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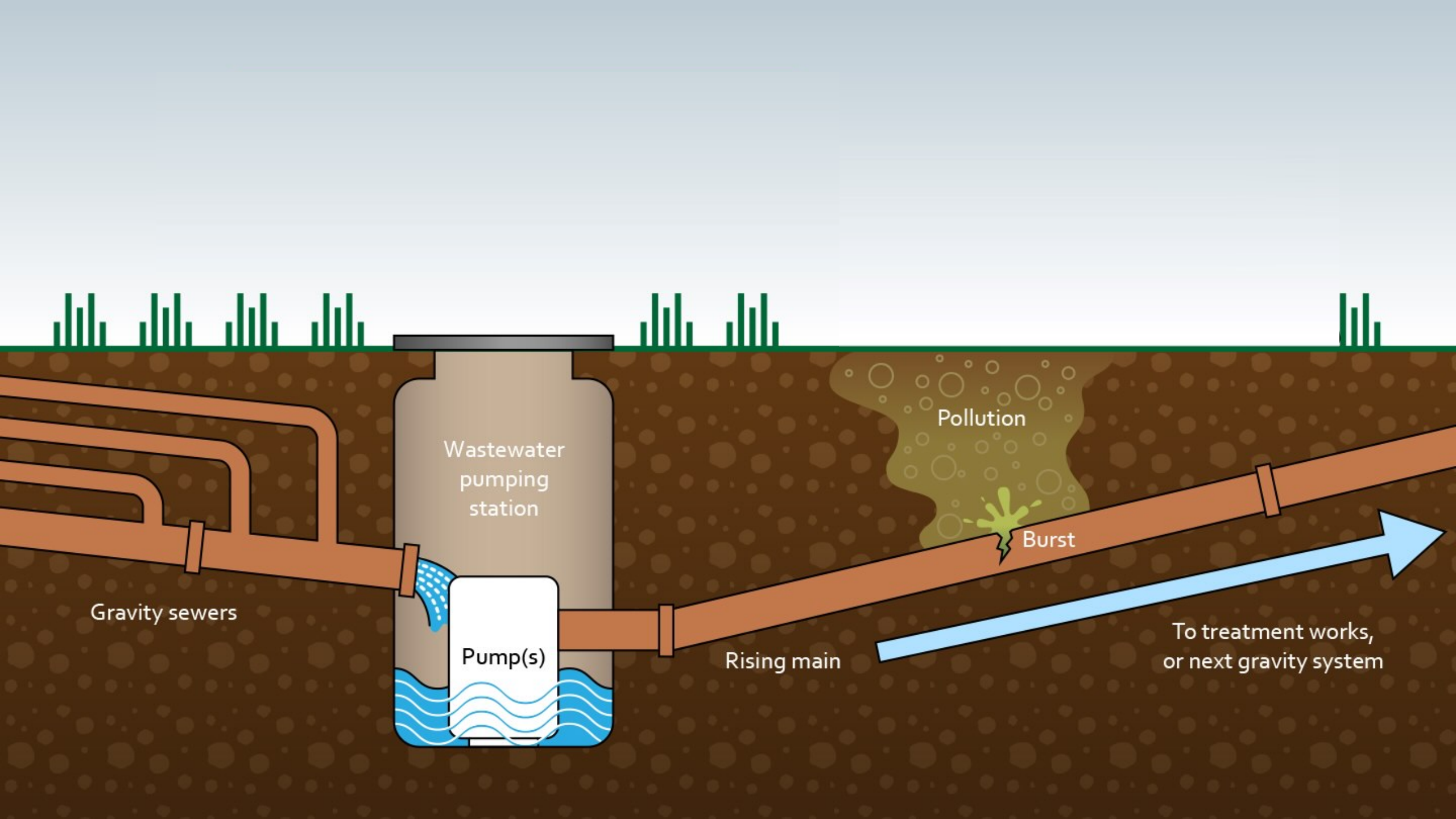
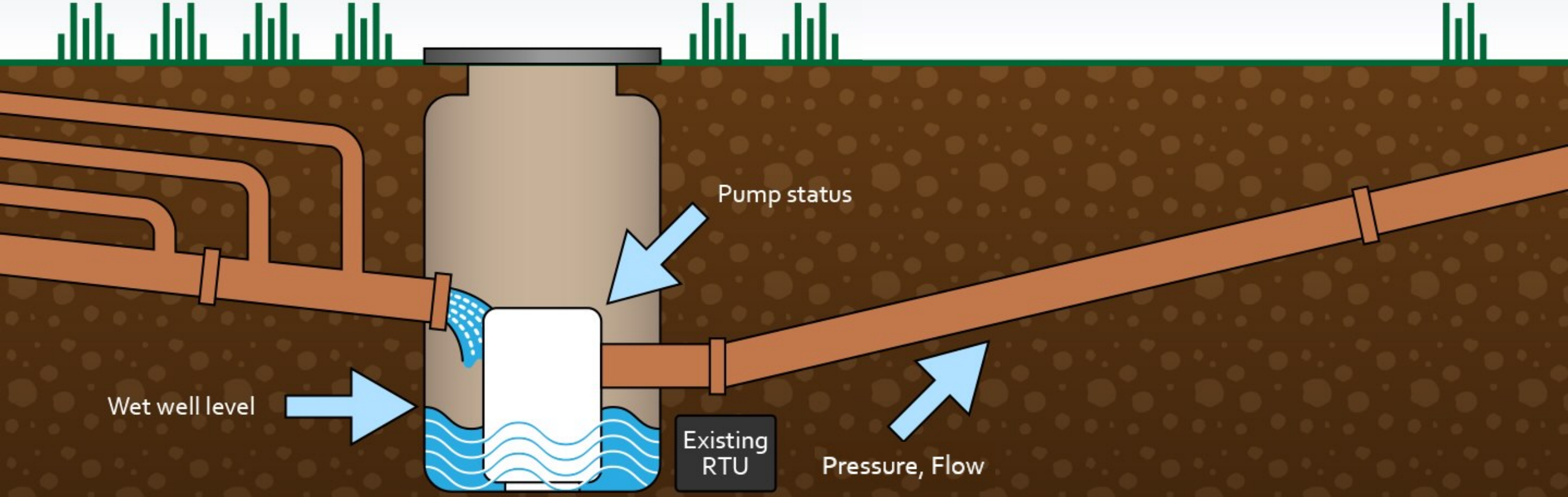
Preventing rising main pollution through machine learning


Wastewater pumping station
Pollution
Burst
Gravity sewers
Pump(s)
Rising main
To treatment works, or next gravity system

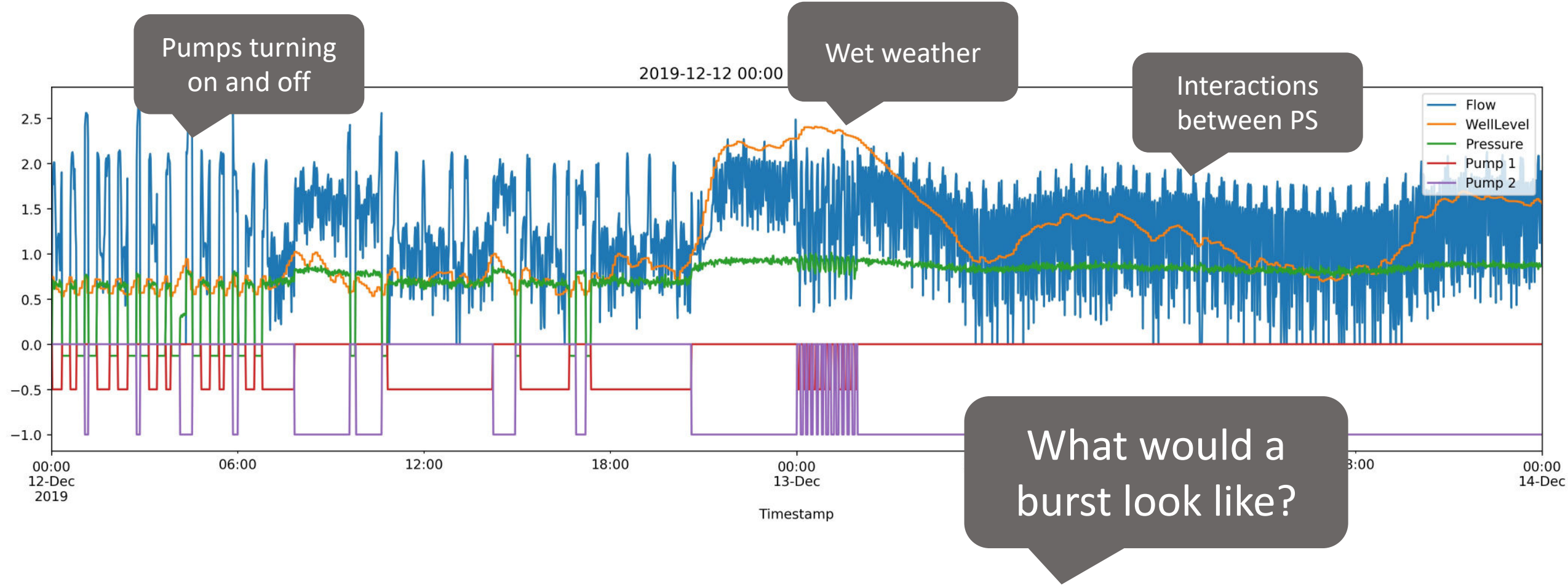
What's the problem?

- Environmental pollution
- Categorised by Environment Agency as Cat 1-3
- Subject to ~£75,000 Ofwat ODI in AMP7
- Property flooding, also subject to ODI
- Clean-up costs (tankering, aeration, restoration, etc.)
- Court cases, legal fees and fines
- EA enforcement undertakings
- Compensation
- Internal and external investigations
- PR costs, for responding to local and national media
- Reputational damage

Existing monitoring



Existing data



Rising Main Burst Detection

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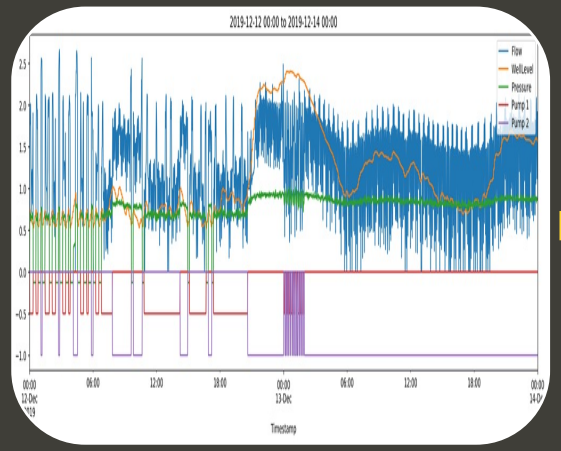
How does it work?

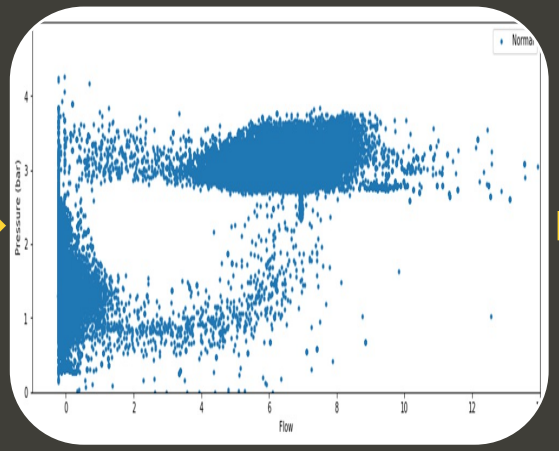
- Existing monitoring
- Multi-tenant Software-as-a-Service in Azure cloud
- Machine Learning algorithms
- Alerts sent by email (other routes to follow)

MACHINE LEARNING ALGORITHMS

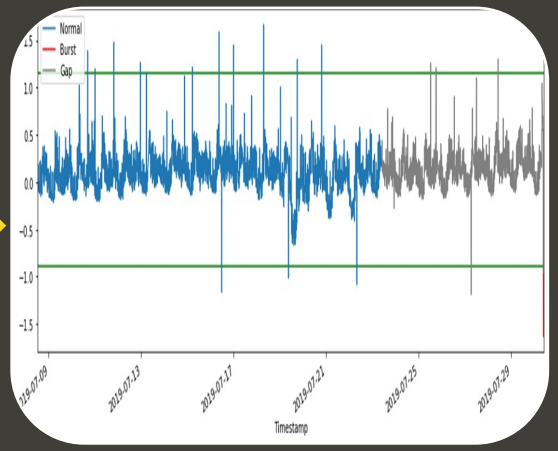
Understand



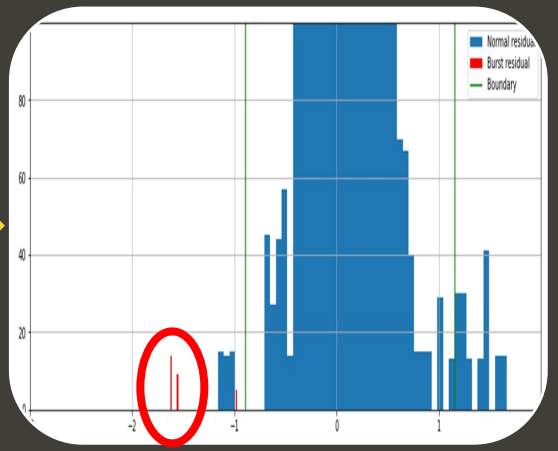
Cleanse



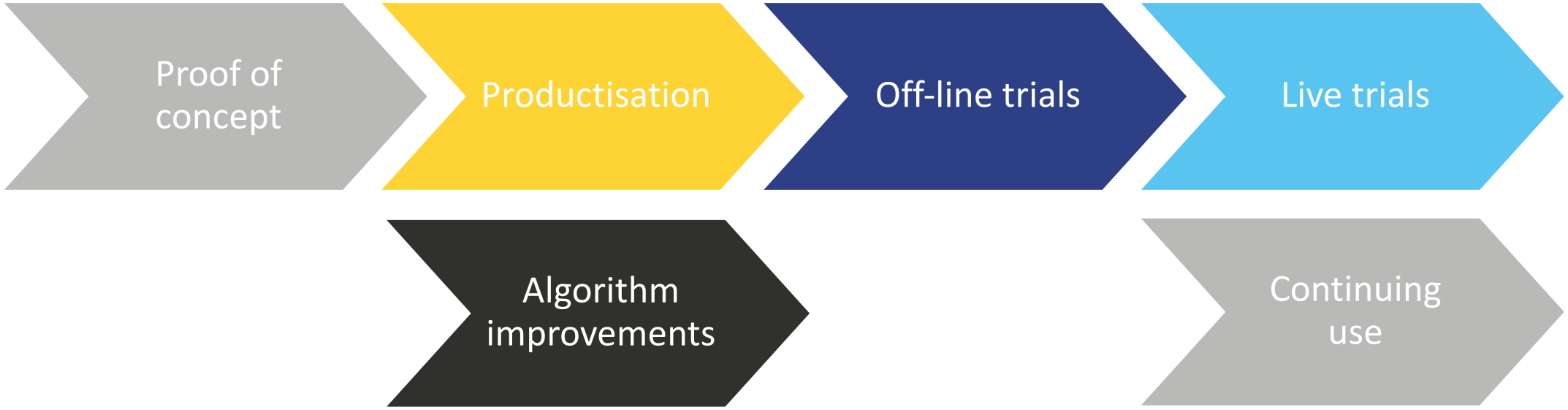
Transform



Detect



The story so far…



Current algorithm portfolio

Algorithm 1

pump status, flow, pressure

NEW

Algorithm 2

pump status, pressure

NEW

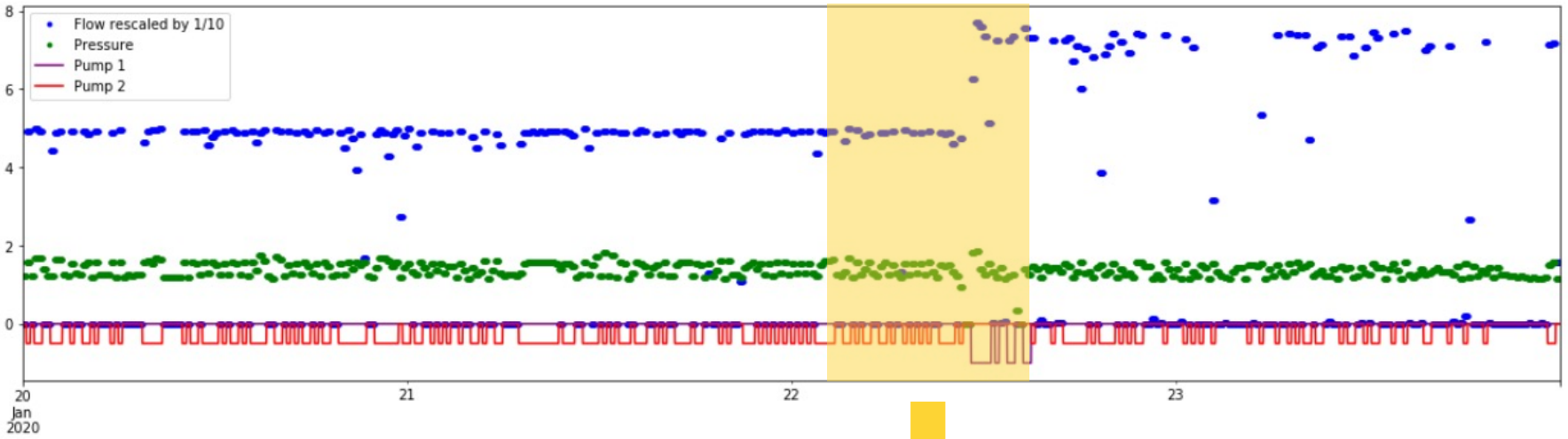
Algorithm 3

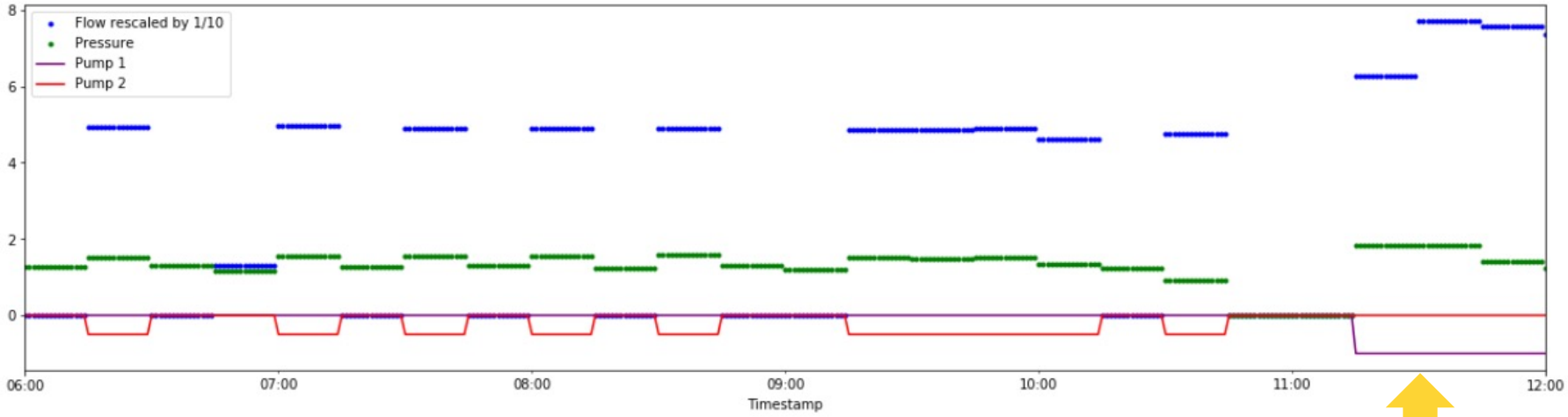
pump status only

The algorithms have been tested against a large data set comprising:

- Data from 6 companies
- 85 pumping stations
- ~12 months of data per pumping station on average
- More than 30 burst events

Examples from off-line trials – 1





BurstDetect Alert raised at 11:35 on 22nd January

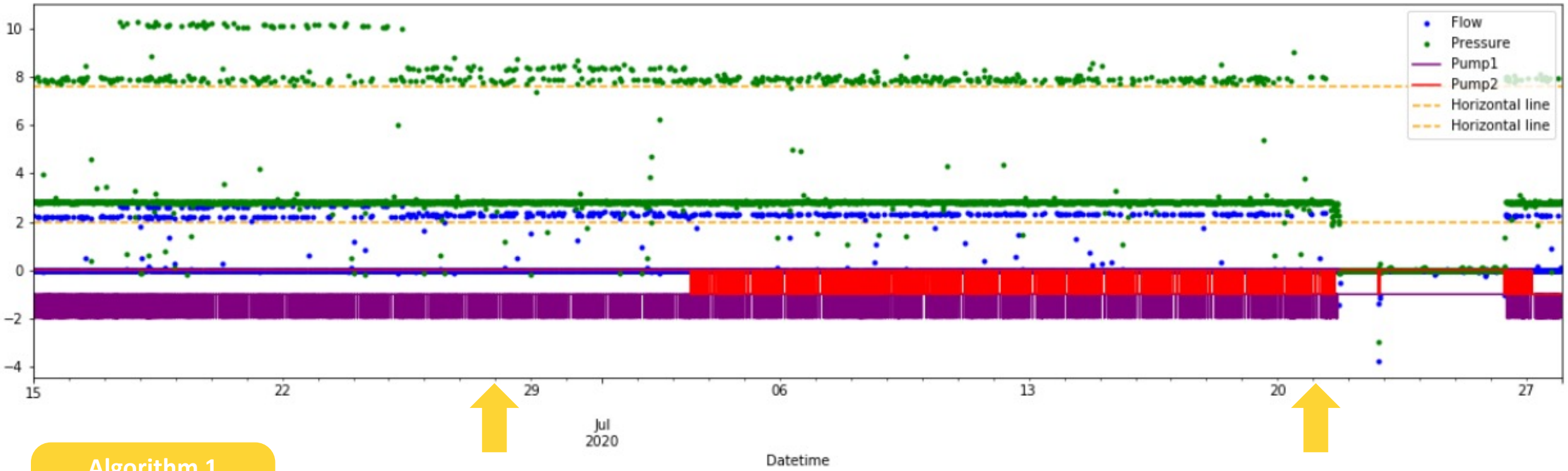
Severe pollution could have been avoided

Algorithm 1

pump status, flow, pressure

BurstDetect Alert

Examples from off-line trials – 2



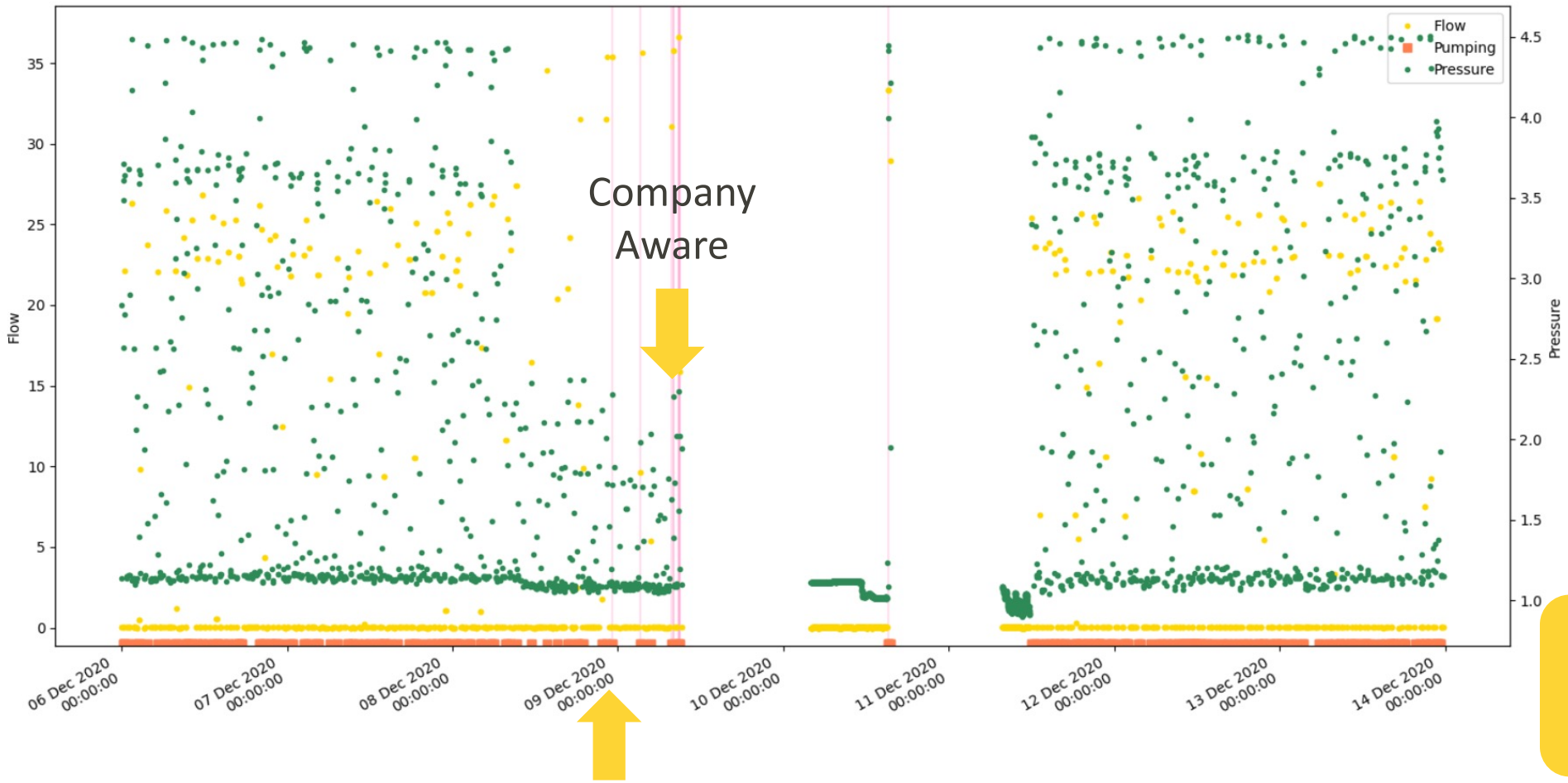
Algorithm 1

pump status, flow, pressure

BurstDetect Alert
01:52 on 28th June

Company not aware until 21st July

Examples from off-line trials – 3



Algorithm 1

pump status, flow, pressure

Examples from off-line trials – 4

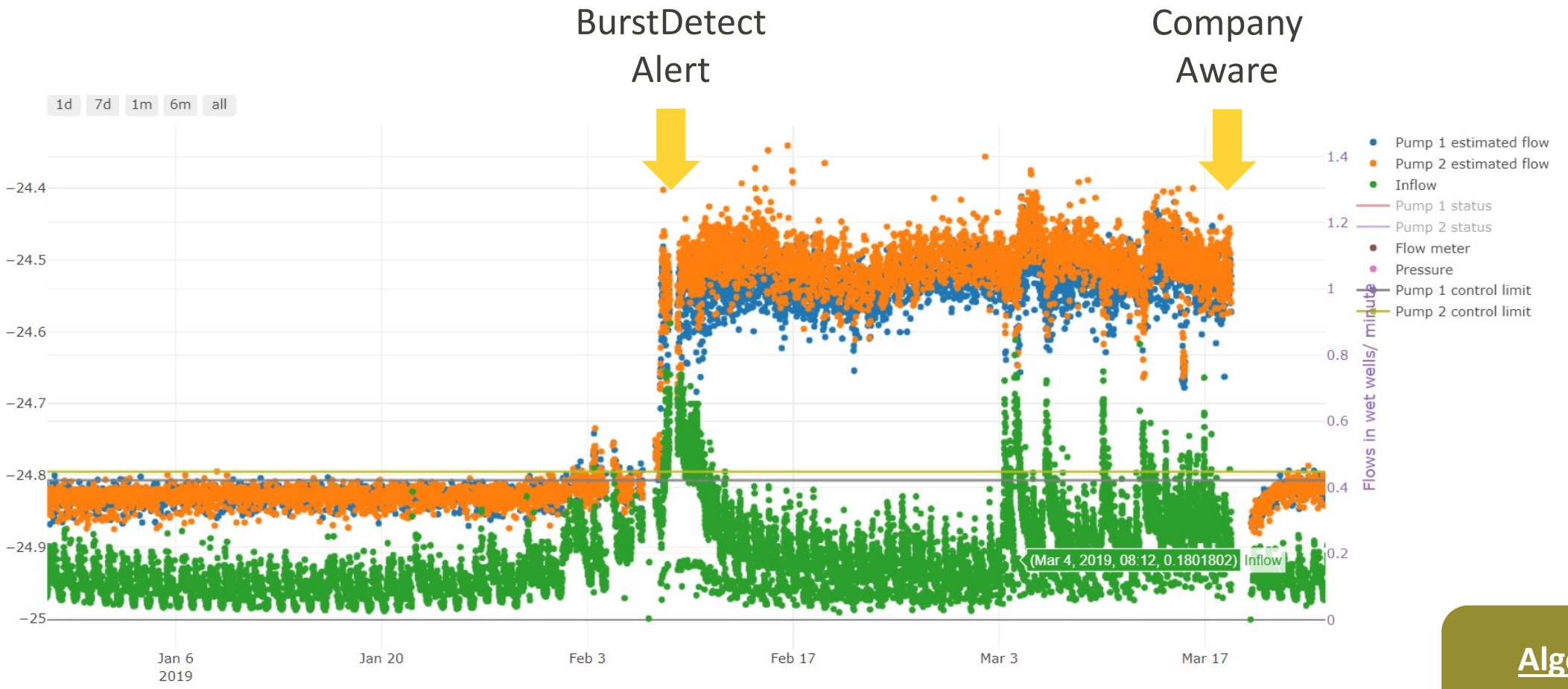
Algorithm raised alert 19th March

Company not aware until 1st April

Algorithm 2

pump status, pressure

Examples from off-line trials – 5



Algorithm raised alert 8th February

Company not aware until 18th March

Algorithm 3

pump status only

OFFLINE STUDIES

SUCCESS SO FAR

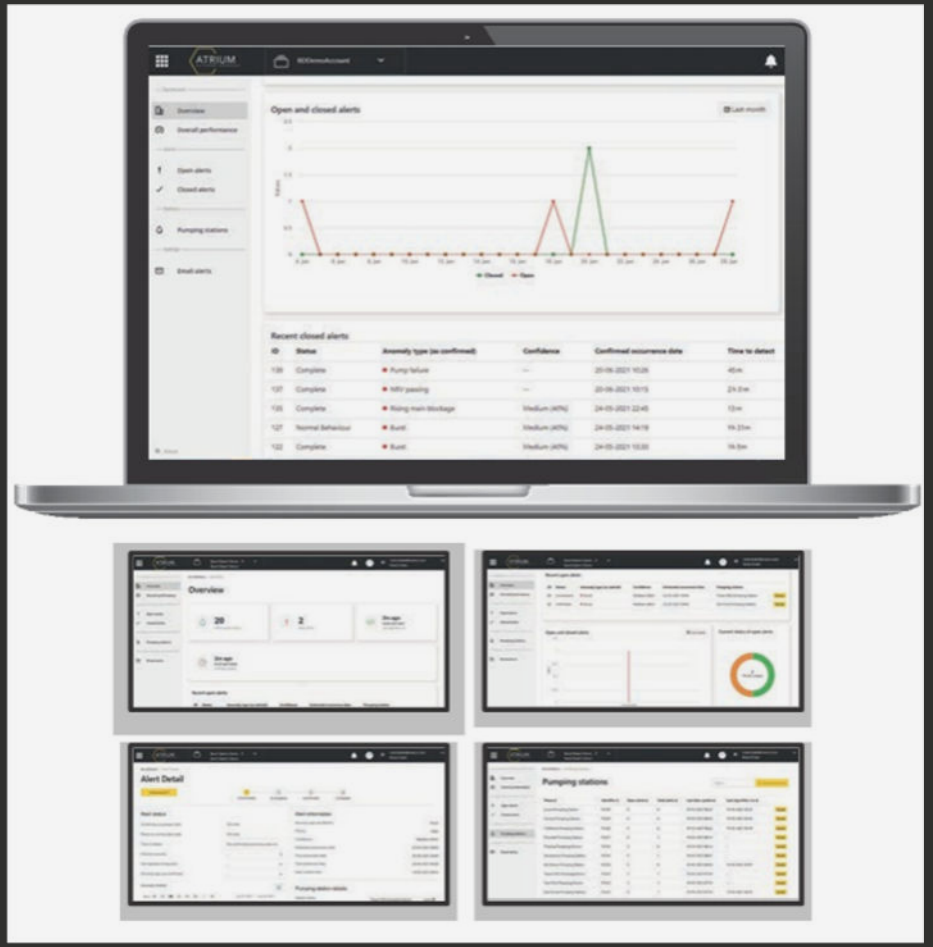
Offline studies completed with 4 UK Water Companies

Offline Study 1:

- Data from 28 sites (flow, pressure, status)
- Burst detected 4 hours before the rising main discharge alarm
- Long running burst detected over a month before it was fixed

Offline Study 2:

- Data from 16 pumping stations over 24 months
- 2 bursts detected
- 1 burst detected 3 weeks faster
- No bursts missed



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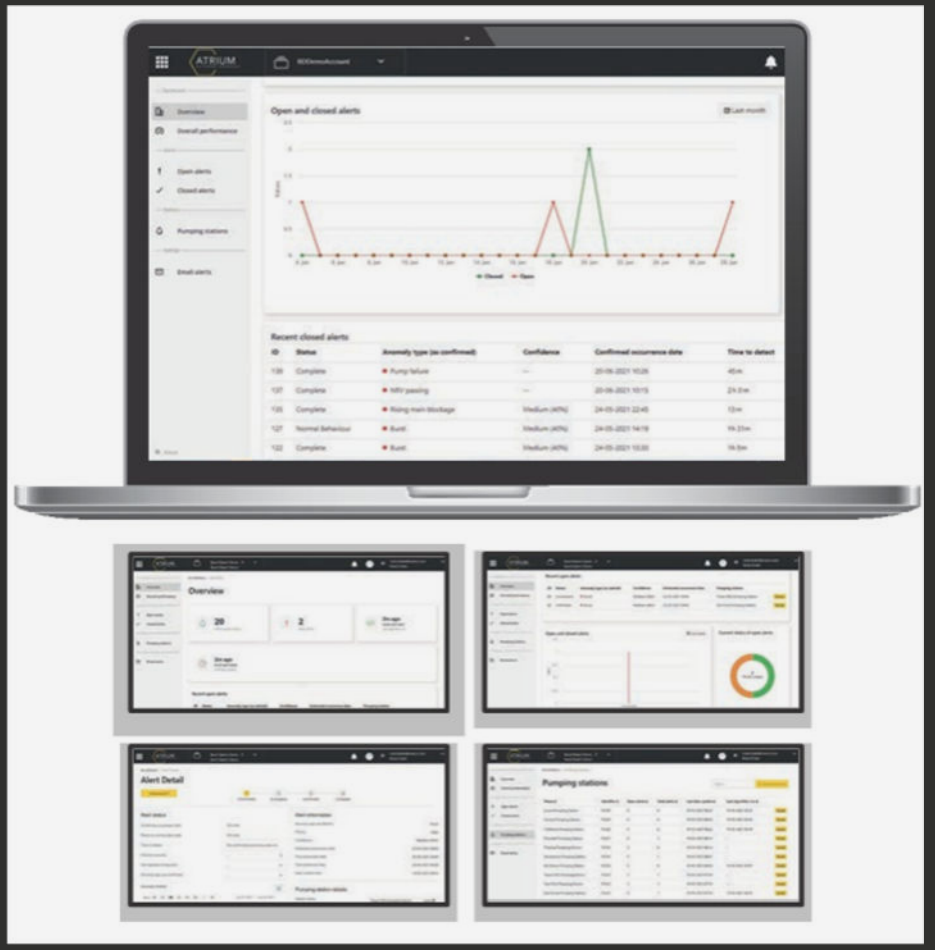
OFFLINE STUDIES

SUCCESS SO FAR



Offline studies completed with 4 UK Water Companies

Offline Study 3:

- **Data from 11 pumping stations over 12 months**
- **2 bursts detected with pump status data only (in one case 3 days earlier than current methods)**

Offline Study 4:

- **Data from 3 pumping stations over 12 months**
- **PS 1 – 5 bursts correctly detected, each within a few hours of starting (full data set)**
- **PS 2 – burst detected 12 days ahead of current methods (pressure and status)**
- **PS 3 – burst detected 1 month ahead of current methods (status only)**

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A short demonstration …

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What's special about BurstDetect?

- Focuses on detecting rising main bursts
- Requires no additional hardware
- Works with a wide range of monitoring setups, with the aim of achieving 100% coverage
- Rapid detection of bursts
- Easy setup
- A large and growing data set to support Machine Learning algorithm development

BENEFITS

- Identify potential bursts more quickly than current methods, sometimes within 30 minutes of occurrence
- Allow rapid action to avoid/reduce impact
- Minimise release of sewage to the environment
- Avoid a Category 1-3 pollution incident and ODI penalty
- Avoid property flooding and ODI penalty
- Meet EA self-reporting requirements
- Reduce clean-up costs
- Minimise reputational damage

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Preventing rising main pollution through machine learning

Any questions?

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