

Ref 5.8G

# PR19: Water Network Maintenance

September 2018



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## Executive summary

### Overview of the investment

The continual supply of clean water to our customers on demand is the expected level of service. Our challenge over AMP6 and into AMP7 and 8 is to improve our interruption of supply performance, measured as Customer Minutes Lost (CML), Acceptability of Water (AoW) and the Compliance Risk Index (CRI) for water quality. With our large rural network and dispersed population centres, away from the South Wales coast maintaining our levels of service through maintenance activities and improving them through enhancement projects, represents a significant ongoing challenge to our business.

Whilst we have developed significant investment programmes focused on improving our service to customers it is important that we maintain our networks asset base to achieve a stable level of performance. This investment case describes the investment required to provide a stable asset base which can be improved by our proposed enhancement projects.

We are continually improving our monitoring, inspection and analysis techniques to understand our network assets more fully and to enable efficient delivery of maintenance activities. Our aim is to maintain service to customers and minimise the risk of asset failure resulting in interruptions to supply, discoloured water or other water quality issues.

Significant changes in our maintenance strategy for AMP7 include;

- A focus on the inspection and improved understanding of our tunnels.
- A programme of investment for our Pipe Bridges and Crossings.
- An increased level of inspection and assessment of our trunk mains.
- A modular approach to pipeline maintenance using desktop assessments and valve maintenance prior to pipeline replacement underpinned by hydraulic modelling.
- Proactive large water pumping station maintenance based on condition and maintenance requirements assessments.
- Delivered efficiently by our Network Alliance.

### The investment

We propose to invest £189 million during AMP7 to deliver the network maintenance programme across the company. This will be targeted at all network assets including the refurbishment and replacement of pipelines, pumping stations, bridges, network ancillaries, air valves and pressure reducing valves. This programme of work links with our other investments by supporting the enhancement projects to improve service to our customers. A summary of our planned maintenance programme for delivery in AMP7 by investment type can be seen in Table 1 below with the associated investment required.


Investment Category	Proposed budget Pre-Efficiency unless stated
<b>Bulk Meter Maintenance;</b> proactively replace input and network meters	£9.712m
<b>Pressure Reducing Valve Maintenance;</b> replacement of PRVs proactively	£8.704m
<b>Air and Sluice Valve Maintenance;</b> proactive replacement of air valves and sluice valves	£7.038m
<b>Clean Water Trunk mains;</b> Maintenance, inspection, replacement of pipes, bridges and tunnels. Includes non-potable mains	£25.416m
<b>Clean Water Network pumping stations;</b> maintenance, refurbishment and replacement of all pumping station elements including pumps, Motor Control Centres, Buildings and Generators	£22.751m
<b>Network ancillaries;</b> reactive replacement and repair of network ancillaries and pipes across the network	£72.999m
<b>Service reservoirs;</b> SRV maintenance including roof, inlet control, walls, bypasses and chlorinators	£16.972m
<b>Distribution mains burst clusters;</b> targeting replacement of frequently bursting mains	£15.157m
<b>Customer meters ;</b> Reactive maintenance of existing customer meters	£10.104m
<b>Pre-Efficiency Programme Total*</b>	<b>£188.853m</b>
<b>Post-Efficiency Challenge Programme Total*</b>	<b>£160.253m</b>


Table 1: Integrated Networks Maintenance programme for AMP7


\*It should be noted that the figures do not include the zonal studies and zonal outputs projects which are included within the AoW business case

## Delivering for our customers

This work will contribute to the achievement of the following of our customer promises:

- 

**Clean, safe water for all:** Improve the quality of the water provided to our customers through fewer interruptions to supply. Proactively maintain trunk mains, pumps and other network assets to return existing assets to their design capacity.
- 

**Put things right when they go wrong:** Reduce the number and repair times for burst mains and leaks by improving our response times through improved monitoring and operational practice.
- 

**A better future for all our communities:** Reduce the number of interruptions to supply and acceptability of water incidents for all our customers to bring our performance in line with industry averages. A proactive programme of maintenance will maintain current performance and provide a platform for further improvements.

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## Delivering for the future

In Welsh Water 2050, we identified future trends. The requirement for this investment is driven by the following trends:



**Climate change:** More extreme temperatures will increase the likelihood of burst pipes in the future.



**Changes in customer expectations:** Changing customer and societal expectations may require us to ensure that all customers have a minimum universal service standard.



**Protecting essential infrastructure:** Our ageing assets and cast-iron water mains present significant issues with reliability and water discolouration.

## Delivering our Strategic Responses

In Welsh Water 2050, we set out to deliver 18 Strategic Responses. This investment will contribute to the following:



**Improving the reliability of drinking water supply systems:** Providing more flexibility and capacity to deal with both short-term shocks and future trends.



**Protecting our critical water supply assets:** Provide greater reliability to water supply systems.



**Addressing our worst served customers:** Undertaking interventions to enable minimum service standards to be delivered to all customers.

## Achieving our measures of success

For PR19, we will measure our performance based on measures of success (MoS). This investment will contribute to achieving the MoS categories summarised in Table 2 below.

Measure of Success	End of AMP6 Position	End of AMP7 Position
Water supply interruptions (Wt2) - Supply interruptions greater than three hours (expressed in minutes per property)	12	8
Acceptability of drinking water (Wt3) - 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	2.4	2.0
Water mains bursts (Wt4) - The number of bursts of water mains	3700	3600
Tap Water Quality Compliance Risk Index (Wt1) - The DWI's Compliance Risk Index	-	0
Leakage - Leakage in mega-litres per day (MI/d) (En4). Three-year average	171	148.2

Table 2 – Measures of success supported by the network maintenance programme. (Improvements achieved through enhancement cases)

## 1 Delivering our customer outcomes

### Need for investment

This investment is required to underpin our plans to deliver reliable water of good quality to all customers - as outlined within our long-term strategy, Welsh Water 2050. We currently deliver water to 1.3 million properties, serving over 3.2 million customers through a network of 27,597km of potable mains, 353 potable service reservoirs to store the water and 621 pumping stations to move the water across Wales and Hereford.

Our plans for improvements are set out in the Customer Minutes Lost (CML) and Acceptability of Water (AoW) investment cases. We will not be able to achieve and sustain these improvements if the network asset base is not maintained to deliver a stable performance.

Our historic performance for CML and AoW has been consistently worse than the industry average across England and Wales.

Our maintenance programme will support the enhancement programme by identifying assets that require maintenance before they fail, for example those located in tunnels or on bridges where repair times and impact on our customers are at their highest. In common with the UK water industry, our pipeline system is steadily aging, which along with climate change will result in a greater number of burst mains over time.

Approximately 11,000km of our water mains are made of cast iron. These pipes also have reliability issues, and on average experience 30 bursts per 1,000km for cast iron pipes, compared to 6 bursts per 1,000km for plastic pipes. A summary of the main material types can be seen in Figure 1 below.

The other pipeline material which results in a significant number of failures are asbestos cement (AC) mains. There is approximately 3,500km of AC mains in our area approximately 12% of our entire mains network. Over the last five years there have

been around 1,000 bursts and leaks per year for mains of this type of material, a rate of nearly 60 bursts per 1,000km.

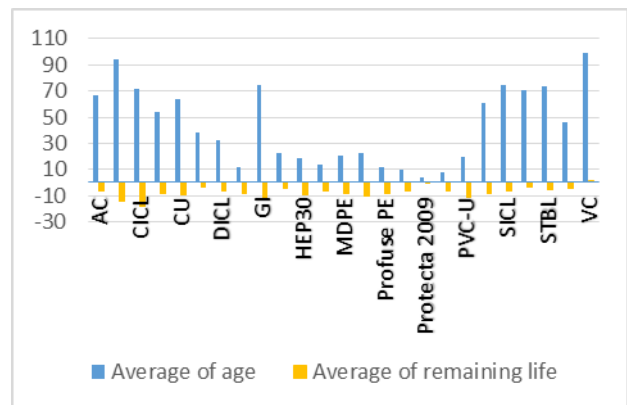


Figure 1-Trunk mains life remaining vs age by material<sup>1</sup>

Our aging water mains network consists of more than 5,000km of pipelines ranging from 200mm to greater than 1500mm. Although these trunk mains generally have a lower probability of failure, when compared with smaller diameter mains, when they do fail they affect large numbers of properties, >10,000 people.

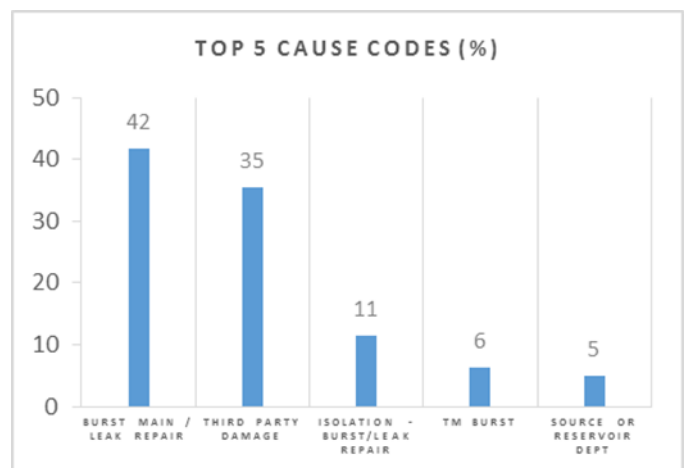


Figure 2-Causes of Interruptions to Supply

<sup>1</sup> AC=Asbestos Cement, CACL=Cast Iron Cement Lined, CU=Copper, DIDL=Ductile Iron, GI=Galvanised Iron, HEP30=PVC (PVC-A), MDPE=Medium density polythene (PE80), MOPVC=PVC (PVC-O) Mondial,

PROFUSE PE=PE Skinned, Protecta=PE Foil, PVC-U=U-PVC, SICL=SP Iron cement lined, STBL=Steel Bitumen Lined, VC=Vitrified clay



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The main causes of interruptions are burst mains and third party damage, see the top 5 causes of interruption to supply during 2016-17 in Figure 2 above. Trunk mains failure have the largest impact on our customers. Climate also has a significant effect on our distribution network as observed during the recent cold weather events in March 2018.

Our bulk meter and network ancillaries' maintenance programmes will allow us to minimise the effect of burst mains by providing an early warning of events and an ability to shut off mains for repair more rapidly where possible.

We have also assessed the performance of our water pumping stations and identified that reactive work orders associated with asset failure have doubled over the last 10 years, see Figure 3 below. Although a more efficient response to failure has been developed a more proactive approach to pumping station maintenance will be required going forward. Developing a greater understanding of these assets will help us to maintain our water pumping station performance.



Figure 3– 10 year summary of reactive Water Pumping Station Work order numbers

Our maintenance programme will provide a greater level of understanding of our strategic and trunk mains assets.

## Water Quality and Acceptability

Our structured programme of interventions for key assets such as trunk mains that address known problem mains will help us reduce the risk of unacceptable water during AMP7. The AoW business case will provide enhancements to our

performance, whilst this case will target those locations where asset maintenance is required.

By proactively repairing, replacing and cleansing network assets including mains, we will maintain the quality of water currently experienced by customers. We will repair and replace AVs and PRVs to help prevent burst pipes, which can lead to discolouration. Our maintenance programme will target the replacement and refurbishment of valves, chambers and other network ancillaries including bulk metering to meet our leakage targets. In conjunction with changes to operational practice this will provide wider benefits to our supply system.

AMP	Year	Source	No of contacts / 1000 population
AMP5	2014-15	Actual	3.29
AMP6	2017-18	Actual	2.79
AMP6	2019-20	Forecast	2.40
AMP7	2024-25	Forecast	2.00

Table 3-Actual and forecast AoW performance, AMPs 5, 6 and 7

## Reliability of Supply

Reliability of supply is the major metric we are trying to address with this programme with repairs, improved monitoring, surveys and replacement work. The below measures of success will be the key metrics to demonstrate whether the programmes of work agreed will be successful or not.

Measure of Success	End of AMP6 Position	End of Investment Position
Water supply interruptions - Supply interruptions greater than three hours (expressed in minutes per property)	12	8
Water mains bursts - The number of bursts of water mains	3700	3600

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Leakage - Leakage in mega-litres per day (ML/d). Three-year average	169	143
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Table 4 – MoS benefits dependent on network maintenance, (improvements delivered through enhancement cases)

We will also look to be more proactive with encouraging customers to assist with monitoring of our assets using social media and other campaigns to encourage customers to report poorly performing assets so that they can be tagged and repaired more readily. By increasing our monitoring throughout the network we will have a better image of how our network is performing, which should allow our focus for next AMP to move to a more proactive maintenance programme.

## Views of our customers and stakeholders

We have undertaken extensive consultation with customers through our PR19 preparation programme, including our Welsh Water 2050 strategy consultation held in the summer of 2017, which engaged with 19,980 of our customers.

Within our Welsh Water 2050 document our customer promise for, “Clean Safe Water for all,” was highlighted by our stakeholders as one of the most important aspects of our future plans, followed by providing reliability of supply and water quality<sup>i,ii</sup>. Customers have stressed that they want stable water quality and a reliable supply, including resilience.

Over the last two years we have consulted with our customers and stakeholders regarding their service expectations of their water supply. While many of our customers are generally happy with the current levels of service<sup>iii</sup>, customers have told us that long term interruptions of greater than 8 hours have a big impact and is considered to affect health and wellbeing. However, interruptions of three to six hours resulting from situations outside of our control for example the weather are not regarded as a big problem.

We have spoken with our customers to better understand their willingness to pay (WTP) for improvements to the reliability and acceptability of water. Table 5 provides a summary of what our customers would be willing to pay per affected property, demonstrating that our customers consider reliability of water supply to be an important area of investment.

Customer feedback measure	WTP per property
Short-term interruptions to water supply (3 - 6 hours)	£1,864
Short-term interruptions to water supply (6 - 12 hours)	£1,021
Long-term interruptions to water supply (24 – 48 hours)	£11,597
Discoloured water Long-term interruptions to water supply (up to 7 days)	£8,623
Taste and smell not ideal	£1,567
Discoloured water	£1,162

Table 5: Summary of stakeholder feedback and proposed willingness to pay (WTP)

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## Benefit for our customers

### Reliability of supply

Our maintenance investments are expected to improve the reliability of our water supply to customers. For example, our proposed investment to deliver additional trunk mains and clean water storage will reduce the risk of long term outages in our main population areas and increase the resilience of our strategic network. Additionally, to allow for the prompt repair of existing water mains, sluice valves need to be fully functioning. Figure 4 depicts our prioritised maintenance programme for sluice valves in AMP 7 in the SEWCUS operational area.

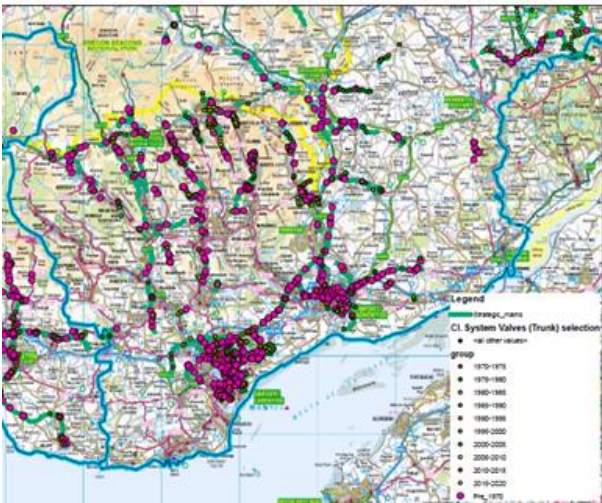


Figure 4- Sluice valves targeted in SEWCUS network as part of maintenance.

Table 6 shows our historic CML performance and our forecast performance between AMP5 and AMP7. The figures are based on our proposed level of network maintenance and CML enhancement investments.

Our forecast position by the end of AMP6 is 12 minutes per property for supply interruptions greater than three hours. This is forecast to fall to 8 minutes per property by the end of AMP7.

AMP	Year	Source	Supply interruptions >3 hours (expressed as minutes/property)
AMP 5	2014-15	Actual	23.0
AMP 6	2017-18	Actual	35.0
AMP 6	2019-20	Forecast	12.0
AMP 7	2024-25	Forecast	8.0

Table 6: Actual and forecast CML performance, AMPs 5, 6 and 7

### Affordability of bills

We understand the importance of balancing the need for this investment with the impact on the bills that our customer pay. To help ensure that our bills remain affordable, we have identified a range of efficiency savings within the proposed investment programme. These efficiencies will allow us to deliver the improvements that we know are important to customers, but at a lower overall cost.

### Wider benefits for Customers

The tools we have put in place and will continue to develop have a wider benefit to our customers. Having wider coverage of our network covered by hydraulic models means that we can respond more quickly to questions on how the system works and operationally respond to burst mains and other events more effectively. It will also allow improvements to our Developer Services team where we are now able to respond much more quickly to requests from developers and customers to connect to our network.

## 2 Investing for now and in the long-term

### Future challenges

Our Welsh Water 2050 strategy identifies significant trends over the next 30 years and how these will impact on us and our customers. The most significant trends in terms of our customer minutes lost performance are set out below.

### Climate change

We expect climate change to have an influence on our distribution network. There will be increases in peak demands as well as larger variability of ground movement after freezing and dry weather periods. This will result in increased numbers of pipeline failures, resulting in low pressure and interruptions to supply for our customers. The recent cold weather event in March 2018 is an example of the impact of climate on our network and the knock on effect to our customers.

### Changes in customer expectations

Changing customer and societal expectations may require us to ensure that all customers have a minimum universal service standard. This will mean that the service we provide our worst served customers will need to improve.

### Protecting essential infrastructure

Industrialisation and urbanisation in parts of our region led to the rapid construction of water supply infrastructure in the late 19th and early 20th century. A growing number of physical assets constructed during this period are expected to reach or exceed their design life within the next 30 years.

Our ageing iron water mains for example are increasingly at risk of catastrophic failure. As well as their age and condition, climate change and increasing volumes of traffic where pipelines cross roads, dual carriageways and motorways are all contributing to the increased likelihood of mains failure and long term outages.

### Land use change

Deindustrialisation in some of our supply areas means that our network is now oversized in places. When former industrial sites are developed contaminated land issues increase risk of corrosion and damage to our trunk mains and higher levels of failure at these locations.

### Legal duties

Our target to improve interruptions to supply (CML), Acceptability of Water (AoW) and Compliance Risk Index (CRI) performance is partly driven by the need to maintain and improve drinking water quality for our customers. Between 2015 and 2017 the DWI have issued notices to make improvements in 32 specific water supply zones. At specific locations they have targeted greater levels of resilience to our network resulting in fewer interruptions to supply that will have a beneficial effect on the quality and reliability of water supply to our customers.

### Planning for the future

#### Long-term planning

This project links with our Water Resources Management Plan (WRMP) and our long-term strategy to improve the reliability of drinking water supply systems, protecting our critical water supply assets and achieving acceptable water quality for our customers.

#### Building on progress

Our proposals are not the start of our journey. We have made significant efforts in recent AMPs to improve the resilience of our drinking water supply. SEWCUS is an example of a conjunctive system which provides resilience of water supply to customers in South East Wales. Our programme of work will build on the existing system by increasing the levels of connectivity and providing clean water storage which will allow operational staff to react

and re-zone the water distribution system to maintain supplies to our customers.

## AMP6 Progress

More recently, our focus has centred on customer minutes lost and its upstream root causes, including the increasing need to maintain network ancillaries, the use of our network by third parties and undertaking increased volumes of maintenance at night when system demand is low and sustainable via a tanker, resulting in no interruption for customers. Currently 94% of the Customer Minutes Lost (CML) are as a result of reactive bursts, this is following our move to undertake 30% of our planned maintenance activity at night.

Improvements to our SMART network management include the use of flow and pressure data to identify potential mains bursts more rapidly in the majority of cases before our customers inform us. The zonal studies outputs, including mains replacement, air valve and pressure reducing valves maintenance and replacement have resulted in a reduction in reactive mains failures.

We have developed a long term customer minutes lost strategy to guide our improvements in this area. The annual update is included as Appendix 1. Our strategy adopts a two-pronged approach to maximise the improvements that can be made.

The first aspect relates to improvements in operational practices. We have implemented a range of changes to how we manage the risk of discolouration in our network, including:

- Approach to planned maintenance, night work, improved risk assessment and project planning;
- Extensive valve training for internal and third-party operators;
- City & Guild training for Technicians to better understand hydraulic data and root cause analysis;
- Low-velocity flushing
- A new third-party partnership for standpipe management ; and

- Ice pigging in distribution systems

A key part of the strategy we delivered is an in Zone Pressure Monitoring Programme. Phase 1 of the programme included the installation and data provision of up to 3,000 pressure points across the network and was completed in 2017. The outputs of the programme enhanced our operational performance offering an average reportable reduction of 30% of interruption events. As part of phase 2 of this project we have released another £2m of funds to be spent on monitors to be delivered by the end of this AMP, to target areas affected by Storm Emma.

Zonal studies combine hydraulic modelling, statistical analysis, and capture the experience of local operations to identify the root cause of performance issues. The outputs from the studies are evidential, auditable and quantitative. This allows for targeted investment within the zone to most appropriately improve long and short term performance for the benefit of our customers.

The zonal studies are a tool that help to streamline our capital gateway process and provide a joined-up, strategic approach to investment. Although the main focus of these studies are improvements to the acceptability of water there are also benefits to CML levels.

To date, four zones have been completed - Holywell/ Mold, Malpas/ Caerleon, Whitbourne, and Llechryd. The zones are currently in their stabilisation period, however early indications of performance improvements are encouraging.

A fifth zone, Flint Connah's Quay is nearing completion but is also already demonstrating improvements in performance. Works have also now progressed into Bolton Hill (Pembrokeshire), Anglesey North, Abergele Rhyl, Maerdy and Hereford North. Table 7 provides a summary of the network improvements we have made to date. It shows that we have cleansed more than 182km of our mains and replaced a further 143km of mains.



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Intervention	2016-17	2017-18 to date	Cumulative Total
Total length cleansed (km)	18.49	164.26	182.75
Total length renewed (km)	80.25	62.65	142.90

Table 7-Summary of zonal studies outputs

During AMP 6 we spent approximately £15m on clean water pumping stations (WPS) maintenance, working on refurbishments and replacements at 11 WPS.

We have spent £7.5m on replacing customer meters to improve reliability of meter readings to provide an improved understanding of demand and leakage. We trialed a pilot area for SMART meters in Grange town in Cardiff to provide real time consumption and network performance data.

We have spent £9.8m on AV's, PRV's and other ancillary assets over the last AMP which has been largely managed by our zonal studies project. The rest of the budget, approximately £65m has been managed reactively by the local operational teams with assets fixed on failure. Replacing and refurbishing these assets is vital in response to maintaining a stable level of burst and leakage compliance.

During AMP6 we have spent £22m on reactive trunk mains repairs and replacements throughout Wales. The budget financed several key emergency replacements and repairs, along the Taff trunk mains for example as well as a number of key feasibility studies and surveys.

We spent £20m on SRV maintenance in AMP6 for a range of schemes including some feasibility studies which have influenced schemes in AMP7, Cefn Hirgoed refurbishment and Llwynypia Quarry studies showing the need to increase resilience for these sites. Planned SRV maintenance during AMP6 has been minimal and has been driven by the inspection and maintenance programme. During AMP7 we have developed a more targeted planned maintenance programme based on our SRV inspection data and operational feedback.

During AMP6 we have also introduced new training academies in the business to train internal and third party staff on valve operation to avoid causing discolouration or affecting water pressure. The two training facility sites are located at Glascoed and Llandegfedd.

## 3. Options

### Background

To deliver maintenance investment we use a mix of reactive and proactive approaches. For many assets the impact of failure can be managed for a reasonable length of time due to the flexibility built into our network so a reactive programme is the most cost effective approach. As we develop our analytical capability we will move to a more proactive approach but will always require some reliance on reactive investment. We prioritise our proactive investment using a risk based methodology, taking into account the impact on customers. We have assessed the programme for AMP7 looking at individual investment classes separately then brought all the information together to take a balanced view of risk across the whole asset base. We will continue to review this through delivery of AMP7 and rebalance the programme to manage emerging risk.

Key elements of the programme are:

- Maintain and replace networks assets which fail, ensuring network capability is maintained
- Maximising the availability of our monitoring and control equipment through proactive replacement and regular maintenance and calibration
- Targeting of water mains burst clusters to remove repeat failures and minimise customer minutes lost
- Addition of bypass arrangements to existing network service reservoirs to increase resilience and maintainability
- Continually improving our asset knowledge by inspections, desktop studies and operator feedback using the latest technology including drones and hand held data capture devices where required
- Proactively targeting maintenance activities across the network including bridges, water pumping stations and tunnels

### High-Level Options Appraisal

In the development of the Water Network Maintenance Investment Case, we have taken on board the challenges, both internal and external, identified in section 2. Our monitoring of business, regulatory and customer requirements has led us to develop and assess 3 plausible high-level options for performance and expenditure for AMP7:

- **Option 1 – Reactive only:** Defer any proactive intervention until AMP8 or beyond.
- **Option 2 – Decrease levels of maintenance investment:** Undertake reactive interventions and minimal proactive interventions.
- **Option 3 – Maintain end of AMP6 investment throughout AMP7:** Undertake reactive and proactive interventions to maintain performance at end of AMP6 levels throughout AMP7.

### Assessment of Options

#### Options 1 - 3

Option 1 has been ruled out (for most cases) because it is not a sustainable option. Deterioration modelling, which takes in to account increasing risk due to deterioration of the network assets has highlighted that a significant increase in failures will occur during the first 15 years, followed by an exponential increase in reactive work orders after 15 to 20 years. A similar increase in failure rates although at a lower volume would result from following the Option 2 approach. Option 1 and 2 however are the only options for cases where stock base is large and asset condition is not well known.

Our customer research demonstrated that our customers had no desire for a deterioration in service and through WtP research showed an appetite for stable to improving performance as a minimum. Our stakeholders, including our economic and environmental regulators, respective Governments and their relevant departments also show no appetite for a deterioration in service.

Option 3 aims to maintain the end of AMP6 performance for all relevant measures over the AMP7 period. This requires investment to offset asset deterioration, but there will be no overall

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improvement in service levels. Through our water networks pipelines deterioration model we have developed a set of investment scenarios which allow us to maintain or improve or allow a deterioration in performance of our asset base. A

combination of this maintenance case and the AoW case will fund a 3% improvement in performance, by replacing 430 km of trunk and distribution mains during AMP7 at an estimated cost of £133.4m.



## Trunk Mains and Tunnels

Our trunk mains are critical assets which carry large volumes of water throughout the network and if one of these pipes degrades and bursts it is not only a significant operation to repair but also has a larger effect on company performance for MOS's such as CML and burst mains.

Therefore careful consideration has been made into the investment options. The large diameter pipelines are generally at a low likelihood of failure. However, as the age of the assets increases the likelihood of failure steadily increases, increasing the risk of an outage which affects a significant number of customers. CML performance figures between 2012-13 and 2017-18 are presented in Figure 5. The figure shows performance worsening in 2017-18 but prior to storm Emma the company was on target to achieve CML objective for the year. Consequently no reduction in the investment for trunk mains is planned during AMP7.

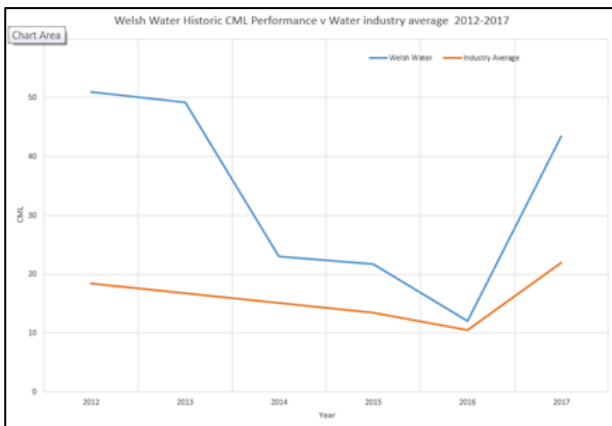


Figure 5 – Historic CML Welsh Water performance v Water industry average

A large amount of our network is either Cast Iron or Asbestos Cement and these materials are bursting more frequently and subject to catastrophic failures more regularly due to climate change and condition effects.

Option 3 provides the most suitable level of investment to provide stable performance to enable the enhancement projects to improve the levels of bursts across our area. This level of investment is supported by our deterioration

modelling scenarios, see the assessment of options section above.

The options of this programme of work were based around maintaining a budget available for reactive work based on the unknowns around asset health within our networks and the ageing assets we are dealing with, see Table 8 below. The table shows a summary of asset lives for asbestos cement (AC) and cast iron (CI) pipelines which indicates that 22% of total asset base is past the forecast asset life.

Option 3 provides the water assets teams some flexibility to develop schemes on a more proactive basis to reduce the risk of worsening performance resulting from our aging asset base.

Material Type	Average pipeline age (years)	Material usable life expectancy (years)	Total length of main (km)	% of total mains length greater than its expected life
Asbestos cement	66.5	60.2	3,346	8%
Cast iron	94	80.2	5,039	14%
Others			14,604	
<b>Total</b>			<b>22,990</b>	

Table 8-summary of asset lives for network mains assets

Table 8 above indicates that approximately 22% of our overall network is made up of AC and CI mains which are beyond their usable life and as a result put performance at risk. We estimate it would cost £1.5 billion to replace all these mains and over the budgets of zonal studies and trunk mains we are proposing a programme of about 10% of this cost.

## Service Reservoirs

Service reservoirs are a key part of our network for maintaining customer supplies and managing pressure and mains health. This is a key component in the company's compliance of DWI targets for bacteriological compliance. This is the key driver for investment for the next AMP, by properly maintaining our 472 service reservoirs.

We are currently on target to achieve 99.98% compliance this year. During AMP6 we have

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reduced the number of failures at service reservoirs and aim to maintain this level of performance in AMP7, see Figure 8 below.

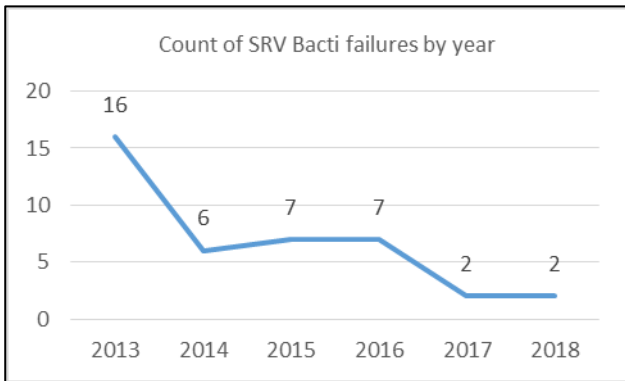


Figure 8- number of Bacti failures by year since 2013

of reactive work orders have been increasing year on year and for the 10 years from 2006 see Figure 10 below. These results were used when developing the water pumping station deterioration model in 2016.



Figure 10-reactive works orders on the increase

One of the tools we are using to drive the programme is our industry leading Bacteriological failure prediction model, see Figure 9, which looks at available data from previous bacteriological samples and live chlorine data to predict which reservoirs are at a higher risk of failure. This provides the top sites targeted each month for inspection and maintenance.

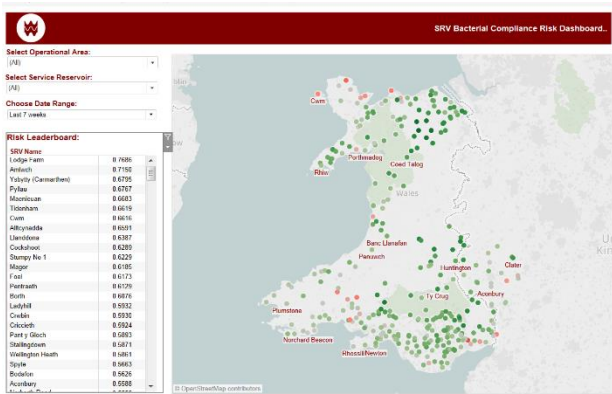


Figure 9 -industry leading bacteriological model

This will be one of the many tools used to help us deliver a more targeted and effective reactive maintenance programme.

## Clean Water Pumping Stations

In AMP6 the vast majority of work done on water pumping stations has been based on a reactive work programme. This has been demonstrated to be detrimental to the company’s performance for asset failures and costs. The failure rate in the form

## Bulk Meters

Our Bulk meters investment programme will target the replacement of meters and loggers that will more accurately allow us to measure demand and normal flows across the network, supporting the achievement of our improved leakage targets. Figure 11 below provides an overview of bulk meters split by type between Trunk and Distribution mains.

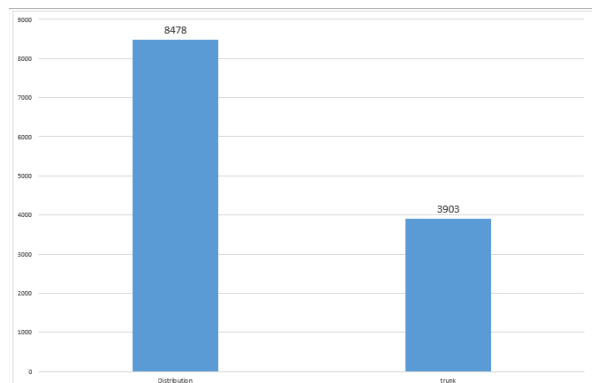


Figure 11 – Summary of All Welsh Water Trunk and Distribution bulk meters

Our Bulk meter asset stock is currently older than we would want it to be. We are aiming to proactively replace meters greater than 50 years old over the next three AMP periods. The number of meters by age band can be seen in Figure 12

below. The older meters will have a higher likelihood of inaccurate meter readings than a new meter.

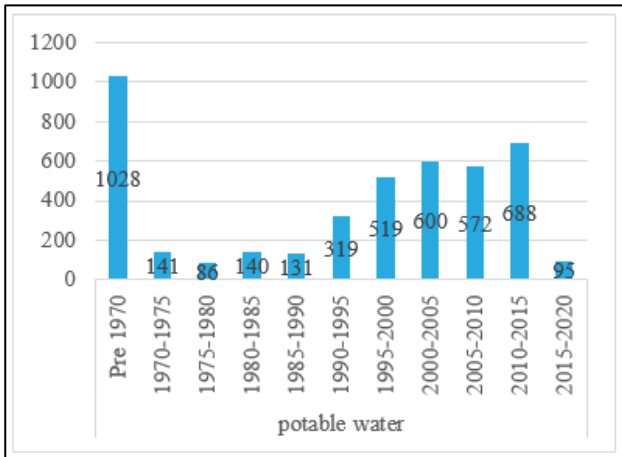


Figure 12 – Age profile of bulk, abstraction, leakage and district meters for trunk mains

There are a great number of meters to monitor and replace which contribute to our understanding of usage and leakage. They are also a key part of driving our SMART network during AMP7. Therefore we believe Options 1 and 2 would not be acceptable for these assets.

The proactive approach, described in Option 3 will provide a planned meter replacement to enable high priority meter replacements to be planned and undertaken as well as reactive replacements. Our programme will look at a strategic replacement regime based on calibration data, local expert knowledge of strategically important meters for understanding of demand and work out from there. We will also have an element of reactive budget available for issues.

## Pressure Reducing Valves

PRV's play an important role in regulating pressure within our network at target levels to maintaining supply and reducing the risk of pipeline failure. Variations in pressure and pressures above design standards cause stress on materials resulting in a high probability of failure, leading to discolouration events and supply interruptions.

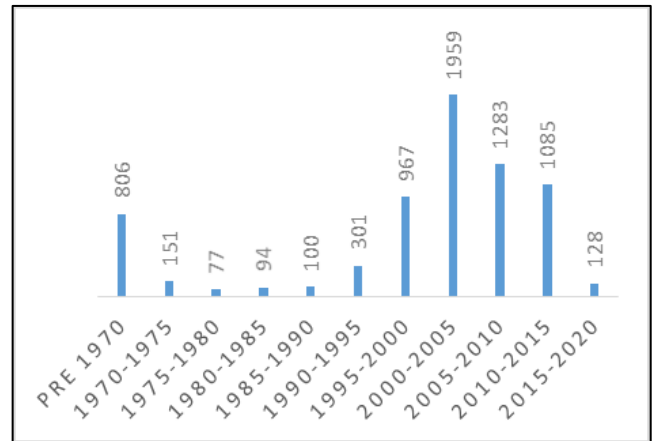


Figure 13- Summary of Welsh Water Trunk and Distribution pressure reducing valves meters.

The PRV asset base is currently operating well beyond their forecast useable lives. The asset age profile can be seen in Figure 13 above which indicates that of our total 6,951 PRVs over 800 are at least 50 years old. This results in a higher rate of failure, higher levels of maintenance and increases the risk of mains failure.

Using this analysis we believe a totally reactive replacement programme would put customers at a higher risk of interruptions to supply. Therefore option 1 would not be acceptable for this asset. The limited proactive replacement within option 2 will not achieve our required outcome from this maintenance programme of stable service to customers.

Option 3 is our chosen option for this asset type. It will support our delivery of challenging targets for leakage and CML during AMP7. These assets are an integral part in maintaining the asset life of our water mains and regulating pressure to reduce bursts. We are targeting PRVs of a proactive and prioritised basis alongside our (modulus) replacement programme and the reactive replacement of failed assets.

## Air Valves and Sluice Valves

Sluice valves allow our pipelines to be isolated and maintained. We have almost 200,000 sluice valves across our network, which are summarised by age in Figure 14 below. Of these around one third are at

# Water Networks Maintenance

least 50 years old significantly increasing the risk of failure.

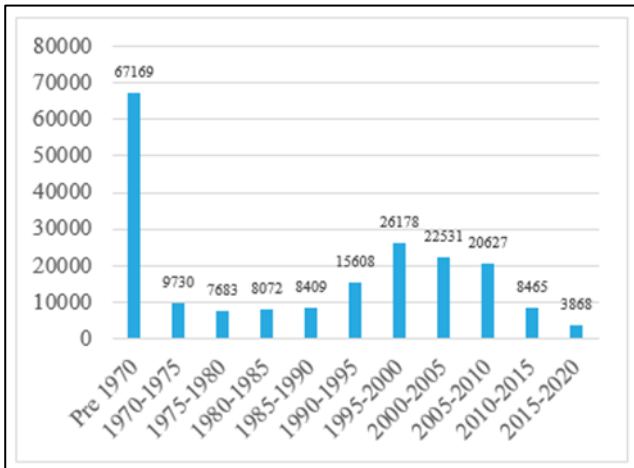


Figure 14- Overview of total asset stock of Sluice valves

Due to the scale of the asset base we feel option 2 is the most suitable programme of work for this asset. This is because we would like to undertake an element of planned maintenance but the scale of work required to achieve option 3 is unrealistic in AMP7. On a proactive scale we need to increase the monitoring and understanding of the health of the asset stock so that in the future we have a better idea of which valves are likely to need attention. We will concentrate first on those valves which are at higher risk, be that strategically or aged based risk.

The replacement of roughly 1% of asset base will link to the zonal studies outputs to target the proactive replacements. The aim of the programme will be to help reduce CML, interruptions to supply and AoW. An operable sluice valve facilitates the rapid isolation of a burst or leaking main reducing outage times for repairs and minimising leakage.

Air valves remove air in the network which can cause pressure build ups and reduce capacity resulting in mains failure. When operating effectively they allow air to be removed from the system. In-operable or faulty air valves can lead to excessive pressure build up in the system which leads to bursts.

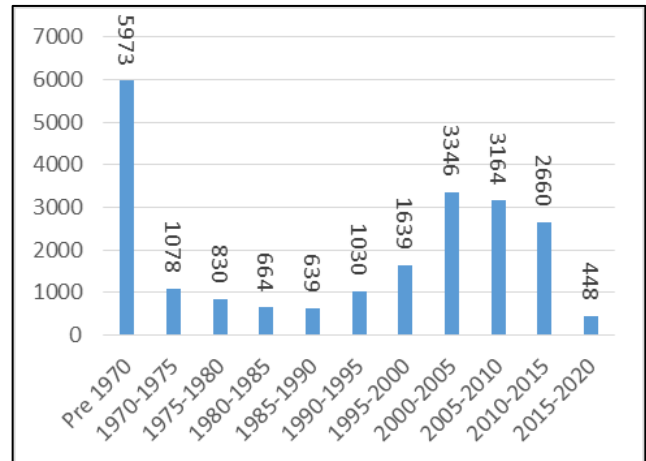


Figure 15 – overview of air valve asset total stock

Figure 15 above provides an overview of our air valve asset stock, which total 21,471. It can be seen that approximately 6,000 of our air valves are older than 50 years and which is significantly greater than the expected asset life of around 30 years and are at a higher risk of failure.

This asset base is large and it would be impractical to assess all of the asset base to prioritise maintenance. We will target significant air valve locations for planned inspections and maintenance and the rest of the programme will be undertaken on a reactive basis. Therefore, option 2 is our choice for this asset type.

## Distribution Mains

We have approximately 25,712km of distribution mains in the network carrying water from our trunk mains to supply water to our customers.

We have a good idea of the condition of approximately 50% of our distribution mains through the AMP6 zonal studies programme which has analysed issues across our Water Quality Zone (WQZ)s. This holistic approach will be rolled out across the whole organisation by the end of AMP7 improving performance for AoW and CML through the replacement of mains and valves within our enhancement cases for CML and AoW compliance.

Within this case we are looking to maintain our performance for distribution mains. The development of care plans to maintain network performance following the improvements

introduced by the zonal studies will be continued in AMP7. Of the mains identified as needing replacement within the zonal studies we will monitor their burst performance and prioritise replacement of sections of mains which burst most frequently.

Although the CML and AoW enhancement cases will improve service there is still a need to assess the performance of the distribution mains based on frequency of burst to try to understand where strategic investment is required. The diagram in Figure 16 below shows some of the work done to assess these areas of poor performance and define the most appropriate intervention.

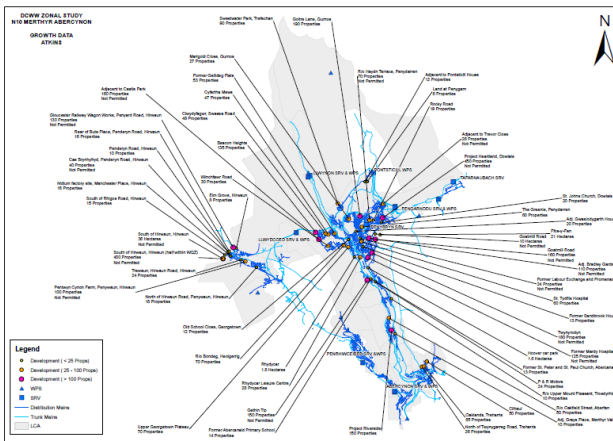


Figure 16 – Desktop assessment process for mains interventions

Using this data we will follow an option 2 approach improving a few areas not currently addressed within the AOW or CML investment cases. The majority of the work will be undertaken reactively using burst frequency to target investments.

## Network Ancillaries

Network ancillaries encompasses many different assets from the network including stop taps, hydrants and washouts, see Table 9 below.

Ancillary Type	Number of assets /length
Communication Pipes	42,924
Stop Taps	Approx. 1.3m
Hydrants and Washouts	115,564
Frames and Covers	Approx. 7,200

Table 9- Summary of network ancillary assets

There is a large asset base which increases due to population growth and increased demand resulting in new connections to our networks and increased mains capacity to supply the new properties. For this type of asset options 2 and 3 are not viable due to the size and age of the asset base. Consequently option 1 is our chosen method to maintain the asset base, replacing assets as they are found to be faulty.

During AMP7 we will look to incentivise customers to have a greater ownership of assets near their homes and in their local community to help us understand when asset fail, for example stop taps or hydrants. This will allow us to repair or replace assets more quickly reducing the levels of leakage and possible interruptions to supply.

## Customer meter maintenance

Although the current meter maintenance programme of work is entirely reactive our metering stock is both increasing in number and age. Between 2011-12 and 2017-18 the number of measured households and non-households increased from c505,000 to c626,000, an increase of approximately 24% over the six years. As a result of the growing number of water meters across our area during AMP7 we are planning to undertake a larger number of reactive meter replacements.

As a result of a reactive only metering plan we have a large proportion of our asset stock of greater than 20 years of age. As result of this we are planning to undertake an element of proactive replacement in AMP 7 to target the replacement of older meters to improve the accuracy of the company's data. Over time we will aim to have no customer meters greater than 20 years old.

In support of our proactive replacement programme there is research by the water research council, for example the CP188 study. This study assessed the long term performance of domestic water meters. The study demonstrated that meters of up to 12 years old showed a gradual increase in under-registration and failure rates when compared with new meters.



# Water Networks Maintenance



## Analysis of future needs

Our intervention programmes have been developed using a range of information and data including; deterioration modelling, our Investment Manager system, data analysis and operational intelligence from a range of teams across our business. We have made use of deterioration models to predict pipeline failures and to understand the future network maintenance programme.

We are now beginning the investigations and reviewing our deterioration models to enable us to identify investment needs for AMP8.

## Assessment

Our performance for MOS's in section 1 (especially CML) is already well below the industry average and the extreme cold weather events in February/March 2018 affected our CML performance significantly adding approximately 30mins to our CML performance figure for the year. Our worst served customers and worst performing water distribution zones are at risk of continual

deterioration without further investment in AMP7. This means that "option 1 – reactive only" is not tenable for all investments.

By considering integrated solutions which can provide multiple benefits to multiple MoS, improvements will result, for example, a scheme to replace a poor condition iron main is likely to improve the risk of burst failures and reduce the risk of problems with discolouration. Consequently options 2 and 3 have been identified as the chosen solution for many of our intervention types

The main benefit of our chosen solution options is that it maintains performance for each of the investment areas at the lowest total expenditure (totex) option to maintain our network performance. This will underpin our enhancement programmes of work achieve our low pressure, AoW and CML targets.

The next stage of work is to undertake detailed feasibility for the more complex projects and for the lower value interventions develop fully prioritised programmes so that the cost, scope of work and benefits are fully understood.

## 4. Preferred Option

### Option

For this case we have assessed the needs of the individual investment categories as listed below and come to the conclusion that a balanced approach is required, where the individual needs are assessed to give the customer the most benefit for their service.

Measures	Option picked	Contribution from this expenditure	Improvement from enhancement expenditure
BMs	1	Stable +	✓
PRVs	1	Stable +	✓
AVs	2	Stable +	✓
Trunk mains	3	Stable +	✓
Water pumping stations	3	Stable +	
Network ancillaries	1	Stable +	✓
Service reservoirs	3	Stable +	
Distribution mains burst clusters	2	Stable +	
Customer Meter maintenance	2	Stable +	

Table 10 - Identification of chosen options by measure

### Programme Overview

There are eight individual investment categories which contribute to this network maintenance investment case. A summary of the Network Maintenance programme by investment categories are outlined in Table 11 below.

Programme of work	Proposed Programme Pre-efficiency budget
BMs	£9.712m
PRVs	£8.704m
AVs	£7.038m
Trunk mains	£25.416m
Water pumping stations	£18.264m
Network ancillaries	£72.999m
Service reservoirs	£16.973m
Distribution mains burst clusters	£15.157m
Customer Meter Maintenance	£10.104m
<b>Total Pre-efficiency</b>	<b>£188.853m</b>

Table 11- Summary of the Network Maintenance Programme

### Clean Water Trunk Mains

The raw and clean water trunk mains programme includes non-potable and potable mains;

We have split the programme of work between reactive and planned maintenance. Planned maintenance will be driven by local knowledge and the use of Investment Manager to prioritise which pipelines and assets require replacement or further inspection. A summary of the trunk mains maintenance investment programme can be seen in Table 12 below.

Programme of Work	Budget
Non Potable mains PCM	£2.067m
Trunk mains PCM renewals and maintenance schemes	£19.944m
Trunk mains RCM	£3.405m
Total pre-efficiency	<b>£25.416m</b>

Table 12-Trunk Mains programme summary

# Water Networks Maintenance

## Trunk Mains

The potable trunk mains programme will include a programme of condition inspections, planned replacements of existing mains and their associated network ancillaries as well as planning for a programme of around 20 reactive replacement/repairs on failure. The planned programme is based on identified risks and has a number of named schemes, for example improvements to the Alwen pipeline to enable it to be restored to its original capacity.

Other refurbishment and replacement of existing pipelines include Bolton Hill where refurbishment of bitumen pipelines for about 10km of main is planned.

Supporting the development of our Trunk Mains programme has been the development of a pipelines deterioration model which indicated that in order to reduce bursts by 3% and improve service approximately 430 km (distribution and trunk) of main should be replaced during AMP7. Between the AoW, CML and Trunk Mains investment cases this target will be achieved.

## Non Potable Mains

Non potable mains are mains which carry partially treated or raw water from some of our raw water sources directly to industrial customers. The programme of work is to understand our asset base more fully by undertaking condition surveys as well as undertaking maintenance of the valves and meters across the asset base.

Table 13 below provides a summary of the non-potable mains asset base.

Mains	Length (m)	Pipe Material	Number of repairs on system since 2002
Ashgrove	20,199	Steel	10
Llandeilo	1,501	Spun Iron	7
Halkyn	12,863	Steel	0
Biglis Wells	9,862	Cast Iron	13

Lisvane	10,790	Steel	52
Ely Wells	18,407	Cast Iron	10
Court Farm	8,287	Steel	1
Sudbrook	10,412	Ductile Iron	14
Ffelinfoel	1,206	Cast Iron	10
Bolton Hill	16,682	Asbestos Cement	2
Canaston Bridge	31,276	Steel	2

Table 13—non-potable mains, material and failure rate

## Tunnels

For potable water tunnels the programme will consist of a series of assessments and surveys to better understand the health of the asset base, to have an idea of programme requirements for AMP 8.

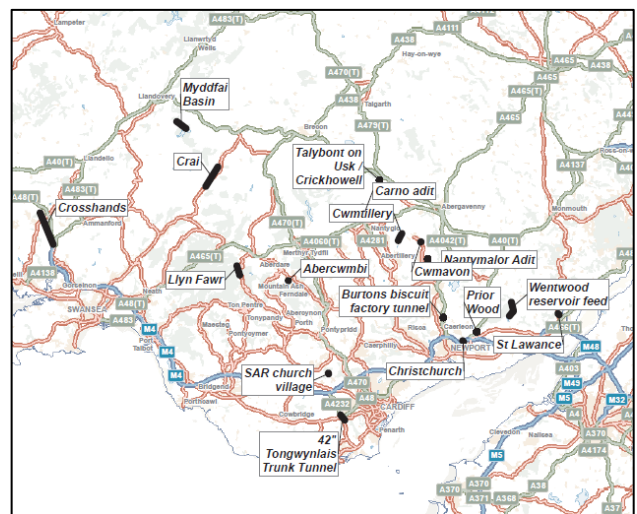


Figure 17- south wales tunnels on GIS

Figure 17 above demonstrates the tunnels in the south of our area. Across our area there are 10 clean water tunnels which will be assessed through this programme and 10 tunnels included within the raw water distribution programme including Crai and Cross Hands.

## Service Reservoirs



# Water Networks Maintenance

The budget for service reservoirs is split into two categories for maintenance, planned and reactive maintenance, see Table 14.

SRV Programme	AMP7 Budget pre-efficiency
SRV PCM (AMP6 run rate)	£13.567m
SRV RCM (AMP6 run rate)	£3.405m
<b>Total Pre-efficiency</b>	<b>£16.972m</b>

Table 14-Summary SRV programme

The maintenance programme will include planned capital work for example; abandonments, sample taps and roof repairs as well as chlorination and reservoir bypasses.

For AMP7 we propose to invest £2.1 million in the installation of bypasses at service reservoirs based on a priority list. A sample of eight sites has been reviewed in detail, which has allowed us to understand the overall size of the programme required.

There is also a reactive element of the budget which is based around AMP 6 run rates to address asset failure and issues identified by our inspection and maintenance programme.

## Clean Water Pumping Stations

Water pumping stations are a key component for moving water around our network system. The maintenance programme for pumping stations has identified a larger proportion of the budget as proactive maintenance than the majority of the other programmes. The investments will include pump replacements, MCC panel replacements, emergency generators and new telemetry systems for pumping stations.

This programme of work will also look to support the company’s vision of a SMART network by factoring in compatibility within the design to ensure new installations are able to integrate into our developing system.

Programme of work	Budget
WPS - PCM (Distribution)	£16.942m
WPS - PCM (WTW)	£3.940m
WPS – RCM Deminimus	£1.868m
<b>Total pre-efficiency</b>	<b>£22.751m</b>

Table 15-Summary Water Pumping Station programme

Table 15 above outlines the investment for water pumping stations for the coming AMP which will consist of mostly capitalised maintenance projects as well increasing the understanding of our assets and increasing the modelling of our assets.

## Bulk Meter Maintenance

The Bulk meters programme will consist of a reactive programme of work, split into to two. A programme to replace the input meters that have been already been identified as being faulty and significantly out of calibration and programme of work to replace faulty meters and loggers when they are identified. Our investigation and replacement programmes will prioritise our older and more strategically important meters to provide the most accurate data for larger populations to improve our understanding of demand across the network. The age of some of our meters currently extends beyond 50 years well beyond the expected asset life of meters. Our investment programme will target reducing the average age of meters towards 30 years over the next 10 to 15 years.

This programme will also focus on more asset surveys and calibration assessments to improve our knowledge of the asset base to further improve our planning for our AMP8 investment programme.

During AMP6 the importance of bulk meters has increased. Their traditional use to accurately measure water demand and leakage across the business has been widened to include SMART and the proactive identification of bursts and other incidents. In order to obtain real time data from our bulk meters from across the network we need to obtain non-standard flow results using logger alarms via telemetry or GSM. Our maintenance programme will concentrate on the replacement and refurbishment of loggers.

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A separate programme of bulk meter and logger upgrades is covered within the Customer Minutes Lost Investment case. The programme increase the number of meters and loggers to improve our real time flow monitoring and its accuracy across our network to support our leakage programme and our SMART networks programme.

## Pressure Reducing Valves

Pressure reducing valves are an integral part of the network system regulating pressures across the network and minimising significant fluctuations which increase the likelihood of bursts and mains scouring.

The maintenance programme for PRV's will be managed reactively, undertaking maintenance and replacement when asset failure is identified. Due to the budget constraints we will prioritise our investments on strategically important assets such as the conjunctive use systems or pipe systems identified by the zonal studies or other assessments for pressure maintenance. This programme also includes an increased level of surveys including asset assessments to improve our understanding of asset health. This will be used to develop a more proactive programme for AMP8.

The PRV programme, see Table 16 for a summary is based around reactive replacement of failing assets which contribute to poor performance (leakage, bursts, AOW events). As well as targeting Modulos PRV's which have become obsolete and replacing these valves with valves that will allow our network to be SMART.

Programme of Work	Pre Budget	Efficiency
Total Network Mains PRV replacements	£2.275m	
Total Trunk Mains PRV replacements	£6.131m	
Trunk Mains PRV Maintenance and inspection	£0.298m	
<b>Total pre-efficiency</b>	<b>£8.704m</b>	

Table 16- PRV programme summary

A portion of the budget will be used to maintain or relocate PRVs in areas where network management schemes are being implemented. Our work in North Wales has resulted in reduced numbers of burst as well as discolouration events.

## Air Valves and Sluice Valves

The Air and Sluice valves programmes are broken down into new, proactive and reactive replacements. The new air valves will be installed as part of our network maintenance programme to target areas where air build up becomes an issue and increase the risk of burst mains.

Programme of Work	Budget efficiency	pre-
Air Valves - New Schemes	£0.637m	
Air Valves - Proactive Renewal	£1.148m	
Air Valves - Reactive Renewal	£2.189m	
Sluice Valves - Proactive	£2.043m	
Sluice Valves - Reactive	£1.022m	
<b>Total pre-efficiency</b>	<b>£7.039m</b>	

Table 17- AV and Sluice Valve programme summary

The plan for this programme will be to identify locations where we would get the largest benefit from having air valves in the network to relieve air build up and reduce bursting.

The isolation valve programme will target the assessment, refurbishment and replacement of the more strategic isolation valves across our network as well as those highlighted for replacement by our AMP6 investigation programmes including the zonal studies.

## Distribution Mains Clusters

The £15.157m Distribution Mains Clusters programme is a proactive programme where we will look at a number of solutions for areas which experience a large number of bursts. A trained network analyst will review the company's DG3 and

# Water Networks Maintenance

burst data and identify DMA's that experience frequent bursts or interruptions of supply. Figure 18 below demonstrates the hydraulic analysis done by a networks analyst to identify area's which will require assistance and potential solutions for the area. Figure 19 below is an example of the GIS analysis.

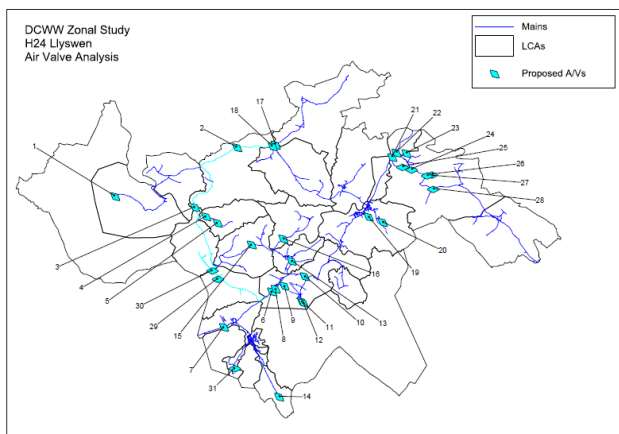


Figure 18-network analysis and potential solutions

The programme will consist of a range of solutions being used which will encompass all aspects of this business including PRV's, air valves and sluice valves as well as mains replacement. Each location will be assessed on a case by case basis. This programme will have positive impacts on our performance for leakage and CML. It will also support other programmes such as worst served customers and acceptability of water outputs which will all affect the quality and stability of customer supplies during AMP7.

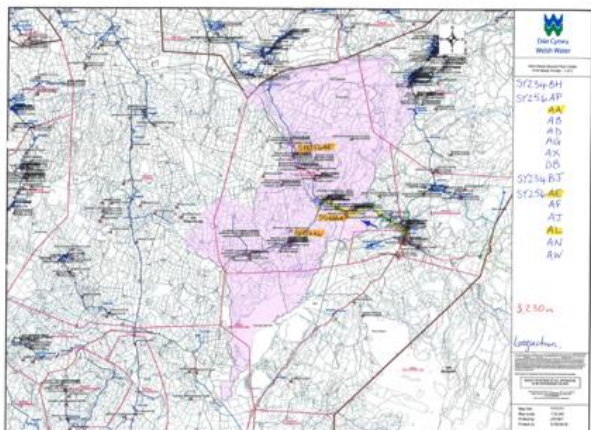


Figure 19- GIS network analysis

## Network Ancillaries

The network ancillaries' programme for AMP 7 will be a reactive programme which will maintain the asset listed in Table 18 below. These assets will be replaced on failure, but will have an additional focus around information for asset health. Any replacement assets will also be installed in a way to align with the company's vision to attain a SMART network.

Programme of work	Pre-efficiency Budget
<b>Network Ancillary Assets - Hydrants and Washouts</b>	£2.626m
<b>Network Ancillary Assets - Large Mains Repairs.</b>	£10.000m
<b>Network Ancillary Assets - Mains Repairs.</b>	£16.268m
<b>Network Ancillary Assets - Service Pipes</b>	£13.815m
<b>Network Ancillary Assets - Stop Taps</b>	£30.160m
<b>Network Ancillary Services - Frames and covers</b>	£0.130m
<b>Pre-efficiency Budget</b>	<b>£72.999m</b>

Table 18-programme of work for Network Ancillaries

The network ancillaries' budget is a reactive programme. The budget is based on the budget for AMP 6 with a larger emphasis on mains repairs as this was under scoped for AMP 6.

The number of stop taps represents a 5% turnover of the stock base which means we will have an aging stop tap asset base. Failing stop taps contribute to leakage for the business so improving the overall condition of this asset base will support the business to achieve its leakage target of 143MI/d by the end of AMP 7.

Hydrants, washouts and frame covers will be managed by the operations departments and the number of assets is based on costs from the unit cost database.

Within this programme we have also created some funds for larger mains repairs so that there is reactive budget available to assist in the repair of major network assets when they fail.

# Water Networks Maintenance

## Customer Meter Maintenance

For our AMP 7 investment we are planning on a mixture of proactive and reactive replacement based on an aging asset base. Our proactive plan will help decrease the average asset age.

As a result of the growing number of water meters across our area during AMP7 we are planning to undertake a larger number of reactive meter replacements.

A summary of the proposed meter maintenance programme can be seen in Table 20 below. The

average cost of replacement has come from an assessment of 2015-16 and 2016-17 maintenance costs of £109.52 for small meters and a figure of £3,500 has been used as the average cost of large meter replacement.

For non-household meters the total forecast for the number of replacements has been based on the historic number of installations during the last six years and expert judgment. The forecast is an annual figure of 2,968 of which 571 are large meters and the rest small meters.

Activity	Pre-efficiency Numbers	Activity	Pre-efficiency Budget
Reactive replacement (based on average replacements over the last 6 years)	<b>49,854</b>	Reactive Replacement Budget per year (£millions)	<b>£5.460m</b>
Proactive replacement (aspirational based on unit rate calculated from reactive replacements)	<b>7,650</b>	Proactive Replacement Budget per year (£millions)	<b>£0.838m</b>
Non household reactive replacement (based on average replacements over the last 6 years)	<b>14,840</b>	Non Household reactive replacement Budget per year (£millions)	<b>£3.563m</b>
Trials and Studies		Other (AMR, Trials and Studies)	<b>£0.243m</b>
<b>Total Customer Meter Maintenance Budget</b>			<b>£10.104m</b>

Table 20 – PR19 Customer Meter Maintenance Programme

## 5. Cost efficiency and innovation

### Cost efficiency

We are proposing to deliver this programme with £28.51m of cost efficiencies as part of this investment programme, as shown in Table 21 below.

We will deliver these savings by challenging our Alliance partners to improve efficiency and by maximising opportunities to innovate.

Programme of work	Proposed programme total budget
<b>Total programme (pre-efficiency)</b>	<b>£188.854m</b>
<b>Total programme (post-efficiency)</b>	<b>£160.253m</b>

Table 21 - Proposed cost efficiency

Our Capital delivery governance process means that projects will be reviewed and the best value solution is chosen for progression.

We have also created our Network Alliance working with our partners to deliver programmes of work, combining our repair, maintenance and mains replacement activities to deliver future efficiencies.

### Summary of innovation in this project

#### Worst Served Customers

The development of a new method to produce the most effective worst served customers' solutions for interruptions to supply. We have built on the lessons learn from our distribution zonal studies and developed a holistic method to assess our worst served customers by both post code and distribution zone and at a strategic level.

This means that we are reviewing the root cause of failures back to the source of the problem using a desktop assessment which includes a review of the zonal study reports where they exist prior to undertaking any work. The assessment includes; valves (including air valves), pumps, pipes and service reservoir level control as well as Water Treatment works.

The outputs of the desktop studies are then reviewed by the operational teams to highlight local issues including long term customer issues. The final project chosen will be a cost effective option which may be delivered in a modular fashion with the valves maintained and where appropriate new ones installed first, followed by pipeline replacement or re-lining where appropriate.

This has then had the knock on effect of changing how we assess burst mains clusters as well as targeting assets throughout the maintenance budget to assess the impact on the entire system that individual maintenance elements will have on the company's performance for CML and leakage.

#### Technology development

Over the last AMP the water network teams have trialled a number of technology developments. Some of the successful trials have been moved forward and are becoming part of normal business for the next AMP.

In AMP 6 we installed customer minutes lost loggers which went about logging data for flow, pressure and water quality, to better understand incidents and demand. The trial of this product has resulted in this becoming used as business usual.

We also trialled mains conditioning system in North Wales based on PODDS mains cleansing system. This took an area of mains and would strategically flush the mains live by increasing the flow to a velocity to which it would lightly cleanse the main. This project was successful in reducing discolouration contacts following bursts. We are assessing whether to automate this system in AMP7 and similar processes and equipment installed in strategically significant network areas.

We have also moved to a new scope-x software to monitor networks performance called Prism. This software gives us new functionality and has allowed us to create some innovative tools for example the reservoir volume tool, which during incidents can predict the approximate storage time remaining before customers lose supply. Which allows us to better plan how we manage the incident. Prism has



# Water Networks Maintenance

also allowed us to access and manage our network remotely operating valves to protect supplies.

In this AMP the business created a data science team. The team are experts in analysing and utilising data in complex models and some basic artificial intelligence. In Figure 20 below there is an image of the bacti predictor models which analyses reservoir levels, flow, chlorine residual and temperature as well as previous sample results and predicts which reservoirs are at the highest risk of failure. This has been used by the network staff to instigate cleaning or secondary dosing and inspections.

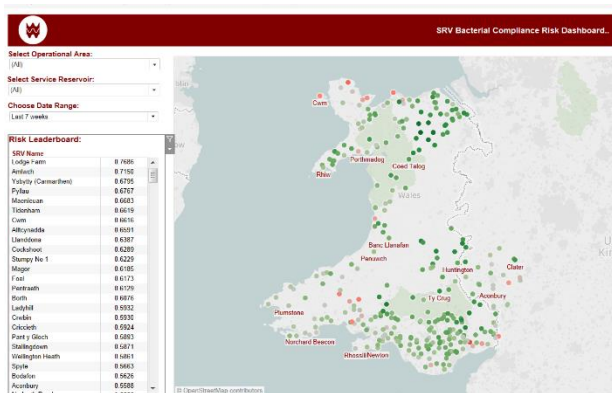


Figure 20- SRV bacti model for predicting the risk of failure

We have also invested in training staff so that they can be more sensitive when operating our network. We know that by operating valves too quickly we can cause discolouration through sudden changes in pressure and flow.

We created a training rig at Sluvad WTW and Glascoed WTW so that staff can see how to manage valves with real time data feedback. This shows the staff how to operate valves without having a detrimental effect on the network. We have also trained the emergency services so that when they need to use the network they can operate it without causing issues. We did to help them understand the challenges we are having so they understand the impact they can have when using our network.



Figure 21- Training rig in Sluvad WTW



Figure 22- Training rig at Sluvad WTW

We have installed GPS pressure loggers within the networks so that we can monitor our pipes and ascertain where potential issues might occur. This allows us to respond quickly when problems occur, but also means we know which customers are affected during incidents so we can communicate with them to give realistic feedback on duration of interruptions for example.

Whilst hydrant locking caps don't seem that innovative we were experienced problems across the country with illegal third party use of our mains which in turn was leading problems for our customers. To help prevent illegal third party use we put on the hydrants and give keys to emergency services so that they can access the network when they need to assist the public.

## Partnering and co-creation

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

# Water Networks Maintenance



We aim to undertake this work in partnership with customers and communities, the Customer Challenge Group as well as the Drinking Water Inspectorate and Environment Agency/ Water Resources Wales.

## 6. Value for money and affordability

### Impact on customer bills

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

### Value for money

We recognise the need to demonstrate value for money in everything that we do. In arriving at the proposed investment, we have closely considered the costs and benefits of different approaches to make sure that the investment represents long term value to our customers.

The projects within the network maintenance investment case have been developed so that they are delivered in conjunction with other

programmes of work. For instance, the worst served customer programme has been developed in conjunction with the AoW and CML and WTW maintenance programme to avoid duplication of schemes and to take advantage of any planned mains shutdowns.

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

In addition to these investments, and funded separately, the AoW Investment Case will provide CML benefits and therefore network maintenance improvements as a result of the mains replacements and other interventions undertaken to improve the acceptability of water.



## 7. Delivery

### Procurement

We have undertaken an assessment of the applicability of direct procurement for these projects. The nature of these projects is such that we consider a direct procurement approach would not be in the best interests of customers.

The various projects will be managed by our Water Assets team throughout AMP7 with scope and programme adjustments being made to meet current operational and other issues. We will monitor performance month by month so that we can respond quickly to emerging signs if we are not getting the benefits we have projected.

### Programme

A prioritised programme of work has been produced linked to the investments, costs and associated benefits. The programme of work has been based on delivering benefits across the five years of AMP7.

We have currently only set out a five year AMP7 programme. Our plans for asset maintenance will be further defined by a process of review, desktop assessment and inspection of some assets. This linked with feedback and review from our operational teams determine the interventions that

will be undertaken. During the next 12 months we are building up the programme for years 1 and 2 of AMP7 and monitoring progress with the projects planned for completion in AMP6. Once that is complete we will review the needs and plan the programme of work for years 3 to 5. This programme will need to be updated every year to reflect the changing priorities as well as assets which have already been replaced or refurbished through the reactive maintenance programme.

### Risk mitigation and customer protection

We will deliver our programme in a modular fashion so that the benefits of lower cost assets, for example valves, can be seen in terms of their effect on reducing the number of burst mains before going ahead with the replacement of a main. This approach will also be used for the worst-served customers.

We have developed an Outcome Delivery Incentive (ODIs) for CML, AoW and Compliance and Event Risk indices which will provide protection for our customers in the event that we do not deliver our planned outcomes.

## 8. Assurance

### Governance

Our current Network maintenance investment programme is supported by the Water Assets team and approved by the Dŵr Cymru Executive. The group meets on a monthly basis and is chaired by the Managing Director of Dŵr Cymru. This helps to ensure that the full focus of the business is directed at this investment.

CML and AoW performance is also targeted in the monthly Managing Director Water Service Meeting. These meetings are attended by key stakeholders including the Water Operations Distribution and Production teams and the Water Assets team.

On a daily basis our performance is shared internally to ensure that emerging trends and problem areas are targeted quickly. There is also strong awareness of our commitment to improve our Network performance (CML and AOW) following the recent cold weather events and regular updates during our company-wide monthly team brief.

Our investments to reduce the customer minutes lost are reported to our Quality and Environment Committee (QEC) on a six-monthly basis. QEC checks the improvement progress against our Strategic Objectives and is provided with the key risks and mitigation measures.

We will continue to apply these effective governance systems for our proposed AMP7 investment programme. The board will carry out a final review of this investment in detail prior to the submission of the business plan in September.

### Cost assurance

We have undertaken a high-level feasibility studies for the three SRV and larger pipeline schemes to enable the high-level scope of work and cost of the options to be assessed. However, further detailed feasibility will be required to define the final scope and cost of each project. Where this has already been undertaken, the Llwynypia Quarry SRV capacity increase for example the costs from AMP6 with a 6% improvement on the delivered costs

through efficiencies. These efficiencies are outlined in the 'Cost efficiency and innovation' section.

### Customer consultation assurance

Our customers have indicated that investments to reduce interruptions to water supply is key and would be concerned if interruptions greater than eight hours were a recurrent problem<sup>iv,v</sup>.

### Measures of Success

We are continuing with our measure of success (MOS) to monitor the benefits that our CML interventions bring – the 'Customer Minutes Lost' MOS. Our target for improvement to this MOS over AMP7 as a result of our proposed investment is shown in Table 22.

Measure of Success	End of AMP6 Position	End of Investment Position
Supply interruptions greater than three hours (expressed in minutes per property)	12	8
Water mains bursts	3700	3600
Tap Water Quality Compliance Risk Index	-	0
Water process unplanned outages	-	0% change from 2019-20
Leakage	171	148
Per Capita Consumption	145	139

Table 22 - MOS improvement predicted.

### Future assurance

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

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## References

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i WW2050 Qualitative Debrief, 2017- engaging with 108 customers  
ii Summer Consultation, Welsh Water 2050,2017  
iii Performance targets qualitative, Welsh Water consultation, June 2017

iv WTP Qualitative research, Welsh Water consultation, August 2016  
v WTP Qualitative research, Welsh Water consultation, August 2016