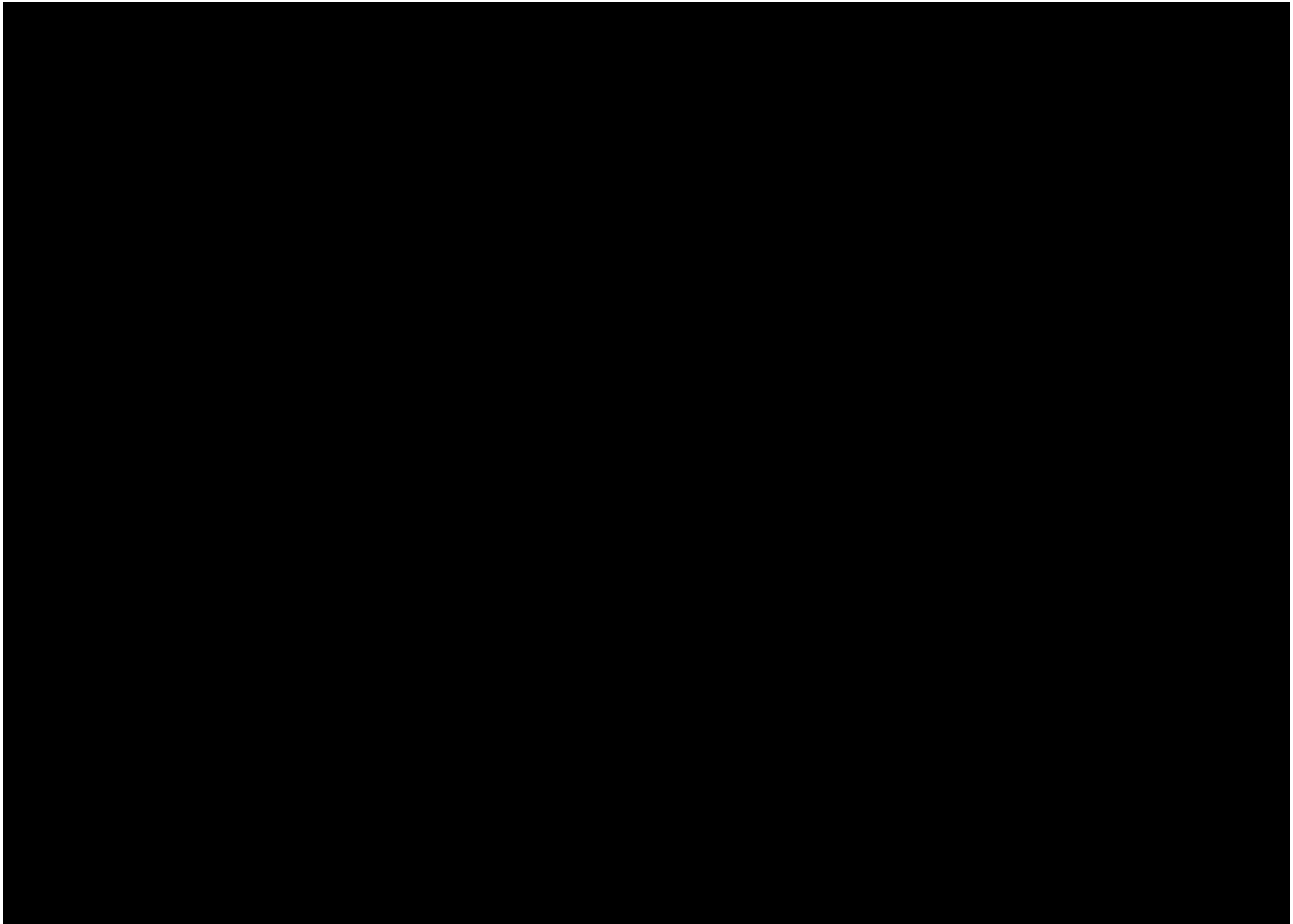
1. Targeted improvement of strategic mains – We will undertake targeted reinforcement of the raw water supply mains to Brede and Beauport WSW. This may include selective replacement or dualling of high-risk sections.

2. Improve Network Connectivity – We will deliver targeted connectivity improvements within the water supply system as necessary including at a strategic level (between the two WSWs) and at a local level (between existing DMAs and Service Reservoirs).

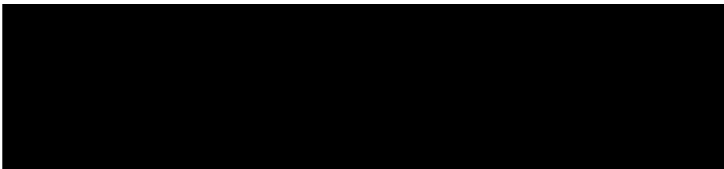
3. Address Single Points of Failure – We will improve redundancy in the Hastings Water Supply System to minimise the risk from single points of failure. Interventions may include dualling of mains, cross-connections and installation of emergency pumping stations.

The figure below provides a high-level overview of the intended resilience improvements to be delivered in Hastings including addressing the risk posed by critical raw water mains supplying the two water supply works on which Hastings depends.

Figure 1: Resilience improvements to the Hastings system



We have included costs of £35 m in this additional resilience enhancement case, to cover the activities identified above. These activities will sit outside our 'core' plan and form part of our 'extended' plan, as part of the proposal to fund this enhancement investment through the special delivery mechanism. We will ensure that we have reviewed the full range of options to enhance the resilience of our Hastings supply system and present all the necessary supporting evidence as part of the annual funding request process within the special delivery mechanism. We will also demonstrate the alignment of our proposed annual investment plans with the long-term strategic direction for the Hastings system and our WRMP obligations.



Isle of Sheppey System Issues

The Isle of Sheppey sits within our Medway East Water Supply Zone. The zone as a whole, ranks in the middle of our resilience ranking for water supply zones, but it is the local configuration of the Isle’s supply system, allied to the recent severe service interruptions experienced by customers on the Isle, which has raised its priority. The isle was supplied by two mains which cross the Swale, the waterbody between the mainland and the isle. These mains are an 18” steel main which is mounted under the bridge deck of the road bridge connecting to the isle and a 600 mm diameter main which crosses on the riverbed. It was a failure of the 600 mm main just upstream of the crossing which started the 2022 supply interruption incident, compounded by a second failure when the main was repressurised after the initial repair.

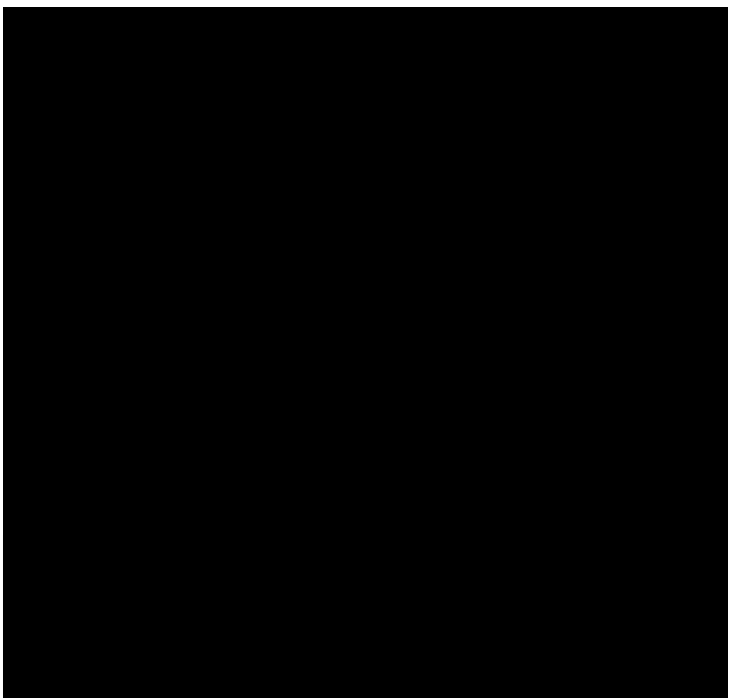
The incident which affected up to 24,000 customers on the Isle of Sheppey highlighted the vulnerability of the water supply system given the age and condition and inaccessibility of the existing river crossings. Southern Water proactively invested over £ 7.5 m from our AMP7 base funding, to construct a new twin pipe crossing of the Swale to mitigate the risk of a failure on the existing crossing which would be extremely challenging to repair. Although this intervention will have addressed the most obvious and imminent risk there are further potential single points of failure in the isle’s water supply which leave some of those same customers exposed to the risk of a repeat incident.

Base on a combination of know risks held in our Asset Risk Management (ARM) system and SME knowledge we have identified several candidate assets for AMP8 investment which would address significant elements of the residual risks in the Isle of Sheppey supply system, which include.

- [Redacted]
- [Redacted]
- [Redacted]
 - [Redacted]
 - [Redacted]
 - [Redacted]

Our initial estimate of costs for this programme of interventions is £15 m. Through the proposed special delivery mechanism for this programme, we will ensure that the costs included in the annual funding request are clearly benchmarked and demonstrably efficient. The figure below provides an overview of the locations of some of the key the proposed investments.

Figure 2: Resilience Improvements to the Isle of Sheppey System



[REDACTED]

We propose to promote the above investments through the annual funding request as part of the delivery mechanism and will keep our extended investment plan under review as our “system / zonal” risk and resilience methodology. We will provide additional detail in support of each funding request to demonstrate efficient cost and customer value for each stage of our plan.

The proposed investment in these systems is intended to enhance the resilience of both systems and protect customers from experiencing a second unacceptable interruption to their supplies. We do not consider it to be appropriate to fund this activity out of our base allowances, given the already significant demands on base funding to support asset health and stretching performance commitment targets.

2.2. Chlorine gas to liquid investment case

2.2.1. Background

While chlorine remains the universal choice for UK water companies’ disinfection processes, and chlorine gas was once the mainstay of that process, it poses health and safety risks. These risks have led to increased use of sodium hypochlorite as a lower-risk and favourable alternative.

Many treatment works are situated near residential areas, hospitals nurseries and schools. Although there are robust regulations and guidelines to manage the risk, chlorine gas is an extremely hazardous chemical, and the repercussions of a major unplanned chlorine gas release could be significant. We have focussed on this risk in determining the priority sites for elimination of chlorine gas disinfection.

Yorkshire Water was the first company in the water sector to eliminate chlorine gas use from its water treatment works in a bid remove any risk of toxic gas escapes, and subsequently, several companies have started to move away from chlorine gas, particularly at their largest sites.

In early 2024 we encountered a chlorine gas leak at one of our key works in Winchester. Although there was no impact on public safety, and full compliance with regulations, this prompted a review of our risk appetite in the context of the sector-wide move away from chlorine gas and initiated a study of all sites/stores containing chlorine gas.

2.2.2. Approach to Reassessing Risk from Chlorine Gas

Southern Water’s Health Safety and Wellbeing team completed audits on all Toxic Gas facilities auditing against the Health Safety Executives (HSE) guidance named Health and Safety Guidance (HSG) 40 ‘Safe Handling of Chlorine Drums & Cylinders’. Consistent with that guidance a Consequence Risk Assessment framework was applied to enable the company to rank the sites according to the consequence and likelihood of a Toxic Gas leak occurring. Full details of our comprehensive approach are set out in Appendix 1 of this document.

The factors driving likelihood can be influenced by management actions and investment however consequence scores are largely outside of the companies influence for example by virtue of the location of where water supply sites are located and their proximity to customers.

Parameters used to determine the consequence were as follows, size of the inventory, occupation of personnel manning the site, the built-up environment using DEFRA categorisation guidance, sensitive/vulnerable neighbours within certain distances, external resources required to control a leak and customer impact of how many customers would lose supply if the site was to fail.

Following this review and with due regard to a recent incident of a gas escape at our Winchester WSW in early 2024, the wider industry trend and exemplars like Yorkshire Water, we have amended our risk appetite with the approval of our executive safety committee and endorsed by the Board HSW committee. This determined that any sites that have a sensitive/vulnerable customer within 100m of a Toxic Gas installation or are manned sites with non-Southern Water employees should be removed from Toxic Gas for disinfection and moved to a liquid disinfection process. This methodology used only Health and Safety parameters rather than customer impact therefore giving 12 sites within the highest consequence within the organisation if a Toxic Gas leak was to occur (not including Toxic Gas storage facilities needing to supply the remote sites.) The 12 sites are listed in the table below: -

Table 3: Chlorine gas to liquid investment – costs by scheme

No	Site Name	Scheme Cost £ m
1	[REDACTED]	£1.743
2	[REDACTED]	£1.815
3	[REDACTED]	£1.832
4	[REDACTED]	£1.790
5	[REDACTED]	£1.804
6	[REDACTED]	£1.693
7	[REDACTED]	£1.709
8	[REDACTED]	£1.727
9	[REDACTED]	£1.754
10	[REDACTED]	£1.787
11	[REDACTED]	£1.764
12	[REDACTED]	£1.815
Total Cost		£21.235

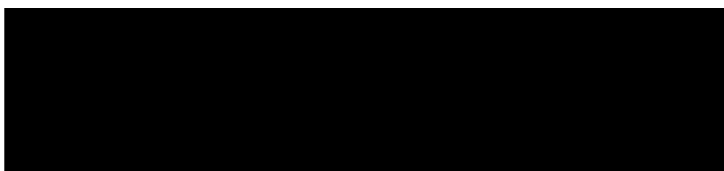
A summary of the risk scoring process and outcomes is included in Appendix 1 of this document.

We have included costs of £21.2 m for the replacement of this existing chlorine gas systems at these sites with liquid (sodium hypochlorite) based disinfection systems in this representation. These interventions are not proposed on the basis of normal base investment activity and are not a like-for-like replacement. The driver for this investment is the health and safety enhancement case outlined above. For these reasons we consider that it would not be appropriate to fund this activity through already stretched base funding allowances.

The costs included in the above table have been developed based on our unit cost models by our Cost Information Team. We propose to deliver this programme of work through an extended delivery mechanism and will provide detailed evidence for the efficiency of those costs and customer value as part of each years' annual funding request process.

With respect to the investment in Chlorine gas to liquid programme we consider that there are three options, either to continue to tolerate the risk, implement our proposed conversion programme (to hypochlorite-based disinfection) or to switch to an alternative disinfection system i.e., UV.

Based on our executive safety committee's revised risk appetite which is focussed on safety for the public especially vulnerable locations we do not consider it appropriate to continue to tolerate this risk. Of the



available alternative disinfection processes the option we have selected if the most cost effective. On this basis we consider it to be the best option for customers.

Best Option for Customers

The investment proposed for Hastings and the Isle of Sheppey Resilience is to target the most imminent residual risks in those two systems whilst we continue to develop our longer-term resilience strategy through our a “system / zonal” risk and resilience methodology. Through market research consultancy, Relish, we have explicitly engaged with a panel of our customers both within the Hastings and Isle of Sheppey area and a selection of customers from across the region too. This engagement comprised the following: -

- 2 x 75-minute discussion groups on Zoom with customers from across the Southern region (total of 16 customers).
- 6 x 40-minute 1-to-1 depth interviews on Zoom with customers who live in the Hastings area.
- 6 x 40-minute 1-to-1 depth interviews on Zoom with customers on the Isle of Sheppey.

All customer panel members were freshly recruited, and none had taken part in any existing Southern Water research panels. All customers in Hastings and Sheppey were aware of the previous water supply issues in their area.

Our consultants concluded that customers are supportive of Southern Water investing £35 million on added resilience in Hastings during AMP8, even with the additional billing impact. The work was seen as urgent work that will prevent future failures. Many customers remain frustrated that this investment has not been made in previous years. Similar conclusions were reached in relation to the investment of £15 million on added resilience on Sheppey during AMP8, even with the additional billing impact and notwithstanding underlying concerns about the wider bill impact of the PR24 plans in this area of low affluence

With respect to the investment in Chlorine gas to liquid programme, as previously stated, given the ongoing need to maintain disinfection and the high cost of alternatives such as UV we consider that our proposed option is the only suitable approach, and that the safety case demands that we address this risk at the earliest opportunity. We consider it to be the best option for customers.

3. Cost Efficiency

Though the proposed special delivery mechanism for this programme we will ensure that the costs included in the annual funding request are clearly benchmarked and demonstrably efficient.

4. Customer Protection

We propose that this investment is delivered under the Delivery Mechanism, whereby efficient annual costs are agreed with Ofwat throughout the AMP, through the annual funding request process with adjustments for previous year delivery reconciled within the allowance setting. We therefore consider that customers are fully protected in the event of any under delivery.

5. Conclusion

Southern Water considers that addressing the key risks included in this submission, namely resilience of the water supplies to Hastings and the Isle of Sheppey and the safety improvements in relation to chlorine gas are in the best interest of our customers and that it would not be appropriate to defer the decision to invest in these areas until a future price review. Our risk appetite and prioritisation of investment in these areas has been influenced in part by the materialisation of risks since our business plan submission in October 2023 (Hastings supply interruptions in May 2024 and Winchester WSW chlorine leak in early 2022).

We consider that the scale and nature of this investment is such that it would not be covered within our base investment allowances which as we set out elsewhere in our draft determination response, are already significantly over-stretched in responding to underlying asset health and performance commitment challenges. We note that in recent AMPs, similar cases (Severn Trent, Birmingham Resilience and Thames NE London resilience) have been recognised as legitimate cases for enhancement funding.

The driver for these investments is to enhance our levels of resilience and operational safety and that is the reason for bringing forward investment, which would not otherwise be a priority for routine base maintenance.

We also recognise that we are presenting this case at a late stage in the Price Review Process and that certain aspects of the case are not as mature as other areas of our plan. In recognition of this, Southern Water are requesting that the case be added to and delivered through the special delivery mechanism.

Southern's bill profile and RCV will only be adjusted annually provided Ofwat are satisfied that the schemes in the plan for that year can be delivered are efficient and are in customer's interests.

References

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Safe handling of chlorine from drums and cylinders Page 59 of 63 Health and Safety Executive 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81

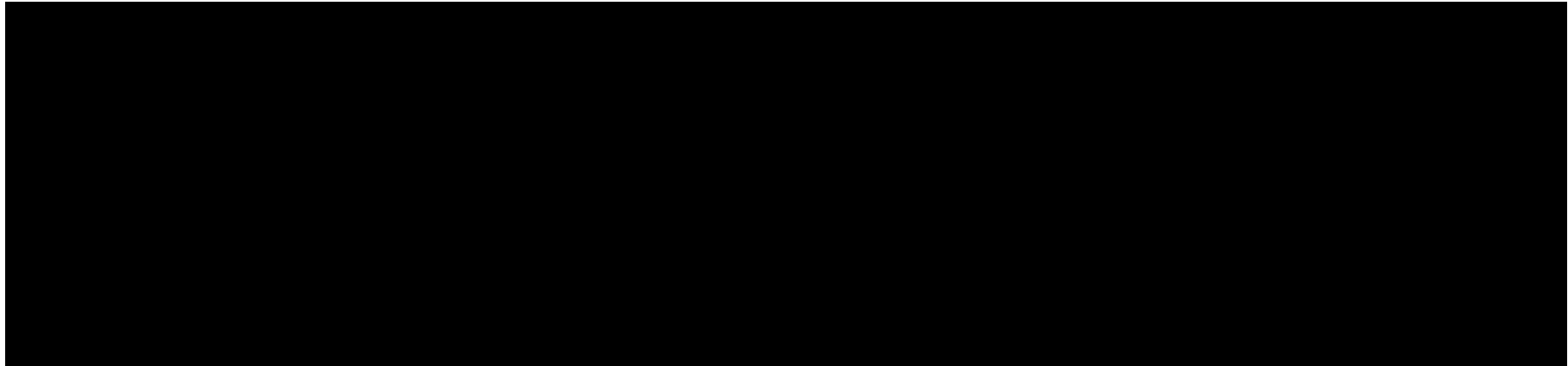
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Appendix 1 – Details of Our Toxic Gas Site Risk Assessment

Our Consequence and Risk Assessment Methodology allows for the risks to be considered in terms of Consequence and Likelihood. The approach to assessing and scoring risk and likelihood is shown in Figure below.

Figure 3: Consequence and Likelihood Framework for risk assessment



Sites are assessed using the framework, which results in a consequence and likelihood score, which are the sums of the individual consequence and likelihood scores in the assessment. These sums are then multiplied to give an overall risk score for the site. The risk score allocated to the sites being considered for Gas to Liquid Sodium hypochlorite systems are provided in the figure below.

Figure 4: Consequence and Likelihood scores, summated scores and site Risk Score



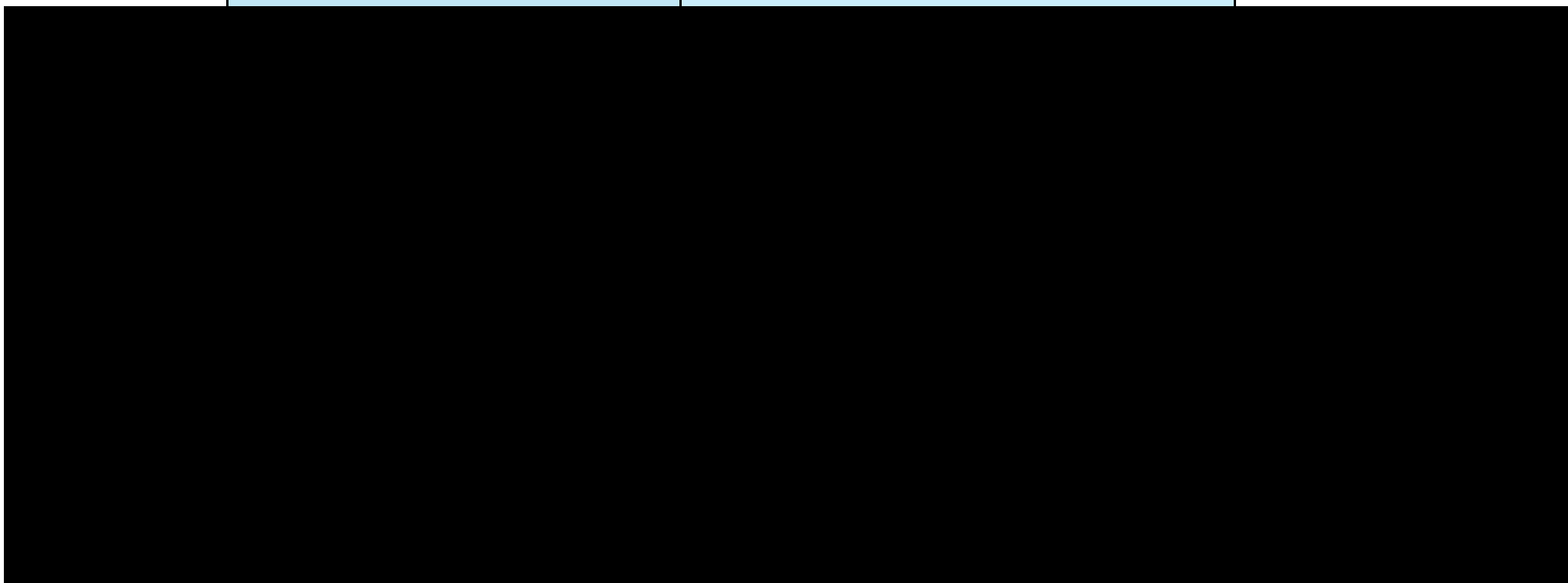
This approach aligns with the HSE risk assessment questions - "What are the hazards?" & "Who might be harmed and how?". Specific risk factors include Inventory (volume of chlorine in storage), Occupation, Built Environment, Population and Emergency Response on a leak considers those who might be harmed or impacted, this list includes all the key groups – site operators, local residents, and the emergency services. Customer Impact considers risks to our customers in terms of loss of supply.

For the Likelihood assessment we have considered the following evaluation criteria:

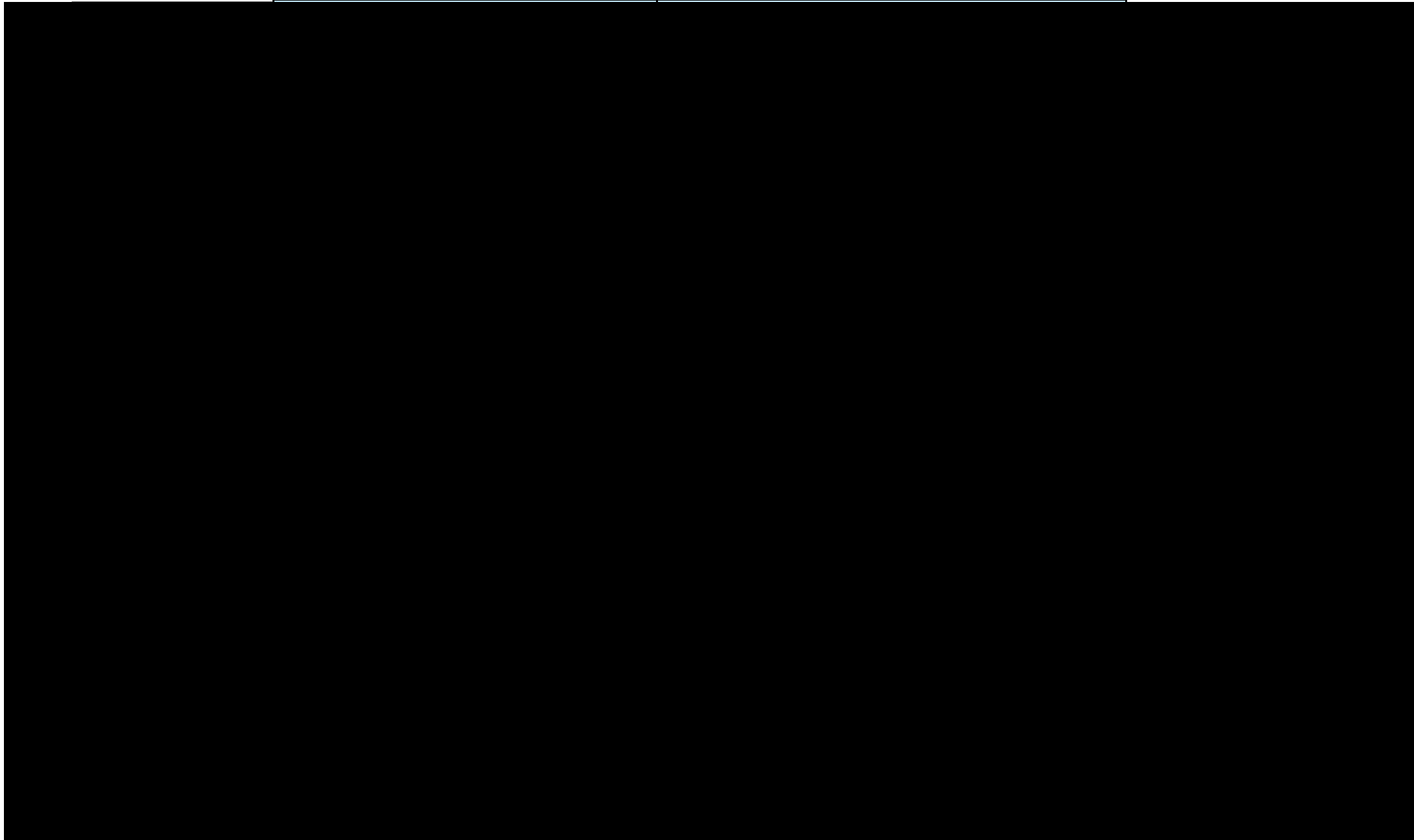
- Detection, Valves/coupling/connections, Shutdown system, Ventilation, Pipework, Response and Containment. Again, this aligns with the HSE risk assessment questions - "What are you already doing to control the risks?". The criteria align with HSG40 guidance in terms of the design and location of installations and Emergency arrangements.
- Another area which aligns with our critical asset strategy is the inclusion of appropriate site operating manuals, procedures and training and maintenance.

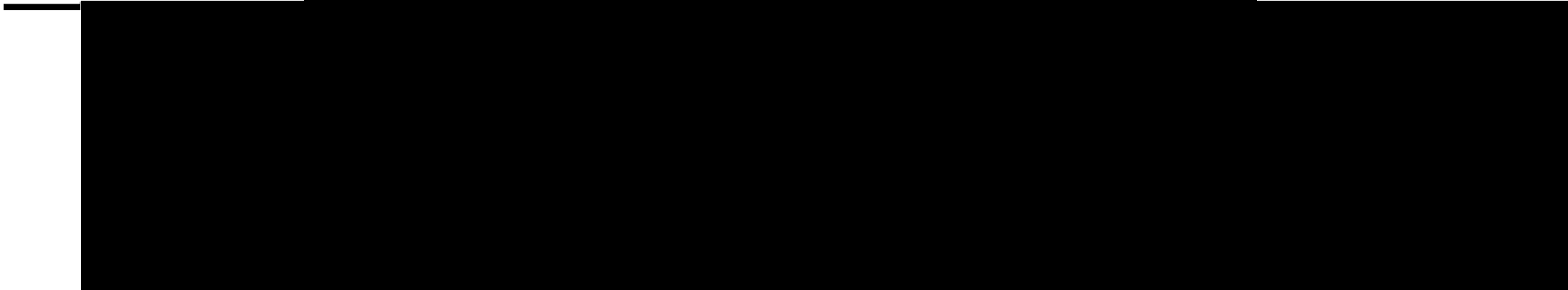
The methodology adds up the individual scores to calculate the combined Consequence and Likelihood scores for each site. Consequence and Likelihood scores are multiplied together to give an overall score for each site, which is a standard technique. We summarise the results in the table below.

Table 4: Risk scores by site









12 sites Prioritised for Investment in AMP8

