Appendix: Resilience: Wastewater

YKY-PR24-DDR-38-CE-Resilience-wastewater-appendix

YorkshireWater

Contents

1. Appendix: Resilience (waste)

1.1 Introduction

This appendix sets out the case for c.£15m of investment to build resilience to climate-related risks across our wastewater asset base, specifically focusing on enhancing resilience to the increasing impact of climate induced storm events and the consequent flooding and power outages that they cause. This case has been created in response to the enhancement uplift (based on 0.7% of base allowances) allowed by Ofwat in the Draft Determination for companies to prioritise their biggest climate related risks. Due to the time available to create this case, we have used best available data, and we have highlighted the robust governance that will be put in place to ensure best value solutions are delivered.

A summary of the key points is set out below:

- Climate change is already impacting Yorkshire and further escalating impacts are expected in future. Projected increases in the severity and frequency of rainfall events will have implications for flooding risk across the region.
- Historic modification of Yorkshire's rivers to provide mill power means we have a legacy of altered rivers near to our major settlements. We have steep sided flashy catchments like Calderdale; flat, wide lowland flood plains in the centre of our region, and the eastern area is artificially drained and pumped through a network of assets, and parts of Hull are below the high-water mark and dependant on coastal defences to remain habitable. We have a large region with a lot of flood risk from all sources and our risk is increasing.
- Due to the nature of our business, many of our wastewater assets are located close to the river systems that drain our region and as such those assets and equipment are increasingly vulnerable to climate-related hazards beyond management control.
- Power supply networks are also vulnerable to the increased in storm events, due to climate change, and this poses a climate related threat to the operation of our asset base and the service to our customers and the environment.
- We also face risks related to the impacts on power networks that result from the transition toward a low-carbon economy.
- Following a detailed review of potential options to enhance resilience across our wastewater asset base, we have selected the following key initiatives to prioritise for funding:
    1. We will take a targeted approach to improving flood resilience at our highest risk assets (based on their operational criticality, hazard exposure, and impact on customer service and the environment), informed by our previous work to understand fluvial and tidal flood risk in detail across our asset base. To ensure efficient costs, we will seek to work in partnership where possible to leverage external funding and manage flood risk holistically but will also deliver schemes directly where no suitable alternative delivery route can be identified.
    2. Risks associated with high ground water levels currently has limited data and certainty, we propose to invest in a partnership study to improve our knowledge and understanding to fully establish the best option for customers in managing this risk in the future. In the interim we propose small scale interventions working with landowners to generate external investment to improve soil health which evidence suggests is a key activity for managing climate related ground water risks.
    3. An increase in back to back storm events has highlighted opportunities to further enhance the resilience of our existing assets. We propose to invest in a platform which will allow us to utilise real time monitoring and weather forecasting to enhance resilience by increasing availability of storage in our network.
    4. Maximising storage in the existing network and increasing the resilience of our network pumping assets to power outage will reduce the risk of external and internal flooding events.
    5. An increase in back-to-back storm events has highlighted opportunities to further enhance the resilience of our existing assets. We propose to invest in a platform which will allow us to utilise real time monitoring and weather forecasting to enhance resilience by increasing availability of storage in our network.

6. We propose to invest in schemes to provide more resilience in the event of an unplanned power outage. These include installing Enhanced Brown Out electrical reset systems, additional Uninterruptible Power Supply (UPS) equipment and enhancement of Instrumentation, Control and Automation (ICA) systems to allow sites to automatically reset themselves to allow an automatic restart.

- Our proposals meet Ofwat's criteria for resilience funding and customer preferences, are not covered by other enhancement areas, align with Ofwat's Public Value Principles, and represent value for money for customers.

1.2 Drivers: Resilience

The driver for this appendix is Ofwat's allowance for all companies to address their biggest risks due to climate change impacts as set out in section 3.7.2 of 'PR24 draft determinations: Expenditure allowances'. Ofwat have requested companies set out what they will deliver for the additional funding in their responses to the draft determination, with a focus on addressing additional flood and power resilience requirements from climate change.

This appendix covers Yorkshire Water's wastewater assets; a separate enhancement case has been submitted for our clean water assets.

1.2.1 Requested Investment

Table 1-1: AMP8 Expenditure

	BP submission (£m)	Ofwat DD (£m)	DDR (£m)	Variance (£m)	Table Line Ref.
Enhancement Expenditure Capex			14.0		CWW3.168
Enhancement Expenditure Opex			1.0		CWW3.169
Base Expenditure Capex					
DPC value					
Total			15.0		

1.2.2 Associated Reporting lines in Data Table

Table 1-2: Reporting Lines

Line Number	Line Description
CWW3.168	Resilience; enhancement wastewater capex
CWW3.169	Resilience; enhancement wastewater opex

1.3 High Level Driver description:

The reliability and quality of our services is essential to the people, economy and environment of Yorkshire. We have invested to create a resilient business, successfully maintaining services through many extreme events over recent years as well as responding to long term trends. However, there are always limits to levels of resilience, particularly given the growing climate-related risks facing our business and the wider region.

Ofwat expects us to incorporate some aspects of climate change into base allowances, but it has also retained a resilience category under enhancement. This is for additional investment to manage increasing risks, or changing acceptance/acceptability of risk, from hazards that are beyond our control. It is for investment not covered by other enhancement areas.

In its Draft Determination, Ofwat proposed a sector wide enhancement uplift (based on 0.7% of base allowances) for companies to prioritise their biggest climate related risks.

Yorkshire Water support this aspect of the Draft Determination, and this document sets out what we will deliver for the additional funding to build resilience across our wastewater assets to climate-related risk as part of our response to the Draft Determination, with a particular focus on addressing additional flood resilience requirements and power resilience from climate change.

1.4 Need for investment

1.4.1 The Need for the Proposed Investment

Our customers highlight resilience as a top priority, with the most important issue being able to receive reliable, uninterrupted services. However, our resilience is particularly stretched when hazards beyond our control impact on our activities. Risks that impact the resilient supply of our services are increasing in the face of climate change.

We are already seeing the impact of climate change on our natural environment, which in turn affects our customers, the communities we serve, and the way we operate our business. Five of the ten wettest years for the UK have occurred in the 21st Century and we have experienced widespread flooding on several occasions across both our water and wastewater assets in recent years. The winter of 2023 was the second wettest on record for the UK. Storm Babet resulted in fluvial flooding which breached Environment Agency defences and exceeded the level of protection previously installed on our asset base. Repetitive storm incidents resulted in sustained, saturated ground conditions, resulting in repeated high river levels, pluvial flood events and significant ground water impacts.

Figure 1-1 Arial image of Catcliffe Rotherham during Storm Babet (Rotherham News)

During Storm Babet, thirty assets in South Yorkshire were flooded, with sites previously defended seeing flood water exceed the existing level of protection.

UKCP18 climate projections suggest both the frequency and intensity of extreme rain events will increase further in future, particularly in winter months. In Yorkshire, the Environment Agency suggest we accommodate a 15-30% increase in peak river flows for the Aire and Calder and a 10-20% increase in rainfall intensity by the 2080s and 30cms of sea level rise for Yorkshire. This will increase our flood risk and at the same time decrease the standard of protection we get from existing defences. A 20% increase in peak river flow decreases a 1 in 200-year flood defence to only 1 in 72.

Such external factors are outside of our direct management control and as such it is critical that we invest in enhancing our resilience to flooding so that we can continue to provide customers with reliable, high-quality services in future.

Figure 1-2 Projected future increases in winter precipitation (Met Office, 2024)

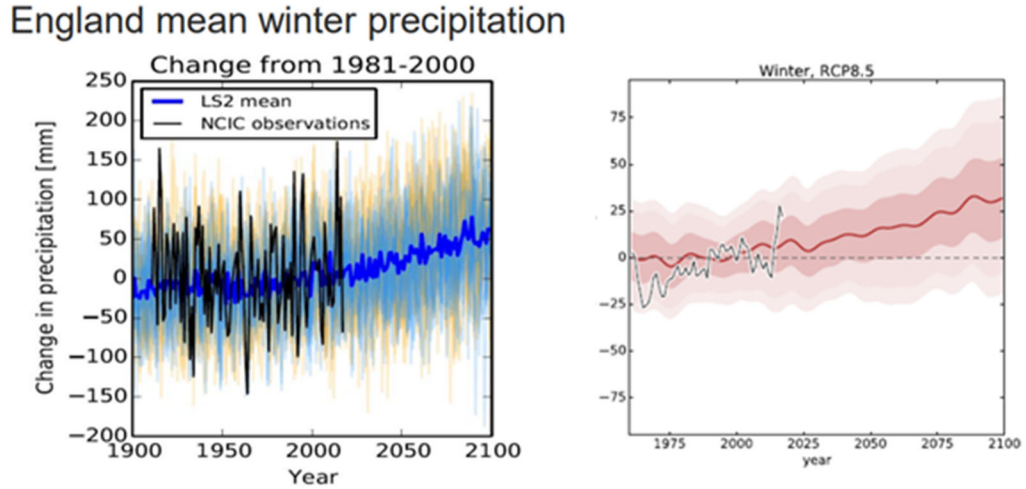
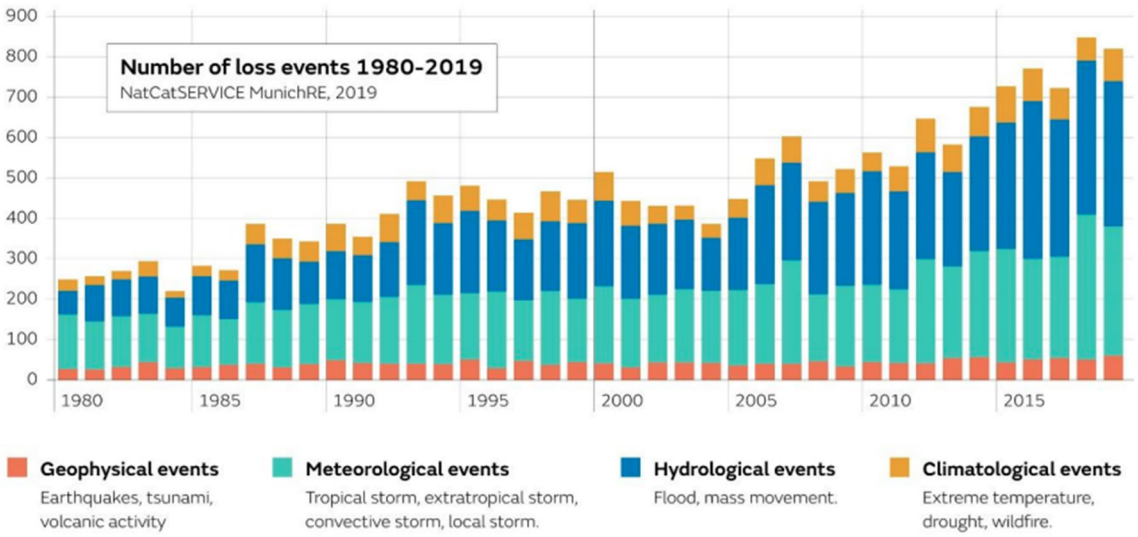


Figure 1-3 Historic evidence of increasing extreme events in England in recent years (Met Office, 2024)



The need to enhance flood resilience is embedded into our current management policies and procedures. For new assets, our end-to-end business funding approval process requires a flood risk assessment and resilience options to be presented prior to detailed design sign off and funding approval. Our flood risk assessment guidance is for critical sites or equipment to be resilient to a 1 in 200 flood plus an allowance for climate change. This is the standard suggested by the Pitt Review, the Cabinet Office, and the National Infrastructure Commission.

Following major flood events in 2015 and 2019, we have invested in our assets to build an enhanced level of resilience to minimise future damage and disruption, this has included raising, relocating and protecting critical equipment. We have previously invested in large scale demountable defences which can be deployed region wide. Despite these investments, however, increasing flood risk to our wider asset base (much of which was designed to lower flood resilience standards) means further investment is required to improve resilience to flooding.

Figure 1-4 Examples of critical assets located in flood risk zones

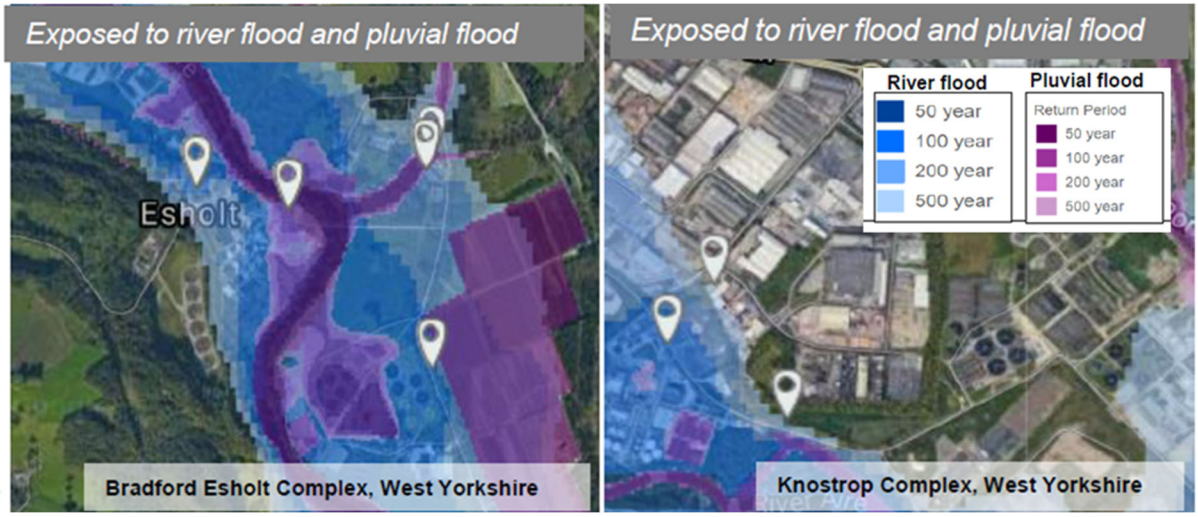
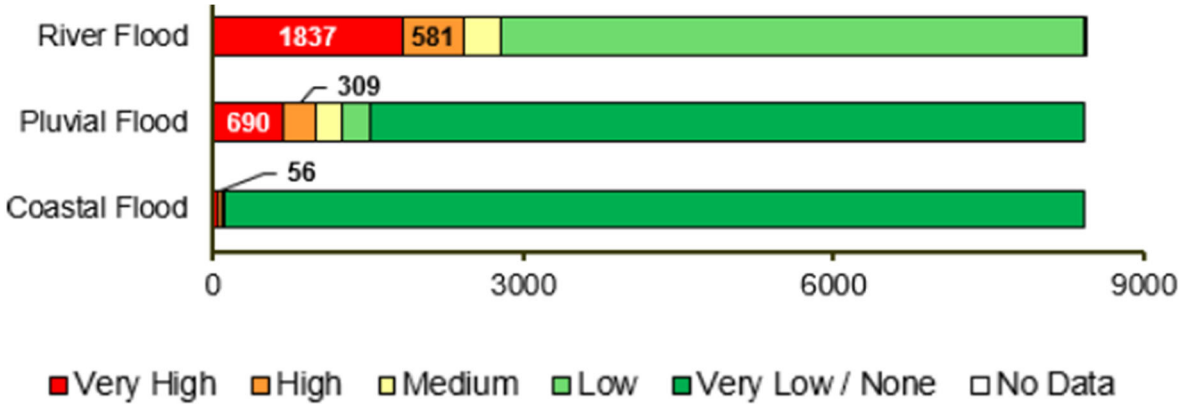


Figure 1-5 Summary of number of assets exposed to different flood types (All YW Assets)



As well as the physical risks posed directly by climate change impacting on power supply resilience (i.e. extreme weather events such as high winds, snow, high temperature, flooding etc.), we also face a number of risks related to the process of transitioning away from reliance on fossil fuels and toward a low-carbon economy in order to support the UK to achieve its obligations under the Paris Agreement to reduce global CO_2 emission to 45% in 2030 and reach net zero by 2050. Increasing demand for electricity and volatility in renewable energy generation and loads places strain on electricity transmission systems and increases the risk of unexpected power outages (Beyza and Yusta, 2021).

Power Outages

For the purposes of this submission, a power outage constitutes either short and/or long-duration disruptions or outage, including a significant voltage dip on 1 or more phases to the normal sinusoidal current and voltage waveforms (see Introduction to power quality conditioning, Patricio Revuelta and Jaime Thomas, 2016) provided to the incoming power supply of a treatment or pumping asset.

UK Power, in an article published on their web page in August 2023 (Link here), suggests UK households can experience 21 power outages per year and that the consequences of these are extremely disruptive with wide ranging impacts including creating safety risks and causing environmental harm. Yorkshire Water's treatment and pumping assets are connected to the same power supplies as UK households, and we experience power outages at the same frequency.

Data from Northern power grid with regard to outages of less than minutes in duration could not be obtained. Capturing empirical evidence of power disturbances / outages that are less than 3 minutes in duration would require the long-term installation of expensive power quality monitoring devices across numerous assets, this has been unaffordable in AMP7. However, later in this document, evidence is provided of the increased number of outages directly attributed to all power outage disturbances. Considering the claimed reduced frequency of blackouts (>3min duration outages) this data evidences the increasing impact of short duration disturbances/outages. Further evidence of this is provided later.

Climate Change Driven Power Outages

Climate change driven power outages are increasing the resilience risk for treatment and pumping across Yorkshire Water for 2 reasons (1) extreme weather conditions and (2) the fossil fuels power sources conversion to renewables, as generally explained below:

a. The growth in electricity demand attributed to extreme weather conditions combined with the pursuit of low CO_2 consumption technologies such as EVs, heat pumps, resistive heating is forecast to out-strip the growth in electricity generation capacity which will lead to power outages increases. (UK Government Science and Technology Committee – First Report). The UK's planned response to this is to increase renewable generation capacity from 42.5GW to 282GW

by 2050. (Renewable energy journal Vol 212. August 2023). However, renewable electricity sources are not only less reliable than fossil fuels, but they also create complex and difficult to model / manage challenges to the generation and distribution of power around the UK

b. UK electricity consumption has already increased and will continue to increase meaning "the grid" cables and switchgear already-at or approaching their rated capacity will inevitably increase asset failures. (UK Government Science and Technology Committee – First Report). This will lead to short term power outages when the network re-configures to compensate. Improvements undertaken by electricity suppliers on "the grid" to reduce long-term power outages have led to more frequent, automated switching events in "the grid". Short duration power outages are causing operational assets to fail or enter an automated shut-down/start-up process which in turn disrupts our treatment and pumping processes with the potential to disrupt customer service and environmental protection.

c. Power generated by large fossil fuels power stations was far more stable than power that is generated by numerous solar, wind micro-generation units. The migration of power generation from large fossil fuels power stations to numerous solar, wind micro-generation units is creating more frequent, switching of electrical supply equipment in "the grid" as weather conditions vary. The Institute of Engineering and Technology has identified several risk factors for the stability of supplies in the predicted 2030 (Future GB Power System Stability Challenges and Modelling) UK electricity network concluding that, "The dynamic characteristics and hence the stability of the GB power system is changing as new forms of generation displace conventional steam units". Our experience is that migration away from fossil fuels is already increasing the frequency of short duration power outages. In turn this is impacting the stability of water production/distribution as well as waste treatment and disposal.

d. Extreme weather incidence is increasing the risk of damage to power supply cables that feed out assets where they are located in or passes through rural, exposed moorlands and are more prone to water, wind and moorland fire damage.

e. Extreme weather has the net effect of increasing power consumption in the UK which erodes the grid's spare capacity which has fallen to c.1.2% (see Moylan 2015). This also increases the risk of power outage/disturbance as generation sources and electricity networks are re-configured or when load shedding is initiated.

All the above factors aggregate to undermine the resilience of the electrical supplies to our assets and translate directly into water production, distribution and wastewater transmission and treatment resilience risk that we need to reduce.

Impact of Power Outage

The impact of a power outage affects Customers, the Environment, Colleagues and the business sustainability with consequences that could involve:

- Loss of customer water supplies and poor customer service
- Water quality events such as discoloration
- Release of sewage or treated/untreated water into a water course
- Asset damage
- Extra workload for colleagues including out of normal working hours.
- Financial loss and reputational harm
- Loss of critically important process safety protection systems

Unless targeted enhancement investment is made to reduce the consequences of climate change driven power outages, then the risk of climate change outages will increase proportionally with the number of events. The activity proposed in this enhancement case will be highly targeted to reduce both the

consequences of a power outage and improve our asset's ability to withstand a power outage which in turn will improve customer service, protect water quality and protect the environment.

We propose to implement highly targeted asset improvements that will establish new and more robust layers of protection against power outages as outlined below:

Production Power Resilience

In 2021, our Graincliffe WTW suffered a prolonged outage resulting in loss of supply to customers that was triggered by a power outage. While this event happened on a clean water asset, the findings are seen to be equally applicable to a Wastewater asset.

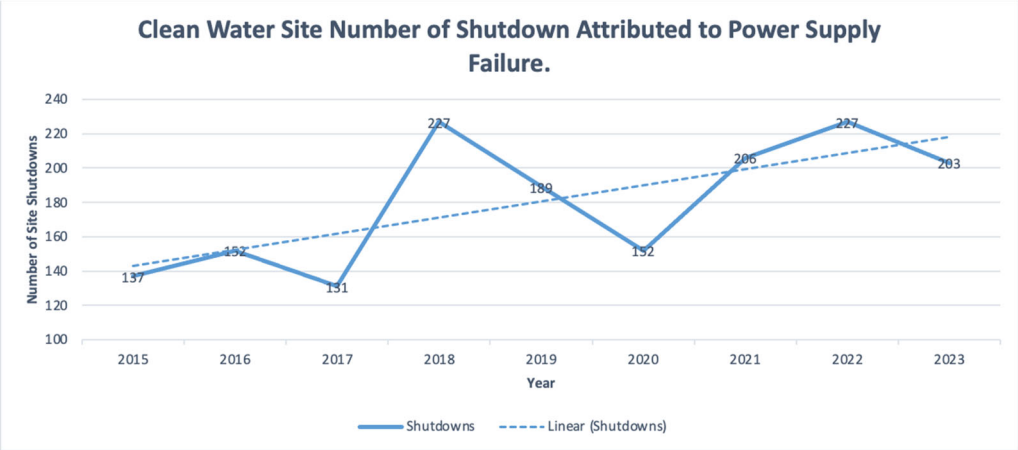
Following a detailed investigation, the DWI served an enforcement notice on Yorkshire Water to improve the resilience of its Water Treatment Works ICA infrastructure on 14 sites and undertake a series of detailed, intrusive investigations across all remaining Water Production and Distribution assets to determine necessary future investments that would de-risk customer supplies and water quality.
The fulfilment of the Legal Instrument is approaching conclusion and the resulting investigation findings have been analysed. This analysis has identified several electrical resilience risks within our assets.

a. Individual motor starters are unable to detect and respond to short duration power outages; when these occur, the motor can become inhibited from auto re-start.
b. Electrical supplies to several assets are particularly exposed to the environment and are suffering frequent, short and long-term power disturbances
c. Standby generation systems take time to accelerate and become able to support treatment and pumping processes. During this acceleration time many instruments are reporting inaccurate data which is prolonging the restart period.
d. Existing Water Quality shutdown control systems are reliant upon the functionality of Basic Process Control Systems, instrumentation and data networks that do not respond to power failure in a consistent manner.

Impacts of Outages on the Business

We are already experiencing a significant number of site shutdowns resulting from power outages with a typical range of 120 to 230 power outages per year across clean water assets which is showing a worsening trend. A similar number of outages will be occurring on our wastewater assets.

Figure 1-6 Unplanned shutdowns of our clean water assets due to power grid outages



In discussions with our Distribution Network Operator (Northern Power Grid (NPG)), we understand future investment by NPG will be targeted at power network automation. This is expected to lead to a greater number of short duration power outages bringing many of the outages below the threshold where they need to be reported to OFGEM to count against their "Customer interruptions and minutes lost: Electrical distribution (R110-ED1)" KPI (see here).

All indications suggest that the underlying trend of increasing site shutdowns due to power issues will, if appropriate mitigation is not put in place, continue to increase and, with the factors around Climate change, a greater rate of increase over the forthcoming years is more likely to occur.

Best value for customers, in our view, would not be created by only upgrading or installing standby-power generation assets, a more integrated approach is needed. The effectiveness of such an approach would be modest at best because standby power generation takes time to start, accelerate and stabilise before it can be used; this would not protect customers from the impact of short duration disturbances/outages. Instead, we propose to enhance power supply resilience by addressing the anticipated increased frequency of short duration power outage/disturbances whilst retaining existing resilience against extended periods of power loss which means we will:

1. Ensure that any asset which cannot be tolerated as “out of service” for a long period of time have suitable mitigation in place through the provision of
    a. An alternative power supply (known as a secondary power supply)
    b. A long-term method of being supplied with power (e.g. a fixed or mobile generator)
    c. Appropriate power storage.

    The added benefit of this part of our solution would be to partially insulate these key assets from an eventuality whereby the capacity of the grid overall is exceeded by the consumption demand and the resulting load-shedding events that are predicted.
2. Ensure that upon restoration of power, the equipment automatically reverted to a “ready to operate state” and where possible/safe, automatically restarts.
3. Improve assets to (a) ensure short term power outages/disturbances do not “lock up” our control systems and cause a site shut down and (b) short-term power disturbances (e.g. <1 second) do not trigger inappropriate plant shutdowns.

1.4.2 The Scale and Timing of the Investment

The scale and timing of the investment is fully justified. This is due to two reasons:

1. **Scale:** Our proposed investments align with the enhancement uplift (based on 0.7% of base allowances) allowed by Ofwat in the Draft Determination for companies to prioritise their biggest climate related risks.
2. **Timing of Investment:** Our proposals are timely due to the changes in climate that are projected to occur during the 21st century and because proactive investment in climate adaptation is proven to be cost effective. The Global Commission on Adaptation estimates every £1 spent on adaptation action now leads to avoided costs of £2 - £10 in the future (GCA.org).

1.4.3 Interactions with base or previous funding

The funding requested in this appendix to represent enhanced flood resilience is new investment that has not been previously funded in earlier price reviews. It will be used to enhance flood resilience to the impacts of climate change.

However, to achieve power supply resilience some base maintenance work will also need to take place. This base maintenance work falls outside of the work listed in this Appendix and relates to Generator and UPS systems repairs, remediation/asset replacement of the Electrical Distribution Systems and remediation/asset replacement of ICA equipment.

1.4.4 Long-term Delivery Strategy Alignment

Wastewater resilience costs are included in our core pathway within our Long-term Delivery Strategy (table LS4) in recognition of the long-term climate-related risks that we face as a business.

1.4.5 Customer Support

Ensuring resilience, particularly against flooding, has been evidenced as an important priority for our customers in recent research we have conducted. When testing support for our Long-Term Delivery Strategy with customers this year (in which we spoke to 1167 customers), the elements relating to flood resilience were all very well supported, with our Living with Water scheme to increase flood resilience in Hull receiving support from 92% of customers. In addition, 'Wastewater resilience', which improves the resilience of our wastewater assets to flood risk had a support level of 96% from customers.

In the Ofwat lead Acceptability and Affordability testing, increasing resilience to flooding was the clear priority of both household and non-household customers – with 44% of household participants and 48% of non-household participants choosing it as being most important (sample of 2,175 and 203, respectively).

Our stakeholder engagement work conducted in 2019 also shows that stakeholders want flood resilience to be a top priority for Yorkshire Water, with stakeholders citing this as their top choice when selecting up to 3 top priorities.

At a local level, a study we conducted with customers in Doncaster in 2022 has shown a majority (69%) of 485 Doncaster residents have experienced at least one form of flooding in the past five years. This experience fed into a similar majority (68%) agreeing that flooding was an issue in the local area.

More generally on supply resilience, numerous customer research studies we have conducted have shown that avoiding interruptions and ensuring a continuous and resilient supply of services is one of the customers biggest priorities and they are therefore supportive of investments made to strengthen supply security.

1.4.6 Factors Outside Management Control

Extreme weather events are increasing in frequency due to climate change. This poses increasing flood risks to the integrity of our assets and operations which, in turn, have potential to lead to negative outcomes for customers and the environment. Such events are outside of management control, and therefore building resilience to flooding across our asset base is critical to reducing our exposure to the problems they cause and future-proofing our operations against increasing climate-related flood risks.

The need to enhance flood resilience is embedded into our current management policies and procedures. For new assets, our end-to-end business funding approval process requires a flood risk assessment and resilience options to be presented prior to detailed design sign off and funding approval. Our flood risk assessment guidance is for critical sites or equipment to be resilient to a 1 in 200 flood plus an allowance for climate change. This is the standard suggested by the Pitt Review (2007), the Cabinet Office, and the National Infrastructure Commission.

Following major flood events in 2015 and 2019, we have invested in our assets to build an enhanced level of resilience to minimise future damage and disruption, this has included raising, relocating and protecting critical equipment. We have previously invested in large scale demountable defences which can be deployed region wide. Despite these investments, however, increasing flood risk to our wider asset base (much of which was designed to lower flood resilience standards) means further investment is required to improve resilience to flooding.
Where our asset base continues to be vulnerable to fluvial and tidal flood risk, this risk is managed with site specific Vulnerable Asset Plans, these plans identify temporary mitigation or recovery activity to minimise impact to customers and the environment.

In this appendix, we propose a step change in our approach, proposing a move towards greater resilience investment in our most at risk, critical assets by moving from a response and recover model to one which promotes resistance or reliability. To promote efficiency and support Ofwat's objective of partnership working, we aspire to prioritise solutions which can be delivered in collaboration with Environment Agency or Local Authorities.

For Power Supply Resilience, the primary source of power to our sites will always be via the local Distribution Network Operating company, which is mainly Norther Power Grid. While this is a regulated industry largely offering high levels of resilience, it is not and can never be 100% resilient. Factors out of both our control include:

Extreme Weather - As power distribution assets are exposed to the elements, excessive weather condition driven by climate change can directly impact on many electrical assets. Excessive Wind, Heavy Snow, Moorland Fires and Excessive High Temperatures can all impact on power supply resilience and result in power disturbances to our assets.

Impacts of Systems Reaching capacity – As systems and distribution networks approach full capacity to facilitate renewable energy and low carbon technology, the likelihood of faults (many of a complex form) on the electrical system increases.

Historically these events would become apparent to us as power blackouts for which they had been addressed via system storage or a secondary power supplies. However, automation on the Distribution Network Operating company's assets to reduce the blackouts has significantly reduced the length of power outages largely to less than 3min (the period at which the outage starts to count as a lost customer minutes). These shorter outages can and often are significantly harder to manage than long duration outages and currently still lead to site shut down. This investment is to deal with the increasing number of short-term outages in order to improve the asset resilience to power disturbances.

1.5 Options considered for resilience funding

We developed a long-list of potential options to be considered for resilience funding across our wastewater asset base. A cross-business, multi-disciplinary team appraised these options based upon a series of critical success factors:

Table 1-3 Criteria

Critical success factor		Measurement criteria	Importance
1	Project aligns with Ofwat's PR24 Methodology for Resilience Enhancement	Consistency with Ofwat Methodology	1
2	Project clearly aligns with Yorkshire Water customer preferences	Consistency with customer top priorities	2
3	Project is deliverable within the five year period	Subject matter expert feedback	2
4	Project offers good value for customers	Qualification at this stage. To be quantified using CBA at a later stage	1
5	Project aligns to the Cabinet Office model for infrastructure resilience	Approach assessed for: Reliability Redundancy Resistance Response and Recovery	2

The options and conclusion of appraisal are detailed below:

Table 1-4 Options Appraisal

Option	Commentary	Value
Targeted investments in priority assets that are particularly vulnerable to flooding, critical to operational service delivery, and have high potential to impact customers and the environment.	Taken forward, aligns with all critical success factors. We have a clear understanding of risk and criticality across our waste water asset base. We propose investment at those which pose the most cost effective mitigation options	£3m
Creating regional strategic resilience stores for flood mitigation kits which can be rapidly deployed to bolster site resilience and aid recovery where sites remain undefended, or defences are at risk of being breached. Our experience shows that at times of emergency, the equipment available across our supply chain, and the wider resilience community is rapidly consumed to protect other critical infrastructure.	Not taken forward as does not meet all critical success factors, we propose to fund this in our AMP8 base programme.	£2m
Real time network interventions through a proactive team of colleagues to ensure that network capacity is realised ahead of larger named storms that are becoming more frequent in our region. We would utilise main sewer and customer sewer alarms along with weather forecasting to create greater capacity in the most affected areas. This practice has been refined in Germany and is now a practice that is built into their own resilience planning for wet weather events. This will not only impact on our customers in a positive way but also reduce our impact on our environment by ensuring all storage is fully available ahead of the events.	Partially taken forward, some elements meet critical success factors. The costs associated a proactive team will be delivered through base, technology to increase the resilience and availability of network storage are taken forward in this appendix.	£3.5m (£0.5m will be funded from base)
Co-funding of a holistic groundwater study with the Environment Agency and local authorities to increase our understanding of regional groundwater dynamics and inform future investment schemes.	Taken forward, meets all critical success factors. Working in partnership ensures an efficient delivery route for the study and ensures we do not just move the risk to another authority/customer to manage.	£0.5m
Creation of a community resilience advisor programme to support farmers, landowners, and other stakeholders to access external sources of funding for natural flood management in catchments susceptible to flooding.	Taken forward, meets all critical success factors. This is a cost-effective approach with an expected return based upon similar schemes for water resource management. Ensures near term, deliverable actions for an emerging climate induced hazard.	£0.5m
Support for communities to identify and rectify the impact of private drainage on sewer asset resilience from groundwater flooding. This would include identifying and rectifying private lateral defects, recognising that individual homeowners are not currently incentivised to address such problems themselves.	Not taken forward, does not meet the critical success factors at this time. May be revisited in future AMPs based upon the study outcomes.	£1.5m
Construction of secondary sub-network for most at risk location as seen in some European countries to tackle risks from groundwater flooding.	Not taken forward, does not meet all critical success factors. This option has been deemed as non-viable on the	£7m

	basis that it would be considered as abstraction and therefore rejected by the Environment Agency.	
Power resilience schemes across wastewater assets including installing enhanced brown out timers, additional uninterruptible power supply (UPS) equipment and enhancement of ICA systems to allow sites to automatically reset themselves to allow an automatic restart.	Taken forward, meets all critical success factors. Significant optioneering and prioritisation has been undertaken to assess the best value package for customers based on optioneering of known best technology available in the marketplace, manufactures recommendations on whole life costing considerations and our knowledge of whole life costs based on maintaining the same or similar equipment elsewhere in our organisation. Solutions discounted as part of optioneering include wholesale rewired/rewrites of sites control systems, rotary UPS systems and site wide battery UPSs.	£8m

1.6 Prioritised resilience schemes to be delivered

1.6.1 Targeted flood resilience investments in priority assets

We have a clear understanding of fluvial and tidal flood risk across our asset base and propose to take a series of measures to enhance our resilience across our wastewater sites, focusing on priority assets that are particularly vulnerable to flooding and critical to operational service delivery.

We have retrofit resistance measures, or enhanced flood resilience as part of site upgrades at our top twelve most at risk waste water treatment works and taken measures across a number of previously flooded pumping station assets. Given the proximity of our waste water asset base to watercourses, a great number of our asset base remains at significant flood risk. For sites without onsite or third-party flood defences we currently focus on response and recovery working with Environment Agency flood warnings to deliver our vulnerable asset plans (VAPs). These are site specific plans which identify locations for temporary flood defences and/or detail site recovery plans. As storm events become more widespread and more frequent, we need to increase our ability to respond, and we are currently undertaking a full review of our VAPs and looking at base options for creating an increased number of flood stores across the county which store temporary defence equipment.

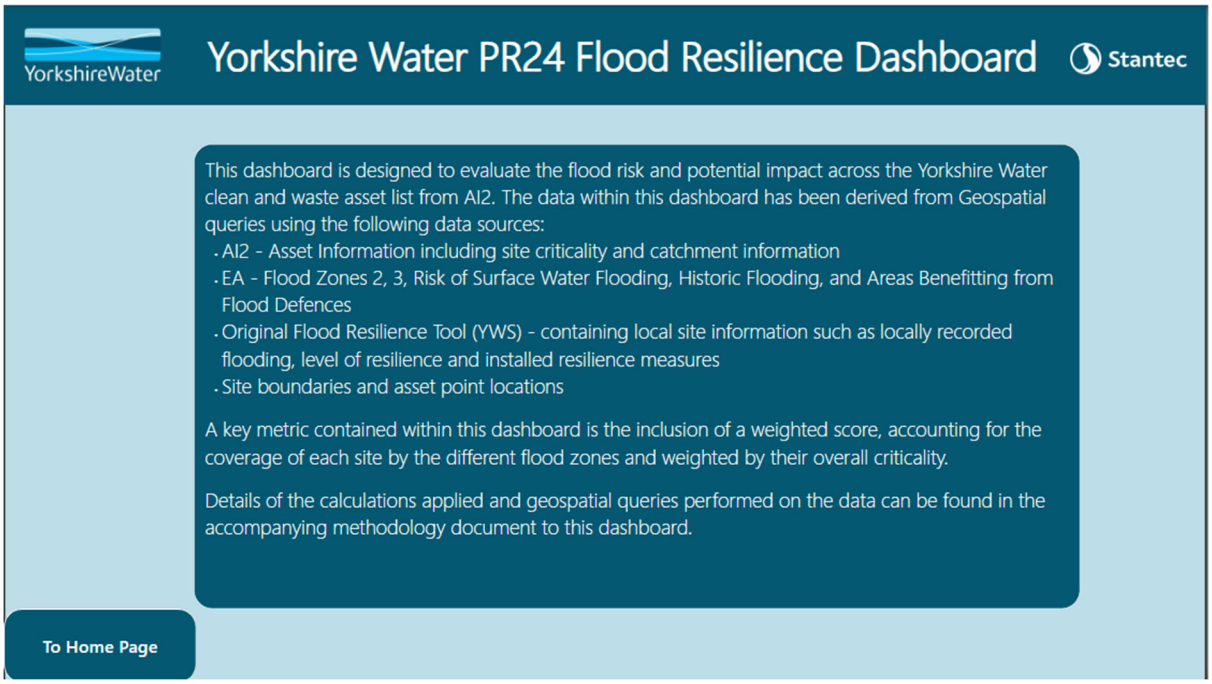
Whilst temporary defences can be very effective, they are limited by accurate forecasting and availability of resources, during the winter of 2023 antecedent conditions and industrial action at the Environment Agency meant that flood warnings were less reliable. We also experienced a high number of consecutive storm events which resulted in deploying significant additional resources to ensure a maintained level of service.

We propose a £3m investment across our asset base to install permanent flood defences at our most critical assets which enhance resilience to the increase in extreme weather, caused by climate change. Whilst this investment is modest in respect to the challenge we face, our ambition is to use this AMP8 investment to work more collaboratively with the Environment Agency in installing flood resilience and this experience will inform our approach for AMP9 and beyond. This aligns to Ofwat's objectives for water companies to both focus on the long-term approach and to work in partnership to deliver greater benefits for customers and the environment.

In preparing this case, we acknowledge that we have had limited time and relies upon existing data from previous investigations. During this time, we have engaged with our partners in the local Environment Agency team and received supporting information from them and a keen agreement for us to provide greater visibility of our assets that are at flood risk to inform their next investment cycle which commences in 2027.

The screenshot from our company dashboard highlights the methodology used to identify flood risk to our asset base:

Figure 1-7 Dashboard home page which highlights the methodology used to identify assets at flood risk



From this data source, we have reviewed our ‘very high’ and ‘high’ criticality waste water assets, their flood history, any previous resilience works and the proportion of assets upon the site vulnerable to flood risk. We have then compared this data to the Environment Agency’s MTP to identify the most likely opportunities for us to work in partnership to deliver flood resilience schemes which may contribute more broadly to wider flood risk outcomes.

The table below sets out a selection of our most at risk assets, the costs associated with installing a series of flood resilience measures and the opportunity we have to look at alternative delivery methods.

Table 1-5 Assets at Highest Risk

Asset	Cost to make site resilient to fluvial or tidal flooding (1 in 200 + climate change)	Proximity of Environment Agency fluvial or tidal defence scheme
Fulford SPS	£980,714	Yes (York FAS – Fulford and Germany Beck)
Anchorage Lane SPS	£652,821	Yes (Frank Road Bentley)
Shay Lane SPS	£271,834	Yes (Oakenshaw Beck, Crofton FAS)

Keighley Marley STW	£361,351	Yes (Keighley and Stocksbridge FAS)
Georges Yard SPS	£259,991	Yes (Millbeck Pumping Station)
Skipton STW	£979,594	Yes (Cowgill NFM)

This table highlights just a small number of the schemes that we have developed to help articulate the approach that we will take in AMP8. Our preferred approach is to work with others to manage fluvial and tidal flood risk holistically in a cost-efficient manner. We propose to work with our Environment Agency and Local Authority partners to identify opportunities for contributions to new or existing flood alleviation schemes that will deliver equal or greater cost benefit than installing flood resilience at a site level. For example, rather than raising and moving equipment, we would seek to work with the EA or LA on projects such as Natural Flood Management or the creation of more traditional fluvial defences, not only does this provide the opportunity for more efficient delivery, we believe this approach will support our partners in accessing match funding which will deliver flood resilience and environmental improvements to the wider area.

To ensure the appropriate governance, we will utilise our six capitals model to carry out a cost benefit appraisal on each of the options identified and we will work in partnership, only when it is at equal or greater benefit to our customers to do so. We propose to establish a Resilience Partnership Fund which will be a managed contribution fund which will provide us with the flexibility to support projects which are still being scoped by our partners at this time. This approach builds on our experience of delivering similar funding schemes, such as our Biodiversity Enhancement Fund and Working With Others performance commitment, to provide cost-effective solutions to improving flood resilience through partnership working.

The table above is for illustrative purposes at this stage only to highlight the potential opportunity that we have, to ensure best value for our customers, the next stage will be to engage more actively with the Environment Agency and Local Authorities to share data and scope options in more detail, as well as updating our own proposals and assessing them through our six capitals model. We will establish a project review board and criteria for assessment in collaboration with our partners. This will include an expectation of an equal or great cost benefit ratio for all proposals (to YW acting alone) to ensure we are making good-value grants. With partners, we will develop a common methodology for flood resilience benefits assessment, based on level of resilience achieved, Yorkshire Water's six capitals valuation framework, and other assessment tools and metrics (e.g. B£ST) to ensure that our contribution is the most effective and efficient way to enhance asset resilience.

The outcomes of the Resilience Partnership Fund will be:

- Co-funded delivery of partnership flood resilience projects
- Quantified assessment of flood resilience benefits resulting from funded projects
- Enhanced flood resilience across Yorkshire Water's wastewater asset base

Applications to the Fund will go to an expert internal review panel, who will assess the value and expected benefits of the project proposal and ensure value for money. All applications will also be subject to approval by the Yorkshire Forum for Water Customers to ensure appropriate independent oversight of the Fund.

Our experience of delivering projects in partnership with a range of stakeholders, demonstrates that savings can be achieved by working collaboratively, delivering more for less. For example, our Biodiversity Enhancement Fund leveraged over £1m of external funding during the 2015-2020 period and our Working with Others performance commitment has unlocked £15m partnership funding through AMP7 to date, with every £1 invested by Yorkshire Water matched by £4.50 in partner contributions.

Should a situation arise that we cannot find suitable partnership delivery routes to maximise our investment, we will undertake site specific activity to enhance resilience at our most critical assets. Given the cost of delivering schemes ourselves is expected to be greater than we could achieve by working in

partnership with others, this approach will ensure we are always incentivised to seek the most cost-efficient delivery routes to building flood resilience across our asset base.

The overall funding requested for this investment is £3m, due to the nature of partnership working and the lack of alignment between partner funding cycles we propose that the majority of our investment will be spent in the final years of the AMP, allowing time for partnerships to develop, mature and co-create. We have a programme of more than £70m of fluvial resilience works identified through previous investigations, we will prioritise the £3m on the sites which offer greatest value for money for customers, aspiring to work in partnership to deliver benefits but working on directly on our assets where more efficient to do so.

Table 1-6 Funding by Year

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Opex £m	0.2	0.2	0.2	0.2	0.2	**1.0**
Capex £m			1	1	1	**3.0**

We have already had significant engagement on a Leeds City Council led project which will enhance the existing defences around Leeds to mitigate the impacts of future climate change. The Aire Resilience Company will undertake NFM activity in the Aire catchment and provides resilience to a large number of our assets.

Figure 1-8 Case study: Aire Resilience Company

Case study: Aire Resilience Company

One likely candidate for investment through our Resilience Partnership Fund is the Aire Resilience Company (ARC), which is carrying out natural flood management (NFM) in the upper Aire catchment to reduce flood risk to downstream communities.

ARC is an innovative partnership between the Rivers Trust, Leeds City Council, the Environment Agency, and other stakeholders in the Aire catchment. It was established to provide a cost-effective solution to the increasing risk of flooding projected in the Aire catchment by complementing hard engineered infrastructure delivered through the Leeds Flood Alleviation Scheme.

Climate modelling predicts by 2069 an 8% increase in peak flow reaching Leeds City Centre during a 1 in 200-year flood compared to 2015. The Leeds Flood Alleviation Scheme is expected to protect against a 3% increase in peak flow and, through a combination of tree planting, soil and land management, ARC aims to deliver a further 5% - 6.5% reduction in peak flow reaching Leeds during a 1 in 200-year flood event by 2069.

ARC's revenue model is based on a buyer consortium comprised of organisations with a mutual interest in flood risk reduction. Thus, a small contribution of ~5% of ARC's annual revenue requirements will unlock 100% of the benefits realised by the scheme.

Given Yorkshire Water has multiple wastewater assets in flood risk areas along the Aire, the operational benefits of participating in ARC are:

1. Cost-effective reduction in flood risk to key assets in the Aire catchment, including two of Yorkshire Water's largest WWTW at Esholt and Knostrop that have experienced widespread flood inundation in previous years.
2. Reduced volume of rainwater entering the wastewater network during storm events.

3. Wider environmental and social benefits arising from the use of nature-based solutions and locally based contract delivery.

In addition to our priority assets at Knostrop and Esholt, due to the nature of ARC, the following assets in the Aire catchment have also been identified as benefitting from catchment based natural flood management via ARC. Whilst this intervention will not offer a specified uplift in resilience at each site the benefits are widespread across our asset base and as such the proposed contribution of £25,000 per year offers excellent value for money.

Name	Site Criticality
ROYD PLACE/SPS	C – MEDIUM
CROSS STREET/SPS	C – MEDIUM
EARBY/NO 2 SWPS	B – HIGH
CONONLEY WORKS/SPS	B – HIGH
KILDWICK/SPS	B – HIGH
HERON CLOSE STEETON/SPS	B – HIGH
THORNTON IN CRAVEN/SPS	B – HIGH
SANDYLANDS/NO 2 SPS	C – MEDIUM
CONONLEY LANE/SPS	C – MEDIUM
RIVERSIDE WALK/SPS	C – MEDIUM
HARD INGS LANE/SPS	C – MEDIUM
STEETON INGS ROAD/SPS	B – HIGH
BRADLEY/SPS	B – HIGH
AIRE BUSINESS PK/SPS	B – HIGH
ST ANDREWS TERRACE/SPS	C – MEDIUM
BOW BRG GARAGE/SPS	C – MEDIUM
ACORN BUSINESS PARK/SPS	C – MEDIUM
LONGROYD ROAD 56/SPS	C – MEDIUM
HAYTON WAY SKIPTON/SPS	NO CRITICALITY
BRACKENLEY LANE/SPS	C – MEDIUM
THE FAIRWAYS/SPS	C – MEDIUM
BROUGHTON HALL/SPS	C – MEDIUM
BROUGHTON OLD MILL/SPS	C – MEDIUM
CROSSKEYS/NO 1 SPS	C – MEDIUM
CROSSKEYS/NO 2 SPS	C – MEDIUM
MARTON HALL FARM/SPS	C – MEDIUM
SCHOOL HOUSE/SPS	C – MEDIUM
WHITE BEAR/SPS	B – HIGH
BROUGHTON/SPS	C – MEDIUM
AIRTON/SPS	C – MEDIUM
OVERDALE PARK/SPS	B – HIGH
MILLFIELDS SILSDEN/SPS	C – MEDIUM
ROBIN DRIVE/SPS	C – MEDIUM
WILLOW WAY/SPS	D – LOW
PRIMROSE GLEN/SPS	C – MEDIUM
STEETON GROVE 12/SPS	D – LOW
ROSTLE TOP ROAD 55/SPS	C – MEDIUM

MILE END CLOSE/SPS	C – MEDIUM
LOW WOOD COURT/SPS	D – LOW
COLNE ROAD BB18/SPS	NO CRITICALITY
MALHAM/NO 2 STW	C – MEDIUM
EMBSAY/STW	B – HIGH
EARBY/STW	B – HIGH
FOULRIDGE/STW	B – HIGH
HETTON/STW	D – LOW
AIRTON/NO 2 STW	E – VERY LOW
KIRKBY MALHAM/STW	E – VERY LOW
EMBSAY/WTW	B – HIGH
BROUGHTON/STW	E – VERY LOW
EAST MARTON/STW	C – MEDIUM

1.6.2 Real time network interventions

The increase in frequency in storm events due to the impacts of climate change has become even more obvious throughout the winter of 2023/24, with ten named storms in quick succession resulting in the most active start to the storm season since naming storms began (The Carbon Brief 2023). Back-to-back storm events threaten the resilience of our network assets and is not resilience that is covered by Drainage and Waste Water Management Plans, which focus more on network capacity.

To enhance the resilience and availability of our network storage, we have looked to European examples and identified the opportunity to utilise our existing network monitoring and weather data to provide a proactive approach to ensuring our networks are emptied ahead of storm events.

The proposed investment is for an online platform, a number of low-cost controllers and a number of pumps. This investment builds upon and utilises existing monitoring that has been installed under other investment drivers in the past and in AMP8 and combines it with weather data, forecasting where areas of the network need activity to ensure capacity ahead of storm events. Typically, detention tanks have been designed to have a drain down time of XXX hours, and whilst this is sufficient for single storm events, availability of storage can be improved by actively monitoring assets and weather to ensure resilience to consistent wet weather and/or back-to-back storm events.

The platform has been costed at £1.5m, to ensure that this is good value for money for customers, we are currently undertaking a trial of the product in Bradford and the results from the trial are showing it is incredibly effective and efficient.

We have looked at the best value option for real time control of our assets, we have reviewed opportunities for SCADA and determined that this is not a good value option: SCADA requires a PCL and profibus fibre network. We have opted for low-cost controllers which offer greater value for money, particularly where these can be retrofit into existing control panels. We propose to install ten of these within the allowance that we have allocated for our AMP8 investment in this project. This allows us to test the effectiveness of the approach, monitor and inform our plans for AMP9 and beyond. We propose £1.5m of investment in low-cost controllers.

Across our detention tank asset base, more than 95% are returned by gravity and as such we propose to invest in ten super silent temporary pumps which will be located in our flood resilience stores across the region (see options appraisal table for context). Using our existing supply chain, we have identified that our best value pumps cost £50k and offer reach out technology and excellent fuel efficiency. We propose £0.5m of investment in temporary pumps that will be stored region wide to manage gravity detention tanks for increased network resilience.

1.6.3 Partnership Ground Water Study and Advisors Programme

Within Yorkshire, in January 2024, groundwater levels were at the highest on record for the time of year in many places. The high levels are due to the unusually high rainfall totals seen since Autumn 2023, which has resulted in very rapid aquifer recharge.

Nejat Zeydalinejad et al (2024) discuss the emerging impacts of ground water on sewer networks and confirm the absence of data and recognised strategies for management. Stating the challenge is overviewed and the need for climate action is urgent.

Through base investment, we have undertaken significant investigation and lining works of our sewer assets in locations most vulnerable to ground water infiltration but to mitigate the impacts of climate change we need to go further.

We propose a significant ground water study with our partners East Riding of Yorkshire Council and the Environment Agency. This study will allow us to identify the best value long term approach and fully establish the best option, this is currently unclear due to a lack of data and uncertainty. We propose £0.5m investment into a holistic study that will be co-funded by Flood Defence Grant in Aid, the support for which has already been agreed in principle with the EA and East Riding of Yorkshire Council. This study cost is based upon the costs associated with the Blue Green Plan which was a co-funded study between Yorkshire Water and FDGiA. The Blue Green Plan was a lump sum £350k but our consultants have advised that a future study of this cost and size would have a minimum cost of £600k, our greater cost estimate for this study accounts for substantial modelling needs

Working in partnership on a study, not only provides the opportunity to leverage external funding, but it also ensures we take a holistic approach so that future schemes may leverage external funding. The nature of ground water flood risk is that the flood risk must occur somewhere, working in collaboration with other Risk Management Authorities means that we can ensure that activities undertaken to enhance network resilience, do not cause detrimental flood impacts elsewhere.

Alongside a longer-term study, we propose short term action in the form of a small team of advisors to work with landowners to improve soil health. This is a proven method for increasing water retention within the soil and ultimately recharging the aquifer at a slower rate. This practice is well proven through our Sustainable Landscapes programme which utilises similar practices to reduce the use of nutrients in farming practices. More details can be found here: Sustainable Landscapes - Adapting To A Changing World

We propose £0.5m of investment in a team of advisors, based upon our salary and overhead costs for a role of this banding, this will pay for one advisor per year. This role will be critical in leveraging access to external funding for landowners to improve land use for groundwater management. Our Sustainable Landscape case studies identify return on investment in the region of 15:1 using the practice. We believe this option offers excellent value for money for our customers.

1.6.4 Power resilience on wastewater assets

To address the worsening impacts of climate change on power resilience, enhancement investment is required to:

1. Ensure appropriate mitigation against a power supply blackout is provided.
   Typical Storage or Secondary power supplies (e.g. generators and standby supplies) are fitted widely across the business to manage power blackouts. It is acknowledged that changes in criticality (resulting from change legislation and expectations from the public) have caused the criticality of impacted assets to increase. For these assets a secondary power supply risk assessment (and where necessary mitigation) is required to ensure appropriate and proportionate mitigation from power failure is provided to meet customers' expectations.

2. Ensure uninterruptable power supplies are available, working and maintainable.

Uninterruptable power supply (UPS) systems provide uninterrupted power to critical process control equipment. The risk of losing power to such systems during power interruption events is that the system does not recover when power returns and a whole site / process areas will be lost for a prolonged period. Funding is required to addresses inadequacies in the current UPS installed or due to an absence of the UPS.

For UPS systems to retain their integrity they must be maintained. While all UPSs have been constructed to be maintainable, only basic maintenance can be completed without impacting on the load. More thorough intrusive maintenance which can predict the failure of the UPS cannot currently take place without the UPS's load being isolated for a short period of time, resulting in additional plant shutdowns. To enable the more thorough intrusive maintenance to take place on all UPSs while retaining process operations a specialised enhanced maintenance by-pass switch must be fitted to all UPS systems. A move to the more thorough intrusive maintenance will enable YW to predict many of the failures of UPS systems before they occur making sites more resilient to power disturbances and meeting customer expectations.

3. Improve ICA systems resilience
   Resilient and effective control systems are vital for the running of our sites and processes. Control systems are increasingly having to deal with more and different types of short-term power disturbances. Control systems, upon reinstatement of power, may lock up and prevent restart of the site. It is proposed to re-assess the resilience of control systems and carry out targeted enhancement work to ensure control systems achieve the level of resilience proportionate to the criticality of site and appropriately manage the increased number of and differing type of power disturbances resulting from the direct effects and indirect effects of climate change.

4. Install enhanced brown out protection and recovery circuits
   To ensure that short-term power disturbance (lasting factions of a second) do not lock up our electrical systems and lead to an inappropriate site shut down we will undertake targeted improvement to electrical assets so they detect power disturbances and respond to ensure that when power stabilises the asset continues automatic operation.

   The strain placed upon our electrical infrastructure resulting from the need to decarbonise to prevent climate global warming has resulted in the nature and type of power disturbances changing. This has resulted in a number of disturbances locking out different control systems on various sites across YW. To prevent this from happening, brown out timers capable of identifying all types of power disturbances and UPSs need to be fitted to sensitive equipment. Note: The proposed brown out timers are significantly more sensitive and are relatively new to the market place.

Initial sites to be targeted for work:-

Table 1-7 Initial Sites

Esholt STW	Knostrop STW	Dewsbury STW
Blackburn Meadows STW	Naburn STW	Harrogate South STW
Aldwarke STW	Colpley STW	Lower Brighouse STW
Upper Brighouse STW	Hull STW	Beverley STW
Sandall STW	Sutton STW	Woodhouse Mill STW

Details of the work to be undertaken can be found in Annex 1.

We have a programme of more than £45m of power resilience works identified across our waste water asset base, we will prioritise the £8m in assets identified in the table above which are at greatest risk and

therefore offer greatest value for money for customers. Any efficiencies will be reinvested to increase the number of sites which can benefit from this resilience investment.

Cost breakdown for power supply Resilience work (full funding):

Table 1-8 Cost breakdown

		Yr 1 (£m)	Yr 2 (£m)	Yr 3 (£m)	Yr 4 (£m)	Yr 5 (£m)	Total (£m)
Secondary Power Supply Assessments	CAPEX	0.1	0.2	0.2	0.2	0.1	0.8
Addressing Known Shortfalls In UPS Systems	CAPEX	0.051	0.051	0.051	0.051	0.051	0.26
Roll-out of Enhanced UPS Bypass Systems	CAPEX	0.2	0.3	0.3	0.3	0.2	1.3
ICA Resilience - Instruments	CAPEX	2.0	3.0	3.5	3.0	2.0	13.5
ICA Resilience – Control Systems (See note 1)	CAPEX	5.5	5.5	5.5	5.5	5.5	27.5
Roll out of Recovery on (SCADA sites only)	CAPEX	0.2	0.2	0.3	0.2	0.2	1.1
TOTAL	**CAPEX**	**8.051**	**9.251**	**9.851**	**9.251**	**8.051**	**44.46**

Note 1 – Assumes £16m Enhanced Money for Cyber Security is also available.

Cost breakdown for power supply Resilience work (£8m Proposed AMP8 Funding):

Table 1-9 Cost breakdown

		Yr 1 (£m)	Yr 2 (£m)	Yr 3 (£m)	Yr 4 (£m)	Yr 5 (£m)	Total (£m)
Secondary Power Supply Assessments	CAPEX	0.018	0.036	0.036	0.036	0.018	0.144
Addressing Known Shortfalls In UPS Systems	CAPEX	0.009	0.009	0.009	0.009	0.009	0.046
Roll-out of Enhanced UPS Bypass Systems	CAPEX	0.036	0.054	0.054	0.054	0.036	0.234
ICA Resilience - Instruments	CAPEX	0.360	0.540	0.630	0.540	0.360	2.429
ICA Resilience – Control Systems (See note 1)	CAPEX	0.990	0.990	0.990	0.990	0.990	4.949
Roll out of Recovery on (SCADA sites only)	CAPEX	0.036	0.036	0.054	0.036	0.036	0.198
TOTAL	**CAPEX**	**1.449**	**1.665**	**1.773**	**1.665**	**1.449**	**8.000**

1.7 Summary of investment costs

Table 1-10 Summary of Costs

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Opex	0.2	0.2	0.2	0.2	0.2	1.0
Capex	2	3	3	3	3	14.0
Total						**15.0**

Table 1-11 Proposed Activity

Investment Activity	£m
Targeted investments in priority assets for fluvial flood risk	3
Real time network interventions	3.1
Partnership groundwater study and community advisors	1
Power resilience	8
Total	15

1.8 Customer protection

This enhancement case does not meet the threshold for a PCD. Customer protection comes from the value for money and the derisking and benefits of enhanced resilience and the use of existing risk sharing mechanisms.

1.9 External assurance

Independent external assurance was undertaken over the resilience uplift expenditure. The assurance concluded that we have established the credibility of the case, options and customer protection by showing the data gathered and processes followed. It found that cost efficiency was based on the best available data to the team in the limited time available.

Annex 1 – Overview of power resilience work

Asset Area	Scope	Investment Category	Site Name														
			Esholt STW	Knostrop STW	Dewsbury STW	BBM STW	Naburn STW	Harrogate South STW	Aldwarke STW	Copley STW	Lower Brighouse STW	Upper Brighouse STW	Hull STW	Beverley STW	Sandall STW	Tadcaster STW	Sutton STW	Woodhouse Mill STW
UPS / Power	UPS Review for Shortfalls, Add new UPS where reqd & Add Alarms for condition monitoring SCADA & Telemetry Status.	Enhancement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
UPS / Power	Review of Westermo Power supply resilence. Not all units are power backed.	Enhancement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PLC Network	Replace lynx Plus and L300 Units with new current Version. Connect alarms where missing Giving Improved Diagnostics and capacilty.	Enhancement	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

PLC Network	Review of Network Fibre Infrastructure redundancy.	Enhancement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SCADA	Create new Topolgy & ICA system page	Enhancement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PLC Network	Replace obsolete E1043 data Exchange Units, with Higher integrity solution.	Enhancement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PLC Network	Migirate to DP2 Files to lastest Version for enhanced diagnostics and reporting.	Enhancement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Instrumentation	ABB Magmasters on profibus to replace with ABB Water Masters.	Enhancement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PLC Network	Biejer E Terminal obsolesence, - Migrate to GOT to improve user interface and functionality	Enhancement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PLC Network	QxxHCPU l obsolesence, - Migrate to QDV ? & GXW2 For Improved support on future operating systems Eg Win 11. Comment: Easier on some site as already on GXW 2?	Enhancement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y