SRN52 Resilience – Flooding
Enhancement Business Case

2nd October 2023

Version 1.0

from Southern Water

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Executive Summary

Globally, our climate is changing. Already we are starting to see the effects of this on our business. Climate change is now considered one of the greatest risks for our industry. It is one of the four material drivers for Water and Wastewater Companies and Ofwat has identified two Representative Concentration Pathways (RCPs) - RCP 2.6°C and RCP 8.5°C - as the 'common reference climate change temperature rise scenarios,' to be used for long term investment planning.

For our long-term planning, Southern Water is using the latest UK Climate Projections (UKCP18) to explore how these different potential climate futures will affect our investment strategies across our geographical region. Climate generated hazards and asset vulnerabilities have been identified and the resultant service impact risks (resulting from any operational disruptions) are being assessed for their likely adaptive resilience enhancement requirements.

For Southern Waters Wastewater Operational region, the escalating wet weather events generated by climate change have caused an increase in the frequency and magnitude of shock flood events. Southern Water's aim is to be proactive in dealing with events like these and take measures to minimise any future risk of impact. The six sites identified as needing flooding resilience enhancement during the AMP8, have been assessed to be those where service is most at risk from the double whammy of more significant flooding events occurring, with an increasing frequency.

An AMP7 investigation identified that our sites are being increasingly impacted by flooding events (both frequency of occurrence and flooding magnitude). The proposed business cases aim to secure the resilience of our sites to these increasingly frequent flooding events, whilst providing our customers with the confidence that we will do the right thing to protect the environment.

Our investigation produced significant insight into the potential scale of our sites historic flooding vulnerability and the escalating risk faced in the future. The increasing frequency and intensity of rainfall events in our region causes service delivery system shocks in several ways:

1. Sites themselves are inundated (both preventing us from accessing to operate them as intended or to respond to any disruptions arising, and preventing the process treatment assets from functioning as designed)
2. The sewage network is inundated (preventing the system from carrying the sewerage collected to be treated, due to extreme levels of rainwater)
3. Historic tidal defences are no longer sufficient to protect assets from sea water levels)
4. Nature based flood management (culverts and flood plains) are no longer able to prevent the flooding of our assets.

The results of our investigation of C.1000 operational sites revealed that:

1. 6 sites have been impacted by flood water, disrupting necessary operational and maintenance tasks so are in urgent need to have their service resilience to being flooded enhanced.
2. 58 sites have been impacted by flooding events and as the frequency of flooding risk increases into the future due to the effect of climate change, the resilience enhancement investment requirements need to be resolved during AMP8 and put into an investment plan submission for AMP9.
3. 52 sites are at high risk from flooding and their resilience enhancement investment requirements need to be resolved for AMP9 investment planning and beyond.
4. The shocks and stresses from climate change need to be better identified and investigated, with a dedicated resources made available for holistic risk evaluation and treatment.

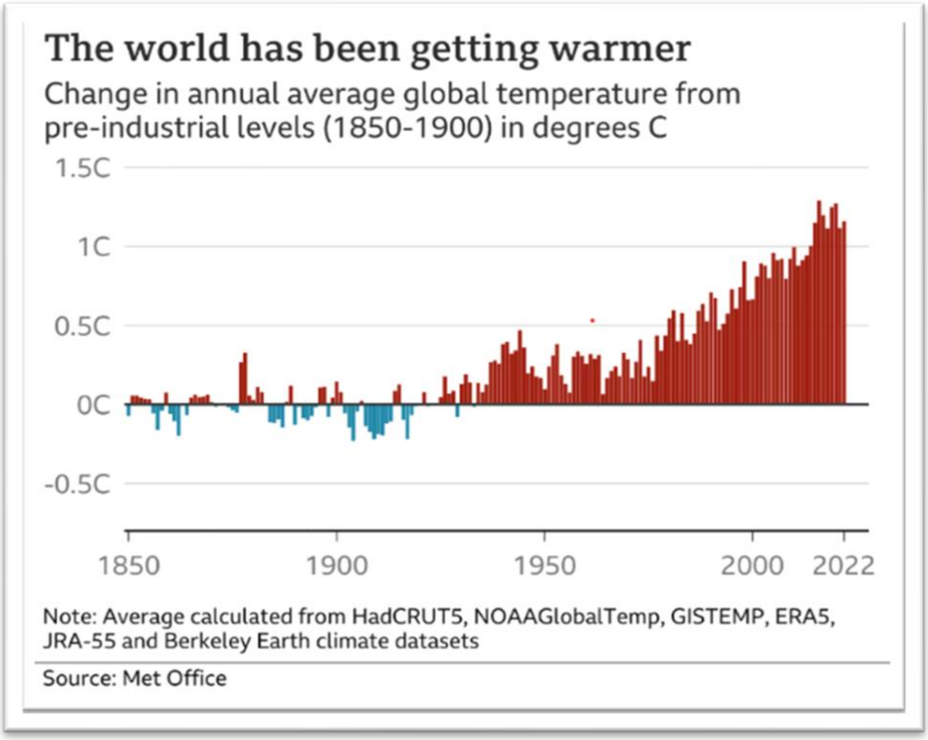
Summary of Enhancement Case	
Name of Enhancement Case	Service Resilience to the Impact of increased flood events caused by climate change.
Summary of Case	▪ We propose to enhance the resilience on 6 wastewater treatment works that have previously been flooded, because the frequency of flood event is accelerating due to climate change. ▪ Resilience resistance measures will look to target ensuring that disruption to the routines operation of our sites to provide essential services can be minimised. ▪ Service reliability and redundancy will be enhanced so the periods of disrupted operations are not the cause of service interruption. ▪ We will look to provide our customers with the certainty that the standards of service delivery can be maintained. This included when the flooding shock experienced repeats on an increasing frequency due to climate change.
Expected Benefits	▪ The 6 sites that are increasingly flooded are capable of delivering resilient service. ▪ Resistance to the shock of being flooded is enhanced to minimise service disruption. ▪ Service delivery reliability is enhanced so that the shock of prolonged flooding minimises risk. ▪ Asset redundancy requirements are enhanced to cope with the shock of being flooded. ▪ Site recovery so that normal operation can resume asap. ▪ We also expect to see a reduction in variability of operational performance in the following areas: o Customer contacts about flooding & pollution incidents. o Treatment works compliance failures. o Reported Pollution incidents. ▪ Additional benefits: o H&S - low risk from operating within flooded environment, including risk from electrical shocks and hidden risks under flood waters'
Associated Price Control	N/A
Enhancement TOTEX	£5.36m
Enhancement OPEX	£0
Enhancement CAPEX	£5.36m
Is this enhancement proposed for a direct procurement for customer (DPC)?	DPC has not been proposed for this enhancement case as the Capex investment is less than £200m, so it does not pass the materiality threshold for DPC.

1. Introduction and Background

1.1. Introduction

Since circa 1950, scientific evidence (see Figure. 1 graph below) shows that global mean temperatures have risen by around 1°C. Environmental modelling has projected that this will have increased by 2 to 4°C by 2100 (a global rise of 1.5°C is anticipated by 2030).

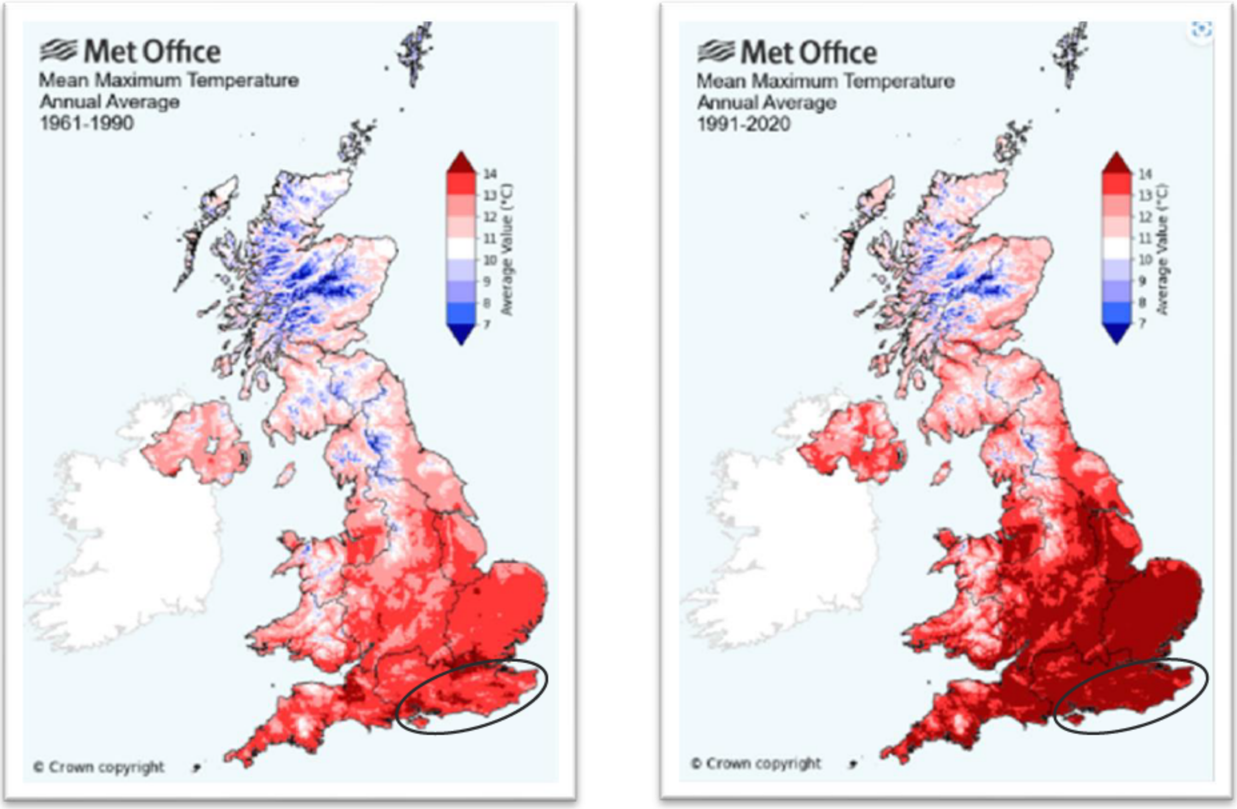
Figure 1: Global mean temperatures



The UK Meteorological Office continually updates its UK climate change projections. Titled UKCP18, this project builds the most up-to date projections of how the climate of the UK may change over the 21st Century (refer to: UKCP18 (metoffice.gov.uk)). A summary of the work presented (refer to: Summary Presentation (metoffice.gov.uk)) sets out that the UK climate will continue to be characterised by warmer, wetter winters and hotter, drier summers, with these being accompanied by an increase in the frequency and magnitude of extreme weather events. UKCP18 makes clear that the need for changes to infrastructure is now more urgent than at any time in the past. Citing that we are already seeing drier summers, more frequent and intense rainfall, more variable river flows and biological changes in water bodies.

Figure. 2 shows, 'Average Maps over time,' taken from the Met Office web site* which show how Climate change is raising the average temperature of the UK, especially within Southern Water's area of operation within the southeast.

Figure 2: 'Average Maps over time,' taken from the Met Office web site



In recent times, the Water sector has already experienced impact from a number of extreme weather events; for example, the 'Beast from the East' in 2018, flooding from storms like Storm Ciara and Storm Christoph in 2020, and surface water flooding in London in July 2021. The heatwave of August 2020 increased pressure on water supplies particularly in the southeast, with prolonged increases in temperature having the potential to adversely impact unique water environments, such as chalk streams.

In our region, the resulting impact of the changing weather patterns (caused by climate change) fall into four main escalating consideration:

1. Increased temperature and more extreme variation in temperature
2. Less rainfall or longer dry periods (drought)
3. More rainfall, or more intense rainfall (increased storminess) all year round
4. Sea level rise

For Southern Water, our AMP8 resilience cases aim to address the climate change effects that have already occurred and have already negatively affected our service delivery asset systems and are worsening and are placing critical service delivery systems at an increasing deliver risk. Existing Flood events already both prevent safe access and operations of out treatment assets and directly interfere with the performance of wastewater treatment system. Future events will only increase the frequency and duration of these impacts. Our customers have also told us that they would like us to enhance the resilience to core services, so to reduce risk of us causing environmental pollution (see Chapter 3). Addressing the ongoing service delivery susceptibility, from site flooding vulnerability, will do this.

For the shock event of flooding, the proposed resilience enhancement investment seeks to control the risk of service impact so that the increasing levels of experienced disruption, due to the flooding brought on by climate change, can be accommodated. Because until recently, the reality of climate change was still being debated, none of the sites identified for investment were designed with the levels of shock flooding now being experienced. Retrospective consideration is therefore now needed.

For the flooding enhancement investment business case development, two flooding hazards were considered as shock scenarios (post severe weather). These were:

1. Flooding from rivers (i.e., fluvial risk).
2. Flooding from surface water (i.e., pluvial risk)

1.2. Background Information

As stated in the Introduction, the UK Meteorological Office climate change projections update (UKCP18) sets out that the UK climate will continue to be characterised by warmer, wetter winters and hotter, drier summers, with these will be accompanied by an increase in the frequency and magnitude of extreme weather events. It is the increasing frequency of shock wet weather events across the year (compounded if they occur after long dry periods), that has caused the increased frequency of shock environmental flood events in our region. There is a clear need to enhance our infrastructure resilience to these shock event, to secure services delivery for the future.

Risk is defined as*:
"A situation involving… (your outcome being) … exposed to danger".

[Risk is therefore understood to mean that:
"There is an uncertainty of outcome"]

Vulnerability is defined as*:
"The… state of being exposed to the possibility of being … (affected)…"

[Risk and Vulnerability are therefore understood to be different and distinct things.
To illustrate: If you are outside and it rains, you are vulnerable to getting wet. There is only a risk to your outcomes if getting wet has the potential to affect your outcome.]

*Refer to Oxford Languages (oup.com)

The Current flood risk predictions available to us can be understood to be as a result of the climate change experienced to date. The dataset we used to undertake the site location flood vulnerability assessment are the *Environment Agency's Flood Map for Planning GIS* layers (Flood map for planning - GOV.UK (flood-map-for-planning.service.gov.uk)).

Quoted in the, 'Preliminary Flood Risk Assessment for England Report (October 2018)' - Preliminary flood risk assessment for England (publishing.service.gov.uk):

- "We use computer modelling to map floodplains, so we can understand the area's most likely to flood in future. This gives us a consistent understanding of what areas may be at risk of flooding across the country."

In addition to this, these specific subsets were also used:

- Surface Water Flood vulnerability maps:
  - Where do you want to check? - GOV.UK (check-long-term-flood-risk.service.gov.uk)
- Watercourse Flood vulnerability Maps:
  - Flood map for planning - GOV.UK (flood-map-for-planning.service.gov.uk)

These Flooding prediction maps have been created by the Environment Agency for the purposes of applying the *National Planning Policy Framework* (NPPF).

The NPPF outlines, in a mapped format, areas that are vulnerable to being flooded. The maps show 3 flood event occurrence likelihood levels. Level 1 is low flood event likelihood, 2 is medium and 3 high.

Refer to: National Planning Policy Framework - Guidance - GOV.UK (www.gov.uk)

For the PR24 submission, we have focused only on the area's modelled as most vulnerable to experiencing a flood event (i.e., they are located within a flood zone 3).
The Flood zone 3 event likelihood is characterised within the EA tool as follows:
"…where Land has a 1 in 100 year (or greater) annual probability of river/surface water flooding, or Land having a 1 in 200 year (or greater) annual probability of sea flooding…"

These mapped flood Zones are used to determine the probability of river, surface, and sea flooding. (It is advised that this modelling cannot account for the presence of any potential flooding barriers (resistance)). The current Flood Zones are modelled on the historic rate of climate change and do not model or predict the possible futures highlighted by the two Representative Concentration Pathways (RCPs) - RCP 2.6 and RCP 8.5. No predictive potential scenario flood models for our region (as far as we are aware) have ever been made available for use by us in this space.

An asset* is defined as:
"An item of property owned by the company, regarded as having value and is available to meet… commitments…"

*Refer to Oxford Languages (oup.com)

Asset delivery system defined here as:
"The combination of multiple sites/facility assets working together to deliver a defined service outcome."

Asset hierarchy defined here as:
"A structured way of organizing asset data the work together within a site. Southern Waters assets are organised as follows:

- Site/Facility Asset
- Process Asset
- Function asset
- Equipment asset
- Component asset

As previously stated, an AMP7 investigation into the current effect of climate change on our site/facility assets was successfully delivered. This investigation was undertaken in two distinct phases.

Phase 1

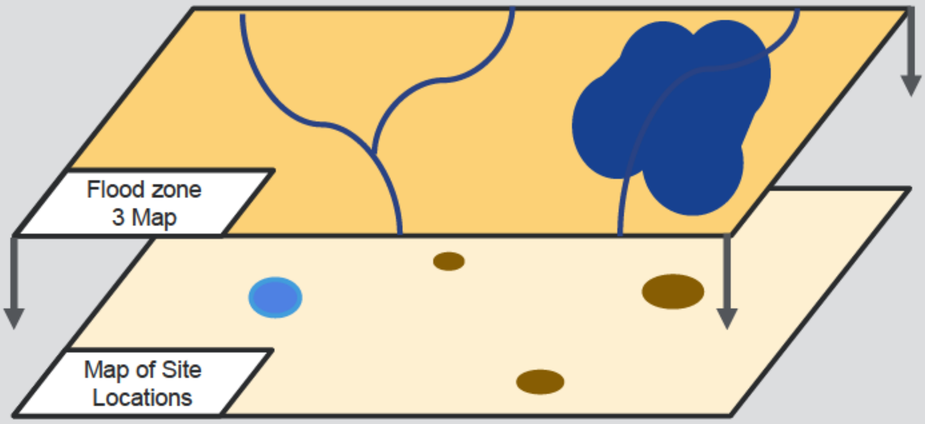
- Desktop Identification of site asset locations that were most vulnerable to flooding (as they are located within a Flood Zone 3).

Phase 2

- Determine Service delivery risk by determining where site assets had been historically flooded and, because sites are not being permanently flooded, determine if they now operate with a service delivery risk caused by the risk of repeat flooding events.

Phase 1

The overlay of mapping to understand site vulnerability to flooding:



1.3. Results

Phase 1

Vulnerability mapping highlighted to us that, because they were located within a Flood Zone 3; 508 of our combined Water supply assets, Wastewater Treatment or Wastewater Pumping sites were identified to be most vulnerable to flooding).

'*Most vulnerable*' means located in an area most likely to be flooded (i.e., are within a flood zone 3). Site located within a flood zone 2 are still vulnerable to being flooded, however the risk of occurrence is much lower.

Phase 2

Investigation to understand which of our combined Water supply assets, Wastewater Treatment or Wastewater Pumping sites have previously come into contact with flooding, it was discovered that:

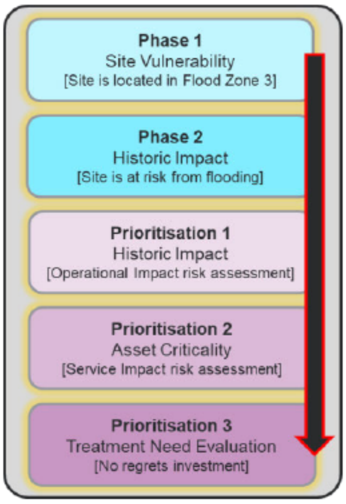
- 285 of the 508 flooding vulnerable sites identified from Phase 1 were either identified to be capable of resisting flooding shock or were confirmed to have never been exposed to a flooding shock. Service delivery risk for these sites was therefore assessed as low.
- 223 of the 508 sites were identified to have historically come into contact with flood waters.
- Other sites not located within a flood zone 3 had been historically affect by flooding.

It was decided here that, although flooding was reported to have happened previously at some sites, for these not also within a Flood Zone 3 location, the flooding could have been caused by factors other than climate change (e.g., system design, asset heath and unaccounted for catchment development). Seeking funding in PR24 for these was therefore inappropriate without further investigation]. [Chapter 3 outlines, 'Our Longer-Term Plan for Flooding Resilience Enhancement Investment due to Climate Change'].

1.4. Determining Priority Investment Needs for AMP8

Armed with the results from Phases 1 and 2, Figure. 4 shows the risk assessment and treatment need evaluation process was employed to identify investment priorities for AMP8:

Figure 3: Risk assessment and treatment need evaluation process employed to identify investment priorities for AMP8



Initial Flooding Risk Assessment and Evaluation for treatment

Assessing and evaluating the flood risk for the 223 sites that had previously come into contact with flood waters concluded that:

223 sites had previously come into contact with flood waters		
65 of the sites impacted by flooding were significant enough risks to service that resilience needs were to be considered for PR24.	52 sites historically impacted needed further investigation during AMP8 to understand the service security at risk from future flooding.	106 sites were concluded to be sufficiently 'resilience capable' to prevent service impact caused by future flooding shocks.
High Priority	Medium Priority	Low Priority

Definition of Asset Criticality:
Asset Criticality is defined by a set of criteria (i.e., Service impacts) used to quantify the importance of its asset base in order for a company to remain viable and continue to deliver its service.

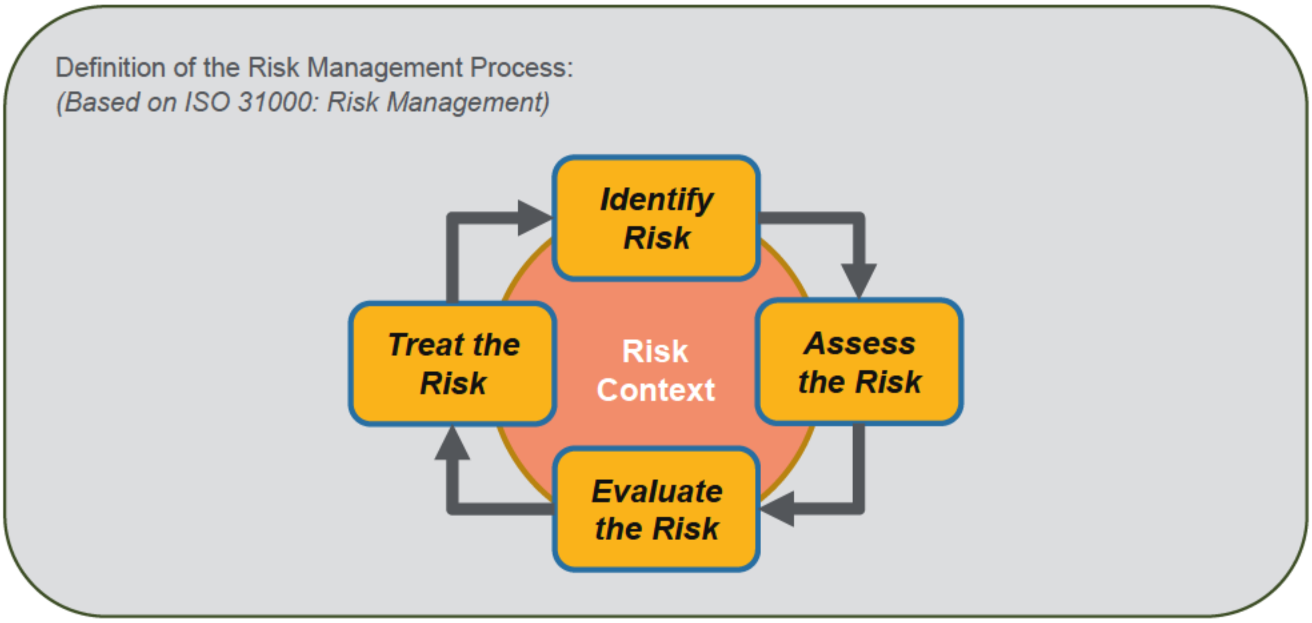
For Wastewater Asset Criticality, the following table summarises how a Southern Water Asset Criticality Classification (SWACC) score is arrived at:

Criteria	Threshold	SWACC
Environmental Impact	Very high impact sites – sites in very close proximity to sensitive waters with a score of more than 60.	4
	High impact sites – sites in close proximity to sensitive waters with a score more than 30 and less than or equal to 60.	3
	Medium impact sites – sites in close proximity to sensitive waters with a score more than 10 and less than or equal to 30.	2
	Low impact sites – sites in close proximity to sensitive waters with a score more than 0 and less than or equal to 10.	1
	No impact sites – sites with no impact to environment.	0
WTW Consent conditions	BOD (<7), NH3 (<3), P (<=0.5), Fe (1), UV (1)	4
	TSS (<=12), BOD (<10 and >=7), NH3 (<5 and >=3), N-Total (<9), P (<=1 and >0.5), Fe (<=2.5 and >1)	3
	TSS (<=35 and >12), BOD (<=20 and >=10), NH3 (<20 and >=5), N-Total (>=9), P (<=2 and >1), Fe (<=4 and >2.5)	2
	TSS (<60 and >35), BOD (<40 and >20), NH3 (>=20)	1
	TSS (>=60), BOD (>=40)	0

Taken from Southern Waters, 'Asset Criticality Framework - ACF001 – Definition- June 2022 version 1.0.'

Using the Asset Criticality SWACC scoring, a further asset criticality prioritisation assessment, of the 65 potential PR24 high priority candidate sites, was then undertaken. Asset Criticality scores were evaluated to assess and value the potential impact caused if the site was taken out by a shock flooding event. This resulted in 25 critical sites being prioritised as candidates for resilience enhancement investment during AMP8.

The 25 prioritise sites were then validated for their treatment needs at a meeting held between our Operations, Asset Strategy & Planning and our Engineering departments. Gathered evidence was presented and this final evaluation stage (of the risk management process) took place to validate that each site needed specific resilience improvement investment, during AMP 8.



Conclusion

The result of this process was:

1. 19 sites were re-prioritised for further investigation during AMP8.
2. 6 sites were identified as requiring investment to enhancement resilience to flood event vulnerability, during AMP8, to minimise the service impact that these events realise.

Table 1 is a summary table showing the 6 sites approved for no regret's investment during AMP8. The calculated valuations in this table can be found (and are defined) in the later sections of this document:

Table 1: Summary table showing the 6 sites approved for no regret's investment during AMP8

WTW Site	AMP8 Solution Budget (£)	Annual Forecast Service Impact Benefit (£)	Anticipated Flood Event Frequency	Forecast Cost Beneficial Payback (years)	Annual Forecast OPEX Cost	Forecast Embedded Carbon (tCO2e)
Battle	£0.99m	£0.11m	1 in 5 years	8.9	£0.00	26.48
Catsfied	£0.99m	£0.05m	1 in 5 years	20.8	£0.00	26.48
Maresfeild	£0.42m	£0.80m	Annual	0.5	£0.00	7.7
Sedlescombe	£0.99m	£0.80m	Annual	1.2	£0.00	26.48
Halland	£0.99m	£0.87m	Annual	1.1	£0.00	26.48
Neaves Lane, Ringmer	£0.99m	£1.10m	Annual	0.9	£0.00	26.48
Total	£5.36m	£3.73m		1.4	0.00	140.10

The evidence gathered to demonstrate that each of the 6 investment candidates are both highly vulnerable to flooding events and have been previously flooded (and will therefore be more frequently flooded due to the impact of climate change), is shown below in the Investment Cases section.

Investment Cases:
The below information evidences the ongoing risk of site flooding as climate change both increases the frequency and magnifies that intensity of shock rainfall events.
Population Equivalents (PE) data taken from JR Population Data (RC23 PE)

1.4.1. Battle WTW

Battle WTW is confirmed as being located in an area vulnerable (Zone 3) to being flooded.
The site serves a PE of 6,412 (increasing post AMP7 due to projected catchment growth).

Figure 4 and Figure 7 shows the site physical location is shown to be vulnerability to flooding with reference to the EA flood maps.

[redacted]

Figure 4: Battle WTW satellite picture

[redacted]

Figure 5: Battle WTW flood maps

Flooding of the site has previously occurred in 2015 and 2023 where flood waters caused by heavy rainfall blocked the site entrance. The local stream/culvert overtopped, the egressing flood water onto the sites access road. The cause of the floodwater is thought to be land run off that overwhelms the natural flood management and diverting flows onto the sites access road. Flood water is then carried by the site access road into the works. These flood waters overwhelm low laying treatment process assets, causing issues with treatment delivery.

<u>Historic Evidence of Flooding from 2015 and 2023</u>

Figure 6 and Figure 7 show photographs taken during the 2015 flooding event and Figure 8 and Figure 9 show the 2023 flooding events. All show that access to the site and processes have been compromised, affecting site performance.

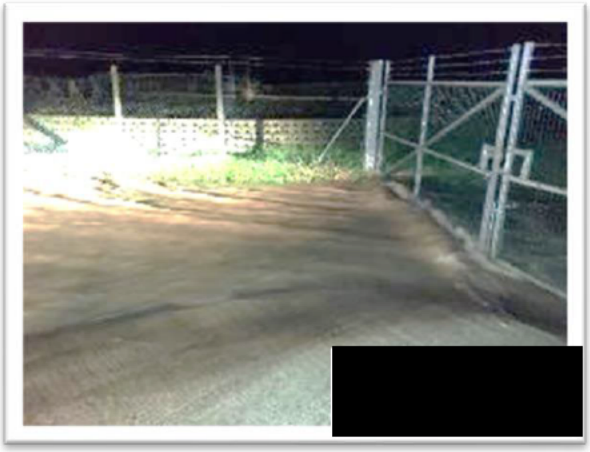
2015

Figure 6: (Site Entrance)

2015

Figure 7:(Humus Tank)

2023



[redacted]

Figure 8: (Site Entrance)

2023

[redacted]

Figure 9: (Humus Tank)

1.4.2. Catsfield WTW

Catsfield WTW is a small filter site serving a population equivalent of 520.

Site physical location (Figure 10) is shown to be vulnerability to flooding with reference to the EA flood maps (Figure 11):

[redacted]

Figure 10: Catsfield WTW satellite picture

[redacted]

Figure 11: Catsfield WTW flood map

Figure 12, shows the Fluvial (River) Flood Mapping and Figure 13, shows Pluvial (surface water) Flood Mapping:

[redacted]

Figure 12: Catsfield WTW Fluvial flooding mapping

[redacted]

Figure 13: Catsfield Pluvial flood mapping

Figure 14 and Figure 15 show that the Access Road to site being Impacted due to the 2016 Flood Event

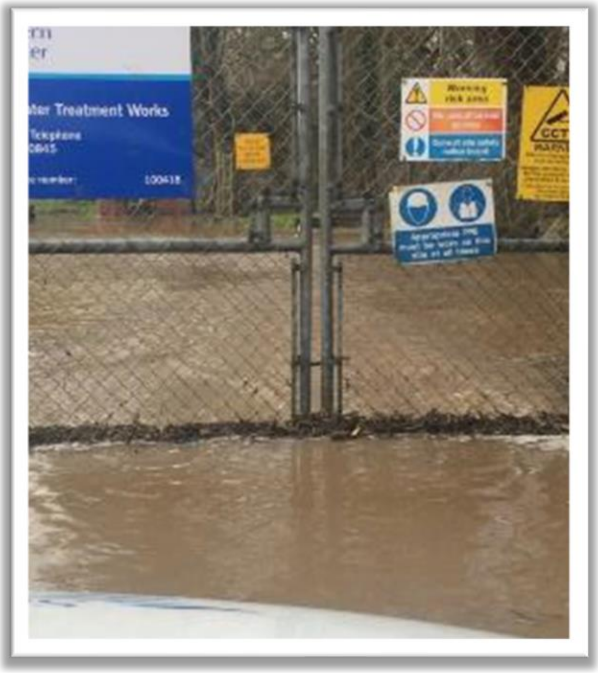


Figure 14: (Site Entrance)

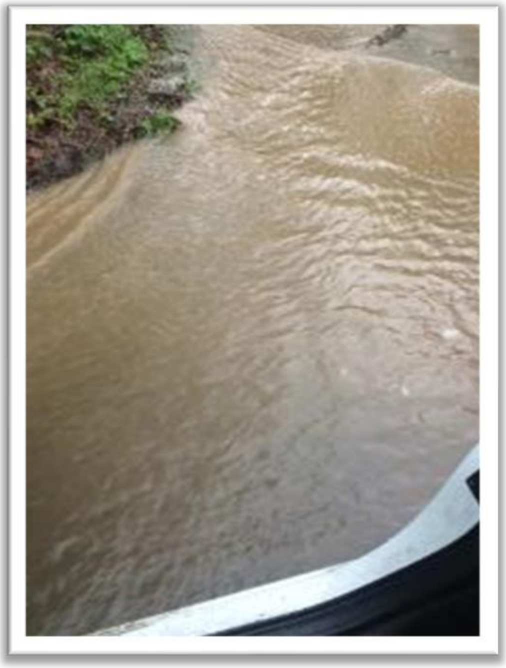


Figure 15: (Access Road)

Figure 16 Shows that extent of the flood water Impact on the site:

Figure 16: (Lower site flooded)

1.4.3. Maresfield WTW

Maresfield is a medium sized biological filter works serving a population of 1751.

Figure 17 shows the sites physical location and Figure 18 the sites vulnerability to flooding with reference to the EA surface water flood map:

[redacted]

Figure 17: Maresfield WTW location

[redacted]

Figure 18: Maresfield WTW flood map

Historic Evidence of Site Flooding from 2020:

Figure 19 shows the evidence of the site impact that previous flooding events have caused:

- The sludge holding tank (right in the picture) fills up and then spills to the storm tank, most likely caused by a combination of ground and surface flood water ingress.
  - (For information - the tank to the left in Figure 19 is the storm tank (the channel in the middle is the storm overflow).
- Storm event rainfall then causes two things,
  - (1) the sludge tank receives even more flow, causing it to over top into the storm tank.
  - (2) The storm tank fills with the excess storm water flow coming into the site and, once full, spills directly to the environment (as it is designed to do).

Figure 20 shows the post event asset condition (what the flooding event results in). Both of these tanks fill to capacity and overtop at that same time, which is a potential pollution risk.

Figure 19: Site impact flooding 1

Figure 20: Site impact flooding 2

The storm tank is for excess rainwater storage. Figure 21 shows the level of solid material remaining in the storm tank once all storm flow captured in the storm tank has been returned to the head of the works for treatment. It is certain that this has not come from the rainwater.

The obvious conclusion is that the adjacent sludge holding tank has flooded and spilt solids into the storm tank.

Figure 21: Solid material in storm tank

Flooding events at the site are estimated to result in the sludge tank overtopping into the storm tanks 4 times annually.

However, the storm-tank outfall is not currently monitored (quantitively or qualitative), so data to verify this is unavailable.

Figure 22 demonstrates that the situation was already present during 2017:

Figure 22: 2017 Storm tank picture

1.4.4. Sedlescombe WTW

Sedlescombe WTW is a conventional biofilter works treating a population equivalent of 1046. Figure 23 and Figure 24 shows the sites physical location and boundary used with reference to the EA flood maps:

[redacted]

Figure 23: Sedlescombe WTW location

[redacted]

Figure 24: Sedlescombe WTW flood map

Figure 25 shows that the site is in a fluvial flood risk Zone 3, and also pluvial flood risk Zone 3 (Figure 26).

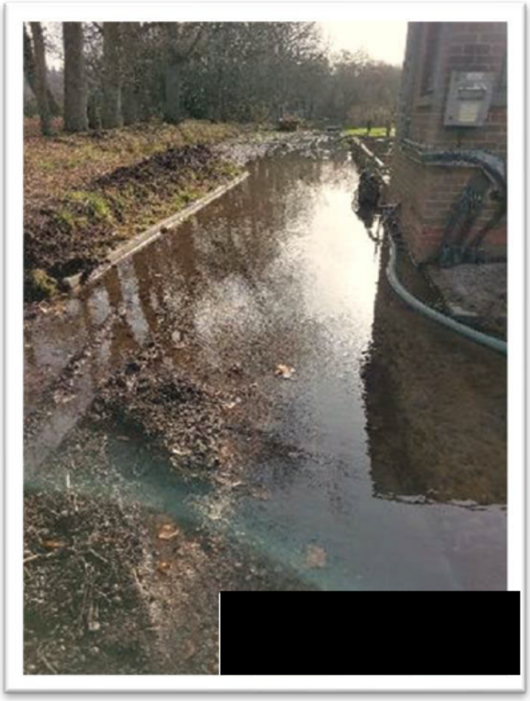
[redacted]

Figure 25: Fluvial flood risk map

[redacted]

Figure 26: Pluvial flood risk map

Figures 27, 28 and 29 shows evidence of the site flooding event in January 2023, they show flooding of the site access road and into the site.



[redacted]

Figure 27: Site flooding 2023 picture 1

Figure 28 (Site Access Road)

Figure 29 (Site Entrance)

Historic Flood Events

Flooding has also occurred yearly between 2018 – 2022. Figure 30 to Fig. 35 below shows the extent of flooding at the site on these occasions.

Figure 30: Flooding impact during 2018

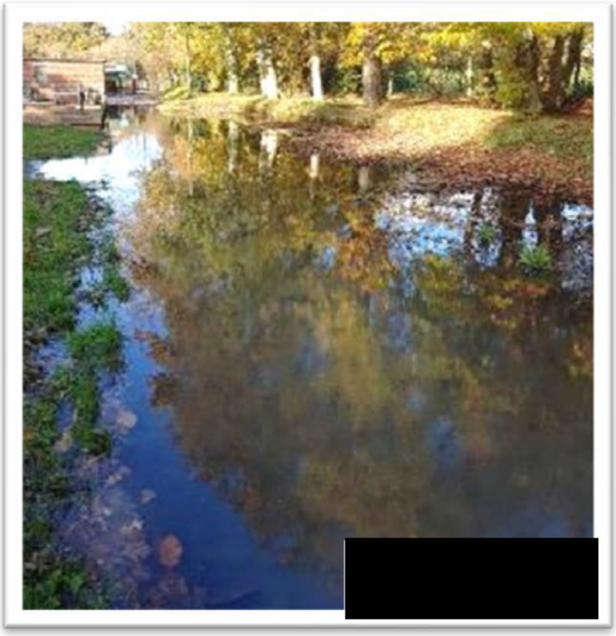

[redacted]

Figure 31:Flooding impact during 2019

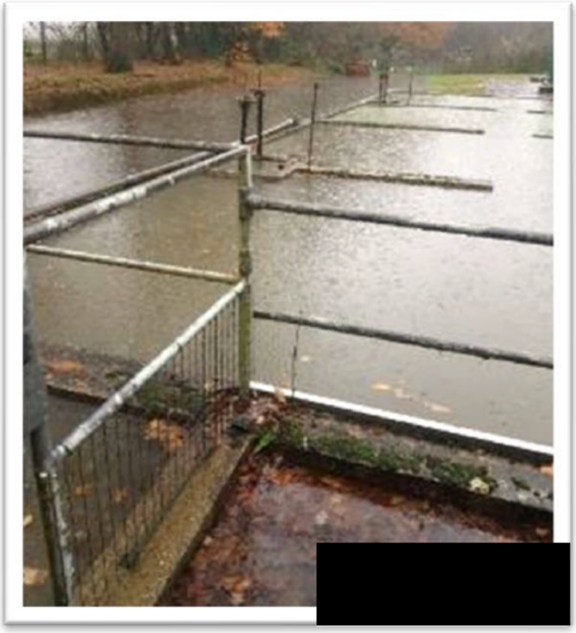

[redacted]

Figure 32: Flooding impact during 2019


[redacted]

Figure 33: Flooding impact during 2020


[redacted]

Figure 34: Flooding impact during 2020


[redacted]

Figure 35: Flooding impact during 2021

Figure 36 and Figure 37 shows that flooding occurred again during 2022.

Figure 36: Flooding impact during 2022


[redacted]

Figure 37: Flooding impact during 2022

1.4.5. Halland WTW

Halland WTW is a small oxidation treatment works serving a population equivalent of 450.
Final effluent discharges to a stream next to the site

Figure38 40 shows the sites physical location. Figure 39 shows the site boundary with reference to the EA flood mapping. Figure 40 shows that the entrance to the site is vulnerable to flooding.

[redacted]

Figure 38: Halland WTW site location

[redacted]

Figure 39: Halland WTW Flood maps

[redacted]

Figure 40: Entrance to site flood map

The site discharges final effluent into the unnamed /stream adjacent to the site. The stream is for land drainage and is the source of the area being in a zone 3 risk of flooding.
When the ditch overtops, the site is unable to fully discharge (the outfall is below the top level of the ditch, so becomes hydraulically blocked). Undischarged flows back up into the works, resulting in the sites treatment process being inhibited. Levels of solids within the treatment process remain high.

Figure 41 and Figure 42 show evidence of the flooding shock caused during 2022:

The stream that floods is located to the right of the sites entrance.
When this bursts its banks, the entrance to the site becomes flooded.

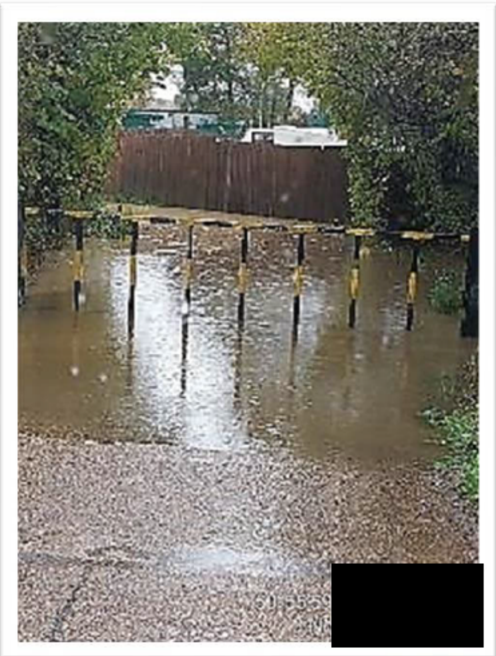
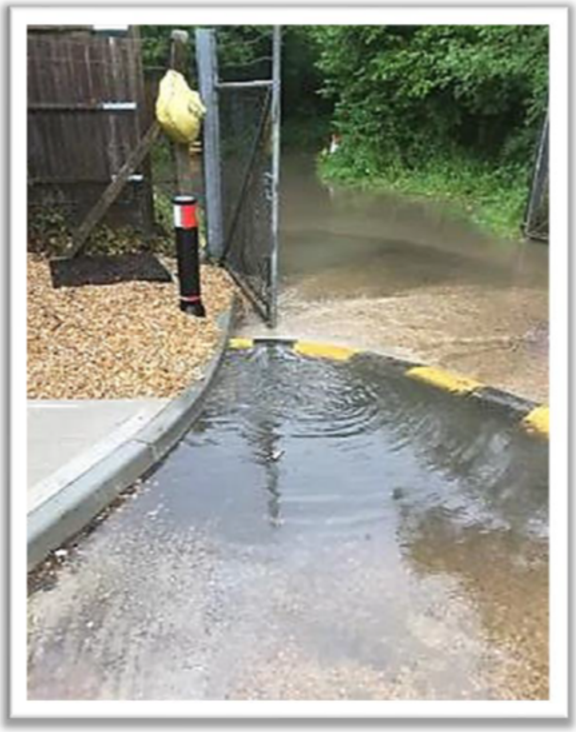


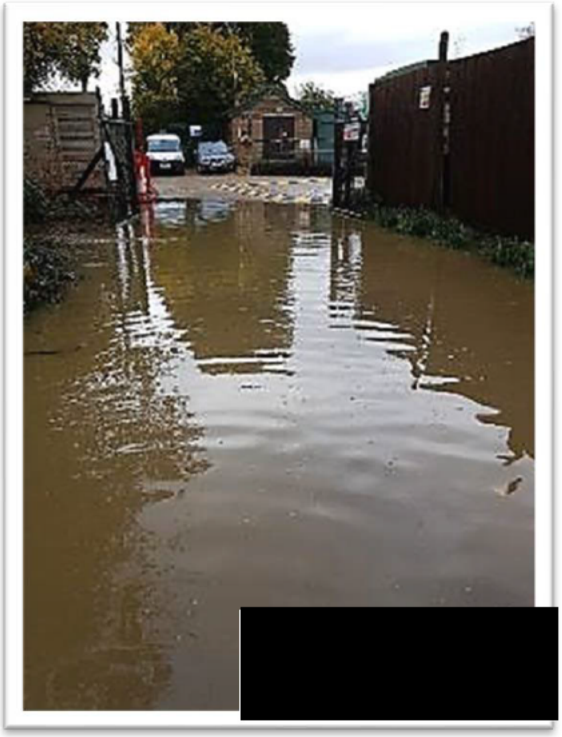
Figure 41:(Access Road Entrance)

Figure 42: (Access Road Entrance)

When flooding has previously occurred, the flow of sewerage coming into the works to be treated then cannot escape, once treated, as Final Effluent from the works outfall. The process therefore becomes backed up, inhibiting treatment. This is forecast to be the result of every flood event.

Figure. 43 and Figure 44 shows that the 2019 flood waters travel the length of the access road and flowed into the site.





[redacted]

Figure 43: (Site Entrance)

Figure 44: (Site Entrance)

1.4.6. Neaves Lane, Ringmer

Neaves Lane, Ringmer WTW is a biological filter works treating a population of 5261 PE.

Fig. 47 show the sites location. Fig. 48 and Fig.49 shows the sites flood zone 3 vulnerability.

[redacted]

Figure 45: Neaves Lane, Ringmer site location

[redacted]

Figure 46: Neaves Lane, Ringmer flood maps

[redacted]

Figure 47: Neaves Lane, Ringmer flood maps

In November 2022 the site experienced what the Site Manager described as the event as, “the worst site flooding anyone can remember”. Figures 48 to 51 show that the flooding was down the entire length of the site’s boundary with the adjacent ditch/stream.

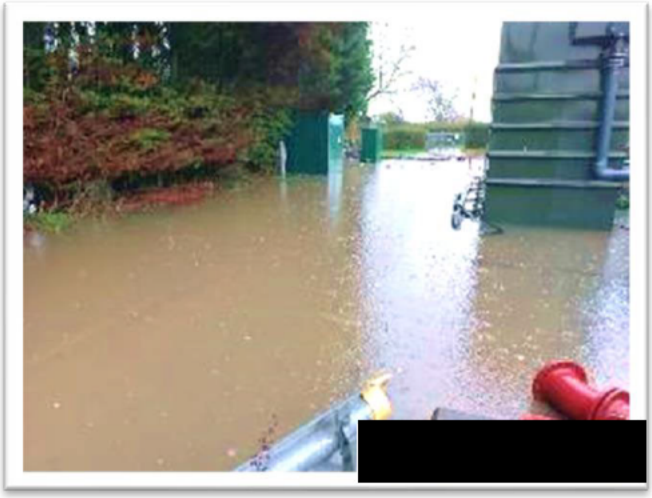


Figure 48: (Back of the site)

Figure 49: (Middle of the site)

Figure 50: (Storm overflow chamber)

Figure 51:(Middle of the site – other direction)

Figure 52 and Figure 53 show that the site outfall was fully submerged by flood water.

Figure 52:(Outfall)

Figure 53: (Outfall)

Operational staff for the site estimate flooding to be occurring 2-3 times per annum. Figure 54 shows the condition of the outfall when the site flooding has been less severe, however it still highlights why there is a need for a wet weather waiver at the site due to impact of flood water.

Figure 54: (Outfall)

During a flooding event in 2021, the ultrasonic detection head was unusable due to flood water in the storm tank (see Figure 55 and 56).

Figure 55: (Storm Tank)

Figure 56: (Storm Tank)

2. Needs Case for Enhancement

Flood events at the 6 identified sites demonstrate, not a future potential flooding risk to be managed, but future flooding certainty (or an issue) needing to be prevented from becoming a problem. Flooding will happen again, and it will disrupt the sites service delivery. Preventing service delivery impacts from climate change caused shocks, rather than responding to the symptoms caused by these foreseeable events (to minimise environmental impact) aligns with both our customers' expectations (customer engagement shows a desire for us to invest more to prevent environmental pollution) and the businesses Long Term Delivery Strategy (LTDS), which highlights the critical environmental impact climate change is causing. Investment to enhance specific site resilience is therefore needed for us to secure site service provision, for our customers, into an uncertain climate future.

A key Business Objective for Southern Water, supported by both our customers and our Board, is the reduction in the number of pollution events caused annually, and with the level of environmental impact occurring. This investment should minimise the probability that the estimated average of 2.4 shock flooding event every year will also result in uncontrolled environmental pollution[1].

The below information points are the most relevant factors (and pieces of information) identified in our LTDS that supports our proactive investment to make our service provision more resilience to the current and projected effects of the Climate change shock events:

- The UK's population has grown significantly in the last in 20 years and is predicted to continue to grow [reference: Overview of the UK population - Office for National Statistics (ons.gov.uk)].
- It is speculated that increased housing development will require new flood water management solutions.
- Climate change is impacting our environment and the way we operate both our water and wastewater services.
- There is an emerging need to reduce carbon emissions.
- Climate forecast projections include more extreme weather; warmer land, air, and sea; the melting of polar ice leading to rising sea levels, changes in ocean currents. Seasonal storms are increasing in intensity and hyper-locality.

Through AMP8 investment, we seek to ensure that the identified sites are made more resilient to flooding caused by the changing climate. Solutions will account for the expected future growth in our catchment and will use technology to demonstrate we are prioritising the environment and providing data transparency.

[1] The weather conditions may be taken into account by the EA when assessing categorisation, so they do not necessarily impact Cat 1-3 pollution performance. However, this does not mean that the environment is not impacted.

The Need for Enhancement Vs. Base Investment

Base service maintenance funding (BOTEX) does not include within its scope the planned investment required to address this type of service risk. Neither is a purely reactive incident response approach valid (because there is nothing, we can do to respond to a flooded site to reduce the impact chance, or impact level, until the flood water has retreated). Sites are not poorly maintained or have been poorly designed. Vulnerability has increased because the environment at the location, that sites are required to operate in, has externally changed. Shock flood events are unpredictable. Climate change has increased the weather unpredictability, so that that there is now a high risk of there being shock flood events occurring during the summer months rather than just during the traditionally wetter winter months. Managing the risks caused by climate change has therefore become a significant challenge for us delivering service maintenance. It now requires a different and innovative approach to understand, and enhance, what our infrastructure service resilience should look like.

UK Summer flood Events*
In August 2022, large swathes of the UK have been hit by thunderstorms and flash flooding in recent days, after weeks of hot and dry conditions. One town in England experiencing almost twice the monthly average rainfall in a three-hour period.

*as reported by the BBC 18th August 2022 - In pictures: Flooding across UK this week after heavy rain - BBC News & UK weather: Storms and rain bring flash floods to southern England - BBC News

The Resilience Enhancement needs case for each of the 6 sites is outlined below:

2.1. Battle WTW

Investment is needed to enhance the resilience of the site to the shock of being flooded.
Enhancement intervention is needed because historic events caused by the current climate change, have significantly impacted the sewerage treatment system performance, and repeat events are certain to occur again and with an escalating frequency due to the ongoing change in climatic conditions. Flood events inhibit treatment to sites ability to treat sewerage.

With reference to the most recent flooding event during 2023, the impact of the flooding was as follows (information provided by the sites Operational Manager)

- Site operations report that the water depth was, in places, knee level.
- Access to the site was prevented for approximately 3 days.
- Once the flood water has abated, Ops estimate that wastewater treatment service was recovered after approximately 2 days.
- In total, the site impact of discharging noncompliant final effluent lasted about 5 days.
- That is risk assessed to most likely to result in the environmental discharge of noncompliant and partially treated effluent.

Given that the last 2 flooding events occurred during 2015 and 2023 (an 8-year gap), and that the evidence discussed in this paper assesses that climate change will accelerate the frequency of flood events, we assess that it is highly likely that the site will be flooded again during AMP8, with a 1 in 5 year assessed risk. Assessed to most likely be impacted by 0.2 flood events per year.

An additional factor for investment at the site is due to is Battle WTW being enhanced during AMP7 to increase treatment capacity (due to population growth in the catchment served). FFT is increasing from 42l/s to 56 l/s (service provision at Battle WTW is therefore increasing by 33%) and the flood event risk is not being addressed by the AMP7 funding pathway.

2.2. Catsfield WTW

Catsfield WTW has a critically (level 4) tight Final effluent discharge permit to maintain compliance with (0.5mg/l Phosphorous annual average).

Currently, flooding occurs at the site every 5 – 10 years. The evidence discussed in this paper assesses that climate change will accelerate the frequency of flood events. We risk assess that it is highly likely that the site will be flooded again during AMP8, with a 1 in 5 year assessed risk. Assessed to most likely be impacted by 0.2 flood events per year.

When a flooding event occurs, the site is flooded for 2 – 3 days and subsequently a wet weather waiver is required as a representative sample of the site final effluent cannot be collected.

In addition, there is an additional pollution risk to the environment from the flooding caused by a previous baseline investment mitigation solution:

- The solution to Sludge holding tank leaks was that the escaping liquors are collected via an open gully in front of the tanks that returned to the treatment process.
- When the site becomes flooded, these gullies are also highly susceptible to flooding. That results in an unquantifiable spill of untreated effluent to the environment.

Investment is needed to enhance the resilience of the site to flooding. Enhancement intervention is needed so that the sewerage treatment system performance will not be impacted due to flood water.

Flooding events like those observed cause the discharge of partially treated final effluent into the environment (the local water course).

2.3. Maresfield WTW

Investment is needed to enhance the resilience of the site to being flooded after heavy rainfall.
Flooding by surface water has previously impacted wastewater treatment assets at the site. Operational teams advise that the flooding currently occurs 3 – 4 times annually and impacts the asset operation for approximately 48 hours per event. There is currently no operational response possible to mitigate because the site operates as it is designed. Enhancement is required to accommodate the increased stress generated by the changing environmental conditions. Assessed to most likely be impacted by 4 flood events per year

2.4. Sedlescombe WTW

Currently the site floods multiple (3-4) times a year. Operational teams advise that the flooding of the site can last up to a week, and that this occurs multiple times every year, so a Category 3 or 4 pollution would be a consequence.

Due to the flooding, a wet waiver for exceptional conditions is needed multiple times a year. Assessed to most likely be impacted by 4 flood events per year

The source of the flooding via the access road (shown in the evidence provided in section 1) is a culvert/stream that runs alongside the site access road.

2.5. Halland WTW

When the ditch adjacent to the site becomes flooded due to rainfall the sites final effluent outfall (which also discharges into this ditch) is submerged. Site treatment is inhibited, and the site requires a wet weather waiver.
The current impact of Climate change is that the shock event currently occurs 2 – 3 times every year. Assessed to most likely be impacted by 3 flood events per year.

The flooding caused by rainfall is estimated to last 1-2 days.

Once the outfall becomes unsubmerged, the sites service is estimated by Operational teams to recover back to compliant in an estimated 24 hours.

We risk assess that it is most likely that the effluent discharge to the environment while the site recovers will cause a Category 3 or 4 pollution.

2.6. Neaves Lane, Ringmer WTW

As previously stated, flood water backs up into the final effluent sample chamber 2 – 3 times per year. Assessed to most likely be impacted by 3 flood events per year.

The level of flooding is increasing, with 2022 being quoted operationally as, "the worst flooding on record". In 2022, the site water severely flooding for approximately 24 hours. Once the flood water has abated, Ops estimate that wastewater treatment service was recovered after approximately 24 hours. In total, the site impact of discharging noncompliant final effluent lasted about 2 days.

It is estimated that 10 – 15 wet weather waivers due to flooding will be needed during AMP8.

Flooding Event like that observed in the winter of 2022 disrupt service delivery and cause the discharge of partially treated final effluent into the environment (the local water course). The annual frequency of events means the that the polluting impact is Category 3 or 4.

The source of the flooding is a culvert/stream that runs alongside the treatment works.

3. Best Option for Customers

All of the 6 Wastewater Treatment sites, to be treated during AMP8 by having their Service Resilience Enhanced, are at Service delivery risk because they have been previously flooded. The accelerated impact of climate change means that repeated flooding events will occur with an increasing frequency, and at an increasing magnitude, into the future.

Doing nothing at these sites during AMP8 was therefore not considered as a viable option. Doing nothing would not align with our business priorities or with the values our customers have articulated that they expect us to prioritise investment in.

Affordability

From feedback received in the run up to PR24, a high priority for our customers was affordability. Although our PR24 customer engagement questioning showed that a significant majority of our customers feel that bills are currently affordable, they do want us to ensure that current billing won't push necessary work out for future generations to pick up the cost. However, our overall business plan will significantly increase bills so flooding enhancements have been spread over multiple AMPs.

Through the site identification and Decision-Making process, used to prioritise those sites requiring additional resilience investment to being flooded, we have then taken a pragmatic approach to our proposed investment and can articulate what is needed across the next 3 AMP periods.

Specifically, those sites where enhanced resilience is needed to address current issues (rather than risks) have been prioritised for AMP 8. When there were vulnerable sites with a high-risk profile, but we only had limited evidence of a service risk from flooding, these have been deferred for investigation with the potential inclusion for investment during AMP 9.
The purpose of this approach is to deliver the greatest positive impact to resilience while minimising the impact our investment plan will have on customer bills. We believe that this approach best ensures that both our customers' needs will get met, and vulnerable customers get supported, by ensuring that the AMP8 bill increases is marginal.

Customer Value

We consider that, by our decision to only pursue investment at 6 (via our robust prioritisation process) of the 65 sites impacted by flooding were significant enough risks to service that resilience needs were to be considered for PR24, we align strongly with the goal of meeting customer affordability. The amount of funding requested to address an average of 2.4 shock flooding events every year (this is the average number of annual flood events we assess as most likely impacting the 6 sites annually, within Section 2 above, i.e., 0.2 flooding events a year at Battle and Catsfield, 4 events a year at Marefield and Sedlescombe, 3 events a year at Halland and Neaves Lane (average = 14.4/6) = 2.4 events a year., we believe, represents good value for the customer (each of our 4.6 million domestic wastewater customers being asked to pay just over £1 (£1.17) over the next 5 years), and this is also a prudent and proportionate way to manage the risks identified.

The total programme notional average pay-back period being just 6 years.

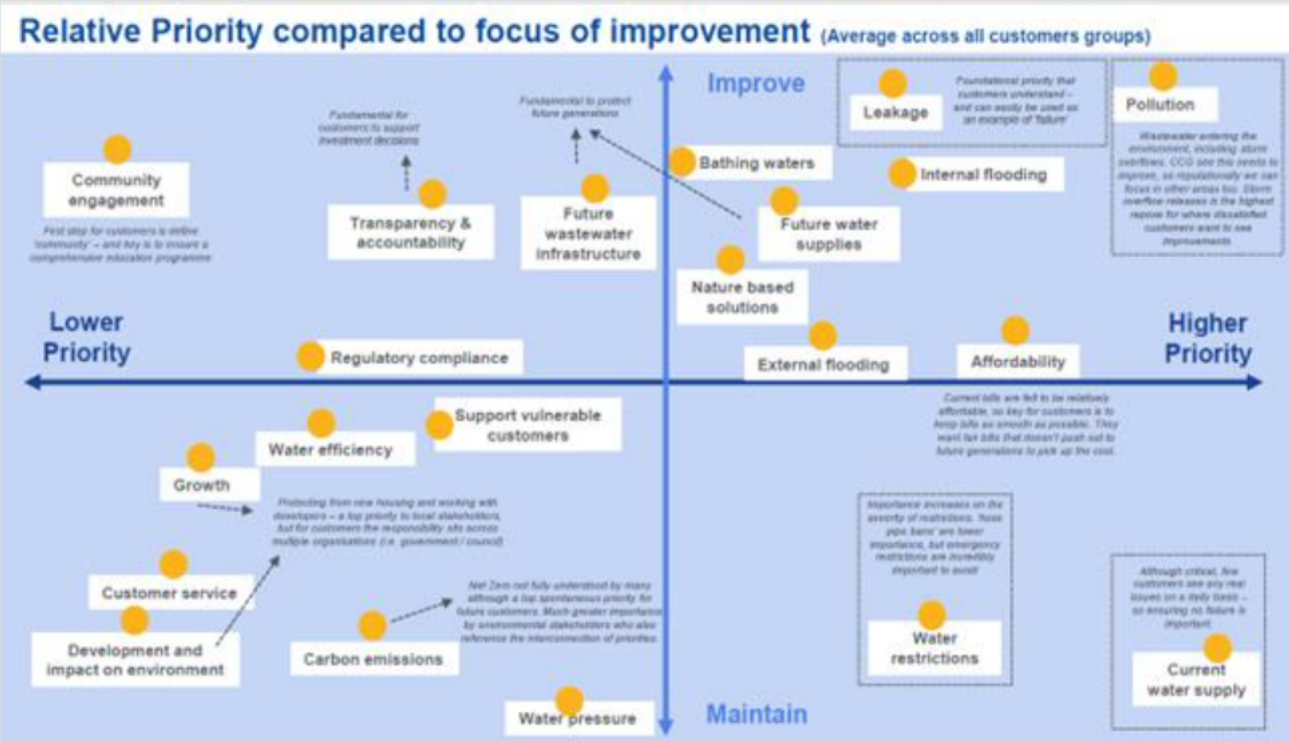
Our Service Measure Framework (SMF) has also provided us with insight for how our customers value, 'service impact prevention'. In this wastewater space, our customers engagement in this space has provided a monetised value for us:

- Prioritising H&S
- Minimising our environmental impact.
- Maintaining our sites as operationally compliant to all permitted requirements and obligations

We maintain a key Business Objective, that is fully supported with evidence gathered via customer feedback forums, to focus on the mitigation and control of environmental pollution risk. Any investment to enhance resilience must also come with high confidence that service impact can be minimised.

While customers were not asked directly if they supported investment to address Climate Change impacts, and pluvial/fluvial flooding specifically, their stated importance that we address the causes of pollution, a clear driver for flood resilience at the 6 sites, was obvious. The 6 sites chosen represent a high confidence investment need. While many of the remaining 59 sites not yet prioritised will likely require similar requests for resilience enhancement during AMP9.

Chart to highlight the work done on the run up to PR24 has highlighted that preventing pollution is a high priority improvement that our customers expect us to deliver on:



Our Longer-Term Plan for Flooding Resilience Enhancement Investment due to Climate Change

The proposed investment during AMP8 is only the start of a sustained programme of vulnerability assessment, risk assessment and investment planning needed to combat the projected negative impact of climate change. Our high-level strategy to the increasing vulnerability of our assets becoming flooded, for the next 3 AMP periods, can be summarised as follows:

AMP8

- Deliver the no regrets programme to enhance the resilience to flooding at Critical Sites identified in highly vulnerable location due to a shock/stress caused by climate change.
- Enhanced investigations and studies to understand the needs for our core future investment planning. Specifically, for:
  - The risk and resilience enhancement need at critical sites that have been impacted by the climate change shock/stress, but are not modelled to also be in a highly vulnerable location.
  - The risk and resilience enhancement need of critical sites that have come close to being impacted by a climate change shock/stress and are modelled to be in a highly vulnerable location.
  - The risk and resilience enhancement need of those less critical sites that have been impacted by climate change and have been affected by a climate change shock/stress.
  - The risk and resilience enhancement needs of those sites that have been identified as vulnerable, from the modelling, but where the historic impact of climate change was unable to be assessed.
- Work to model and understand the climate change minor and maximum vulnerability adaptive scenarios (2.6°C and 8.5°C temperature rise) and identify the future trigger points that will facilitate the need for deviation from our core investment plan (only core or current vulnerability has been modelled during AMP7. Future scenarios were not available).
- Create a complete company core risk and resilience baseline position for all vulnerable asset types.

AMP9

- Deliver a core no regrets investment programme to enhance the resilience to climate change identified in highly vulnerable locations, due to a shock/stress service risk caused by climate change.
- Update resilience baseline position to climate change.
- Update core and adaptive vulnerability models and re-baseline the AMP10 and LTDS investment plans

AMP10

- Deliver a core no regrets investment programme to enhance the resilience to climate change identified in highly vulnerable locations, due to a shock/stress service risk caused by climate change.
- Update the asset resilience baseline position due to climate change shocks/stresses.
- Update core and adaptive vulnerability models and re-baseline the AMP11 and LTDS investment plans

Our Responsible Business commitments.
[April 2022 V.2]

Because it seeks to make our service delivery more resilient for our customers and puts protecting the environment first, the climate change investment proposal aligns with many of the priorities we have articulated within our published Corporate Responsibility Policy:
[corporate_responsibility_policy (southernwater.co.uk)]

“Our vision is to create a resilient water future for customers in the Southeast. We have a critical role in looking after public health and are committed to making a positive impact for the good of our customers, communities, and the environment. As a business we work to a strong set of core values: doing the right thing, succeeding together and always improving. We also believe that being a responsible business requires a clear and continuing focus on environmental, social, and governance (ESG) matters. This policy sets out the various ways we demonstrate our commitment to being a responsible business.

Committing to high standards of corporate governance and complying with the relevant principles and provisions of the UK Corporate Governance Code and objectives of the Ofwat Principles. For example:
- Understanding what matters most to our customers and stakeholders, considering their priorities alongside our own assessment of what has the biggest impact on our ability to create value.
- Treating customers with fairness and respect, considering their diverse needs, and meeting or exceeding the performance levels promised to them while ensuring affordable bills for current and future generations.
- Ensuring excellent customer service, putting customers, the environment and other water users at the heart of everything we do.
- Conforming to our compliance obligations and being honest and transparent in communicating our strategies, targets, performance, and governance.
- Valuing the contribution and wellbeing of employees and aiming to ensure they, and job applicants, are treated fairly, equally, and with respect and dignity.
- Providing and striving to maintain a clean, healthy, safe, and secure working environment.
- Leading and participating in research and development to enhance quality of service to
- customers, improving methods of working and addressing long-term strategic challenges.”

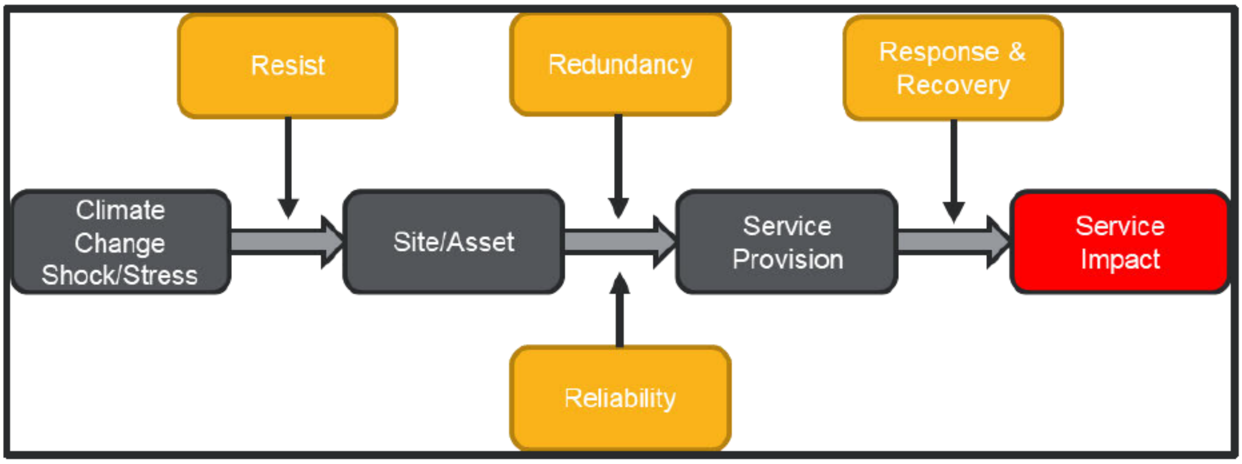
Innovation

Resilience is not one thing, so resilience enhancement will not involve one, or a standard, solution. Being resilient to flooding might invoke images of us needing to build a wall around our entire site to keep the water out. This type of response is, in fact, only part of the resilience consideration.

Resilience is a blanket term used to cover four separate ways in which an infrastructure delivery system can become deformed, without what the system delivers becoming compromised.

Figure 57 shows the four elements of resilience in context of how that prevent service impact despite the event occurring:

Figure 57: four elements of resilience



Resilience enhancement therefore refers to an improvement in any or all of these four areas, so that the overall site system can adapt, when flooding occurs, to prevent service impact.

Solution Development

Prior to gaining the funding required to design the bespoke site solutions, via our Risk and Value project delivery process, for PR24; [redacted] were engaged to provide Southern Water with three levels of the most likely generic resilience enhancement solutions, to the escalating consequence of flooding.

These solutions were to cover the different types and sizes of assets with our portfolio, and the options were to cover an escalating resolution complexity within the Totex hierarchy. All the developed solutions were cost estimated, via our Cost Intelligence Team (CIT), using the standard method (cost curves) used for all of the other items within this wider business plan submission. Details of how can be found in SRN15 Cost and Option Methodology Technical Annex section.

The Totex Hierarchy:
This is an expression used when undertaking the development of a solution to enhance an existing delivery system (i.e., one that already has assets in situ).

Solution Category		Example - River Quality (P)	Certainty
	Eliminate	**Remove the root cause** of the Risk through modified customer behaviour or process/ system changes.	L/M
	Operate	**Operational or Maintenance** Solution require adherence to standards to ensure Outcomes are met and system failures are eliminated.	M/H
	Invigorate	**Leverage Asset capabilities or unused headroom** by increasing the capability of existing or redundant assets through the implementation of latest thinking, best practice, proactive principles, advanced data analytics and control systems	H
	Fabricate	**Construction of new assets** to meet Customer outcomes.	H

Increasing TOTEX
Collaborative effort required

These solutions focus on dealing with the site-based symptoms of flooding. Innovation and Catchment solutions have not been discounted. These things, however, can only be explored once a full project is funded and the root causes of site flooding can be fully identified and explored to identify the best holistic treatment mode.

Option	Impact Level Scenario	Solution Complexity
1	1	Low
2	2	Medium
3	3	High

Table 2 outlines the range of escalating generic flooding treatment solution options that have been proposed to increase the resilience of an entire WTW site to being flooded:

Table 2: Solution options

Option	1	2	3
Expected level of Impact from Shock	Flood water encroaching on the treatment works	Safe access to the Treatment works is prevented due to flooding	Treatment works is inoperable due to flooding
Option Description	Install temporary flood protection measures & improve asset reliability	Build perimeter defences preventing water ingress	Contribute/invest in catchment wide schemes which store/divert water.
Intervention Type Description	Install de-mountable defences to doors and vents (etc.). Seal identified leak pathways and resolve building fabric issues. Move equipment out of the flood waters path.	Build perimeter defences from a mixture or permanent and de-mountable flood defence products. Install 'up and over' steps to allow for access during flood events.	Increase the standard of protection of existing flood defences (internal & external) Creation of additional flood plain storage/management upstream to reduce peak water level/flood extent.

Engineering Technical Solutions (ETS) has anticipated at this stage (i.e., prior to root causes of the flooding being determined beyond shock rainfall) that the solution to enhance the resilience of service from this site will most likely require a combination of the three Treatment options to provide the level of resilience required.

We are referring to this as Option 4

CIT were provided with the generic flooding solution options derived by [redacted] They then used their standard cost estimation processes to estimate the Capex material and associated cost likely required to deliver each of the 3 options. These are:

Option 1 - Install temporary flood protection measures & improve asset reliability.

Direct Capex Costs	Indirect Capex Costs	Total Project Cost	Anticipated Annual OPEX Cost	Anticipated Embedded Carbon (tCO2e)
£25,000.00	£29,167	**£54,167**	£0.00	0.0

Option 2 - Build perimeter defences preventing water ingress.

Direct Capex Costs	Indirect Capex Costs	Total Project Cost	Anticipated Annual OPEX Cost	Anticipated Embedded Carbon (tCO2e)
£133,728	£156,018	**£289,746**	£0.00	15.3

Option 3 - Contribute/invest in catchment wide schemes which store/divert water.

Direct Capex Costs	Indirect Capex Costs	Total Capex Cost	Anticipated Annual OPEX Cost	Anticipated Embedded Carbon (tCO2e)
£296,727	£346,187	**£642,914**	£0.00	11.2

[Option 1 + Option 2 + Option 3 = Option 4
£54,167 + £289,746 + £642,914 = £986,827]

Option 4 – Is the combination of all these 3 of these options. It will therefore be to:

- Install temporary flood protection measures & improve asset reliability.
- Build perimeter defences preventing water ingress.
- Contribute/invest in catchment wide schemes which store/divert water.

Direct Capex Costs	Indirect Capex Costs	Total Capex Cost	Anticipated Annual OPEX Cost	Anticipated Embedded Carbon (tCO2e)
£455,455	£531,372	**£986,827**	£0.00	£26.48

ETS have confirmed, on review of the [redacted] generic options provided, that Option 4 is the best solution investment plan for the following 5 Sites:

1. Battle WTW
2. Catsfield WTW
3. Sedlescombe WTW
4. Halland WTW
5. Neaves Lane, Ringmer WTW

3.1. Maresfield WTW Requires a different generic solution Option

Our investigation demonstrated that the effect of surface water flooding is manifesting in a specifically different way at Maresfield, than at the other 5 prioritised sites. Here, the impact of surface water collection and ingress is more of a ‘stress’ to the asset service delivery system (rather than experiencing a shock fluvial flood water ingress to the entire site). Surface water (as shown in Fig. 58) finds its way into the sludge storage tank. Surface water flooding is definitely tied to this at Maresfield, the difference, however, is that service delivery is only currently impacted at the point of discharge to the environment, i.e., it is not impacting the treatment assets.

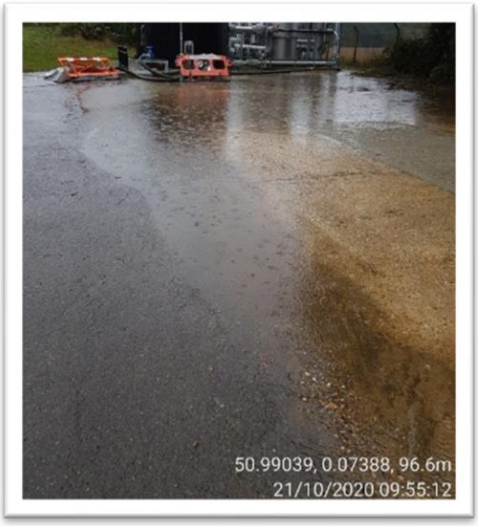


Figure 58 Maresfield WTW flooding

The following table (Fig. 62) outlines the range of escalating generic flooding treatment solution options that have been proposed by [redacted] (and best fit the situation). These increase the resilience of excess discharge from outfalls asset scenarios that are caused by flooding. The fit of these solutions is not perfect, however the options proposed are the most credible than the options produced for treatment site flooding.

Table 3: Alternative solution options

Option	1	2	3
Expected level of Impact from Shock	Minor overflows experienced during periods of heavy rainfall	Occasional significant or frequent minor overflows experienced during periods of heavy rainfall	Frequent and significant overflows experienced during periods of heavy rainfall
Option Description	Implement smart systems to monitor the wastewater system so that performance can be monitored	Incorporate multifunctional SuDs schemes contributing to better recovery from rainfall	Install flood mitigation schemes that incorporate flood storage to reduce the impact of heavy rainfall on assets.
Intervention Type Description	Install flow/level monitoring. Install quality monitoring to outfalls. Once implemented, use data analytics to prioritise intervention or response activities	Installation of natural resistance measures (e.g., rain gardens, trees, etc.) and storage (above and below ground). Retrofitting within existing systems.	Installation of new storage (above and below ground). A programmed flood management scheme

It is anticipated that, at this stage of solution maturity, i.e., prior to root cause of the service impact being determined beyond surface flooding, that a solution to enhance the resilience of for this site will include a combination of Option 1 and Option 3 from Fig. 61. This becomes Option 4. CIT were provided with the generic solution options derived by [redacted] They used their standard cost assessment processes to outline Capex material and associated cost estimates to deliver options 4. These are:

Option 1

- Installation of monitoring

Direct Capex Costs	Indirect Capex Costs	Total Project Cost	Anticipated Annual OPEX Cost	Anticipated Embedded Carbon (tCO2e)
£7,826	£9,130	£16,956	£0.00	0.2

Option 3

- Installation of above/below ground storage.
- A programmed site flood management scheme.

Direct Capex Costs	Indirect Capex Costs	Total Project Cost	Anticipated Annual OPEX Cost	Anticipated Embedded Carbon (tCO2e)
£187,620	£218,893	£406,513	£0.00	£7.53

This solution option has been generically cost by CIT as follows:

Direct Capex Costs	Indirect Capex Costs	Total Project Cost	Anticipated Annual OPEX Cost	Anticipated Embedded Carbon (tCO2e)
£195,446	£ 228,024	£423,470	£0.00	7.7

WATER for LIFE from Southern Water

[Option 1 + Option 3 = Option 4
£16,956 + £406,513 = £423,470]

Overall, we assess this enhancement case paper to be a Low Regret Investment

We have assessed this programme against the criteria for low regret investment identified in the LTDS guidance and Appendix 9 of the Final Methodology. The guidance identified that low regret investments meet the needs across a wide range of plausible scenarios, meet short-term requirements; or keep future options open, including cost minimisation.

We consider that the investment proposed in this enhancement case is a low regret investment for the following reasons:

- **Need -** Why the need meets the long-term ambition/regulatory requirements
  - The six sites identified in the programme are all sites that are demonstrated to be in locations most vulnerable to flooding (flood zone 3). They are also already being flooded on an escalating frequency (due to the impact of climate change causing more frequent shock rainfall events).
  - In all cases the vulnerability has become a service risk, as the sites available resilience has become increasingly inadequate. Many more sites within Southern Water have previously been in contact with flooding. These other sites are also located in areas vulnerable to flooding. These 6 sites selected for AMP8 all have significant service criticality, and in all cases, flooding has already disrupted service delivery,

- **Timing** - Why the work needs to be undertaken in this AMP
  - The core treatment pathway requires that we address the resilience shortfall to the affect that climate change has already had to the UK weather. The sites were all flooded during AMP7, and will continue to be flooded more frequently, so the escalating service risk experience needs to be minimised as a priority.
- **Optioneering** - A range of options were considered to meet the need across a range of plausible futures, see the options above (Fig. 60 and Fig. 61) for further detail.
  - Service resilience solutions are required. Service resilience is more than just preventing the site from being flooded, it requires individual investigations and studies into the best value combinations of resistance, redundancy, resistance and response and recovery. Bespoke resilience solutions from each site still need detailed design, however out line solutions are all likely to use a combination of those identified, to yield the best result.
- **Future Scenarios -** The solution is an imminent need and is unlikely to be made obsolete by future planning need
  - The solutions delivered will be to address the current and the foreseeable worsening instances of plausible flooding events. They will deliver a defined new level of flood protection; however, the sites will remain vulnerable to escalating extremes. This means that a future investment need, in latter AMPs if needed, cannot be ruled out. We are not gold plating these solution for all possible outcomes.

Impact of our Solutions

Delivering our flood resilience enhancement schemes during AMP 8 will help us begin to tackle our Climate Change challenges. This will help us deliver improved Pollution and Treatment Quality Compliance outcomes, while also increasing overall resilience and workforce capabilities as highlighted in the table below.

Table 4: How our solutions impact our challenges and how it will help us improve performance

Our Challenges	6 Wastewater Treatment Works	Pollutions	Customer Flooding	People Capability	Sewer Collapses
Drought					
Climate change (Extreme Weather Impacts)	X	X	X	X	
Population & Demand Growth					
Transition to Net Zero					
Rapid changes in technology					
Cyber security					
Ageing Assets					
Capability	X	X	X	X	

4. Cost Efficiency

This section provides detail on how we have developed our options and the associated costs. For our AMP 8 Flooding Resilience schemes we have applied our standard Cost Estimation and Optioneering approach to ensure they are based on robust cost-evidence and represent efficient delivery for our customers.

Whilst developing the schemes to enhance the resilience to the shock of being flooded at our prioritised sites, we have applied our organisational optioneering process. This process is governed by our Decision-Making Framework. This framework provides the context for solution optioneering and is aligned to our Risk and Value (R&V) process. The process that is also used to manage the full lifecycle delivery of each investment project. Information on how we've applied this as part of our Flooding Resilience Enhancement schemes decision making, is provided in the following section.

More information on the general approach to cost estimation and optioneering, with all the associated definitions, is provided in **SRN15 Cost and Option Method Technical Annex**.

A Summary of Our Approach to Estimating the Direct Costs would be:
Direct Costs are what we have scoped within our solution development process. We consider what new physical assets will be needed for the solution and then follow good practice cost estimation to provide the capital cost of supply.

CIT have used a combination of approaches to attempt to make sure our costs are comparatively efficient and will not adversely impact our customers.

These approaches include:

- Using Engineering Consultants to develop initial scope breakdowns for our proposed solutions.
- Engaging with industry Cost Intelligence experts to develop a bespoke costing tool that uses a range of cost data sources.
- Using the outputs of this tool within our solution optioneering process to increase our operational resilience, whilst considering the impact on customer affordability.

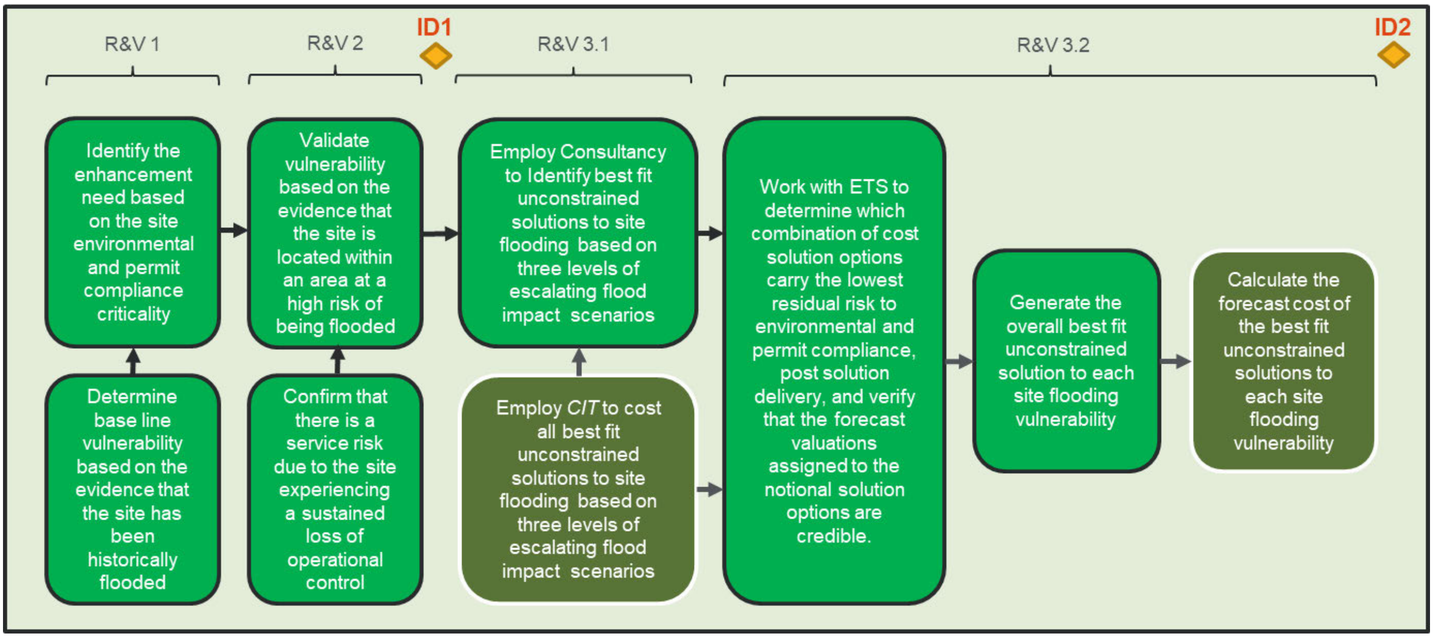
Specifically for these solutions we have worked extensively with [redacted] who developed our initial solution options and [redacted] who developed our '[redacted],' to estimate the costs associated with our AMP 8 solutions. More information on this process is provided below:

- As an outcome of our work to investigate the threats posed to us by Climate Change, we asked [redacted] to develop a number of climate change adaptation solution options.
- [redacted] provided a number of investment options to each threat.
- These options were fed into our [redacted], developed and operated by [redacted] to use their industry benchmarking expertise to estimate the direct Capex, Opex and Carbon costs associated with each solution.
- The tool used a number of cost data sources to build the costs for each solution, these included:
  - Early-Stage Contractor Quotes.
  - Southern Water Cost Curves.
  - Industry Benchmarking data provided by [redacted]

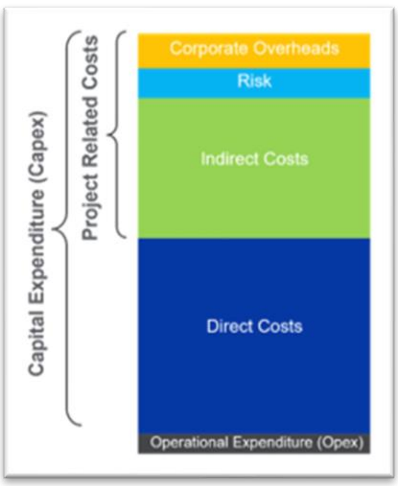
  - [redacted] [redacted] Subject Matter Expertise on cost estimates for specific scope items in the solution design where other quotes/cost curves or benchmarking data could not be aligned to the solution scope items.
- The outputs of the [redacted] were then taken forward to be assessed as part of our Optioneering process to prioritise investment in schemes for AMP 8.

The below graphic shows the Decision-Making Pathway used to identify and value the funding required to Provide Enhanced Resilience to Site flooding:

Figure 59: Decision-making Pathway



As set out in the **SRN15 Cost and Option Method Technical Annex**, through CIT, we separate our capital expenditure into the following four categories:



- **Direct Costs** – These are what we have scoped within our solution development process. We consider what new physical assets will be needed for the solution and then follow good practice cost estimation to provide the capital cost of supply.
- **Indirect Costs** – These are the costs incurred to design and manage the delivery of the capital project. We have followed a robust approach to estimating Indirect Costs, using actual AMP7 delivery data to project the required uplift to the AMP8 Direct Costs.
- **Risk** – How confident are we with our cost forecast? We have developed a bottom-up approach to estimating the risk profile of our PR24 programme, assessing the complexity and maturity of design of each individual scheme within the programme to enable a precise estimate of the required risk adjustment to our PR24 plan. Our approach is in-line with good industry practice, such as the Infrastructure and Projects Authority (IPA) Cost Estimating Guidance.
- **Corporate Overheads** - Our Finance team has modelled our PR24 Corporate Overheads by using our AMP7 data as our baseline cost for a typical capital programme and then extending this to account for the increased size of the AMP8 enhancement programme, factoring in economies of scale as are able to spread our fixed overheads of a larger spending plan.

Our organisational process builds up the full cost stack by applying cost multipliers for Indirect, Risk and Corporate Overhead cost categories onto the Direct Costs for each scheme. More information on the definitions and rationale for the criteria is provided in the **SRN15 Cost and Option Methodology Technical Annex**.

What cost multipliers have been applied for our Flooding Resilience Schemes?

The Flooding resilience scheme's cost multipliers are based on the following criteria:

- The scheme involves delivery of Non-Infrastructure Projects.
- The scheme is to be 'Traditionally Funded'.
- We have Low degrees of confidence in design maturity and medium degrees of confidence in scheme complexity for the activity to be delivered at each site.

Design Maturity	Complexity	Risk (%)
Low	Medium	9.9%

Design maturity is low as we have not carried out a full assessment of root causes for why rainfall is causing flooding at each location. The exact combination of solution options would need to adapt to these assessments. This would be completed as we move into detailed design once funding has been approved.

The Table below shows the breakdown of costs and Cost Category Multipliers for our Flooding Resilience Schemes solutions we propose to deliver in AMP 8:

Scheme	Direct Cost	Indirect Cost	Risk	Corporate Overhead	Totals
Multiplier (%)	100.0%	76.5%	9.9%	11.7%	2.17
Costs	£2.47m	£1.89m	£0.43m	£0.56m	£5.36m

Site (WTW)	Direct Cost (£)	Indirect Cost (£)	Risk (£)	Corporate Overhead (£)	Total Cost (£)
Battle	£0.46m	£0.35m	£0.08m	£0.10m	£0.99m
Catsfield	£0.46m	£0.35m	£0.08m	£0.10m	£0.99m
Maresfield	£0.20m	£0.15m	£0.03m	£0.04m	£0.42m
Halland	£0.46m	£0.35m	£0.08m	£0.10m	£0.99m
Neaves Lane Ringmer	£0.46m	£0.35m	£0.08m	£0.10m	£0.99m
Sedlescombe	£0.46m	£0.35m	£0.08m	£0.10m	£0.99m
Total	£2.47m	£1.89m	£0.43m	£0.56m	£5.36m

Cost beneficial investment payback:
This is a simple and high-level way to indicate if the level of proposed investment is reasonable. It isn't as definitive, as other risk parameters and intangible factors have to be taken into consideration.

$$\text{The forecast number of years it takes for the investment to cover the value of risk} = \frac{\text{Cost of Solution}}{\text{Annual Service Value}}$$

Table 5: Summary Table of costs and benefits

Site (WTW)	Total Solution Cost (£)	Annual Service Impact Value (£)	Cost Beneficial Payback (Years)
Battle	£0.99m	£0.11m	8.9
Catsfield	£0.99m	£0.05m	20.8**
Maresfield	£0.42m	£0.80m	0.5
Sedlescombe	£0.99m	£0.80m	1.2
Halland	£0.99m	£0.87m	1.1
Neaves Lane, Ringmer	£0.99m	£1.10m	0.9
Average	£0.89m	£0.62m	1.4

**Catsfield was still prioritised, even though the solution 'payback indication' forecast is potentially a longer return. This is because the site assets are assessed to be far more susceptible from flooding. Due to a previous baseline investment risk mitigation solution, leaking sludge liquors are captured from the tank and returned (refer to the site risk information in Chapter 2). There are additional requirements to refurbish the sludge holding tank repairs, however these will be funded via Botex.

Response to the level of flooding that has already been experienced at these sites (see detailed evidence, by site, below) demonstrates that:

1. The formal categorisation of a pollution event by the Environment Agency would typically be a Cat 3 or 4 pollution in recognition of the extreme weather impacts.
2. The granting of a Wet Weather Waiver by the Environment Agency to permit the non-compliant Discharge, because a representative sample of our treated final effluent cannot be obtained due to the site flooding, is highly likely.

Public opinion, however, has now shifted. Compliance to the rules set before Climate Change was a recognised reality, are no longer blindly tolerated by our customers when environmental impact is clear. Historic Climate change has proven that flooding events caused by extreme weather are no longer only a 'remote chance', or 'once in a generation' occurrence.

Our customers should expect that Southern Water will, 'do the right thing'. If we are aware that our sites will become flooded to the point where we cannot operate them to protect the environment, our customers should expect that we will do something to prevent environmental impact and minimise any site compliance or environmental impact.

Assessing Performance Commitment benefit for Asset Criticality

We have linked our SMF valuations of service impact prevention, to the Asset Criticality SWACC assessment score, for each site:

- Environmental Impact has been translated to an environmental pollution characterisation.
- WTW Consent conditions have been translated to a Final Effluent Discharge Quality.

Pollution Categorisation:
Pollution incidents get given a rating based of the level of environmental impact that is caused. This included damage to water quality, land, aquatic life, species habitat, etc.

SWACC Score	Category	Environmental Impact Description	SMF Valuation per Incident (£)
4	1	Major Impact	£574,976 per event in AMP8
3	2	Significant Impact	£276,193 per event in AMP8
2	3	Minor Impact	£199,049 per event in AMP8
1	4	Insignificant Impact	£411 per event in AMP8

Final Effluent Discharge Quality

If the site has an Upper Tier/Absolute Final Effluent Quality discharge limit, a breach is valued in our SMF at £276,193 per year in AMP8.

Service Measure Framework (SMF):
The is how we value (in monetary term) specified service impacts.
For each service measure, we assess if there is a risk of us failing to meet it.
We then give the failure risk a monetary value that is based on industry bench marked valuations of:

1. The private cost to the business of responding to the Impact.
2. What customers place want us to be preventing the Impact of.
3. Any societal value in addition to that of our customers.

Annual Service Risk Benefit Calculations

Below is our internal assessment of the impact prolonged site flooding will result in, if service resilience is not enhanced.

Site	Criticality based Service Impact Assessment	Service Benefit Valuation	Annual Flooding Event Frequency	Annual Impact Risk Valuation of the Flooding Event	Cost Benefit Determination
Battle WTW	Pollution Impact Risk: Asset Criticality shows that Battle WTW has a SWACC Score of 3. It is therefore assessed that future site flooding will cause a Category 2 pollution event. Discharge Quality Risk: Battle has winter/ summer Upper Tier Final Effluent Quality discharge limits for both BOD and Ammonia. It also has an all-year Upper Tier discharge quality limit for Iron. Prolonged site flooding will result in the discharge of partially treated Final Effluent that is at high risk of breaching one of these limits.	A Significant (Category 2) impact to the environment - Valued at £276,193 per event in AMP8. A quality breach is valued at £276,193 per year in AMP8.	Events have occurred in 2015 and 2023. This indicates that its most likely there will be 5-10 years between repeat events. As the frequency of wet weather events will increase due to the UK temperature rise, we assess it as 'Most likely' that the flooding events will repeat every AMP period at Battle WTW (i.e., 20% chance that the flooding event will repeat every s)	The annual service risk is valued at (£276,193 + £276,193) £552,386. The annualist benefit value of the Flooding Event at Battle WTW is therefore £110,477. (20% of £552,386)	£987,000 of investment will be needed in AMP 8 to deliver £110,477 of annual service risk. The investment will therefore completely cover the annual risk value from flooding in 8.9 years.

Site	Criticality based Service Impact Assessment	Service Benefit Valuation:	Annual Flooding Event Frequency	Annual Impact Risk Valuation of the Flooding Event	Cost Benefit Determination
Catsfield WTW	Pollution Impact Risk: Asset Criticality shows that Catsfield WTW has a SWACC Score of 2. It is therefore assessed that future site flooding will cause a Category 3 pollution event. Discharge Quality Risk: Catsfield WTW has a very tight annual average discharge limit for Phosphorous (0.5 mg/l). It also has an all-year Upper Tier discharge limit for Iron. Prolonged site flooding will result in the discharge of partially treated Final Effluent that is at high risk of breaching one of these limits.	A minor impact to the environment - Valued at £199,049 per event in AMP8. A quality breach is valued at £276,193 per year in AMP8.	A Flood Event occurred during 2016. It is now 2023 and as the frequency of wet weather events will increase due to rising UK temperature, we asses it as 'Mostly likely' that the flooding events will repeat every 2 AMP periods at Catsfield WTW (i.e., 10% chance that the flood event will repeat every year)	The annual service risk is valued at (£199,049 + £276,193) £475,242. The annualist benefit value of the Flooding Event at Catsfield WTW is therefore £47,524 (10% of 475,242)	£987,000 will be needed in AMP 8 to deliver £47,524 annual service benefit. The investment will therefore completely cover the annual risk value from flooding in 20.8 years.

Site	Criticality based Service Impact Assessment	Service Benefit Valuation:	Annual Flooding Event Frequency	Annual Impact Risk Valuation of the Flooding Event	Cost Benefit Determination
Maresfield WTW	Pollution Impact Risk: Asset Criticality shows that Maresfield WTW has a SWACC Score of 2. It is therefore assessed that future site flooding will cause a Category 3 pollution event.	A minor impact to the environment - Valued at £199,049 per event in AMP8.	Flood Event currently occurred 3-4 time a year if nothing changes. As the frequency of wet weather events will increase due to global temperature rise, we asses it as 'Mostly likely' that the flooding events will repeat 4 times every year (20 times an AMP period) at Maresfield WTW (100% change that the flooding event will repeat every year)	The annual service benefit is valued at (4 x £199,049) £796,196.	£423,000 will be needed in AMP 8 to deliver £796,196 annual service benefit. The investment will therefore completely cover the annual risk value from flooding in 0.5 years.

Site	Criticality based Service Impact Assessment	Service Benefit Valuation:	Annual Flooding Event Frequency	Annual Impact Risk Valuation of the Flooding Event	Cost Benefit Determination
Sedlescombe WTW	Pollution Impact Risk: Asset Criticality shows that Sedlescombe WTW has a SWACC Score of 2. It is therefore assessed that future site flooding will cause a Category 3 pollution event.	A minor impact to the environment - Valued at £199,049 per event in AMP8.	Operations estimate 3-4 flood events every year, if nothing changes As the frequency of wet weather events will increase due to global temperature rise, we asses it as 'Mostly likely' that 4 flooding events will repeat every year, 20 in the next AMP period (100% change that the event will repeat every year)	The annual service benefit is valued at (4 x £199,049) £796,196.	£987,000 will be needed in AMP 8 to deliver £796,196 annual service benefit. The investment will therefore completely cover the annual risk value from flooding in 1.2 years.

Site	Criticality based Service Impact Assessment	Service Benefit Valuation:	Annual Flooding Event Frequency	Annual Impact Risk Valuation of the Flooding Event	Cost Benefit Determination
Halland WTW	Pollution Impact Risk: Asset Criticality shows that Halland WTW has a SWACC Score of 2. It is therefore assessed that future site flooding will cause a Category 3 pollution event. Discharge Quality Risk: Halland WTW has quite tight annual average discharge limits for both Phosphorus, and also has an all-year discharge Upper Tier limit for Iron. Discharge of partially treated Final Effluent is most likely going to breach on of these limits.	A minor impact to the environment - Valued at £199,049 per event in AMP8. A quality breach is valued at £276,193 per year in AMP8.	Operations estimate 2-3 flood events every year, if nothing changes As the frequency of wet weather events will increase due to global temperature rise, we asses it as 'Mostly likely' that 3 flooding events will repeat every year, 15 in the next AMP period (100% change that the event will repeat every year)	The annual service risk is valued at ([3 x £199,049] + £276,193) £873,340.	£987,000 will be needed in AMP 8 to deliver £873,340 annual service benefit. The investment will therefore completely cover the annual risk value from flooding in 1.1 years.

Site	Criticality based Service Impact Assessment	Service Benefit Valuation:	Annual Flooding Event Frequency	Annual Impact Risk Valuation of the Flooding Event	Cost Benefit Determination
Neaves Lane, Ringmer WTW	Pollution Impact Risk: Asset Criticality shows that Neaves Lane, Ringmer WTW has a SWACC Score of 3. It is therefore assessed that future site flooding will cause a Category 2 pollution event. Discharge Quality Risk: Neaves Lane WTW has Upper Tier discharge limits for SS, BOD and Ammonia. It also has an all-year discharge upper tier limit for Iron. Discharge of partially treated final effluent is most likely going to breach on of these limits.	A Significant (Category 2) impact to the environment - Valued at £276,193 per event in AMP8. A quality breach is valued at £276,193 per year in AMP8.	Operations advise that flooding will occur 2-3 times every year if nothing changes. As the frequency of wet weather events will increase due to UK temperature rise, we asses it as 'Mostly likely' that the flooding events will repeat every AMP period at Neaves Lane WTW will repeat 3 time every year.	The annual service risk is valued at ([3 x £276,193] + £276,193) £1,104,772.	£987,000 of investment will be needed in AMP 8 to deliver £1,104,772 of annual service risk. The investment will therefore completely cover the annual risk value from flooding in 0.9 years.

5. Customer Protection

The proposed Flooding Resilience enhancement programme is below the threshold applicable for a Price Control Deliverable to be set.

The principal benefit for customers from this investment case, is consistency of service provision. It will ensure that service resilience for those sites being repeatedly flooded is enhanced sufficiently to meet the escalating challenges from the increasing frequency and magnitude of flooding events, caused by climate change. Enhanced resilience will minimise the probability, or the magnitude, of the pollution impacts cause by our wastewater treatment asset becoming flooded.

Affordability has been a consideration, and we have robustly challenged the need to invest to enhance service resilience. Our AMP7 investigation highlighted 65 sites as having significant enough risks to service that resilience needs were considered for. The fact that we have tested and assured the credible need for investment and arrived at only 6 prioritised sites for AMP8, demonstrates that we have taken our duty of care to balance affordability with the customer priority for protecting the environment.2

All of our wastewater treatment sites are unique, so the impacts of a flood event can mean many things depending on each individual site characteristics.

However, there are two consistent general impacts:

1. The prevention of safe Operational access for staff to deliver both their routine and proactive interventions to maintain the treatment delivery assets, and to respond to both known and unanticipated stress.
2. Ingress into the wastewater treatment asset delivery system restricts its designed delivery and interferes with providing a compliant service.

Flooding of our sites can last (based on current experience) for multiple days, and in worst cases close to an entire week. In wastewater, most of our operational resilience to maintain the services our customers expect, comes from our ability to respond quickly and reactively to asset related issues. We fix or mitigate these as they appear, to prevent those issues becoming service problems. Flooding of the site assets eliminates this response opportunity, so that the resilience to flooding events approaches zero.

Currently, the sites are vulnerable to these unpredictable and unpreventable shock external weather events. These events are getting more severe, and are occurring more frequently, due to the effects of climate change. This investment will provide site service delivery resilience, so that the sites are better prepared in anticipation that they will be flooded in the future.

In doing so, we will reduce the businesses dependency on site recovery, once the flooding experienced subsides. No response resilience is available, as the flooding prevents safe access for operational staff. Instead, we will seek to find the most robust resilience service provision that is based on all the resilience leavers (resistance, redundancy, reliability, and response). This newly required holistic resilience to being

[2] SRN03 Customer Acceptability Chapter, Section 3.2.5.2: Environmental Ambition

flooded, requires planned enhancement investment. Sites will likely already have had minor operational interventions made to them in response to past flood event, for example, external electrical outlets repositioned off the ground; however, we have confirmed that the resistance to flooding by, for example, addressing external causal factors like the 3rd party management of the wider area flood alleviation or the provision of larger scale civil interventions, have never been possible. This is mostly because the increasing risk of flooding occurrence, caused by climate change, has never previously been a priority.

- We have evidenced, within this business case, both the sites where previous flooding events have occurred and how climate change is making shock flooding event more annually prevalent. We have used our asset criticality assessments to show the extent to which the environment can be impacted due to our sites being flooded. Through the recognition of the appropriate Service Measures, and the highlighted customers expected response aligned to our LTDS, the full benefit needs to be seen in terms of the Service Continuity provided, as a result of escalating wet weather events.
- Our resilience investment approach will be a holistic system one, that is designed to achieve the maximum benefit for Customers for the least cost. I.e., not undertaking investment in schemes that are purely preventive (resisting the shock) but embrace all the other resilience leavers (reliability, redundancy, response & recovery) to achieve the desired outcome.

6. Conclusion

Our PR24 strategy to deal with the impact of Climate Change is to address the obvious impacts that the change has already wrought on our assets.

Our WINEP, NEP and DWMP investment programmes do not have climate change as a specific assessed risk or driver, because they are focused on service provision. However, all of these (via the R&V project delivery process) will need to accommodate climate change predictions into the solutions delivered within AMP8. Only this AMP8 Operational Resilience Enhancement cases is addressing the impact of flooding specifically. LTDS involves investment plans to address climate change as a base line predictive activity over multiple AMPs, and also supports the needs to adapt the level of investment in the face of changing and potentially escalating climate change futures. Our plan for the next 3 AMP periods is outlined in Chapter 3. This recognises that climate change is both an externally risk to service in need of being managed and is a volatile situation that is no going away any time soon.

With ongoing and stretching targets in both minimising pollution and dealing with environmental flooding, resilience enhancement is forecast to become a crucial investment planning tool, that will forestall service erosion but without significantly impacting service provision affordability.

In AMP 8 we will address current repeat flooding risk at 6 prioritised WTW sites and also invest in gaining a greater understanding for which sites will be affected by climate change into the future and most likely also require service resilience enhancement investment during AMP 9 and beyond.

Table 6: shows the AMP8 investment:

Site (WTW)	Direct Capex Cost (£)	Total Project Cost (£)	Annual Value of Service Benefit (£)	Beneficial Payback Indicator (years)	Anticipated Annual OPEX Cost (£)	Anticipated Embedded Carbon (tCO2e)
Battle	£0.46m	£0.99m	£0.11m	8.9	0	26.48
Catsfield	£0.46m	£0.99m	£0.05m	20.8	0	26.48
Maresfield	£0.20m	£0.42m	£0.80m	0.5	0	7.7
Seddlescombe	£0.46m	£0.99m	£0.80m	1.2	0	26.48
Halland	£0.46m	£0.99m	£0.87m	1.1	0	26.48
Neaves Lane	£0.46m	£0.99m	£1.10m	0.9	0	26.48
Totals	£2.47m	£5.36m	£3.73m		0	140.1

Section	Key Commentary	Page
Introduction & Background	Climate change has already happened. It has already impacted our service delivery and is predicted to further increase both the magnitude and the frequency of dry and wet weather shock events, resulting in escalating flood shock events. Ofwat has told us to prepare for this flooding outcome by identifying where service resilience needs to be enhanced and to which climate change scenarios.	5
Need for Enhancement Investment	If flooding has happened before and nothing was done in response, it will happen again. Climate change means events of increasing magnitude and on a shortening event frequency. The increasing risk (uncertainty of event frequency) is becoming less uncertain, so the risk of annal flooding events is increasing. For the 6 sites prioritised, the site history shows the flooding impact experienced. Climate change means that impact will occur more frequently, and possible on a greater scale. Our customers expect us to respond to events and invest in stopping them repeating. As the cause of the increasing flood risk in not within Southern Waters control, investment is needed to provide the service resilience our customers expect.	30
Best Option for Customers	From the many sites that have already been affected by accelerated flooding due to climate change, we have selected to address the ones that represent to greatest alignment to the investment values our customers have shared with us.	35
Cost Efficiency	We aim to make service resilient, not prevent sites from becoming flooded. The most appropriate and value for money combination of resistance, redundancy, reliability, and response & recovery will be delivered for the money available to assure service delivery for AMPs 9 & 10.	46
Customer Protection	The proposed Flooding Resilience enhancement programme is below the threshold applicable for a Price Control Deliverable to be set. Flooding events occur due to extreme weather conditions which can result in shock rainfall. These events are variable in level and duration and may be difficult to predict. Data does indicate that they are becoming more frequent. It is difficult therefore to state with accuracy the absolute annual service benefit to be delivered by any flood resilience improvement programme in terms of impacts such as interruption to supplies, WQ or pollution incidents being prevented. However, it is anticipated that the business will experience an overall improvement in the following areas: ▪ Category 3 pollution incidents ▪ Treatment works compliance. ▪ Reactive Operational costs associated with recovering from site floodings.	58