

Ref 2.2

PR19 Water Network Plus Business Plan

September 2018

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List of abbreviations

CCW	Consumer Council for Water
CNI	Critical national infrastructure
CML	Customer minutes lost
DMA	District Metering Areas
DOC	Dissolved organic carbon
DOMS	Distribution Operational Management System
DWI	Drinking Water Inspectorate
EU	European Union
GAC	Granular activated carbon
INNS	Invasive non-native species
IoT	Internet of Things
LOWAN	Low-power wide-area network
MoS	Measure of Success
NERC	Natural Environment Research Council
NRV	Non-return valves
NRW	Natural Resources Wales
PAC	Powdered activated carbon
PRV	Pressures reducing valves
RARs	Risk Assessment for Reservoir Safety
SCADA	Supervisory control and data acquisition
SEMD	Security and Emergency Measures Directive
Solar PV	Solar Photovoltaic
THM	Total Trihalomethanes
WFD	Water Framework Directive
WRc	Water Research Centre
WRMP	Water Resource Management Plan
WTW	Water treatment works
WWF	Wales Water Forum
WWTW	Wastewater treatment works

Executive Summary

Introduction and purpose

This document supports our submission for PR19 for Wastewater Networks Plus price control for the next asset management period, 2020-2025 (AMP7). It details our plans to deliver our customer promises in AMP7, and the contribution of our plan towards meeting our Welsh Water 2050 aims.

Our focus within this document is on our water supply services, including water treatment works (WTWs), pumping stations and water supply networks. Water resources is covered separately to reflect Ofwat's requirements for price review separation. However, our business is highly integrated, and therefore many of the programmes we have discussed in this document will provide benefits across other business plans and activity.

Customers outcomes and support

Our mission is “to earn the trust of our customers every day”. As a customer-driven business, our customers' views, preferences and priorities are the foundation of our business plans.

The delivery of clean, safe and reliable drinking water is taken as a given by customers, and we need to continue to do this to maintain their trust. Most of our customers rarely or never experience supply interruptions, however the rapid resolution of problems when they do occur is still seen as a top priority. Responding to droughts is also one of their ‘top of mind’ threats.

Our customers expect us to compare favourably to other companies in the industry with respect to the taste, odour and colour of the water we supply. It is recognised that we do not perform as well as other water companies in this area, and there is support for performance improvements.

Moreover, we recognise that a small number of our customers experience repeatedly unacceptable service levels. Our broader customer base expects us to address these longstanding issues.

Our customers consider current levels of leakage to be unacceptable, and that it undermines their trust and confidence in the industry. They expect that more should be done to reduce leakage, but appreciate that the cost of repairs is a limiting factor.

Welsh Water 2050

In response to the long-term trends that we are facing, globally and locally, we have developed a strategy, Welsh Water 2050. Meaningful consultation with our customers was a key part of developing this strategy. This has helped us clarify, articulate and frame our strategy around the issues that are most important to them.

Welsh Water 2050 sets out the challenges that we expect to face over the next 30 years, and the 18 strategic responses that will be required to address them. Strategic responses relevant to this business plan are:

- **Strategic response 2: “Enough water for all”** - Confronted with an increasing water supply-demand gap due to population growth and climate change, we will review the water supply balance to 2050 in our Water Resources Management Plan. We propose to implement water transfers, demand management measures and leakage reduction programmes to address any deficits
- **Strategic response 3: “Improving the reliability of drinking water supply systems”** – Faced with an increased risk of outages due to agricultural run-off, extreme weather events,

terrorism, and cyber-attacks, we will build more flexibility and integration into our water treatment and supply systems.

- **Strategic response 4: “Protecting our critical water supply assets”** – With increasing risks of disruption and limited customer tolerance of supply outages, we will improve the resilience of critical water assets which have high consequences of failure.
- **Strategic response 5: “Achieving acceptable water quality for all customers”** – Ageing water mains and more extreme weather events increase the risk of supplying water which is discoloured or has a poor taste. This will be addressed through a targeted replacement of iron mains.
- **Strategic response 6: “Towards a lead-free Wales”** – We have the opportunity to help improve public health and propose a targeted replacement of lead communication and supply pipes in Wales and the areas of England that we serve.
- **Strategic response 7: “Working with customers and communities”** - We will work with customers and communities to co-create solutions, share knowledge, and support initiatives which reduce water use, prevent sewer abuse, and provide wider benefits for communities and the environment.
- **Strategic response 8: “Ensuring affordability of services delivered to our customers”** - We will ensure that we continue to provide the best service in increasingly innovative and efficient ways and pass these savings on to our customers to ensure that our services remain affordable for all.
- **Strategic response 9: “Supporting customers in vulnerable circumstances”** - We will give appropriate and effective support to customers in vulnerable circumstances.
- **Strategic response 10: “Addressing our ‘worst-served’ customers”** – We will address the longstanding service complaints of ‘worst-served customers’ to ensure that everyone receives an acceptable level of service.
- **Strategic response 13: “Smart water system management”** – With the opportunity to capitalise on technological advances, we will improve the service performance and resilience of our assets through remote sensing, data analysis and automation - solving problems before they impact on our business, our customers, or the environment.
- **Strategic response 14: “Supporting ecosystems and biodiversity”** – In the face of habitat loss and more extreme weather, we will look for ways to help nature, enhance biodiversity and promote ecosystem resilience while we carry out our water and sewerage activities.
- **Strategic response 18: “Promoting a circular economy and combatting climate change”** – Faced with a changing climate and increased energy costs, we will aim to become an energy neutral business, whilst maximising resource reuse and contributing to a sustainable wider economy in Wales and parts of England which we serve.

We intend to start delivering on these long-term commitments in AMP7. This plan has been developed to demonstrate our alignment with, and progress towards, this long-term strategy.

AMP6 progress

We have made good progress towards meeting the strategic objectives for the current asset management period 2015-20 (AMP6) that we outlined in our PR14 business plan. We have recognised that a shift in our approach was required to build resilience into our organisation in the face of changes to the climate, demographics, politics and technology, which will all provide opportunities and present significant challenges to us going forward. We have:


- Started to implement catchment scale measures for managing water quality;
- Built additional treatment resilience into many of our works;
- Identified critical parts of our distribution network;
- Trialled innovative new leakage reduction techniques;
- Begun a new lead supply pipe replacement programme;
- Replaced the majority of our SCADA estate; and
- Built considerable new renewable energy generation capacity.



We have experienced issues in complying with disinfection turbidity regulations, however by the end of AMP6 all our WTWs will have emergency 'run to waste' facilities installed. This will allow us to divert flows from our WTWs into the sewage network, and supply our customers from our storage facilities for short periods as the ultimate defence against water quality failures.



AMP7 drivers and investment



Our AMP7 plans build on our progress in AMP6 and will move us towards the outcomes outlined in our Welsh Water 2050 strategy. Our priority activities will include expanding our catchment management programme, reducing leakage on the supply and domestic side (Project Cartref), continuing with Zonal Studies to improve acceptability of water, investing in a major new WTW in the Merthyr Tydfil area, increasing storage across our network, replacing lead piping and starting to build a 'smart' water business. Our planned investments for AMP7, aligned with our long-term strategy Welsh Water 2050 and our Measures of Success for performance improvements, are shown in Table 1.




Table 1: Summary of investments in AMP7



Strategic Response		Investment Cases	Operational Strategies	Cross-cutting strategic responses	Measures of Success	Narrative	2017/2018 performance	AMP6 target	AMP7 target	2050 target	AMP7 Optimised Totex
2. Enough water for all		Leakage Cost Adjustment Claim - Cwm Taf Water Supply	Water Demand and Leakage Strategy PR19 Annex A Merthyr treatment works strategy	SR 6 Towards a lead-free Wales SR13 Smart water system management	En4: Leakage	Leakage in mega-litres per day (Ml/d). Three-year average	173	169	143	75	£163.17m
					En5: Per capita consumption	Average daily water use, litres, by each person in a residential property	145	145	138	100	

Strategic Response		Investment Cases	Operational Strategies	Cross-cutting strategic responses	Measures of Success	Narrative	2017/2018 performance	AMP6 target	AMP7 target	2050 target	AMP7 Optimised Totex
3. Improving the reliability of drinking water supply systems		Cost Adjustment Claim - Cwm Taf Water Supply		SR4 Critical Water Assets, SR5 Acceptable Water Quality for all SR10 Worst Served Customers SR13 Smart water system management	Wt2: Water supply interruptions	Supply interruptions greater than three hours (expressed in minutes per property)	43.3	12	8	2	£125.85m
		Customer Minutes Lost Service	Customer Minutes Lost Strategy								
		Raw Water Distribution Maintenance	Merthyr treatment works strategy		Wt6: Tap Water Quality Event Risk Index	DWI's Event Risk Index	-	-	UQ (Industry Upper Quartile)	UQ (Industry Upper Quartile)	
4. Protecting our critical water supply assets					Ft6: Water + network above ground asset resilience	Percentage of critical assets that are resilient against a set of criteria	-	84.0%	86.5%	100%	£17.27m
		Water Network + Growth	Resilience and Security Business Plan	SR2 Enough water for all SR3 Reliability of supply systems SR8 Affordability SR13 Smart water system management							
		Water Network Maintenance	Water Treatment Works Operational Strategy		Ft7: Water + network below ground asset resilience	Percentage of critical assets that are resilient against a set of criteria	-	47.0%	56.2%	100%	
		Water Treatment Maintenance	Resilience Scorecards								
		Cross-Service Maintenance			Wt4: Water mains bursts	The number of bursts of water mains	4,181	3,700	3,600	3,100	

Strategic Response		Investment Cases	Operational Strategies	Cross-cutting strategic responses	Measures of Success	Narrative	2017/2018 performance	AMP6 target	AMP7 target	2050 target	AMP7 Optimised Totex
5. Achieving acceptable water quality for all customers		Special Factor - Acceptability of Water Quality	Iron and Acceptability of Water Strategy	SR2 Enough water for all SR3 Reliability of supply systems, SR13 Smart water system management	Wt1: Tap water quality compliance risk index	Tap Water Quality Compliance Risk Index	The DWI's Compliance Risk Index	-	UQ (Industry Upper Quartile)	UQ (Industry Upper Quartile)	£155.36m
					Wt3: Acceptability of drinking water	The number of contacts received from customers per 1,000 population served	2.79	2.4	2	2	
6. Towards a lead-free Wales		Water Quality	Welsh Water Lead Strategy	SR2 Enough water for all	Wt8: Lead supply pipes replaced	Number of lead supply pipes replaced (cumulative over an AMP)	-	1,800	7,000	50,000	£19.86m

Strategic Response		Investment Cases	Operational Strategies	Cross-cutting strategic responses	Measures of Success	Narrative	2017/2018 performance	AMP6 target	AMP7 target	2050 target	AMP7 Optimised Totex
7: Working with customers and communities		Across all investment cases	Across all strategies	SR2 Enough water for all	Ft11: Visitors to recreational facilities	The number of visitors to our educational and recreational sites across Wales.	450,000	570,000	830,000	1,000,000	No dedicated spend in this price control.
				SR5 Acceptable water quality for all							
				SR6 Lead free Wales							
				SR8 Affordability for customers							
				SR9 Vulnerable customers	Ft10: Community education	The total number of children and adults who have participated in educational activities.	62,000	67,000	75,000	85,000	
				SR10 Worst Served Customers							
				SR13 Smart water business							
8: Ensuring affordability of services delivered to our customers		Across all investment cases	Across all strategies	SR2 Enough water for all	BI1: Change in average household bill	The average percentage annual increase in the average household bill over the 5-year period	<RPI	<RPI	<CPIH	=CPIH	No dedicated spend in this price control.
				SR3 Reliability of supply systems							
				SR4 Critical water assets							
				SR5 Acceptable water quality for all							
				SR6 Lead free Wales							
				SR7 Working with customers and communities							
				SR8 Affordability for customers							
				SR9 Vulnerable customers							
				SR10 Worst Served Customers							
				SR13 Smart water business							

Strategic Response		Investment Cases	Operational Strategies	Cross-cutting strategic responses	Measures of Success	Narrative	2017/2018 performance	AMP6 target	AMP7 target	2050 target	AMP7 Optimised Totex
9: Supporting customers in vulnerable circumstances		Customer Minutes Lost Service	Vulnerable customers strategy	SR2 Enough water for all SR3 Reliability of supply systems SR4 Critical water assets SR5 Acceptable water quality for all SR8 Affordability for customers	Sv5: Vulnerable customers on priority services register	The number of customers who are registered on our Priority Services Register	26,000	52,000	100,000	127,000	No dedicated spend in this price control.
10: Addressing our 'worst served' customers		Customer Minutes Lost Service	Worst served customers strategy	SR3 Reliability of supply systems	Rt6: Worst served customer for water service	The number of customers that have had repeat incidents of low pressure or interruptions to water supply	-	1,131	871	0	£11.52m
13: Smart water business		Water Network Maintenance Cross-Service Maintenance	Welsh Water Smart Strategy	SR2 Enough water for all SR3 Reliability of supply systems SR5 Acceptable water quality for all SR8 Affordability	Wt4: Water mains bursts Wt5: Water process unplanned outages	The number of bursts of water mains Total unplanned outage as a proportion of total production capacity (%).	4,181 -	3,700 -	3,600 0% change from 2019-2020	3,100 0% change from 2019-2020	£24.99m

Strategic Response		Investment Cases	Operational Strategies	Cross-cutting strategic responses	Measures of Success	Narrative	2017/2018 performance	AMP6 target	AMP7 target	2050 target	AMP7 Optimised Totex
14: Supporting ecosystems and biodiversity		Across all investment cases	Making time for nature, Welsh Water	SR7 Working with customers and communities	Wt7: Water catchments improved	The number of our WTWs with catchments designated as requiring Safeguard Zones	1	23	18	5	No dedicated spend in this price control.
18: Playing our part in the supply chain, local economy and circular economy.		Energy Investment Case	Welsh Water Energy plan for AMP7	SR3 Reliability of supply systems SR8 Affordability	Ft3: Energy self-sufficiency	Electricity generated, and gas injected to grid as a percentage of all electricity and gas consumed (gas expressed as an electricity equivalent)	19%	26%	35%	100%	£8.85m
All Strategic Responses		Botex which contributes to the delivery of Strategic Responses Water Network + Post Efficiency			Contributes to the delivery of Strategic Responses	The Botex provides base maintenance and operation of the Network + assets to maintenance stable performance to underpin the enhancement project improvements					£798.88m

1. Introduction

1.1. Wider context

Our customers expect us to deliver clean, safe and reliable drinking water, therefore doing this is essential for maintaining their trust.

To do this we capture and store surface water from our catchment areas in reservoirs, treat this to potable standards in our water treatment works (WTWs), store the treated water in service reservoirs, before distributing this through our networks to our customers. This process must be resilient and sustainable if we are to continue meeting our customer expectations.

Our focus within this document is on our water supply services, including WTWs, pumping stations and water supply networks. Our management of raw water resources is treated within a separate price control. It should however be noted that our business is highly integrated, and the management of raw water is critical to the delivery of safe reliable drinking water. Therefore, many of the programmes we have discussed in this document will provide benefits across other business plans and our strategic responses.

1.2. Purpose and scope of document

The purpose of this document is to support our submission for PR19 with respect to wholesale water network plus controls for the next asset management period from 1 April 2020 to 31 March 2025 (AMP7). This document outlines the plans for our water supply network and how these plans will contribute to our long-term strategy, Welsh Water 2050, and deliver improvements in service for our customers.

Our plan integrates the pioneering long-term resilience thinking that was developed as part of our long-term strategy, Welsh Water 2050, and forms a tangible part of this journey. To continue meeting our Customer Promises in the face of future challenges, we have recognised the need to innovate beyond our traditional service delivery models and collaborate wider than ever before. This will help us keep bills low, unlock partnership funding, reduce our environmental impacts, and support our communities.

This plan will help us to meet our six customer promises:

- Clean, safe drinking water for all;
- Safeguarding our environment for future generations;
- A personal service that's right for you;
- Fair bills for everyone;
- Putting things right if they go wrong; and
- A better future for all our communities.

1.3. Relationship to wider PR19 methodology business plan

Our Water Network Plus Plan is part of a larger plan, our Welsh Water Business Plan. This contains greater detail on our customer and stakeholder engagement, how we propose delivering outcomes in AMP7 and beyond, the levels of service we will provide, financial implications and the impact on our customers' bills.

Our plan supports and provides more detail for the water networks plus sections of the Business Plan. It is produced in alignment with Ofwat's final methodology for the PR19 price review, including the customer, stakeholder, assurance and long-term planning approaches. Our management of raw water resources is treated within a separate price control. However, managing raw water is critical to the delivery of safe reliable drinking water, and therefore our Water Resources Business Plan is referenced in this document.

1.4. Our business



Figure 1: Llyn Conwy WTW. © Welsh Water.

Welsh Water is the sixth largest of the ten regulated water and sewerage companies in England and Wales in terms of customers, but the third largest by operational area. By the end of AMP6 we will operate 62 WTWs and treat on average around 830 million litres of water every day, which are distributed through a 27,400km network of water mains. Our network includes around 700 water pumping stations and 570 service reservoirs. Our biggest responsibility is to provide a safe and reliable drinking water supply to 3.1 million people in Wales and parts of England and, crucially, look after the assets that supply our customers for future generations.

1.5. Our customers

We are a company without shareholders and run solely for the benefit of our customers. We therefore have a unique position in responding to their priorities.

As part of our plan to deliver great customer service in the next AMP, we have collated the findings of our customer engagement activities with more than 40,000 customers over the past two years. These activities included:

- 'Have Your Say' large summer consultation (2017);
- 'Have Your Say' focused consultation (2017);
- Welsh Water 2050 response to long-term strategy (2017); and

- Welsh Water customers in vulnerable circumstances survey (2018).

The views of our customers from these consultations, in alignment with the national and international context, has shaped our long-term strategy, Welsh Water 2050. It has also guided our approach to AMP7, and how we have considered their specific needs, wants and desires – including those customers that are in vulnerable circumstances. We have worked with our customers to understand how we should prioritise our investments, given the future trends that will present significant challenges for our organisation going forward. Our customers have highlighted that leakage reduction is a top priority for them and that we should address issues of acceptability of water and long-standing issues for our ‘worst served’ customers. We have also shown how we want to keep bills affordable in the long term by investing in resilience and using innovative approaches in our capital investments and operations. Through these exercises, we have built a collaborative programme of prioritised investment.

1.6. Welsh Water 2050: Purpose and content

Our PR19 Business Plan is set firmly in the context of our long-term purpose which is “to become a truly world class, resilient and sustainable water service for the benefit of future generations.”

Following a major consultation exercise with customers and stakeholders we published our long-term strategy, Welsh Water 2050, in 2018. It sets out the challenges that we expect to face over the next 30 years, and the 18 strategic responses that will be required to address them. It also identified and scored areas of resilience strength and areas which require enhancement for almost all aspects of our business.

We acknowledge that it is vital for us to identify and address emerging challenges, and harness new opportunities, to ensure we don’t store up problems for future generations. We have identified key future challenges that are likely to have a significant impact on our service provision, particularly on our ability to deliver our customer promises.

Our strategic responses set out how we will mitigate or harness these future challenges. They include detail on how we will use research and innovation, the organisations that we will need to work with and how our activities will align with our customer promises and relevant legislation, including the Well-being of Future Generations (Wales) Act 2015.

1.7. Welsh Water 2050: Future challenges

Significant future challenges and opportunities that are likely to impact on our clean water business are:

Key challenges for our water supply services in the AMP7 are:



Change in customer expectations: Our customers expect us to take a more proactive role in addressing problems such as domestic leakage. They also desire a more personalised service and are less tolerant of service outages.



Protecting essential infrastructure: Many of our assets are ageing and beyond their original design life, our supply chain is limited, and we are facing additional physical and technological threats including terrorism and cyber-crime. However, technological advances could lead to significant efficiencies in the planning, delivery and operation of new assets.



Demographic change: Population growth and seasonal demand in the summer will lead to increased water demand in certain areas, and an ageing population may lead to more customers in vulnerable circumstances in the future.



Changes to the structure of the economy: Industrial decline is leading to sub-optimal flows in parts of our operating area, leading to reduced acceptability of water for our customers. However, the growth of the digital, knowledge-based economy will create opportunities to provide services more efficiently.



Policy and regulatory change: We are likely to experience tightening water quality standards going forward and possible abstraction restrictions, whilst improved regulatory methods and innovative policy developments could lead to more efficient delivery of services to our customers. However, there will be uncertainty around some policy areas as the UK leaves the European Union and during potential future devolution.



Climate change: Drier summers, wetter winters and more frequent storms will put pressure on our ability to provide continuous safe water to our customers by putting additional pressure on our assets.



Environmental change: Our catchments are experiencing deteriorating raw water quality due to land use change and environmental pollution, and without interventions this will increase the cost and complexity of water.



Protecting public health: We are facing emerging contaminants and an increased awareness of the health implications of lead in drinking water.

1.8. Welsh Water 2050: Strategic responses

Our strategic responses include a long-term direction of travel for how we will mitigate the challenges and harness the opportunities, which will be continually reviewed and revised over time. Relevant strategic responses for our water supply business include:



Strategic response 2: Enough water for all – Confronted with an increasing water supply-demand gap due to population growth and drier summers, we will implement water transfers, demand management measures and leakage reduction programmes to address any deficits.



Strategic response 3: Improving the reliability of drinking water supply systems – Faced with an increased risk of outages due to agricultural run-off, extreme weather events, terrorism, and cyber-attacks, we will build more flexibility and integration into our water treatment and supply systems.



Strategic response 4: Protecting our critical water supply assets – With increasing risks of disruption and limited customer tolerance of supply outages, we will improve the resilience of critical water assets which have high consequences of failure.



Strategic response 5: Achieving acceptable water quality for all customers – Ageing water mains and more extreme weather events increase the risk of supplying water which is discoloured or has a poor taste. This will be addressed through targeted replacement of iron mains.



Strategic response 6: Towards a lead-free Wales – We can help improve public health and propose a targeted replacement programme for lead communication and supply pipes.



Strategic response 7: Working with customers and communities - We will work with customers and communities to co-create solutions, share knowledge, and support initiatives which reduce water use, prevent sewer abuse, and provide wider benefits for communities and the environment.



Strategic response 8: Ensuring affordability of services delivered to our customers - We will ensure that we continue to provide the best service in increasingly innovative and efficient ways and pass these savings on to our customers to ensure that our services remain affordable for all.



Strategic response 9: Supporting customers in vulnerable circumstances - We will give appropriate and effective support to customers in vulnerable circumstances.



Strategic response 10: Addressing our 'worst-served' customers – We will address the longstanding service complaints of 'worst-served customers' to ensure that everyone receives an acceptable level of service.



Strategic response 13: Smart water system management – With the opportunity to capitalise on technological advances, we will improve the service performance and resilience of our assets through remote sensing, data analysis and automation; solving problems before they impact on our business, our customers, or the environment.



Strategic response 14: Supporting ecosystems and biodiversity – In the face of habitat loss and more extreme weather, we will look for ways to help nature, enhance biodiversity and promote ecosystem resilience while we carry out our water and sewerage activities.



Strategic response 18: Promoting a circular economy and combatting climate change – Faced with a changing climate and increased energy costs, we will aim to become an energy neutral business, whilst maximising resource reuse and contributing to a sustainable wider economy in Wales and parts of England which we serve.

1.9. Structure of the Water Network Plus Business Plan and supporting documentation

The Water Network Business Plan is structured by Strategic Response in alignment with our long-term strategy, Welsh Water 2050. For each strategic response, we set out:

- Our customers' priorities for AMP7 as reflected in the results of our customer engagement activities;
- Our approach to delivering our customers' priorities in the face of future challenges;
- Our progress during the current asset management period 2015-2020 (AMP6);
- Our plans for AMP7 and how these plans will build-on our work in AMP6 and contribute to our long-term strategy, Welsh Water 2050; and
- Our longer-term plans for the next asset management periods 2020-2025 (AMP8) and beyond.

Where a strategic response covers many price controls, we have discussed the information relevant to this business plan in this document.

This business plan is supported by additional submission documents. These include:

Document title	Reference	Description
Past Performance Report	5.4	Description of our AMP6 performance against PR14 Measures of Success.
PR19 Performance Commitments	5.2	Description of how our Measures of Success and commitments have been developed
PR19 Water Resources Business Plan	2.1	Description of our water resources price control plans.
Welsh Water 2050	1.4	Our long-term strategy, outlining future trends for our business, and how we will harness the opportunities and mitigate the challenges we will face up to 2050.

Investment cases	
Document title	Reference
Water Treatment Maintenance	5.8D
Cwm Taf Water Supply Strategy	5.8E
Water quality	5.8F
Water Network Maintenance	5.8G
Customer minutes lost service improvement	5.8H
Acceptability of water service improvement	5.8I
Leakage reduction	5.8J
Water Network Plus Growth	5.8K

A list of additional documents available on request is provided as Annex A.

2. Strategic Response 2: Enough water for all



Figure 2 : One of our many customers.

2.1. Drivers

Our long-term strategy, Welsh Water 2050, identified future challenges that will impact upon the level of water resources required to meet our customers' needs including:

- Population growth, especially in South Wales;
- Growth in tourism and seasonal summer demand;
- Tightening environmental regulations which can restrict our ability to abstract;
- Land use change which can affect the quality of the raw water we abstract;
- Changes in customer behaviour including when and how they use water;
- Ageing infrastructure, which results in more leakage; and
- Extreme weather events due to climate change which will affect water resource availability and patterns of demand.

Whilst many of our proposals for responding to these challenges are contained within our Water Resources Price Control plan, there are some elements included in this price control. These include how we will reduce water supply demand. We will focus in two areas: we are using new approaches to actively identify and reduce leakage, and we will empower our customers to manage their demand.

2.2. Customer and stakeholder priorities

Our customers have made clear that a reliable source of water is of great importance to them, and that we should be able to sustain water supply to customers in all but the most extreme of droughts. They view old pipes, a growing population and drought among the top threats to water supply¹.

Our customers often give us an emotional response when we talk about leaks – they feel it is wasteful². Most of our customers want us to introduce initiatives to avoid wasted water and reduce leakage, including meter telemetry and water efficiency products. They support incentives for rainwater harvesting and are keen for us to educate and provide advice on services to save water³

The Consumer Council for Water (CCW) has highlighted that it would like to see all water companies focus on demand management that aims to influence lifestyle and behaviours.

2.3. Our approach

We are actively engaged in demand-side and supply-side measures to ensure there will be enough water for all in the long term.

We are working with our customers to meet our ambitious long-term demand reduction targets. We are proactively identifying domestic-level leakage and are offering free repairs and water efficiency audits to help our customers reduce the amount of water they use. Moreover, our Smart Meter trials and provision of free water efficiency devices are contributing towards our understanding of how behavioural change will contribute to reduced demand.

Where we predict a long-term supply-demand deficit, we are planning to respond with the lowest whole life cost solution, increasing our raw water abstraction volumes or implementing water transfer schemes between our water resource zones, as described in our Water Resources Business Plan.

Leakage reduction

In AMP6, we identified that domestic-side leakage is higher than we originally anticipated, and that the traditional ‘find and fix’ approach to leakage is not going to be sufficient to drive the leakage reductions that we need over the long-term.

We are developing a more innovative model for leakage reduction, based on active customer participation, that proactively identifies leaks, focuses beyond the customer boundary and enables us to carry out repairs or replacements where required. Our investigations in AMP6 have shown that around 5% all properties in Wales have some form of continuous water use, a significant proportion of which is likely to be leakage. This is far higher than previously thought and therefore has challenged us to rethink our historic leakage practices.



Innovation: Customer-side leakage detection

During AMP6 we have been trialling the use of new ‘stop-watch’ leakage detection devices on individual supply pipes to detect very low flows that might be indicative of domestic leakage, that is, dripping taps and toilet cisterns, within individual properties.

The devices, developed by Invenio Systems, use non-acoustic methods to detect flow rates. They are battery powered, and can communicate wirelessly to log data. They do not depend on an existing meter so work equally well for non-metered properties.

They have played a major role in providing evidence of ‘customer-side’ leakage which has informed the development of our AMP7 ‘Project Cartref’ approach to leakage reduction.

In AMP6, as part of our Leakage Transformation Programme we created a new team, incorporating areas responsible for leakage strategy, leakage detection, pressure management and water efficiency. It allows us to focus on the strategic planning, leakage targeting and site operations of leakage reduction as well as taking the impact of upstream pressure management on downstream leakage into account.

We have converted to Ofwat's new leakage reporting methodology, which will increase our reported leakage by 17 – 26 Ml/day.

Holistic approach to reactive and planned network maintenance

To improve the efficiency of our approach, we are taking a more holistic approach to reactive and planned network maintenance. We have combined our reactive and planned network maintenance programmes, including leakage reduction, burst main detection, lead pipe replacement and Zonal Studies.

These maintenance programmes will be undertaken by our new Water Network Alliance, which will:

- Increase productivity and performance through collaboration and incentivisation;
- Minimise the impact of our operations on communities;
- Work more effectively with third parties; and
- De-risk our delivery programme.

Water use efficiency

We are actively engaging with technological and cultural-change solutions to help our customers reduce long-term per-capita demand. This is strongly in line with the views of our customers and stakeholders, who feel we should be doing more to influence demand. We have offered free efficiency devices and extensive advice on water efficiency through our 'save water this summer' campaign.

2.4. AMP6 performance

We have met challenging AMP6 targets and delivered the biggest leakage reduction in the industry over the last five years. We have also met our PR14 target for per capita consumption and our new measure of 'risk of severe restrictions in the event of a drought', in the face of some of the most challenging weather conditions seen in over 20 years.

Leakage reduction


	PR14 Measure of Success	Narrative	2014/15 performance	2017/18 performance	2020 target (current forecast)
	F2: Leakage	Leakage measured in megalitres/day for the year.	180	173	169

Table 2 : PR14 Measures of Success

We expect to meet or exceed our leakage reduction target of 169 megalitres/day set out in our PR14 Business Plan by the end of AMP6.

We have significantly improved our performance and efficiency in detecting and resolving leakage. This has been achieved through the use of pressure monitoring and analytics to identify failing assets and leaking assets; optimisation and reducing water pressure where necessary to reduce the impact of leaks and risk of bursts and our pipe replacement programme.

To address customer side leakage, we have trialled our Project Cartref approach (see page 26) in a number of areas. Within each area, leakage detection devices were installed, and we followed up directly with those customers likely to be experiencing in-home leakage. Customer feedback was positive, stating that this approach is of great benefit. To gain greater efficiencies, we are integrating the trials with other initiatives, for example, replacing lead pipes when they are found.

To become compliant with Water UK's approach to managing leakage consistently throughout the industry, we are also upgrading our leakage management software to WaterNet. It is at the forefront of innovation and will allow us to use the latest improvements in data science to understand and prioritise areas of higher leakage for detection and repair activities. We have also recently trialled drone surveys and satellite imagery monitoring for leakage identification. Where these are shown to add value, we will continue to expand these programmes into AMP7.



Innovation: Leakage reporting and identification

During AMP6 we invested in trialling a wide range of innovative leakage detection technologies. Leakage is an issue at all levels of the distribution system, from our raw water supply pipes to our customer supply pipes. This means that a toolbox of different technologies will be required to meet different challenges.

Across our distribution network, we are moving to a new leakage reporting system, 'WaterNet'. This will increase our rate of reporting from 10 second averages over 15-minute periods to 64 times per second, dramatically improving the granularity of our data capture. This will allow us to more rapidly and accurately respond to leakage events.

We have successfully trialled both aeroplane based aerial photography and thermal imaging (APEM) as well as drone-based systems (Team UAV). The drone-based systems have successfully identified existing known leaks during our trials. We have also signed up to a proof of concept with satellite imagery company SUEZ for the detection of underlying leakage.

In our distribution network we have explored pipe technology systems such as smart pressure sensors and listening monitors such as the 'Permnet+' to provide us with acoustic sensing of leakage events.

In addition to identifying new technologies to help us identify leakage, we are also looking at ways to reduce the costs and disruption of leakage repairs for our customers. We have trialled AquaPea for small leakage repairs, which is a non-invasive technology for repairing customer supply pipes. It is far quicker than conventional methods and eliminates the requirement to use regulatory enforcement when a customer cannot repair the leak themselves.

We have also been involved in a range of industry-wide projects through UKWIR and the Water Research Centre (WRc), including assessments of fast logging, metering studies, and methods of estimating unmeasured household consumption. We will continue to play an active role in such projects and look to apply findings where performance can be improved in a cost-effective manner.

Water use efficiency


Through the EU funded 'WISDOM' project, we have installed 250 digital smart meters in the Grangetown area of Cardiff. We are in the process of assessing the value of this initiative for promoting water efficiency and are extending the trial to all household customers in the Tywyn Aberdyfi zone to understand the value in a more rural location⁴.



Innovation and collaboration: Smart meter trials

Our smart meter trials project uses a community-centred and collaborative approach to reducing wastage and gaining an understanding of domestic water use. In collaboration with the residents of Grangetown, Cardiff, we installed 250 digital smart meters in households. The meters continuously measure water usage and send readings to the customers, which they can view online or with an app on their phone. We also have visibility of the data, which allows us to rapidly detect leaks or bursts at the property, as well as gain a better understanding of demand patterns. This initiative reduces waste as well as improving the efficiency of our interventions. Furthermore, the data is being used to better understand demand across the entire area, enabling us to more efficiently manage supply. This, in addition to reducing water loss through leaks, will decrease overall water use and reduce the strain on our water sources and the environment.

2.5. AMP7 plan



PR19 Measures of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
En4 Leakage	Leakage in mega-litres per day (ML/d). Three-year average.	173	169	143
En5 Per capita consumption	Average water use per person in a residential property (litres per head per day). Three-year average.	145	145	138
Ft1 Risk of severe restrictions in a drought	Percentage of the population the company serves, that would experience severe restrictions in a 1-in-200 year drought.	4%	-	0%

Table 3 : PR19 Measures of Success

The table above shows our Measures of Success related to ‘Enough Water for All’ for PR19. Our success in reducing leakage will be directly monitored by Measure of Success En4. Reducing leakage will also allow us to reduce the risk of severe demand restrictions during a drought, monitored by Ft1. Our success in improving water efficiency and reducing demand will be monitored by En5.

Leakage reduction and demand management

Our target is to reduce leakage by 15% during AMP7 as well as reducing demand. As described in our Leakage Reduction investment case (Ref 5.8J), our three-pronged strategy will involve tackling upstream losses on trunk mains, reducing losses on the distribution system, and a new focus on customer side losses (both from external underground supply pipes, and internal plumbing) - see ‘Project Cartref’ below.

We will:

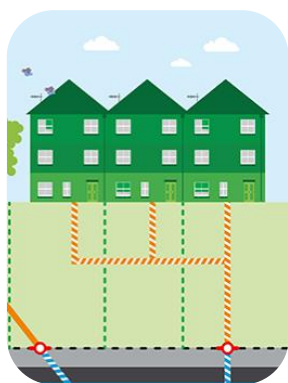
- Begin to introduce permanent acoustic monitoring on our trunk mains and service reservoirs, giving us the ability to continually monitor activity on our largest assets and respond quickly and effectively to resolve any leaks.
- Build on our work using drone and satellite imagery to identify burst mains, with an aim of responding to and repairing high volumetric leaks within five days.
- Continue to deploy our ‘WaterNet’ leakage reporting tool, as described above, to respond to leakage events more quickly and accurately.
- Use automated and predictive systems to monitor pressure and manage leakage.
- Continue to develop an improved economic model for leakage that encompasses a wider range of economic solutions through the development of improved optimisation tools (SALT+).
- Embed our ‘Project Cartref’ approach (see below) to manage customer side leakage and deliver water efficiency audits to over 30,000 properties (a 600% increase compared with AMP6), alongside identification of properties supplied by lead pipework. We will also commit to undertake free leak repairs or whole pipework replacements to help manage leakage and reduce per capita consumption further.

- Continue to deploy digital smart meters in our deficit or marginal water resource zones in AMP7, and continue to collaborate with the Welsh Government and CCWater on the results of our metering research and any potential implications for our future metering policy.⁴

Innovation: Project Cartref - customer-side leakage reduction

Project Cartref (meaning ‘home’ in Welsh) is our customer-side leakage reduction strategy for AMP7. It responds to the innovation, trials, and research we have conducted during AMP6 to better understand losses on the part of the network that is owned and controlled by customers.

Utilising new technology that can detect very low flows even in unmetered properties, we have established that the volume of water ‘lost’ through in-home leakage, such as through dripping taps and faulty toilet cisterns, is much higher than previously thought. This is both a challenge and an opportunity. If we can work with customers to tackle these ‘plumbing losses’, then we can reduce water usage and overall leakage, at a lower cost than seeking further leakage reductions from our mains and distribution networks, where we face diminishing returns.



We have piloted Project Cartref during AMP6 with trials in 20 areas. When a home has been identified as being suspected of having significant plumbing losses, a dedicated trained plumber follows up with the customer and offers to carry out a domestic water efficiency audit to understand the source of leakage and provide other water efficiency advice. We then offer repairs and water efficiency devices at our cost. The trials have been successful, in that they have been welcomed by customers and have reduced leakage and consumption in those areas. They have also provided useful learnings on how to make the approach successful when rolled out at scale.

In conjunction with Project Cartref we will continue with our policy of repairing leaking or damaged supply pipes for free and replacing lead supply pipes when they are found.

Project Cartref means providing a different kind of service to customers and will rely on our customers to trust us to work in their homes for mutual benefit. We believe that our high trust scores and our ‘not for shareholder’ model will help us to do so successfully. Project Cartref marks an important innovation in our approach to leakage; one that is based on active customer participation and behavioural change. Our existing ‘find and fix’ and ‘upstream’ leakage detection and prevention activities will also need to continue in order to deliver the significant overall leakage reduction target to which we are committing in AMP7.

We will continue to leverage the benefits of working as an integrated Water Network Alliance, which will be fully operational by the beginning of AMP7, delivering us efficiencies of £10 million/year. This will include combining our leakage delivery partners into a single contract for the whole of our operating area. The Alliance will also integrate a new ‘pain and gain’ commercial model to drive improved performance and encourage risk sharing.

2.6. Long-term planning: AMP8 and beyond


	Measures of Success	Narrative	2025 target	2030 target	2050 target
	En4 Leakage	Leakage in mega-litres per day (Ml/d). Three-	143	128	75
	En5 Per capita consumption	Average water use by each person in a residential property (litres per head per	138	139	100
	Ft1 Risk of severe restrictions in a drought	Percentage of the population the company serves, that would experience severe restrictions in a 1-in-200 year drought.	0%	0%	0%

Table 4: Long-term Measures of Success

Looking forward, through an increased focus on customer-side leakage in AMP7, we are planning to continue working towards our target of no greater than 10% overall leakage by 2050. We will continue to develop and trial new leakage detection and repair techniques as they become available, as well as continually looking to harness the improvements in data science to predict leaks before they occur.

We have a long-term target of reducing potable water demand to 100 litres/capita/day. This is likely to require additional technological development (such as low flush toilets and smart showers) and a generational behavioural change programme around water use amongst our customers.

3. Strategic Response 3: Improving the reliability of drinking water supply systems



Figure 3 : Dolbenmaen treatment works, Gwynydd.

3.1. Drivers

Deteriorating raw water quality, population growth, ageing infrastructure, and climate change are all increasing stresses on our water supply assets. Given these challenges, it will be increasingly important for us to be able to respond quickly when things go wrong, as we understand that any loss of supply has a significant impact on our customers, both domestic and business. We currently don't have an extensive grid system for our potable water supply and much of our network is built around the model of single source, feeding a single treatment works which supplies single trunk mains to a distribution system. Failure of any part of this system can lead to supply interruptions for our customers and is not always resilient to shocks and stresses.

3.2. Customer and stakeholder priorities

Customers tell us that a continued supply is our core business function⁵, but that the severity of supply disruption depends on its length. They typically consider anything up to six hours as inconvenient, but a period longer than this would be considered to have a much higher impact⁶. Our customers also believe that special provisions should be made for vulnerable groups and that on-going communications around disruption events is critical, especially for businesses¹.

CCWater has noted that this strategic response aligns with their priorities.

3.3. Our approach

In line with our Customer Minutes Lost Strategy and Water Treatment Strategy, we are building flexibility and resilience into our water treatment and supply systems to enable us to respond quickly and reduce the impact on our customers when we experience outages or water quality failures. These include:

- Increasing the operational robustness of our WTW through run-to-waste facilities and our maintenance programme;
- Providing resilience to our water supply systems through a shift from point-to-point through grid-based systems;
- Building strategic storage in our network;
- Increased deployment of predictive analytics and emergency response equipment; and
- Rationalising and consolidating our WTWs.

Robust water treatment works

We use our bacti action audits for identifying potential bacteriological risks at our WTWs and the operational or capital interventions required to mitigate these, for example, an improved process of tank inspections and inter-stage and wash water tank cleaning at our WTWs. Where it is effective and provides long-term value to our customers, we carry out process improvements to our existing WTWs, and the installation if run-to-waste

Our ageing WTWs can have difficulty in providing a good service in the face of deteriorating raw water quality, have limited space for additional treatment capacity and have little resilience to shocks in water quality and droughts. We recognise that long-term resilience can sometimes be achieved more cost-effectively through the rationalisation and construction of new WTWs that are more resilient to power outages, flooding and water quality contaminants.

Innovation: Lime Silo Acoustic Cleaner

Several WTWs across our operating area experience 'rat holing', where lime is compacted on the side of the silo. This not only reduces the operating volume in the silo, but compromises quality control by providing inconsistent lime batching strengths.

We have trialled an acoustic cleaner that produces high pressure sound at set frequencies. This causes the compacted material to resonate at a different rate to the surrounding environment, breaking up the lime and allowing it to fall off by gravity.

The trial of the acoustic cleaner was held at Buih Wells treatment works to improve the use and efficiency of the lime silo. The acoustic cleaner is a safe way to clean silos, as the unit is non-invasive and does not require the silo to be emptied. It has been estimated that since the system was installed it has saved at least 210 hours per year in reduced call-outs.

Resilient trunk mains and grid systems

Our approach is to increase the resilience of our critical trunk mains and begin to transition from a point to point distribution systems to grid and ring main supply systems in urban areas, providing multiple supply routes in the event of a failure. These transfers helped our response during storm

Emma and the dry-weather in 2018. We also have a long term aim of ensuring that there is never just a single point of supply to groups of 5,000 properties or more.

Strategic storage

Our long-term approach is to build 24 hours' worth of treated water storage capacity at all our treatment works, initially targeting areas at high risk of prolonged outages or water quality shocks such as Herefordshire and Merthyr Tydfil.

Predictive analytics and emergency response

Having a clear view of live network operations is a critical part of ensuring the reliability of our water supply services. Our approach is to link our telemetry to predictive systems in our SmartHub, enabling us to identify and resolve network issues before they impact on our customers. We also recognise the need to have robust temporary solutions, such as tankers, available to supply our customers in the event of emergencies.

Continual learning from past extreme weather events to improve future management

We have and will continue to learn from shocks that impact our ability to supply water to our customers. We have a robust crisis management including a command structure depending on the severity of the event. We also have a post-event review process to ensure that we embed learning from events into our business. For example, during the cold snap in December 2010, we found that our winter planning was not in depth enough to properly manage the situation. Based on this experience, we now have a far more extensive water winter plan, with each operational area having a separate plan which gets reviewed and re-signed off every year. We also increased our fleet from 10 to 35 tankers and 50 to 200 four-wheel drives as well as investing in our own snow clearing tools for them. We also recognised that we needed to improve how we looked after our people during extreme events. There was a 'hero culture' around working long shifts which would not be sustainable were the event to last for a long period. This led us to implement maximum 12-hour shift, mandatory days off, and named staff responsible for the welfare of Gold and Silver Teams.

3.4. AMP6 performance


	Measures of Success	Narrative	2014/15 performance	2017/18 performance	2020 target (current forecast)
	A3: Reliability of supply - minutes lost per property per year	Supply interruptions greater than three hours (expressed in minutes per property).	23	43*	12.0
	A1b: Safety of drinking water	Compliance with the DWI regulations as measured by mean zonal compliance (MZC).	99.94	99.96	99.98

Table 5: PR14 Measures of Success

Our PR14 business plan stressed the importance of delivering a reliable and stable service to our customers, and during AMP6 we have worked hard to build resilience against supply disruption into our water supply assets and processes. We are on track to meet our target of just 12 minutes lost

per property by the end of AMP6, down from 21.74 in 2015/16. This is a considerable achievement, given the nature of our operating area with long pipe lengths per customer and high operating pressures. We are also close to achieving our target of 100% compliance with DWI regulations for water quality. We acknowledge the worse than expected result of 43 minutes lost per customer in 2017/18. This was largely due to the impact of Storm Emma in March 2018. We still expect to achieve our target of 12 by 2019/20.

Robust water treatment works

Our relative performance in bacteriological compliance in the water industry remained in the upper quartile on this measure for the 2016 reporting year, but since then we have experienced a number of disinfection turbidity failures. In our PR14 business plan we committed to improving the run to waste facilities at our sites, our ultimate defence against water quality failures. In AMP6 we expanded on this programme and have committed to ensuring that all our WTWs have emergency run to waste facilities installed by 2020.

In 2015, we commissioned a new WTW, Garn Dolbenmaen, in North Wales. It replaces two older WTWs that were not designed to meet current water quality standards. The new treatment process improves taste for customers, avoids the need for costly re-chlorination of water in the distribution system and reduces disinfection by-products. Since commissioning, we have experienced an improvement from approximately 85 customer contacts from September 2012 – August 2013 to just over 60 contacts from September 2016 – August 2017.

We have also improved our resilience to water quality shocks at several key WTWs. At Bryn Cowlyd treatment works, we have experienced increasing levels of organics in our raw water. To avoid issues associated with disinfection by-products following chlorination, we replaced our GAC filters with a new dissolved air flotation and filtration plant (including coagulation), our largest project in AMP6. We will monitor and review these to inform our programme of works in AMP7.

In addition, we have performed a power analysis on all our pumping stations and installed software to allow them to be reset remotely upon failure.

We are also developing our outage management plans for our WTWs in AMP6, and will be implementing them in AMP7.

Resilient trunk mains and grid systems

We have replaced our Maerdy-Pontypridd trunk main system as part of a £23 million investment. The system previously consisted of two independent mains, and as part of the replacement scheme we added a cross connection between them. This is part of our wider journey towards an interconnected grid system.

We have also undertaken a study to identify critical sections of our trunk mains based on the consequence of their failure and ease of repair and we have begun to develop action plans to protect, replace or duplicate these critical length of trunk mains. This will enable us to implement a pro-active, risk-based approach to network improvements.

Strategic storage

After an incident in 2015 when the shutting down of Broomy Hill treatment works, due to raw water quality issues in the river Wye, had the potential to affect supplies to 50,000 people, we carried out a review of potable water storage options at Broomy Hill treatment works. To address potential future outages, we are constructing additional storage at the downstream Bewdley Bank reservoir

and rezoning part of the area of the Ridgehill reservoir. This will increase potable water storage from 20 to 40 hours and be completed in AMP6.

Predictive analytics and emergency response

We have installed 2,300 pressure loggers across 80% of our network, to enable us to accurately calculate supply interruptions and more quickly mobilise to address burst mains. We also deploy temporary loggers during incidents.

We have installed alarms to alert us of sudden pressure drops, and by the end of AMP6 we aim to link our pressure loggers to predictive systems in our SmartHub. To help mitigate the impact of emergency incidents on our customers, we have also purchased four additional tankers to strengthen our response capability.

In AMP6 we installed additional hydrants and isolation valves in our distribution system, which allows us to rapidly mitigate the immediate impact of any burst mains. We have also ensured that emergency tankers and rapid response units are in place in each of our operational areas to maintain supply if necessary and have worked with local repair specialists to provide local fabrication facilities.

Our Zonal Studies programme has included the installation of additional valves to reduce the number of customers affected by a burst main, and additional hydrant points to enable us to restore supply effectively. So far, we have installed 1,886 additional valves and 933 additional fire hydrants. We have noted a marked reduction in CML in areas where we have completed our Zonal Studies programme.

Through innovation we have also made good progress in improving our capability of tackling live repairs of our large diameter, high pressure trunk mains. This included a live repair on our highest-pressure trunk main at Grwynne, a pipe that carries over 100 tonnes of thrust.

Continual learning from past extreme weather events to improve future management - Storm Emma and 2018 'developing drought'

During AMP6 we learnt lessons from incidents to improve the robustness of our service. In August 2015 Broomy Hill treatment works was shut down due to loss of source of supply, which had the potential to impact 50,000 properties. This led us to review potable water options in the area and to the construction of additional storage at a downstream reservoir and rezoning another, increasing potable storage from 20 to 40 hours.

We are seeing new extremes in weather, with 2018 being the hottest and driest summer in Wales since records began, as well as experiencing significant snow fall and freeze-thaw.

During Storm Emma in 2018 a number of our customers faced a prolonged and highly regrettable period of service disruption. We quickly identified a number of areas to improve and, after the post incident review, our Board has already provided £4 million investment to address these issues. We identified that our remote network monitoring in rural areas was not consistent. This led us to invest in the implementation of monitors across the whole network, down to hamlet-sized residential areas: implementation is currently in progress. As well as this, we have a new role in Silver response teams of a communications role, with a focus on identifying problem areas from social media traffic. We also plan, in AMP7, to invest in more heavy-duty snow clearing kit, and rely less on the Local Authority, to ensure that we are always able to access our sites.

We are effective at getting extra staff support in extreme events, with staff from across the business manning the customer lines during Storm Emma. For our response, we were commended by Ofwat, in 'Out in the Cold', for our customer communication response. This plan was recently shared as

‘good practice’ at the Water UK ‘post Freeze / Thaw’ workshop on 13 July 2018. Despite this positive feedback, we still plan to learn from issues that we flagged in the event, including creating an easier to use customer software and a wider training programme to prepare our people. We also aim to improve how we target communications better, especially to customers in vulnerable circumstances. We intend to enhance the current emergency procedures to further integrate management of customer communications into the ‘Crisis Management’ and Gold level command structures. There are also plans to create satellite customer contact centres and the introduction of home working to increase the resilience of customer communications.

We also ran a programme called ‘Wrap up Wales’, which involved educating our customers to ensure that when buildings were left empty, water was turned off and drained to avoid leakage following a freeze-thaw event.

Our response to the 2018 ‘developing drought’ included temporarily connecting five water resource zones. This involved a two-way transfer between Anglesey and the mainland, overland connections between water resource zones, use of standby boreholes, and temporary pipelines. We will look to make these temporary solutions permanent in AMP7, where suitable, to improve our long-term resilience.

We were also adaptable to changing circumstances by using our tanker fleet and deploying an extra 150 contract staff to undertake this work to ensure other day to day tasks we not impacted.

We are the first company to provide drinking water to people not connected to the mains in a drought event. We worked in partnership with the Local Authorities, who distributed bottled water provided by us.

3.5. AMP7 plan


	Measures of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
	Wt2 Water supply interruptions	Supply interruptions greater than three hours (expressed in minutes per property).	43.3	12	8
	Wt6 Tap Water Quality Event Risk Index	DWI’s Event Risk Index	-	-	UQ (Industry Upper Quartile)

Table 6: PR19 Measures of Success

Our focus on WTWs, storage, distribution and risk management will allow us to reduce water supply interruptions, monitored by MoS Wt2, and unplanned water outages, monitored by MoS Wt5. Improving the resilience of our water distribution systems will also contribute to a reduction in mains bursts, monitored by MoS Wt4.

The DWI’s Event Risk Index is a measure designed to illustrate the risk arising from water quality events. It includes elements relating to:

- The seriousness of each drinking water quality event;
- A measure of the company performance in managing the event; and

- The impact of each event – based on a simple measure of the population affected and time in hours.

Our plan will help us move towards achieving upper quartile scores for the DWI's Event Risk Index, monitored by MoS Wt6. Our Operational Strategies have driven our programme of works in AMP7.

Robust water treatment works

One of our focuses in AMP7 is the replacement of water treatment works with high rates of failure that cannot be improved by cost-effective maintenance practice or capital investment. Where we replace existing works, we will seek to rationalise the number of water treatment works and replace them with more resilient water treatment works. In AMP7, we aim to reduce our total number of WTWs to 59, down from 62 in 2018/19.

One of our major capital investments in AMP7 will be the replacement of three existing WTWs (Pontsticill, Llwynon and Cantref) with a new facility at Merthyr Tydfil, with the possibility of decommissioning a further two assets at a later stage. Pontsticill and Llwynon WTW have DWI enforcement notices on them due to customer contacts around poor water quality, and we expect Cantref WTW to have enforcement notices in the next five to ten years. The decision to replace these WTWs to meet the new required regulatory standard, rather than to upgrade the existing sites, was driven by:

- The replacement option is the lowest whole life cost option for customers;
- It would be difficult to upgrade some of the works due to very limited land availability at the current location;
- Major maintenance is constrained by short shut down window availability;
- Resilience will be significantly improved by the replacement option (our older WTWs at Pontsticill, Llwynon and Cantref experience approximately three times the rate of failure relative to our other WTWs);
- Water quality standards could also be tightened in the future; and
- Cardiff is expected to be the fastest growing core city in the UK by 2035, and we need to continue to supply our capital city even in the event of asset failure.

Our new WTW at Merthyr will have a maximum capacity of 225 Ml/day with three separate treatment streams and 24 hours of storage to allow for maintenance and outages. This is a multi-AMP project, which will begin implementation in AMP7 with an initial investment of £91 million for building of the necessary network connections and additional treated water storage. The scheme has support of the DWI⁷.

In AMP7, we will decommission our small Capel Curig treatment works and source an alternative supply from a larger WTW nearby. This will ensure resilience of supply for individuals in this remote part of Wales.

We will implement our Outage Management Plans for our WTWs that we developed in AMP6.

Resilient trunk mains and grid systems

We recognise that we are, at present, not able to mitigate burst mains for some of our customers through emergency response. In AMP7 we plan to perform resilience assessments for all communities where over 5,000 properties are fed from a single source of supply and identify possible operational and capital solutions in the event of a supply failure.

Our long-term focus is to link and rationalise our water resource zones to ensure we can better move water to where it is needed. We will begin by linking our Vowchurch and Hereford water resource zones in AMP7. We will also invest £20 million for repairing clusters of recurrent burst mains in AMP7, improving service to customers who face repeated service failures.

We will implement resilience improvements for our east-west Felindre Trunk Main. This will include the twinning of strategic mains at vulnerable points, including where they pass under rivers, roads and railways. This will help us to ensure resilience of supply and enough water for all in South Wales, and is part of our journey towards building an interconnected grid system.

These activities, along with operational strategies, will deliver a 30% reduction in interruptions to supply, from 12 minutes to 8 minutes by 2025.

Strategic storage

Building on our work increasing strategic storage at Bewdley Bank service reservoir in Herefordshire during AMP6, we will assess how much additional storage can be accommodated at Broomy Hill WTW to build additional supply resilience into the Broomy Hill distribution system.

As part of our Merthyr treatment works investment, we will build 24hrs of treated water storage for the Merthyr area by increasing the capacity of Pengarnddu service reservoir.

Several post-tensioned reservoirs in the Maerdy Porth system, along with the Quarry Tanks storage system, are reaching the end of their service life and will be renewed to maintain their levels of storage.

As part of our ongoing cleaning and inspection programme, we will build bypass arrangements into several service reservoirs, to enable us to remove these tanks from service when necessary in the future. This will reduce risks to water quality and mitigate the potential for supply failure.

Predictive analytics and emergency response

Our pressure loggers, which we plan to link with predictive systems in our SmartHub by the beginning of AMP7, will also help us manage leakage and improve the resilience of our distribution systems. We also plan to proactively address pressure issues by maintaining or replacing air valves, pressures reducing valves (PRVs) and non-return valves (NRVs) where necessary.

We will continue our Zonal Studies programme (see Chapter 5), including the installation of additional valves to reduce the number of customers affected by a burst main, and additional hydrant points to enable us to restore supply effectively. We will also optimise tanker base locations and other emergency equipment and we will enable tankering into hydrants, to allow us to continue to offer a piped potable water supply to our customers in the event of critical distribution network failures. We also plan to develop quiet pumps for our tankers to reduce noise complaints when we have to use them.

Continual learning from past extreme weather events to improve future management

In the remainder of AMP6, we will continue to learn from our and other companies' cold weather response to Storm Emma. For example, we have identified that one of vulnerabilities is the ability to access assets during heavy snowfall. In AMP7, we will explore working with farmers and landowners who carry out road clearance for Local Authorities to clear access to our remote assets, as well as investing in our own snow clearing kit.

Our response to the 2018 ‘developing drought’ included temporarily connecting five water resource zones. We will look to make these temporary solutions permanent in AMP7, where suitable, to improve our long-term resilience.

3.6. Long-term planning: AMP8 and beyond

	Measures of Success	Narrative	2025 target	2030 target	2050 target
	Wt2 Water supply interruptions	Supply interruptions greater than three hours (expressed in minutes per property).	8	6	2
	Wt6 Tap Water Quality Event Risk Index	DWI's Event Risk Index	UQ (Industry Upper Quartile)	UQ (Industry Upper Quartile)	UQ (Industry Upper Quartile)

Table 7: Long-term Measures of Success

Going forward, through our proactive interventions we are planning to achieve further reductions in our Wt2 – Water Supply Interruptions MoS. We recognise this will be a challenge, due to our unique geography and the contribution of third party impacts on our network. We also recognise that the future deterioration of our asbestos cement mains (particularly in south-west and north Wales) could pose a risk to their future integrity, resulting in an increased burst frequency. However, we will continue to target burst main clusters, deliver operational improvements to reduce pressure surges and achieve ‘calm networks’.

By the end of AMP8, we are planning to complete our Merthyr Tydfil treatment works. When our Carno and Nantybwh treatment works come to the end of their asset life, we will integrate these areas into our new Merthyr Tydfil system, if this proves to be the lowest whole life cost option for customers. We are also planning the replacement or major refurbishment of a further three WTWs by the end of AMP8.

By 2050, we aim to rationalise the number of WTWs we operate down to around 39. This will allow us to focus on the refurbishment and modernisation of these works, including specific measures for resilience against future shocks, such as physical and cyber security upgrades, flood and power resilience, and increased treatment flexibility. We also plan to connect our water resource zones, reducing the number of zones from 24 to 11. We have already begun to link our zones with temporary solutions, moving towards more permanent solutions in AMP7 and AMP8. We also plan to replace all our MEI equipment and control systems at our treatment works and build 24 hrs of treated potable water storage at all our sites.

We are working on a long-term strategy that encompasses intelligent and predictive management of pressure to reduce bursts and improve the efficiency of our operations, building on our work in AMP6 and AMP7. We also plan to develop resilient, cost-efficient small package pumping stations that can resolve issues of low pressure or no water.

4. Strategic Response 4: Protecting our critical water supply assets



Figure 4 : Pontsticill reservoir

4.1. Drivers

Our long-term strategy, Welsh Water 2050, highlights how trends such as more frequent and extreme flooding events due to climate change, and increased risk of cyber-attack and terrorism could pose a greater risk to our assets going forward.

We will provide a high degree of resilience for all our assets for where failures cannot be mitigated by operational responses, such as rezoning or tankering. For these critical assets, we have assessed the resilience to the following threats: security, flooding, coastal erosion, catastrophic failure, contamination, loss of power and cyber threat. We want to mitigate these threats at our assets to reduce the risk of outages for our customers.

4.2. Customer and stakeholder priorities

Our domestic and business customers have some tolerance for brief outages of supply, however, they become increasingly less accepting of outages the longer they last and the more frequent they are. Protecting our critical supply assets is consistently ranked as being of high importance by our customers, as problems would have a major impact upon them. Terrorism is one of the 'top of mind' threats to water supply¹.

In addition, CCWater considers 'resilient, sustainable, wholesome water supply now and in the future' to be one of their priority areas, which is in line with our approach.

4.3. Our approach

We are facing increased environmental and human risks to our assets, including emerging threats from terrorism and cyber-crime. To mitigate these, we are using our resilience scorecards to prioritise our investments for improving the resilience of our critical water treatment and supply assets. As part of this, we have identified critical sections of trunk mains that are vital for communities of 5,000 people or more, and others that have a high consequence of failure or are difficult to repair. We are also transitioning towards predicting clusters of bursts rather than repairing them on a reactive basis.

In addition, we manage our Critical National Infrastructure (CNI) under the Security and Emergency Measures Direction (SEMD), and non-designated assets using Water UK Security Standards.

Resilience scorecards

In our PR14 business plan we committed to improving our understanding of the resilience of our most critical water treatment and supply assets. We are taking a proactive, resilience-based approach to protecting our critical water supply assets to ensure that we minimise disruption and maintain affordability for our customers. We have identified our most critical assets, where failure would lead to a significant service impact. In these cases, risks cannot be mitigated by operational means alone. We have developed resilience scorecards for these critical assets and we are undertaking a prioritised programme of improving protection. These scorecards rate resilience in terms of how well protected they are against extreme weather events, power failures, control failures, stresses including coastal erosion and their ability to recover from service failures arising from those events. Our scorecard resilience scores are reported to Ofwat annually, to demonstrate progress made in protecting our assets.

Our approach is focussed on three main asset types: our dams, our water network above-ground assets such as critical WTWs, storage and pump assets and our below-ground assets such as critical sections of trunk mains. The resilience of our dams is covered in our Water Resources Business Plan.

Above ground assets

The scorecards for above ground assets focus on our critical water treatment assets, pumping stations and storage tanks. We measure the resilience of these assets against our scorecard criteria of SEMD, flooding, erosion, power, control, treatment, asset failure and access.

Below ground assets

Our trunk mains are critical for the delivery of drinking water, and bursts or other failures can have a significant impact on our ability to supply customers, can also flood local properties and disrupt transport links. Our approach is to identify critical sections of our trunk mains based on the consequence of their failure and ease of repair. This will enable us to implement a pro-active, risk-based approach to network improvements. Specifically, we have identified trunk main sections that are a single connection to communities of 5,000 or more households, where tankering during an outage would not be feasible. We have also identified trunk mains that cross motorways, trunk roads, railways and rivers, where a repair would be challenging.

We measure the resilience of these strategic assets (287 in total) against our scorecard criteria of control, isolation, temporary works, duplication, storage, access, erosion and asset condition.

Burst Management

We understand that the biggest cause of unwanted customer contacts are interruptions to supply. We experience amongst the highest pressures in our network amongst water companies operating in England and Wales, and so face a unique challenge to mitigate burst pipes. As an organisation, we are moving from a reactive response to bursts towards predictive capability that draws upon leading thinking in resilience, smart technology and data science. This approach will allow us to address supply interruptions and burst mains before they have any significant impact on customer services.

Critical National Infrastructure

Our resilience scorecards are in addition to our responsibilities for sites designated as Critical National Infrastructure (CNI) under the SEMD (Water and Sewerage Undertakers) 1998. If a site is designated as CNI then we have a specific duty to carry out security work, install appropriate protection, and implement surveillance. This ensures we mitigate against vandalism, extortion, terrorism and sabotage (including chemical, biological and radioactive attacks). All our assets that distribute, treat or store water for more than 350,000 customers are treated as CNI. For non-designated sites, we will mitigate risks based on the Water UK Security Standards.

4.4. AMP6 performance


	PR14 Measure of Success	Narrative	2015/16 performance	2017/18 performance	2020 target (current forecast)
	F3: Water network + asset resilience	Percentage of critical assets that are resilient against a set of criteria. Critical assets are those where failure would have a major impact	88.2%	90.4%	91%

Table 8: PR14 Measures of Success

In AMP6, we have progressed our approach to improving the reliability of our water supply network, primarily focusing on gaining an understanding of our vulnerabilities and the actions and investment required to improve our supply reliability for our customers. For PR14, we developed a bespoke resilience scorecard and completed the assessment of all our critical assets, including our reservoir and raw water assets. We are confident that we will exceed our regulatory target of 87% on this measure.

Above ground assets

We have proactively intervened to increase the physical resilience of our WTWs. At Pontsticill treatment works, we installed additional flood resilience through the installation of flood proof doors, sealing of ducts into the building, raising of a pipe bridge and by providing a bypass in the event of high water levels. We have completed a new resilient treatment works at Garn Dolbenmaen, replacing two older sites, and have upgraded our Bryn Cowlyd treatment works to make it more resilient to floods, power failures, treatment shocks and access resilience.

We have installed new telemetry and SCADA systems in our treatment works, to ensure we have visibility of their operations and they are fit for the future and resistant to cyber-attack. We have

also implemented a new auditable security pass key system for chemical deliveries to our treatments works, which ensures that only certain individuals can accept chemical deliveries.

By the end of AMP6, we will also have built in 'run to waste' systems in all our WTWs. These bypasses will act to fully protect our customers in the event of sudden water quality failures. We have also implemented an improved programme of tank cleaning.

Our end of AMP6 resilience score for these assets, on this new basis, is expected to be 84%.

Below ground assets

In AMP6, we have identified our critical trunk mains that are a single connection to communities of 5,000 or more households or that cross motorways, trunk roads, railways and rivers. There are around 287 sections of strategic trunk mains defined as 'critical' according to our mains criticality definition criteria. Our critical crossing pilot study has developed a matrix that we will use to record the critical information associated with crossings. This will then be applied to all our critical assets identifying operational mitigations and future investment requirements.

Our end of AMP6 resilience score for these assets, on this new basis, is expected to be 47%

4.5. AMP7 plan


	Measures of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
	Ft6 Water + network above ground asset resilience	Percentage of critical assets that are resilient against a set of criteria.	-	84.0%	86.5%
	Ft7 Water + network below ground asset resilience	Percentage of critical assets that are resilient against a set of criteria.	-	47.0%	56.2%
	Wt4 Water mains bursts	The number of bursts of water mains.	4,181	3,700	3,600

Table 9: PR19 Measures of Success

In AMP7, we will be continuing to invest in a prioritised approach to protect and improve our assets to reduce the risk of outages for our customers. We will also continue to gather information on the condition of our assets to inform future investment plans. This will allow us to increase our score against our resilience scorecards, monitored by MoS R3.

We will continue to review the security measures at our sites designated as CNI every two years and ensure these are externally audited every three years. We will also continue to manage our non-designated sites using our adopted Water UK standards^{xxv}.

In AMP7, we will complete security upgrades at 22 sites per year. These upgrades will include:

- Securing access points, including windows and doors, and fencing and enclosures with appropriate resistance to intrusion;

- Installing intrusion detection systems, including CCTV and lighting, linking alarms and access control systems to our corporate and telemetry systems; and
- Installing attendance management systems, to provide information around the presence and identity individuals in a controlled area.

Above ground assets

In AMP7, we are proposing the following upgrades to our assets:

- Improvements at Court Farm and Felindre treatment works;
- Improvements at Lower Lliw pumping station;
- Beginning construction of our Merthyr Tydfil treatment works, as detailed in chapter 2; and
- Improvements at six of our service reservoirs.

Our end of AMP7 resilience score for these assets is expected to be 86.5%.

Below ground assets

In AMP7, through rolling out our critical crossings risk assessment tool, we will improve the failure planning for all 287 sections of critical main, which will ensure we are able to make rapid repairs in the event of a catastrophic failure. We will also perform condition assessments on 53 critical pipeline sections to build our information base and better understand the risk of failure.

As detailed in chapter 2, we have built a plan of works for our Felindre Trunk Main, a major link between South East and South West Wales. This will include enabling two-way capability, the twinning of strategic mains at vulnerable points, including where they pass under rivers, roads and railways. This will help us to ensure resilience of supply and enough water for all in South Wales.

We will also provide additional resilience of supply on our strategic Alwen trunk main, replacing the Bwlch Tunnel, which is a longstanding single point of failure.

We have identified several of our assets that are inside third-party owned tunnels. We will review the condition of these and develop collaborative solutions with these third parties to reduce risk. We are also planning to implement non-intrusive pipe repair technologies that have already been demonstrated as technically and commercially viable within other industries

Our end of AMP7 resilience score for these assets is expected to be 56.2%

4.6. Long-term planning: AMP8 and beyond

We will continue to work towards achieving a resilience score of 100% for all our water supply assets by 2050. We will continue to strengthen and duplicate critical sections of trunk mains and trunk main crossings.


	PR19 Measures of Success	Narrative	2025 target	2030 target	2050 target
	Ft6: Water + network above ground asset resilience	Percentage of critical assets that are resilient against a set of criteria.	86.5%	90%	100%
	Ft7: Water + network below ground asset resilience	Percentage of critical assets that are resilient against a set of criteria.	56.2%	60%	100%
	Wt4 Water mains bursts	The number of bursts of water mains	3,600	3,500	3,100

Table 10: Long-term Measures of Success

5. Strategic Response 5: Achieving acceptable water quality for all customers



Figure 5 : One of our customers enjoying a glass of water.

5.1. Drivers

Our performance for acceptability of water is lower than that of other water companies in England and Wales. This is primarily due to discolouration, but also due to taste and odour. The prevalence of ageing unlined iron mains in our network, and the fact that 95% of our raw water is surface derived from soft water sources with high manganese contents, are the two main contributing factors to this performance. In our long-term strategy, Welsh Water 2050, we identified several future trends that will put increasing pressure on acceptability of water. These include more extreme weather events and intensification of land use, which could result in further deterioration of raw water sources, and increasing ground movements leading to more cast iron main failures.

The quality of raw water at our abstraction points has been steadily deteriorating over the past 5-10 years, with an increase across several water quality parameters including pesticides, manganese, MIB, Geosmin and turbidity. MIB and Geosmin can create detectable earthy or musty tastes and odours and high levels of naturally occurring manganese cause discolouration when our network is disturbed. On average, raw water manganese has increased from 50 µg/l in 2007 to over 80 µg/l in 2016. We have also noted an increase in dissolved organic carbon (DOC) in our raw water. This can lead to an increase of disinfection by-products in our drinking water, which are caused by the reaction of free chlorine with organic content.

Our network is also a contributor to poor acceptability of water performance due to the high proportion (40%) of cast iron mains in our network and misuse by third parties, much of it illegal. The iron particulates created by soft water corrosion of our unlined cast iron mains, acting with manganese in the treated water, contribute to discolouration. Deindustrialisation in our supply area in recent years also means that our network is often oversized, leading to sub-optimal velocities in our cast iron mains. Due to the age of our cast iron mains, they are also more prone to bursts, which

may result in an increase of disturbance to flow and discolouration of water supply. Seasonal variations in flow can also lead to discolouration.

Because of our high number of customer contacts, The DWI issued improvement notices for 32 of our 82 water quality zones during AMP6.

5.2. Customer and stakeholder priorities

Customer contacts in relation to discoloured water have increased from 7,000 in 2015 to 7,800 in 2016. As there is little understanding amongst our customers as to whether discoloured water is safe to drink, most of our customers would avoid drinking discoloured water – and would prefer to purchase bottled water instead. They would see a significant period of discoloured water, such as a week, as a significant disruption and expensive, as they would have to source alternatives. The idea of poor tasting or smelling water is problematic for our customers – some have experienced this, but the problem has generally been rectified quickly. Old pipes are one of the ‘top of mind’ threats to water supply for our customers¹, and they are keen to see pipes replaced with new materials to ensure supply is future-proofed.

CCWater has noted that our proposal to address issues associated with acceptability of water is in line with their priorities⁸ and the DWI has acknowledged that our approach to acceptability of water is best-practice in the UK and they invited us to share our practices with their inspectors.

5.3. Our approach

In 2015 our performance for acceptability of water was highlighted by the business as an area where significant improvement was required. Challenges such as deindustrialisation, deteriorating raw waters and ageing cast iron mains could put further pressure on this area, and we recognise that third parties have a role to play for many of our acceptability of water contacts. We are focussing our efforts on targeting the root causes of discolouration through our 'source to tap' approach. This includes, as set out in our Acceptability of Water Strategy¹⁴:

- Our catchment management approach to address manganese and taste and odour issues at source (as set out in our Water Resources Business Plan);
- Investing in water treatment processes to reduce manganese and taste and odour at high risk assets;
- Using Zonal Studies to target poor performing areas for acceptability of water contacts and drive network improvements such as replacing unlined cast iron mains and cleansing pipes made of preferred materials;
- Develop 'Care Plans' to maintain the benefits derived from the Zonal Studies investment, updating our DOMS processes; and
- Training our operators and third parties operating network to reduce impact using our specialist training rigs.

Catchment management

Our approach to catchment management is set out in our Water Resources Business Plan. However, our proposals form a vital part of our overall strategy for improving customer acceptability of water in AMP6 and AMP7. Many of the catchment interventions that will help to improve acceptability of water are defined as part of our 'WaterSource' catchment management approach. In our reservoirs, we are adopting reservoir management technologies such as Resmix and ultrasound units to help control MIB and Geosmin, which contribute to poor taste and odour.

Investing in water treatment processes to control chlorine and reduce manganese, Geosmin and MIB that leads to discoloration, and taste and odour

Our approach to WTWs upgrades is prioritised based on where we can deliver the largest improvements for our customers. Manganese is a significant contributor to discoloured water experienced by our customers. As we have determined a direct correlation between our treatment works that perform well on manganese removal and our better performing zones on acceptability contacts, we are working towards a long-term target of 2µg/litre manganese at our WTWs. This is well below the PCV level of 50ug/litre required by the DWI. We are maximising manganese removal at our WTWs by improving the processes of oxidation to manganese dioxide and then removal by filtration.

To reduce chlorine in our drinking water, we will carefully monitor chlorine levels through our SmartHub, invest in secondary chlorine dosing and reduce DOC in our WTWs final waters.

Activated carbon processes will be used at high risk sites to mitigate taste and odour issues from MIB and Geosmin.

Minimising disinfection by-products

To reduce the amount of disinfection by-products in our drinking water we are tackling the issue of increased dissolved organic carbon (DOC) in our catchments (as detailed in our Water Resources

Business Plan) and are trialling aeration, ion exchange techniques and ultrasound to reduce the difficulty to remove organics at key reservoirs in our operating area.

Zonal Studies and Care Plans to target poor performing areas for acceptability of water contacts

In 2015, 80% of customer contacts in relation to acceptability of water came from just 24% of our water supply zones, and therefore a geographically focussed approach is helping us to address the issues in our water supply network in an efficient and cost-effective manner. Our Zonal Studies approach (outlined in Supporting Document 5.8I.1) helps us to prioritise our investments and maximise improvements for our customers. The studies combine hydraulic modelling, statistical analysis and the experience of local operations to identify the root cause of performance issues.

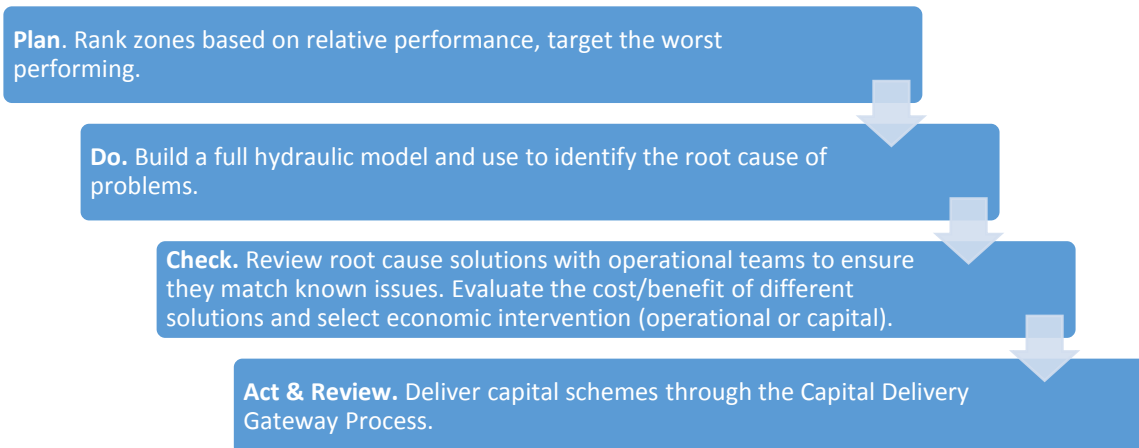


Figure 6: Our Zonal Studies process

Our Zonal Studies help us to identify the high-level interventions required in the water quality zone to improve acceptability of water. These interventions include:

- Mains cleaning, using ice pigging and exploring more innovative techniques such as air scouring;
- The replacement of ageing cast iron mains with plastic water mains; and
- Mains abandonment, increasing velocities in neighbouring mains to prevent sediment build-up.

Operationally we are also:

- Hydrant capping where there is evidence of illegal use (which can be the root cause of around 30% discolouration incidents) and taking legal action against those exploiting standpipes;
- Dead end cleansing, to minimise the build-up of iron, manganese and other solids across the network;
- Mains conditioning – focussing on automated and proactive flow and velocity changes within the trunk mains, enabling the flushing of sediment in a controlled way; and

Our Care Plans build on the success of the Zonal Studies and ensure that the benefits gained through investment are preserved through operational practices. The Care Plans adopt the following approach updating our DOMS processes for the future.

- Update hydraulic models following investments to reflect changes;
- Use updated models to derive flushing plans and other maintenance activities;

- Embed activities in work planning system to monitor compliance; and
- Review monthly performance data in zones and review activities if required.

Following these steps will ensure that where we have replaced or cleansed a pipe, it remains in a clean state and does not return to the pre-investment condition. This will maintain the benefits of the investment over a longer period.

Innovation: Zonal Studies

Our zonal studies are our targeted, innovative approach to addressing taste, odour and discolouration issues experienced by our customers. By using up-to-date hydraulic modelling and statistical analysis, combined with local operational knowledge, we can identify the root cause of water quality issues within our poorly performing water quality zones. Software tools are used to identify the root cause of problems in our network, such as areas of unusual pressure or velocity. As far as we are aware our approach is unique in England and Wales.

By working closely with our operational teams, we can also understand the operational conditions and whether operational measures could also help mitigate the identified issues rather than capital solutions. All the outputs from our zonal studies are evidential, auditable and quantitative. In addition to improving the acceptability of water for our customers, our studies allow us to mitigate the risk of asset deterioration or failure and optimise whole life asset cost.

The development of our Care Plan follows the same innovative approach based around hydraulic modelling, bringing our DOMS processes up to date.

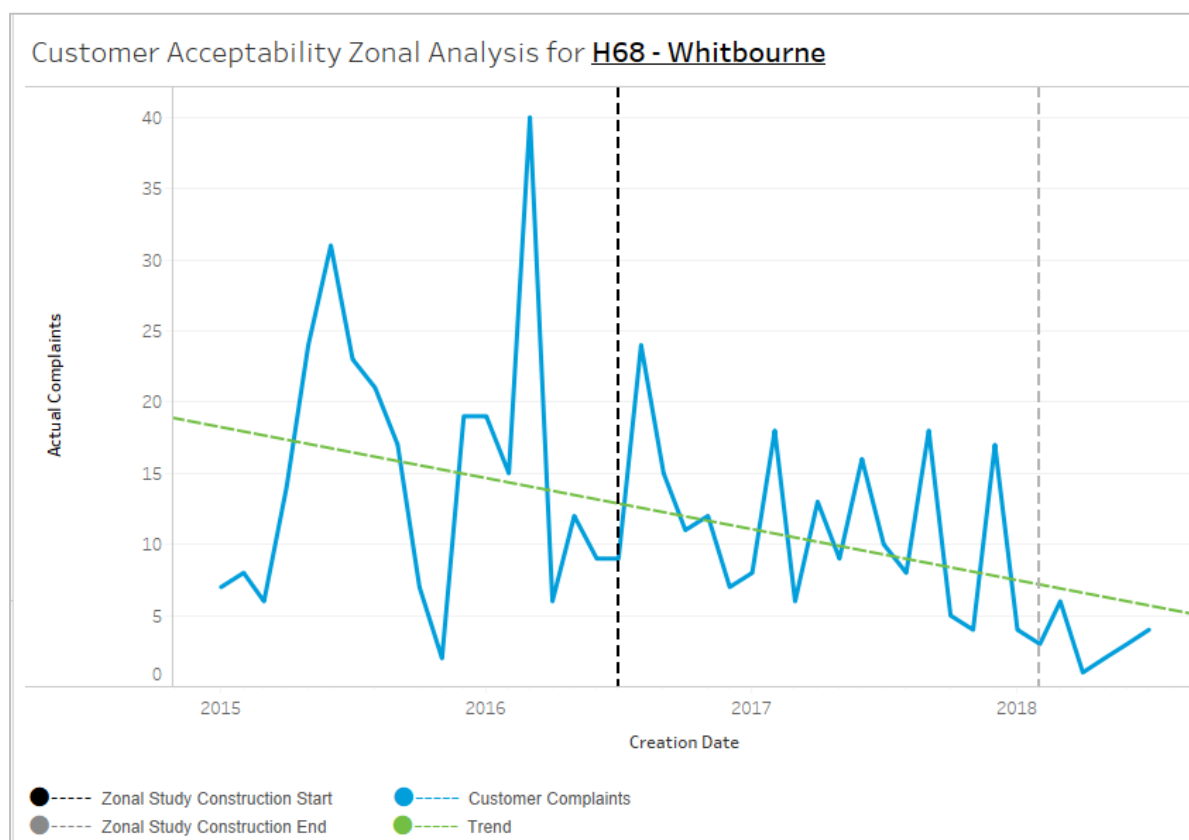


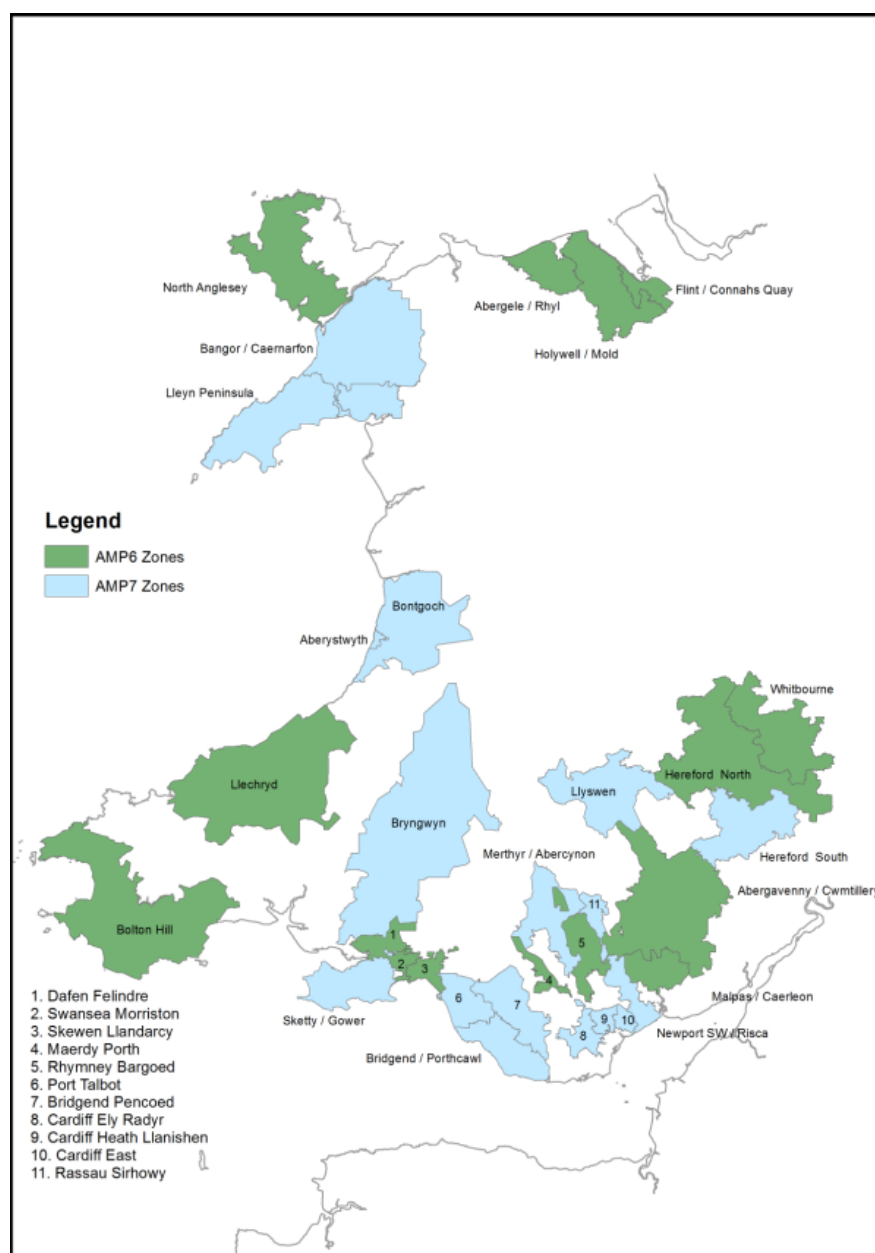
Figure 7: Impact of the delivery of the zonal programme in Whitbourne.

Training our operators and third parties operating network to reduce impact

Operational activity and third-party use of our network can adversely impact water quality by causing pressure surges leading to burst mains or flow increases. We are investing in further training for our workforce and working with external parties to improve operational practice. This includes training our operators and third-party users, such as the fire service, through our e-learning programme, with practical assessment using our two state-of-the-art valve training rigs.

Water Network Alliance

We will deliver our reactive and planned maintenance programmes through our Water Network Alliance, which will improve the effectiveness of our pipe maintenance and replacement programmes, resulting in a better service for customers. More detail is provided in chapter 2.



Zonal studies in AMP6 and AMP7

5.4. AMP6 performance


	PR14 Measure of Success	Narrative	2014/15 performance	2017/18 performance	2020 target (current forecast)
	A2 Customer acceptability of water	The number of contacts received from customers in the calendar year regarding the appearance, taste or odour of drinking water per 1,000 population served.	3.53	3.19	2.75

Table 11: PR14 Measures of Success

The number of customer contacts we receive in relation to the acceptability of water is higher than other water utilities. In our PR14 business plan, we made it clear that addressing the root causes of discolouration, taste and odour problems are a priority for us. At the start of AMP6 we received 3.53 contacts per 1,000 customers, and by the end of AMP6 we are forecast to reduce this to 2.75. This is worse than the AMP6 final determination target set by Ofwat for 2020 of 1.23, which we highlighted at the time was unachievable due to our particular operating environment. Performance in 2017-18 and 2018-19 has been impacted by periods of hot weather which lead to increased flow velocities and elevated flows from third party use of our network. Our Zonal Studies plan also experienced some slippage during the asset management period, as resources were diverted to deal with periods of extreme weather, which is resulting in benefits being realised later than originally planned. However, we believe our underlying performance is improving where seasonable demand impact is excluded, and we have gained an increasing recognition of the impact of third parties on the acceptability of water. Early in AMP6 we implemented the new approach outlined above to gain the improvements needed for our customers.

Progress on water treatment process upgrades – manganese removal

In AMP6, we added dissolved manganese testing to all raw water samples, rather than just total manganese which has been analysed historically. This gives a true indication of manganese challenge and improvement solutions for the treatment works.

On our journey to 2µg/litre manganese at our WTWs, we have:

- Trialled manganese removal modifications at our Alwen treatment works to remove manganese in the first stage filters;
- Changed coagulant to a low manganese ferric sulphate at Crai treatment works; and
- Reinstated sand media in the second stage filters at Glascoed treatment works to improve removal.

Tracking performance of these and other initiatives has shown a reduction in average manganese levels from 5.5ug/litre in 2015 to 4.2ug/litre in 2017 – a 24% reduction.

Progress on water treatment process upgrades – taste and odour reduction

To reduce musty and earthy tastes for our customers at Glascoed treatment works we have increased the volume of GAC treatment filters by over 50%, and at Pontsticill treatment works we have trialled GAC in the first stage filters. We have also introduced PAC dosing at nine high-risk sites, and some of these are mobile and can be moved to other sites as required.

To mitigate chlorine taste complaints, we have focussed on maintaining levels as low as possible without risking a decrease in bacteriological compliance. We will continue to install three further secondary chlorine dosing units during AMP6 to aid this process.

Progress with our Zonal Studies

In AMP6 we have assessed the acceptability of water across all 82 of our water quality zones. We identified the 38 most poorly performing zones for further assessment. Of these 38, we agreed improvement notices with the DWI in 12 zones for delivery in AMP6. To date, we have fully completed working in 5 zones, cleansing 335km and replacing a further 176km of pipework. By the end of AMP6, we will have completed detailed Zonal Study plans 44 zones and completed interventions in our worst performing 15 zones.

During the remainder of AMP6, our technicians will receive city and guilds level training on the use of hydraulic data to undertake root cause analysis, and our network analysts will undergo modelling training in order to maximise the benefits of the 38 hydraulic models completed to date.

We have developed Care Plans in four zones as a pilot and will now roll the process out each time we complete investment in a zone.

Progress on training our operators and third parties operating network

We have trained all our network inspectors on two state-of-the-art valve training rigs to demonstrate the impact of correct and incorrect valve operation on the network. We are also training third-party users, such as the fire service, through our e-learning programme and with practical assessment using our training rig. We are also working with Aquam to develop GPS-linked standpipes that will record and locate standpipe usage in our network.

5.5. AMP7 plan


	Measures of Success	Narrative	2017/18 Outturn	2019/20 Target (AMP 6)	2024/25 Target (AMP 7)
	Wt1: Tap water quality compliance risk index	Tap Water Quality Compliance Risk Index	The DWI's Compliance Risk Index	-	UQ (Industry Upper Quartile)
	Wt3: Acceptability of drinking water	The number of contacts received from customers per 1,000 population served.	2.79	2.4	2

Table 12: PR19 Measures of Success

By the end of AMP7, due to our investment, we expect customer contacts to fall to 2.00 per 1,000 customers against MoS Wt3. It will also help us to achieve a Compliance Risk Index score in the industry upper quartile, monitored by Measure of Success Wt1. The DWI, which has issued legal

notices for improvements in the 17 zones that we will tackle during AMP7, has offered their support for our continued Zonal Studies programme⁹ (see below).

In AMP7 we will build on the progress made in AMP6 and continue our 'source to tap' approach.

Investing in water treatment processes to control chlorine and reduce manganese, Geosmin and MIB that leads to discoloration, and taste and odour

We will build on our manganese removal trials at our Alwen treatment works in AMP6 to implement manganese schemes at six WTWs through a major £16.5 million investment. Sites have been chosen based on criteria that identifies sites with the highest manganese concentration, together with elevated customer contacts.

This investment will be combined with our wider journey to 2µg/litre manganese operational strategy. This sets out our catchment, in-reservoir management and treatment approaches to reduce the manganese loading within the network and mitigate its impact on customer acceptability. By adopting this approach, we will also ensure that the benefits of our pipe cleansing and replacement programmes will be maintained for a prolonged period, helping to maximise the value of these investments for our customers.

We are aiming for no customer to receive water with greater than 0.2 mg/l of chlorine by 2025 with a maximum deviation of 0.1mg/l. We will improve our data gathering of chlorine levels across the network to proactively manage the supply system through the SmartHub, continue to invest in chlorine dosing systems, use flow cytometry to assess the optimum levels of chlorine for our distribution systems and develop a plan for reducing the level of DOC in all our WTWs final waters.

Activated carbon processes will continue to be used at high risk sites to mitigate taste and odour issues from MIB and Geosmin.

Collaboration and Innovation: Working with academia

We are currently implementing learning from Sheffield University and the Prediction of Discolouration in Distribution Systems (PODDS) programme to install turbidity monitoring on the Taff Trunk mains, Talybont Trunk Mains and Crai Trunk Mains.

Our Zonal Studies

In AMP7 we will complete interventions in an additional 17 zones which have legal notices for improvement, including the replacement of 420 kilometres of water mains along with mains cleansing and rehabilitation. Up to 400,000 customers living in these zones will benefit from improvements to the quality of their tap water as a result of these interventions.



Innovation: Pipe replacement

We are in the process of developing more cost-effective and less intrusive methods of pipe replacement including new reinstatement technologies (including 'no dig' techniques), new more efficient materials, ecological assessments, and jointing methods.

We will complete an operational Care Plan for each zone and implement its findings to ensure the benefits remain into future AMP periods.

5.6. Long-term planning: AMP8 and beyond


	Measures of Success	Narrative	2025 target	2030 target	2050 target
	Wt1 Tap water quality compliance risk index	Tap Water Quality Compliance Risk Index	UQ (Industry Upper Quartile)	0	0
	Wt3 Acceptability of drinking water	The number of contacts received from customers per 1,000 population served.	2	1.75	1

Table 13: Long-term Measures of Success

The approach we have put in place will take several AMP cycles to reap the full benefits, but we will continue to follow our approach of using data to target the worst performing areas and focussing on root cause solutions rather than short term fixes. Using the outputs of our Zonal Studies we aim to replace 500km of iron mains per AMP from AMP8 (2025-2030) to AMP12 (2045-2050), comprising 2,500km in total. If it should prove necessary and cost effective, we will investigate the possibility of upgrading a further 8,000km of iron mains serving smaller populations to improve water quality and reduce customer minutes lost (CML). We recognise that the incremental benefits of our Zonal Studies programme will reduce over time, as the most beneficial zones and schemes have already been targeted.

In the long-term, we plan to reduce our customer acceptability contacts to 0.8-1.3 per 1000 customers and replace over 2500km of poor condition iron mains by 2050 (end of AMP12)¹⁰, as monitored by MoS Wt3.

6. Strategic Response 6: Towards a lead-free Wales



Figure 8 : One of our colleagues at work. © Welsh Water.

6.1. Drivers

We are committed to play our part in delivering the well-being goals set out in the Welsh Government's Well-being of Future Generations Act 2015¹¹. This includes promoting a healthier Wales.

There are known adverse health effects of excessive long-term exposure to lead, with children under six years old and expectant mothers being particularly vulnerable. Children with lower socio-economic backgrounds are at an increased risk of lead exposure as they are more likely to live in poorer quality ageing housing, have a poorer diet (poor nutrition can increase lead adsorption) and live in more polluted areas¹². In Wales, 24% of households and 28% of children experience relative income poverty¹³.

It is estimated that 25% of homes in Wales have lead pipes. To mitigate this, we dose phosphate at 41 of our WTWs, which has resulted in 99% compliance with the lead standard (PCV - Prescribed Concentration or Value - 10 µg/litre). However, in some water quality zones the lead failure rate is higher, due to the nature of the housing stock, the condition of the lead pipes or poor plumbing practices¹⁴. To compound this matter, we have also estimated that 25% of our leakage is from customers supply pipes, many of which are lead. Therefore, addressing lead in our wider water supply network could form a crucial path towards achieving our leakage reduction targets.

Although we are not legally responsible for customer supply pipes, we want to play an active part in wider societal effort to address lead in drinking water.

6.2. Customer and stakeholder priorities

Customers who are aware of the risks following a lead failure or the detection of lead solder in their property can become anxious about the potential health effects, particularly when children are

present on their property. Our less well-off customers typically prioritise the replacement of lead piping over other groups.

The DWI and CCWater have offered their support for our proposed programme to replace lead drinking water pipes¹⁵. The Welsh Government has set a goal of achieving a “lead free Wales” in its Water Strategy.

6.3. Our approach

The health impacts of lead in drinking water are increasingly unacceptable. We are therefore working towards our 2050 goal of contributing towards a lead-free Wales, as set out in our Lead Strategy. Our Strategy was developed in partnership with other public health stakeholders through the Water Health Partnership, and has four key programmes of work:

- Offering free lead pipe replacements for properties with high lead levels;
- Linking to other partners’ schemes like Welsh Government’s Arbed scheme to identify lead piping; and
- Supporting the WaterSafe scheme to prevent the use of lead solder during plumbing works.

Free lead pipe replacement

Communication pipes between the water main and the boundary of a customer’s property are our responsibility to maintain and repair. The supply pipe between the customer’s boundary and their internal stop tap however, is not our legal responsibility. Typically, we have replaced lead communication pipes up to the customer’s boundary because of a leak or a water quality failure but not replaced their supply pipe.

In our lead strategy, we have set out to replace both lead supply and communication pipes for customers who record a lead concentration greater than 5 µg/litre of lead in the water, which is 50% of PCV. In addition, we will undertake a risk-based lead monitoring programme focusing on properties which are likely to have lead pipes and replace both lead communication and supply pipes for customers who have high lead levels for free.

Linking to other schemes

We also want to focus our investment on vulnerable groups, especially low-income households with young children. We are working closely with Arbed, a Welsh Government Scheme aimed at improving housing conditions throughout Wales. The Arbed Scheme is targeted at improving energy efficiency within communities and often includes upgrading internal plumbing systems in areas which we know are supplied with lead pipes. Properties in the process of Arbed renovations present the opportunity for cost effective replacement of lead pipes with minimum disruption to the household. By funding lead pipe replacement through the Arbed scheme we will target areas with low income households. It is not considered feasible to restrict offering lead pipe replacement just to those houses with young children so we will work with the Arbed team to prioritise areas for the pipe replacement schemes where there is a concentration of young children.

Furthermore, we will link up with our Project Cartref Scheme, taking the opportunity to remove lead pipes when properties are targeted under the leakage scheme (as detailed in chapter 2).

Engagement with customers and stakeholders about lead

We are aware that some lead failures are caused by poor plumbing standards. Lead solder is widely used by Gas Safe accredited plumbers to ensure gas pipework is installed correctly. Where this practice is used on water supply systems, it presents a risk for lead contamination. As water plumbing standards are not regulated in the same way as gas or electricity installations, we will continue to work with WaterSafe, an organisation set up to accredit plumbers in good water plumbing standards.

Our aim is to increase the number of qualified WaterSafe plumbers through working with professional bodies and direct trade liaison to ensure safe drinking water is delivered to all customers.

We will also encourage local authorities across Wales and the parts of England which we serve, to specify the use of WaterSafe plumbers in their properties.

Water Network Alliance

We will deliver our lead pipe replacement programme through our Water Network Alliance, which will improve the effectiveness of delivery and lead to a better service for customers.

6.4. AMP6 performance

Free lead pipe replacement

During AMP6 we have trialled replacements of the full communication and supply pipe after a water sample has indicated an exceedance greater than 5 µg/litre of lead in the water. Eight households of ten agreed to this trial approach and on average the cost of replacement was £3,500 per property.

During AMP6, we released £5 million of investment to continue with this approach in replacing all lead communication and supply pipes where exceedances are detected. We will also target vulnerable customer groups for free pipe replacement.

We have also been undertaking a risk based, sample monitoring programme focused on properties likely to have lead supply and communication pipes, taking approximately 2,000 samples per year in AMP6.

Innovation: Lead pipe replacement

We are working to reduce the cost of replacing lead supply pipes from around £3,500 per property to £1,500 per property using the KOBUS Pipe Puller. This uses vibrational impacts to remove old lead piping, and simultaneously install new plastic piping. We will continue to trial this technology to assess if it will add value for our supply pipe replacement scheme. We will also continue to understand the impact on our business of possible adoption of our customer supply pipes in the future.

Linking to other schemes

In AMP6, we developed the programme of works which includes the replacement of lead communication pipes to properties being renovated by the Welsh Government's Arbed schemes.

Engagement customers and stakeholders about lead

We have improved our customers’ understanding of lead, recommending customers to replace lead pipes and advise the flushing of taps until lead pipes are removed. We are working with the Welsh Housing Partnership (WHP) Lead group to raise awareness of the misuse of lead solder and the use of WaterSafe plumbers with key, influential stakeholders such as those associated with education and child care in Wales and in landlord forums. As part of this engagement we have been reviewing the sources of information on lead pipe locations from independent surveys such as the Living in Wales survey and ensuring that a multi-agency response protocol to lead failure is maintained and reviewed.

Corrosivity control

To optimise our corrosivity control measures, we have dosed drinking water with phosphate at an increased number of WTWs during AMP6, with 95% of our customers receiving phosphate dosed drinking water in 2017. However, as phosphate is a finite and increasingly scarce resource¹⁶, this is not a sustainable long-term solution. We are undertaking research into the future of phosphate in water treatment.



A Phosphate Mine. By Jason Parker-Burlingham, CC BY 2.0

Innovation: The future of phosphate

We recognise that phosphate is a finite resource, and thus we will need to find new sources if we are to sustainably continue with our phosphate dosing programme. We will investigate the feasibility and value of extracting phosphate at our WwTWs.

We also will build our understanding of the impact of reducing dissolved organic carbon in water on plumbosolvency, the ability of water to dissolve lead, and identify ways of mitigating this that don’t rely on phosphate-derived chemicals.

6.5. AMP7 plan


	Measures of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
	Wt8 Lead supply pipes replaced	Number of lead supply pipes replaced (cumulative over an AMP).	-	1,800	7,000

Table 14: PR19 Measures of Success

Our proactive approach will enable us to dramatically increase our rate of lead pipe replacement in AMP7, monitored by MoS Wt8. We also aim to demonstrate the value of our collaborative, cost effective approach to lead pipe replacement, and will raise awareness of lead pipes with local authorities and housing agencies. We expect to receive a notice from the DWI requiring the replacement of up to 7,000 customer supply pipes and/or communication pipes in AMP7.

Free lead pipe replacement

In AMP7 we will considerably upscale our lead pipework replacement programme by investing a further £20 million to replace a further 7,000 lead pipes. This will be focused on target areas where lead is found and as a response to recording a high level of lead (exceeding 50% PCV) is detected, either due to a random sample or where a sample taken in response to a customer request.

Linking to other schemes

In addition to this, we will continue to work with the Welsh Government on their Arbed scheme to identify lead piping, which is funded through to 2021.

Working with our innovative approach to tackling leakage, Project Cartref (chapter 2), we will also identify properties which are supplied by lead pipes and are also leaking. This project will take the opportunity to replace this pipework, decreasing the numbers of customers supplied with lead and our leakage.

Working with our customers and stakeholders about lead

We will continue to work with the Water Regulations Advisory Scheme and their WaterSafe scheme to ensure lead solder is not used on water pipes and encourage local authorities to specify the use of WaterSafe plumbers in their tender documents.

6.6. Long-term planning: AMP8 and beyond


	Measures of Success	Narrative	2025 target	2030 target	2050 target
	Wt8 Lead supply pipes replaced	Number of lead supply pipes replaced (cumulative over six AMP periods)	7,000 (for AMP)	7,000 (for AMP)	50,000 (total)

Table 15: Long-term Measures of Success

To move towards the goal of a 'lead-free Wales' as set out in our long-term strategy, Welsh Water 2050, we will develop and expand the lead replacement programmes that we have developed in AMP7. We also expect the legal limit for lead in drinking water to fall from 10µg/l to 5µg/l within the next few AMPs.

Our 2050 target is significantly higher than we have historically achieved and will rely on the co-operation of the Welsh Government and our customers, and innovative ways of replacing lead pipes.

As our understanding of properties with lead supply pipes improves and technology allows us to replace lead supply pipes non-intrusively, we will seek to maintain the level of investment required to continue to proactively replace lead pipework, and start to reach properties that have no leaks, have had no lead failure and have no customer vulnerability, working towards a 'lead-free Wales'.

7. Strategic Response 7: Working with customers and communities



Figure 9: Working with our customers as part of a behavioural change campaign. © Welsh Water.

7.1. Drivers

As set out in our long-term strategy, Welsh Water 2050, we recognise the importance of working with customers and communities to shape how drinking water is delivered. This will help to ensure community buy-in and ownership of projects, achieve behavioural change such as reduced water use and improve the public's perception of us as a water company.

7.2. Customer and stakeholder priorities

A common theme across our customer engagement initiatives has been that our customers place a high value on our investment in education projects⁵. Improving water use efficiency and water conservation through education is a priority. Most customers want us to introduce initiatives to avoid waste and reduce leakage, incentives for rain water harvesting and further education and information.

Safeguarding the natural environment is also regularly highlighted as a customer and stakeholder priority. Several stakeholders who responded to our Welsh Water 2050 stakeholder survey have said that they are keen to work with us to achieve our mutual shared objectives including CCWater, The Campaign for the Protection of Rural Wales and the Wildlife Trust Wales.

7.3. Our approach

Working in partnership with customers will be essential for retaining their trust whilst meeting our Customer Promises. Our customer engagement activities underpin our final long-term Welsh Water 2050 strategy.

We are engaging households for demand management, delivered through customer communication, education and behavioural change programmes. By collaborating with a range of

partners, we also use our education programmes to raise awareness of water issues with our customers and other stakeholders and landowners.

Customer-driven strategies

We recognise customers are at the heart of decision-making at Welsh Water. We will continue to build on our wide range of customer engagement activities in AMP6, and work with our customers to understand what is important to them and how we should prioritise our investments. Through our Water Resilient Communities approach, we have built a long-term relationship with a community to align our approach and our investments with their specific needs.

Demand management and behaviour change

We work with customers to improve understanding of the value of water and reduce their demand by offering advice on water-saving devices, water harvesting and recycling grey water. We harness research to identify smart technologies to reduce water use for both domestic and business users, helping them to save money and improving the sustainability of our services.

For our domestic customers, we have trialled Project Cartref (Welsh for 'home') to address customer-side leakage, as part of which we have worked to install new 'stopwatch devices' on individual supply taps to understand water consumption and the likelihood of leakage within individual properties. This allows us to target our engagement activities at households most likely to be experiencing leakage and offer free water audits and repairs (as detailed in chapter 2). We are also raising awareness of poor plumbing practices that increase the risk of lead in drinking water (as detailed in chapter 6).

Communicating the right messages to our customers at the right time in the right way is important to building strong relationships to facilitate our collaborative projects. We underpin our engagement programmes with research to improve our understanding of relevant technological innovations, the behavioural economics driving water use, and appropriate communication channels. This ensures we are well placed to advise our customers and build on our reputation as a trusted service provider.

Education

We aim to use our education programmes to build awareness of water issues of both the public (for demand management and stewardship) and landowners (on pollutants and land use). These programmes are delivered in collaboration with the following partners:

- CCWater;
- Waterwise;
- Energy Savings Trust;
- Local Health Boards;
- Local charities;
- Local Authorities;
- NRW;
- Officer of the Future Generations Commissioner; and
- Housing Associations.

Our education programmes include:

- Our four education centres;

- Our River Schools Education Programme; and
- Our Education Plan.

These programmes include raising awareness and understanding of green infrastructure and the link between urban water quality and land management in our upland catchments, placing our customers as active participants in the water system.



Figure 10: Children benefit from free activity programmes at our Discovery Centres

7.4. AMP6 performance

Customer-driven strategies and behaviour change

In AMP6, we have worked with our customers to understand what is important to them and how we should prioritise our investments, given the future challenges that we will experience going forward. Throughout the development of our final long-term strategy, Welsh Water 2050, we have engaged around 40,000 customers over the past two years to build a collaborative programme of prioritised investment. This has allowed us to tailor our approach to AMP7, considering their specific needs, wants and desires – including those that are in vulnerable circumstances.

In AMP6, we also began the trial of our first Water Resilient Communities pilot project. This takes a holistic approach to our work in communities, alongside raising awareness of our ongoing work in the community to replace or remediate water mains. It also helps us to target our efforts to encourage customers in vulnerable circumstances to join social tariffs and the Priority Services Register.

Demand management and behaviour change

We have trialled Project Cartref, installing stopwatch devices on the supply taps of individual properties in 20 water supply areas. More detail around Project Cartref is provided in chapter 2.

Communication and education

Our education programmes have gone from strength to strength in AMP6. Our four education centres receive half a million visits each year, and we are planning to complete a new visitor centre in Cardiff by the end of AMP7. Through our education plan we have reached 67,000 children so far in our Discovery Centres or schools.

7.5. AMP7 plan


	PR19 Measure of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
	Ft11 Visitors to recreational facilities	Number of visitors to our educational and recreational sites across Wales	450,000	570,000	830,000
	Ft10 Community education	Total number of children and adults who have participated in educational activities	62,000	67,000	75,000

Figure 11: Our AMP7 Measures of Success

Customer-driven strategies

We will continue to co-create strategies and projects with our customers, allowing them to develop a sense of stewardship for their own water use and behaviours and improving their appreciation of how this relates to the wider water environment. We will also be continuing our work alongside local communities to identify the most efficient approach to investing in our drinking water network as well as exploring other initiatives such as RainScape, lead pipe replacement, support for community groups and apprenticeships.

Collaboration: Rhondda Fach Water Resilient Communities



Despite being one of the most economically disadvantaged communities we serve, only 96 of 10,000 households in the Rhondda Fach area were on social tariffs. The area, which faces numerous challenges both from a water utilities asset and a community point of view, is currently the focus of a new type of project: co-creating and co-delivering schemes with our customers.

Since January 2018 we have been collaborating with key stakeholders from the Rhondda Fach area to align our £23 million investment in the drinking water network with the objectives of the Cwm Taf Well-being Plan.

A bespoke outreach programme is underway to increase engagement with our customers. These include raising awareness of our water supply projects in the local area, our social tariffs, the priority services register, our community fund and community group support, our lead pipe replacement, and our apprenticeship scheme. We also work with existing Local Authority campaigns, such as the Milk Teeth Campaign for dental hygiene.

Demand management and behaviour change

We will expand Project Cartref (as detailed in chapter 2) to identify properties that are likely to be experiencing leakage and offer repairs and water audits at our cost.

Communication and education

We will continue to work with our customers to achieve a lead-free Wales, including raising awareness of poor plumbing practices (as detailed in chapter 6). We will continue to build on our existing customer and community education programmes, including our visitor centres, and significantly increase the number of children and adults to visit our educational or recreational sites, or participate in educational activities.

7.6. Long-term planning: AMP8 and beyond

	Measures of Success	Narrative	2025 target	2030 target	2050 target
	Ft11 Visitors to recreational facilities	Number of visitors to our educational and recreational sites across Wales	830,000	880,000	1,000,000
	Ft10: Community education	Total number of children and adults who have participated in educational	75,000	85,000	85,000

Figure 12: Our long-term Measures of Success

Over the long-term, we are committed to making customers increasingly central in our decision-making processes. Our work with communities can respond to pressures on the environment and biodiversity through community-led projects. Specific activities could include raising awareness

about water consumption, water-saving devices, smart metering, water harvesting and recycling grey water.

Moreover, we will work internally to help our colleagues have a better understanding of our customers, and the opportunities and incentives to change behaviour around water use and enhance their participation in water cycle management.

Communicating the right messages to our customers at the right time in the right way is important to building strong relationships to facilitate these collaborative projects. To support this, we will continue to horizon scan customer communication technologies, while also improving our understanding of how to influence customers to use the most appropriate channels for contact.

8. Strategic Response 8: Ensuring affordability of services delivered to customers



Figure 13: Our customers expect an affordable service for the long term.

8.1. Drivers

Affordability is defined in Delivering Water 2020 as “the ability of a customer to pay their water bill”. Currently the majority of our customers believe that Welsh Water’s bills represent good value for money, however with debt and poverty on the rise in Wales,¹⁷ we must work to ensure that our services remain affordable for all customers. We need to consider both current and future needs to ensure that delayed investments do not result in unaffordable bills for future generations. As set out in Welsh Water 2050, we are committed to ensuring that we continue to provide the best service in increasingly innovative and efficient ways and pass these savings on to our current and future customers to ensure that our service remains affordable for all.

8.2. Customer and stakeholder priorities

Affordability and the ever-changing vulnerability of our customers in Wales is recognised by Consumer Council Water as one of the key challenges the company is facing in the future.

Our customers recognise that collecting bills is a fundamental part of our operations, but nearly 5% of our customers say they cannot afford their water bill and many more say they find affording their water bill a ‘stretch’ (see Supporting Document 1.1C). A key theme across our customer consultations is efficiency: our customers are keen to see us demonstrate that we are investing responsibly in delivering cost-effective service, and they are largely willing to play their part in achieving this.

8.3. Our approach

We must respond to the challenge of affordability for our customers and demonstrate to them that we are providing a cost-effective service. Our approach includes:

- Reducing our expenditure on energy and minimising our running costs;
- Implementing cost-effective operational improvements where these allow us to delay or avoid costly capital expenditure and bring long-term value for our customers;
- Seeking procurement efficiencies;
- Working with customers and stakeholders to take advantage of better ways of working together.

Reducing our expenditure on energy and minimising our running costs

We are improving the energy efficiency of our sites, as well as investing in on-site generation. Within our offices, we minimise our running costs by looking at new ways of working and adopting new technologies.

Implementing operational improvements

We always look to implement cost-effective operational solutions, for example measures in our reservoirs to avoid treatment upgrades or working in partnership to reduce costs and achieve shared objectives. Our Water Network Alliance will continue to drive efficiencies in the delivery of our reactive and planned maintenance programmes, and our Zonal Studies target operational improvements where they bring long-term value (as detailed in chapter 5). We also target catchment-scale initiatives where these bring value (as detailed in our Water Resources Business Plan).

Seeking procurement efficiencies

Our Capital Delivery Alliance brings our partners together and drives value in the planning and pre-construction phase. This is achieved by co-locating our colleagues, contractors and consultants in a single team. This allows them to work more collaboratively on innovative solutions, package work more effectively and optimise the supply chain, whilst maintaining partner-specific accountability for all aspects of construction.

Working with customers and stakeholders

We work with our customers and in partnership with other stakeholders to take advantage of better ways of working together, especially where this aligns with our shared objectives and delivers improved outcomes for society more efficiently.

8.4. AMP6 performance


	PR14 Measure of Success	Narrative	2014/15 performance	2017/18 performance	2020 target (current forecast)
	E1 Affordable bills	The extent to which the company will continue to make bills more affordable. After 2014-15, customer bill increases will be 1% below the rate of inflation each year.	-	1% below	1% below

Table 16: PR14 measures of Success

Throughout AMP6, we have committed to ensure customers' bills increase at a rate of no more than 1% below the rate of inflation, which we expect to achieve against our MoS E1.

Reducing our expenditure on energy and minimising our running costs

Our investments in energy efficient technologies at our sites as well as wind, hydro and solar PV renewable generation schemes are enabling us to reduce the cost of our energy (as detailed in chapter 13). In one innovative project we installed sophisticated software at our Court Farm site that can modify our pumping to help the electricity grid maintain stable performance. This generates an income from the energy supplier to offset our operating costs.

We have improved our operational practices, through the introduction of LEAN operating principles. This will be delivered through a project which aims to significantly reduce our operating costs by retaining only those practices that add value and are core to good operations and asset management. We have also piloted process optimisation software, working in partnership with Veolia, at two sites resulting in reduced power and chemicals costs.

Implementing operational improvements

We have identified innovations that reduce the need for treatment process upgrades at our WTWs, such as 'Resmix', which reduces manganese in raw water.

Seeking procurement efficiencies

Our Capital Delivery Alliance was required to deliver savings against our core in-house benchmarking resource, our "unit cost database" (UCD) of around 2% per annum cumulative, over the course of the AMP6 period. Our commercial model includes pain/gain and KPI arrangements that ensure that partners are highly incentivised to outperform the UCD cost curves, as well as incentives to work with us to identify the least (totex) cost solutions in the first place.

Working with customers and stakeholders

We have worked with customer to reduce their demand through customer engagement initiatives such as Wrap Up Wales in Winter and Save Water This Summer. Wrap Up Wales encourages

customers to drain their water system if their property is going to be unoccupied to prevent burst pipes in Winter and Save Water This Summer encourages customers to be mindful of their water use in the Summer. We are also undertaking a pilot project, called Project Cartref to undertake water audits of customers' homes to find leaks.

We have worked with the agricultural community through our Pest Smart and Weed Wiper catchment management initiatives. Weed Wiper, one of our pilot catchment management projects to improve raw water quality has delayed an investment of £10 million for additional granular activated carbon treatment (GAC) at Llechryd treatment works (as detailed in our Water Resources Business Plan).

8.5. AMP7 Plan


	Measures of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
	BI1 Change in average household bill	The average percentage annual increase in the average household bill over the 5-year period.	<RPI* ¹	<RPI	<=CPIH* ²
			¹ Retail Price Index	² Consumer Price Index, including housing costs	

Table 17: PR19 Measures of Success

Ensuring efficiency of our service for all will be critical to successful delivery of our AMP7 plan. Our plan includes an ambitious target to further reduce our operating and maintenance costs by around 12% a year in real terms by 2024-25. Overall, we will reduce our total costs by around £300 million (or 10%) over the next period as a whole, as compared to our current level of costs.

Efficient investments form a fundamental part of each of our strategic responses. We have provided some examples below of how we will achieve these challenging efficiency targets in AMP7:

Reducing our expenditure on energy and minimising our running costs

We will reduce our expenditure on energy to make our services more cost effective by identifying options to minimise the amount of energy we use to deliver our compliance and customer service objectives. We will also generate an increasing proportion of the energy we use ourselves and minimise the price of the energy we buy (as detailed in chapter 13). We will continue to develop process optimisation software across our network alongside individual treatment works to continue to drive down costs, ensuring that in conjunctive use systems the cheapest water is always maximised. Our 'Lean' programme will be rolled out to more areas eliminating unproductive tasks and focussing attention on equipment that fails more frequently, hence reducing operational failures and call outs.

Implementing operational improvements

We will continue to invest in collaborative catchment management through our WaterSource programme. By building on the AMP6 successes of PestSmart and the Weed Wiper initiative, we will continue to drive water quality improvements upstream of our networks and avoid requirements for costly treatment works upgrades (as detailed in our Water Resources Business Plan). We will continue consider a full suite of operational options before resorting to capital solutions. For example, we will make use of our Zonal Studies to target operational measures (as detailed in Chapter 5).

We will reduce reactive maintenance by investing in predictive proactive measures. We will support this by implementing our 'Calm Networks' project, enabling us to optimise pressure through dynamic operations and reduce pressure surges leading to bursts (as detailed in chapter 11).

Seeking procurement efficiencies

We will continue to work with our Capital Delivery Alliance of leading engineering and design companies to harness worldwide best practice to find the optimal scheme solution, whilst

maximising efficiency through a stable supply chain and a defined forward programme of work. We will continue to implement our Water Network Alliance to identify the most efficient design and construction options for our network improvements to ensure that we are implementing the most affordable solutions for our customers.

Working with customers and stakeholders

We will work with our customers to drive down leakage rates through the continuation of projects such as Project Cartref (as detailed in chapter 2). We will also work with social housing providers to include water saving devices in new properties or during refurbishment to reduce costs for our customers.

8.6. Long-term planning: AMP8 and beyond


	Measures of Success	Narrative	2025 target	2030 Target	2050 Target
	BI1 Change in average household bill	The average percentage annual increase in the average household bill over the 5-year period.	<=CPIH	=CPIH*	=CPIH*
*Consumer Price Index, including housing costs					

Table 18: Long-term Measures of Success

As evidenced throughout our long-term strategy Welsh Water 2050, we are committed to continued delivery of water services that are affordable for households and businesses in the long term. On-going activities which will help us to maintain affordable services will focus on improving efficiency and opportunities for us to innovate.

9. Strategic Response 9: Supporting customers in vulnerable circumstances



Figure 14: We want to tailor our approach to support all our customers in vulnerable circumstances, even on a temporary basis.

9.1. Drivers

Our customers can experience vulnerability through a combination of factors, including physical or mental health, financial conditions or a change in life circumstances (such as a bereavement or a job loss). We are acutely aware that the areas of Wales and England that we serve include communities that are amongst the poorest in the UK. Moreover, Ofwat has identified that 32% of households spend more than 3% of their income on water, while 15% spend more than 5%¹⁸. It is vital we consider the economic and non-economic factors that lead to customer vulnerability, so that we can tailor our services to meet the needs of all our customers.

9.2. Customer and stakeholder priorities

We have developed our strategic response for supporting vulnerable customers in our long-term strategy, Welsh Water 2050, following consultation with the Consumer Council for Water, in acknowledgement of the challenge of increasing vulnerability in the coming years.

Our customers think that bills and details of tariffs can be confusing for vulnerable customers. They also recognise that individuals can still find it difficult to access the help that we already provide, for example, due to barriers like making phone calls or using the internet¹⁹. They also believe that special provisions should be made to help vulnerable groups deal with outages¹.

Waterwise also recognises the significance of customer vulnerability and believes that efficiency in water supply delivery can be a method for helping these customers. NRW recognises the significance that any increase in our bills could have on vulnerable customers and supports using cross subsidy to reduce bills for those most in need.

9.3. Our approach

We recognise that many of our customers are vulnerable, and that the rate of vulnerability could increase in the future. Our approach is to use our Priority Services Register to tailor the ways in which we communicate with our vulnerable customers and prioritise the provision of emergency water. We plan to expand our register by working with third parties wherever possible. We are working closely with our customers to improve how we deliver this service, both through our consultation events and Rhondda Fach Water Resilient Community project.

We have been recognised as an exemplar company by both Ofwat, at the launch of their focus report on customer vulnerability, and by the National Mental Capacity Forum for the work we are doing to support customers. However, we recognise the need to continuously strengthen our approach to ensure we understand and respond to the vulnerability of all our customers, including those who might be vulnerable on a temporary basis.

Priority services register

Our register is a database of those who may require practical help due to, for example, visual impairment, hearing impairment, age, physical or learning disabilities or other medical conditions. This register ensures we can prioritise the provision of emergency water in the event of service disruptions. We also tailor the way we offer our bills, for example, ensuring they are provided in large print, braille, or audio format for our customers that require it.

Working in collaboration

We work with Wales and West Gas and Western Power Distribution to share data on customer vulnerability and provide a more effective service. We have also partnered with around 180 voluntary groups and charities to promote them directly to eligible customers, including the Cardiff Foodbank and the Citizen's Advice Bureau.

Other services to support customers in vulnerable circumstances are included in our PR19 Retail Business Plan.

9.4. AMP6 performance

Priority services register

At present, we have around 26,000 customers registered on our Priority Services Register, around 2% of our total customer base, which is considered relatively high for a water company. However, this is smaller than similar registrations for energy companies, who typically have around 8% of their customers registered. This could indicate that we aren't fully identifying our vulnerable customer base.

We have regularly attended Cardiff Foodbanks to sign customers up immediately onto our affordability tariffs and promote other support services. To further support the work of the Cardiff Foodbank, we also maintain their two delivery vans and provide a pool vehicle if one of theirs is off the road.

We have also funded a utilities debt advisor for the Pontypridd Citizens Advice Bureau. The advisor helps clients in debt and promotes our support schemes and priority services as well as provide further citizens advice support.

Working in collaboration

As part of our Rhondda Fach Water Resilient Communities Project (as detailed in chapter 7) we have been working with the local community to develop our social tariff and Priority Service Register strategy – including how we improve the sign-up process.

9.5. AMP7 plan


	PR19 Measures of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
	Sv5 Vulnerable customers on priority services register	The number of customers who are registered on our Priority Services Register	26,000	52,000	100,000

Table 19: PR19 measures of Success

Details of our plans for customers in vulnerable circumstances are provided in supporting document 3.2 (supporting our customers) and supporting document 2.5 (household retail business plan).

Priority services register

We plan to expand our Priority Services scheme by promoting it through third parties and through a targeted data-driven campaign. We already have links with over 150 organisations who we have trained in our affordability tariffs and will use our existing connections to maximise the exposure of the Priority Services Register.

Working in collaboration

In AMP7 we will adopt a community-centred approach, where we will advertise social tariffs and Priority Services at the same time as delivering infrastructure upgrades. We plan to expand our Water Resilient Communities Project to other communities, especially those that are economically disadvantaged and would most benefit from this customer-led approach.

More widely, we will train and support our colleagues so that they recognise factors that make our customers vulnerable and provide them with the knowledge and skills to respond or refer the customer on to a specialist team or external source of support.

9.6. Long-term planning: AMP8 and beyond


	PR19 Measures of Success	Narrative	2030 Target	2050 Target
	Sv5 Vulnerable customers on priority services register	The number of customers who are registered on our Priority Services Register	105,000	127,000

Table 20: Long-term Measures of Success

Into AMP8 and beyond, we want to use our data and systems and work with the UK Government and other utilities under the Digital Economy Act to better identify customers in vulnerable circumstances, whilst ensuring our customers' right to data privacy is protected.

10. Strategic Response 10: Addressing our ‘worst-served’ customers



Figure 15 : One of our colleagues at a customer engagement event.

10.1. Drivers

As highlighted in our long-term strategy, Welsh Water 2050, we believe that all our customers deserve the same level of service, and therefore we need to improve the service we provide to our customers who suffer from repeatedly poor service.

This investment focuses on improving the service we provide to ‘worst-served’ customers. Generally, we prioritise investment that benefits the most customers through a cost-benefit approach. However, this means that higher cost approaches that would benefit our worst served customers are overlooked and they continue to experience poor quality service over long periods. Currently, around 1,500 households in our operating area are designated as ‘worst-served’ across water supply and the wastewater service.

10.2. Customer and stakeholder views

There is strong customer support for investing to improve the situation for those who suffer repeated incidences of poor service. However, some of our customers are less supportive of paying to only improve the service provided for a relatively small number of our customers (see Supporting Document 1.1D).

CCWater has supported our focus on worst served customers and has highlighted acceptability of water for our worst served customers as a topic which should be a priority in the next five to 10 years.

10.3. Our approach

We recognise the issues faced by our worst served customers are not resolved by our targeted programmes, such as our Zonal Studies, and a new approach is required to achieve our long-term

target of zero worst-served customers. We will do this by developing minimum service standards for all and, under our innovative WaterFair scheme, not charging our customers for the period when they continue to receive a level of service below this minimum. Service improvements will be delivered through our Worst-Served Customers Strategy.

Our Worst Served Customer Strategy aims to address the longstanding complaints of worst served customers to ensure that everyone receives an acceptable level of service. Typically, this will be where these are not being resolved through our Zonal Studies or other programmes. We will target both worst served clusters and individual households where customers have experienced unacceptable levels of service.

Our 'worst-served' customers are those that experience:

- **Low pressure for 3 years or more:** Properties on the DG2 (low pressure) register; and/or
- **Water supply interruptions over a two-year period:** Properties that have had their water supply interrupted *at least once* in year one and *more than twice* in year two; and/or
- **Water supply interruptions over a three-year period:** Properties that have had their water supply interrupted *at least once* in year one, *once or twice* year two and *twice or more* in year three.

Our MoS for AMP7 and onwards encapsulated this definition of our worst-served customers. Our improvements in service within our Worst Served Customers Strategy are on these areas. As part of this strategy we will develop a minimum service standard for all, and any customer who does not receive this level of service will not be required to pay us throughout the period of poor service provision.

We have a range of approaches for addressing pressure issues, including maintaining or replacing air valves, pressures reducing valves (PRVs) and non-return valves (NRVs), improving the resilience of our pump supplies and improving the resilience of long supply mains that only serve a very small number of properties.

10.4. AMP6 performance


	PR14 Measure of Success	Narrative	2014/15 performance	2017/18 performance	2020 target (current forecast)
	D2: 'At risk' customer services - low pressure only	The number of customers who are on our register of 'at risk' at the end of the financial year. They are deemed to be "at risk" because their service has repeatedly fallen short.	702	613	425

Table 21: PR14 measures of Success

By listening to our customers in the development of our previous business plan for PR14, we were able to shape and adjust our AMP6 plan to ensure investments were made available to address long standing supply interruptions and low-pressure problems. In AMP6 we started our programme of proactively addressing our worst served customers and gathered data to support continued action in AMP7 and beyond. We are on track to meet our target for at-risk customer services by the end of AMP6. Our focus has been on replacing all our untreated supplies and targeting clusters of customer and planning solutions.

We have gained valuable insights into the geographical clusters of our worst served customers as well as the root causes behind some of the levels of service they have experienced. Based on these insights, we have developed a work programme for resolving them.

In AMP6, we connected five properties to the potable water supply network that previously only relied on a raw water connection and a domestic treatment system. We therefore have no remaining 'Point of Use Systems' (POUS) in our operating area.

10.5. AMP7 plan


	PR19 Measures of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
	Rt5 'Worst served' customers for water service	The number of customers that have had repeat incidents of low pressure or interruptions to water supply.	-	1131	871

Table 22: PR19 measures of Success

As an initial response in AMP7, we will introduce our new WaterFair scheme and will not charge for our water supply to those 'worst-served' customers who experience a repeatedly poor service until their issues are resolved.

Our interventions will include maintaining and replacing air valves, PRVs and NRVs. Where required, to resolve long-term low pressure, we will install pumps or alternative equipment to deliver pressure at greater than the statutory minimum. By the end of AMP7, we aim to have:

- Addressed low pressure complaints affecting 131 customers;
- Resolved repeated disruption to supply affecting 250 customers; and
- Developed minimum service standards for all, irrespective of cost-benefit constraints.

We aim to resolve long standing issues by funding improvements to deal with remote pump stations with intermittent power and small numbers of customers on long distribution mains.

10.6. Long-term planning: AMP8 and beyond


	Measures of Success	Narrative	2025 target	2030 target	2050 target
	Rt5 Worst served customer for water service	The number of customers that have had repeat incidents of low pressure or interruptions to water supply.	871	670	0

Table 23: Our PR19 long-term Measures of Success

We have a long-term target of zero worst served customers by 2050. We understand that the most complex and costly solutions are likely to be delivered towards the end, so the rate of improvement will reduce over the years. We recognise that the financial value of addressing our worst served customers will fall over time as we begin to tackle problems that affect fewer and fewer customers. Therefore, the benefit cost ratio will drop steeply as we tackle these problems.

11. Strategic Response 13: Smart water system management

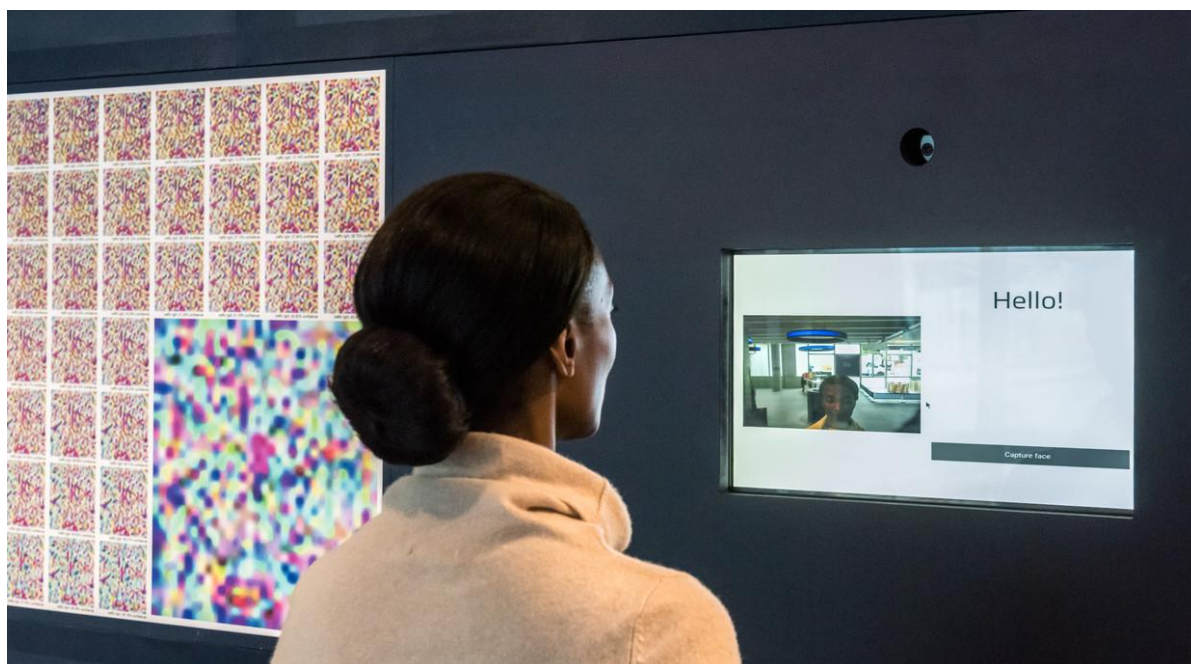


Figure 16 : Artificial intelligence – which could form a key part of the way we deliver services in the future. © Paul Carstairs/Arup.

11.1. Drivers

In our long-term strategy, Welsh Water 2050, we highlighted many of the critical challenges we face, including population growth, deteriorating raw water quality and ageing infrastructure. These complex and multi-dimensional challenges have been the drivers behind our focus on adopting smart technologies and changing how we use data. To meet these new challenges and take full advantage of the emerging possibilities that the development of smart technologies and data bring, we have developed our Smart Strategy.

Digital technologies will change what our customers expect of us. Emerging digital technologies will also change the way that networks are managed, with new opportunities for remote asset control and integration of networks. At the same time, digital initiatives will increase our vulnerability to cyber threats and drive a need for resilience against cyber-attacks.

11.2. Customer and stakeholder views

Our customers expect that future technology, such as analytical tools and enhanced monitoring, will help to eradicate supply interruptions. They also believe we will need increased resilience against cyber-attacks. Several of our stakeholders, including Waterwise, have told us that smart water system management should be a priority for us in the next five to 10 years, with a focus on water efficiency and metering.

11.3. Our approach

Technology and better use of data are vital components of our overall approach to mitigating the diverse range of challenges we will face going forward. They will also allow us to operate our sewerage network more efficiently and provide long-term value for our customers. Specific elements include:

- Proactively detecting leakage using acoustic and airborne devices;
- Upgrading SCADA, telemetry and control systems and installing additional pressures monitors to improve efficiency and achieve 'calm' networks; and
- Implementing better monitoring to understand and mitigate sources of quality and acceptability issues.

Through our Smart Strategy we have focused on achieving four main outcomes through the work that we undertake - leakage reduction, calm networks, asset resilience and asset compliance risk.

Demand reduction

To reduce leakage, our approach includes Project Cartref (Home), which combines a behavioural change campaign with new Stopwatch technology to reduce background level leakage in customers' homes. We will also implement new leakage monitoring technology to improve our identification of when and where leaks are occurring, rectifying issues quickly and reducing the impact on customers. These include acoustic sensing devices, drone monitoring and satellite monitoring. Smart water system management and smart meters can also ensure that we use potable water more efficiently, potentially reducing the need to abstract, benefitting the environment and relieving pressure on our assets.

Calm networks

We experience very high pressures in our distribution network compared to other water companies in England and Wales. We want to achieve low and predictable pressures through our distribution network, which we refer to as our 'calm networks' approach. We are installing pressure monitoring equipment linked to our SmartHub and control systems, to better monitor and manage our network pressure.

Asset resilience, control and sensing

Our approach is to harness technology to build reliability and resilience into our assets. We can do this by upgrading our legacy SCADA, telemetry and control equipment, and through our regional 'motherships' programme. Our 'motherships' enable centralised regional monitoring and intervention of assets, integrating SCADA and telemetry into a common platform. Smart sensing and water supply system management will allow us to improve service performance and respond to service failures predictively and help us provide a personalised service for our customers.

We are also improving our raw water quality sensing and sensors for emerging pollutants in partnership with our catchment interventions (as outlined in our Water Resources Business Plan) and are using customer connections as water flow and quality monitors.

11.4. AMP6 performance


	PR14 Measure of Success	Narrative	2014/15 performance	2017/18 performance	2020 target (current forecast)
	A3: Reliability of supply - minutes lost per property per year	Supply interruptions greater than three hours (expressed in minutes per property).	23	43	12.0

Table 24: Measure of Success

Our PR14 business plan acknowledged the enormous potential that advances in technology could have on the quality and affordability of the service we can offer our customers. As noted above we are on track to achieve our target of 12 minutes lost per property by the end of AMP6, in part due to our use of smart operational technologies.

Demand reduction

We are continuing to trial our Smart Meter programme in Grangetown, and Project Cartref in 20 water supply areas (as detailed in Chapter 2).

Calm networks

We plan to link our existing pressure loggers with predictive systems in our SmartHub by the end of AMP6, which will also help us manage leakage and improve the resilience of our distribution systems. We are also proactively addressing pressure issues by maintaining or replacing air valves, PRVs and NRVs.

Innovation: Our Customer Sentiment Dashboard



Our Customer Sentiment Dashboard is an interactive dashboard tool that we can use to better understand how customers feel about our service (also known as customer sentiment). It uses text analysis methods and other statistical techniques to evaluate sentiment based upon how our customers have interacted with us. By gathering and presenting this information in an easy-to-use and interactive dashboard, our staff can closely monitor customer sentiment across our operating area, identifying and focusing on areas for improvement.

Future development plans include the incorporation of social media data into the sentiment calculation, allowing us to identify sentiment from customers who choose to contact us via this medium.

The Dashboard is ultimately helping us ensure we earn the trust of our customers every day by understanding how our customers feel about us, and whether they are content with the level of service we provide.

Asset resilience, control and sensing

In AMP6 we successfully implemented our Smart/OT (operational technology) programme, the first and second phases of the cyber security programme, and the SCADA programme. These aimed to improve our smart water systems management, address the resilience of our assets and systems and update and replace obsolete legacy equipment. Within these three programmes we successfully replaced 70% of our outdated SCADA estate with new cyber-security compliant equipment and enhanced our control, automation and telemetry capabilities. Furthermore, we made significant progression towards Enterprise SCADA and integrating our telemetry systems. These systems allow us to better control our assets, improving their reliability and reducing CML. We have also installed or upgraded appropriate control valves and telemetry to allow fully automated control of high-level assets. We have implemented automated pump restart technologies at sites most at risk of power failure, reducing the risk of disruption to supply.

We have started developing our Water Distribution 'Control Groups' Operating Manuals. These will provide full details of how assets within that control group are managed and controlled and will help to improve the reliability of supply to our customers.

We have also implemented the first mothership, including the associated upgrade of SCADA and control equipment at our Bretton treatment works. This has allowed the site to go from 24 hours a day, seven days a week manned time to eight hours a day, seven days a week.

11.5. AMP7 plan


	PR19 Measures of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
	Wt4 Water mains bursts	The number of bursts of water mains.	4,181	3,700	3,600
	Wt5 Water process unplanned outages	Total unplanned outage as a proportion of the company's total production capacity (%)	-	-	0% change

Table 25: PR19 Measures of Success

In AMP7 we will continue to move towards creating a secure, resilient and efficient network using smart technologies, and will implement our Smart Strategy to build and operate a smart network of interconnected assets. These will contribute to reduced mains bursts, monitored by our MoS Wt4.

Demand reduction

We will implement new monitoring technology to optimise the water network, including acoustic logging, additional pressure logging and increased flow monitoring. This will allow us to identify when and where leakage is occurring and to rectify the issue quickly and efficiently.

We will continue to deploy digital smart meters in our deficit or marginal water resource zones, building on our work in Grangetown, Cardiff, and will expand our deployment of innovative stopwatch devices as part of Project Cartref.

Calm networks

In AMP7 we will move towards achieving a 'calm' network, using effective monitoring techniques and predictive analytics. This will ensure the pressure in our supply network is constant, predictable and efficiently managed with low levels of leakage.

We will replace 450 pressure loggers, which will allow us to analyse data more effectively, monitor pressure trends and undertake burst analysis to create more reliable pressure in our networks. This work enables us to optimise pressure through dynamic operations, as well as reducing water discolouration.

Asset resilience, control and sensing

In AMP7 we will continue to replace legacy SCADA, telemetry and control equipment to build the reliability and resilience of our assets and reduce our customer minutes lost. In tandem, we will continue to develop our regional mothership programme, with the aim of doubling in size by the end of AMP7.

We will continue to deploy new technologies as they mature by:

- Launching a low-power wide-area network (LOWAN) pilot to increase throughput from our sensors to facilitate the management of our networks;

- Researching and piloting better raw water quality sensors for detection and testing of known and emerging pollutants to support our catchment management activities;
- Launching a pilot project using customer connection as monitors for water quality, turbidity, pressure, pH, temperature and lead content for more targeted water quality monitoring;
- Developing a comprehensive robotics and artificial intelligence strategy, and extending the use of our deep learning tools as part of our journey towards more automation; and
- Implementing a new tailored visualisation tool, allowing us to respond more rapidly to emergency events.

As part of our commitment to working in partnership with stakeholders, we will launch an open data pilot project to share data with third parties, including NRW, Surfers against Sewage, Public Health Wales and others. This will increase the transparency of our operations and help us to co-create solutions with our partners going forward.

11.6. Long-term planning: AMP8 and beyond


	Measures of Success	Narrative	2025 target	2030 target	2050 target
	Wt4 Water mains bursts	The number of bursts of water mains.	3,600	3,500	3,100
	Wt5 Water process unplanned outages	Total unplanned outage as a proportion of the company's total production capacity (%)	0% change	0% change	0% change

Table 26: Long-term Measures of Success

In AMP8 we plan to upscale the pilot projects we are starting in AMP7, where these will bring proven value to our customers.

12. Strategic Response 14: Promoting ecosystems and biodiversity



Figure 17 : Zebra mussels attached to structures at Llandegfedd Reservoir

12.1. Drivers

Our long-term strategy, Welsh Water 2050, highlights that changing demographics, land use change, climate change and new sources of pollution all contribute to increasing pressure on the environment. A growing population could lead to habitat loss and fragmentation, while at the same time increasing the demand for abstraction. In addition, in the future we might be subject to new, more stringent environmental standards and legislation. At the same time, we know that an environment that supports biodiverse ecosystems benefits our raw water supplies and encourages public participation and engagement with the natural world. Considering our customer's priorities, the Well-being of Future Generations Act (2015) and our own commitment to becoming a holistically sustainable water service, we recognise that we have a duty to enhance biodiversity and promote the resilience of ecosystems in our work.

12.2. Customer and stakeholder views

This strategic response was added to our long-term strategy, Welsh Water 2050, due to customer and stakeholder feedback that protecting and enhancing biodiversity and the environment were key priorities.

Our customers want us to have a strong environmental conscience and reduce the impact we have on the environment¹. An important aspect of the feedback was the viewpoint that the countryside and rivers should be protected for wildlife, health and tourism benefits²⁰.

Many of our stakeholders, such as NRW, Wildlife Trust Wales and RSPB Cymru, also support our focus on fulfilling our biodiversity duty. The Wildlife Trust Wales has highlighted that healthy ecosystems and a resilient environment are fundamental to us and our customers, as they improve raw water quality, maintain healthy rural and urban ecosystems and provide value for money services. Stakeholders, such as the Canals and Rivers Trust, are also keen to work with us in partnership to improve ecosystems.

12.3. Our approach

A multitude of challenges threatens the integrity of our environment, and we want to mitigate this by protecting nature, enhancing biodiversity and promoting ecosystem resilience while we carry out our water and sewerage activities. Our Biodiversity Plan sets out our commitment to maintaining and enhancing biodiversity. Our approach includes working with our communities and colleagues to highlight the importance of the environment, as well as undertaking specific environmental enhancements, including our National Environment Programme as agreed with NRW.

Biodiversity Plan

We published our Biodiversity Plan in July 2017 and it sets out our commitments to maintain and enhance biodiversity to 2019 how our direction of travel going forward. This plan is required for us under the Environment (Wales) Act 2016 and we are the first public body in Wales to publish a biodiversity plan.

Community engagement and education

To increase public understanding of the environmental issues around water services, part of our approach us to use customer and community education programmes. These programmes aim to raise awareness of how we can work together and how the customers can contribute to protecting the environment and enhancing biodiversity through their behaviours

Collaboration with partners and stakeholders

We are actively promoting and funding more creative and collaborative approaches to catchment management, the protection of the environment and enhancing biodiversity. This can be seen in our WaterSource initiative (as detailed in our Water Resources Business Plan) and our work with the invasive-non-native species (INNS) funding scheme.

Encouraging colleagues and suppliers

We aim to ensure that our colleagues understand the importance of biodiversity and how to manage the threats to it. To achieve this, we will continue to educate and engage our people and ensure that staff can recognise invasive species and know how to manage them, by supplying them with training courses and the non-native species identification booklet.

12.4. AMP6 performance


	PR14 Measure of Success	Narrative	2014/15 performance	2017/18 performance	2020 target (current forecast)
	B1: Abstraction for water for use	Percentage compliance with our abstraction licences, as regulated by NRW.	100	100	100

Table 27: PR14 Measures of Success

Community engagement and education

In AMP6 we continued to engage with our customers through our community outreach projects, as well as expanding on already existing education programmes. Current and developing programmes include:

- Four current education centres, with a new Cardiff centre planned before the end of AMP6. These have been visited by 164,000 children to date, and almost half a million visits in total each year. These centres are run by environmental rangers and seconded teachers, providing children with free access to practical activities to learn about water, tours and nature trails;
- The River Schools Education Programme, in which we work in conjunction with Groundwork North Wales and NRW and with schools in catchments which are not WFD 'good' status to raise awareness of the importance of the environment;
- Our Education Plan, which has so far reached 67,000 children and young people in 2017/18. This educational activity is focused on primary school children, but has expanded out to older children including several challenges for the Welsh Baccalaureate. The lessons are conducted in 'Discovery Centres' or in schools as part of a wider outreach programme. The lessons and workshops are focused on key business objectives like water efficiency, RainScape and STEM promotion and are planned to also influence the parents of these children; and
- Our work with our customers on how to reduce water use, with the goal of reducing the amount of water abstracted from the environment. This is done through projects like Project Cartref, and our water efficiency auditing team (see chapter 2).

Encouraging colleagues and suppliers

To promote biodiversity among our colleagues, we have produced a booklet on 'invasive non-native species identification' and created an in-house e-learning course on biodiversity.

12.5. AMP7 plan


	PR19 Measures of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
	Wt7 Water catchments improved	The number of our WTWs with catchments designated as requiring Safeguard Zones	1	23	18

Table 28: PR19 Measures of Success

In AMP7 we will further continue to enhance biodiversity and the resilience of ecosystems, through research projects, customer education, improved catchment management, reduced pollution and collaboration with third parties. Our actions will help to reduce our number of Safeguard Zones, monitored by MoS Wt7 (as detailed in our Water Resources Business Plan).

We will continue to implement our commitments to improving our biodiversity plan and we will create an environmental improvement programme, running from 2020 to 2025.

Community engagement and education

We will make funds available to support community and volunteer groups who have projects to curb the growth and spread of invasive species. We are also looking to double the number of visits to our recreation centres to 830,000 visits a year, to engage more people in the natural environment²¹.

Encouraging colleagues and suppliers

We will raise awareness of our biodiversity duties to contractors and encourage them to play their part, whilst continuing our education and employee engagement programmes.

12.6. Long-term planning: AMP 8 and beyond


	Measures of Success	Narrative	2025 target	2030 Target	2050 Target
	Wt7 - Water catchments improved	The number of our WTWs with catchments designated as requiring Safeguard Zones	18	13	5

Table 29: Long-term Measures of Success

In the longer-term, where they add value, we will continue to increase the scope of our programmes from AMP6 and AMP7. Our work will contribute to a reduction in the number of Safeguard Zones, as monitored by MoS Wt7.

13. Strategic Response 18: Promoting a circular economy and combatting climate change



Figure 18 : Solar PB at Bolton Hill

13.1. Drivers

In our long-term strategy, Welsh Water 2050, we highlighted future trends that will affect us, such as climate change and more intermittent power failures. We also stated our commitment to playing our part in mitigating climate change and adapting to and building resilience against it.

In response to these challenges we have adopted a bold target – that we would become an energy neutral business by 2050. We plan to do this by:

- Minimising the amount of energy we use to deliver our compliance and customer service objectives by becoming more energy efficient;
- Generating an increasing proportion of the energy we use ourselves, renewably wherever feasible and economic to do so; and
- Minimising the price of the energy we use through our purchasing and time of use.

13.2. Customer and stakeholder views

Our customers recognise that many organisations have commitments to increase the proportion of their energy consumption from renewable sources and understand the importance of energy efficiency measures⁵. This is seen as an important area to invest in, and our customers would like us to continue to do so (see Supporting Document 1.1B).

Our stakeholders, such as RSBP Cymru, have also welcomed our ambition to become an energy neutral company.

13.3. Our approach

We want to increase our resilience to power failures and reduce our long-term energy costs, recognising that our customers' want to see us increase our consumption from renewable sources. Our approach is to boldly build self-generation capacity, reduce our demand by improving the energy efficiency of our assets and ensuring we can buy energy when it is cheapest where possible. We want our new energy generation capacity to be renewable where economic and feasible to do so, using hydropower, solar PV and wind turbines.

Our approach to becoming energy neutral by 2050 has been set out in our Energy Plan (Supporting Document 5.8T). This articulates our plans for energy efficiency, renewable energy production and demand side management and storage. This approach will enable us to better respond to price signals and therefore reduce energy costs.

Renewable energy generation

Our approach is to increase self-generation through wind turbines, hydropower and solar PV by acquiring existing assets and building new facilities on our sites.

Energy efficiency and purchase

Our approach is to continue to improve the energy efficiency of our assets by investing in low-power equipment, operating our assets more intelligently and driving behavioural change throughout our organisation. We also want to manage demand to purchase externally produced renewable energy at the lowest cost.

13.4. AMP6 performance


	PR14 Measure of Success	Narrative	2014/15 performance	2017/18 performance	2020 target (current forecast)
	C2: Carbon footprint	The total GWh of renewable energy generated within the year	14.02	42.38	55.6

Table 30: PR14 Measures of Success

Renewable energy generation

We have proactively invested in wind turbines, solar PV and hydropower at our sites and on our assets. We predict that due to these investments, we will significantly exceed our target of producing 17.78 GWh of renewable energy by the end of AMP6. We have also increased the number of solar PV projects at several sites, with the largest of these (750kW) at Felindre treatment works.

We have increased the number of hydropower sites we own through acquisition of generators already situated on our sites, but previously leased to third parties. We have also completed and made operational six of our planned eight new sites, with the final two planned to become operational by the end of 2018. This includes a 550kW hydropower facility integrated into the inlet of the new WTW at Bryn Cowlyd and an innovative 70kW facility at Mynydd Llandegai, both in North Wales.

Innovation: Mynydd Llandegai Hydropower Plant

We have installed hydropower generators at Mynydd Llandegai near Bethesda in North Wales. From studies conducted in AMP5, we discovered that installing generators on the two inlet mains would not be economically feasible, as the two mains operate at different pressures.

To overcome this, we had the innovative idea to combine the two inlet flows onto a single hydro turbine by connecting two different Pelton wheels to a single generator shaft. This enabled both sources to be balanced and drive a single turbine. This ensured that the costs were minimised and that we can produce up to 50% more power for a given flow compared to two separate generators. This is the only one of its type in operation in the UK.

Energy efficiency and purchase

The successful implementation of energy efficiency measures has meant that an overall increase in number of sites, part new and part ex-private assets, have not significantly increased the energy we consume.

We have reduced the energy used by our water business by improving the way our network is controlled and are currently ensuring that we have the most efficient pumps available. We have also started a programme to switch to LED lights at all but our smallest sites, which is supported by a behavioural energy efficiency programme that has reached over 500 colleagues over the last year.

Our overall AMP6 energy programme aims to reduce energy consumption by 5% between water and wastewater. We aimed to invest £26 million across water and wastewater to create savings of £3.8 million per year, and we have gone further than this by investing £32 million which has provided us with savings of £4.8 million a year.

In 2017, we secured a new energy contract through which all our sites are now powered by energy from renewable sources.

13.5. AMP7 plan


	PR19 Measures of Success	Narrative	2017/18 performance	2019/20 target	2024/25 target
	 Ft3 Energy self-sufficiency	Electricity generated, and gas injected to grid as a percentage of all electricity and gas consumed (gas expressed as an electricity equivalent).	20%	26%	35%

Table 31: PR19 Measures of Success

In AMP7 we plan to:

- Generate 35% of our energy consumption generated from our own sources. This will be achieved by both minimising the energy we use and maximising the energy generated;
- Continue to transition towards our long-term goal of energy neutrality by 2050; and
- Deliver value for customers through contributing to lower costs and therefore lower bills.

We will focus on three types of projects: renewable energy generation, energy efficiency and demand management and purchase optimisation. Our progress in achieving energy self-sufficiency will be monitored against MoS Ft3.

Renewable energy generation

The amount of renewable energy generation across the whole company will be increased to 30% of electricity use by 2021 and 35% by 2025. We plan to invest £4.5m to implement renewable generation at two sites, producing 5.5GWh and saving £571k per annum

We will build hydropower schemes on a mixture of reservoir outlets and treatment works inlets. These will include bringing hydro power back to Cantref, building on experience from Mynydd Llandegai to form an economically viable unit.

We will build on our solar and wind investments in AMP6. We will also look to innovate in how we deliver these schemes. For example, floating solar is becoming an increasingly viable option at our reservoirs. Within the clean water network, our total spending will be £723k resulting in savings of £99k per year within these three areas.

We have been investing in renewable energy for many years, and therefore there is a need for planned capital maintenance to enable them to continue to operate at full efficiency and maximise their asset life during AMP7. A total of £4.7 million will be invested for maintenance requirements.

Energy efficiency and purchase

Our energy consumption is predicted to reduce through AMP7 as we continue to deliver energy neutral solutions and reduce the energy used on existing sites.

We expect our total energy efficiency programme to save us 3.3GWh and £646k per year within the clean water network alone. These savings will be made possible by undertaking the following:

- **Pumps and controls:** 29 sites have been identified where pumps can be replaced with a more efficient pump, motor specification and network controls. We will invest £2.84 million and will save £520k and 2.3GWh per year going forward.
- **Lights:** We will continue to convert lights to LEDs. We will invest £633k over six sites which will save £126k and 1GWh per year going forward.
- **Smart networks:** Introducing smart network and asset control systems will allow us to maximise the efficiency of our assets, by e.g. ensuring that pumping only occurs when it is needed and for the correct length of time.

Energy costs could become increasingly variable dependent on the time of day at which energy is bought or sold. We will begin several schemes that will allow us to better respond to price signals, investing £825k and saving £95k annually.

13.6. Long-term planning: AMP8 and beyond


	Measures of Success	Narrative	2025 target	2030 target	2050 target
	Ft3 Energy self-sufficiency	Electricity generated, and gas injected to grid as a percentage of all electricity and gas consumed (gas expressed as an electricity equivalent).	35%	50%	100%

Table 32: Long-term Measures of Success

Our long-term plan is to achieve our aim of becoming a completely energy self-sufficient company by 2050, and in AMP8 and beyond we will continue to make progress towards this goal. We will build on what will have been completed in AMP7 and monitor our progress against MoS Ft3. Our 2050 aim of energy neutrality is heavily dependent on innovation and the development of new technologies, so we will continue to invest in trials and new technologies.

14. Summary

Our Water Network Plus Business Plan demonstrates how we will continue to meet our customer promises in the face of a diverse range of future challenges to our business. We have built this plan based on our range of recent customer engagement activities, and in alignment with our long-term Welsh Water 2050 Strategy. We have recognised that we will need to innovate and collaborate, whilst partnering with a wider range of stakeholders achieve our shared objectives.

We are confident that our plan delivers of Ofwat's priorities for great customer service, affordable bills, resilience in the round and innovation for PR19. We are excited to be embarking on a journey in alignment with our Welsh Water 2050 strategy, building an inclusive and resilient water supply business fit for future generations.



Figure 19: We are building a resilient water supply business fit for future generations.

Annex A: Additional documentation

The documents below are available on request.

Document title	Date	Comments	Strategic Response(s)
Brecon Beacons Mega Catchment Strategy	Dec-17	Our long-term strategy for how we will work in partnership to mitigate water quality pressures and achieve resilience of supply using catchment management measures in the Brecon Beacons.	SR1,SR2,SR5
Draft Water Resources Management Plan 2019, Welsh Water	Mar-18	Describes the water resources risks that need to be overcome between 2020 and 2050 to ensure we can meet our customers' long-term needs.	SR2
Making time for nature, Welsh Water		Our plan for maintaining and enhancing biodiversity in the work that we do.	SR1,SR14,SR18

References

- ¹ Welsh Water, Resilience Customer Research, October 2016
- ² Welsh Water, Water Resources Management Plan Qualitative Research, January 2017,
- ³ Welsh Water, Willingness To Pay Qualitative Research, August 2016
- ⁴ Welsh Water, Draft Water Resources Management Plan 2019, March 2018
- ⁵ Welsh Water, Customer Priorities Research, October 2016
- ⁶ Welsh Water, Deep Dive: Worst Served Customers Research, March 2017
- ⁷ Drinking Water Inspectorate, letter PERIODIC REVIEW 2019: Dŵr Cymru Welsh Water
DWI Scheme reference: DWR 4 - Merthyr Works - Taste and Odour, dated 30th May 2018
- ⁸ Welsh Water 2050 Stakeholder Feedback
- ⁹ Drinking Water Inspectorate, letter PERIODIC REVIEW 2019: Dŵr Cymru, Welsh Water DWI Scheme reference: DWR 2 – Acceptability, dated 30th May 2018.
- ¹⁰ Welsh Water DWI Submission, Annex A, January 2018
- ¹¹ Welsh Government, 2015, Well-being of Future Generations (Wales) Act, <https://futuregenerations.wales/wp-content/uploads/2017/01/WFGAct-English.pdf> [Accessed on 10th July 2018]
- ¹² Public Health Wales
- ¹³ Welsh Government Statistics and Research, data published 22nd March 2018. <https://gov.wales/statistics-and-research/households-below-average-income/?lang=en>
- ¹⁴ Welsh Water – Annex A- Proposals to carry out improvements for drinking water quality reasons – submission of information – Acceptability of Water - Submitted 19/01/2018
- ¹⁵ Drinking Water Inspectorate, letter PERIODIC REVIEW 2019: Dŵr Cymru Welsh Water DWI Scheme reference: DWR 1 – Lead Strategy- Lead, dated 30th May 2018.
- ¹⁶ Harvard International Review, The Essential Element: How Phosphorus Scarcity Endangers the World, 2016. <http://hir.harvard.edu/article/?a=13155>, accessed 07/08/2018
- ¹⁷ Consumer Council for Water, Response to Welsh Water 2050 Consultation
- ¹⁸ Ofwat, PR19 Framework Report, 2017
- ¹⁹ Welsh Water, Vulnerable Customers Research, January 2018
- ²⁰ Welsh Water, Environment Customer Research, March 2018
- ²¹ Welsh Water, Making time for nature: Dŵr Cymru Welsh Water’s plan for maintaining and enhancing biodiversity