# FOLLOW THE FORMULA

Binnies is bringing AI from elite motorsport to eliminate most preventable asset failures in water.

Imagine a world in which at least 80% of preventable water and wastewater asset failures could be eliminated. That would improve industry performance enormously; eradicate multiple negative customer and environmental impacts; reduce costs and carbon; and support wider work to restore public trust. It would also be in keeping with the Cunliffe Review's call for asset health reform, and the direction of travel of Ofwat's existing asset health roadmap.

According to Binnies, it's not a pipe dream. Last month, the engineering expert announced a partnership with pioneers from the worlds of elite motorsport and technology to introduce a new class of AI to the water sector, to overhaul asset health. The collaboration – between Binnies, engineering consultancy Williams Grand Prix Technologies and AI specialist JuliaHub – aims to bring a proven AI technique already in use in other complex engineering environments to water, to help companies get ahead of the failure curve.

## SciML

At the heart of the initiative is scientific machine learning (SciML). This approach combines physics with machine learning, using scientific laws – such as fluid dynamics and thermodynamics – to fill data gaps and model how assets *should* behave. This supports accurate predictions, even without historical data, and with only minimal sensors.

Binnies explains that most market and in-house predictive analytics still rely on traditional machine learning, which demands large volumes of clean, historical data — something the water sector rarely has. When data is incomplete or inaccurate, these models falter: they miss unfamiliar failure modes and drive up costs through the need for extensive sensor deployments and data-cleansing efforts. The heavy data demands of traditional machine learning have largely prevented predictive analytics from achieving full scalability, leaving most projects stuck in fragmented pilots — and reinforcing the industry's reliance on reactive practices.

SciML provides the ability to overcome these problems. According to Binnies, it will enable water companies to build models that are up to 80% accurate using engineering information alone (such as pump curves and design specifications). They can then calibrate the remaining 20% using available telemetry – allowing for reliable predictions even when data is limited.

Tom Ray, director of digital products and services at Binnies UK, enthuses: "Genuinely for all of us, we feel this is the most exciting thing we've ever worked on in our careers."

## Origins and adoption

The benefits of going predictive were documented initially by organisations including the US Department of Energy. It established that getting ahead of failure offered a 10x return on investment; a 25-30% reduction in maintenance costs; a 70-75% elimination of breakdowns; and a 35-45% reduction in downtime.

Multiple complex engineering environments, including in top-level motorsport, aviation and aerospace, now employ SciML, extracting predictive insights largely from the data they already hold. For instance, in Formula 1, Atlassian Williams Racing and JuliaHub worked together to create a digital twin which uses SciML to provide in-lap insights without the negative impact of extra weight and poor aerodynamics that would come with running a race with a physical sensor. This twin enables 169x faster modelling and more accurate predictions.

Other industry examples are shown in the box.

## Introduction for water

Ray explains that Binnies sourced the SciML idea after asking water leaders about their biggest worry. "It was 'we want to be able to predict failure, get ahead of the failure curve'," Ray reports. "But then in the next breath, they said 'the quality of our data is limiting our ability to predict'…That then led to us understanding that the whole industry is operating using traditional machine learning, which requires huge amounts of historical data and high quality data. So we went around to lots of sectors asking, how do you predict when data is not good? Long story short, that led us to motorsport."

He explains that Binnies partnered with Williams Grand Prix Technologies to understand SciML applications in the world of motorsport. Williams Grand Prix Technologies then offered an introduction to its AI specialist contact, JuliaHub. "So we all jumped on a call and learned how they do it for NASA, for Boeing, to predict engine failure, and obviously for Atlassian Williams Racing.

"Essentially, you don't start with the data, you start with the engineering information, which companies have more readily available than sensor data – like, what's the make and manufacturer of that pump, and what are the design specs? Is there a pump curve we can get hold of? Instead of guessing from data patterns alone, SciML builds its models on equations like mass balance and energy conservation. These equations act as the scaffolding of a bridge, with data filling the gaps to make the whole structure.

"This means you can build a predictive model to 80% accurate from a standing start without any data, which traditional machine learning can't do… Then that final 20% is calibrated with the data. We thought, well, let's go and test this. Let's see how this works out in the industry."

Binnies found the water sector to be very keen to engage. Perhaps this is unsurprising, considering a 2025 survey identified that 84% of the industry's maintenance programmes rely on reactive (52%) or planned (32%) work, while only 16% are driven by real-time condition-based (13%) or predictive analytics (3%). This leaves the sector highly exposed to unplanned failures and escalating financial penalties under AMP8.

In June, Binnies ran a Predictive Asset Health Summit attended by senior leaders from 19 water companies, Ofwat and others. Three quarters of those who gave feedback said they would like it to become an annual event; 93% rated it 'very good' or 'excellent'. A survey of delegates on the day further revealed a need for change (see charts).

A number of proactive water companies have already taken up the opportunity to run feasibility studies. Ray says these have fully justified the excitement around SciML.

## Southern study: borehole pumps

A case in point is a project with Southern Water, to work out the greatest value SciML could demonstrate in six weeks on borehole pump health, using existing information. This took place at Matts Hill water supply works, but Southern operates 81 water supply works in total and has 1,484 pumps in service.

Binnies took available sensor data on the Matts Hill borehole pumps – voltage, current, flow and level measurement – and layered this with engineering information on pump make, model and curves sourced from the manufacturers, and site information including borehole depth, contact tank volume, pipelines and configuration.

A virtual model of the Matts Hill pumps using SciML was built and used to analyse five years of historical data while also simulating failure events to test and refine model accuracy. The model detected specific pump faults with up to 95% accuracy. SciML demonstrated the ability to provide high-fidelity, live and predictive asset health monitoring – using the existing data – covering pump health and efficiency, impeller health, bearing health and sensor health. The model also identified the energy efficiency loss caused by changes in pump control settings over time, enabling recommendations on how to run the pumps as a system to save energy.

Tim McMahon, managing director of water at Southern, comments: "We in Southern Water have ambitious plans to revolutionise our approach to maintenance and in doing so we are working with Binnies, Williams Grand Prix Technologies and JuliaHub to leapfrog the traditional approaches to condition-based monitoring. Although early days, we are incredibly excited at what this technology will bring and see it is a vital initiative at improving service for our customers and the environment."

## Predictive potential

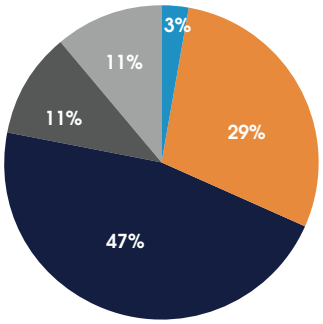
The trial illustrates the multi-layered potential of SciML in water. Ray points out: "It isn't a single product with a fixed, narrow purpose – it's a new AI methodology. That means its potential applications are far broader. Asset health is our first focus, but it's only the start. For example, with Southern Water the next phase is already looking at how SciML can also drive down energy use, optimise treatment processes and cut carbon emissions."

Binnies believes the overall impact of SciML on water could be groundbreaking, and will support water companies to shift from reactive to predictive asset health to prevent failures. Ray continues: "This partnership could fundamentally change how the water industry approaches asset health. For the first time, predictive insight doesn't require perfect data, and that's a breakthrough the industry's been waiting for."

> **We feel this is the most exciting thing we've ever worked on in our careers.**

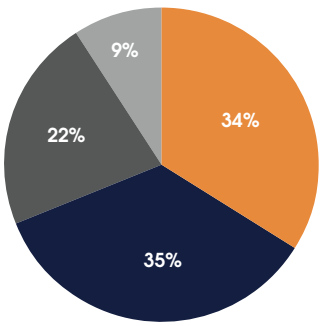
## PREDICTIVE ASSET HEALTH SUMMIT SURVEY RESULTS

### HOW CONSISTENT IS THE WATER SECTOR DEFINITION OF ASSET HEALTH TODAY?



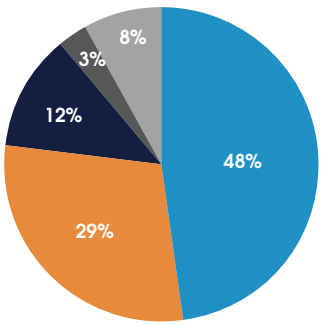

Very **3%**
Somewhat **29%**
Inconsistent **47%**
Highly fragmented **11%**
Still evolving **11%**

### HOW ALIGNED IS THE INDUSTRY ON ASSET HEALTH MEASUREMENT?




Tightly **0%**
Loosely **34%**
Misaligned **35%**
Disjointed **22%**
Still searching **9%**

### WHERE IS YOUR ORGANISATION RE PREDICTIVE ASSET HEALTH?




Reactive **48%**
Planned **29%**
Condition-based **12%**
Predictive **3%**
Not sure **8%**

**If you think about SciML, don't think about it as a small, fragmented pilot on one asset class, because the best ROI comes at scale.**

The team added: "This marks more than just a tech upgrade – it's a mindset shift. The sector is moving from reactive to predictive operations, from lagging indicators to leading insights. By rethinking how existing data is used, risk is managed, and investment is targeted, this partnership unlocks a new level of operational resilience across the industry."

### Managing cost and risk

Water companies may understandably be wary of the cost. Ray says pricing proposals are being calculated as we speak, but highlights two key things. First, that what's important is "the balance between how much you have to spend on this technology versus the return on investment and how much efficiency saving you can make". Second, that the bulk of the cost sits in the development of a SciML module for each use case – say, for an activated sludge or pumping station module. Deployment, in contrast, is fast. So the greatest return on investment will be found from application to a large portfolio of critical assets.

Ray: "A larger portfolio doesn't mean lots of sites, it just means maybe more asset classes, more asset bases. The best way of putting it is, if you think about SciML, don't think about it as a small, fragmented pilot on one asset class, because the best ROI comes at scale."

Binnies' first port of call is to approach each company one-by-one for interest, but it is not closed minded to other options. It would also welcome some kind of industry-level framework to endorse the technology, to encourage the more hesitant to get on board.

Binnies' view is that other risks can be managed. The key ones include:

- Loss of critical know-how from over reliance on AI – SciML should enhance, not replace, human judgement. Teams must keep applying and developing their critical domain expertise.
- Inappropriate use-cases – this could waste resources but can be avoided by targeting the most critical assets first.
- Skills shortages and change resistance – shifting to AI-assisted operations requires new skills, processes and cultural acceptance. Resistance to change or insufficient training can limit adoption and benefits. This must be addressed upfront.
- 'Set and forget' risk – insufficient maintenance and adaptation is a risk. Models should be updated as new assets come online – for example, during upgrade works – to maintain maximum accuracy and value.

The team is now in advanced discussions with several companies to scope large deployments on some of their most critical assets. This will further build the evidence base and demonstrate just how game-changing the potential of SciML in water is. TWR

## SciML EVIDENCE FROM OTHER SECTORS

**Manufacturing**
Delivering a 50% uplift in operational efficiency, equivalent to $400m in financial gains.

**Aviation**
Delivering a 20% cost saving on a $1bn maintenance budget while delivering 99.9% accuracy in engine maintenance and 100× faster model speeds.

**Automotive**
Reduced costs by 20%, with 500x faster and 2x more accurate models.

**Heating, ventilation and cooling**
On track for 15% reduction in downtime and 10% cost saving.

**Motorsport**
Achieved a 10% cost reduction in sensor optimisation, enabled by 4x faster model performance and 50% reduction in error rates.

**Pharmaceutical**
Cut drug trial costs by 50% – saving $80m per trial – through a 50% increase in model accuracy.