Using machine learning to improve detection and prediction of rising mains bursts and sewage pumping station issues

Additional information document

What are rising mains and sewage pumping stations (SPSs)?

Wessex Water is responsible for around 35,000km of gravity sewers, which transfer wastewater from our customers' homes and businesses by gravity to a water recycling centre (WRC). Here the wastewater is treated before being discharged back to the environment.

Where the topography does not enable our sewers to flow by gravity, we use sewage pumping stations (SPSs) to transfer flows over hills using pressurised pipes called rising mains.

Wastewater arriving at an SPS accumulates in a large tank called a wet well. Once the wastewater reaches a certain depth in the wet well, it is pumped out through the associated rising main. At the other end of the rising main the wastewater is discharged into a gravity outlet.

We measure various parameters at SPSs (e.g. wet well level, pressure) to ensure they are operating appropriately. Measurements are transmitted back to a central control centre in the form of 'telemetry signals'.

Detecting rising main bursts and SPS issues – our current approach

Rising main bursts and SPS issues can result in potential flooding and pollution. Bursts may not be visible or obvious from the surface and so data is key to detecting these incidents.

When a major issue at an SPS (e.g. a high wet well level or pump failure) results in these parameters breaching a specific threshold, our wastewater telemetry system generates an alarm. More minor issues (such as partial blockages, air locking pumps or instrument faults) may not breach the required threshold to generate an alert. However, over time these issues can develop into service failures. Prompt identification allows action to be taken to avoid such failures.

We currently use in-house analytics to identify when rising mains have burst and to detect anomalies at SPSs or upstream in the network. To some extent this is predictive, i.e. identifying issues as they develop.

We can then direct operational crews to investigate. However, the level of triaging involved in the in-house analysis limits the speed of our response.

Applying a machine learning approach

Machine learning tools are now available in this area. As such, we are looking for a machine learning solution that uses real-time wastewater telemetry data to identify when behaviour of an SPS or rising main deviates from the expected range for the prevailing conditions – which

may be an early indication of a problem. The solution should then generate an alert that could be transmitted to our network monitoring team.

In this way, a successful tool would allow us to:

- more rapidly identify bursts and SPS failures that occur, thereby improving response times
- identify developing or imminent issues, allowing us to intervene and reduce the likelihood of a rising main burst, SPS failure, or other incident occurring.

The benefits of this include:

- A potentially lower number of SPS failures or rising main bursts – reducing our environmental impact.
- A shift in focus from reactive maintenance to proactive maintenance.
    - This will improve the performance of our assets, which will also reduce our environmental impact (e.g. in the case of a spill).
    - Our assets will operate more efficiently, with lower energy consumption.
- A reduced alarm load in our control room (as fewer developing issues would become an incident), thereby improving response times when incidents do occur.
- Better understanding of the relative importance of different monitoring parameters as indicators of rising main issues. This will inform our future monitoring approach, ensuring that it is as fit-for-purpose and cost-effective as possible.

Marketplace challenge overview

We are inviting suppliers to use our historical data to develop and demonstrate this predictive machine learning capability. Any solutions must outperform our in-house analytics.

To facilitate this, we have published **asset information and historical telemetry and rainfall data** for 24 sewage pumping station sites in our region. The two years of data represent a dry year (2022) and a wet year (2023) and include instances of rising main bursts.

The majority of Wessex Water's rising mains consist of a 'simple' arrangement whereby a single SPS is located at the start of the rising main, with a single discharge point at the other end (into a gravity outlet). The focus of this Marketplace challenge is on these 'simple' arrangements, and the 24 SPSs for which we are sharing data all adhere to this principle.

We are looking to take up to three solutions forward to proof of concept (POC) trials using a near real-time data feed to test their capabilities. The POC trials are expected to run for three months starting in late 2025 / early 2026. Funding of up to £15,000 per POC is available.

For the POC trial, suppliers will use their solutions to analyse near real-time telemetry data, generating alerts when the behaviour of an SPS or rising main deviates from the expected range. The accuracy of alerts will be verified against the actual behaviour of the SPS or rising main.

If trials are successful, we would like to undertake a procurement exercise and a tender may be required. But please note that participation in this Marketplace challenge does **not** guarantee a contract at the end.

Teams session

If you're interested in this opportunity, please join us for a Teams information session on **Monday 21 July, 13:00-14:00**. Email **marketplace@wessexwater.co.uk** to register for the session and we'll send you the joining details.

The session will include an opportunity for questions. You can submit questions in advance via email or simply ask them on the day. We will publish all questions and responses (unless there are questions that wouldn't be appropriate to share answers to that may relate to the specific IP of an organisation).

Submitting a proposal

Proposals should then be submitted by email to **marketplace@wessexwater.co.uk** on or before **Wednesday 24 September**.

Please keep submissions concise (an absolute maximum of 20 pages) at this stage to allow our team to review all that come through. Proposals should ideally include the following, where this is available:

- Details of the system you propose to use.
- Outline of any funding requirements for the POC (up to £15,000).
- Confirmation that the system is available for purchase and implementation following a successful POC.
- Demonstration of capability using our historical data (see the next section for details).
- Details for each bullet point in our 'further assessment criteria' on pages 3 and 4.

Suppliers involved in the POC stage will, amongst other things, be asked to complete our cyber security questionnaire, and adhere to any relevant Wessex Water policies.

Initial assessment of proposals

We will carry out a desktop review of submitted proposals.

The key assessment criteria will be **demonstration of capability using our historical data**. Suppliers need to show that they have used their solution to analyse the historical data to detect rising mains bursts or issues at an SPS. They should be able to indicate the point at which the analysis has identified an anomaly, suggest a likely cause and indicate when the SPS returns to normal operation. We would also be interested in anything else of note that you can tell us from the data – the initial requirements are a starting point but part of the reason for an open challenge such as this is to understand wider learnings. Suppliers need to demonstrate a basic understanding of wastewater pumping systems.

We will also consider these **further assessment criteria**:

- Case studies of any UK or worldwide use (or similar applications)
- Data and information security
- Compatibility / connectivity with Wessex Water systems, particularly Ovarro Scope telemetry system, Microsoft Azure and business reporting tools.
- Indicative long-term costs and support for up to 500 rising mains / pumping stations, and for up to 2000 rising mains / pumping stations
- Feasibility of deployment
- Commercial benefits

We will invite shortlisted suppliers to face-to-face meetings (currently planned for November 2025) to determine who we would like to take forward to POC stage.

Ideally shortlisted suppliers would give a live walkthrough of the working system using the published historical data, although we do understand that there is a difference between historical and real-time analysis.

Information available for suppliers participating in the POC trial

The POC trial will cover the 24 sites from the original data publication.

Depending on the location of the data management solution, we will provide the following data.

Telemetry Data

We published the following historical data files (years 2022 & 2023) as part of this Marketplace challenge:

- SPS run-stop data
- Rising main pressure data
- Rising main flow data
- SPS wet well level data

For the POC trial we will provide equivalent data as a near real-time feed (regardless of whether the solution is hosted on-premise, or is off-premise / cloud based).

	SPS run-stop data	**Rising main pressure data** **Rising main flow data** **SPS wet well level data**
Frequency of recording	Variable time stamps	Every minute
Frequency of transmission to WSX servers	Once per hour	Once per hour
Signal type	Digital	Analogue
Data delivery method for POC trial and ultimate solution	**For on-premise solutions:** Delivered via a direct push into a Wessex Water corporate SQL database, then extracted by the solution (i.e. a publisher / subscriber method) **For off-premise solutions:** Delivered via sFTP	
File format	**For on-premise solutions:** database **For off-premise solutions:** CSV	

Asset Data

The following files were part of the data published for this Marketplace challenge:

- Rising main route and elevation profile
- Rising main diameter and key to telemetry signals

The same 24 sites will be used for the POC trial. We will provide trial participants with a version of the 'Rising main route and elevation profile' where the grid references of the rising mains and pumping stations have **not** been anonymised.

We expect the information to remain unchanged throughout the POC trial but will provide updates as needed.

Rainfall Data

For proposed solutions that are hosted **off-premise**, we are unable to provide rainfall data. Rainfall data of equivalent quality to that we are currently receiving will need to be provided by the supplier.

For proposed solutions that are hosted **on-premise**, we can provide the following rainfall data at near real-time:

	Historical rainfall data (Met Office Nimrod)	**Predicted rainfall data – forecast 6 hours ahead (Met Office Nowcast)**
Frequency of recordings	Every 5 minutes	Every 15 minutes
Frequency of transmission to WSX servers	Every 5-15 minutes	Every 15 minutes
Resolution (spatial)	1km	2km
File format	Binary data file	Binary format GRIB 2 (Gridded Binary)

Assessment of the POC trial

The POC trial will take place over a 3-month period using 24 SPS sites selected to be representative of our asset base. Suppliers will use their solutions to analyse near real-time telemetry data, generating alerts when the behaviour of an SPS or rising main deviates from the expected range. The accuracy of alerts will be verified against the actual behaviour of the SPS or rising main.

We will apply a number of measures and metrics, based around the following:

1. Alert volumes and accuracy

Metric: Percentage of alerts that are genuine issues – calculated fortnightly

As the system learns we expect to see the accuracy improve.

Any solution needs to adjust the expected operating envelope according to rainfall.

We may simulate a rising main burst or other SPS issue during the trial.

Any solution would need to demonstrate better performance than our current in-house analytics. For transparency, each time we feed back on trial participants' performance against this metric, we will provide a comparison against our current in-house analytics.

2. Alert severity categorisation

Metric: Percentage of appropriate categorisation – calculated fortnightly

Any solution would need to categorise alerts into urgent or non-urgent.

3. Alert latency

Metrics:

Average time between an urgent event and receipt of alert – calculated fortnightly
Average time between a non-urgent event and receipt of alert – calculated fortnightly

Anomalous behaviour needs to be identified as close to 'live' as possible.

Any solution would need to demonstrate better performance than our current in-house analytics. For transparency, each time we feed back on trial participants' performance against this metric, we will provide a comparison against our current in-house analytics.

4. Reliability

Metric: Percentage up-time

Solutions will need to demonstrate 99% availability.

5. Machine learning capability

Metric: Qualitative

Any solution needs the capability to be modified (i.e. to 'learn') according to whether alerts (or lack of) were correct / appropriate. The system would also need to be able to re-learn a baseline as a result of operational variation or changes. (Where possible we would notify you of changes that we instigate e.g. in response to one of your alerts.)

6. Compatibility / connectivity

Metric: Qualitative

Any solution should demonstrate compatibility / connectivity with Wessex Water systems, particularly Ovarro Scope telemetry system, Microsoft Azure and business reporting tools.

7. User experience

Metric: Qualitative

Solutions should be easy to use with helpful system visuals.

8. Other system functionality

Metric: Qualitative

- Differentiation between actioned alerts, repeat alerts and new alerts.
- Classification of sites into a top list of anomalous sites.