



Dŵr Cymru  
Welsh Water

Enhancement Investment  
Case:  
WSH60-RS04 -  
Increasing Resilience of  
Tap Water Supply -  
Network Capacity and  
Connectivity

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## Executive Summary

The aim of this enhancement investment is to improve resilience in the clean water system for low probability and high consequence events. This will be achieved by a £54.402M TotEx programme which consists of a range of interventions ranging from the installation of large diameter strategic pipelines and upgrades to strategic water pumping stations through to feasibility studies which will inform our Long Term Delivery Strategy as well as our PR29 investment plan. The programme of work is driven by our approach to resilience which is set out in WSH35-CS00 – Resilience and Security.

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. The enhancement assessment criteria are divided into four criteria groupings:

- need for enhancement investment (5 sections)
- best option for customers (4 sections)
- cost efficiency (2 sections)
- customer protection

**Need:** There is a need to reduce the risk associated with low probability and high consequence catastrophic failure events. This will be achieved by reducing the likelihood or removing/reducing the consequences of these events. Throughout AMP7 we have continued to undertake risk assessments to understand potential weak points in our strategic water distribution system.

These assessments include analysis of specific risks such as riverbank erosion and river flooding. We have also looked to understand specific weak spots within our network, which if compromised, would lead to significant loss of supply. These risks are collectively lower probability but with significant consequences.

If we do not undertake an intervention programme to deliver improvements to resilience across the Welsh Water supply area in AMP8, we can expect to see:

- increases in the frequency of significant supply interruptions which result from the failure of single strategic assets for example, the single sections of strategic main between Felindre Water Treatment Works (WTW) and Cefn Hirgoed Service Reservoir
- the impact of these events will not only result in an interruption to supply to over 84,000 properties as well as impacting our customer minutes lost score by greater than 10 minutes/property significantly more than our end of AMP8 target of 3:16 minutes/property.

**Options:** We have assessed a range of nine types of option across our intervention programme following our standard approach, see further detail in Section 3.1 below. Our chosen for each scheme or programme of work will address key resilience risks across our strategic network identified during our strategic area reviews which informed our Long Term Delivery Strategy.

**What We Will Deliver:** This Enhancement Case will deliver three material areas of work; 1) 4.4km of 1000mm pipeline connecting 2 redeveloped pumping stations, 2) 8 critical pipeline crossing and 10 critical pipeline connection improvements, 3) 720m of new pipeline to divert the existing Wye transfer.

**Efficient Costing:** We will invest £54.402M of TotEx (post efficiency, 22/23 price base, overlap removed) to implement the resilience programme of work.

In developing schemes, we have reviewed a range of options from detailed assessment of individual schemes for example, the Wye Transfer from our AMP7 programme. A second example, Increasing the reliability of our water supply by increasing transfer capacity within Tywi/SEWCUS has used details from the hydraulic assessment of the network to identify solution options. We have also built on the insights from root cause analysis undertaken following dry weather and freeze/thaw events. These have enabled the developed of an efficient and cost beneficial programme.

**Customer Protection:** This work will be in addition to that delivered in our Base Maintenance programs for water pumping stations, service reservoirs, trunk and distribution mains interventions

(£153M, post efficiency, 2022/23 price base) This will be ringfenced through a price control deliverable (PCD) linked specifically to investment delivered, feasibility studies completed, network capacity increase, crossings improved and km of water main relocated, detailed in Section 5.1, Tables 10 and 11.

If the agreed deliverables are not achieved funding will be returned to customers on a proportional basis.

**Benefits:** The benefit to this investment is a reduction in high consequence, low probability risks which will not materially impact on our performance commitments but would have a significant impact on customer service if they emerge.

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

## 1. Introduction

The aim of this enhancement investment is to improve resilience in the clean water system. The work is driven by our approach to resilience which is set out in WSH35-CS00 – Resilience and Security.

The benefit to this investment is a reduction in high consequence, low probability risks which will not materially impact on our performances commitments but would have a significant impact on customer service if they emerge.

Throughout AMP7 we have continued to undertake risk assessments to understand potential weak points in our strategic water distribution system. These assessments include analysis of specific risks such as riverbank erosion and river flooding. We have also looked to understand specific weak spots within our network, which if compromised, would lead to significant loss of supply. These risks are collectively lower probability but with significant consequences.

They have been gathered into a single Enhancement Case as they share similar characteristics.

Table 1 below summarises the evidence of need, cost and benefits for each of the schemes. Further cost detail by year for each scheme can be seen in Appendix B.

*Table 1: Summary of the evidence of need, cost and objective for each scheme*

Scheme name	Evidence of need	Cost 2022/23 Prices	Benefits
<b>Increasing the reliability of short- and long term water supply by increasing transfer capacity within Tywi/SEWCUS</b>	Following the completion of the AMP7 scheme there will be short duration resilience of the Strategic network of up to 30 Mld West/East and East/West. But the AMP7 investment will not provide long duration resilience for the network and further investment is required to deliver this in AMP8. This is identified within detailed hydraulic assessment reports undertaken during AMP7.	£22M	This scheme builds on the project Extending the South Wales Grid which was part of the PR19 submission (WSH.DD.CE.4). The proposed scheme will improve the supply reliability of long and short duration outages by providing increased capacity upstream of the AMP7 scheme. The improvements to the network will benefit up to 87,485 properties downstream of Birchgrove and Margam water pumping stations.
<b>Network Connectivity Improvement Schemes</b>	Improved interconnection between distribution networks will improve the reliability of supply and reduce the risk of tankering in dry weather and following freeze thaw events. A programme of short lengths of mains is proposed to achieve this.	£10M	Up to twelve network connectivity and dualling schemes are proposed to improve resilience and reduce the risk of interruptions of supply and the need of tankering to mitigate during dry weather or following freeze thaw events.

Scheme name	Evidence of need	Cost 2022/23 Prices	Benefits
<b>Critical crossings</b>	Reducing the risk of supply interruptions and third-party impact from flooding to transport systems, properties, disruption to businesses, communities and transport systems. Improvements to resilience of critical crossings and the installation of additional assets to reduce the risk of long duration outages and improvements to failure responses.	£7M	High level feasibility for the 42 highest criticality sections where a large diameter pipeline crosses both a road and a railway and a single solution can reduce the risk of long duration interruptions at both crossings. Detailed feasibility for 16 sites to understand the risk and scope of work in more detail. A prioritised programme of work based on the findings of detailed feasibility will be undertaken to deliver 3 x dual mains projects and 5 x mains connectivity schemes.  A small programme of work to undertake a high-level desktop assessment of all 282 critical crossings will also be undertaken to inform future intervention planning.
<b>Mains relocation caused by river erosion (Wye Transfer)</b>	Mains Relocation required due to the impact of climate change. There is a risk of mains failure due to erosion of the riverbank, which can lead to loss of production and interruptions to supply.	£5M	Divert the main away from the river erosion area to address the immediate need and provide a long term solution.
<b>Strategic Resilience Schemes - Feasibility Studies</b>	Undertake feasibility studies to assess options and develop Strategic Resilience Schemes for the North, East and Tywi West to Pembrokeshire. Limitations around the water supply across Wales and the need to incorporate the significant areas of growth to provide a long term clean water costed and scoped solutions. 'Need to provide a long term solution to the resilience of Welsh Water's Water Supply by developing a strategy and undertaking feasibility for the solution during AMP8.	£3M	Feasibility studies to provide a long term solution for Strategic Resilience in three areas of Wales during AMP8.

Scheme name	Evidence of need	Cost 2022/23 Prices	Benefits
<b>Cardiff Strategic Resilience – Feasibility Study</b>	Within this document the “Feasibility study in AMP8 for the continued reliability of short- and long term water supply to Cardiff to define scope and cost for a scheme in AMP9/10” will be known as the Cardiff Strategic Resilience – Feasibility Study Limitations around the water supply to Cardiff and the need to incorporate the significant areas of growth to provide a long term strategic solution for clean water supply.	£2M	Provide a long term solution to the resilience of Cardiff’s Water Supply by developing a strategy and undertaking feasibility for the solution during AMP8.
	<b>CapEx Programme Total</b>	<b>£48M</b>	
<b>Inspections to Reduce Incident of Third Parties Compromising Water Quality</b>	An enhancement programme of Non household Water regulations inspections targeted to reduce the risk associated with low probability high consequence network contamination events because of third party safeguarding failures.	£5M	Provide a resource to undertake an enhancement programme of enhanced inspections to identify water regulations failures and high risks of contamination on customer water systems and connections to the Welsh Water mains supply. This programme of work will be an operational cost because it consists of staff costs only
<b>Increasing the reliability of short- and long term water supply by increasing transfer capacity within Tywi/SEWCUS</b>	OpEx Associated with the scheme. See details for scheme in CapEx above.	£1M	See benefit details for scheme in CapEx above.
	<b>OpEx Programme Total</b>	<b>£6M</b>	
	<b>Resilience Programme TotEx</b>	<b>£54M</b>	

## 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:

ID from Appendix 9	Abbreviated Assessment Criterion	Addressed
<b>A1.1.1 Need for enhancement investment</b>	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
<b>A1.1.2 Best option for customers</b>	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 Our Approach to Investment Planning (Section 3.4)
	h Have customer views informed the selection of the proposed solution?	Please refer to A Reliable Water Supply for the Short and Long Term (Section 1.2)
<b>A1.1.3 Cost efficiency</b>	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
<b>A1.1.4 Customer protection</b>	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.

We describe the limitations in our water supply network that risk continuity of supply to our customers, the environmental and climate change factors (outside of management control) which are driving this low probability and high consequence risk and the implications for interruptions to supply performance. The need to invest in AMP8 is quantified by presenting the increase in costs and reduction in service which would emerge without action. We set out overlaps with our Base Maintenance program, which we have examined and removed from the Enhancement Case and give confidence that past allowances have been effectively invested.

The proposed investment aligns with our Long Term Delivery Strategy – responding to the need for long term stewardship and improvement in service. The five 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*

There is a need across the clean water network to provide resilience of supply to our customers. This programme of work includes a range of resilience schemes to reduce the risk of low probability and high consequence water supply interruptions.

Through our systematic approach to resilience, we have quantified the potential customer impact should these high consequence, low likelihood events materialise and these are summarised in Table 2 below for each of the seven schemes proposed within the resilience Enhancement Case.

*Table 2: Summary of the Current Risk and Future Risk Associated with the Programme*

Scheme	Current Position Risk £ per year	Do Nothing Risk end AMP8 £ per year
<b>Increasing the reliability of short- and long term water supply by increasing transfer capacity within Tywi/SEWCUS</b>	£33.690M	£33.690M
<b>Network Connectivity Improvement Schemes</b>	£11.403M	£11.713M
<b>Critical Crossings</b>	£34.908M	£41.207M
<b>Mains relocation due to river erosion (Wye Transfer)</b>	£0.635M	£0.794M
<b>Strategic Resilience Schemes - Feasibility Studies</b>	£11.080M	£14.773M
<b>Cardiff Strategic Resilience - Feasibility Study</b>	£12.276M	£12.584M
<b>Inspections to Reduce Incidents of Third Parties Compromising Water Quality</b>	£0.802M	£1.002M
<b>Total Programme Risk Values</b>	<b>£104.793M</b>	<b>£115.763M</b>

This provides a total current annual monetised risk of **£105M** which will deteriorate to **£116M** at the end of AMP8 if no enhancement interventions are undertaken. A more detailed of the current risk can be found in Appendix 1.

All the above schemes, except Wye transfer, have been produced using a risk and value lite approach to reflect the high-level feasibility for the low probability events not well represented in the CBA.

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

Our customers support the need to provide a reliable water supply. Using the Tywi conjunctive use system (TCUS) as an example in the event of a catastrophic failure of a single section of the treated water main, Felindre water treatment works or raw water tunnel would result in a long term outage for over 200,000 properties. Our Resilience programme will deliver those wishes in a cost-effective way.

## Scale and Timing of Investment

The scale of activity proposed has been selected to balance affordability, deliverability and the desired increase in resilience:

### 2.1.1 Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS:

The scale and timing of the investment is driven by the need to provide a sustainable long term resilient supply within SEWCUS as well as an increase in capacity to meet future planned development growth in the Felindre East (TCUS) network. Over the next 10 to 20 years this growth will exceed network headroom and compromise capacity to meet contingency transfers to the SEWCUS network as delivered in AMP7.

Consequently, the need to increase network capacity on the strategic mains network is required during AMP8. In terms of the impact of growth on the strategic network, the modelling report has summarised the following. A total of 17.8 Mld growth from known developments exceeding 18,000 domestic properties and industrial use approaching 6Mld. A further 3.6 Mld (20%) is allowed for smaller 'infill' developments, to give a total growth estimate of 21.4 Mld. Of this forecast growth, 17.3 Mld is downstream of Margam WPS and a further 4.1 Mld is upstream between Margam and Felindre WTW.

**Project Case Study:** Following the completion of the AMP7 scheme there will be short term resilience of the Strategic network of up to 30 Mld West/East and East/West. But the AMP7 investment will not provide long term resilience of the network and further investment is required to deliver this in AMP8. A further assessment of need in AMP8 will be undertaken through the Strategic Resilience Schemes Review and feasibility of three areas; the West TCUS and the Growth review of the area to the West of Cardiff as well as for Cardiff Strategic Resilience all of which may highlight further improvements to the planned system to manage resilience and growth into the future.

In support of AMP7 delivery and PR24/AMP8 strategic planning, a hydraulic assessment has been undertaken for the TCUS. This has assessed the Felindre water treatment works (WTW) and the East trunk mains network (including pumping stations) which serve the Cefn Hirgoed and Llantrisant Service Reservoirs. This has included the impact of the planned AMP7 strategic interconnections and temporary pumping station as well as the future impact of growth in the area.

### Simplified Schematic of TCUS and SEWCUS Networks

Showing:  
 AMP7 Delivery: Extending the South Wales Grid  
 AMP8 Planned: TCUS Reinforcements

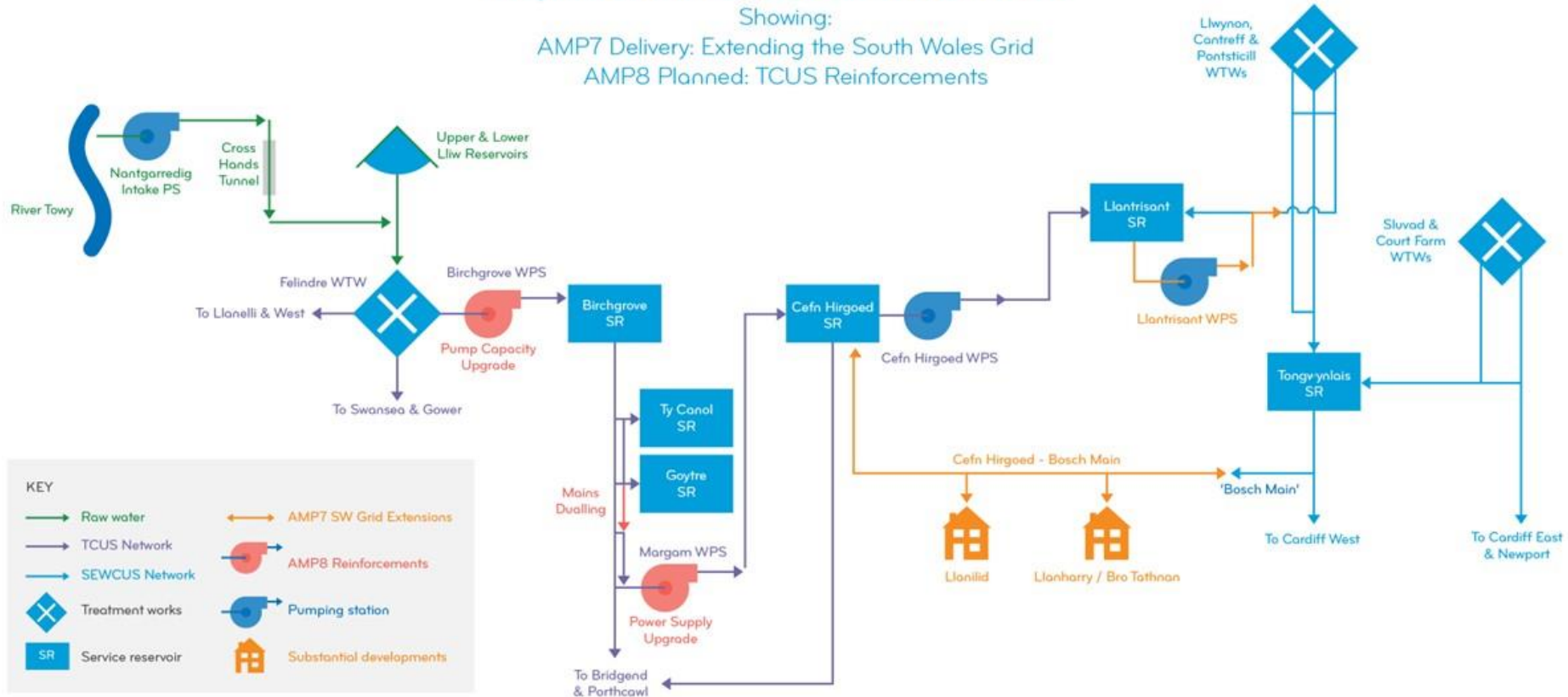


Figure 1 - South Wales Strategic Network and Planned Interventions

The modelling identifies several capacity issues and interventions to improve the current network restriction, across the trunk mains network, which limit the system's ability to meet growth and long duration contingency demands and present a risk to security of supply. Of these the following specific needs have been prioritised for AMP8 delivery to provide a more sustainable water supply from West to East for longer durations.

**1. Capacity upgrade of Birchgrove WPS**, see Figure 1 above.

This pumping station has a modelled headroom of 25Mld, which is insufficient to meet growth in demand of 21.4 Mld. In addition to growth, a long duration contingency transfer to SEWCUS of up to 30 Mld is also required which means a capacity upgrade of 25-30 Mld. The scope of work required for this will be to provide an additional pump at the site to meet future demand and contingency duty.

**2. Dualling of 4.4km x 800mm main upstream of Margam WPS**

While most of the 20km distance between Birchgrove WPS and Margam WPS is served by dual pipelines, a 4.4km section remains as a single pipe only. Dualling of this section would:

- Remove a significant 'single point of failure' service risk to over 87,4859 downstream properties.
- It will also significantly reduce pipeline head loss by providing additional flow to the Margam WPS and increase the potential effective capacity of Margam WPS, equivalent of up to an additional 40-50 Mld capacity.

**3. Upgrade Power Supply and Generation at Margam WPS**

Margam Park WPS performance assessments undertaken in 2020 highlighted the limitation on power supply and how this restricts pumping capacity, and available headroom. An upgrade to the power supply system and its associated standby system is necessary to ensure that Margam WPS can meet demand under the full range of operating conditions and that power is not a single point of failure for the site. For optimal delivery, this work will be planned to be undertaken alongside the replacement of the current Motor Control Centre (MCC) and switchgear at Margam, funded through Base Maintenance.

## 2.1.2 Network Connectivity Improvement Schemes

Across Welsh Water during periods of high demand, parts of the current distribution network do not have sufficient capacity and/or storage to maintain supplies. These events are linked to periods of high demand and freeze thaw events which are becoming more common and extreme due to climate change. The summer and winter of 2022 being the most recent examples, see Section 2.3.2 of the [Water Resources Management Plan \(WRMP\)](#). Consequently, there are locations across the network where there is a need to tanker water to maintain customer supplies.

This programme of work is targeted at those locations identified as having the highest levels of risk associated with local network capacity during high demand periods and tankering is no longer a sustainable solution. The need for this programme is to connect distribution networks with smaller length and diameter links and dual mains to improve the current capacity. The programme will also improve resilience across the network and reducing the risk of interruptions to supply during mains failures and tankering during dry weather periods. These are issues that impact the business now and have been experienced more frequently over recent years.

## 2.1.3 Critical crossings

Currently Welsh Water has over 287 critical crossing locations which serve more than 70,000 people, of which 100 have been identified as high risk. To understand the consequences of failure and prioritise these interventions further, a small programme of work is required during AMP8. The programme of work will enable a more detailed quantification of risk for those locations which have the highest consequences. This will enable the highest risk locations to be addressed first.

## 2.1.4 Mains relocation due to river erosion (Wye Transfer)

The Wye Transfer Main is a raw water main that transfers water from the River Wye Intake, located in Monmouth, to Court Farm WTW. The raw main is a 50-inch diameter steel pipeline that has several river, dual carriageway and road crossings along its c35 km length. The main has failed several times over the last 15 years due to riverbank erosion where the main crosses the river Usk.

The pipeline is 40 years old, and over the last 15 years the river has begun to significantly change course and undermine the pipeline.

The regular erosion of the main and supporting evidence from a third-party erosion report indicate that levels of erosion will continue and the risk of catastrophic failure of the pipeline will continue to increase. The current position shows a loss of at least 0.5m of soil due to erosion. Operational mitigation has been put in place this is becoming more difficult and more expensive to maintain each time further erosion occurs. A permanent solution is required to reduce the risk of failure and safeguard this strategic raw water supply.

Based on this historic information, it is not unreasonable to assume that the minimum annualised do-nothing risk (assuming the risk does not increase over time) would comprise £0.6M riverbank erosion mitigation and pipeline repair – 1 in 3 yrs.

However, we have evidence to suggest that this river erosion will become more severe over time, increasing the risk to the pipeline and the frequency of failure as described within the HR Wallingford Report. A more extreme estimate of the risk over the next 5 years could therefore be comprised of the following:

**Interruptions to supply:** At worst case, a pipeline burst could take 10 days to repair; in this scenario it has been estimated that 4,667 properties would have their supply interrupted. This takes into consideration the potential for tankering and the use of storage within the network to minimize the risk of interruption to supply.

**Repair costs:** Assumption that a major burst due to temporary access roads, and other enabling works cost circa £0.6M (based on previous work), which includes work required on manholes and gabion walls.

#### 2.1.5 Strategic Resilience Feasibility Studies (Strategic Resilience Schemes and Cardiff Strategic Resilience)

##### **Strategic Resilience Feasibility Studies**

We propose to undertake feasibility studies on the list of areas below, to define strategic schemes which will provide long term resilience across the Welsh Water area and facilitate the maximisation of water resources, major maintenance for water treatment works and strategic mains. A summary of the scope of the three priority area schemes and Cardiff Strategic Resilience for assessment are listed in the bullets below.

- **North Wales Strategic Resilience:** this assessment will review the most effective way to improve resilience and connectivity across North Wales. Current thinking is that a new trunk main that will enable Bretton and Alwen in the East to be connected to Bryn Cowlyd and through to Mynydd Llandegai and the Britannia Bridge link in the West. The whole scheme for this project will be c100km in length. Consequently, our proposed approach will be to do an initial assessment for the whole of the scheme and potential routes with further assessment of the Bretton to Bryn Cowlyd section. The delivery programme will then be broken into phases of delivery across future AMPs.
- **Improve Tywi Conjunctive Use System (TCUS) linkage with Pembrokeshire:** the aim of this strategic link will be to improve the connectivity between the two water resource zones as well as improving the connectivity within the western area of the TCUS system. This will allow improved connectivity between Felindre, Bryngwyn and Capel Dewi water treatment works (WTWs) and provide additional water into the Eastern part of the Pembrokeshire area. The assessment will also review the options of installing new WTWs in the Pembrokeshire area and the clean water supply which will include the future of the Pendine WTW in the medium to long term.
- **Long Term East Area Supply and Resource Resilience:** this study will develop the long term plan for the Eastern Area which will secure water supplies in the mid Wales and Herefordshire areas into the long term. The review will include the assessment of water resources, water treatment works and the pipeline options to provide a resilient water supply across the area. This is a large geographic area with relatively small population centres and limited existing connectivity. The holistic assessment will develop the short-, medium and long term options to enable customers water supplies to be safeguarded into the future.

- **Cardiff Strategic Resilience - Feasibility Study:** This feasibility scheme is required in AMP8 to understand the strategic network requirements around and within Cardiff. Currently the interconnectivity is limited with single sources of supply to many customers. Planned increases in growth, forecast over the next 10 to 15 years, will make this situation more critical requiring a strategic approach to resolve these issues. A hydraulic model is currently under development which will provide the quantification of network constraints and the network needs to overcome them.

The outputs of the feasibility will be a scoped and costed programme of work which will also priority areas to be targeted in AMP9 and 10.

#### 2.1.6 Inspections to Reduce Incidents of Third Parties Compromising Water Quality

An enhancement programme of Non household Water regulations inspections targeted to reduce the risk associated with low probability high consequence network contamination events because of third party safeguarding failures. This programme of work focuses on promoting good practice and a step change in the level of Water Regulations inspections with the aim of identifying where regulation infringements may impact on our level of service for water quality, discolouration, taste & odour and maintaining a reliable water supply, The programme of work can be summarised within four key areas of work which are summarised in the bullets below.

- **Plumbers: Increasing the number of approved plumbers during AMP by implementing a** Welsh Water Plumber Approval Scheme moving away from the Water Regs UK managed one. The main purpose of bringing the scheme in house would be to ensure closer management of members, but to allow members to be part of the Welsh Water brand which is trusted by our customers. The scheme will provide different approvals for example approved plumbers and approved groundworkers to undertake inspection and approval work on behalf of Welsh Water for examples Trench inspections, Completion of Water Regulation infringement rectifications and new connections inspections.
- **Inspections:** Increasing the number of inspections to move away from the very highest risk premises only to all high-risk premises which will mean an additional 35,000 inspections during AMP8. This is based on an assessment of 247 high risk premises inspected in 2021/22 which accounted for 409 infringements with 174 of those being of the highest risk category. To Inspect all High-risk premises based on 1 officer doing 450/year over an AMP equates to an extra 15 officers to do an extra 35,000 inspections. This would also require an increase in the number of Customer Resolution officers (CRO's) for planning and scheduling which would require an increase of 2.
- **Point of Sale:** The technical team receive around 2,000 notifications which would have multiple installations of pipework and fittings that have the potential to not comply with Regulation 4. The team will focus on working with; merchants, wholesalers, retailers and manufactures in Welsh Water's operational area to have a greater awareness of their requirements, responsibilities, and obligations under consumer protection to ensure that all saleable items are compliant. This would also include collaboration with other enforcement bodies including trading standards to increase awareness of water regulations and their enforcement.
- **Education & Support:** for the key stakeholders from merchants and wholesalers to ground workers and contactors provide standard training in these areas; The Water Supply (Fittings) Regulations 1999, Application of the regulations, Consequence of non-compliance, Awareness of the Approved Plumber scheme, The benefits of using an Approved Plumber. In addition to this support in all areas of the scheme would be provided by the Welsh Water inspections team.

## 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

The investment set out in this case is entirely separate from Base Maintenance and has overlap in two projects only the Tywi/SEWCUS scheme and Inspections to Reduce Incidents of Third Parties Compromising Water Quality. The programme of work involves the construction of new assets which will sit alongside our existing ones.

For the “Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS scheme” separate Base Maintenance and enhancement interventions have been identified at the two water pumping stations, Margam and Birchgrove. The enhancement interventions will increase the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS systems and the Base interventions will increase the reliability of the two sites.

The Inspections to Reduce Incidents of Third Parties Compromising Water Quality project will provide a step change in the current level of risk. The inspections will be over and above our current programme and provide the resource to both undertake additional inspections at all high-risk premises and manage the rectification process it will also manage an approved plumber scheme to enhance capability across the Welsh Water area.

## 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

Neither the need or proposed enhancement investment overlap or duplicate with activities or service levels already funded at previous price reviews for any of the proposed schemes.

With regards to the scheme ‘Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS’, the PR19 EWWE commitment set in section 1.2.36 of the ‘PR19 final determinations Dŵr Cymru-Outcomes performance commitment appendix’ will be substantially completed (100% spend) in AMP7 and bi-directional capacity fully commissioned (permanent provision for temporary contingency pumping) by AMP8 Y1. This delay is a result of a review of the scheme needs to accommodate new developments at Llanhilid and Llanharry. The AMP7 scheme will provide a short-term bidirectional transfer of 30 Mld between the West (TCUS) and East (SEWCUS) to address time limited issues such as burst mains.

The proposed AMP8 Scheme will provide additional resilience to maintain water supplies for long durations by increasing the capacity of the strategic network between Birchgrove water pumping station and Cefn Hirgoed SRV.

The feasibility assessment proposed for Cardiff Strategic Resilience will identify further improvements to the strategic network within the around the city. This is a phased development of the strategic network and will allow the benefits of the AMP7 strategic improvements to be factored into the assessment along with the latest growth position and strategic resilience needs.

## 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

The development of a Long Term Delivery Strategy includes improvements to the Tywi and SEWCUS systems as well as further feasibility work to define needs in more detail in readiness for the next iteration of the Long Term Delivery Strategy. The feasibility schemes include Cardiff Strategic Resilience and Improved TCUS connectivity with Pembrokeshire and feasibility of growth needs to the West of Cardiff.

For the wider programme the Strategic Resilience Feasibility schemes are required to define, scope and cost the strategic improvements required across the Welsh Water area. All the interventions within the proposed infrastructure programme of work focus on resilience for water network assets and which in some cases will improve Water Treatment resilience, the mains relocation due to erosion scheme for example. The long term resilience target focuses on reducing water supply resilience risk, this programme reduces this from £105M to £66M. It also reduces the number of customers who are supplied by single sources of supply.

The investments outlined in this infrastructure resilience Enhancement Case directly aligns to our core pathway and our long term aim to address the 89 pipeline related single points of failure currently identified within the distribution network. Further details can be seen in WSH01 Long Term Delivery Strategy.

## 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*

Some of the Need for this investment is outside management control for example climate change and third-party damage. This programme of work is driven by our overarching long term strategy to improve resilience across our strategic network and manage the impact of Growth, Climate Change and Demand reductions, see further details in Sections 2.3.2 and 5.3 of the [Water Resources Management Plan \(WRMP\)](#). These issues are all factored into the current thinking regarding programme development.

As part of the solution development process various options were considered and the most cost beneficial schemes identified. Using the most cost beneficial schemes and following a phased approach to network improvements have resulted in a least cost programme for AMP8 and through the feasibility schemes approach this will continue into AMP9 and beyond.

## 3. Best Option for Customer

In this section we will describe how we have developed options for addressing the need identified in Section 2 above. Our approach has been to assess a range of nine types of option across our intervention programme following our standard approach, see further detail in Section 3.1 below. Our chosen option for each scheme or programme of work will address key resilience risks across our strategic network identified during our strategic area reviews which informed our Long Term Delivery Strategy. The four 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 and A1.1.2b*


Our standard approach to scheme optioneering has been followed for this scheme was followed.

During the long listing process nine options were assessed from do nothing to Creation of New Assets, see Table 3 below. It should be noted that the solution options considered in the Table 3 below are in line with the Welsh Water solutions hierarchy but have been reordered for presentation purposes. For the selected Options a shortlisting appraisal was then undertaken with cost benefit analysis which is described in more detail in Section 3.2 below.



Table 3 – Summary of the Longlist of Options Considered

Option	Type of Option	Brief Description of Option and Comments	Potentially Viable, i.e., progress to shortlisting?
1	<b>Eliminate, reduce or delay the need for change.</b> Manage demand	Not viable: Although managing demand will have a benefit in terms of resilience to some locations those locations being investigated are because by their natures it is not possible to manage demand due to the lack of resilience.	
2	<b>Maintain the effective risk controls already in place.</b> Manage operation or use of the existing asset or service	Not viable: This intervention method would not provide a sufficient step change in resilience to address the business need risks.	
3	<b>Maintain the effective risk controls already in place</b> Maintain the existing asset or service	Not viable: Although continued maintenance of the asset Base should be undertaken as business as usual (BAU), resilience improvements are largely strategic network assets where maintenance will not have a material impact.	
4	<b>Maintain the effective risk controls already in place</b> Replace the existing asset like-for-like	Not viable: Like for like replacement is part of BAU and would not have a material impact on resilience with respect to strategic single points of failure across the network.	
5	<b>Enhance existing resources or add new resources.</b> Enhance/upgrade the existing asset or service	Viable: Although not likely to be commonly utilised upgrading existing assets may be appropriate in some instances to improve resilience. This will largely be replacement of existing asset with additional capacity or cross connections between existing pipelines and systems.	
6	<b>Maintain the effective risk controls already in place</b> Mothball/dispose of the existing asset or service	Not viable: This is part of the BAU process to maintain the existing network and not material to the resilience programme.	
7	<b>Enhance existing resources or add new resources.</b> Create/acquire a new asset or service	Viable: New asset installation will be the method that would provide the greatest level of resilience for clean water assets as it would facilitate the ability to supply customers from alternative sources, increase levels of storage and increase outputs from WTWs.	
8	<b>Enhance existing resources or add new resources.</b> Innovation	Not viable: No innovation opportunities have been identified for this asset group. But improvements to network control, actuation and treatment for example will continue to be part of the assessment process, for example Chemical free treatment.	

Option	Type of Option	Brief Description of Option and Comments	Potentially Viable, i.e., progress to shortlisting?
9	<b>Enhance existing resources or add new resources.</b> Other	Viable: A combination of Options 5 and 7 where the most appropriate intervention is identified for each need including a phased approach to project delivery.	

Our approach to cost benefit appraisal and its role in decision making is set out in WSH50-IP00 Our Approach to Investment Planning (Section 4.3). This includes a cost benefit analysis (CBA) tool, which comprises a detailed analysis of benefit against costs for all proposed shortlisted options. The outputs for each solution option include quantification of risk and benefit over the long term via service measure framework (SMF) values, including valuation of the following criteria: customer service impacts including interruptions to supply, natural capital; social capital; human and intellectual properties.

### Example: Mains relocation caused by river erosion (Wye Transfer) scheme

Following on from our long listing assessment outlined in Table 3 above the outcome for the CBA undertaken for the Wye Transfer scheme, during our shortlisting process, assessed the best solution option involving mains relocation to mitigate the impact of climate change and safeguard long term water supplies.

Option 1: This option consists of a 135m each new twin water mains beneath the river, aiming to divert the main locally and laying it deeper. This option benefits from shortest constructed route and lowest cost out of all constructed options.

Option 2: This option provides a diversion length of 490m, in addition to this there are 230m of dual pipeline sections. One of which is the section beneath the river includes 150m (each) new twin water mains. The total length of pipeline that will be laid as part of this scheme is planned to be 720m. This option avoids the high-risk areas of riverbank erosion and reduces the number of pipeline bends compared to Option 1, reducing frictional losses.

Option 3: This option consists of a 1240m diversion (includes 100m twin mains beneath river). This option of a long main diversion would avoid the area where the river erosion has been more prominent over recent years and the area where the new river path meets the original river alignment, further south.

Option 4: Retain the existing main alignment and the existing erosion control east of river crossing and carry on undertaking reactive maintenance, not possible during flood events.

Our preferred option is Option 2 when this scheme is considered on its own, as it provides the highest benefit to cost ratio and highest whole life value and delivers a payback significantly more quickly than the other options. It significantly reduces the risk of deterioration of the existing main caused by erosion of the riverbed in the area surrounding the existing pipe river crossing. The likelihood of ground settlements further downstream of the river due to its change of course is still to be determined by the additional erosion study to be carried out at the investigation stage. Depending on the outcomes from that study, Option 3 may become the only viable option.

The output of the CBA for the Wye Transfer scheme can be seen in Table 4 below. 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. The equivalent assessments have been undertaken for the other schemes and programmes of work within the Resilience Programme.

Table 4 – Wye Transfer Cost Benefit Analysis Summary

Solution Option	Option Name	CapEx	NPV Total Costs	NPV Whole Life Benefits	Benefit/Cost Ratio	Net Present Value (=WLB - WLC)
<b>Option S1</b>	135m each new twin water mains beneath river Keep erosion control east of river crossing (Previously Option 2 at Long Listing)	£4.112M	£4.679M	£5.698M	1.22	£1.020M
<b>Option S2</b>	490m diversion (includes 150m twin mains) beneath river Keep erosion control east of river crossing (Previously Option 3 at Long Listing)	£5.749M	£6.222M	£9.493M	1.53	£3.270M
<b>Option S3</b>	1240m diversion (includes 100m twin mains beneath river) Keep erosion control east of river (Previously Option 4 at Long Listing)	£9.547M	£9.414M	£10.863M	1.15	£1.449M

**Example: Increasing the reliability of short and long term water supply by increasing transfer capacity within Tywi/SEWCUS**

Following on from our long listing assessment outlined in Table 3 above the outcome for the CBA undertaken during our shortlisting process for the Increasing the reliability of short- and long term water supply by increasing transfer capacity within Tywi/SEWCUS scheme is summarised below. The scheme will improve the reliability of long and short duration outages by providing increased capacity upstream of the Extending the South Wales Grid AMP7 scheme. The options below have been developed through our hydraulic analysis of the Tywi and SEWCUS systems.

Option 1: This option consists of upgrades to Birchgrove and Margam water pumping stations and 4.4 km of large diameter dual pipeline. This option provides a long term benefit to the strategic network to increase capacity and the interventions described are no regrets.

Option 2: This option provides the same assets as Option 1 with addition assets downstream including dualling 3.2km of 800mm pipeline on the delivery side of Margam WPS and dualling the main, (the Bosch Main), 5.3km of 650mm main that at the end of AMP7 will connect TCUS and SEWCUS.

Option 3: This option consists of an upgrade to Cefn Hirgoed WPS to increase its capacity by 25Mld and a new Tongwynlais to Cefn Hirgoed WPS and dualling of the Llanharry to Bosch main section. This will facilitate improvements to long duration bidirectional flow resilience between TCUS and SEWCUS.

Our preferred option is Option 1 when this scheme is considered on its own, as it provides the highest benefit to cost ratio and highest whole life value. It significantly improves the capacity of the TCUS system and provides a long term sustainable alternative supply and removes a single point of failure. This reduces the risk of long term interruptions supplies because of a catastrophic failure of one of the single points of failure on the SEWCUS or TCUS system. The other options are at a greater risk of needing to change through adaptive planning due to the levels of change in growth and demand in the distribution network to the West of Cardiff. Consequently, further assessment will be undertaken on this area during AMP8 to inform our Long Term Delivery Strategy and AMP9 strategic investment plans TCUS and SEWCUS.

The output of the CBA for the Increasing the reliability of short and long term water supply by increasing transfer capacity within Tywi/SEWCUS scheme can be seen in Table 5 below. The equivalent assessments have been undertaken for the other schemes and programmes of work within the Resilience Programme.

*Table 5 – Increasing the reliability of short- and long term water supply by increasing transfer capacity within Tywi/SEWCUS scheme Cost Benefit Analysis Summary*

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)
<b>Option S1</b>	Do Nothing in addition to completion of the PR19 project only (short term resilience)	0	£0	£0	<b>0.000</b>	£0
<b>Option S2</b>	Birchgrove and Margam WPS and Dual Pipeline project elements	£24.083M	£21.617M	£259.720M	<b>12.015</b>	£238.103M
<b>Option S3</b>	Option 2 with downstream dual pipeline and Dual Bosch Main	£56.204M	£50.449M	£312.676M	<b>6.198</b>	£262.227M
<b>Option S4</b>	Option 3 with Cefn Hirgoed WPS upgrade & new Tongwynlais to Cefn Hirgoed WPS and dual Llanharry to Bosch main	£89.590M	£80.417M	£316.239M	<b>3.932</b>	£235.822M

For the other schemes in this programme of work a similar approach has been followed with risk and value assessments undertaken to provide the CBA which has been adapted to take account of the size and scope of the programme of work.

Using the critical crossings schemes as an example, a review process has been undertaken of the 287 most critical crossings using our Resilience Risk assessment. Outputs of the 100 mains which have been assessed as 0% resilient were identified as priority locations for further assessment. Of these, the 53 road and rail locations were prioritised over river crossings due to the additional third-party impact of these mains failing in addition to service impacts.

The prioritised list was further assessed and mains locations where a planned intervention is planned during AMP8 were removed to avoid any duplication leaving. This left a list of priority 42 crossings for further assessment. The proposed approach will be two-fold, a desk top assessment of the priority crossings to identify the requirements and need for each project.

This additional information will then enable the 42 sites to be further prioritised and site visits undertaken for detailed site assessments of 16 sites. This will enable the scope of each crossing to be more fully understood and a detailed scope and cost developed for delivery. The eight highest priority sites will then have a dual crossing or cross connection installed as defined by the feasibility assessment.

## 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

In its analysis of option cost benefit, Welsh Water has considered the impact of Carbon and Natural and other Capital benefits. Carbon impact is calculated over the life of an asset and includes both the operational impact and embedded impact of Carbon. The data used for this coming from the Cost and Carbon template used to develop the costs and carbon impact both operational and embedded. Whole Life Carbon (WLC) estimation is an important input to inform decision making and programme development by Welsh Water. In our development of programme options, we have developed appraisals of the carbon impact of shortlisted options using Carbon Unit Cost Database Models. Carbon referred to as Green House Gas Emissions (GGE) have been used as a direct input to calculate the benefit or disbenefit of scheme options to inform Cost Benefit Assessment (CBA). The monetised natural capital impact of carbon forming an overall ‘benefit’ or ‘disbenefit’ position alongside other service measure impacts, see Table 6 below.

Natural capitals and wider societal capitals have also been considered through application of Welsh Water’s Multi Capital Approach (MCA) valuation of service measure impacts. Like GGE impacts these are considered as part of the CBA. The benefits of a scheme have been calculated by our asset planning and engineering teams based on the best available information available and have been used forecast the impact a scheme will have on service measures in comparison to the pre investment position/do nothing position. Benefits are quantified against the Welsh Water service measure framework meaning they are well understood and trackable through regular business activity.

*Table 6 – Summary of the Benefits for the Low Probability High Consequence Enhancement Programme*

Scenario	Benefits from AMP8 Spend relative to baseline				
	Unplanned Network Interruptions	Drinking Water Complaints	Traffic and Transport Disruption	Other*	Total
Preferred –	74.0%	24.5%	0.1%	1.4%	100%

\* Avoidable Costs

**3.2.1 Quantifying the Impact on Need and Performance Commitments** This programme of work will undertake the following schemes to improve performance:

- Interventions at 24 locations,
- Four strategic feasibility studies,
- Detailed feasibility assessment at 16 sites
- High level desktop feasibility at 42 sites

As a result of the intervention programme the total resilience related risk associated with the proposed schemes will reduce from the current position of £105M to £66M.

### 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 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. For this Enhancement Case we have evaluated a wide range of options in line with our TotEx hierarchy approach, these are set out below.

We have highlighted areas in which the calculation of costs or benefits are unusual or uncertain and how we have mitigated for this in our evaluation. Innovation and new approaches such as nature-based work is inherently more uncertain than tried and tested engineering approaches.

As we mention in the investment options section above, the management of benefit and cost risk is inherent throughout our planning process. In the example the lower-risk solution is favoured as not only it delivers the greater net benefit it is also lower risk than the next-best option.

The resilience programme has been driven by an assessment of future needs to maintain water supplies to customers. This means that many of the interventions are to reduce high value risks generated by low probability and high consequence events. Consequently, the needs associated with the programme and the associated solutions to mitigate these risks have been developed considering the drivers for adaptive planning. This means that the solutions in the programme are part of a modular approach to deliver the Long Term Delivery Strategy and its associated improvements to resilience.

Using the Mains relocation due to river erosion (Wye Transfer) scheme as an example the proposed solution will need to be reviewed as part of the feasibility process to understand the latest climate change figures and the impact that these will have on erosion in the area. This approach allows for the scheme final scheme installed to be based on the best available data forecasts. The options considered to develop the proposed scheme can be seen in Table 7 below.

Table 7 - Options considered for Mains Relocation due to the impact of climate change (Wye Transfer)

Option	Description	Risks associated with costing this option or valuing its benefits	Mitigation
<b>Option 1</b>	Replace the river crossing pipeline Like for Like, 4m beneath riverbed, in parallel to the existing main.	The following items contribute to cost uncertainty: - the depth at which the new twin pipe will be laid (assumed 4m beneath the riverbed) has not been confirmed by the Environment Agency (EA) and ground conditions are unknown. - Although mitigation work has been undertaken the riverbank erosion is continuing and the river is creating a new route that will affect the pipeline – further mitigation work could be required during and/or post construction. - The location of the crossing means that during spate conditions it is not possible to access the main to repair it or install the new one.	Although the works would be planned to avoid periods of high river water levels, in case of unforeseen extreme weather conditions we would finance any extra costs caused by delays during construction.
<b>Option 2</b>	Replace the river crossing pipeline downstream away from the main area of bankside erosion.	The pipework located within section of river is still liable to flooding (flood plain), erosion and river alignment changes, leading to cost uncertainty.	Although the works would be planned to avoid periods of high river water levels, in case of unforeseen extreme weather conditions we would finance any extra costs caused by delays during construction.
<b>Option 3</b>	Change the route of the pipeline moving it out of the flood plain and the crossing downstream	The cost uncertainty would be significantly reduced as the new main would be moved out of the flood plain.	Although the works would be planned to avoid periods of high river water levels, in case of unforeseen extreme weather conditions we would finance any extra costs caused by delays during construction.
<b>Option 4</b>	Do nothing keep the mains in their current location and undertake reactive repairs	The potential for further damage to the main caused by riverbank erosion leads to cost uncertainty.	Not applicable

The “Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS” scheme proposed is another modular improvement to resilience for South Wales. The scheme improves the duration of the resilience schemes from short term delivered in AMP7 to long term and factoring the latest growth forecasts for the area during AMP8. Further detailed assessments are planned for AMP8 which will enable any additional interventions to be defined and planned in for AMP9.

The options considered to deliver long term resilience through removal of single points of failure and the ability to supply the area from more than one source have used detailed hydraulic assessment which considers future growth and demand requirements for the area. This has allowed a series of intervention options to be developed of which those of the Eastern Tywi strategic main may be subject to further change over the next five years to factor in growth and the impact of the AMP7 Extending the South Wales Grid scheme.

The other schemes included in this business case have been produced through a risk and value lite approach as these are low probability events not well represented in the CBA. For all schemes should unforeseen circumstances arise we would finance the corresponding extra costs.

### 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*

No third-party funding is involved in any of the projects included in this Enhancement Case.

## 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 (Section 4.10).

The two 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

***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*

Our approach was to use, where possible, like-for-like costing using our unit cost database (UCD) and the associated Cost & Carbon Estimating Tool (C&CET) as described in WSH50-IP00 Our Approach to Investment Planning (Section 4.10). This has been the approach for projects where a solution option has been selected for example the Mains relocation due to riverbank erosion (Wye Transfer), Dry weather Improved Connectivity and Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS schemes.

A scope is developed that is aligned to our Work Breakdown Structure (WBS), which was developed to support our data capture process of historical project cost against delivered assets, into a scope input sheet. Within this, sizing of the assets based on the relevant yardstick, which is dictated by the WBS, is provided following calculation in the previous engineering stages. Our costs models are developed in line with our WBS, and this allows us to input this information into the C&CET and generate a project estimate. WBS details the inclusions and exclusions of works under each cost model and the limitations of the model, so we can ensure all project costs are captured and there is also no over costing.

As example of some key estimating assumptions made for costing, on the Wye Transfer, we assumed that the crossing will be a single tunnel and not twinned. We assumed a tunnel given the diameter required for the pipeline. We have not included for any permanent chambers and as such no land purchase on the assumption we can carry out the works through third party compensation and easements given there is a current tunnel in existence.

For smaller interventions where specific intervention for each site have not been determined we used the C and CET to provide standard costs for each of the Critical Crossings scheme types. These two costing methods accounted for c90% of the total programme cost.

The scope of the Wye Transfer Scheme for the selected option is summarised in Table 8 below.



Table 8 – Summary of the Scope of Work Included within the Wye Transfer Scheme

Scope of Work
Installation of 2 x 150m 1200mm micro-tunnelling carrier pipes
Installation of 2 x 150m 900mm Ductile iron main in the micro-tunnel
Includes additional 80m of pipe transition pipework to enable dual pipelines either side of the new micro tunnelled pipework.
Decommission the existing 460m length of Pipe
line stop to enable capping of redundant pipe x 2 ends.
1200mm Ductile iron pipe- (pipe length m)
Demolition of 2 x existing chambers - 2.4m DIA chambers (no. of chambers 2)

The estimate for Wye Transfer lists out the scope items such as pipework, with their location, diameter and length and tunnels with the diameter and length etc. With the relevant quantities against these, the C&CET calculates the costs for each item using the cost models. With the workstream selected the C&CET applies the correct models to the Direct Works and Site-Specific costs, to cost the contractor indirect and project oncosts, associated with delivering the project.

The costing was carried out by Welsh Water costing team. The governance procedures, as outlined in Section 5 Costing Methodology were adhered to with the appropriate use of cost models being confirmed and all manual allowance verified prior to providing sign offs throughout the different iterations of the costings.

The development of costs for the four strategic feasibility studies is based on internal expert judgement. This method was used for c10% of the overall cost of the programme.

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.

Any costs which were derived from the UCD have also been through the internal assurance process that determines their accuracy and relative efficiency.

## 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*

The cost estimates for schemes have been based on Welsh Water’s unit cost database and its associated Cost and Carbon tool to generate cost estimates for schemes. The costs generated are based on internal outturn costs collected by Welsh Water as described in WSH50-IP00 Our Approach to Investment Planning (Section 4.10).

## 5. Providing Customer Protection

In this section we set out the template for the proposed PCD. This is designed to provide strong controls in terms of work delivered against funding allowed – if the proposed activity from this investment is not delivered funding will be returned to customers on a proportional basis. The work within this program is broad as such we have selected the most material elements of the program to be included within the PCD: this consists of network capacity increase, crossings improved and km of water main relocated, detailed in Section 5.1, Tables 10 and 11 below.

The sub section below corresponds to the three criteria set out in Ofwat’s PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A.1.1.4. There is no third-party funding for this Enhancement Case.

### 5.1 Proposed Price Control Deliverable (PCD)

**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.ab

The proposed approach is set out below. The response to low likelihood high consequence events is diverse with multiple projects being undertaken. We have reviewed the proposed activity and identified the most material elements for inclusion in the PCD. The PCD covers 70% of the value of this Enhancement Case.

Summary of deliverables	<ol style="list-style-type: none"> <li>1) Additional capacity delivered in the Strategic South Wales Grid area</li> <li>2) Reduction in the risk of interruptions through improvements to critical crossings and improvements to distribution mains linkage</li> <li>3) Relocation of Strategic Raw Water main impacted by erosion</li> </ol>
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*Table 9 – Proposed Price Control Deliverable*

<b>Customer Facing Description of Enhancement Case</b>	<b>Reduced customer risks from low probability high consequence events on infrastructure assets</b>
<b>Short Description of Enhancement Case / PCD Area</b>	<b>Improving Long Term Resilience within the Water Network</b>
<b>PCD Number</b>	<b>PCD6</b>
<b>Description</b>	<p>The company’s Water Network Resilience Programme contains a range of projects. We are proposing to implement specific controls in relation to three (3) of the most material areas of work (each a ‘Scheme’). Together, these three (3) areas of work will cover circa 70% of the proposed TotEx investment in this Enhancement Case (£53M (2022/23 price base, post efficiency adjustment)).</p> <p>The three schemes are as follows:</p> <ol style="list-style-type: none"> <li>1. ‘Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS’ scheme - the largest single scheme in the enhancement programme. The investment will encompass the next stage of work for ‘Extending the South Wales Grid’ that started in AMP7. The AMP7</li> </ol>

	<p>scheme will deliver short duration resilience for the water supply in TCUS and SEWCUS.</p> <p>The proposed AMP8 scheme will provide medium to long duration resilience by improving the Strategic Network to Birchgrove WPS and Margam WPS and dualling of a single length of main between the two sites. This will both increase the capacity of the network as well as increase resilience by eliminating a single point of failure. The scheme has an AMP8 TotEx cost of £23M. For the PCD the new main element is proposed as the most material with a TotEx of £17M is circa 31% of this Enhancement Case.</p> <ol style="list-style-type: none"> <li>2. 'Critical Crossings and Connectivity Improvement Schemes - the company's network analysis has identified locations where a single asset failure would create a significant negative impact on customer supplies. <ul style="list-style-type: none"> <li>- The company have developed a 'targeted interventions' programme to reduce these risks through a programme of site interventions and improvements to critical crossings.</li> <li>- In addition, extreme weather events have highlighted priority areas for improved connectivity between distribution systems. The company has therefore developed a 'programme of improvements' to the distribution network cross-connections.</li> <li>- The CapEx value of these schemes is £16.7M.</li> </ul> </li> <li>3. 'Relocation of the Wye transfer crossing' - this will reduce the risk of a catastrophic failure resulting in a long term interruption to supply to our Court Farm water treatment works. Changing climate patterns have resulted in increased levels of soil erosion where the main is currently laid. Relocating the main and river crossing will reduce this risk. The CapEx value for this scheme is £5M</li> </ol>												
<p><b>Measurement and Reporting</b></p>	<p>A summary of the three schemes to be delivered, along with their proposed outcome(s), is provided in Table 10 below.</p> <p>Scheme 1 - For the Increasing the reliability of short and long term water supply by increasing capacity within Tywi/SEWCUS scheme, the proposed deliverables to be tracked are the benefits resulting from the additional main and upgrades to the two WPS. We will report on the delivery of pipeline length and progress in construction of the pumping stations.</p> <p>Scheme 2 - For the Critical Crossings (8 sites) and Connectivity Improvement (10 sites) Schemes the number of interventions delivered is proposed.</p> <p>Scheme 3 - The Wye transfer relocation, as a standalone scheme, would be reported separately. We would report when the current main could be abandoned. We propose that work would be reported on an annual basis as part of the APR, with final assessment of delivery in the last year of AMP8.</p> <p style="text-align: center;"><i>Table 10 – Summary of Network Resilience Programme Measured Deliverables</i></p> <table border="1" data-bbox="379 1641 1426 1948"> <thead> <tr> <th style="background-color: #0070C0; color: white;">Scheme No.</th> <th style="background-color: #0070C0; color: white;">Scheme Name</th> <th style="background-color: #0070C0; color: white;">Outcome Description</th> <th style="background-color: #0070C0; color: white;">Quantitative Outcome</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td>Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS</td> <td>Improvement of Capacity from Margam to Cefn Hirgoed</td> <td>Installation of a 4.4km 1000mm pipeline and enhance 2 pumping stations</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Critical Crossings and Connectivity Improvement Schemes</td> <td>Interventions complete</td> <td>8 x crossing improvements 10 x connectivity improvement schemes</td> </tr> </tbody> </table>	Scheme No.	Scheme Name	Outcome Description	Quantitative Outcome	1	Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS	Improvement of Capacity from Margam to Cefn Hirgoed	Installation of a 4.4km 1000mm pipeline and enhance 2 pumping stations	2	Critical Crossings and Connectivity Improvement Schemes	Interventions complete	8 x crossing improvements 10 x connectivity improvement schemes
Scheme No.	Scheme Name	Outcome Description	Quantitative Outcome										
1	Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS	Improvement of Capacity from Margam to Cefn Hirgoed	Installation of a 4.4km 1000mm pipeline and enhance 2 pumping stations										
2	Critical Crossings and Connectivity Improvement Schemes	Interventions complete	8 x crossing improvements 10 x connectivity improvement schemes										

	<b>3</b>	Wye Transfer	Relocate the raw main from the erosion area	Completion of the scheme main relocated, 720m total pipeline length (340m of 1200mm and 380m of 900mm)
<b>Conditions on scheme</b>	No additional conditions identified.			
<b>Assurance</b>	The company will agree appropriate assurance with Ofwat as part of Final Determination.			
<b>Price control deliverable payment rate</b>	<p>The calculation will be made separately for each of the three schemes within the Enhancement Case.</p> <p>If only part of a scheme is delivered, a proportion of the funding will be returned to customers.</p> <p>For example, if 90% of the scheme is delivered, an amount equal to 10% of the value will be returned to customers. In the event of non-delivery of a scheme, the whole value would be returned to customers.</p> <p><i>Table 11 – Summary of Network Resilience Programme Measured Deliverables</i></p>			
	<b>Scheme No.</b>	<b>Scheme Name</b>	<b>Quantitative Outcome</b>	<b>Benefit Proportion Summary at End AMP8</b>
	<b>1</b>	Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS	Installation of a 4.4km 1000mm pipeline	Scheme Delivered (£17M) with 100% of cost. Scheme delivered 90% of cost return 10%
<b>2</b>	Critical Crossings and Connectivity Improvement Schemes	8 x crossing improvements 10 x connectivity improvement schemes	Schemes delivered Crossings (£7M) 8 x crossings = 100% 4 x crossings = 50% 1 x crossings = 12.5% 1 x crossing 87.5% of funding returned etc. Similar approach for the 10 x connectivity improvements (£10M) 5 delivered 50% funding returned to customers etc.	

	<b>3</b>	Wye Transfer	Completion of the scheme main relocated, 720m total pipeline length	Scheme Delivered (£5M) with 100% of cost. Scheme delivered at 90% of cost return 10%
<b>Impact performance in relation to performance commitments</b>	<p>This work will help reduce the consequence of low likelihood events which would materially impact on interruptions to supply.</p> <p>The work will improve resilience's but is not linked to a quantified improvement in the annual interruption performance.</p>			

### 5.1.1 Extent of Protection

The work proposed within this Enhancement Case focuses on mitigating risks to interruptions to supply identified through analysis in AMP7. Each scheme will have a positive impact on increasing resilience. We have not identified wider benefits from the proposed work to other performances commitments.

## 6. Appendices

### Appendix A - Current Risk Position

Table 12 – Project Specific Current Risk Position Build up.

Consequence	Rationale for calculating risk	Risk per year
<b>Increasing the reliability of short- and long term water supply by increasing capacity within Tywi/SEWCUS and see below.</b>		
<b>Over 24 hours Interruption to Supply</b>	Interruptions to supply from Felindre unable to supply water assumed 43,743 properties affected.	£24.852M
<b>Between 12 to 24 Hour Interruption to Supply</b>	Interruptions to supply should the Felindre to Cefn Hirgoed main fail. Assumed 87,485 properties affected.	£8.808M
<b>Annual avoidable costs</b>	Emergency repairs, tankering and customer visits.	£0.03M
<b>Network Connectivity Improvement Schemes</b>		
<b>Over 24 hours Interruption to Supply</b>	Interruptions to supply from insufficient capacity within the distribution network assumed 4,500 properties could be affected.	£10.653M
<b>Annual avoidable costs</b>	Emergency repairs, tankering and customer visits.	£0.75M
<b>Critical Crossings</b>		
<b>Between 6 to 12 Hour Interruption to Supply</b>	84 critical sections have a temporary work plan in place with equipment and spares available to deploy in 12 hours. Each critical section could impact 70,000 properties.	£5.585M
<b>Between 12 to 24 Hour Interruption to Supply</b>	96 critical sections have a temporary work plan in place with equipment and spares available to deploy in 12 hours. Each critical section could impact 70,000 properties.	£12.493M
<b>Over 24-Hour Interruption to Supply</b>	107 critical sections have no plan, material or equipment in place. Each critical section could impact 70,000 properties.	£16.571M
<b>A roads and main commuter roads</b>	Based on 127 critical sections crossing an A Road.	£0.072M
<b>Rail</b>	Based on 28 critical sections crossing a rail line.	£0.188M
<b>Mains relocation due to river erosion (Wye Transfer)</b>		
<b>Annual avoidable costs</b>	Cost of temporary fix which is needed once erosion is apparent	£0.153M

Consequence	Rationale for calculating risk	Risk per year
<b>Loss of production</b>	Reactive repair was required on the wye transfer main it would depend on conditions as to how long a repair would take, estimated at 7 days to complete.	£0.224M
<b>Annual avoidable costs</b>	Catastrophic failure of the main estimated 1 in 20 yrs.	£0.050M
<b>Annual avoidable costs</b>	Repeat CapEx to relocate the main following erosion	£0.208M
<b>Feasibility studies</b>		
<b>Strategic Resilience Schemes - Feasibility Studies</b>		
<b>Between 12 to 24 Hour Interruption to Supply Annual avoidable costs</b>	Interruptions to supply should the pipelines or WTWs fail in East, North or West Wales. Assumed 82,500 properties could be affected.	£11.043M
<b>Annual avoidable costs</b>	Emergency repairs, tankering and customer visits.	£0.038M
<b>Cardiff Strategic Resilience – Feasibility Study</b>		
<b>Between 12 to 24 Hour Interruption to Supply</b>	Number of customers at risk with limited resilience assume 15% of the 151,000 Cardiff properties	£12.127M
<b>Annual avoidable costs</b>	Emergency repairs and tankering	£0.150M
<b>Inspections to Reduce Incidents of Third Parties Compromising Water Quality</b>		
<b>Minor Injury</b>	1 minor injury every 5 years	£191
<b>Between 6 to 12 Hour Interruption to Supply</b>	5000 properties having a 6 to 12 hour duration interruption to supply every 5 years	£0.798M
<b>Customer Contact by Telephone - Unwanted Call</b>	100 customer contacts resulting from water regulations related failures every 5 years	£0.004M

## Appendix B - Amp 8 TotEx Enhancement Costs

The CapEx, OpEx and TotEx costs in Amp 8 for this Enhancement Case can be seen by Scheme or Programme in Table 13 below. These costs contribute to Lines CW3b.118, CW3b.119 and CW3b.120 respectively.

Table 13 – TotEx Costs Associated with this Enhancement Case

Project/Programme	Contribution to Table Line Ref	Year in AMP8 CapEx in £M					Grand Total
		1	2	3	4	5	
<b>Increasing the reliability of short- and long term water supply by increasing transfer capacity within Tywi/SEWCUS</b>	CW3b.118	£4.390M	£4.327M	£4.326M	£4.354M	£4.405M	£21.802M
<b>Network Connectivity Improvement Schemes</b>	CW3b.118	£1.491M	£1.959M	£3.917M	£1.478M	£0.997M	£9.842M
<b>Critical crossings</b>	CW3b.118	£1.209M	£1.533M	£1.532M	£1.542M	£1.040M	£6.856M
<b>Mains relocation caused by river erosion (Wye Transfer)</b>	CW3b.118	£0.483M	£1.904M	£2.141M	£0.239M	£0.000M	£4.767M
<b>Strategic Resilience Schemes -Feasibility Studies</b>	CW3b.118	£1.044M	£1.029M	£1.028M	£0.345M	0.000M	£3.446M
<b>Cardiff Strategic Resilience – Feasibility Study</b>	CW3b.118	£0.447M	£0.441M	£0.441M	£0.148M	0.000M	1.477M
<b>Total CapEx</b>	<b>CW3b.118</b>	<b>£9.064M</b>	<b>£11.193M</b>	<b>£13.385M</b>	<b>£8.106M</b>	<b>£6.442M</b>	<b>£48.190M</b>
<b>Inspections to Reduce Incident of Third Parties Compromising Water Quality</b>	CW3b.119	£1.033M	£1.033M	£1.032M	£1.033M	£1.033M	£5.164M
<b>Increasing the reliability of short- and long term water supply by increasing transfer capacity within Tywi/SEWCUS</b>	CW3b.119	£0.000M	£0.000M	£0.150M	£0.449M	£0.449M	£1.048M
<b>Total OpEx</b>	<b>CW3b.119</b>	<b>£1.033M</b>	<b>£1.033M</b>	<b>£1.182M</b>	<b>£1.482M</b>	<b>£1.482M</b>	<b>£6.211M</b>
<b>Total TotEx</b>	<b>CW3b.120</b>	<b>£10.097 M</b>	<b>£12.226M</b>	<b>£14.567M</b>	<b>£9.588M</b>	<b>£7.924M</b>	<b>£54.402M</b>

**What We Will Deliver within this case** Reduced customer risks from low probability high consequence events on infrastructure assets, this Enhancement Case: This Enhancement Case will deliver three material areas of work;

- 1) 4.4km of 1000mm pipeline connecting 2 redeveloped pumping stations,
- 2) 8 critical pipeline crossing and 10 critical pipeline connection improvements,
- 3) 720m of new pipeline to divert the existing Wye transfer.