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Preventing fatbergs by foreseeing potential sewer blockages

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About the Author

With a PhD in Civil and Sanitary Engineering from TU Delft, one of the top engineering and technology universities in the world, Christof Lubbers has been working in the water sector for over 22 years.

Christof has gained diverse experience in smart automation solutions for enabling smooth operations throughout the water industry. In his role as Product Manager for Aquasuite at Royal HaskoningDHV Digital, he now helps wastewater companies to achieve their business goals by optimising the operation of their infrastructure.

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1. Introduction

Many thousands of sewer blockages, which cause unconsented spills, occur every year. Most blockages are caused by items that should not be flushed in the first place, such as wet wipes and fats, oil and grease. These blockages, also known as ‘fatbergs’, can cost millions of pounds to clean up, as well as causing significant environmental damage, not to mention inconvenience and misery to customers.

2. What happens when a sewer is blocked?

The sewer pipes that drain wastewater from our homes are designed to convey wastewater, containing fluids, driven by gravity, to the sump of a pumping station. Gravity force is not always strong enough to force these solids down a pipe, especially if the pipe has only a slight incline. Once these solids settle, it is more difficult for sewage to flow through the pipe. This increases the risk of further settlement of solids. Over time, the pipe will clog, reducing the space available for more wastewater and precipitation. As a result, the water level rises more quickly and causes unconsented spills, where wastewater, including untreated sewage, can end up discharged into the environment, or even backed up into homes.

As well as the environmental impact caused to watercourses, blockages can also create flooding incidents and do huge damage to drainage systems, causing system failures and increasing maintenance costs. In addition, these incidents lead to massive financial penalties for utilities companies.

3. The causes of blockages

Blockages can be caused by a number of factors, such as infiltration or unexpected industrial discharge. Another cause can be heavy rainfall, where a large amount of silt is displaced and washed into sewers, along with excessive floodwater. Sometimes, roots of trees and other vegetation can work their way into joints between pipes and, over time, cause significant blockages. The most challenging cause of blockages is the modern phenomenon of so-called 'fatbergs'.

Made up of fat, oil and grease (FOGs) that have been poured down sinks and drains and combined with items such as disposable nappies, sanitary items, cotton wool, food waste and wet wipes, fatbergs cause problems all round the world, from Australia to New York. The congealed material can be as strong as a rock and requires specialist equipment and hours of manpower to remove.

Annually, the UK spends about £100 million clearing an estimated 300,000 fatbergs from its sewers.1 In 2019, a fatberg the size of a London bus, weighing 40 tonnes, was removed from a London sewer.2 The removal took three weeks. Four years ago, the largest fatberg found so far in the UK, at 250 metres long, was also located in London.3 Over a five-year period, New York City spent 18 million dollars mitigating fatbergs.4 It is not just a problem for major cities, fatbergs are often found in small towns too.

Once a blockage like this has been reported, it may already be too late to avoid extensive damage. The sewer may have already overflowed, needing a huge amount of time and money to clear up the resulting devastation.

4. How do you prevent blocked sewers?

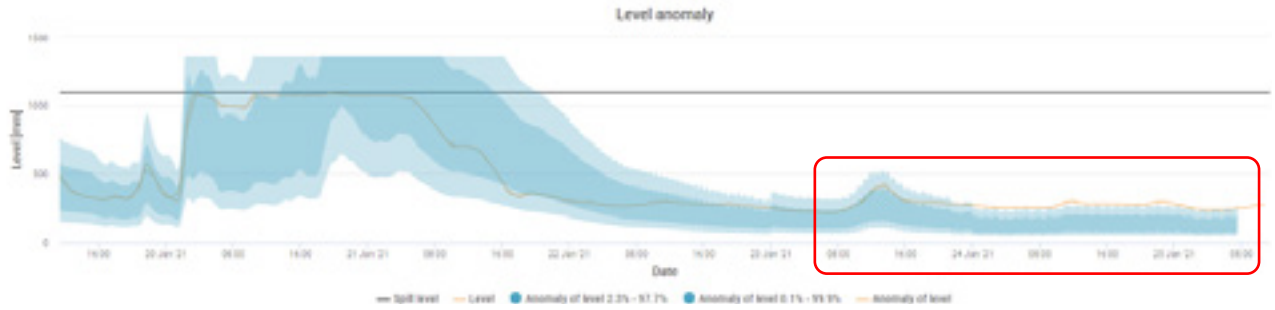
The most fundamental way to prevent blocked sewers is to stop consumers flushing items down the drain that do not belong there, such as wipes and nappies. The public needs to be educated as to how to dispose of these things hygienically and safely. At the same time, utilities companies urgently need to find cost effective solutions to minimise and avoid unconsented spills and the resulting high penalty costs.

The key to these solutions is to identify the location and cause of a blockage before a spill occurs. The ability to predict water levels in wastewater systems can help ensure that operators are better prepared to prevent events.

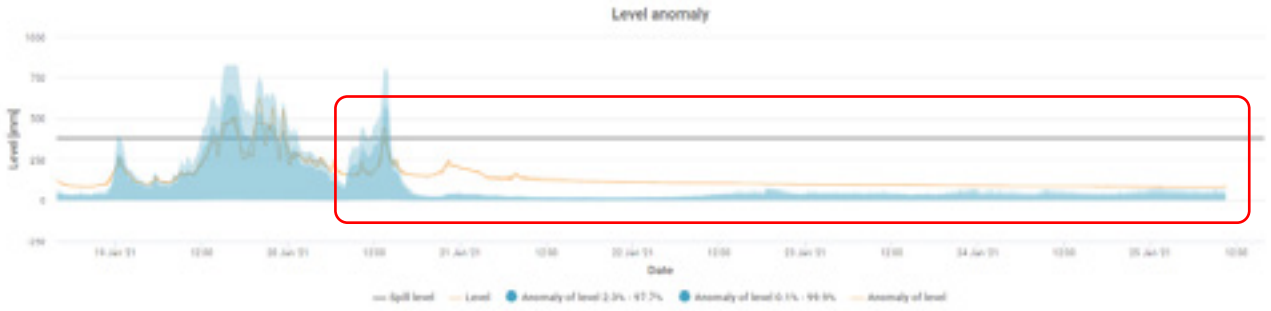
Anomaly Events

The following examples show how data remained high following a storm event and alerted the water company to investigate. The anomaly trend has risen with the expected rainfall based on the normal operating region for the sensor.

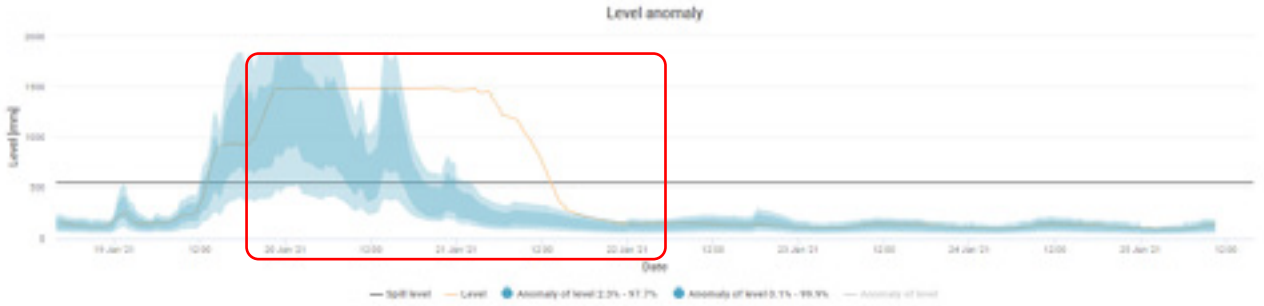
Example 1 – possible silt build-up



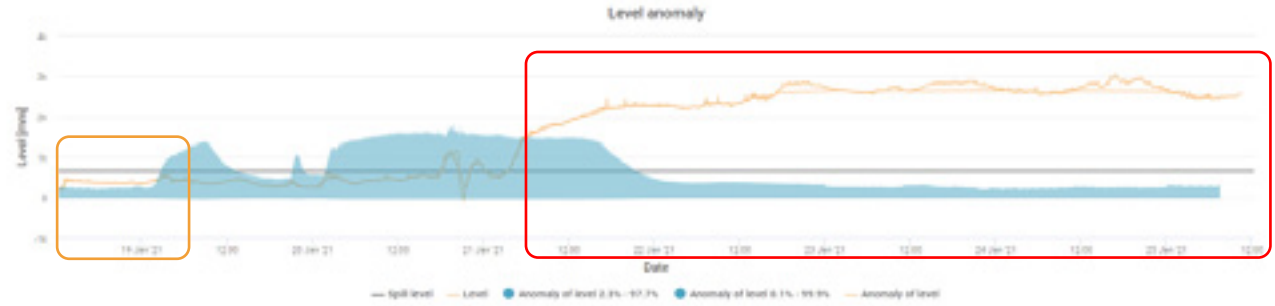
Example 2 – possible silt build-up/blockage



Example 3 – possible blockage



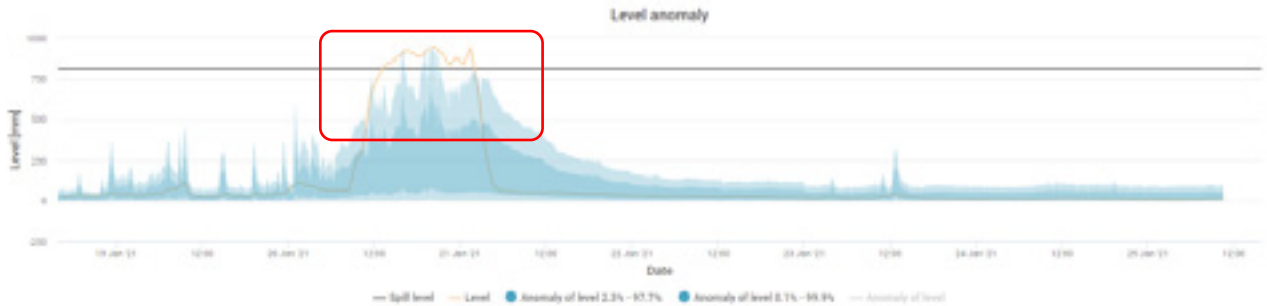
Example 4 – suspected blockage



Example 4 – had already been highlighted (Orange area) as high before the storm event.

Example 5

The example below shows how the site spilled although it was not expected to. This allowed the water company to be aware of the spill sooner, take steps to clean up any pollution (if required), and take steps to improve the performance of the asset.

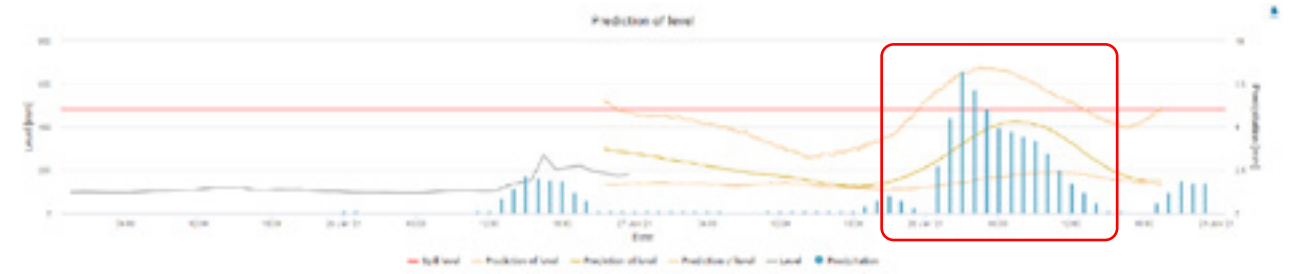


Future predictions

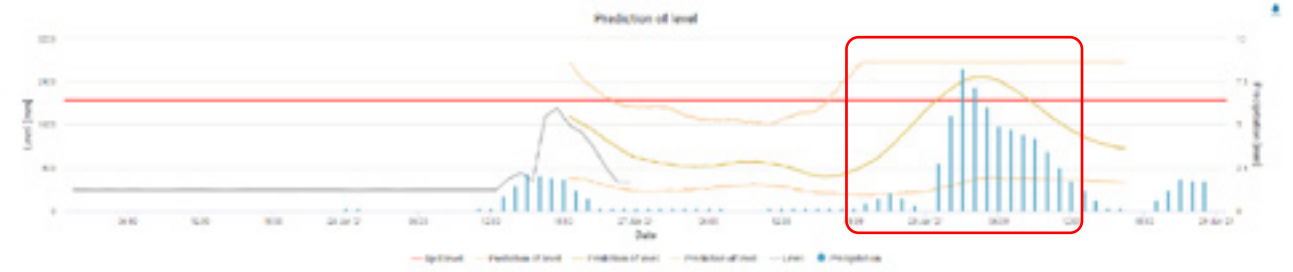
The following examples show future predictions where the level is expected to exceed the spill. These events are provided prior to 48 hours of the expected event which allows the water company to take steps to change the outcome as required. It is also understood that some of these assets are designed to spill during these types of events.

Example 6 – suspect high level/spill

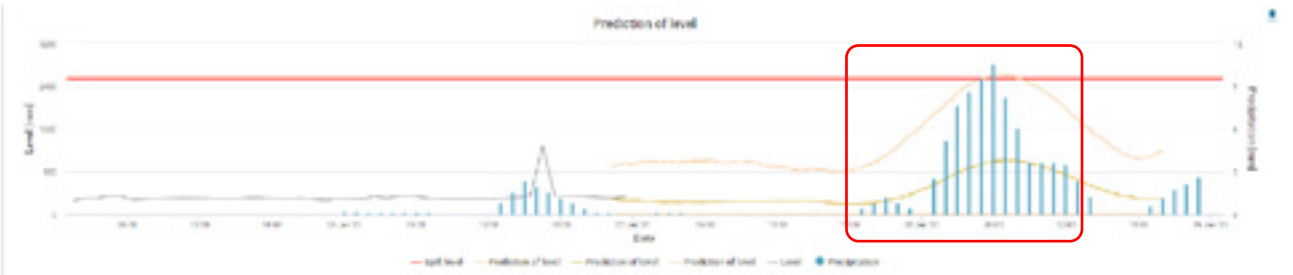
Example 7 – suspect high level/spill



Example 8 – suspect high level/spill



Example 9 – suspect high level/spill



5. Predictive monitoring

One way to tackle the problem is to detect disturbances in the sewer network at an early stage. This means that when water levels in the network increase to higher values than normal, the operator can be warned so that mitigating action can be taken.

'Normal' water levels vary depending on the time of day and the amount of rainfall. Defining this 'normal' level depends on a number of conditions, variables and local characteristics of the sewer network. Predicting a variation to normal levels is a big challenge for wastewater operators.

An innovative method has been developed that provides an alert when levels are higher than expected and also predicts the level for the next 48 hours. This is known as predictive monitoring, and supports wastewater operators' compliance to AMP7 regulations, which require them to be able to demonstrate the ability to anticipate problems.

6. How does predictive monitoring work?

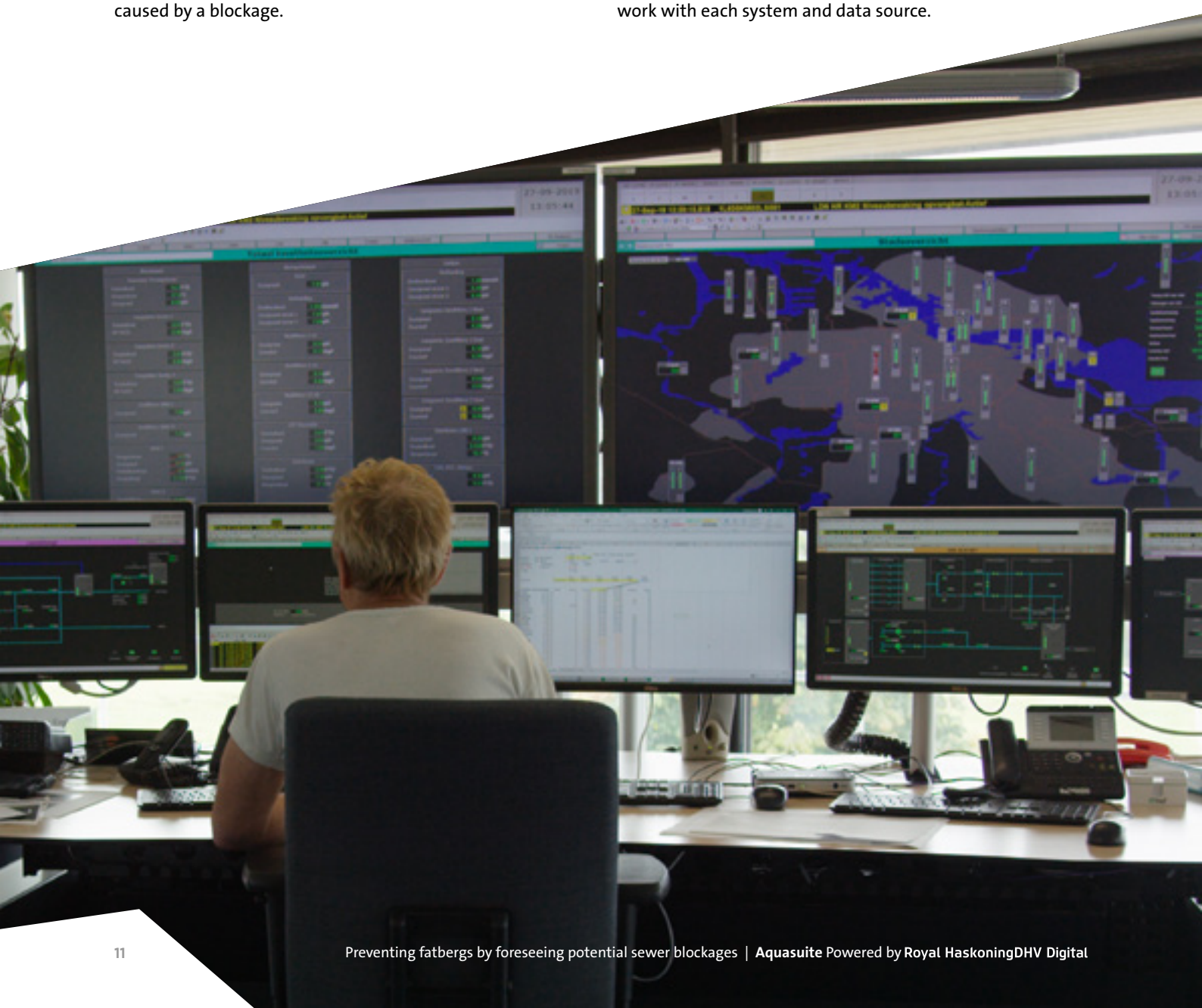
The automated analyst, which is an automated machine learning model, has been trained to learn the normal water levels for all the different weather conditions. Based on historic data and weather forecasts, it predicts the current water levels to identify any anomalies and the water levels for the next 48 hours.

Multiple sensors are located throughout the wastewater network to record what is happening with the water levels currently and in real time. In addition, they simultaneously learn the expected behaviour of the sewage system and the subsequent predicted water levels. As soon as the sensors detect a deviation from the expected levels, such as levels remaining high, this is noted as an event, potentially caused by a blockage.

Depending on the nature and extent of the blockage, the automated analyst system can prioritise different types of event and react differently, depending on whether it is a relatively minor, short term problem or a significant event. It can also identify where locations and times of planned in maintenance are taking place, so these are not incorrectly recorded as problematic incidents.

The wastewater operator can decide what its priorities are, and the system builds different alarms around these, so if X takes place, then Y must be completed within a specific timescale.

The automated analyst is completely agnostic so it can work with each system and data source.



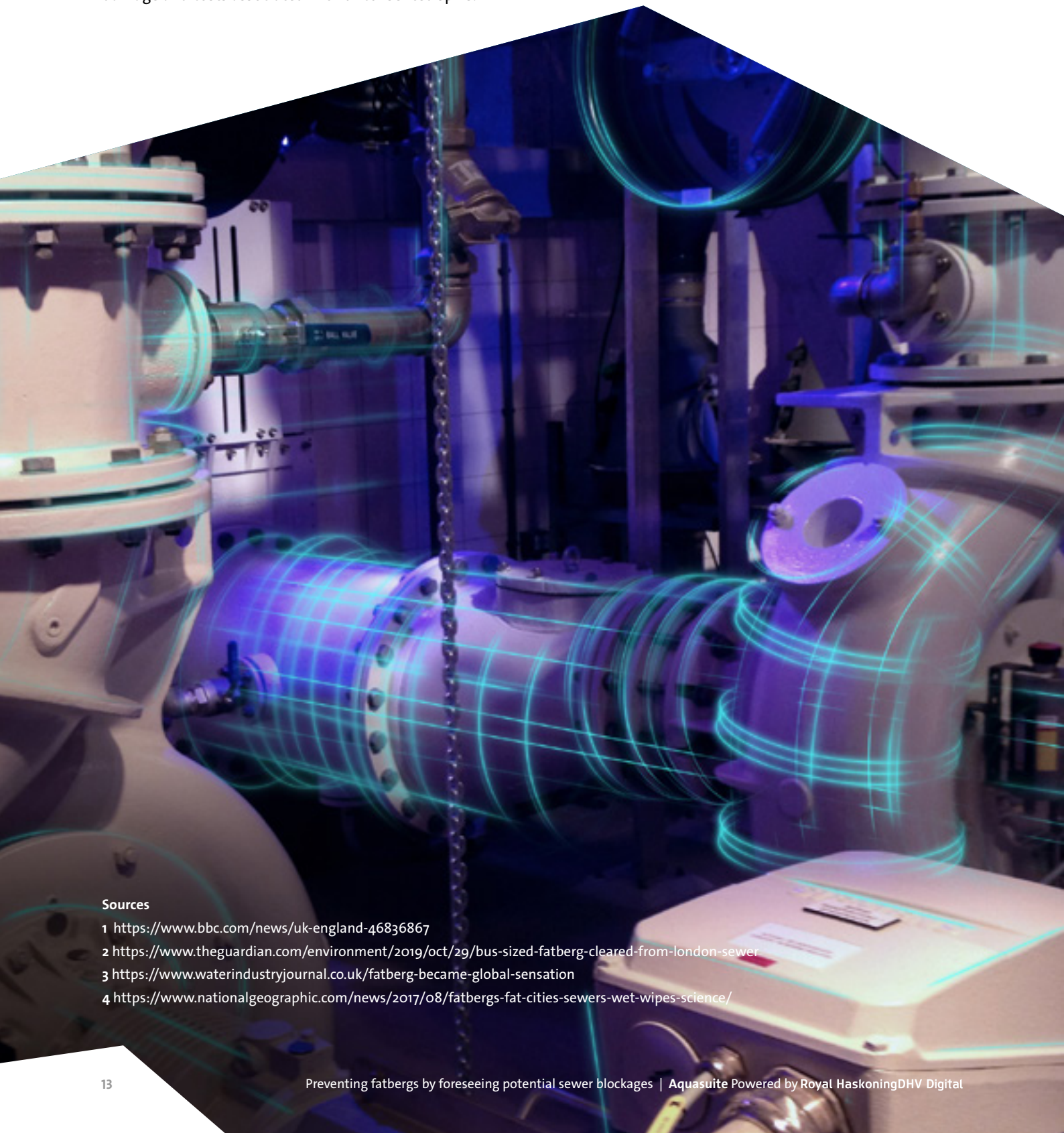
7. Advantages

Predictive monitoring and targeted interventions have both economic and environmental advantages:

- Anomaly detection reveals the slow process of the fouling of a sewer network early enough to avoid the extensive damage that results from unconsented spills.
- It saves people having to spend many hours analysing huge amounts of data in order to make operational decisions.
- It records the exact location of the event, which reduces the number of man hours spent in trying to locate blockages in a network which may be many kilometres long, covering a very large distance.
- It increases the efficiency of repairs as maintenance operatives can now not only go straight to the relevant location, but they will also be fully prepared for the situation they are likely to find there, reducing the number of further journeys they need to make.
- It removes a high level of dependence on a particular individual's knowledge. This is useful when key members of the workforce are on holiday or unwell. Also, with an ageing workforce, years of experience and 'insider' knowledge regarding a network's past behaviour are in danger of being lost when someone retires.
- It is consistent and reliable, whereas human operators can become fatigued or distracted.

8. Conclusion

Predictive monitoring provides actionable insights into blocked sewers for wastewater operators. The data-driven predictions that are made by the automated analyst means that human operators can make sure they are better prepared to foresee events and thus avoid the resulting damage and costs associated with unconsented spills.



Sources

1 https://www.bbc.com/news/uk-england-46836867

2 https://www.theguardian.com/environment/2019/oct/29/bus-sized-fatberg-cleared-from-london-sewer

3 https://www.waterindustryjournal.co.uk/fatberg-became-global-sensation

4 https://www.nationalgeographic.com/news/2017/08/fatbergs-fat-cities-sewers-wet-wipes-science/

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About Aquasuite

Aquasuite is an AI-powered analyst and autopilot for utilities and industries. It monitors, analyses, visualises and controls the performance of water and wastewater infrastructure through predictive analytics and machine learning.

While you gain full real-time visibility across your complete water and/or wastewater network and treatment, Aquasuite controls your day-to-day operations.

It has already helped thousands of industrial, municipal and commercial assets to:

- maintain a calm network
- avoid water losses and improve customer service
- meet environmental compliance
- meet effluent quality regulations
- reduce opex costs
- turn waste into a renewable energy source

For more information visit our website:

aquasuite.ai

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Royal HaskoningDHV Digital is part of Royal HaskoningDHV. Royal HaskoningDHV Digital builds on the company's mission to enhance societies by combining specialised digital capabilities with deep engineering knowledge. Royal HaskoningDHV Digital offers a comprehensive portfolio of digital consultancy and software solutions to create value for clients across the globe. Royal HaskoningDHV Digital focuses on accelerating innovation and implementation of emerging technologies. Its portfolio of services will support clients in sectors such as water, industry and mobility as they optimise their operations and future performance through digital transformation.

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