

IAP Response

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Wastewater Resilience Investment Case

1 April 2019



Contents

EXECUTIVE SUMMARY	3
1 CUSTOMER AND STAKEHOLDER VIEWS RELATING TO RESILIENCE	7
2 OUR APPROACH TO IDENTIFYING AND PRIORITISING RISK	9
3 DEVELOPING SOLUTIONS TO MITIGATE THE PRIORITISED RISKS	14
4 OPTIONEERING DETAIL FOR EACH RESILIENCE INVESTMENT	16
5 COST EFFICIENCY AND INNOVATION	38
6 VALUE FOR MONEY AND AFFORDABILITY	41
7 DELIVERY	42
8 ASSURANCE	43
APPENDIX A: RESILIENCE RISK REGISTER	45
APPENDIX B: ASSET RESILIENCE SCORECARD EXAMPLES	51

Executive summary

Our September 2018 Business Plan contained a number of investment proposals associated with our wastewater resilience strategy. However, it is now clear they were not presented in a way that demonstrated a clear “line of sight” between risks to resilience and the measures we intend to take. The purpose of this document is to set out in one place the methodologies, the analyses, the judgements and the information that together explain the decision-making processes that we undertook and the justifications for the proposals that emerged.

The point of departure for our approach to resilience is the strategic framework provided by “Welsh Water 2050”, which was shaped by the long term aspirations of our customers and other stakeholders in relation to the services that we provide. One of the principal features of Welsh Water 2050 was a full appreciation of the long term risks that we face and the need for a comprehensive resilience planning approach to deal with them.

As the bulk of this paper explains, this has been applied for the purposes of developing our proposals for AMP7. Beginning with the identification of all of the major risks that we face, together with their likelihood, we systematically analyse their potential effect on our assets and systems. From this, we can assess the consequences for service and thereby customer and environmental outcomes.

Equipped with this information we are then in a position to prioritise risks for intervention. We do this by evaluating the probability of risks occurring and their potential impact. Having identified the priorities the next stage is the assessment of options for risk mitigation and management. For this we apply our “five Rs” categorisation to ensure that we examine all of the different strategic approaches to risk mitigation.

To evaluate the options, we carry out a rigorous optioneering process involving consideration of alternative ways of addressing the priority risk in question, quantification of whole life cost, potential interaction with other programmes or priorities, and the prospective benefits for customers and the environment.

The result of this process, for wastewater, is a programme comprising 7 elements for AMP7. These are summarised below. The way in which the framework summarised above has been applied to arrive at each one is described in the rest of this paper.

Table 1 Delivering investment across the 5 qualities ('Rs') of resilience for our wastewater system

Resilience mitigation	Investment programme		Proposed programme total budget (post-efficiency)	Proposed enhancement (post-efficiency)
Reliability	WwS3	Newport tunnel resilience (40%)	£17.261m	£6.904m
	WwS7	Sewer flooding	£42.335m	£42.335m
Redundancy	WwS1	Additional strategic storage of sludge	£6.016m	£6.016m
	WwS4	Power resilience at WWTW and SPS	£5.192m	£5.192m
Response and Recovery	WwS5	Condition surveys and temporary works plans for critical sewer failures	£3.655m	£3.655m
Reflectiveness	WwS2	Drainage and wastewater management plans	£13.624m	£13.624m
	WwS6	Information Systems programme to provide greater resilience	£9.821m	£9.821m
Principal use adjustment			-£9.295m	-£9.295m
Total Resilience enhancement investment (post-efficiency) (Line 14)				£78.252m

Delivering for our customers

This work will meet the following of our customer promises:



Safeguard our environment for future generations: Safeguarding the quality of water in the environment by reducing pollution events.



Put things right when they go wrong: Reduce the need for reactive maintenance, deliver effective approaches to response and recovery



A more sustainable and prosperous future for communities: Improving the environment for our communities to enjoy and reducing the likelihood of pollution events.

Delivering our strategic responses

In Welsh Water 2050, we set out to deliver eighteen strategic responses. This investment will contribute to the following:



Addressing our 'worst served' customers: By improving resilience, the needs of our 'worst served' customers will be addressed.



Smart water business: Capitalising on technological advances such as remote sensing and automation will allow our system to become more resilient by mitigating problems before they have an impact.



Supporting ecosystems and biodiversity: Under the Environment (Wales) Act 2016, we have a duty to enhance biodiversity and promote the resilience of ecosystems and we are constantly looking for ways to promote and protect biodiversity in our actions.



Using nature to reduce flood risk and pollution: Sustainable urban drainage will help us to reduce risk of sewer flooding and pollution.



Cleaner rivers and beaches: Through improving our wastewater assets we can do our part to help achieve 'good' environmental status for our rivers, lakes and coastal waters.



Protecting our critical wastewater assets: Faced with an increased risk of disruption, we will improve the resilience of our critical wastewater assets, which have high environmental and customer impacts of failure.



Promoting a circular economy and combating climate change: We will aim to become an energy neutral business and will maximise opportunities to contribute to the circular economy in our local region.

Achieving our measures of success

For PR19, we will measure our performance based on measures of success (MoS). This investment will contribute to achieving the following MoS:

Measure of Success	End of AMP6 Position	End of AMP7 Position
En1: Water and wastewater compliance	100%	100%
En3: Pollution incidents from wastewater	95	78
En6: km of river improved	562	418
En8: Bioresources disposal compliance	100%	100%
Rt1: Sewer flooding on customer property (internal)	280	253
Rt2: Sewer flooding on customer property (external)	4,121	3,800
Rt6: Worst served customers for wastewater service	368	359
Ft2: Risk of sewer flooding in a severe storm	30%	29.45%
Ft4: Surface water removed from sewers	25,000	47,000
Ft8: Asset resilience (wastewater network + above ground assets)	77.7%	80.0%
Ft9: Asset resilience (wastewater network + below ground assets)	28.3%	45%
Co2: Employee training and expertise	95%	95%
Sv3: Customer Trust	Upper quartile	Upper quartile

1 Customer and stakeholder views relating to resilience

Need for investment

It is critical that our customers have confidence in our ability to maintain good levels of service, even when faced with unexpected or unlikely events. Building our resilience means increasing redundancy in the system so we are less reliant on single points of failure, increasing the resistance of our assets to current and future risks, becoming more reliable and improving our ability to respond to shocks and recover from them. Strengthening our resilience will allow us to improve our service and maintain high levels of customer trust.

Our wastewater assets are increasingly under pressure from climate change, environmental change and changes in consumer behaviour and lifestyle. Alongside these long-term pressures we are experiencing increasingly unpredictable and extreme weather events. In the last 12 months alone, we experienced a severe winter storm in early spring (storm Emma) followed by a heatwave and an exceptionally dry summer. These challenges will become more pressing as the climate changes, and we need to be prepared, to ensure we can continue to deliver our customers the service they expect.

Views of our customers and stakeholders

We have used targeted engagement as well as a comprehensive ongoing programme of gathering customer and stakeholder insight to inform our investment decisions.

Our engagement and research work has helped us to understand:

- our customers' and stakeholders' views and perceptions of risk and resilience;
- their preferences in relation to the different mitigation solutions available to us; and
- their willingness to invest for future resilience.

Customer views on resilience

We carried out specific customer research work relating to resilience in the early stages of our PR19 planning. This aimed to understand how well customers comprehend resilience issues in relation to wastewater services and to what extent customers believe we should be addressing resilience issues in our business.

From this research we know that our customers believe that risks such as extreme weather, terrorism and contamination are important to manage. This understanding has fed into our prioritisation of risk.

At a strategic level, for our long-term resilience planning, we published our 'Welsh Water 2050' vision for public consultation on our proposed strategic responses. Following this consultation, which resulted in over 20,000 responses as well as 17 detailed responses from stakeholder groups, we mapped each of the strategic responses according to how customers & stakeholders perceived their importance. This helped to prioritise areas for investment.

Our customer research on resilience included testing possible solutions, as well as investigating customers' willingness to invest for future generations. We found consistent support across customers as a whole for prioritised and affordable invest now to mitigate the effects of potential extreme events in the future.

Stakeholder views on resilience: the Welsh context

The Welsh Government has emphasised the importance of resilience within the water industry in Wales. For example, its statutory Strategic Priorities and Objectives Statement to Ofwat, published under section 2B of the Water Industry Act 1991, said, “*Ofwat has a key role to play in the delivery of a resilient water sector. Ofwat’s approach and regulatory framework should encourage, enable and incentivise resilience both in regard to short and long-term challenges. Companies are responsible for ensuring their assets and the services they provide are resilient against natural hazards and other problems that can be reasonably anticipated and that their services are resilient against asset failure and other threats.*”

In terms of the broader agenda, “A resilient Wales” is a statutory well-being goal under section 4 of the Well-being of Future Generations (Wales) Act 2015 and, for example, includes, “*the capacity to adapt to change (for example climate change)*”. In addition, the Environment (Wales) Act 2016 advocates a Sustainable Management of Natural Resources approach, defined as “*using natural resources in a way and at a rate...to maintain and enhance the resilience of ecosystems and the benefits they provide...*”.

We believe that the investment we are proposing for AMP7 responds to the strategic objectives of the Welsh Government. It forms a programme of well targeted measures that will significantly strengthen the resilience of some key parts of the wastewater services that our current and future customers rely upon.

Alongside the Welsh Government, we engaged with several stakeholders including Natural Resources Wales, British Trust for Ornithology, Citizens Cymru Wales, Waterwise, Wildlife Trust Wales, RSPB Cymru, Salmon and Trout Conservation UK, The Canal & River Trust, Chartered Institute of Plumbing and Heating Engineering, Brecon Beacons National Park Authority, and the Campaign for the Protection of Rural Wales during the development of Welsh Water 2050.

Stakeholders are supportive of the approach we are taking to identifying and mitigating future trends we face and they have welcomed a collaborative approach to addressing the future problems Wales will face through the development of partnerships.

2 Our approach to identifying and prioritising risk

Resilience in the Round

Our approach to building Resilience in the Round can be broadly described under a series of stages:

Risk identification: We take a structured approach to identifying risks using many different sources to identify acute shocks, which may impact our business immediately and the future trends, which will impact on our business in the longer-term.

System impacts: The impacts that these shocks and future trends will have on our systems from source to sea are assessed. We also assess the impact on other systems, on our customers and on the environment.

Risk prioritisation: The risks are prioritised based on their likelihood of occurrence and the impact. This prioritisation is undertaken both within programmes of work and across programmes.

Low likelihood, high impact risks screening: The high likelihood, high impact risks are prioritised and addressed under business as usual investment. The low likelihood, high impact risks are prioritised in a separate stream and addressed under our resilience investment programme. The risks prioritised within this investment case are those where the impact is of a significance to make it intolerable to our customers. For example, this might be because the risk would impact a large number of our customers, or because it would impact interdependent systems, for example, flooding of a highway.

Mitigation options: Options to mitigate the risk are developed. We follow an efficiency hierarchy: first removing the root cause through upstream management or encouraging customer-led actions; secondly considering changes to operation or leveraging the existing capabilities of the system to reduce risk; and finally building smart solutions to address our risks.

Across the hierarchy, we consider innovation, best practice research, and how we can work with other stakeholders who have an interest in improving resilience across systems.

Optioneering: The identified options are screened through feasibility work and then valued using our service measure framework and assigned a whole-life cost, calculated using our unit-cost database. A cost-benefit ratio is calculated to prioritise the options. Assessment of benefits to customers form an important part of this process.

Preferred options: The preferred option is progressed to implementation through the Operations Team, In-house Delivery Team, Network Alliance, Direct Procurement for Customers (DPC) or Capital Delivery Team.

Monitor and review: We monitor and review our investment using our Performance Commitments.

Our decisions at each stage are based on the evidence we obtain from our customer and stakeholder engagement including overarching customer and stakeholder engagement and project-specific engagement. It is also overseen by the risk and value challenge at a project-level and strong Board governance at a company-level.

Identification of risks, future challenges and impacts

We have a variety of processes for identifying current risks, future trends and their potential impacts at the strategic, tactical and operational levels of our business. These are set out in Figure 1 overleaf.

Strategic processes

Strategic risk prioritisation is managed by our Board. The corporate risk register is informed by high impact risks from across the business, identified in the operational and tactical risk prioritisation processes. Longer term trends such as climate change and changes in customer expectations have been identified and prioritised through Welsh Water 2050, which focuses on future trends that will impact our business over the next 30 years.

Through this work we identified a set of strategic responses for the business that would help us prepare for the long-term challenges highlighted in the study. We published this work for public consultation, to help us understand the relative importance of each strategic response to our customers. Taking on Board over 20,000 individual responses to the consultation as well as 17 detailed responses from stakeholder groups, we ranked each strategic response according to its perceived importance.

Tactical processes

Tactical risk prioritisation is managed by the Directors of Service and focuses on risk prioritisation across catchments or asset portfolios. The methods of risk identification and prioritisation within catchments include the business risks register, which focus on risks across the asset base; Sustainable Drainage Plans, which focus on drainage and wastewater risks within a catchment; and service resilience approach, which identifies asset and systems risks within a catchment.

We also have a robust post-incident review procedure. This procedure was used following serious incidents that have tested our resilience, including the severe weather and significant flooding in Rhyl in 2017, Storm Emma, and the drought of 2018. These post-incident reviews are led by a member of the Executive Leadership Team and bring the operations, emergency management, communications and planning teams together to review the root cause of the incident, the preparedness and emergency response, temporary and permanent mitigation measures put in place and communications to the public.

Many of these risks and issues are being addressed through our wider programme and business-as-usual work.

Operational processes

Operational risk prioritisation is managed by Heads of Service level. It focuses on risk identification and is facilitated through the asset resilience scorecards for risks to critical assets and Investment Manager (our corporate asset risk system) for risks to other assets.

The first step in building our asset resilience scorecard was screening our operational assets to identify the 'critical' assets. We have identified 56 critical above ground assets and 187 critical sewers in the scorecards we are using for AMP7. The assessment of criticality is linked to the potential impact of failure on the local environment.

At an asset and operational level, our asset managers and operations leaders own the asset resilience scorecards and review them at least annually. Through a set of targeted questions, they establish the resilience status of each critical wastewater asset, including any dependency on external systems such as power and access. The resilience measures include flooding, erosion, power, access, security, temporary works, duplication, storage, condition, treatment, control systems and asset failure.

The structure of the asset resilience scorecards allows us to identify gaps in resilience either by asset or by resilience measure. Appendix B shows examples of the structure of the scorecard. This structure supports a multi-dimensional approach to prioritising programmes and encourages efficiencies in delivering solutions.

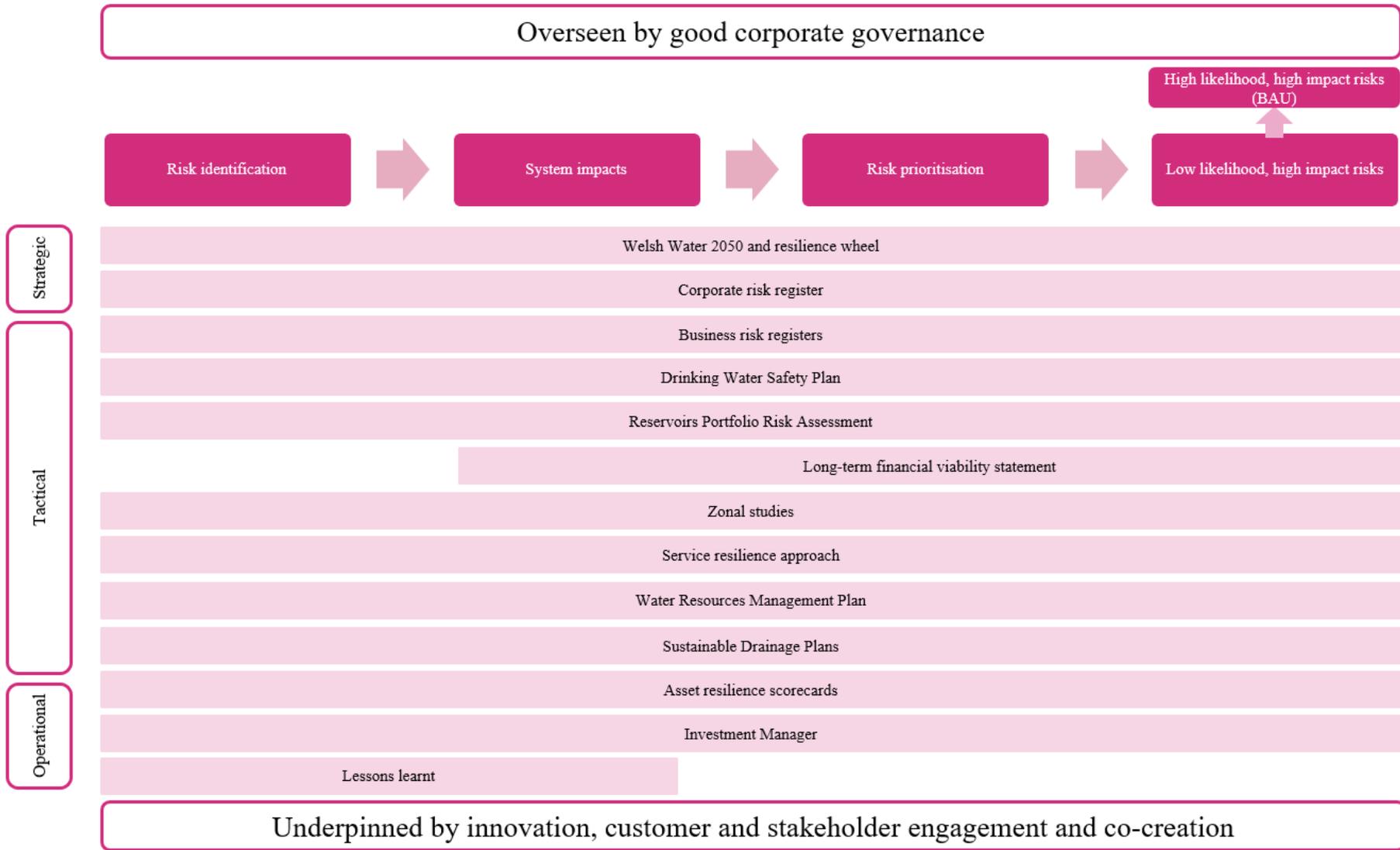


Figure 1 Risk identification processes

Prioritising our risks and our resilience investment programme

Our business as usual activities and expenditure address high-likelihood risks. This leaves us with low-likelihood, high-impact risks, for consideration as resilience investments.

Comparing resilience risks from the different sources is difficult due to the differences in scale – company- wide versus asset level, low probability high impact. Developing this methodology is a key next step for us in developing our approach to resilience and this will be set out in more detail in our Resilience Action Plan on 22nd August 2019, as suggested in IAP action WSH.LR.A2. For PR19 we reviewed risks from the various sources shown in Figure 1 and prioritised consistently across the wastewater business. We then combined the wastewater risks with the prioritised risks from water and retail to prioritise across the company as a whole. The initial review was facilitated by our Head of Wastewater Assets and the Managing Director of Wastewater Services. The combined review took place with the Executive team. The final investment programme was derived from this combined prioritisation process. The Board challenged our prioritisation and the selected investments.

The prioritisation included consideration of risks identified through the strategic, tactical and operational risk identification processes, explained in more detail below.

Strategic risks

Key messages coming out of the Water 2050 review that we have reflected in our assessment of risk are:

- Climate change: Extreme weather events such as high intensity storms and flooding are likely to increase in frequency and intensity due to climate change. High intensity storms can impact our wastewater network causing internal and external sewer flooding of properties and pollution.
- Customer service expectations: The digital revolution and lifestyle changes are altering our customers' expectations of what good service looks like
- Smart wastewater system: Technology is developing quickly giving us the opportunity to improve the service performance and resilience of our assets through remote sensing, data analysis and automation; solving problems before they impact on our business or the environment.
- Worst served customers: Faced with increasing customer expectations for a good service at all times, we need to address the longstanding service complaints of 'worst served customers' to ensure that everyone receives an acceptable level of service.

Government policy and industry best practice has developed relating to the management of wastewater networks to steer the development of Drainage Wastewater Management Plans. These plans provide a great opportunity to enhance our decision making capability and create a longer term strategy for the management of key issues.

Tactical processes

Our review of the tactical risk identification results highlighted the following key messages:

Business risk register: The majority of risks are being dealt with through business as usual processes but concerns about the landbank for disposal of sludge remain outstanding

Lessons learnt review: All issues raised through lessons learnt are being dealt with through business as usual processes and maintenance investment. There were no resilience risks identified through this process.

Service resilience review: Some key concerns were raised through the service resilience review relating to climate change. In particular the risk for a number of coastal towns and cities was highlighted. At a company level the change in storm patterns was noted, with the impact this is having on sewer flooding

to properties. The highest asset level risks that were identified relate to the major sewage pumping stations on the Cardiff network, which have the potential to cause flooding to wide areas of the city.

Operational processes

At an operational level, we reviewed the risks on Investment Manager and concluded that our capital maintenance processes were working well to manage these.

The review of the asset resilience scorecards highlighted power supplies to sites as a resilience risk on many sites. The operations teams have experienced a number of failures to supplies, for a variety of reasons. The risk of environmental impact as a result of these power outages is significant. For this reason the operations teams recommended that this resilience gap should be the top priority to address for above ground assets.

With below ground assets the scorecard has highlighted that we are missing condition information for a large proportion of our critical sewers. Closing these gaps will give us an improved ability to prioritise the remaining resilience risks and for this reason is the first priority for investment. The second highest priority identified is to put in place plans for dealing with asset failures, where they do not currently exist, and reducing the impact to customers and the environment.

A full resilience risk register was developed bringing together the results of the strategic, tactical and operational reviews. The register includes an explanation of the reasons for prioritising some risks over others. The register is included in Appendix A. The risks prioritised for investment in AMP7 are shown in the table below.

Risk ID	Need	Risk identification approach
2	Mitigate temporary loss of the landbank for biosolids disposal	Business risk register
6	Improving our understanding of the performance of our networks	Strategic review, external priorities
7	Address risk of rising tides in Newport	Service resilience review
11	Address properties newly identified as being at risk of sewer flooding	Service resilience review
18	Improve power resilience at sites	Asset resilience scorecards
24	Identify temporary mitigation plans for critical sewers	Asset resilience scorecards
28	Understand the condition of critical sewers	Asset resilience scorecards
5	Improve our ability to monitor and analyse our performance	Welsh Water 2050

3 Developing solutions to mitigate the prioritised risks

In planning and prioritising investments, we use the 5Rs framework; the four 4Rs set out by the Cabinet Office (Resistance, Redundancy, Reliability and Response & Recovery) as well as 'Reflectiveness'; a quality we believe is essential for incorporating lessons from previous experience into our plans for the future. We consider options and deliver activities across all of the 5Rs. Our overarching investment planning approach is explained in more detail in supporting document 5.1 of our Business Plan.

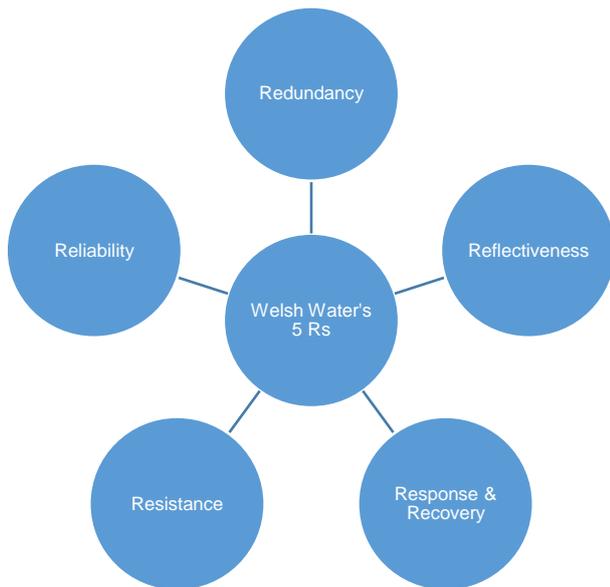


Figure 2: Our 5Rs mitigation approach

Our programme is also set within the framework of our legal duties relating to the environment, biodiversity, drinking water quality and supporting national security. We are very mindful of the role we play in delivering the Welsh Government's policies for the water industry, as well as its broader, agenda, such as that set out in the Well-being of Future Generations (Wales) Act 2015.

Following selection of our prioritised risks we spent time developing outline solutions and considering the costs and benefits. We then undertook a further round of review and senior management challenge to identify the options that have formed our selected plan.

The table overleaf shows the projects selected to meet the needs that had been prioritised.

The detailed options appraisal is addressed separately for each investment in section 4.

Risk ID	Solution ID	Proposed solution	Type of mitigation	Selection criteria
2	WWS1	Increasing availability of strategic sludge storage by 1 month	Redundancy	Flexible solution that allows us some headroom in the event of short-term disruption to normal disposal routes
6	WWS2	Deliver prioritised DWMPs through a mix of upgrades to SDPs and modelling new catchments	Reflectiveness	Allows improvements to the new standards at an affordable pace
7	WWS3	Address key elements of risk to Newport tunnel	Reliability	Reduces the risk to an optimal level
11	WWS7	Programme to manage risk of sewer flooding	Reliability	Identified the right level of investment to prevent the number of properties affected growing
18	WWS4	Improve power resilience at sites	Redundancy	Eliminating power resilience gaps at an affordable cost
24 & 28	WWS5	Improved understanding of risk of failure of critical sewers	Response and Recovery	This programme will give us a good understanding of risk across all critical sewers.
5	WWS6	Improved capability for modelling and understanding risk through predictive analytics and automated responses	Reflectiveness	Improved technology and data analytics will enable us to drive innovation and efficiency in the prioritisation and delivery of improved services and resilience to customers.

4 Optioneering detail for each Resilience investment

Overview

Following the processes identified in section 3, this section sets out in more detail, for each individual element of investment:

- **The need for investment**, including a description of the key risks that will be addressed through the investment;
- How we are **building on progress** from AMP6, to make the most of our investments over time;
- The **options that we have assessed** to respond to the investment need, and the **preferred option**;
- Any **residual risk** remaining, following investment in AMP7;
- **Innovation** that forms part of each project or programme;
- **Benefits** that we expect to deliver for **our customers** and for **other systems**, reflecting any interdependencies
- The **measures of success**, or performance commitments, that we will use to monitor delivering of these investments.

Additional strategic storage of sludge

Investment Ref: WwS1

Need for investment

The majority of the sewage sludge (biosolids) we produce is recycled onto agricultural land. This is the most sustainable and cost-effective process for our sewage sludge management up to 2040 and beyond. This approach is recognised by both the EU and UK government as the best practicable environmental option for sludge management. It is also in line with the Welsh Government's ambition that Wales should become a circular economy nation¹.

In November 2018, the Welsh Government announced plans to “*introduce regulations to tackle agricultural pollution. These will apply across the whole of Wales to protect water quality from excessive nutrients. The regulations will come into force in January 2020*” and include “*Protection of water from pollution related to when, where and how fertilisers are spread; and Manure storage standards.*” This regulation change may change how sewage biosolids are used in agriculture across Wales.

As the landbank that we dispose to is not in our control, we need to ensure we have resilient procedures in place to manage the risk of its loss. A loss could occur as a result of outbreaks of livestock diseases, prolonged wet weather, a reduction in demand due to Brexit or regulatory changes to reduce nutrient loadings of agricultural land. The potential loss of the landbank has been identified as a risk on the wastewater business risk register as shown below.

Extract from the wastewater business risk register

Landbank loss for biosolids disposal	There is a risk that the DCWW landbank for biosolids disposal could be lost leading to an increase in disposal costs, breaches of environmental regulation and odour issues for our customers. Loss may occur in any of three scenarios; partial loss (e.g. phosphorous restrictions), short-term loss (e.g. foot & mouth disease outbreak) or long-term loss (e.g. increase in restrictive clauses of land use).
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If we are unable to dispose of our sludge it will have a detrimental impact on treatment operations, leading to the risk of widespread non-compliance, increased costs and could result in odour issues and water pollution.

Our sludge strategy identifies our aim to provide four months of emergency storage for final product cake to mitigate any partial, short or long-term loss of land bank. Our analysis of the risk concluded that four months is sufficient to put a long term solution in place. The storage that will be available at the end of AMP6 only provides approximately 21 days of emergency storage.

Building on progress in AMP6

In AMP6, following the identification of the risk of loss of landbank, our 25-year sludge strategy was developed. Three scenarios resulting in the potential reduction in the agricultural landbank were outlined:

- **Scenario 1: Short term loss of access to the landbank** – for example, due to outbreak of a disease such as foot and mouth disease with a regional impact, or prolonged poor weather reducing

¹ Welsh Government press release 17 October 2017 'Our route to becoming a Circular Economy nation'

access to agricultural land. The 2001 outbreak of foot and mouth disease lasted for over seven months and resulted in movement restrictions on agricultural land.

- **Scenario 2: Partial loss of landbank** – for example, due to regulatory restrictions such as phosphorous limits; due to restrictions based on crop types grown; limits on sludge / biosolids disposal in environmentally sensitive areas; or restrictions due to nitrate vulnerable zones (NVZs). In 2016/17, the Welsh Government held a consultation on tackling nitrate pollution in Wales, and one of the proposals was for a ‘Whole Wales NVZ designation’. Over 60% of respondents favoured this option, and whilst it was not taken forward by the Welsh Government at the time, there remains a high likelihood that increased restrictions will be implemented in the future.
- **Scenario 3: Long term loss of the majority or all of the landbank** – for example, as a result of additional exclusion clauses relating to the use of biosolids on grassland or animal feed crops, which would prevent us recycling biosolids on the majority of our land bank.

Strategic storage of sludge became a priority during AMP6. Over the course of the AMP, 21 days of sludge storage was made available at designated sites in Cardiff, Afan, Moreton on Lugg and Five Fords.

Options appraisal

Several options were considered for the provision of sludge storage in AMP7:

Option 1: Reactive only - £0 planned expenditure

In this option we would seek to address the consequences of the loss of landbank when it occurs rather than proactively planning to address such an event. This is a reactive approach which relies on the existing 21 days of storage currently available. Any incident would be likely to last considerably more than three weeks and the available sludge storage would not be adequate. Biosolids would consequently be likely to be stored on land with no management facilities, with resulting risks of pollution to the environment, odour issues and potentially health concerns.

Option 2: Provision of an additional 1 month of sludge storage over AMP7 - £6.2m planned capital expenditure

In this option we would construct facilities to provide an additional 1 month of biosolids storage across Wales, incorporating all necessary odour management and drainage / treatment facilities, by the end of AMP7. This would provide a total storage capacity of seven weeks. Additional storage to provide a total of four months of sludge storage would be provided over AMPs 8 and 9.

Option 3: Provision of sludge storage facilities over one AMP - £23m planned capital expenditure

In this option we would construct facilities to provide a total of four months of sludge storage across our service area in England and Wales, incorporating all necessary odour management and drainage / treatment facilities, by the end of AMP7.

We also considered using external storage capacity from other companies. Our analysis showed that this is not an option across all areas, and not cost beneficial for all sites. We have incorporated this where possible into our overall sludge strategy.

Preferred option

Option 2 would address the additional storage capacity need identified in our Sludge Strategy and improve the overall resilience of our sludge management activities.

We believe that as the market for biosolids becomes available we will be able to use surplus capacity in other companies to manage short to medium term risks.

Customers expect us to manage for future shocks and stresses but also expect affordability and therefore spreading out the programme reduces the impact on customer bills in AMP7, requiring £6.2m of investment for option 2 versus £23m of investment for option 3.

We consider that option 2 reflects our customer and stakeholder sentiments as well as fitting in with an affordable wastewater programme over AMP7.

Residual risk

Despite the preferred option achieving the designated volume of storage by the end of AMP9, there is a residual risk that a sudden shock such as a large foot and mouth outbreak, during AMP7 or AMP8, lasting several weeks or months would exhaust the available storage, risking environmental damage and loss of reputation among customers and stakeholders.

Summary of innovation in this programme

We have two main innovation projects in this area:

- Research is currently being undertaken into optimising sludge process/sludge thickening technique to reduce sludge transport costs. This will progress into the development of sludge to land products.
- To address longer term risk we are supporting research into the circular economy by way of novel processes to extract additional energy and valuable resources from our residual biosolids, e.g. hydrogen and bioplastics.

We are also exploring the potential for service suppliers to treat and dispose of raw / partially treated sewage sludge cake in our North Wales region. An open expression of interest invitation is being run through April on this.

Benefits for customers

The provision of strategic sludge storage facilities, sludge will reduce the risk of odour issues for customers and pollution to the environment.

Benefits for other systems

The storage or disposal of sludge is crucial to the treatment of wastewater and any backup of sludge at wastewater treatment works could affect the treated effluent quality leaving the works, impacting receiving waters. Some of these receiving waters are sensitive receptors, for example, Jackson's Bay bathing waters near Cardiff WwTW and Swansea Bay shellfish waters for Afan WwTW.

The strategic sludge storage facilities will also be available to support other water companies in the event of reduction of landbank availability or asset failure in their areas.

Measures of Success

The strategic sludge investment will contribute to several PR19 Performance Commitments. These are:

	End of AMP6 position	AMP7 Target
Water and wastewater treatment compliance (En1)	100%	100%
Pollution Incident from Wastewater (En3);	95	78
Bioresources disposal compliance (En8)	100%	100%

Drainage and Waste Management Plans

Investment Ref: WwS2

Need for investment

We have a statutory duty, under Section 94(1) of the Water Industry Act 1991, to provide an effective system of public sewers and to maintain these assets to ensure effective drainage. Reducing internal flooding is consistently a high priority for our customers and is universally accepted by all stakeholders as our worst service failure due to the health hazards, damage to property and impact on businesses. There is a high willingness to pay for preventing sewer flooding of £22,470 per property prevented from flooding internally. Customers are clear that they expect us to reduce such flooding by developing and maintaining a resilient sewerage network to protect them in the long-term.

We want to adopt a proactive and reflective approach to improving the resilience of our sewerage networks to climate change using Drainage and Wastewater Management Plans (DWMP). We led the 21st Century Drainage Programme, helping to shape the pan-industry framework to be used in the preparation of DWMPs.

Our DWMPs will be used to develop a holistic view of the sewerage network (foul, combined and surface), interconnecting drainage systems, and treatment, the impact of both climate change and urban creep on flooding and pollution and the subsequent impacts on customers and the environment. They will enable us to develop and test potential mitigation options and identify our sewerage and wastewater treatment needs over the next 25 years.

They will also provide a platform for key stakeholders such as Welsh Government, Natural Resources Wales, Environment Agency and Local Authorities to influence and collaborate with us on our long-term plans.

In AMP7, the Welsh and UK Governments, as well as our other stakeholders expect a step-change in wastewater planning, through the production of DWMPs. The Welsh Government has stated that, *“Ofwat should encourage and incentivise companies to manage waste water and surface water in an integrated and sustainable way”* in its statutory Strategic Priorities and Objectives Statement to Ofwat under section 2B of the Water Industry Act 1991.

The DWMPs will support our objective to have an industry-leading wastewater planning capability. They will build on investment made in AMPs 5 and 6 on our Sustainable Drainage Plans (SDPs), and will ensure we deliver sustainable and holistic solutions across our wastewater assets that meet the expectations of our customers and stakeholders.

Building on progress in AMP6

To date, we have developed our approach to long-term wastewater planning, based on what works best for customers and the conditions that apply in our operating areas, in line with other English and Welsh companies.

We currently undertake long-term planning of our wastewater services through our SDPs and growth assessments. SDPs focus on our sewerage networks and provide assessments (at the level of individual wastewater treatment works catchments) on how we need to manage these over the next 25 years to deal with current and future sewer flooding risk, reduce our impact on the environment, cope with climate change, provide capacity for growth, assess the impacts of network deterioration and ensure our assets and service are resilient. By the end of 2020 we will have produced 133 SDPs covering 79% of our population (2.4m population equivalent).

Options appraisal

Two options were considered:

Option 1: Adopt new DWMP process across identified high risk catchments: Expenditure £13.62m

We will apply risk-based approaches to identify those catchments that meet DWMP trigger criteria. Once we have conducted an initial high level screening and applied the DWMP Baseline Risk and Vulnerability Assessment (BRAVA), we will identify and develop catchment-wide solutions on our highest risk catchments.

This option would produce detailed risk assessments and long-term plans for high-risk catchments only, with outputs meeting the scope of the DWMP framework. We propose that ~90% of our population would be covered by level 3 assessment DWMPs over AMP7, this being an increase of 11% above the predicted 79% AMP6 outturn for SDP coverage. Intelligence would be gathered on current and future risks and challenges and recommendations made as to how these should be managed, together with estimates of costs. This option meets stakeholder expectations.

Option 2: Adopt new DWMP process across all catchments: Expenditure > £40m

This option is more comprehensive than Option 1 in that it would produce detailed risk assessments and long-term plans for all of our wastewater catchments, with outputs meeting the scope of the DWMP framework. This would increase the percentage of our population covered to 100% from the current predicted AMP6 SDP outturn coverage of 79%. Intelligence would be gathered on current and future risks and challenges and recommendations made as to how these should be managed, together with estimates of costs. This option would exceed stakeholder expectations.

We have not considered a “do nothing” option as there is an expectation from both UK and Welsh Governments for us and other water companies to complete DWMPs; in fact both are considering making them a statutory requirement on WaSCs. We have also not considered continuing our current SDP approach as this will not deliver the full DWMP requirements.

Preferred option

Option 2 has been discounted on the grounds that the additional expenditure required to assess the additional smaller, lower risk catchments outweighs the benefits from applying the detailed DWMP process, together with the affordability of the option. We also consider that the extent of the work required is unlikely to be feasible in one AMP, let alone the tighter timescales which stakeholders expect DWMP outputs to be produced by. It also exceeds the expectations of our stakeholders that we identified through ongoing industry and regional meetings and discussions.

The level of investment proposed was informed from our experiences of applying the Drainage Strategy Framework in developing our SDPs over AMPs 5 and 6, and a review of the outputs from the Water UK 21st Century Drainage project ‘Developing a Framework for DWMPs’. We have recognised the potential for a significant amount of additional stakeholder engagement once we begin the production of our DWMP.

DWMP Programme	Expenditure
Production of new DWMPs	£6.37m
Update of existing ‘SDPs’ to meet DWMP level 3 criteria for the current iteration and update the plans for the 2 nd iteration planned for 2027 in the latter part of AMP7.	£6.05m
DWMP support team - Manpower and support services	£1.20m
DWMP Programme total	£13.62m

To produce our DWMPs, we will build on and develop the structure of the current SDP programme, with the incorporation of the additional requirements for DWMPs. There will be three levels of DWMP:

- Level 1 - A consolidation of levels 2 and 3 in a published strategic report for our whole operational area, setting out our plan of how we will address the challenges we have identified to achieve our long-term wastewater and drainage aims and so increase the resilience of our networks;
- Level 2 - An amalgamation of the significant elements from Level 3 plans for a WFD River Basin District (RBD). This will be undertaken for 3 WFD River Basin Districts in our operating area. Through consultation we will identify and develop opportunities that integrate the wider needs of stakeholders and seek mutually beneficial solutions, along with those of our own from level 3;
- Level 3 - At this level we undertake a detailed assessment of risks and opportunities at the sewerage catchment level areas (or sub-catchment areas for larger sewerage areas) and set out a long-term catchment plan of interventions to achieve both the aims specific to the local catchment and those of our strategic plans. Regard will be given to local planning / development proposals and needs.

The first iteration of studies will be complete by the end of 2022 to form the basis of our AMP8 (2025-2030) wastewater investment plans. Our aim by the end of AMP7 is to represent all customers in a level 2 DWMP with the majority of areas modelled at a more detailed level.

Residual risk

Despite the development of DWMPs over AMP7, there is still a residual risk of flooding during their development and the gradual implementation of mitigation measures.

Summary of innovation in this programme

The DWMPs are being developed to build-on our industry leading SDPs, which propose opportunities for a green infrastructure or RainScape as a mitigation option. We are an industry-leader in the implementation of green infrastructure in the UK to reduce surface water entering combined sewers. Green infrastructure brings additional benefits of new habitat and biodiversity creation, providing amenity value, regenerating neighbourhoods and improving air quality and reducing urban heat island effect.

Our RainScape approach is in line with Welsh Government legislation and policies including:

- the Flood and Water Management Act 2010, which, in Wales, requires the use of sustainable urban drainage systems in most new developments in Wales;
- the Well-being of Future Generations (Wales) Act 2015, which sets statutory well-being goals, including 'A resilient Wales' which, for example, refers to Wales' capacity to adapt to climate change.
- the Environment (Wales) Act 2016, which advocates a Sustainable Management of Natural Resources approach, defined as "*using natural resources in a way and at a rate...to maintain and enhance the resilience of ecosystems and the benefits they provide...*"; The definition also refers to the achievement of the well-being goals in the Well-being of Future Generations (Wales) Act 2015.
- the statutory Natural Resources Policy, published under section 9 of the 2016 Act which sets out the Welsh Ministers' policies for achieving the sustainable management of natural resources. It advocates harnessing nature-based solutions, including green infrastructure, in view of the wider benefits it brings. Specifically, it says the Welsh Government wants to, "*Improve the outdated drainage systems across Wales, with an emphasis on sustainable, nature-based drainage in our urban areas. This will include new frameworks for new development and incentivising natural interventions in areas of pressure by water, sewerage and drainage authorities. This will both increase green areas and resilience to changes in our climate.*"

- The Welsh Government’s Strategic Priorities and Objectives Statement to Ofwat published under section 2B of the Water Industry Act 1991, which advocates the “Sustainable management of natural resources” approach and says, “The Welsh Government recognises the need for more integrated approach to managing our natural resources, including through whole catchment approaches...Ofwat should encourage and incentivise companies to manage waste water and surface water in an integrated and sustainable way. Companies should be incentivised to seek solutions which deliver wider benefits to society and the environment, where this is justified by sound evidence.”

Our DWMP programme will be delivered in collaboration with stakeholders such as Welsh Government, Natural Resources Wales, the Environment Agency and Local Government. It is proposed that we can find common objectives and opportunities for co-investment across the wider programme.

Benefits for customers

By the end of AMP7, we will be able to adopt a more proactive approach to address properties flooding, which is considered the worst service failure by our customers.

Benefits for other systems

By taking a more holistic, strategic approach, our DWMPs will be used to proactively identify pollution hotspots, their causes and prioritise mitigation measures.

Measures of success

The investment in DWMPs will contribute to several PR19 Performance Commitments. These are:

	End of AMP6 position	AMP7 Target
Percentage of Population at risk of flooding in a 1 in 50 year storm(Ft2)	31%	29.45%
Pollution Incident from Wastewater (En3);	95	78
Sewer flooding on customer property (internal) (Rt1);	280	253
Km of river improved (En6).	562	418

Newport Tunnel Resilience

Investment Ref: WwS3

Need for investment

Heavy rainfall events and rising sea levels due to climate change are a risk to our wastewater assets and the populations they serve. We have identified the need to improve the resilience of our wastewater assets in low lying areas along the coast, to mitigate the increased risk to our customers.

Newport has been identified as the priority low-lying catchment for AMP7 as it has the largest number of properties, 2,533, at increased risk of low probability but extreme flooding. The current probability of such an event is 1 in 100 years, but this will become more likely with climate change.

The wastewater catchment in Newport is a low-lying catchment with a predominantly combined system which ultimately enters the Nash WwTW for treatment. The Newport sewerage system is divided into two catchments: the Liswerry catchment and the Orb catchment. From the Orb catchment, Newport tunnel conveys flows to a terminal pumping station, Orb pumping station and to Nash WwTW. Along the length of the tunnel, there are several CSOs, which can discharge into the River Usk to prevent property flooding.

The Usk at Newport has the highest tidal range of any city in the world - 11.63m difference for a mean spring tide between high and low water and is susceptible to storm surges.

Flooding from Newport Tunnel was recorded in 2009, 2010, 2013 and 2016. Initial investigations identified that the cause of flooding was a combination of high flows in extreme weather conditions and tide locking of combined sewer overflows (CSOs).

Climate change will cause increased frequency and severity of rainfall, storm surges and rising sea levels and consequentially, exacerbate the risk of flooding in Newport. In November 2018, the Met Office updated the 2009 climate change projections (UKCP09). The new UKCP18 projections identify increased severe weather and rainfall precipitation up to 2050. Projections also show a continued and accelerating sea level rise around the UK, and even if emissions are significantly reduced this century, the sea level rise will continue well beyond the year 2100. Wales is likely to experience some of the UK's highest average sea level increases in future years, particularly along our most heavily populated low-lying areas on the South Wales coast, with a sea level rise of 0.2m by 2050 under all scenarios, and a potential range between 0.27m and 1.13m by 2100.

Our customers view property flooding as the worst service failure they can experience and therefore, we are proposing to invest in the resilience of the sewerage system in Newport to protect our customers against increased climate change risk and high-consequence asset failure.

In addition, in the event of the failure of the terminal pumping station in the Orb catchment, the current CSOs would not be able to provide effective overflow capacity for sewage flows, with risk of flooding the 240 properties.

Building on progress in AMP6

In AMP6, we have worked with local customers to provide some flood risk reduction by annual cleansing of the sewers immediately adjacent to the flooding locations and installation of flood doors to reduce the risk of internal flooding.

Options appraisal

The Newport Tunnel feasibility study reviewed ten options to increase resilience and mitigate the increasing risk of flooding due to climate change. This included measures to resolve operational issues associated with pumping station capacity and blinding of screens.

Option	Description	Resolve operational issues	Mitigate flooding due to climate change	Pre-efficiency capex £m	Comments
0	Reactive only	N	N	£0	
1	Screens and outfalls resolved at all 5 CSOs	Y	N	£5.2	
2	Replace Church St CSO with new CSO in Town sub-catchment plus Storm PS (14,000 l/s)	Y	Y	£22.5	
3	New 14,000 l/s Storm SPS (at site of Orb SPS) + new CSO plus pipework modifications	Y	Y	£21.5	
4	Rainscape 26ha i/c 2 no. new outfalls + 5 no new CSOs	Y	N	£31.2	Note assumed in study that 26ha would remove 50% of flooding (likely to be optimistic)
5	Reduce flows to Nash WwTW - New Caerleon WwTW	Y	Y	£23.7	Note high OPEX to operate WwTW
6	Reduce flows to Nash WwTW - New Magor WwTW	Y	N	£47.4	
7	Increase storm treatment at Nash WwTW, storm PS at Orb PS	Y	Y	£52.5	
8	Catchment flood mitigation measures (providing storage of 189,000m ³ or equivalent) + 1 new CSO	Y	Y	£189.0	
9	New CSO at Shaftsbury Park plus 14,000 l/s storm PS and CSO pipework	Y	Y	£23.5	

Preferred option

Many options considered were discounted because they did not achieve both objectives of increasing resilience and reducing operational failures or they were too costly. RainScape has been ruled out in this catchment as it is disproportionately expensive due to the nature of the local topography.

Our preferred option is the highlighted option to construct a new 14000l/s storm SPS with a single CSO. The existing CSOs and their river outfalls will be decommissioned with the new pumping station and associated CSO being constructed at the site of the existing Orb SPS. The new outfall will be located downstream of the City Centre and the existing CSOs to reduce aesthetic impact within the city and reduce potential pollution to the Special Area of Conservation.

This solution will provide increased protection to Newport during severe storm conditions and reduce the risk of failure of the Orb SPS, mitigating flood risk to 2,533 properties.

Our proposed investment of £17.26m includes efficiencies to be delivered over AMP7. As the scheme will include works on existing CSOs and their river outfalls, 50% of the expenditure is identified as

maintenance and 50% as enhancement. We have also allocated a proportion of the cost into the wastewater growth programme.

AMP7 Total Capex Post Efficiency	AMP7 Capex Enhancement Post Efficiency	AMP7 Capex Base Post Efficiency
£17.26m	£8.63m	£8.63m

Summary of innovation in this programme

In AMP7, we are deploying innovative tools to manage flood risk. One of these is the ‘Storm Harvester’, which will predict rainfall to allow us to prepare for extreme weather events by for example, emptying storm tanks, de-silting critical trunk sewers and deploying property level protection measures.

Benefits for customers

Our preferred option for Newport contributes to our long term aim to improve the resilience of our wastewater assets in coastal areas, to mitigate the impacts of climate change and protect our customers against the increasing likelihood of low probability, high consequence events. This investment will reduce the likelihood of flooding to 2,533 properties in the Newport area, who are currently at risk of sewer flooding (50% internal and 50% external) in a 1 in 100 year storm.

The Orb catchment is mixed-use catchment with large industrial and commercial businesses including Tata Steel, distribution warehouses and car sales warehouses. This investment will reduce the risk of flooding to these businesses and therefore any reduce the detrimental impacts on the economy of Newport.

The investment will also increase resilience in the event of failure of the Orb Sewage Pumping Station, which would result in the flooding of 240 properties in itself.

Benefits for other systems

The River Usk is a Special Area of Conservation (SAC), with Newport an important location for the passage of migratory fish, including Atlantic salmon. The improved screens at the CSOs and reconfiguration of the CSOs and outfall will reduce the impact of storm sewage on the River Usk and the migratory fish passing through the city.

Measures of success

The investment in Newport Tunnel will contribute to several PR19 Performance Commitments. These are:

	End of AMP6 position	AMP7 Target
Percentage of Population at risk of flooding in a 1 in 50 year storm(Ft2)	31%	29.45%
Pollution incidents from wastewater (En3)	95	78
Sewer flooding on customer property (internal) (Rt1)	280	253
Sewer flooding on customer property (external) (Rt2).	4,121	3,800

Power resilience at WwTW and SPS

Investment Ref: WwS4

Need for investment

Power resilience is a supply chain dependency. Reliance upon a single supply can result in sewer flooding and pollution when power fails. We have identified 15 assets on our resilience scorecard that are not resilient to loss of power.

Our PR19 Customer Engagement and Welsh Water 2050 consultation shows that our customers and stakeholders have increasing expectations for a resilient wastewater service. We therefore need to prioritise improvements to our resilience over AMP7.

The Welsh Government Strategic Priorities and Objectives Statement to Ofwat supports the need for investment in power resilience: *“Ofwat has a key role to play in the delivery of a resilient water sector. Ofwat’s approach and regulatory framework should encourage, enable and incentivise resilience both in regard to short and long-term challenges. Companies are responsible for ensuring their assets and the services they provide are resilient against natural hazards and other problems that can be reasonably anticipated and that their services are resilient against asset failure and other threats.”*

Preferred option

A proposed investment of £5.192 million has been included within our PR19 Business Plan to improve power resilience. We developed this plan by undertaking investigations into all of our critical assets that had been identified as not being resilient to loss of power.

The primary focus of the resilience assessments was on the plant, systems and procedures that have been put in place to either generate or restore power in the event of mains failure. Our review also considered whether a physical intervention was required, or whether automatic changeover was possible.

The predicted expenditure for this programme is based on detailed scopes and costs from our Unit Cost Database.

We considered whether to tackle all power resilience gaps in AMP7 but felt that the identified programme was affordable and would ensure that 56 critical WwTW and SPS sites have 100% power resilience against our scorecard criteria. Solutions will ensure that there are two discrete reliable sources of power available for each site, or build enhanced protection against current surges.

We are planning to undertake enhancements to improve the power supply resilience at 12 WwTW and three SPS bringing the respective power resilience scores for each site up to 100%. We will develop a prioritised programme, completing the highest risk sites first. Completion of this AMP7 work will contribute to our overall target of 80% for MoS Ft8.

Resilience schemes	Budget (post-efficiency)
Power resilience at critical WwTW	£4.44m
Power resilience at critical SPSs	£0.75m

Summary of innovation in this programme

We are looking to innovate by carrying out battery storage trials. If successful, this will give us backup power systems that can be rapidly deployed in case of mains failure.

We have research collaborations proposed with SP Energy Networks (SPEN) and Western Power Distribution (WPD).

Benefits for customers

The primary benefit for customers through improving the power resilience at critical sites is reduced disruption to service. Power outages can disrupt treatment processes, which can cause environmental pollution if not resolved rapidly. Power outages at critical SPSs can also lead to flooding, as failure to operate pumps can cause the system to back up and flood.

Customers will have an increased confidence in the reliability of our service.

Measures of success

	End of AMP6 position	AMP7 Target
Asset Resilience (wastewater network+ above ground assets) (Ft8)	77.7%	80.0%
Pollution incidents from wastewater (En3)	95	78

Condition Surveys and Temporary Works Plans for Critical Sewer Failures

Investment Ref: WwS5

Need for investment

Critical sewers with interdependencies such as road, rail and river crossings would have a high impact on people and the environment in the event of failure, to such an extent they can be categorised as “black swans” in terms of asset management. They present some of the most challenging practical conditions for remedial work in the event of asset failure.

Given the importance of these assets to the resilience of our wastewater assets, we need to improve our understanding of their condition so that we can prioritise and plan future investment on our critical sewer assets. This aligns with the relevant Welsh Government policies (see below).

Options appraisal

Option 1: Reactive only- £0 planned expenditure

In this option we would seek to address the consequences of critical sewer failures when they occur rather than proactively planning to understand the condition of these sewers. This is a reactive approach which will not reduce the service disruption our customers experience.

Option 2: Condition survey of our critical sewers- £3.655m planned expenditure

Understanding asset condition is good value investment as it allows us to understand the urgency of addressing the resilience gaps on a critical sewer. This will help us build a better understanding before making informed decisions in relation to prioritising further work with higher capital investment needs. Building response plans allows us to react quickly in the event of a failure is also a good value option which will allow us to minimise the impact of a failure on service.

In the options appraisal we then considered the number of assets that should be covered. We decided that processes should be developed and tested before being rolled out across all mains to balance the full resilience programme within the wider investment programme.

Preferred option

Our preferred option over AMP7 is to undertake a condition survey of our critical sewers. Undertaking this work is a pre-requisite for being able to fully deploy a systems based resilience approach. There are currently significant practical constraints to surveying these assets and hence we are working to identify innovative means of understanding their condition before moving to solutions.

Each critical sewer will receive a condition survey resilience score. A score of 100% is based upon the following criteria: structures that are class 1 or 2 and have been surveyed within 10 years OR structures that are class 3 and have been surveyed within five years. Critical sewers that fall outside of these criteria receive a resilience score of less than 100%, depending on further criteria. Costs are based on bespoke example scopes from AMP6 applied to our AMP7 dataset.

All of our critical sewers will also score 100% against our temporary works resilience criteria. To achieve this, each critical sewer will have a specific plan in place with equipment and spares available to deploy in 2 hours. The indicative cost for developing a site specific plan is based on a unit cost per length of critical sewer against the classification of criticality.

Residual risk

There are significant constraints to accessing and surveying some of these critical sewers. The risk of being unable to carry out vital survey work will be mitigated by utilising innovative survey techniques.

It is possible that the condition of some key sewers could be much worse than expected, thus requiring our immediate intervention. This would, in turn, have a detrimental effect on the rest of this programme and expenditure. As far as possible, this risk will be mitigated by allowing the programme to be flexible.

Summary of innovation in this programme

This programme will allow for some new and cutting edge technologies to be trialled. Primarily, innovative sewer investigation and monitoring technologies/techniques will be used. We are planning to trial innovative approaches - including sewer bat, electro-scan, radar flow survey and sonar - related to sewer flow performance and condition which will allow us to develop suitable methods to inspect our often difficult to access sewers and provide us with a picture of the risk they present.

The condition surveys will be supported by the implementation of DWMPs to aid the understanding of risk especially where there are third party drainage assets involved. This will contribute to a better, big picture understanding of key areas.

We are also planning research into new ways of monitoring sewer leakage from 2020, with plans to increase this scope by using drones from 2025.

Benefits for customers

The primary benefit of carrying out condition surveys and preparing for temporary works is to reduce disruption to service in the case of failure. By increasing our understanding of assets that are in a poor condition and critical to service, we can target future investment to managing this risk. In the long term this will increase reliability and increase customer confidence in the service we provide, thus significantly enhancing the resilience of our wastewater service.

Benefits for other systems

Interdependent systems will also benefit from condition surveys and temporary works plans, especially the other critical infrastructure at the highlighted sites such as roads and railways.

Understanding the condition of sewers crossing rivers could also prevent pollution, so protecting these watercourses against potentially very damaging pollution incidents. This will help to ensure that obligations, such as the Water Framework Directive and Bathing Water Directive, are met.

Responding to the Welsh Government's agenda

As noted above, the Welsh Government Strategic Priorities and Objectives Statement to Ofwat supports the need for investment to improve the resilience of our networks. It also says, "*Assets should be monitored and maintained appropriately to ensure that the costs borne by future bill payers are efficient,*"

The Water Strategy for Wales acknowledges that, "*Deteriorating performance of sewerage assets poses a significant risk to water quality and we want to see a structured approach to the planning and maintenance of the sewerage and drainage network*" and says "*We want sewerage and drainage systems to be well managed and maintained in an integrated water, with sufficient capacity to manage the demand placed on it and without causing pollution or sewer flooding of peoples' homes.*"

We believe improving our understanding of the condition of these critical sewers is very relevant to the delivery of the Welsh Government's aspirations. It is a key part of the wider agenda within our waste water business to enhance our resilience, representing significant progress toward our Welsh Water 2050 strategic response, "*Protecting our critical wastewater assets*".

Measures of Success

The success of this programme will be measured against the following criteria:

	End of AMP6 position	AMP7 Target
Asset Resilience (wastewater network + below ground assets) (Ft9)	28.3%	45%

Information systems projects to provide greater resilience

Investment Ref: WwS6

Need for investment

If we are to strengthen our long term resilience, we need to harness emerging technological opportunities to improve our understanding of our sewerage and drainage systems, including their interdependencies and vulnerabilities.

With increased information systems (IS) capability, we will be able to understand and control our assets better. We will also be able to respond better in real-time in the event of an unexpected incident.

This enabling investment will benefit all our programmes and all our customers.

A better understanding of events as they happen across the network will improve our response to failure incidents and strengthen our ability to cope with challenging conditions, such as heavy and prolonged rainfall or drought. The aim is also to improve our ability to have centralised and flexible response. Improving our IS systems will also allow us to identify the early warning signs of asset failures and respond before major incidents occur so that we can mitigate the impacts.

Building on progress in AMP6

Our approach to using IS to improve resilience was developed during AMP6. The primary activity was to leverage data and IT to deliver an improved streamlined process and more efficient operations. During AMP6 the focus was on improving the key areas of areas of control and automation telemetry, allowing real time decisions to be made about the operation of assets while also allowing for centralised oversight.

Preferred option

We have developed a vision and strategy for IS in AMP7. Our vision is to invest in people and technology to improve predictive capability, use Artificial Intelligence and continuous improvement through machine learning. We wanted to ensure that our AMP7 programme aligns with vision and strategy.

We have adopted an agile approach to development across our IS portfolio. Given the speed of IS technology development, we must avoid unnecessary obsolescence. We therefore want to retain maximum flexibility to utilise the IS solutions that emerge in the years ahead. Enabling this adaptability was also a fundamental part of our options assessment.

Our preferred option combines IS activities that will align with our 2025 IT strategy, fundamentally improving our underlying infrastructure and our analytics capabilities. This will lead to improved customer experience. In particular, we are proposing the development of a system that will track our jobs and allow customers to live track technicians. This aligns with best practice from a range of other sectors, and with feedback from our customers.

Currently, some assets require manual intervention on site. This can be challenging, given the geographical constraints of our operational area. Developing IS systems that would allow for a remote, centralised response would improve response times and allow for solutions to be tailored to the particular incident.

Our IS programmes would allow for more effective operation and troubleshooting.

Residual risk

As noted above, whilst additional IS investment improves our capability to reflect, learn and respond, it can also increase our vulnerability to cyber-attacks.

Summary of innovation in this programme

Innovation is at the heart of our approach to IS. These include:

- Implementation of real time monitoring, both of assets and of technicians carrying out jobs to improve the customer experience.
- Integration of IT and operational data collection. This will allow us to take a bigger picture view of the data gathered and increase collaboration with stakeholders
- Testing of robotic process automations.

Benefits for customers

Investment in our IS systems will have a related effect of reducing disruption to service and increasing our reliability in the future. Our planned investment in live updates for customers will also improve their overall experience in interacting with our company.

Responding to the Welsh Government's agenda

The statutory Strategic Priorities and Objectives Statement to Ofwat supports the need for this investment. It says, *“Ofwat has a key role to play in the delivery of a resilient water sector. Ofwat’s approach and regulatory framework should encourage, enable and incentivise resilience both in regard to short and long –term challenges. Companies are responsible for ensuring their assets and the services they provide are resilient against natural hazards and other problems that can be reasonably anticipated and that their services are resilient against asset failure and other threats.”*

It also says, *“Ofwat should encourage and incentivise long-term planning by companies to protect against anticipated future social, economic, and environmental challenges, while taking advantage of technological innovations.”*

Measures of success

The IS investment is an enabler and will ultimately contribute to improvements to several PR19 Performance Commitments. These are:

	End of AMP6 position	AMP7 Target
Asset Resilience (wastewater network + below ground assets) (Ft9)	28.3%	45%
Employee Training and Expertise (Co2)	95%	95%

Sewer flooding

Investment Ref: WwS7

Need for investment

Sewer flooding can result from 'hydraulic overload (HO)' in the sewerage network (where flow in the sewer exceeds its capacity) and 'other cause (OC)' flooding (where something disrupts the free flow of wastewater in the sewerage networks), including sewer blockages and collapses. Expenditure to address the 'other causes' of sewer flooding is included within our base maintenance expenditure, and therefore only HO is considered here.

There are three causes of hydraulic overload flooding:

- population growth;
- increased drainage area (urban creep); and
- climate change.

We have analysed our Strategic Drainage Plan (SDPs) hydraulic models to understand how much of predicted flooding is linked to new build properties and how much is linked to the impacts of storms and urban creep. The results showed that 98% of the predicted flooding is related to storms and urban creep, and therefore 100% of our sewer flooding investment is in the resilience case. In the IAP Ofwat have assessed the cost efficiency of sewer flooding by linking it to growth in new connections. We believe that Ofwat's wastewater growth modelling does not adequately take account of the actual drivers of sewer flooding in our operating area.

To provide our customers with an effective service, as well as discharge our statutory duty to provide effective public sewers (Water Industry Act 1991), we consider it a priority to improve our sewer resilience to climate change over AMP7. Historical statistical analysis identified an expected 33 new internal flooding incidents per annum to be observed over the course of AMP7. Our flooding enhancement investment is for addressing those properties that will be added to the internal flooding and external flooding risk registers in AMP7 as a result of more extreme storms due to climate change. Most new incidents at properties are due to increasing severity and frequency of rainfall events caused by climate change. Our combined sewers rely on overflows to watercourses as protection to properties from extreme weather events, and the increasing severity of storms will lead to new additions to the flooding risk register.

Our customer engagement has identified that customers consider sewer flooding to be the worst service failure that can experience. They expect us to reduce such flooding and develop and maintain a resilient sewerage network to protect them in the long-term. Ofwat expect that all water companies target upper quartile performance with respect to internal flooding.

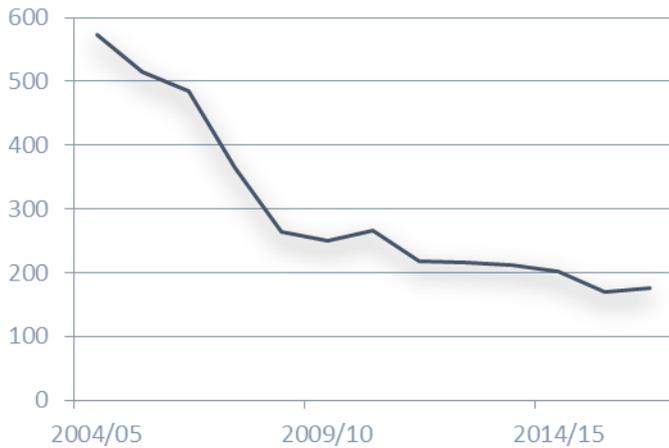
This investment is needed to reduce the risk of sewer flooding, reducing the risk of causing distress and hardship to our customers, as well as being a public health threat.

Building on AMP6 progress

During AMP6 we have worked to develop our approach to long-term planning of our wastewater services through our SDPs. These focus on how we need to manage our sewerage networks over the next 25 years to deal with current and future sewer flooding risks, reduce our impact on the environment and cope with climate change. 2020 will see us produce SDPs to support improved service resilience for 79% of our population served. As part of this, we have committed to remove surface run off from an area equivalent to 25,000 roofs by 2020, which supports the reduction of HO flooding.

We have made significant progress over several AMPs in reducing the number of properties at risk of sewer flooding (on our At Risk register)

Number of properties on the At Risk Register for internal sewer flooding



Options appraisal

We have developed options which reduce reactive responses, reduce flooding, and meet customer expectations.

In reviewing options for investment, consideration has been given to:

- historic and AMP6 performance and expenditure;
- the level of risk the business is exposed to from the current and future operation of these assets;
- performance targets that can be achieved, in particular having regard to Ofwat’s expectation that water companies target upper quartile performance;
- proposed wastewater expenditure in other investment cases; and
- customer and stakeholder expectations.

To support our analysis of options we also considered the results of cost benefit analysis at an individual property level based on our ‘at risk’ register, before working up a programme of investment. Our strategy for managing HO flooding in the future now focuses on the new additions to the ‘at risk’ register each year. Our assessment of the size of the plan for AMP7 has used generic assumptions based on historical data, using cost curves such as the example in Figure 3.

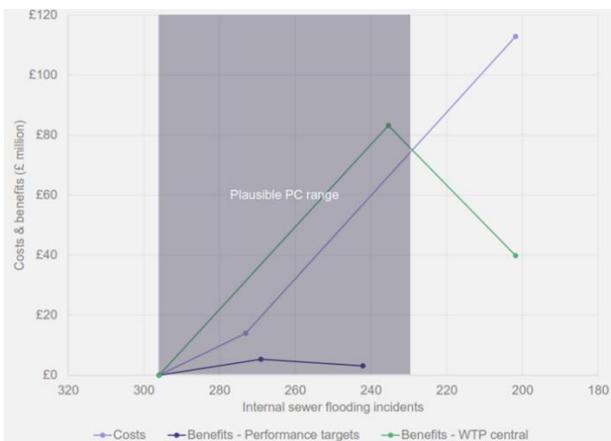


Figure 3 Internal sewer flooding - cost curve from cost benefit analysis

Preferred option

For this investment we will carry out proactive interventions to reduce flooding caused by sewers over AMP7. This will particularly focus on new additions to register, mainly caused by climate change - as identified by our hydraulic models. This budget has been set based on the number of additional properties expected to be added each year, this has been trended from recent historic data.

Summary of innovation in this programme

The development of our DWMPs will provide a step change in our ability to understand our risk of sewer flooding.

We also plan to collaborate with councils and Natural Resources Wales on our green infrastructure programme. This has been successful at our Greener Grangetown pilot.

We are looking at novel ways to reduce flooding risk to customers which will leave them at a lower likelihood of flooding, where it is not cost beneficial to remove their risk entirely.

Benefits for customers

165 customers will benefit from a reduced risk of flooding. This will therefore reduce the level of distress and public health hazards that they are subject to.

Benefits for other systems

The installation of green infrastructure into some catchments will bring additional benefits of increased biodiversity, improved amenity and improved air quality.

Measures of success

	End of AMP6 position	AMP7 Target
Sewer flooding on customer property (internal) (Rt1)	280	253
Sewer flooding on customer property (external) (Rt2)	4,121	3,800
Worst-served customers for wastewater service (Rt6)	368	359
Surface water removed from sewers (property equivalent) (Ft4).	25,000	47,000

5 Cost efficiency and innovation

Cost efficiency

Our costs are built up using our Unit Cost Database (UCD), and then efficiencies are applied, based on the recent performance of our Capital Delivery Team and Alliance partners. The efficiency challenge that was used in our plan is set out in Supporting Document 3.6 of our business plan.

The post-efficiency costs for each element covered in this paper are presented below:

Investment programme		Budget post-efficiency challenge
WwS1	Additional strategic storage of sludge	£6.016m
WwS2	Drainage and wastewater management plans - innovation for AMP7	£13.624m
WwS3	Newport tunnel resilience (40% of total project) Note that the 50% of the project is base expenditure and 10% growth.	£6.904m
WwS4	Power resilience at WWTW and SPS	£5.192m
WwS5	Condition surveys and temporary works plans for critical sewer failures	£3.655m
WwS6	IS projects to improve systems and provide greater resilience	£9.821m
WwS7	Sewer flooding	£42.335m
	Principal use adjustment	-£9.295m
Total Resilience Programme		£78.252m

Major capital investment schemes are delivered by our Capital Delivery Alliance and our in-house engineering team. Our Capital Delivery Alliance consists of three consortia partnerships and has been in place since 2015. The Capital Delivery Alliance contract is a long-term arrangement extended to 2025, which will allow us to deliver significant improvements in efficiency.

There are benefits to working collaboratively with our partners, including:

- Providing visibility of the AMP7 programme so that the Alliance can start advanced planning for AMP7 in AMP6.
- Creating a rolling three-year programme to enable planning and packaging of work based on geography and/or technical specifications to reduce design input, increase supply chain leverage and use of standardised products and offsite construction.
- Reducing project management costs through packaging of work into programmes.
- Closer integration with our operations teams in the design phase to align outcomes (service) and costs (whole life costing) with the long-term needs of the business.

This approach enables a consistent size of our capital programme, enabling our supply chain partners to work with a stable resource level, avoiding the wasted costs incurred at previous regulatory reviews in both downsizing delivery resource and then rebuilding again a couple of years later.

Innovation

We have an innovation strategy, which seeks to deliver our long-term plan described in Welsh Water 2050 and our mission “to become a truly world class, resilient and sustainable water service for the benefit of future generations”. Our enablers are (also shown in Figure 4):

- **Co-creation and communication:** We will co-create and co-deliver solutions in Wales’ unique environment with our partners, and work to communicate our innovation challenges and successes, so as to help develop and improve the regulatory frameworks we work within
- **Resources:** We will assign appropriate resources to innovation, and leverage our skills, time, funding and partnerships so that we are able to deliver the strategic outcomes committed to in Welsh Water 2050
- **Processes and systems:** We will adapt our process and systems to improve traction, to embed value, and provide sound governance so as to better evolve and develop new ways of working
- **People and culture:** We will build an innovative culture, where our people are supported to innovate, learn and succeed by testing ideas through a learn fast and scale up quickly approach

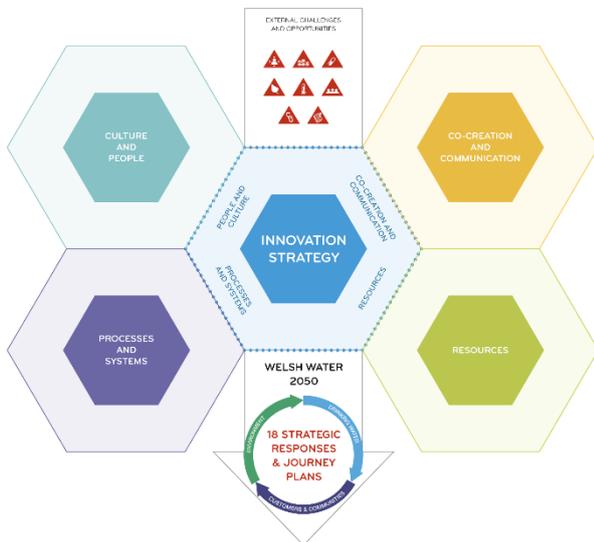


Figure 4: Enablers of innovation

One of our company values is to be ‘open to new ideas’; we encourage development of an environment in which our people are enabled to innovate and take reasonable risks to test their ideas. To support this, we will work with governments to review the regulatory landscape in which we work. By working openly in this way, we can develop the regulatory framework we work within and enable innovative solutions to be co-created and delivered for and with our customers. Our ‘Rainscape’ solutions and Peak Flow treatment process are internationally recognised examples of our innovation in practice. See our PR19 Business Plan supporting document Ref 3.3 Innovation for further details.

Partnering and co-creation

Working closely with our partners is essential to the way we work. Our 2050 strategy highlights this through identifying partners for each of our programmes of future work.

We have a strong relationship with our customers, as well as with external partners such as universities, third sector organisations, our supply chain, regulators, and the Welsh Government amongst others. We recognise that we are unable to achieve our commitments for the future alone, and that we must be flexible in the way we engage with our customers. It is important that they both support our innovations and are part of the solutions.

We aim to enable further innovation by working closely and more openly with our partners to create an environment that supports co-creation and transparent communication. To achieve this, we aim to:

- Develop and implement a joined up approach to working with strategic partners, identifying suitable routes for co-creation and co-delivery in the long term, such as the approach taken to Greener Grangetown
- Collaboratively build a strong evidence base to support improved regulation and policy, making the most of relationships with academic and research institutions such as the GW4 and NERC
- Co-deliver pilot projects with the partners including the supply chain, customers, the third sector and regulators, such as those planned for the Brecon Beacons Mega Catchment
- Building on the success of projects such as RainScape and Rhondda Fach Water Resilient Communities, we plan to roll-out new ways of working with partners; sharing cost and benefits equitably
- Build on our existing successes (such as the Innovation Conference) and global relationships to share lessons, pilots and successes across Wales and beyond. We will also continue to build and improve our internal communication and delivery channels so that the right messages are shared with the right people and at the right time
- Develop strong, long-term multi-sectoral partnerships to help deliver innovation for the long-term benefit of water services in Wales
- With our supply chain, we enable innovation by having the Capital Alliance which fosters innovation and collaboration
- Work with WPD and SPEN to investigate battery storage at WwTWs

We also recognise our interdependent risks and the need to work closely with power companies (such as WPD and SPEN), the transport network (Transport for Wales) and emergency services to enable us to tackle our interdependent resilience. We continue to assess and understand the changing risks associated with our interaction with highways, railways and other utilities.

6 Value for money and affordability

Impact on customer bills

We understand the importance of balancing the need for investment with the affordability of our bills. We believe the investment will help to deliver the level of service our customers and regulators expect, and represents an optimal approach for sustained long-term improvement.

We confirm that we undertake the best value options to meet our requirements, through our gateway delivery process. We also create schemes that provide us with benefits in the long term. Due to our unique customer ownership model, the cost savings accrued will be passed on to our customers through affordable bills.

Our overall PR19 Business Plan including the wastewater resilience investments resulted in a £22 reduction in customer bills. Customer acceptability testing of our plan found that 92% of our customers found the plan acceptable and 95% found it affordable. Further information of this research including the bill and service package options can be found in our PR19 Business Plan supporting document Ref 1.1 Customer engagement.

Value for money

We understand the need to demonstrate value for money in everything that we do. In arriving at our preferred solution to the challenges we face in terms of resilience, we have considered the costs and benefits of different options to make sure that any investment represents value to our customers.

Avoiding future costs as part of these programmes is key to delivering value for money.

The programmes of work have been developed so that they are delivered in conjunction with other programmes of work. For example, Newport tunnel has been selected, so that it can be delivered in conjunction with planned maintenance.

As outlined in the previous section of this document, we will also seek to ensure value for money by promoting innovation throughout delivery, by learning lessons from the work we have delivered to date, and by working closely with our partners to encourage best practice and incentivise efficiency.

We are assured of the value for money of our schemes by taking them through a risk and value process in the delivery phase. This quantifies the cost and risk of each option and the option with the best benefit cost ratio is chosen, unless there is a specific reason that this option is not appropriate.

7 Delivery

Procurement

We procure using our Capital Delivery Alliance for most projects. However the DWMPs will be procured via our Wastewater Asset Strategy team, using the existing Sustainable Drainage Plan (SDP) framework. This has been extended to enable us to continue to use the knowledge and relationships built in AMP6 to deliver momentum as we progress to delivery of our first DWMPs.

IS products and services are also procured under a different framework, which is managed by our Business Information Systems (BIS) directorate.

Programme

We have a gateway approval process that all capital projects must pass through so that there is sufficient scrutiny and challenge from senior management.

There are six stages of the capital investment process and a gateway between each stage. The gateway defines the requirements that are to be met before a project can be approved to move to the next stage. The gateways are as follows:

1. Commit to risk;
2. Commit to feasibility;
3. Commit to solution;
4. Commit to delivery / start on site; and
5. Commit to handover.

Our Capital Programme group (CPG) has the delegated authority to approve projects through the gateways. The approach provides strong governance for approving investment decisions and is transparent and fully auditable.

Where advantageous, we will explore opportunities to advance the progression of our schemes by working closely with our collaborators and our delivery partners.

Risk mitigation and customer protection

As part of our feasibility assessments, we have sought to understand and document the key risks associated with the planning and delivery of our resilience projects. This information will feed into a risk register that we will use throughout the delivery of every project to actively manage risk – by continually identifying areas of risk and implementing mitigation measures.

We have experience of successfully delivering projects of this nature and magnitude alongside our partners and believe that risks can be managed to make sure that projects are delivered to target and do not compromise the interests of our customers.

We have identified a suite of ODIs associated with the performance commitments related to this investment case (as set out above).

8 Assurance

Board assurance

We use the “Three Lines of Defence” model to mitigate risk of non-compliance with our processes and policies.

- First line of defence is ownership and management of risk. This is fulfilled by our operational teams and managers.
- Second line of defence is risk management and risk control. This is fulfilled by our compliance team and internal committees.
- Third line of defence is independent review and oversight. This is fulfilled by internal and external Auditors, including our technical adviser on regulatory reporting issues (Jacobs Engineering Group) who review our approach to risk and request evidence of risk reviews in the business.

We have a Business Assurance “Risk Assurance Map”, which shows the route to escalate risks from the “bottom up”, and also the Executive Team have a “top down” discussion of risk every month.

The Audit Committee oversees the risk management process and procedures and reports to the Board. There is an annual Risk and Compliance Statement declaration each year, overseen by the Compliance function.

We will continue to apply these effective governance systems for our proposed AMP7 investment programme.

Cost assurance

We have taken steps to provide accurate scheme costs which were derived from our Unit Cost Database (UCD).

The UCD model is updated annually and externally verified every five years to make sure that costs remain current. This assurance was undertaken by Mott MacDonald by comparing to ‘industry average’ from blending a selection of other water companies’ cost information.

We will continually review the costs of a scheme as we move into the detailed design phase. We will seek to drive cost efficiencies in order to keep customer bills affordable.

Customer consultation assurance

Our customers have indicated that they are very supportive of investments to improve resilience, including safeguarding our environment for future generations, putting things right when they go wrong and creating a better future for all our communities.

The approach that we have taken to seek our customer views has been reviewed by our Customer Challenge Group.

Future assurance

We have strong governance procedures for the planning and delivery of our capital investment. Our Board and audit committee will continue to provide high-level assurance and governance so that we deliver these much-needed improvements in the interests of our customers.

We employ a number of systems and processes to continually monitor and review resilience, at a strategic, tactical and operational level, as shown in Figure 5. These are outlined in further detail in our IAP test response on securing long-term resilience [B2.7.WSH.LR].

We are currently developing our Resilience Plan, building on what we currently do. This will be shared with Ofwat in August 2019. This will build on our current processes and will set out our assurance processes for resilience, from risk identification through to mitigation options, monitoring and learning.



Figure 5: Our monitoring and review process for resilience investment

Appendix A: Resilience Risk Register

Risk ID	Risk source	Risk Type	Description	Decision	Reason for decision
1	Business risk register	External interfaces	There is a risk that the DCWW Landbank for Biosolids Disposal could be lost. Leading to increase in disposal costs and potentially not achieving compliance and serviceability measures with no alternative means of disposal and limited strategic storage capacity. Loss may occur in any of three scenarios; Partial Loss (e.g.: Phosphorous restrictions), Short-term Loss (e.g.: Foot & Mouth Disease outbreak) or Long-term Loss (e.g. increase in restrictive clauses of land use).	No	The likelihood of a permanent loss of landbank is still low. We should progress with short-term mitigation measures at this stage.
2	Business risk register	External interfaces	There is a risk that the lack of strategic sludge storage in the event of a catastrophic occurrence (e.g. foot & mouth outbreak) would mean sludge cake having to be stored in ad hoc locations causing a risk of odour, pollution and contravention of Waste Regulations.	Yes	We cannot currently manage short-term incidents. There would be a high cost attached to any incident. We should progress a short-term mitigation plan.
3	Water 2050	Customer expectations	Worst served customers - We have a register of c. 370 customer receiving significantly worse service than the majority of customers. Customer expect a standard level of service.	Yes	It is important to address this - which is a serious service failure for too many customers but include a modest programme within AMP7.

Risk ID	Risk source	Risk Type	Description	Decision	Reason for decision
4	Water 2050	Customer expectations	Customer service - customers expect us to adapt our service to be comparable with companies in other sectors and adopt modern technologies. If we don't adapt then they will lose their trust in us.	Yes	We won't be able to push for changes in customer behaviour, relating to blockage reduction for example, if we lose their trust. Investigate new technologies that will support maintaining good customer service
5	Water 2050	Customer expectations	Smart water system - technology is advancing and gives us greater capability of identifying problems before service failures occur.	Yes	In order to continue to improve customer service and meet our commitments we will need to adapt our analysis and technology capability. Include element in plan for ongoing improvements.
6	Water 2050	Customer expectations	Best practice relating to drainage management plans is evolving. This gives us greater capability to understand areas of service risk.	Yes	Welsh Government expect us to adopt best practice in relation to drainage management planning.
7	Service resilience review	Extreme weather	Climate change is predicting higher tides which could cause problems with our assets in these areas and lead to flooding of properties. In Newport the interceptor tunnel under the Usk estuary is affected by tides and has come close to flooding properties in the centre of Newport city.	Yes	We are prioritising Newport for investment in AMP7. It is the highest priority due to the history of near misses.

Risk ID	Risk source	Risk Type	Description	Decision	Reason for decision
8	Service resilience review	Extreme weather	Climate change is predicting higher tides which could cause problems with our assets in these areas and lead to flooding of properties. In Swansea we have a range of pumping stations and overflows that could be affected. The city centre is low lying and could suffer sewer flooding if assets back up.	No	We are prioritising Newport for investment in AMP7. It is the highest priority due to the history of near misses.
9	Service resilience review	Extreme weather	Climate change is predicting higher tides which could cause problems with our assets in these areas and lead to flooding of properties. In Cardiff we have a range of pumping stations and overflows that could be affected. The city centre is low lying and could suffer sewer flooding if assets back up.	No	We are prioritising Newport for investment in AMP7. It is the highest priority due to the history of near misses.
10	Service resilience review	Extreme weather	Climate change is predicting higher tides which could cause problems with our assets in these areas and lead to flooding of properties. In Cardigan we have a range of pumping stations and overflows that could be affected. The town centre is low lying and could suffer sewer flooding if assets back up.	No	We are prioritising Newport for investment in AMP7. It is the highest priority due to the history of near misses.
11	Service resilience review	Extreme weather	Every year we identify more properties at risk of sewer flooding due to hydraulic overload. This is linked to changing patterns of storms.	Yes	Maintain a programme to tackle new additions to the register in line with high customer preference for resolving sewer flooding.

Risk ID	Risk source	Risk Type	Description	Decision	Reason for decision
12	Service resilience review	System constraints	There may be efficiencies to make by combining sewage treatment works, which would make the network easier to manage.	No	When individual projects arise for quality or growth reasons consider the opportunities for rationalisation but the efficiencies are not large enough to make this a primary driver for investment.
13	Service resilience review	Extreme weather	Cardiff Western District PS - Hydraulic overloading of pumping	Yes	Progress work within AMP6 to improve the site and mitigate the risk.
14	Service resilience review	Asset resilience	Cardiff East PS - If the penstock failed in the closed or partially closed position it could cause flooding to 100s of properties in the East end of Cardiff for the duration of the incident.	No	Undertake an investigation first to ensure we understand the root cause before investing.
15	Asset resilience scorecards above ground	Asset resilience	Our asset resilience score for SEMD is 46%. Improving security will reduce the risk of sites failing.	Yes	Lack of security at sites can cause operational issues so it is important to continue to invest in improvements.
16	Asset resilience scorecards above ground	Asset resilience	Our asset resilience score for flooding is 73%. Improving security will reduce the risk of sites failing.	No	The risk associated with power is higher than flooding so we will delay this risk to future AMPs.
17	Asset resilience scorecards above ground	Asset resilience	Only Cardiff WWTW is at risk of coastal erosion but key assets are predicted to be at risk in 20 years' time. A feasibility study has been completed in AMP6.	No	Cardiff council are considering options for resolution of the coastal erosion risk so we should not invest at this stage.

Risk ID	Risk source	Risk Type	Description	Decision	Reason for decision
18	Asset resilience scorecards above ground	Asset resilience	Our asset resilience score for power is 77%. We have had site failures when power supplies have failed.	Yes	Given the history of power failures this is the highest priority for improving resilience at above ground assets.
19	Asset resilience scorecards above ground	Asset resilience	Our asset resilience score for control is 85%. We have had site failures when control systems have failed.	No	We will continue to invest in control system priorities as they arise through our base maintenance budget but delay wholesale changes until future AMPs.
20	Asset resilience scorecards above ground	Asset resilience	Our asset resilience score for treatment is 73%. Greater capacity would allow us to better manage maintenance needs at sites.	No	The risk associated with power is higher than treatment so we will delay this risk to future AMPs.
21	Asset resilience scorecards above ground	Asset resilience	Our asset resilience score for failure of pumping stations is 66%. Greater network flexibility would allow us to better manage maintenance needs at sites.	No	The risk associated with power is higher than failure so we will delay this risk to future AMPs.
22	Asset resilience scorecards above ground	Asset resilience	Our asset resilience score for access is 94%. Some sites could be difficult to access in a time of emergency.	No	We will continue to invest in access priorities as they arise through our base maintenance budget but delay wholesale changes until future AMPs.
23	Asset resilience scorecards below ground	Asset resilience	Our asset resilience score for control is 28%.	No	We should focus on understanding the condition before making other investments.

Risk ID	Risk source	Risk Type	Description	Decision	Reason for decision
24	Asset resilience scorecards below ground	Asset resilience	Our asset resilience score for temporary works is 16%.	Yes	Having temporary mitigation plans will help us avoid serious service failure. These can be developed quickly for the highest risk assets.
25	Asset resilience scorecards below ground	Asset resilience	Our asset resilience score for flow management is 17%.	No	Sequencing is a key consideration for these risks. We need to understand the condition of our sewers before we are able to prioritise the rest of the programme.
26	Asset resilience scorecards below ground	Asset resilience	Our asset resilience score for access is 42%.	No	Sequencing is a key consideration for these risks. We need to understand the condition of our sewers before we are able to prioritise the rest of the programme.
27	Asset resilience scorecards below ground	Asset resilience	Our asset resilience score for coastal and river erosion is 60%.	No	Sequencing is a key consideration for these risks. We need to understand the condition of our sewers before we are able to prioritise the rest of the programme.
28	Asset resilience scorecards below ground	Asset resilience	Our asset resilience score for asset condition is 7%.	Yes	Understanding asset condition is critical to allow us to prioritise other resilience investments so this should be the starting point of the resilience investment programme.

Appendix B: Asset resilience scorecard examples

Excerpt from the wastewater above ground assets scorecard

Asset Name	Asset Type	Score (Avg)	SEMD	Flood Resilience	Coastal Erosion Resilience	Power Resilience	Control Systems	Treatment Resilience	Failure Resilience	Access Resilience
A	Sewage Pumping Station	59%	0%	100%	100%	25%	100%	N/A	0%	90%
B	Sewage Treatment works	74%	0%	100%	100%	100%	50%	100%	50%	90%

Company score (Avg) 67%

Excerpt from the wastewater below ground assets scorecard

Critical Sewer Ref No	Resilience Score (Avg)	Control	Temporary Works	Storage	Access	River / Coastal Erosion	Condition
1	33%	0%	0%	0%	100%	100%	0%
2	47%	0%	50%	0%	50%	100%	80%

Company score (Avg) 40%