TOIHAN

PREDICTIVE ANALYTICS FOR USER LEVEL ASSISTANCE

PAULA-WWTP®

Monitoring & Control

See what is coming.
Control what happens next.

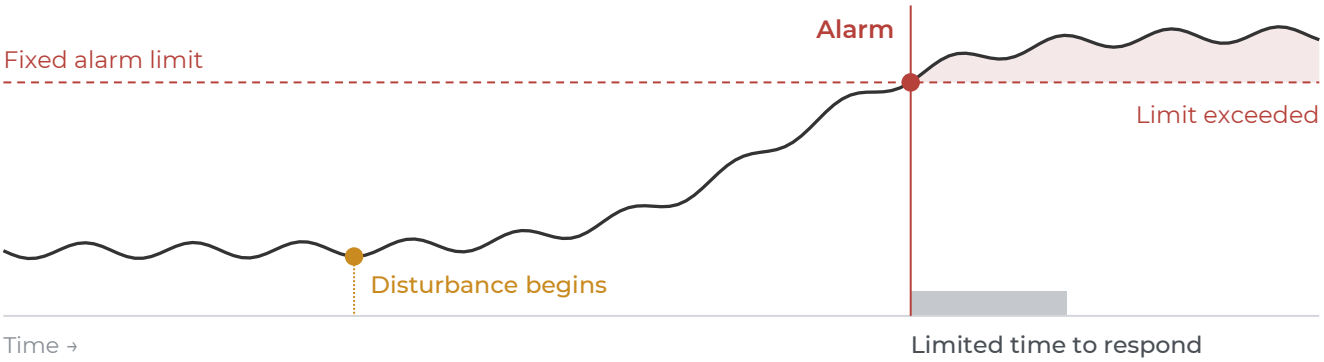
01 THE CHALLENGE

By the time an alarm sounds, the process has already changed

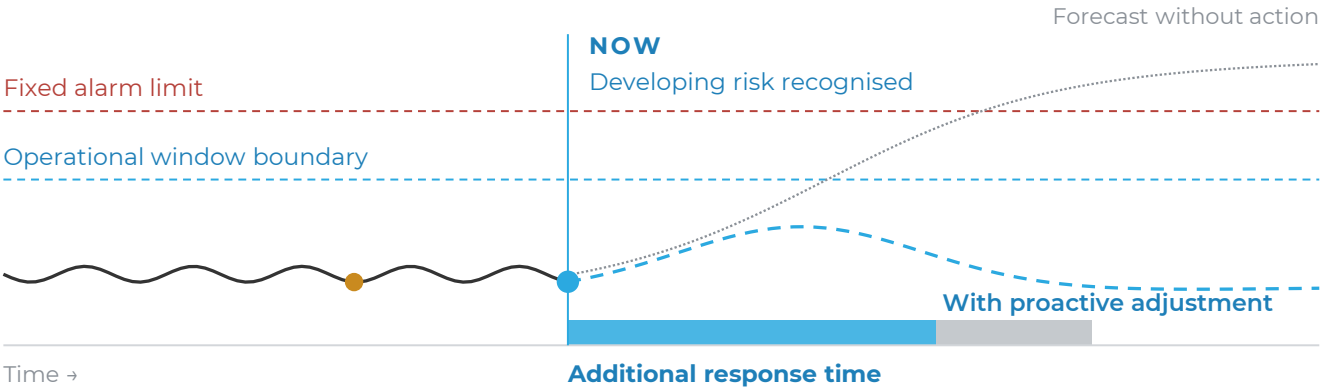
In biological treatment, microbes convert dissolved organic load and nutrients into biosludge. Retention times are long and changes are slow – what comes in today is coming out tomorrow.

Conventional monitoring compares measurements with fixed alarm limits. Operators react once a limit is crossed – often after the biomass is already affected. Without accurate control, plants also tend to run with unnecessary chemical and nutrient buffers.

CONVENTIONAL MONITORING

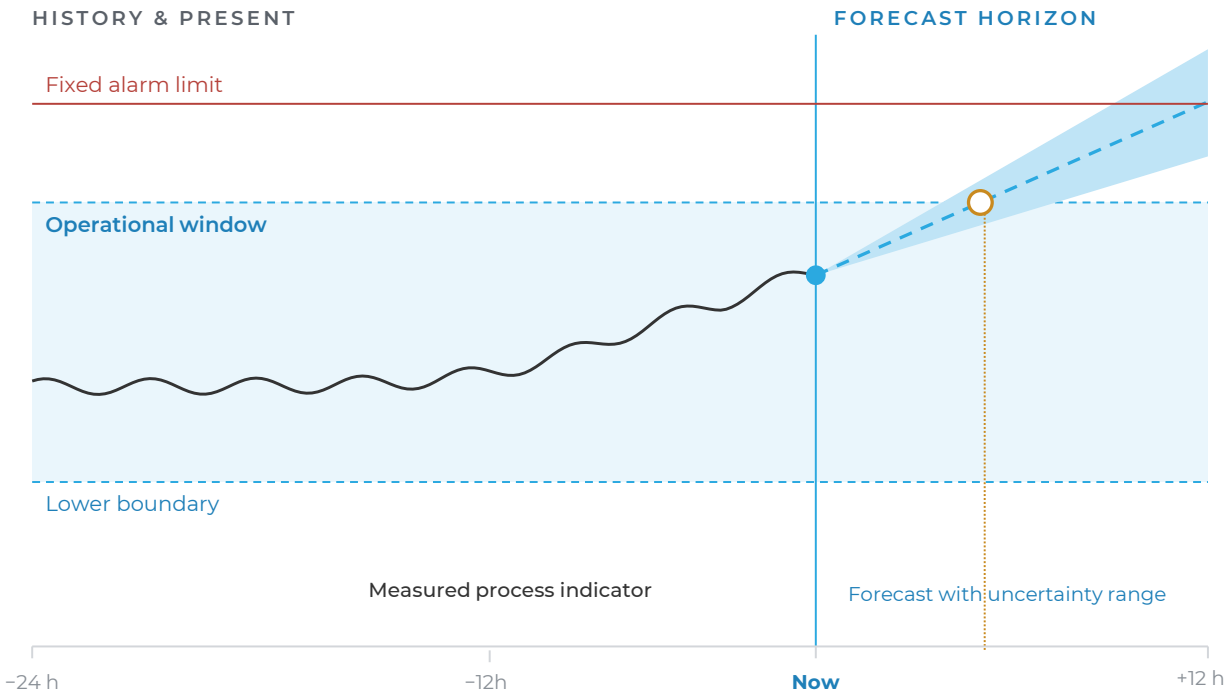


OBJECTIVE OF PREDICTIVE MONITORING



The further ahead a change can be anticipated, the better operators can prepare for it.

Past, present and likely future on one timeline



Historical data

Mill-specific process history – used to calibrate the models before start-up.

Present state

Online measurements and laboratory analyses, quality-checked and interpreted through engineering calculations.

Predicted trend

Hybrid-model forecasts. Mill production data reveals incoming load changes before they reach the plant.

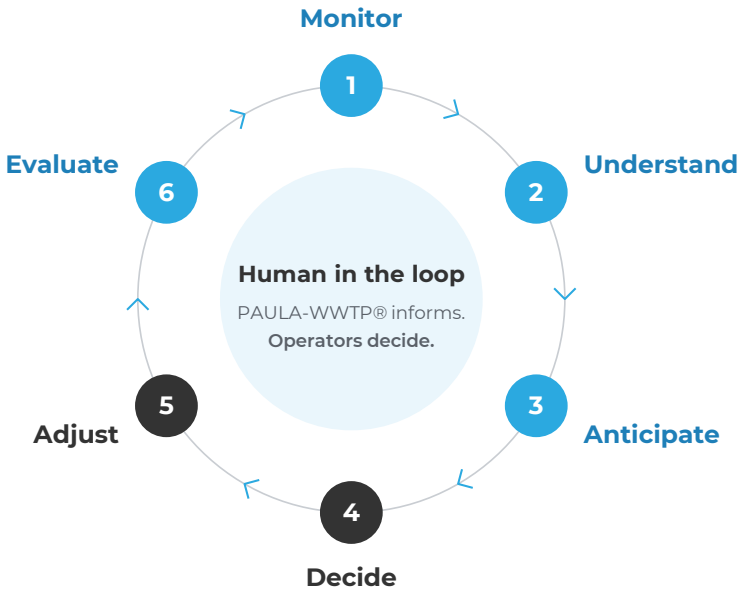
Operational window

Process-specific boundaries that flag risk before a fixed alarm limit is reached.

03 PROACTIVE CONTROL

Predictions become decisions, made by your operators

PAULA-WWTP® returns calculated recommendations to the mill database and operator screens: nutrient dosing, return sludge ratio, waste activated sludge and sludge retention time.



PAULA-WWTP® provides

- Forward-looking situational awareness
- Early warnings of developing disturbances
- Recommendations with traceable reasoning

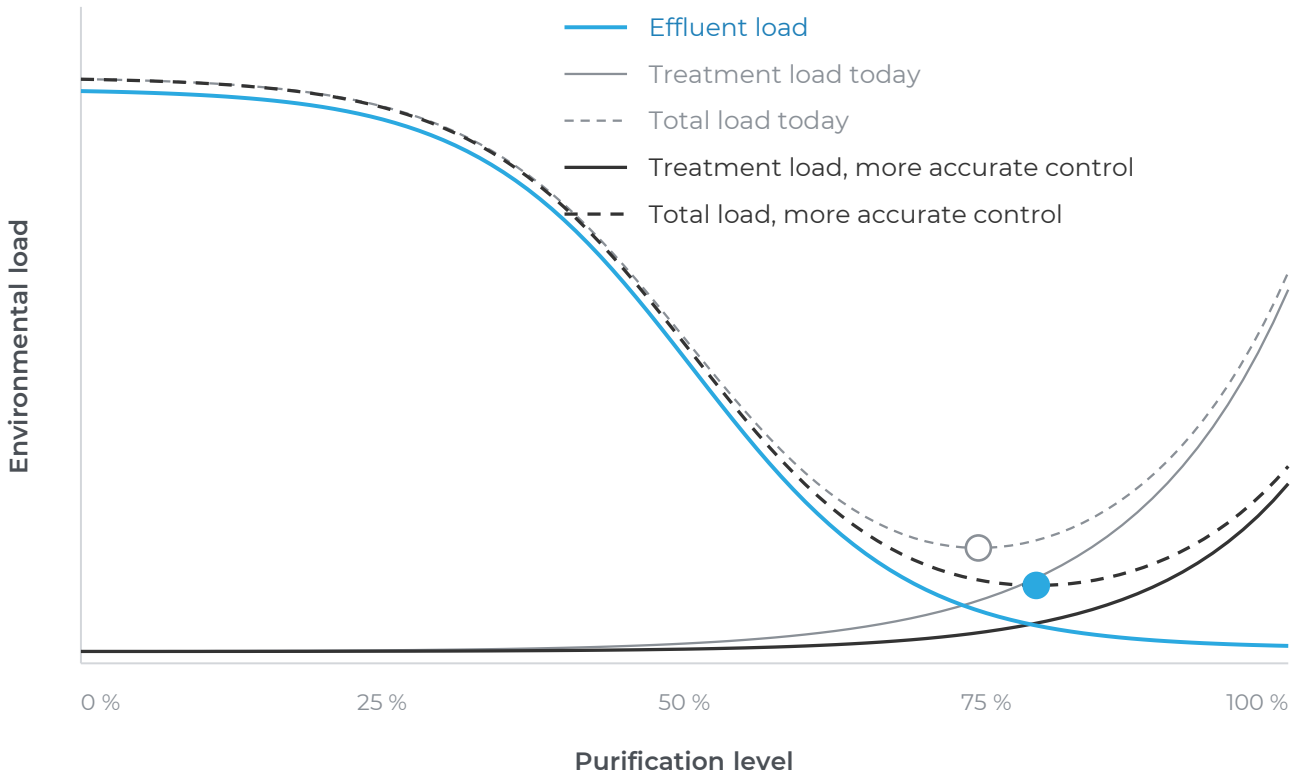
Plant personnel

- Assess recommendations in context
- Decide on and implement adjustments
- Retain full operational responsibility

Evaluate closes the loop: algorithm accuracy is continuously improved from the process response to adjustments and from process simulations.

Moving the sustainability curve

Treatment performance should be judged by both effluent load and the load caused by treatment itself. More accurate control removes unnecessary buffers – and lowers the total.



Concept adapted from Laukkanen, Dahl & Martikka (2014), Environmental Management and Technology in Industry.

Resource efficiency

Chemical dosing and energy consumption based on process requirements and biosludge growth.

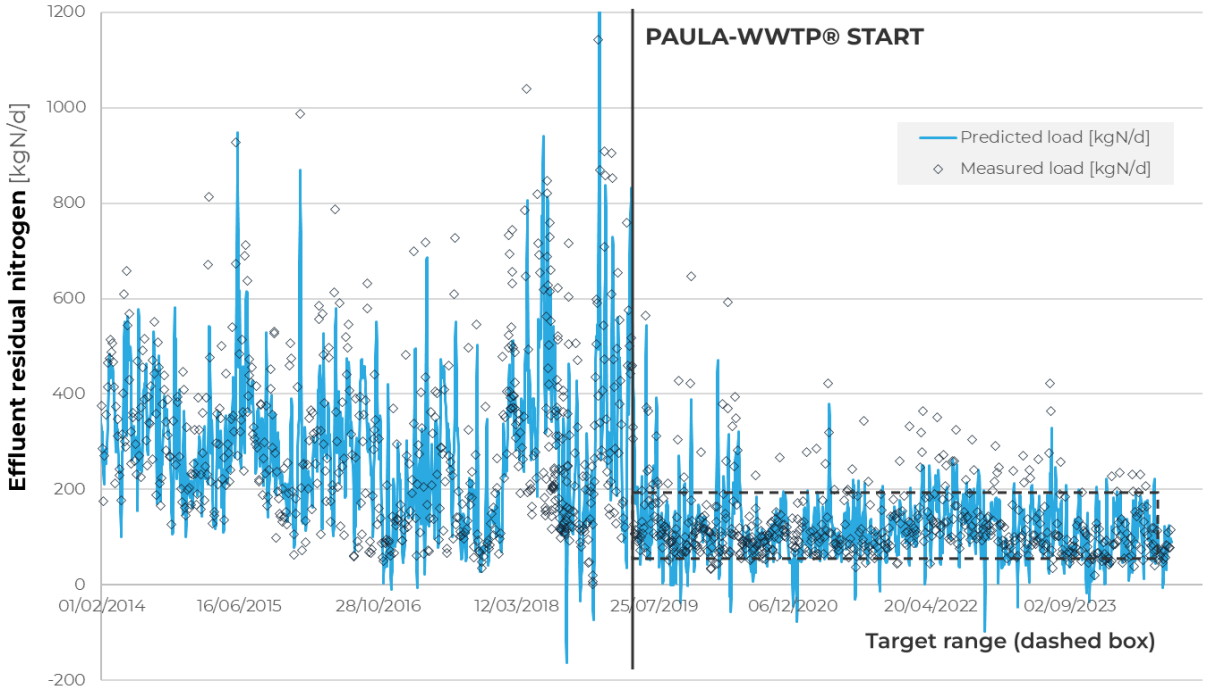
Operational reliability

Disturbances anticipated earlier and a more stable activated sludge process.

Environmental performance

Lower effluent loads, better sludge quality and nutrients matched to real demand.

Predictive nutrient control in daily operation

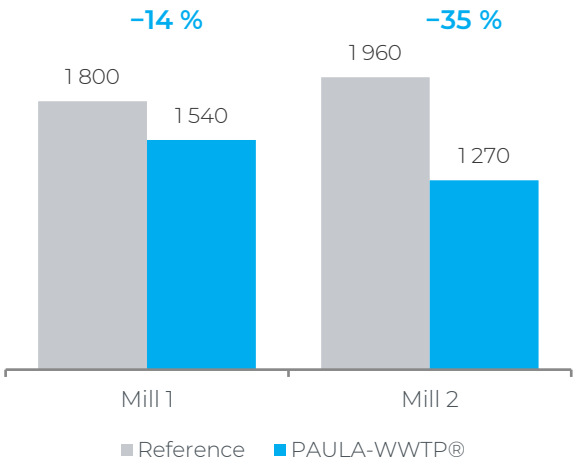


Customer example: effluent residual nitrogen (kgN/d), predicted and measured, 2014–2024.

Nitrogen held in its target range

After PAULA-WWTP® start, dosing follows predicted demand and residual nitrogen in the effluent stays close to target.

Urea addition, daily average (kg/d)



Lower effluent loads in three North European mills

48–68 %
lower total suspended solids load

43–51 %
lower total nitrogen load

12–29 %
lower total phosphorus load

9–32 %
lower COD load

Mill	Production	WWTP layout	Period	COD	TSS	Ptot	Ntot
Mill A	ECF pulp	Pre-settler, ASP	4 months	−22 %	−61 %	−21 %	−49 %
Mill B	TMP	Pre-settler, two-stage ASP, tertiary	12 months	−32 %	−68 %	−12 %	−43 %
Mill C	CTMP, RCF	Pre-settler, MBBR, ASP, tertiary	12 months	−9 %	−48 %	−29 %	−51 %

How the results were measured. Average final effluent loads per air-dry tonne before and after daily use of the advisory application. Mill operators set adjustments more often and with better timing; sludge settling improved and reported disturbances decreased. Results are mill-specific.

Source: Hannukainen & Toivakainen, O Papel 82(4), 2021.

Start with a conversation about your plant

Let's discuss opportunities of predictive monitoring and control at your wastewater treatment plant.

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