

Freeze-thaw 2020/21: Recommendations from an unprecedented winter

A follow up on the Water UK series of reports 'Learning from the impacts of the 2018 freeze thaw'
<https://www.water.org.uk/publication/learning-from-the-impacts-of-the-2018-freeze-thaw-4/>





What this report will tell you

Following Storm Emma in 2018, which affected a number of water customers across the country, Water UK worked closely with government, regulators and consumer representatives to publish a series of documents on [‘Learnings from the impacts of the 2018 freeze-thaw’](#). It is now three years later, and the water industry has recently experienced a more serious freeze-thaw event than the one seen during 2018 – a good moment for us to reflect on our progress since then and assess whether further actions are needed.

Water companies have completed all the short-term actions identified in 2018, and continue to deliver on all of the long-term commitments as well (for example, by providing advice to non-household customers, and working on data-driven approaches to freeze-thaw management).

As part of our continuous improvement, we wanted to reflect on the opportunities for working more closely at a cross-industry-level, too, examining the way that companies come together to manage freeze-thaw events.

This report begins by providing a refresher on what freeze-thaw is, how we manage freeze-thaw, and why it can be a problem – before delving into an assessment of how well the industry managed freeze-thaw this year, including considering the impacts of COVID-19, and identifying some new operational and incident response recommendations to take forward. It also reflects on the impact that freeze-thaw can have on leakage. Case studies from Thames Water and Scottish Water are also included.

Overall the report finds that water companies performed very well in early 2021 in their response to freeze-thaw. This freeze-thaw demonstrated that water companies have successfully implemented the industry-led recommendations issued after March 2018. This, combined with strong incident management processes consolidated during the pandemic, allowed water companies to manage the unique concurrent risks posed by COVID-19 and Brexit with little-to-no customer impact. This freeze-thaw was, for many companies, more challenging than the freeze-thaw of 2018, particularly given the unique circumstances posed by COVID-19. This report also highlights the significant impact that freeze-thaw can have on leakage.

What is freeze-thaw, and how is it managed?

Freeze-thaw is the phenomena which results in water pipes bursting as periods of cold weather are followed by a period of warming. The pace of the thaw is a key factor in determining the scale of the event.

Freeze-thaw events predominantly affect **supply pipes**, which are owned by whoever owns the building the supply pipe serves. In summary, they are owned by customers, rather than by water companies.

Supply pipes are often exposed to the elements, with little or no insulation, making them vulnerable to the cold. Customer-side intervention prior to a freeze-thaw can help to prevent freeze-thaw, and awareness of supply pipes can help customers to locate issues swiftly.

However, helping customers to understand or take an interest in supply pipes is challenging. Many supply pipes are partially or wholly out of sight or under the ground, adding further complexity as the issue may not be visible.

Bursts on supply pipes can be costly for consumers where water is metered.¹ Supply pipe leaks may go undetected for weeks or months, particularly if the water is not metered. For water companies, the cumulative impact of supply pipe bursts and leaks can cause significant operational challenges, as the amount of water leaving the network (demand) suddenly increases, meaning that demand is higher than what companies can feasibly put into the network (distribution input/supply).

Weather related bursts can also take place **within customer properties**, and these are particularly detrimental for consumers, as not only do they face a potential impact on bills, there is also the potential for property damage. These bursts or leaks can also be difficult to manage as the responsibility will sit with the customer. Many water companies, though, will support customers with property-side bursts and leaks. For water companies, this again impacts on the supply versus demand balance.

However, freeze-thaw can affect water **mains and communication pipes** too. Whilst a larger burst on a mains or communication pipe may be easier to detect, these types of incidents can be challenging to manage. As an example, a mains or communications pipe burst may require taking customers out of supply to resolve the issue. Or, if the pipes run under a busy road, closing the road may be challenging and external factors may delay its fixture. Water companies can also receive fines for burst water mains. During this freeze-thaw, some companies actually reported seeing greater instances of burst mains than before, but why this occurred is not yet understood.

Why else is freeze-thaw a problem for water companies and for customers?

The main problem from freeze-thaw is the additional water lost from networks due to increased bursts and leaks. In some cases, this can mean demand outstrips the ability to supply water.

Other related issues are:

¹ Some water companies will allow customers to claim back any water lost due to an issue that could not have been prevented.

What is a supply pipe?

As a rule of thumb, you can think of the supply pipe as the pipe that takes your water from the pavement, under your driveway, into your home (though in reality, it can be a bit more complicated than this).

- Water sources or intake structures themselves can become frozen, meaning that water cannot be accessed or is difficult to access;
- Increased water demand means increased chemical demand;
- At times when demand is high, the carbon intensity of the water industry increases;
- Inlets into water treatment facilities can freeze, meaning that they are temporarily out of action and also at risk of bursting;
- Freeze-thaw conditions often come with other difficult weather conditions, which makes getting staff or resources to site, for example, more challenging;
- Freeze-thaw events often have a large geographical coverage, meaning that the wider water industry is put under stress, and therefore the industry-level resource position is more challenging and mutual aid can be less available.

Freeze-Thaw January and February 2021

January and February 2021 was an unprecedented winter for the water industry. Not only were companies managing the risks posed by COVID-19 and end of the EU Transition Period, but extreme weather was felt across much of the UK.

1. How did it compare to Storm Emma?

1.1 Weather

Whilst the dramatic visuals of deep snow seen in 2018 were not seen during early 2021, the hidden impact of the winter was felt by the water industry.

During Storm Emma, the UK experienced a sustained period of freezing temperatures, resulting in cold ground temperatures. The temperature then rose, creating a freeze-thaw event.

Similarly, in early 2021, sustained levels of freezing ground and air temperatures were followed by spike in temperature, creating the conditions for a freeze-thaw event. For many water companies, this freeze-thaw was worse than March 2018. January also brought Storm Christoph to the UK, followed by Storm Darcy in early February.

Over 500 flood warnings were in place across the UK during Storm Christoph, including those presenting a danger to life. Warnings were also in place for rain, snow and ice. Six water companies reported flooding in their areas.

The increased and changed demand profile that resulted from COVID-19 also added further challenge, as different areas of the



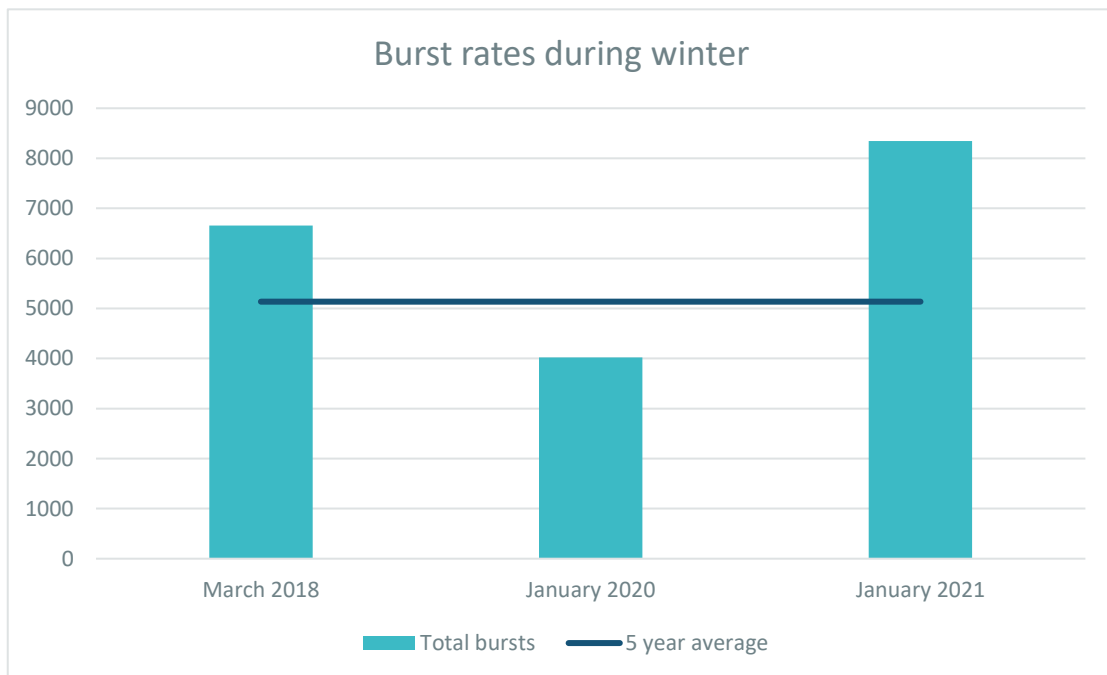
Dr Mark McCarthy, Head of the Met Office National Climate Information Centre said that: *“February 2021 has seen a wide temperature range resulting from the two predominant weather patterns we’ve seen this month, with the first half of February experiencing some bitterly cold easterlies originating from Russia, and recent days seeing the influence of air coming from the Canary Islands.”*

<https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2021/2021-winter-february-stats>

network came under strain when demand shifted away from businesses to households.

1.2 Burst rates and leakage

Compared to the average number of bursts experienced by the industry during the month of January throughout AMP6², 62% more bursts were reported in January 2021. Perhaps more surprising is that this also represents a 25% increase on the number of bursts reported during March 2018, when Storm Emma hit the UK.



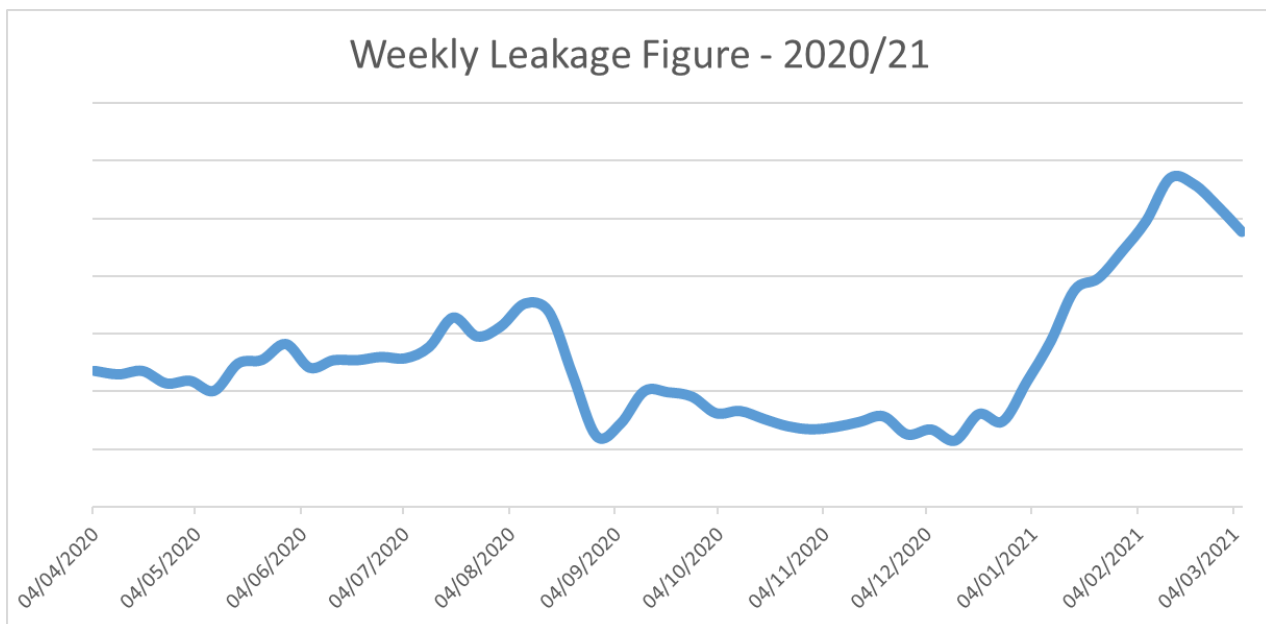
Description: A graph showing total bursts across 16 water companies. This graph does not include Northern Ireland Water but is representative of Great Britain

These statistics demonstrate the significant operational challenges that the water industry faced this winter due to the challenging weather conditions and unprecedented external factors including COVID-19.

Burst mains cause operational challenges for water companies, as they require staff-time and resource to tackle, and the volume of water leaving the network in a single location can be particularly high. Water companies reported being exceptionally busy for weeks and in some cases for over a month after the freeze-thaw conditions settled.

Bursts also have a significant impact on leakage. The graph below demonstrates the weekly leakage rate over the period 4th April 2020, through to 4th March 2021, in Great Britain. It shows that leakage significantly increased from the start of January, when the cold snap hit, peaking towards early February following Storm Christoph.

² AMP6 refers to the sixth asset management period, a five year period running from 2015-2020.



Description: A graph showing the weekly leakage figure based on 16 companies' data – this graph is typical of most water companies

For water companies, the concurrency of a challenging winter 2020/21 and COVID-19 demand means that some water companies will struggle to meet their annual leakage targets, due to the exceptionally high levels of burst rates seen from the freezing ground and air temperatures, and the subsequent thaw. The timing of this freeze-thaw, which comes close to the reporting year-end, should be noted, as this makes it harder to tackle the peak in leakage by investing to further reduce leakage afterwards.

1.3 Business Premises

One of the biggest factors creating supply and demand issues during Storm Emma was that the thaw occurred over the weekend, when business premises were left unattended, meaning that bursts went undetected for hours or even days. This meant that water demand remained high for a number of days.

Going into freeze-thaw period of 2021, the national lockdown, which saw many business premises closed entirely, added additional cause for concern, as business premises could be left unattended for days or weeks at a time. The peak of the freeze-thaw also, once again, came over the weekend.

1.4 Demand

Since the first UK lockdown in March 2020, demand has remained higher than pre-COVID-19 averages across the sector. In general, companies have reported that demand is 5-10% higher,

even throughout winter. In addition to increased demand, the lockdown over Christmas and into the new year, shifted demand away from non-household demand, to household demand.

Higher demand, and demand stresses in new or different areas of the network can be associated with higher levels of leakage, as different parts of the network come under strain and more water travels through the network, potentially at higher pressures.

1.5 Working from home: operational challenges

This year posed a unique operational challenge for water companies, as operational and incident management challenges posed by the weather have had to be handled mostly from home. Typically, water companies would respond to an incident or risk from a control centre, meaning that staff are face-to-face in the same room. Water companies have had to adapt instead to the changing circumstances we find ourselves in, with new information sharing processes, reporting, communications procedures and response.

The positive of this was that for non-operational teams, home working was well established so there was no need for travel and no disruption to normal day to day working. Some companies also reported that remote processes actually supported effective management of multiple incidents across large regions, and many intend to continue remote working going forward.

1.6 Customer impact

During Storm Emma, 200,000 customers lost water supply for more than four hours, 60,000 for more than 12 hours, and 36,000 for more than 24 hours. This level of customer impact led to interest from Ofwat, Defra, the Drinking Water Inspectorate (DWI) and others, in how water companies prepare for and manage freeze-thaw events. The industry worked closely with its regulators and government to identify lessons learned, and take actions to improve its resilience ahead of another freeze-thaw.

The implementation of these measures put the industry in a stronger position heading into the winter of 2020/21, and as a result, the customer impact from water company operations was minimal.



Description: An image of a frozen spillway

Credit: Welsh Water

This freeze-thaw had minor short term impacts, on fewer customers, in areas local to the bursts, as the water companies had repair teams at the ready to respond and re-zone supplies.

Freeze-thaw affects the water industry in many different ways. This **case study** demonstrates a unique example:

One water company saw the inlets to their water treatment works freeze, resulting in an increase in manganese in the water treatment process. As a result of the frozen inlets, 9,000 properties lost supply to water as the treatment works was shut for 24 hours.

2. How we delivered good customer outcomes throughout the freeze-thaw of winter 2020/21

2.1 Improved warning systems

Freeze-thaw is now an indicator built into many water companies' models for supply/demand impacts, alongside sunshine, bank holidays, temperature, and so on. This meant that companies had an early indication that a potential freeze-thaw event was coming in January/February 2021.

2.2 Clear escalation processes and procedures within companies

The escalation processes used by the industry also came into question during 2018, in particular how soon problems were escalated to executive level. With the establishment of the industry's Platinum Incident Management Group (PIM), which is responsible for managing sector-wide risks at an industry-level, executive-level awareness and involvement began early, and issues were readily escalated.

Water companies also have well established and developed escalation procedures at a company-level, and executives were made aware of the risks at a company-level as soon as trigger points for a freeze-thaw were hit.

As the water companies identified the potential threat from another freeze-thaw event, it triggered internal readiness teams to stand up, and also escalated the risks to PIM and the National Incident Management Group (NIM), enabling readiness and activity monitoring across the UK water industry.

2.3 PIM and NIM stood up and monitoring the situation with a dedicated SitRep

The industry stood up PIM in response to the freeze-thaw, and NIM drafted a dedicated situation report (SitRep), to collate data and information about the customer impact and company response to support industry resource planning and mutual aid. This information was then shared with government and regulators through cascade protocols.

NIM, which was stood up in response to the freeze-thaw, acted effectively to assess the risks of a freeze-thaw, triage mutual aid requests, and support companies to escalate any issues to appropriate decision-makers. Monitoring took place daily, and an emphasis was placed on customer impact.

2.4 Government, regulator, local authority and LRF communication

After March 2018, water companies came under scrutiny for not communicating with local authorities and local resilience forums (LRFs) in advance of the freeze-thaw. During this freeze-thaw, water companies ensured that appropriate communications routes and escalation processes were well established, and that resilience partners were notified early about the potential risk. Water UK also supported this through early communication with Defra and Welsh Government.

2.5 Reprioritising staff deployment

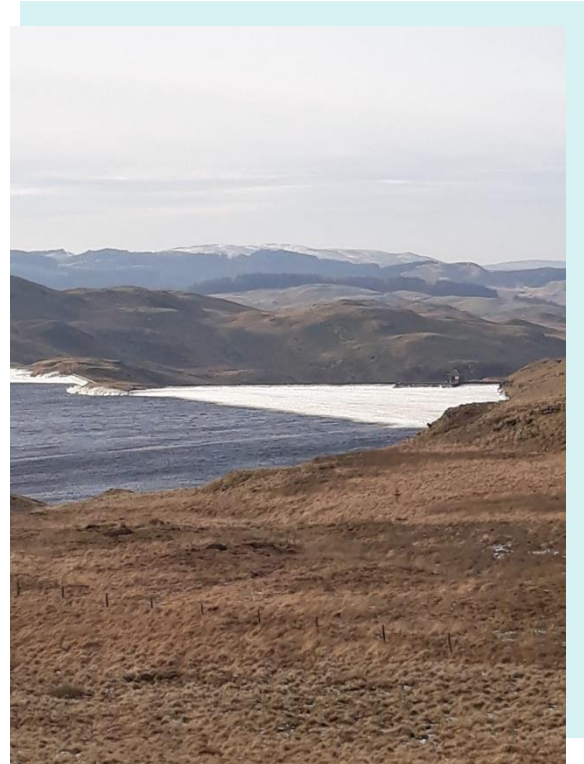
Reprioritising staff is a key way that water companies manage freeze-thaw events, and incidents more generally. When trigger points were hit, companies responded by redeploying staff to focus on operational priorities for ensuring good customer outcomes during a demand incident, including redeployment to call centres and for fixing bursts and leaks.

2.6 Resilient and ready stocks of alternative water

Water companies also readied their alternative water supplies (AWS) in case they should be needed, and PIM's Mutual Aid Workstream readied itself to respond to any potential mutual aid requests for AWS. The Mutual Aid Workstream also prepared for the potential freeze-thaw by undertaking a stocktake across industry of the AWS available to companies, to present a national picture of AWS resource.

2.7 Starting from a strong resource position: storage

Thanks to learnings from 2018 and operational changes adopted, water companies also went into this freeze-thaw period in a stronger resource position, in particular with regard to reservoir levels, which were higher in 2021 than in 2018, in part thanks to early warnings.



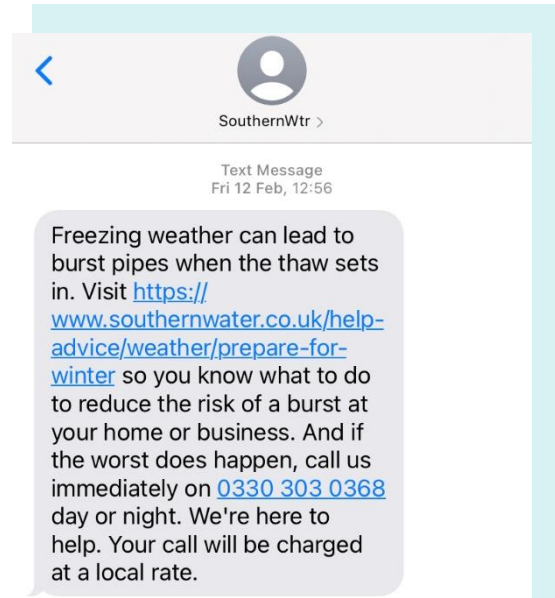
Description: An image of a frozen reservoir

Credit: Welsh Water

2.8 Customer communication

All of the water companies affected by the weather ran customer-facing communications campaigns, using text messages, social media, radio, and more, to communicate with customers about the potential impacts of a frozen or burst pipes, and what customers can do to prevent or manage the situation.

Water UK also ran its first ever customer-facing communications campaign for freeze-thaw to make domestic and non-domestic customers aware of the risks and issues posed by frozen and thawing pipes, and steps they could take to reduce the risk. Defra supported Water UK to reach an even bigger audience by sharing this message on their social media – a move that was welcomed by industry.



Description: Some examples of water company and Water UK communications

Credit: Southern Water, Water UK

Recommendations and conclusions

Since Storm Emma in March 2018, water companies have taken onboard the recommendations from regulators, government, consumer representatives, and the industry itself, and subsequently managed the operational challenges posed by this difficult winter without little-to-no customer impact. During an incident, water companies work to the preferred outcome of maintaining piped supply of wholesome drinking water to customers. In this regard, the incident management displayed by the industry in response to this incident was successful.

We now reflect on what more we can do at an industry-level to support good customer outcomes, and have developed 14 recommendations, including a key recommendation.

Key Recommendation: The key area where the water industry, government and regulators should focus going forward, is considering how to reduce the burst rate during a freeze-thaw event, in order to reduce leakage. There is still a knowledge gap about the correlation between a freeze-thaw event and the volume of leakage that occurs, as well as how this translates into areas that are more at risk; more data, information and research is needed in this area. The forthcoming Leakage Routemap, currently being developed by the water companies, should go some way to developing our knowledge and understanding here – we look forward to its publication in Autumn 2021.

There are several further recommendations below which expand upon this recommendation.

1. Water UK should continue to create some standardised customer-facing communications material that can be used on social media by Water UK and water companies in the event of a freeze-thaw. These assets should be created prior to winter 2021, and stored in a known, centralised location, accessible by water companies. This material should be re-circulated to water companies prior to any potential freeze-thaw, and should be shared proactively with Defra, Welsh Government, Ofwat, and others stakeholders.
2. Water companies should continue to notify the industry and Water UK through NIM when the triggers for a potential freeze-thaw have been hit at company level – this will allow industry to consider appropriate escalation, stand-up and reporting procedures, and support Water UK to brief government and regulators, and to roll out customer-facing communications.
3. A SitRep which captures the risks posed by freeze-thaw should be drafted by NIM and agreed during peacetime, and prior to winter 2021/22, so that it is ready to roll out, to save time during an incident and ensure companies are aware what information they will be expected to provide. This could be based on the SitRep used during Storm Christoph.
4. All SitReps should make clear at the top whether and how many customers have been impacted by an incident – this is a recommendation we are already taking forward.
5. During long and ongoing incidents, such as freeze-thaw, the health and wellbeing of water company staff within emergencies or resilience teams can suffer, in particular as a result of remote working. The Water UK Occupational Health and Safety Group should consider how

health and wellbeing of staff can be promoted and managed throughout and after incident management.

6. All potential freeze-thaw incidents should be treated by water companies as a possible Storm Emma-type incident, to ensure appropriate management, and to recognise the number of unknowns and external factors in managing a potential freeze-thaw. This worked well in early 2021.
7. Clear trigger levels should be agreed to prompt a PIM stand up in the event of a potential freeze-thaw – these could be demand, number of customers affected, or a BRAYG status, for example. Those used in 2021 are a useful starting point.
8. Although effective, a review of the mutual aid process is needed to ensure that the process remains robust. A review is needed into the mailing lists and points of contact, and the responsibilities and principles under which companies operate should be reinforced. This recommendation is already being carried forward by the Mutual Aid Workstream.
9. Water company directors and CEOs reportedly ‘upped the ante’ in response to the possible freeze-thaw, with companies escalating their understanding of the scenario in response to neighbouring water companies. This then drove a demand for additional resources such as alternative water supplies. NIM and PIM should review how to address stockpiling and reiterate agreed anti-stockpiling principles, and consider how to prevent ‘upping the ante’, by agreeing a common picture of risk when initial trigger points for a freeze-thaw are hit.
10. More should be done in advance of potential freeze-thaws to share information at an industry-level on how companies are investing in resilience to prepare for and manage freeze-thaws (and other supply/demand incidents). This should be explored by Water UK and its Operations Strategy Group.
11. Water UK should pick up a discussion with Defra and Department for Transport about how best to manage bursts that occur under busy and congested roads which cannot be closed in whole or in part.
12. Joint research between government, regulators and industry is needed to better understand freeze-thaw. For some water companies, this freeze-thaw event saw more mains impacted than in previous events, and why this happened is not well understood. This may be a project for UKWIR to explore.
13. Water UK should consider what can be done to encourage greater use of leak detection devices in homes and non-household buildings, including linking with energy efficiency and low carbon heat policies to build ‘homes fit for the future’. Water UK should engage with the Ministry of Housing, Communities & Local Government and Defra on this.

Annex

Case study: Thames Water

Following the Storm Emma, Thames Water updated all of its forecasting models to take into account the extreme nature of the incident, identifying early warning indicators that would allow early preparation for a similar event. This warning system takes into account preceding weather factors and allows an update the demand forecast. In response to an early warning in February 2021, Thames Water paused a planned maintenance outage on the London ring main, and made all treatment plants available to support potential increased demand expected from the freeze-thaw. For some biological plants, this takes time, but the early indication allowed the effective management of this, whilst maintaining the highest standards of water quality.

The warning also triggered the stand-up of the incident command structure earlier than during Storm Emma, allowing time for a clear management strategy to be implemented.

Thames Water also increased its service reservoir storage, changing the operating strategies, reducing turnovers and fore-going it's optimum energy management strategy. This allowed the company to maintain storage in service reservoirs at levels 25% above the level at the time Storm Emma struck, providing additional resilience.

Field teams were also redeployed from planned work to focus on repair and maintenance, as well as bringing in additional resource over the weekend, and using the supply chain to support with initial triage on the ground. Refresher training was provided to call agents in other business areas to allow them to move across to support in the operational call centre to manage the increased call volumes experienced.

Customer communication was also boosted, via social media and radio. Engagement with regulators, local authorities, local resilience forums, retailers and government was also increased.

During this freeze-thaw, thanks to improved leakage detection, early warning signs, fast response to reported incidents and strong proactive incident management, demand increased by just 297 megalitres, compared to the 529 megalitre increase seen during March 2018.

Case Study: Scottish Water

Scotland saw particularly challenging conditions during both January and February 2021, with some of the coldest temperatures felt in the north of the UK. In some areas, recorded temperatures dropped to below -23 degrees during February.

The cold conditions had a variety of impacts such as frozen raw water intakes, burst mains, frozen pressure reducing valves and issues accessing several water treatment sites due to significant snowfall.

In a normal month, Scottish Water will receive around 20,000 customer contacts. During January alone, this increased to 34,000 customer calls received, and increased further to 36,000 in February.

Incident management arrangements were put in place to ensure a coordinated response in advance of the severe weather and ensure that resources were in place to manage the impacts of the expected cold temperatures and subsequent thaw.

Frozen intakes impacted our operations at 15 sites across Scotland. High demand for water due to burst mains also put pressure on water treatment works and affected tank levels, with widespread impacts across Aberdeenshire and Moray, as well as in the Highlands. The cause of the increased demand was a combination of bursts in the public water network, as well as high levels of customer side leakage.

A significant tankering operation was implemented to ensure that supplies were maintained for customers until demand could be returned to more normal levels. This was achieved through the repair of burst mains, identifying where there were private side leaks, and for some areas where demand was particularly high, also asking both domestic and non-domestic customers to help by checking their own properties.

The tankering effort, along with hard the work of the operational teams they were supporting meant that there was limited customer impact despite the large number of issues being managed.



Description: Challenging conditions for Scottish Water teams in the north east of Scotland, as a car is seen in deep snow

Credit: Scottish Water

For more information:

Charlotte Owen
Drinking Water and Resilience
Water UK

cowen@water.org.uk
07920 752344

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