Application Note

# Weather-Resilient Water: Automating Solutions for Reliable Drinking Water Quality



## Abstract

**In recent years, the Swiss municipality of Saxon has experienced episodes of heavy bacteriological contamination of its spring water. The pollution occurred mainly during heavy rainfall and snowmelt. In collaboration with an engineering firm (PMAX), they overcame this problem by installing a fully-automated monitoring and control system. Modern measurement technology, chlorine pumps and shut-off valves are incorporated in an innovative system that guarantees high-quality water supply. It is based on rain event detection and flow cytometry. Villages can now be selectively alerted in real- time when risks of contamination occur in their supply area.**



**Keywords**
reservoir monitoring, network monitoring, drinking water distribution system, DWDS, water utility, self monitoring, online microbiology, flow cytometry, water characterisation

## Bad weather threatens water quality

At the base of the emblematic Pierre Avoi mountain, the village of Saxon has a unique history with water. A spa resort in the 1850s and the birthplace of Cristalp mineral water (sold until 2022), the town draws most of its drinking water from mountain springs. This pure, natural water is injected directly into the network (Figure 1) without filtration or treatment. A network of 10 reservoirs and chambers and a communal interconnection supply the homes of 7,300 inhabitants in the area. A large proportion of the water in Saxon and its mountain communities (up to 70% in an average year) comes from high-altitude springs. Following two heavy bacteriological contaminations in 2019, the commune has developed an automated system to control the risks of microbiological pollution.

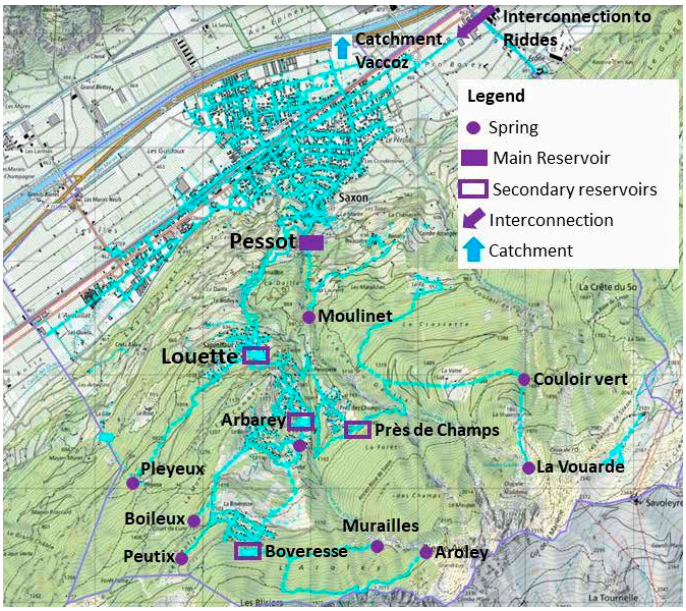


**Figure 1:** Saxon Network: location of springs and reservoirs.

## Setting up an automated management system

PMAX, a local automation company, implemented Saxon's comprehensive microbiological contamination risk management system. It consists of three parts (see Fig. 2):

1. The water quality is determined by online flow cytometry
2. In the event of increasing bacterial populations, the water supply is interrupted, chlorination takes place, and the lower network is supplied by alternative sources
3. The manager is automatically alerted by the system and he can inform the population if need be.

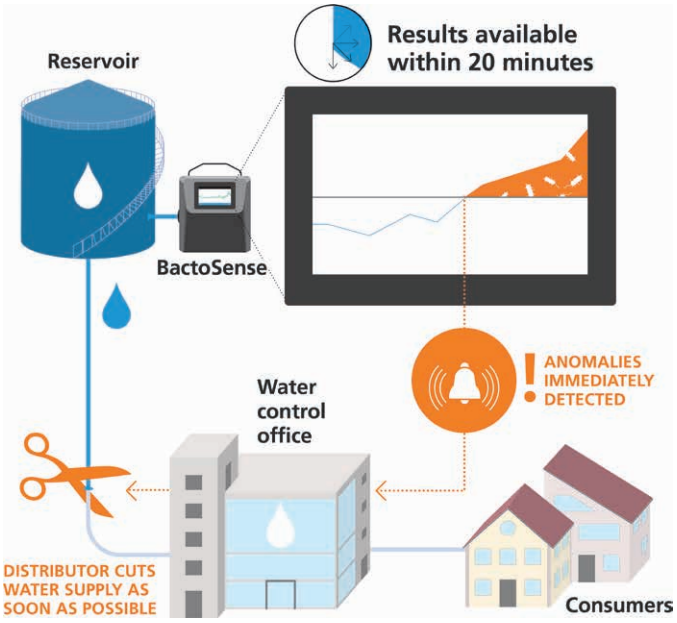


**Figure 2:** Automated risk management system for the residents of Saxon.

## Reservoir surveillance with BactoSense

BactoSense units were installed at two reservoirs (Pessot and Louette) to measure bacteria in the water. In the event of poor quality, the water is automatically isolated. At the Louette reservoir, measurements are alternately conducted at two distinct inlet points: one from the Arbarey reservoir, which is connected to the upper springs and reservoirs, and the other from the Pleyeux spring inlet (Figure 1).

**Figure 3:** Daniel Claret at the BactoSense installation.

## Automated result interpretation

The measurement intervals of BactoSense are set via PLC and SCADA. The frequency of measurements is adjusted depending on real-time weather data, which are obtained from the MeteoSwiss („RainAlert") cloud application. For example, rain periods present more significant pollution risks and require greater attention. The measurement interval is adjusted according to the weather (Figure 4), and the water quality is determined by using BactoSense results. High HNA (high nucleic acid) cell counts indicate a high risk for microbiological contamination, for example with E.coli, and poor water quality.

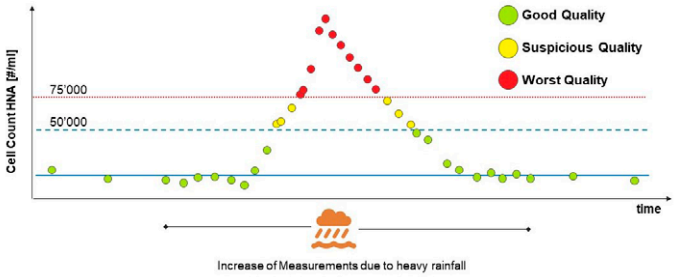


**Figure 4:** Meteorological information and cell number used to determine water quality.

Table 1 displays the two available action levels. When the water is of suspicious quality, a chlorination with 0.1 mg/l is done and the frequency of measurements is increased. When the water is of poor quality, it is chlorinated with 0.2 mg/l and alternative water supplies are tapped. In both cases, the person in charge receives a notification by SMS.

| Action Level | Measures |
|---|---|
| Suspicious Quality | Verification measurement by BactoSense<br>If the value is confirmed:<br>• Chlorination: 0.1 mg/l<br>• Measurement with a high frequency<br>• SMS alarm to the person in charge |
| Poor Quality | • Closing the reservoir outlet valve and opening the alternative supply<br>• Trigger the water supply from another source<br>• Chlorination: 0.2 mg/l<br>• Measurement with a high frequency<br>• SMS alarm to the person in charge |

**Table 1:** Actions and measures.

## Convincing results for pollution incidents

Here are two examples of four significant events in 2022:

In May, the number of cells increased sharply in both the Pessot and Louette reservoirs. At Louette, the contamination came from the Arbarey catchment (Figure 5) and not the spring of Pleyeux. Chlorination was triggered, and a more detailed examination led to the rejection of specific springs, which an employee of the Saxon Water Department manually discharged. Once the number of HNA cells had returned to normal, chlorination was stopped. After two days, the follow-up microbiological monitoring samples showed mostly conform values, and the results were as expected after three days. The surge in bacteria was attributed to intense snowmelt rather than a specific rainfall event.

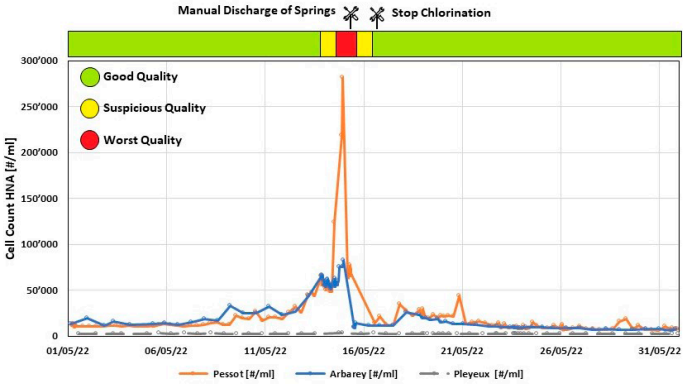


**Figure 5:** Number of HNA cells and manual intervention in May.

In late December, shortly before Christmas, an incident occurred at the Louette reservoir. The BactoSense system promptly identified an anomaly (Figure 6), leading to the initiation of chlorination in the Pessot reservoir and isolation of the Louette reservoir. Swift action was taken, effectively resolving the situation and ensuring a joyful festive season for the residents.

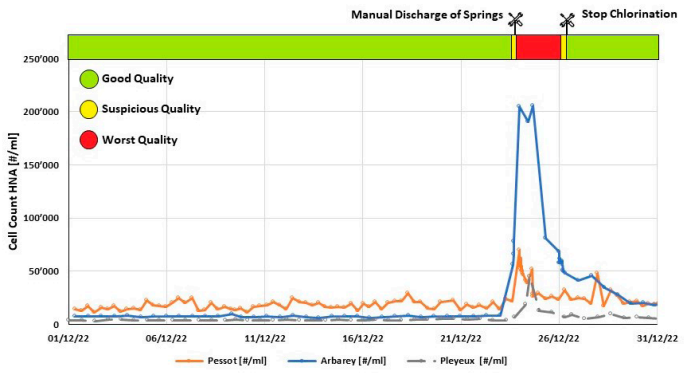


**Figure 6:** Number of HNA cells and manual intervention in December.

## Conclusion

The prevention system installed by the municipality of Saxon consists of precipitation analysis combined with online bacterial monitoring, automated valves and chlorination pumps. This highly effective system has a low consumption of resources and energy. Due to targeted rejection of individual sources, water treatment was only required for a few days in 2022. In this way, for most of the time, the drinking water network supplies untreated spring water and the safety of the drinking water distribution for the village of Saxon is simultaneously increased.

## Benefits

- Increased water security for the communities
- Localisation of microbial contamination events, isolation of affected communities and targeted information to inhabitants
- Low power consumption for the entire microbiological contamination risk management system (a few hundred watts), which leads to the cost of around 4 to 5 cents per m3
- Reduced chlorine usage: In 2022, 3.5 kg of chlorine was used. In contrast, continuous chlorination would have required around 129 kg of chlorine
- Due to the targeted discharge from individual sources, water treatment was only required for a few days in 2022. Moreover, only water of poor quality is discharged

## References

**This Application Note is adapted from a technical article**

Automatiser pour garantir la qualité de l'eau potable, Aqua & Gas, 2023.

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