Dŵr Cymru
Welsh Water

Enhanced Investment Case – Addressing Disproportionate Risk to Customers from Sewer Flooding

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Executive Summary

Sewer flooding has a significant negative impact on customers. This enhancement investment case will deliver an improvement in flooding caused by sewers which are hydraulically overloaded. Flooding from other causes (blockages, collapses and equipment failure), as well as investigating and modelling our sewer network are covered by Base Maintenance. Whilst a relatively small proportion of sewer flooding is caused by hydraulic overload, it carries a disproportionate risk of affecting the same customers repeatedly. We see this enhancement investment case as being aligned with the findings and recommendations of the joint Ofwat/CCW report on customer experiences of sewer flooding, published in May 2022.

We are amongst the industry leaders in managing internal sewer flooding. Our approach remains focused on internal flooding as a priority since this represents the most consequential service failure to our customers. Improving hydraulic capacity in these areas will generally have co-benefits of reducing the risk of external flooding and in some cases pollution events at the same time. We will also address repeat external flooding.

Need: With ongoing changes in environmental conditions (increasing rainfall intensity due to climate change) and increases in impermeable surfaces in built up areas, our sewer network in an increasing number of locations is under capacity (overloaded). This is increasing the existing number of properties at risk of sewer flooding. Whilst the number of properties impacted is relatively small, the consequences for our customers' homes is significant. We are seeking to act to mitigate the factors increasing risk and go further to reduce the overall likelihood of sewer flooding affecting our customers' homes. To deliver further service improvements, we will need to tackle some complex issues impacting customers, engaging with other risk management authorities.

Options: The outcome of this investment will be to reduce flood risk in AMP8 and the future through a series of flooding schemes, mitigation techniques and investigation. This aim is to reduce the flooding impact on customers and reduce the damage from flooding events. We have considered a broad range of options in line with our TotEx hierarchy. The preferred investment case for sewer flooding is made up of four different lines which all contribute to the overall flooding package:

- Reducing the number of worst served customers (suffering repeat flooding).
- Resolution of new additions to the Flooding Register (plus linked properties / areas).
- Enhanced mitigation and property-level protection to minimise impact.
- Root-cause-assessment programme (informing future solution development).

What We Will Deliver: We will deliver investment to reduce flood-risk at 52 locations, prioritised on customer impact (both severity and long-term effects). This will involve measures to store, transport or remove flows from the network.

Efficient Costing: We will invest £36M of TotEx in AMP8 to deliver schemes that target internal flooding incidents from hydraulic incapacity.

In developing schemes, a methodology utilising a Unit Cost approach for setting the Conventional Solution Budget for AMP7 has been used. The method is based upon a similar approach applied since AMP4 and uses a sliding scale cost which varies according to the number of properties included in the flooding scheme.

Customer Protection: Performance will be monitored by reporting against the Ofwat PR24 common performance commitments: Internal Sewer Flooding and External Sewer Flooding

Benefits: The identified investment will contribute to a forecast reduction in internal flooding incidents from all causes from 200 per annum at the end of AMP7 to 165 at the end of AMP8; and of external flooding incidents from 3,400 to 2,700 over the same period.

An overall programme benefit value of £37.4M is calculated.

The programme will also contribute to reducing risk of watercourse pollution due to hydraulic incapacity, and opportunities to contribute to storm overflow (SO) spill reduction will be explored in scheme design.

Our approach has been independently assessed by Jacobs (for Engineering and Costs) and Economic Insight (for CBA).

1. Introduction

The range and extent of our sewer network covers strategic assets such as major Trunk Sewers serving urban conurbations through to isolated sewers in remote rural locations. Ensuring that these assets operate in all weather conditions, with the increasing threat of extreme weather events due to climate change, requires a range of capital and operational investments. The outcomes of this investment will be to continue to reduce flood risk in AMP8 and the future through a series of flooding schemes, mitigation techniques and investigation. This will reduce the flooding impact on customers, especially our worst served customers, and reduce the damage from flooding events.

Strategic reduction in sewer flooding is supported both in the Welsh government *Water Strategy for Wales* and in our Long Term Delivery Strategy.

1.1 Structure of this Document

We have structured this document using the enhancement assessment criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A1.1.

ID from Appendix 9		Abbreviated Assessment Criterion	Addressed in
A1.1.1 Need for enhancement investment	a	Is there evidence that the proposed investment is required?	Section 2.1
	b	Is the scale and timing of the investment fully justified?	Section 2.1
	c	Does the proposed investment overlap with base activities?	Section 2.2
	d	Does the need and/or proposed investment overlap/duplicate with previously funded activities or service levels?	Section 2.3
	e	Does the need clearly align to a robust long term delivery strategy within a defined core adaptive pathway?	Section 2.4
	f	Do customers support the need for investment?	Section 2.1
	g	Have steps been taken to control costs, including potential cost savings?	Section 2.5
A1.1.2 Best option for customers	a	Have a variety of options with a range of intervention types been explored?	Section 3.1
	b	Has a robust cost-benefit appraisal been undertaken to select the proposed option?	Section 3.1
	c	Has the carbon impact, natural capital and other benefits that the options can deliver been assessed?	Section 3.2
	d	Has the impact of the proposed option on the identified need been quantified?	Section 3.2
	e	Have the uncertainties relating to costs and benefit delivery been explored and mitigated?	Section 3.3
	f	Where required, has any forecast third party funding been shown to be reliable and appropriate?	Section 3.4
	g	Has Direct Procurement for Customers (DPC) delivery been considered?	Please refer to WSH50-IP00 Our Approach to Investment Planning (Section 3.4.1)
	h	Have customer views informed the selection of the proposed solution?	Please refer to Stepping up to the Challenge: Business Plan 2025-30 (Section 2.2)
A1.1.3 Cost efficiency	a	Is it clear how the company has arrived at its option costs?	Section 4.1
	b	Is there evidence that the cost estimates are efficient?	Section 4.2
	c	Does the company provide third party assurance for the robustness of the cost estimates?	Section 4.1
A1.1.4 Customer protection	a	Are customers protected if the investment is cancelled, delayed or reduced in scope?	Section 5.1
	b	Does the protection cover all the benefits proposed to be delivered and funded?	Section 5.1
	c	Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments?	Not applicable for this case

2. Need for Enhancement Investment

This section will set out the drivers behind the Enhancement Case and describe the context within which it has arisen.

As one of the most distressing events that our customers can suffer, there is a need to further reduce flood risk in AMP8 and the future. We propose to deliver this through a series of flooding schemes, mitigation techniques and investigation, which will reduce the impact on customers from both single and repeat flooding events.

The sub sections below correspond to the seven criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A.1.1.1.

2.1 Evidence that Enhancement is Needed

> ***Is there evidence that the proposed enhancement investment is required?***
> ***Where appropriate, is there evidence that customers support the need for investment?***
> ***Is the scale and timing of the investment justified?***
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.1a, A1.1.1b and A1.1.1f*

Flooding, especially internal flooding, is the worst service failure our customers can experience water, containing human waste, floods into a customer's home. In our PR24 'Phase 2' research, internal and external sewer flooding came second and third overall, in terms of the importance customers placed on addressing these issues in our long-term plans. See Stepping up to the Challenge: Business Plan 2025-30 (Section 2.2) for more details.

This is recognised by the Welsh government **Water Strategy for Wales** which states:

"We will work to improve Wales' overall resilience to provide safeguards from major threats to the safety of life and livelihoods – such as those posed by drought, flooding or major pollution incidents."

"Our aim is for sewerage and drainage systems to be resilient and well maintained, with sufficient capacity to manage the demand placed on them without causing pollution or sewer flooding of people's homes."

"We want sewerage and drainage infrastructure for both wastewater and surface water to be well managed and maintained in an integrated way, with sufficient capacity to manage the demand placed on it and without causing pollution or sewer flooding of people's homes."
Water Strategy for Wales (2015), Welsh Government, pp.11, 34, 47

The risks of sewer flooding are set to increase in future, as recognised in **Welsh Water 2050** which states:
"Climate change interacts with urban creep and increased housing development to increase the expected incidence of sewer flooding. Most sewerage infrastructure has been designed based on historic hydrologic data. Climate change may make this infrastructure unsuitable for future needs as historic data may become less useful to predict the future."

With a 30% increase in precipitation and more intense rainfall in winter months, there may be higher numbers of incidents of sewer flooding of properties, increasing call-out and compensation costs, whilst reducing customer satisfaction."

Responding to these trends, the ongoing need to address sewer flooding in the long term is further reflected in the **Welsh Water 2050 Strategic response 10. Addressing our 'worst served' customers:**

"Currently Welsh Water have 1,500 households who suffer frequent problems- 'Worst Served'. In part, these issues arise because we prioritise investment that has the potential to benefit a significant number of customers. This cost-benefit approach means that high-cost solutions for individual, often rural, customers are not undertaken. Changing customer and societal expectations may make this cost-benefit approach unacceptable, as all customers are entitled to a minimum universal service standard."

In addition to the above strategic drivers, Welsh Water has regulatory Performance Commitments to achieve for both Internal and External Flooding. We have continually improved our performance in recent years, see graphics below). In 2021/22 Ofwat recognised us as a top performer on preventing internal sewer flooding (Water company performance report 2021-22, Ofwat, December 2022). However, whilst customers remain at risk we must continue to build on this position.

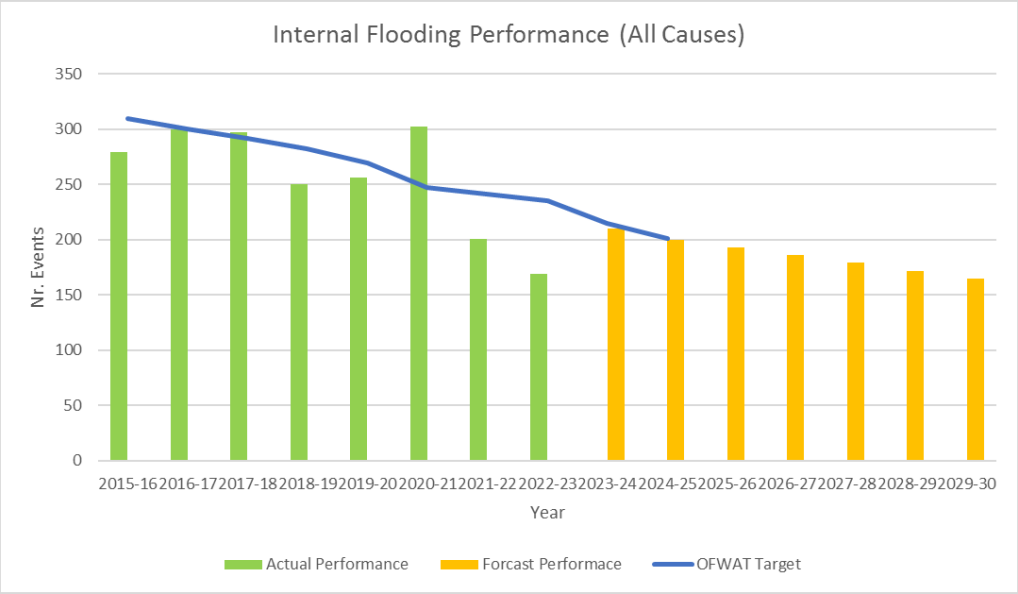

Figure 1: Graph of Internal Flooding Performance

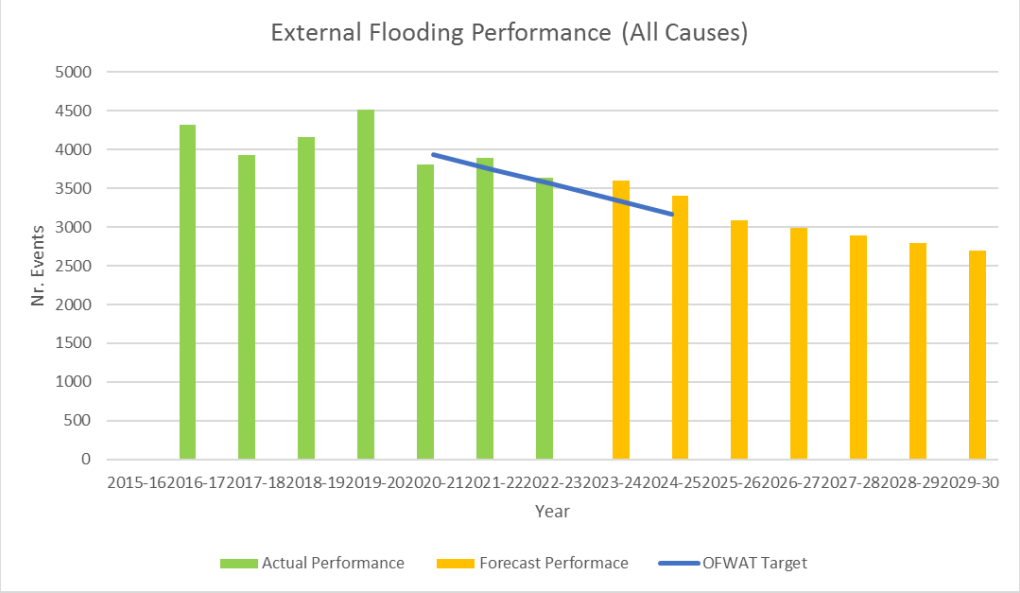

Figure 2: Graph of External Flooding Performance

2.1.1 Customer Engagement

Our approach to customer engagement is set out in Stepping up to the Challenge: Business Plan 2025-30 (Section 2.2).

We have not consulted specifically around this Enhancement Case, but customers are clear, for example in Ofwat and CCW publications, that sewer flooding of customer homes is unacceptable. The foreword to Customer experiences of sewer flooding (Ofwat, May 2022) begins:

"Being flooded with sewage is one of the most distressing things that can happen to you in your home, yet this is a very real experience for thousands of households every year. The lasting effects it leaves behind are not just limited to damaged property, but can extend to psychological and emotional damage, often leaving people in vulnerable circumstances."

The same research *"found that any type of sewer flooding has a significant negative impact on customers regardless of severity. Even incidents that may seem 'low severity' can cause a lot of inconvenience and stress, while 'high severity' events can lead to significant emotional trauma."*

We have also engaged with customers through our Drainage and Wastewater Management Planning (DWMP) process. As part of the consultation programme, independent research was undertaken consisting of an online focus group (30 no. customers) and online survey (500 no. customers). This was also supplemented by an online survey of 100 no. Business Customers. The objective of the research was to establish customer opinion on the direction and strategy set out in the DWMP, as well views on storm overflow/discharge reduction investment. Focusing on flood prevention, customers expressed that they do not want a situation where sewage flooding becomes the norm and they wish for us to address the wastewater issues at source, being generally supportive of environmentally friendly approaches such as sustainable and green drainage solutions.

2.1.2 Scale and Timing of Investment

The issues to be addressed in this case are well known. We are focused on existing properties which have flooded and for which we have modelled the risk of future flooding. We have a clear understanding of risk at these locations and there is a clear mandate and regulatory performance commitment to continuously roll out our programme of investment to address these risks.

We are also aware that climate change, and more intense rainfall patterns are acting to increase the risk of sewer flooding. We must act to counter this emerging threat.

In establishing the scale of required activity, we have considered several options, these are discussed below, and looked to balance improved performance with affordability.

Our approach is to focus our attention on Internal flooding locations as a priority since this usually represents the most consequential service failure to our customers. Improving hydraulic capacity in these areas will often have co-benefits of reducing the risk of external flooding at the same time.

We will also reduce high frequency/consequence instances of external sewer flooding.

2.2 Overlap with Activities to be Delivered through Base

> ***Does the proposed enhancement investment overlap with activities to be delivered through base?***
>
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.1c*

We have a standardised approach to ensuring base and enhancement overlaps are removed, this is set out in WSH50-IP00 Our Approach to Investment Planning (Section 3.4.2).

This work programme will focus on reducing the risk of flooding from hydraulic incapacity. This enhancement investment will contribute to an integrated programme of flood risk reduction from all causes. This programme will allocate interventions costs as follows:

- Sewer investigations and modelling: Base
- Interventions to resolve blockages or other causes: Base
- Interventions to upgrade sewer capacity: Enhancement

2.3 Overlap with Funding from Previous Price Reviews

Does the need and/or proposed enhancement investment overlap with activities or service levels already funded at previous price reviews?
– Ofwat's final methodology for PR24, Appendix 9, A1.1.1d

Schemes which were identified to prevent sewer flooding during AMP7 have been or will be delivered within the AMP, in pursuance of Performance Commitments.

However, with changing demographics, urban creep and climate change, on top of asset deterioration (which is covered by Base Maintenance), new flooding locations will arise, either in new areas, or in areas which have previously been improved but which are subject to increased risk in future.

Furthermore (see section 2.1 and WW2050 Strategic response 10) we will seek to intervene at flooding locations which may previously have been assessed as insufficiently cost-beneficial to address.

Consequently, the funding requested within this Enhancement Case is to respond to ongoing flood risk, beyond that previously funded and therefore has no overlap.

Investment in AMP8 represents the next phase in long term strategic intervention to minimise flood-risk for our customers.

2.4 Alignment with the Long Term Delivery Strategy

Is the need clearly identified in the context of a robust long term delivery strategy within a defined core adaptive pathway?
– Ofwat's final methodology for PR24, Appendix 9, A1.1.1e

Internal and external sewer flooding are both specific outputs of Welsh Water's Long Term Delivery Strategy.

DWMP modelling has been used to support in developing a core pathway that looks to achieve a 2050 target of 0.57 internal and 7.8 external sewer flooding incidents per 10,000 connections. This compares to 1.07 and 17.4 incidents per 10,000 connections, respectively, forecast at the end of AMP8.

The schemes outlined in this Enhancement Case directly align to the achievement of this long-term ambition. DWMP models have assessed a range of scenarios and alternative pathways have been established based on both climate change and growth scenarios.

Further details can be seen in WSH01 Long Term Delivery Plan.

2.5 Management Control of Costs

Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings been accounted for?

– Ofwat's final methodology for PR24, Appendix 9, A1.1.1g

The risk of sewer flooding continues to increase due to a combination of factors, including climate change driven changes in rainfall patterns, urbanization, and ageing infrastructure. We are seeing the impacts of climate change - six of the ten wettest years for the UK in a series from 1862 have occurred since 1998.[1]. Our investment programme must overcome these strategic headwinds, integrating base and enhancement investment to move beyond 'stable' performance to deliver material reductions in flood risks and improvements to customer service.

Climate Change: Climate change has led to altered weather patterns, including more frequent and intense rainfall events. These extreme weather events can overwhelm sewer systems that were designed to handle less intense rainfall. The most recent decade (2009-2018) has been on average 1% wetter than 1981-2010 and 5% wetter than 1961-1990 for the UK overall.

Urbanization: The UK has experienced significant urban growth and development over the years. As cities expand, more impermeable surfaces like roads, parking lots, tarmacked over front gardens and buildings are created. These surfaces prevent rainwater from naturally soaking into the ground and instead contribute to rapid runoff. This increased runoff can overwhelm sewer systems during heavy rainfall events, leading to localized flooding. We have several catchments (such as Wrexham and Port Talbot) that are predominantly combined with connected highway and roof drainage, where we are seeing increasing flooding during storm events.

Aging Infrastructure: Aging pipes and infrastructure can become more susceptible to leaks, blockages, and failures, which can contribute to sewer flooding due to 'other causes'. For clarity, responding to this need is included in base and not part of this Enhancement Case.

Addressing these challenges requires a combination of investment in infrastructure upgrades, adoption of sustainable drainage solutions, and climate change adaptation strategies. Water companies and local authorities need to work together to manage these risks and ensure the resilience of sewer systems in the face of changing conditions.

[1] Kendon, M, McCarthy, M, Jevrejeva, S, Matthews, A, Legg, T. State of the UK climate 2018. *Int J Climatol*. 2019; 39 (Suppl. 1): 1–55.

3. Best Option for Customer

In this section we will describe how we have developed options for addressing the need identified above. We deploy our standard TotEx hierarchy approach, set out in in WSH50-IP00 Our Approach to Investment Planning (Section 4.4.1), to identify and compare option for delivery.

We have a long-established process for managing hydraulic flooding.

In developing options for AMP8 we have used the latest data and analytical techniques to quantify risk as well as embracing new ways of working with stakeholders and delivery of sustainable urban drainage (SUDS) thinking.

The sub-sections below correspond to the eight criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A.1.1.2.

3.1 Identification of Solution Options

> ***Has the company considered an appropriate number of options over a range of intervention types to meet the identified need?***
> ***Is there evidence that the proposed solution represents best value for customers, communities, and the environment over the long term?***
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.2a, A1.1.2b*

The following table identifies the four specific business cases within the integrated flooding programme. Irrespective of the budget line, each individual flooding intervention goes through a similar solutions development process as outlined below.

Table 1: Description of Business Case outcomes

Title (enhance existing resources or add new resources)	Description
Reducing the number of worst served customers	Targets properties designated as 'worst-served customers' which are properties that flood on a regular basis (internal and external).
Resolution of new additions to the Flooding Register (plus linked properties / areas)	Targeting flooding issues that arise or escalate following PR24 submission.
Enhanced mitigation and property-level protection	Delivers enhanced mitigation to reduce the risk of internal or external flooding - it may be at current known issues or as issues emerge/escalate. This covers measures such as non-return valves, flood gates/doors/barriers, potentially localized works (small surface-water disconnections, relocating manholes away from properties).
Root-Cause Assessment programme	This line allows Welsh Water to start the capital investment process for new Hydraulic Overload (HO) flooding/pollution issues and continue working down the Register preparing schemes for release into optioneering.

3.1.1 Assessment and Selection of Solution Options

We have a well-established process of response, analysis and option development for reducing flood risks.

- After a flood has occurred, there is the standard reactive process– attendance, clean-up, restore service, customer support etc.
- Initially we use prioritisation methodology based on highest risk of internal/external flooding, worst-served customers, and associated pollution risk to select issues for root-cause assessment (RCA).
    - We have a programme of around 25 RCAs per year – outputs of the RCA are Root-Cause Statement (including hydraulic assessment), Plan of Issues, Mitigation Options, and an Operational Presentation (example set out in Appendix B)
- We then use the same prioritisation across issues that have completed RCA to select what goes forward for optioneering (typically as a batched annual sub-programme)
    - Expected outcomes of optioneering are solution options providing hydraulic protection to 1:10, 1:20 and 1:30 standards, plus mitigation-only. To promote our commitment to SUDS, there must always be an option including removal of surface water.
- Next stage is a Sustainability & Optioneering workshop – this discusses all potential options at high level, discounts those that are undeliverable or clearly unaffordable and agrees what options are to be developed for review at CBA.
- Next stage is a Risk & Value workshop – presentation of the options including risk and cost-benefit assessment for each, agreeing which option is best-value and selected for design.
- From here we progress through outline, detailed & final design with checkpoints/approval at each stage before construction & signoff.

Following the above process, we have currently selected a total of 52 hydraulic flooding interventions for AMP8, totalling £36M TotEx (22/23 post efficiency) as detailed in the table further below.

These interventions, when combined with Base Maintenance activities, particularly around managing flooding from other causes will deliver our overall performance commitments in AMP8.

The table below shows an example CBA for Flooding Register Mitigations, with a clear understanding on likelihood and consequences of flooding (with and without intervention) we can clearly articulate the NPV for the proposed work.

All monetary values are expressed in 2022/23 prices and are prior to portfolio adjustments for corporate overheads and efficiency challenge. Welsh Water ref: SMF version 5.

Table 2: Example of CBA for Flood Risk Mitigations

Solution Option	Option Name	CapEx	Present Value Whole Life Costs (WLC)	Present Value Whole Life Benefits (WLB)	Benefit/ Cost Ratio	Net Present Value (=WLB - WLC)
Option S1	Full mitigation	£1.237M	£1.110M	£14.191M	12.781	£13.081M
Option S2	Do Nothing		£0	-£0.174M	0.000	-£0.174M

The table below shows an extract from our programme level analysis, this shows the relative benefits of projects being considered for delivery in terms of impacts on flood frequency (internal and external).

Again, clear quantification allows us to weight options within the portfolio of work to maximise benefits.

Table 3: Programme Level Analysis Example

Scheme Name	In PR24	Scheme Status	Internal Flooding incidents per year (Rt1)	External Flooding incidents per year (Rt2)	No of Worst-Served Customers (Rt6)	Pollution Risk (En3)	No of Regulatory Outputs
Port Talbot (Crawford Road)	New Additions	In design	0	3.181	1		6
Pontardawe (Lon Hir)	New Additions	Investigation	0.885	2.871	1		2
Llanyre (Cagebrook Lane)	New Additions	RCA completed	0.385	2.247	0		3
Moreton-on-Lugg	New Additions	RCA completed	0.647	2.204	2	Y	4
St Athan 2	WSC	RCA completed	0	1.703	1		3
Wrexham (Trident Way)	WSC	RCA completed	0.006	1.596	3		6
Pontardawe (Waun Sterw)	New Additions	RCA completed	0	1.498	1		1
Ffynnongroyw	WSC	Solution available	0.15	1.467	1		13
Cemaes Bay (Beach Road)	New Additions	RCA completed	0.041	1.462	0	Y	5
Gronant (Moel View Road)	New Additions	RCA completed	0	1.395	2		7
Johnston (Vine Road)	WSC	Solution available	0.01	1.345	1		3
Llangefni (Talwrn)	WSC	RCA completed	0	1.18	0	Y	2
Prestatyn (Ffordd Penrhwylfa)	New Additions	File	0.119	1.162	7		29
Llandudno Junction	WSC	Solution available	0.011	1.154	2		19
Glynneath (Aberdare Road)	WSC	Solution available	1.505	1.084	7	Y	7
Blackwood (Woodfieldside)	New Additions	RCA completed	0	1.076	1	Y	1
Cardiff (Grand Avenue)	WSC	RCA completed	0.002	1.057	1		3
Pen-y-Fai (Graham Avenue) 2	New Additions	RCA completed	0	1	2		3
Tal-y-bont (Barmouth Bay)	New Additions	RCA completed	0	0.996	1		3
Wellington (The Marsh)	WSC	RCA completed	0.013	0.964	1	Y	6
Valley (Gorad Road)	New Additions	RCA completed	0	0.919	1		2
Wrexham (Little Acton)	WSC	RCA completed	0.024	0.784	2		5
Penyffordd (Hawarden Road)	WSC	RCA completed	0.05	0.643	1		5
Llandudno Junction (Ronald Av)	WSC	RCA completed	0	0.491	3		7
Briton Ferry (Ritson Street) 2	WSC	RCA completed	0.314	0.396	1		3
Christleton (Plough Lane)	New Additions	RCA completed	0	0.392	2		5
Abergele (Glan y Mor)	WSC	RCA completed	0.032	0.238	1		3
Saron (Saron Road)	New Additions	RCA completed	0.388	0.187	0		4
Llanishen (Coed Glas Road)	New Additions	RCA completed	0.058	0.15	1		3
Mynydd Isa (Llys Wylfa)	New Additions	RCA completed	0.164	0.137	1		6
Upton (Mill Lane)	WSC	RCA completed	0	0.111	1		4
Penhow (Rockfield Glade)	New Additions	RCA completed	0	0.109	1		1
Colwyn Bay (Woodland Road East) 2	New Additions	Investigation	0.764	0.103	1		1
Newport (Cunningham Road)	New Additions	RCA completed	0	0.098	1		1
Hawarden (Overlea Drive)	WSC	RCA completed	0	0.055	2		2
Tremadog (Glanmorfa Terrace)	New Additions	RCA completed	0.869	0.051	1		2
New Brighton (Moorcroft)	New Additions	RCA completed	0.328	0.049	1		2
Bow Street (Y Ddol)	WSC	RCA completed	0	0.044	1	Y	5
Neston (Bushell Road)	New Additions	RCA completed	0.07	0.033	1		2
Keeston (Chapel Road)	WSC	RCA completed	0.25	0.03	1		2
Dinas Powys (Millbrook Close)	New Additions	RCA completed	0	0.03	0		5
Abercynon (Park Street)	New Additions	RCA completed	0.917	0.006	2		2
Cardiff (Celyn Avenue)	New Additions	RCA completed	0.003	0.004	0		1
Bromyard (Porthouse Ind. Estate)	New Additions	File	0.817	0	0		1
Prestatyn (Meliden Road)	New Additions	File	0.189	0	0		1
Penygroes (Llys y Bugail)	New Additions	File	0.182	0	0		2
Rhayader (Bridge Street)	New Additions	RCA completed	0.161	0	0		1
Wrexham (Abenbury Road)	WSC	RCA completed	0.154	0	1		1
Aberaman (Cardiff Road) 2	New Additions	File	0.114	0	0		1
Pwllheli (Sand Street)	New Additions	RCA completed	0.105	0	0		1
Wrexham (Eagles Meadow)	New Additions	File	0.091	0	0		1
Builth Wells (The Strand) Phase 3	New Additions	Solution available	0.011	0	0		2

3.2 Quantification of Benefits

Has the company fully considered the carbon impact, natural capital and other benefits that the options can deliver?
Has the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?

– Ofwat's final methodology for PR24, Appendix 9, A1.1.2c and A1.1.2d

The identified investment will contribute to a forecast reduction in flooding incidents from all causes over AMP8 of 17.5% for Internal Flooding and 20.6% for External flooding.

This case will contribute around 30% of the proposed flooding benefits.

These improvements are set out in the table below and reflect the values in our data tables.

Table 4: Performance Targets

	Incidents per Year (Forecast)		AMP8 Reduction Target	
	2024-25	2029-30	Incident reduction over AMP	%
Internal Flooding	200	165	35	17.5
External Flooding	3,400	2,700	700	20.6

The table below shows the mix of benefits which have been assigned within our CBA assessment, using our Service Measure Framework (SMF). Within our cost benefit process the impacts of each option on the need have been quantified. Our methodology is set out in WSH50-IP00 Our Approach to Investment Planning (Section 4.3).

Table 5: Benefits from AMP8 expenditure

Scenario	Benefits from AMP8 Spend relative to baseline					
	Customer Contacts	Nuisance - Noise, Pest	Pollution Incidents	Flooding Internal	Flooding External	Total
Preferred –	1.2%	0.5%	26.6%	41.7%	30.0%	100%

Overall, the schemes provide benefits split across several categories within our SMF with a reduction in internal flooding providing the largest proportion of this (41.7%), closely followed by a reduction in external flooding and reducing pollution incidents providing 30% and 27% respectively.

3.2.1 Quantifying the Impact on Need and Performance Commitments

The numeric impact on Performance Commitments for Internal and External Flooding is presented in sections 3.1 and 3.2

The general approach used to assess the impact of proposed work on sewer flooding risks is outlined below.

- Collecting relevant data, including historical flooding events, sewer system characteristics, rainfall patterns, and potential sources of flooding.

- Hydraulic modelling software is used to simulate the behaviour of the sewer system under various conditions, including heavy rainfall events. This modelling can help predict how the system would respond to different levels of precipitation and identify areas with a higher risk of flooding.

- By running simulations with and without the proposed work (such as upgrades or expansions to the sewer system), we can compare the results and assess how the changes would affect the system's capacity to handle stormwater and mitigate flooding.

- Using the results from the hydraulic modelling, flood risk maps would be created to show areas of high, moderate, and low flooding risks based on different scenarios. These maps can help prioritize areas where the proposed work would have the most significant impact.

- The impact of the proposed work can be quantified in terms of reduced flooding frequency, reduced flood depths, and the number of properties that would be protected from flooding. This information can be used to communicate the potential benefits to stakeholders and decision-makers.

- Cost-benefit analysis is conducted to evaluate whether the expected benefits of the proposed work outweigh the associated costs. This analysis can help prioritize schemes or options that provide the best return on investment in terms of flood risk reduction.

- Throughout the process, engagement with local communities, regulatory agencies, and other stakeholders to gather input, address concerns, and ensure that the proposed work aligns with the needs and expectations of the affected areas.

In summary, we have a strong process for modelling the impacts of intervention on risk and subsequently on performance. We have well developed hydraulic models which we can use with confidence.

3.3 Uncertainties relating to cost and benefit delivery.

> ***Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?***
>
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.2e*

Our methodology is set out in our WSH50-IP00 Our Approach to Investment Planning (Sections 4.10 and 4.3). This includes commentary on our approach to optioneering, costing and cost benefit analysis. Our optioneering requires development of a range of options of varying levels of risk reduction. Our assessment of risk and prioritisation of investment is applied across our entire Flooding Register.

Overall, intervention to mitigate flooding risk is a well-established programme over several AMP periods, therefore confidence in costs and benefits is high.

For this Enhancement Case we have evaluated a wide range of options in line with our TotEx hierarchy approach, these are set out above, choosing the right blend of solutions to meet customer expectations.

The investments we propose are well established solutions and are not inherently uncertain.

Whilst nature based sustainable drainage solutions have historically been more difficult to model, they have become part of the fabric of our investment programme and can be deployed with confidence.

As this investment case is made up of many smaller solutions to upgrade sewer capacity, cost and benefit uncertainty will vary on the individual project level but at the aggregate level we can be confident that the overall benefits can be achieved, and costs are controllable.

3.4 Third Party Funding

Has the scale of forecast third party funding to be secured (where appropriate) been shown to be reliable and appropriate to the activity and outcomes being proposed?
– Ofwat's final methodology for PR24, Appendix 9, A1.1.2f

We have not included third party costs within our submission as part of achieving our proposed service improvements. We will not need third party funding to deliver the benefits we have set out. We do however continue to work with third parties to increase the overall benefits which can be provided to communities. For example,

- We have worked closely with Rhondda Cynon Taff (RCT) County Borough Council following storm Dennis which caused widespread flooding from multiple sources (primarily fluvial) across the county in 2020. We have engaged at Executive, Planning and Operational levels to help develop flooding strategy across RCT, sharing information and aligning operational activities where necessary.
- We are currently exploring the potential for collaboration with Cardiff Council in Rumney, where there is an issue of high-volume flooding from both combined sewers (a Welsh Water issue) and surface-water drainage (a Local Authority issue).
- We are developing options for significant surface-water removal from the combined sewer network in Wrexham, have briefed our progress to date to the Senedd Member for North Wales and are liaising with the Local Authority with a view to potential investment commencing in AMP8.
- Through our DWMP programme we are currently holding individual meetings with Local Authorities to identify areas where we can work together on shared opportunities to improve drainage.

We have previously held meetings specifically with Flintshire Council to review flooding issues across the county. In recent discussions with Flintshire and Wrexham Council officers, we agreed to hold a joint meeting to explore how to better facilitate partnership working on flooding issues between our respective organisations.

We regularly share details of locations at risk of sewer flooding, as well as our sewer mapping data, with Lead Local Flood Authorities. This is to give visibility of sewer flooding issues, as well as helping to identify opportunities to work together to reduce flooding. Our next update of sewer flooding data to Local Authorities is scheduled in September 2023. We are working with several Local Authorities, developing memoranda of understanding to enable sharing of hydraulic model data.

We also work closely with Lead Local Flood Authorities as required in the production of Section 19 flooding incident reports, drainage reviews, Flood Consequence Assessments and Flood-Risk Management Strategies.

4. Costing Efficiency

In this section we give specific details on our approach to costing and benchmarking. Our overarching approach to developing efficient costs is set out in WSH50-IP00 Our Approach to Investment Planning (Sections 4.10 and 7).

The sub sections below correspond to the three criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A.1.1.3.

4.1 Developing a cost for reducing hydraulic flooding

> ***Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate? Does the company provide third party assurance for the robustness of the cost estimates?***
>
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.3a and A1.1.3c*

Due to the nature of work in sewer flooding, the cost can vary significantly for the same intervention. This can be down to several factors, such as location, cause, region, flows etc. However, this type of work is regularly carried out by Water Companies, and we have good records our expenditure against these activities.

We used a bottom-up approach, as described in WSH50-IP00 Our Approach to Investment Planning (Section 4.10), informed by previous expenditure.

We calculated values based on out-turn costs of previous capital flooding schemes. These rates where then used to calculate the future expenditure based on our programme set out in this investment case.

We have a documented approach through which we derived a 'unit cost' matrix for Flooding-Hydraulic Overload (FHO) schemes, based on previous scheme out-turn information. This led to a cost-per-property matrix being developed for AMP7 which allowed us to set target budgets (cost to deliver) for schemes. i.e., a scheme protecting one property only would be deemed acceptable to progress with budget from the FHO investment case up to £0.217M.

These values were uplifted for the PR24 208 investment case, as per below:

Table 6: Matrix of Cost Per Output (CPA)

No of Regulatory Outputs	AMP7 CPA	PR24 CPA
1	£0.217M	£0.238M
2	£0.378M	£0.414M
3	£0.517M	£0.567M
4	£0.643M	£0.704M
5	£0.758M	£0.831M
6	£0.866M	£0.948M
7	£0.966M	£1.058M
8	£1.060M	£1.161M
9	£1.150M	£1.259M
10	£1.235M	£1.352M

Along with our overall costing strategy being reviewed and assured by Jacobs, we have also employed third party consultants to review single Enhancement Cases to provide confidence that the estimates within them are robust, efficient, and deliverable. Please refer to WSH50-IP00 Our

Approach to Investment Planning (Section 6) for more information regarding the review and assurance undertaken.

4.2 Benchmarking our approach

> ***Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?***
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.3b*

We are committing to reduce the number of external sewer flooding incidents between 2025 and 2030 by 700 and internal sewer flooding incidents by 35.

Robust and comparable information is incomplete in this area: the APR does not separate between the cost of reducing internal and external sewer flooding risk. It is clear from analysing the performance data published by WASCs that performance varies significantly from year to year.

Considering the lack of separate cost information on sewer flooding for the purposes of this assessment we have aggregated the number of internal and external incidents to calculate a simple unit cost per incident.
Welsh Waters' proposed unit cost, using this combined approach, outturns at £0.047M per incident (£34.2M / 735 incidents)

To benchmark this unit cost, we have used information available from the APR across all WASCs. The data showcases a very wide spread of information, with the cost of reduction costing from £0.300M per incident to £0 – and some companies have a negative cost calculated over the period as performance has deteriorated.

We have therefore used several approaches to estimate an average unit cost across the industry, given the widely varying water company performance.

Aggregating across all companies produces a unit cost reduction of £0.157M per incident. We believe this is unrealistically high as it includes performance failure as three companies produce negative unit costs (Anglian, Thames and Wessex).

Aggregating across all companies but excluding those with deteriorating performance results in a unit cost of £0.047M per incident, and taking a distributional approach across all companies with improving performance results in the following:

- Upper quartile threshold £0.012M per incident
- 2nd quartile threshold £0.056M per incident
- Lower quartile threshold £0.113M per incident

We consider these unit costs are potentially slightly low due to asymmetrical way we have removed companies with deteriorating performance. However, we consider that our proposal of a unit cost within the 2nd quartile is not inappropriate given the difficulties experienced benchmarking this area.

5. Providing Customer Protection

This case is linked directly to performance against the internal sewer flooding and external sewer flooding performances commitments. These Ofwat regulated PCs provide strong customer protection for non-delivery.

The text below corresponds to the three criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A.1.1.4.

5.1 Proposed Performances Commitment

> ***Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed, or reduced in scope?***
> ***Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?***
>
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.4a and A1.1.4b*

This investment will deliver the required level of performances against the Internal and External flooding common performance commitments.

As illustrated graphically in section 2.1, our forecast performance commitment for AMP 8 is as follows:

Table 7: AMP8 Performance Commitment

	Year	2025-26	2026-27	2027-28	2028-29	2029-30
Internal Flooding Events	per Annum	193	186	179	172	165
	per 10,000 connections	1.28	1.22	1.17	1.12	1.07
External Flooding Events	per Annum	3090	2993	2896	2797	2700
	per 10,000 connections	20.45	19.69	18.95	18.20	17.47

The benefits are fully covered by the performance commitments.

6. Appendices

Appendix A

The table below shows the total CapEx enhancement costs in Amp 8 for this Enhancement Case. The Ofwat driver this Enhancement Case maps to is:

• Reduce flooding risk for properties; enhancement CapEx – CWW3b.156
• Reduce flooding risk for properties; enhancement OpEx – CWW3b.157

No other Enhancement Cases contribute to this driver.

Table 8: Allocation of Costs in the Data Tables

Driver Ref	Year in AMP8					
	Year 1	Year 2	Year 3	Year 4	Year 5	Grand Total
CWW3b.156 - CapEx	£6.884M	£6.786M	£6.782M	£6.826M	£6.907M	£34.185M
CWW3b.157 - OpEx	£0.172M	£0.343M	£0.252M	£0.336M	£0.851M	£1.954M
TotEx	**£7.056M**	**£7.129M**	**£7.034M**	**£7.162M**	**£7.758M**	**£36.139M**

What We Will Deliver: We will deliver investment to reduce flood-risk at 52 locations, prioritised on customer impact (both severity and long-term effects). This will involve measures to store, transport or remove flows from the network.

Appendix B

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Cardiff (Romilly Crescent)

Connectivity:

Fully combined catchments downstream of the flooding properties discharging to the trunk sewer.

Pontcanna, Riverside and Grangetown have no dedicated surface water systems. (except the newly constructed Greener Grangetown elements).

This is likely to be because of:

- The age of the area and type of housing which are typically combined.
- Pontcanna and River side are low lying, leading to difficulty in discharging surface water to the River Taff.
- The flood risk posed by the river, as shown in the plan, would risk increased surface water flooding if the surface water outfalls were connected to the river.

Even where surface water networks have been developed, they tap into the combined trunk sewers.

Flood mapping showing the flood risk areas near the flooding property.

Pontcanna combined network. Note no outfalls to the River Taff.

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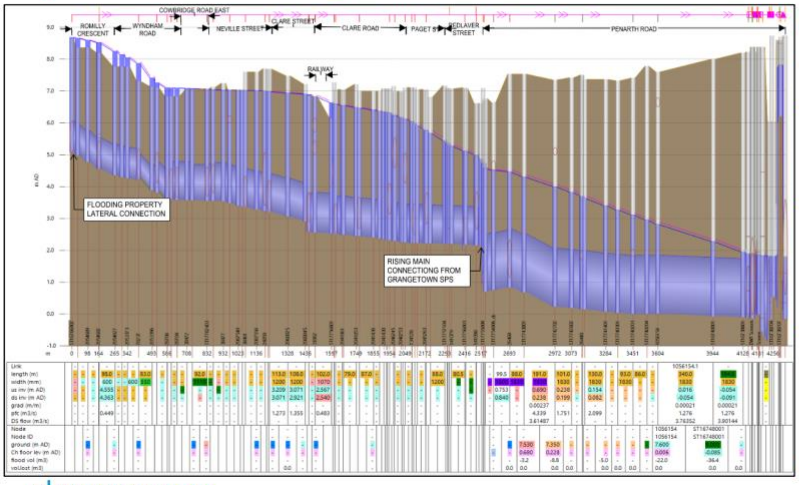
Cardiff (Romilly Crescent)

Hydraulic Assessment – Grangetown Eastern stretch to Cardiff Western District - 1 in 30yr RP.



Hydraulic Assessment:

- Flood level at 6.5m AOD (estimate)
- *The brick egg trunk sewer from the flooding properties, through Riverside and Grangetown to Grangetown SPS is under-capacity.*
- *The Penarth Road trunk sewer to Cardiff Western District SPS is under-capacity, reflecting back high levels to the trunk running to Grangetwon SPS via the bifurcation.*
- *High flows originate from upstream of the flooding properties, but particularly high runoff is present in:*
  - *Pontcanna,*
  - *Riverside and*
  - *Grangetown*
- *These areas are typically fully combined.*

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