From Compliance to Control

A Risk-Based Triage Model for Strategic Legionella Prevention in Large Municipal Building Portfolios

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BACKGROUND

Water safety is a management responsibility and requires careful planning, construction and commissioning. This also includes the responsibility of builders and architects, of planners, plumbing contractors or even laboratory [1]. The operational phase requires a structured management system for building water systems, with clear responsibilities, technical controls, monitoring, documentation and corrective actions [2,3,4]. The factors influencing Legionella behaviour are widely documented [5], yet recognition in management and insurance practice still lags behind. In large portfolios, prevention is typically driven by compliance sampling and isolated remediation. Such a reactive approach rarely achieves sustainable risk reduction, and recurrent contamination often results from poor planning, construction or maintenance failures.
This work presents a model for strategic Legionella prevention in a portfolio of the following scale:

- approximately 1,950 buildings managed by the municipal real estate organisation ‘Immobilien Stadt Zürich’ (IMMO)
- 2.6 million m² gross floor area
- insured asset value: CHF 8.3 billion
- annual investments: CHF 476 million (data from 2025)

OBJECTIVES

- Enable management to take standardised decisions at strategic level within 24 hours of receiving an analysis report.
- Structured supervision and Legionella management of a large, mixed-use public building stock.
- Transition from case-by-case intervention to portfolio-level risk governance.

METHODOLOGY

Four key milestones over several years (Fig. 1), applied to drinking water plumbing systems (DWPS):

- Standardisation: A standard sampling and testing method for Legionella in DWPS.
- EGM Model: A feasible escalation and risk management system.
- Normative Output: Contributing to technical standards (e.g., SVGW Guideline W3/E4).
- Advanced Diagnostics: Additional routine testing of potable cold water.

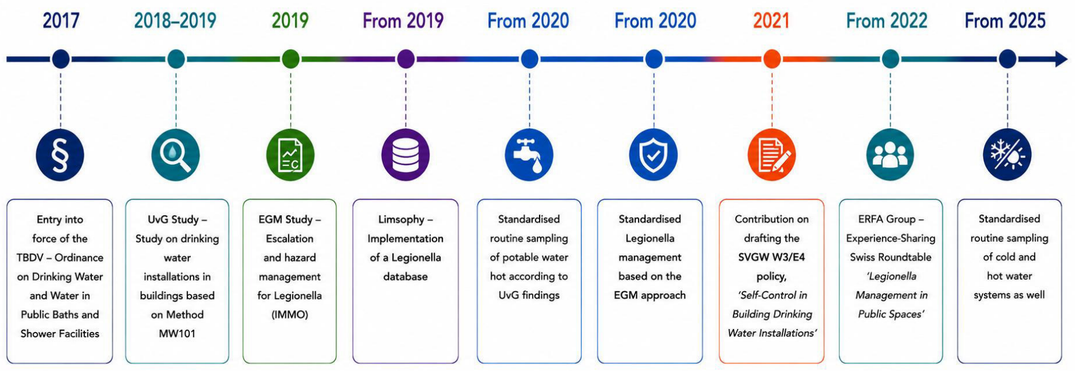

Fig. 1: Milestones in the development of the City of Zurich’s Real Estate Legionella Management System.

RESULTS / FINDINGS

Vulnerable users	Legionella *pneumophila*	≥ 30 aerosol-generating water outlets	10’000 cfu/l	> 1’000 cfu/l	Priority
x	x	x	x		1
x	x	x		x	2
x	x		x		3
x	x			x	4
x		x	x		5
x		x		x	6
x			x		7
x				x	8
	x	x	x		9
	x	x		x	10
	x		x		11
	x			x	12
		x	x		13
		x		x	14
			x		15
				x	16

Fig. 2: Triage Model for strategic portfolio segmentation.

Triage Model: Strategic Portfolio Segmentation

The project resulted in a **risk-based triage matrix** (Fig. 2) that enables efficient portfolio segmentation and resource allocation. Prioritisation criteria are listed in descending order:

1. **User Group**: Building classification by user group (building category, ‘at high risk’).
2. **Occurrence of Legionella type**: Presence of *Legionella pneumophila*.
3. **System Complexity**: Buildings with more than 30 aerosol-generating water outlets.
4. **Contamination Level**: *Legionella* spp. concentrations exceeding 10,000 KBE/L.
5. **Legal Classification**: Official value for the enforcement of measures.

Note: Remediation time and costs are subordinate factors in this decision framework.

Data Directory & Analysis Tools (specific)

To implement the triage model, specific data must be exported from the IMMO data directory and visualised.

Data Category	Required Data Points (Export from IMMO Systems)	Visualisation and Analysis Tool
Master Data	Building ID, usage type (e.g., school, care home), year of construction.	**Portfolio Mapping**: Categorisation into risk classes ("High Risk" vs. “Standard”).
Technical Data	Number of sampling points per property (> 30 as a trigger).	**Complexity Matrix**: Identification of large-scale systems requiring increased monitoring.
Laboratory Data	Test results (KBE/L), species identification (*L. pneumophila*), sampling date.	**Pin-Map**: Spatial and temporal distribution of limit violations (geodata).
Lifecycle Data	Acquisition of new properties, warranty periods.	**Monitoring Dashboard**: Tracking the 2-year intensive monitoring for new constructed buildings.

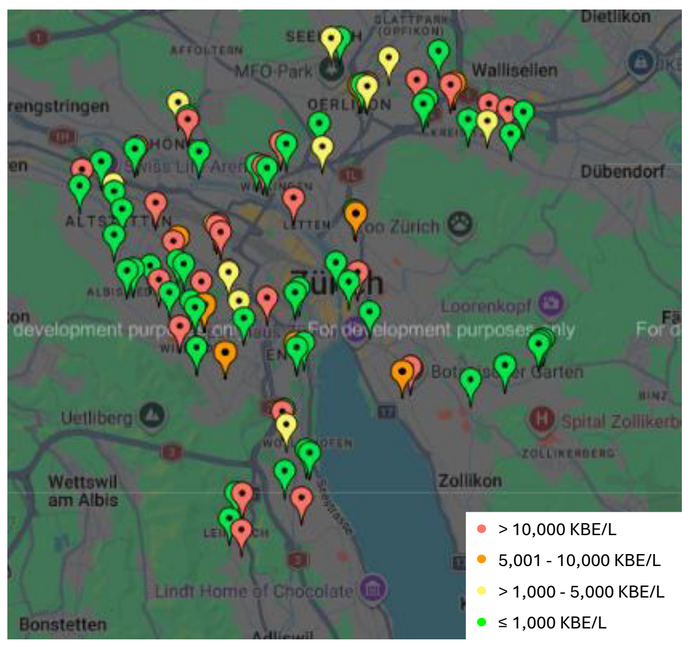

Fig. 3: Spatial and temporal distribution of buildings that have tested positive for Legionella contamination.

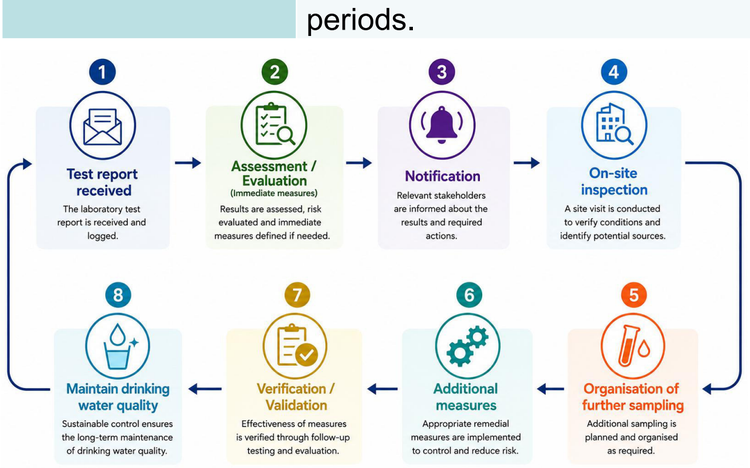

Fig. 4: Structured process defining workflow action.

Transfer Into Practice

Clear structures led to a (semi-)standardised process (Fig. 4) that triggers a defined sequence of actions. Automated notification on receipt of laboratory results combines the finding with technical building data for evaluation.
The framework has shifted Legionella management from isolated responses to portfolio-based preventive planning:

- Efficiency: Microbiological evidence is converted directly into strategic asset decisions.
- New Properties: Newly added buildings undergo closer 2-year monitoring, so that defects and warranty claims against design engineers and contractors are identified early.

CONCLUSION

Sustainable Legionella prevention at scale is primarily a question of management intelligence. Only by integrating laboratory analytics with building technology data and standardised workflows can drinking water hygiene be controlled efficiently, transparently and over the long term. Authorities are currently discussing stricter limits: a maximum of 10 KBE/L for *Legionella pneumophila* in high-risk buildings and a guideline value for *Legionella* spp. of around 100 KBE/L [6] .

This would replace the existing maximum of 1,000 KBE/L for *Legionella* spp. in shower water and would force operators of large portfolios to revise their routines comprehensively. Risk-based self-monitoring during operation and monitoring during construction must therefore be reviewed and, where necessary, adjusted to provide necessary and sufficient protection [7]. Limitation: this is a single-portfolio case study without a control group, so transferability remains to be tested.

REFERENCES

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NOTE: *Data presented here result from selected analysis and tools applied by City of Zurich Real Estate Department (‘Immobilien Stadt Zürich’ / IMMO). The content is context-specific, evidence-based and tailored to the overall project design. For further information please contact the corresponding author: thomas.leiblein@ewah.ch*