KWB

Annual Report 2024

Welcome

Our urban water cycle is becoming increasingly strained, with dwindling water resources and mounting challenges. These challenges are diverse, ranging from growing water scarcity and maintaining existing infrastructure to planning future supply networks, adapting to climate change, and embracing digitalisation – all while operating under considerable financial constraints.

Prof. Dr. Christoph Donner (left)
Nicolas Zimmer (right)

The solution lies in an integrated water cycle approach, which harmoniously combines various aspects of water management, such as water usage, wastewater treatment, and water pollution control. This approach leverages cutting-edge technologies and scientific knowledge to ensure a sustainable and forward-thinking use of water. Innovation and new ideas drive progress, and this is where the Kompetenzzentrum Wasser Berlin (KWB) plays a crucial role. As a think tank and active player in the Berlin-Brandenburg metropolitan region, as well as nationally and across Europe, KWB offers applied research and practical solutions, fostering thinking ahead, sharing knowledge, and driving change.

The past year has been eventful at KWB. Prof. Dr. Martin Jekel concluded his interim role as Managing Director, which he had taken on after coming out of retirement. As one of the founding figures of the KWB over 20 years ago and a renowned expert who has dedicated his career to water science, particularly in Berlin, we would like to extend our heartfelt gratitude to him for his significant contributions. He has been succeeded by Dr. Pascale Rouault as the new Managing Director. She brings extensive experience, having worked at KWB for 15 years before serving as Head of Water Management and Urban Development at HAMBURG WASSER. We are delighted she has decided to return to KWB to lead the team forward, address new and diverse challenges in integrated water management, and shape the future of water management. We wish her every success in this endeavour! KWB can count on our full support as shareholders, sponsors, and research partners.

To ensure the Berlin-Brandenburg metropolitan region has reliable access to the intellectual and human resources needed to tackle growing water-related issues, and to harness the strengths of KWB and its dedicated team, we also back the goal of securing stable core funding from the State of Berlin. The KWB team comprises not only passionate and collaborative professionals but also seasoned experts who successfully lead major collaborative projects and secure essential funding. This benefits not only the project partners but the entire region.

We extend our heartfelt thanks to all the staff at KWB for their outstanding dedication over the past year and wish them continued success. Here’s to a productive collaboration in exciting projects that pave the way for a hopeful future!

Prof. Dr. Christoph Donner
CEO of Berliner Wasserbetriebe
Chairman of the Supervisory Board of KWB

Nicolas Zimmer
CEO Technologiestiftung Berlin
Chairman of the Shareholders of KWB

Executive Summary

I returned to KWB in April this year, after spending two years with a wonderful team at HAMBURG WASSER, for which I am deeply grateful.
The experience I gained there was invaluable. Coming back to lead KWB presents a unique opportunity to shape water management in Berlin, Germany, and to further develop our team while addressing broader challenges.

Managing Director
Dr. Pascale Rouault

The water sector is facing numerous escalating challenges: increasing legal requirements, such as those in the new Urban Wastewater Treatment Directive aimed at achieving climate neutrality, climate change adaptation, growing water demand amidst dwindling resources, ageing infrastructure, technological and demographic shifts, and limited financial resources. Yet, these challenges also bring immense opportunities! I am committed to contributing to overcoming these issues, and KWB is the perfect platform to do so.

KWB offers distinct advantages, particularly its dedicated employees who are passionate about researching the urban water cycle. It's rare to find so many individuals with diverse skills collaborating interdisciplinarily to tackle urgent problems and gain long-term experience. Unlike universities, where academic staff often work only temporarily, leading to a loss of expertise, KWB retains its skilled workforce. Our focus on applied research is another distinguishing feature; we work directly with practitioners, ensuring our research is applied effectively. We are involved in many exciting projects with committed partner organisations, including our shareholders, Berliner Wasserbetriebe and Technologiestiftung Berlin, and this collaboration must be strengthened further. As a non-profit limited company, KWB shares its research findings widely for the benefit of the public — a special and fulfilling task.

KWB's journey has been anything but linear. What began as an initiative to bolster Berlin's status as a scientific hub has evolved into a renowned center of competence, now employing over 40 people. As an independent research institute, KWB delivers innovative solutions to water management challenges on local, national, and international levels. Leading KWB fills me with pride, and I am deeply grateful for the trust bestowed upon me.

I would like to take this moment to reflect and express our gratitude to Prof. Dr. Martin Jekel. Martin, a founding member, has been integral to KWB since its inception. Even after retirement, he returned to serve as interim Managing Director in June 2023, embracing the role as a “a matter of personal importance.” His leadership during this period was marked by pragmatic effectiveness, setting a crucial course for our future. On behalf of the entire team, I warmly thank him for steering us once again.

Since I assumed my role in April, the past few months have been both busy and rewarding. My extensive experience at KWB enabled a swift transition, allowing me to engage quickly with new responsibilities and initiate a new strategic direction. We've seen significant changes: shortly before I joined, we relocated to Berlin-Schöneberg, where we now enjoy a sustainable, energy-efficient office space and flexible workstations. All six management positions within our research groups are now filled. Additionally, our “WasserWerkstatt” event series, which had paused during the pandemic, has been revitalised and is gaining popularity.

We are dedicated to maintaining the quality and appeal of our research while actively working to enhance our operational procedures and processes. We have embarked on an intensive strategic planning initiative, “KWB 2035,” which aims to strengthen our impact on Berlin and its surrounding metropolitan region. This strategy focuses on key areas such as the environment, economy, education, urban planning, and health, while reinforcing our long-term and sustainable position as a leading research institution.

A major objective is to deepen our collaborations—not only with universities and research centres but also with small and medium-sized enterprises and major corporations. This will facilitate the broader and easier application of our research findings.

Additionally, we aim to extend our expertise to benefit more individuals, local authorities, and policymakers, offering support in addressing future challenges across the entire water cycle.

Turning to this year's annual report, we begin with the "Immersion" section, featuring an article on PFAS, the so-called "forever chemicals," in Berlin, and findings from our EU Green Deal project, PROMISCES. This project stands out not only for its contentious topic but also for its international collaboration involving 27 partners. At KWB, five of our six research groups, alongside numerous staff and students, engage in this interdisciplinary endeavour. Through our involvement in PROMISCES, KWB has gained critical insights into the presence of PFAS in Berlin's water cycle, marking a significant step towards their elimination and achieving a pollutant-free circular economy locally. More details on our research findings can be found on page 10.

On page 14, we delve into the Dual Model as a promising tool for active leakage detection in pipe networks. Leakage management holds substantial potential for improvement, especially considering the looming water shortages exacerbated by climate change. The Dual Model aids in early leak detection, helping utilities to reduce water waste, reduce energy expenses, limit infrastructure damage, and improve service continuity.

Beginning on page 20, you will encounter brief updates on selected projects, followed by an article on phosphorus recovery's future in the "Swimming out" section. With nearly 15 years of research, evaluation, and support in phosphorus and nutrient recycling, KWB has explored various recovery processes through over 10 projects, totalling more than 40 million euros. What does the future hold, especially after the 2017 amendment to the Sewage Sludge Ordinance in Germany? The answers await you from page 38 onwards.

We then explore the Smart City and its administration, crucial in an increasingly digital economy and urban society. Effective data governance is key for cities to leverage digitalisation while safeguarding citizens' rights. From page 42, discover how we assist German municipalities in overcoming challenges related to data governance.

Finally, starting on page 46, I reflect on my first six months at KWB, our consulting services, and future goals.

KWB is very well-positioned today.
The quality of our work is our greatest asset, and we face the future with creativity, courage, and confidence. This outlook is fueled by KWB's successful economic performance in 2024 and our dedicated, skilled, and curious employees, who are full of ideas and committed to acquiring and advancing pioneering national and international research projects. I extend my heartfelt thanks to the entire team, especially for their warm welcome as Managing Director.

I hope you find our annual report both enjoyable and inspiring, and that it shares our enthusiasm and drive in addressing the many challenges related to water and cities, climate change, and digitalisation, which we view as opportunities for innovation.

Dr. Pascale Rouault
Managing Director | 31. October 2024

Immersion

Dive in and explore the latest advancements in applied research at KWB. Discover our findings on the presence of PFAS in Berlin's water cycle and learn about the Dual Model, a promising tool for leakage detection.

Here's what you can explore:

- ▶ PFAS in Berlin: what have we discovered?
- ▶ Dual Model as a tool for active leakage detection programs
- ▶ Selection of projects

PFAS in Berlin: *w*hat have *we* discovered?

Dr. Veronika Zhiteneva
Dr. Daniel *W*icke
Dr. Christoph Sprenger

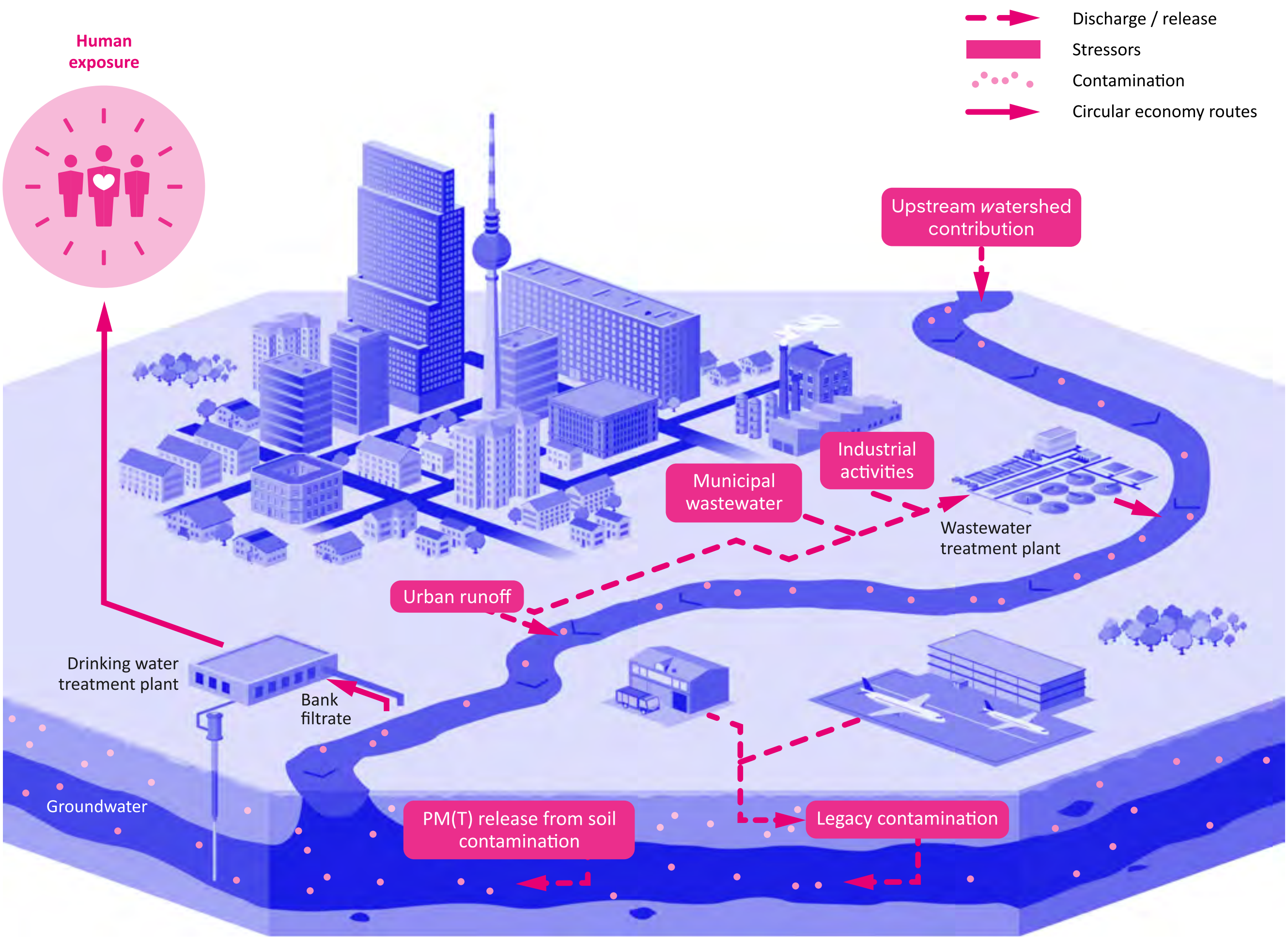


Fig. A: The semi-closed water cycle circular economy route investigated in Berlin in PROMISCES

The European Green Deal has catalysed efforts to advance resource reuse and accelerate the shift from a linear to a circular economy (CE). A potential challenge to achieving the CE goals of the EU is the increased instances of per- and polyfluoroalkyl substances (PFAS) in soil and water. These anthropogenic and extremely stable "forever chemicals" are now at the forefront of the EU's research and regulatory agenda, are regulated in the updated Drinking Water Directive (2020/2184) and are being considered in the updates to the Environmental Quality Standards Directive (2008/105/EC), and the Groundwater Directive (2006/118/EC).

"At KWB, 19 employees (out of 43 total) across 5 of the 6 research groups, in addition to numerous students, were involved in PROMISCES over the project's lifetime."

The presence of PFAS and other industrial persistent, mobile, and potentially toxic compounds (iPM(T)s) in the environment is a particular challenge for the CE since they have demonstrated negative consequences for environmental and human health. To accomplish the goals of the European Green Deal, as well as the Zero Pollution Action Plan and the Circular Economy Action Plan, innovative approaches are required to address the presence and removal of these compounds. This is precisely the focus of the PROMISCES project.

The PROMISCES project team, led by the French Geological Survey (BRGM), includes 27 partners from 9 countries who have studied PFAS and iPM(T) presence in five particular CE routes, where resources such as water or nutrients are recycled, in seven case studies in Europe. At KWB, 19 employees (out of 43 total) across 5 of the 6 research groups, in addition to numerous students, were involved in PROMISCES over the project's lifetime. This highlights not only the breadth of work done by KWB, but also the effort needed to plan, organise, monitor, sample, develop, model, and control different practical and technical aspects of the project.

The Berlin case study

The case study in Berlin was led by the Berliner Wasserbetriebe (BWB), with the participation of the German Environment Agency (UBA), the German Federal Institute of Hydrology (BfG), and KWB. These partners analysed the presence of PFAS and iPM(T)s (e.g. in indirect industrial discharges) and developed a toxicological assessment workflow for PFAS and other iPM(T)s in Berlin's semi-closed urban water cycle. KWB focused on monitoring and modelling the fate and transport of PFAS and iPM(T)s in urban runoff, surface water, and groundwater, and specifically on quantifying contaminants in stormwater runoff.

The Berlin case study addressed the PFAS knowledge gap in several ways: along the urban water cycle, monitoring of wastewater and urban runoff was conducted in a sub-area of Reinickendorf in Berlin to identify influencing factors which can cause contamination and be potential sources of industrial chemicals. Based on the monitoring results, a suitable modelling approach to improve the overall management of the urban water cycle, e.g. the ability to reliably detect a wide spectrum of PFAS, was developed. ▶

Sampling the Flughafensee

Stormwater runoff and surface water monitoring

Monitoring of stormwater runoff from two different industrial sites at the Reinickendorf study area was conducted in 2023. Flow measurement devices and automatic samplers were installed in the storm sewers of two sites transporting stormwater runoff to the nearest surface water, which was the Flughafensee. For over 24 storm events, samples were taken automatically and processed in such a way that the measured concentrations represented the average concentration of each storm event. The results showed that 13 out of 26 analysed PFAS were detected, in addition to other PMT substances.
To evaluate the relevance of the measured concentrations, results were compared to the PFAS concentration threshold currently being discussed in the update to the Environmental Quality Standards Directive (2013/39/EU), which stands at 4.4 ng/L PFOA-equivalents for the sum of 24 PFAS. To determine the PFOA-equivalent, a relative potency factor (RPF, a factor normalising the concentrations to the toxicity of PFOA), which has been defined for 24 PFAS compounds, is multiplied by the measured concentration. This normalises the concentrations to the toxicity of PFOA. Results for the sampled stormwater runoff show average PFOA-equivalent values at the proposed threshold, with maximum values exceeding the threshold by a factor of more than 10. This means that stormwater may cause surface waters to exceed the threshold. Since the threshold does not apply to stormwater runoff but to surface waters, exceedance depends on the dilution factor. However, shares of stormwater runoff above 50 % can be reached during storm events, especially in smaller urban streams.

“Through our multidisciplinary engagement in PROMISCES, KWB delivered more knowledge on the presences of PFAS in the Berlin water cycle, the first step to removing them and moving towards a local zero pollution CE.”

To evaluate the effect of stormwater runoff discharge on a connected urban lake, samples were also taken from the Flughafensee, which is near a legacy contamination site affected by the decades-long operation of the nearby Tegel Airport, but also receives stormwater runoff from a catchment which includes the aforementioned investigated industrial area. Initial results indicated that PFAS concentrations in the lake were even greater than those in the stormwater runoff (by a factor of about 10). This could either be attributed to an accumulation of stormwater inputs over time, or to contamination via groundwater flow. To further investigate this, samples from nearby groundwater wells as well as lake sediments were taken.

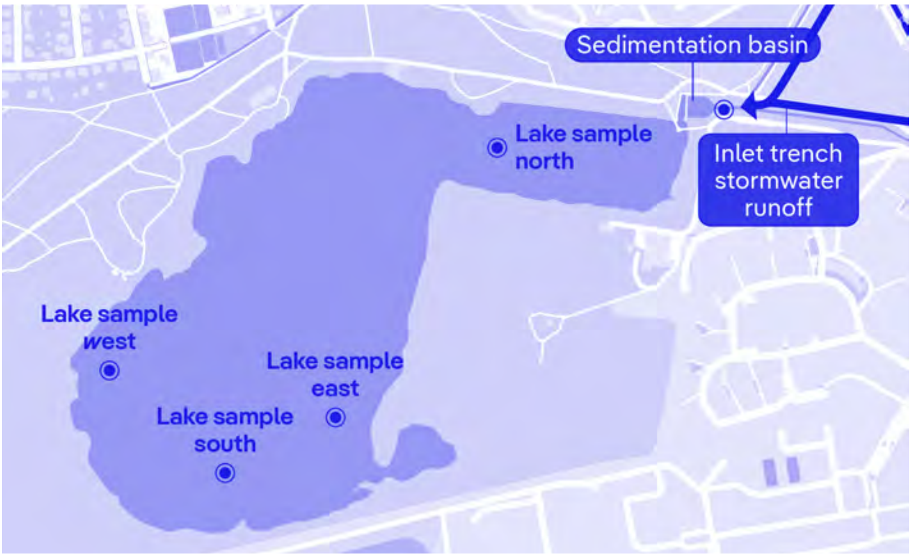


Fig. B: Sediment core sampler being deployed; sampling sites at Flughafensee

Groundwater and sediment monitoring

The aim here was to investigate the role of the Flughafensee as a potential migration source of PFAS and other iPM(T)s into the adjacent groundwater aquifer, which is an important source of drinking water. The lake is located north of the former Tegel Airport, and with a maximal water depth of 34 m, is the deepest lake in Berlin. Local groundwater flow is directed from east to west, which (potentially) builds gaining hydraulic conditions on the eastern and losing hydraulic conditions on the western shore of the lake. Consequently, shallow groundwater monitoring wells situated up- and down-gradient of the lake were sampled. Additionally, undisturbed sediment cores from 4 locations at the lake bottom using a corer device were extracted and analysed for PFAS and iPM(T)s (see Fig. B).

The dark, organic-rich, and fine-grained lake sediment (sapropel) was then sampled at regular intervals of the core and stored under cool conditions. The sampling equipment was generously lent to KWB by the Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB) in Berlin. Extractable organic bound fluorine (EOF) analyses on the sediment samples were then generously conducted by the Bundesanstalt für Materialforschung und -prüfung (BAM) in Berlin.

The monitoring approaches developed and analysed in the Berlin case study will be reported on in multiple PROMISCES deliverables as well as in a peer-reviewed publication, preparation of which is currently in progress.

(Why) is it important to communicate?

A “WasserWerkstatt” event on the topic of PROMISCES and PFAS was held on 19 June 2024 at Technologiestiftung Berlin’s Audimax (please also see p. 54 for photos). The event garnered a lot of interest, with many different stakeholders attending, including employees of multiple district offices in Berlin as well as other German cities, politicians, and local decision makers. In addition to presentations from PROMISCES partners from KWB (Daniel Wicke) and BWB (Regina Gnirß, Fiona Rückbeil, Frederik Zietzschmann), Astrid Klose from the Berlin Senate Department for Urban Mobility, Transport, Climate Action and the Environment (an associated partner in PROMISCES) presented on the current state of knowledge about PFAS in soil and groundwater in Berlin. Such publicly financed events on important topics relating to the water cycle and the CE are critical for raising awareness and stimulating discussion about how to best protect environmental and human health.

Our hope is that through PROMISCES and other projects focused on PFAS, we can encourage strict but feasible PFAS restrictions and put more pressure on polluters to pay for treatment and remediation of contaminated areas. Through our multidisciplinary engagement in PROMISCES, KWB delivered more knowledge on the presences of PFAS in the Berlin water cycle, the first step to removing them and moving towards a local zero pollution CE. ●

Dual Model as a tool for active leakage detection programmes

Dr. Enrique Campbell

Dr. David Steffelbauer

The problem of leakage in *w*ater supply net*w*orks

A reliable water supply is crucial for the effective functioning of any city. In this context, “reliable” encompasses both quality and quantity. Over time, water transportation and distribution infrastructure age and deteriorate, reducing its service capacity. This is particularly true for pipes, which, without adequate rehabilitation programmes, accumulate breaks that lead to water leaks, ultimately compromising the reliability of the water supply.

The buried nature of these pipes, often spanning thousands of kilometres, makes it exceptionally challenging for water utilities to detect and repair damages. Consequently, this results in significant volumes of non-revenue water that is lost "en route" before customers are billed. As a result, water utilities are unable to recover the investments made in extraction, treatment, and pumping, not to mention the depletion of available resources. In Europe, non-revenue water averages a staggering 25 %, according to the European federation of national associations of water services EurEau (EurEau, 2021).

Despite the pressing issue of water scarcity exacerbated by climate change and the extensive discussions and documentation of leakage in water supply networks, there remains considerable room for improvement in leakage management. This is recognized by the European Drinking Water Directive since 2020 (European Parliament and Council of the EU, 2020) and sets five steps that member states must undertake to reduce leakages within the next six years. The Drinking Water Directive outlines the following provisions:

- Member States are required to conduct leakage inspections, especially for larger water suppliers that provide a minimum of 10,000 m^3 daily or serve at least 50,000 people.
- Results from these assessments must be communicated to the Commission by January 12, 2026.
- The Commission will establish a leakage threshold value, informed by these assessment results, by January 12, 2028.
- Should a Member State's leakage value exceed the threshold, an action plan must be developed within two years of the threshold being set, specifically by January 12, 2030. Annual updates on leakage will be made publicly available.

How are water utilities currently addressing the leakage problem?

Today, many water utilities tackle the leakage issue with a reactive approach, waiting for leaks to be reported before initiating repairs. This often results in sudden bursts that not only lead to significant water loss but can also inflict serious damage on both public and private infrastructure. The associated repair costs can be substantial and may take days or even months, disrupting city functions, heightening the risk of contaminants entering the water supply, and ultimately leading to user dissatisfaction.

The problem with this passive strategy is that leaks in a water supply network can remain unreported for extended periods—days, months, or even years—resulting in vast quantities of water being wasted and contributing to non-revenue water (see Fig. A). So, how can water utilities address this issue more effectively? The answer lies in adopting an active leak management strategy that prioritizes early leak detection, thereby minimizing water loss over time and reducing the risk of sudden bursts.

Methods for active leckage management

▸ Acoustic methods

Among the various techniques employed by water utilities for active leakage detection, acoustic methods – such as listening rods and leak-noise correlators – are particularly noteworthy. These methods rely on the noise produced by leaks to identify their locations. While effective for early leak detection, they come with certain limitations. They require well-trained personnel and specialized equipment, are time-consuming, and limited personnel and resources can lead to incomplete temporal and spatial coverage, especially in medium and large networks. While field personnel monitor one area, leaks or bursts may occur elsewhere. Furthermore, these methods tend to be less effective in plastic pipes, which become increasingly popular.

Fig. A: Categories of leaks based on the BABE concept (adapted from Thornton et al., 2008) and their effects

	Reported	Unreported	Background
Non revenue water	●	●	●
Risk of contamination	●	●	●
Energy waste	●	●	●
Damage infrastructures	●		

▸ Data-driven solutions

To overcome the scalability problem of the method above, measuring and analysing the pressure and flow of the network offers an alternative. When a leakage occurs, besides noise, it also causes an increase in flow and a drop-in pressure. Sensors placed in sensitive spots in the network can detect these changes. By using advanced data analysis techniques, it is possible to identify leaks. This is the concept behind data-driven methods. However, relying solely on sensors can only determine of the nearest sensor to the leak but cannot pinpoint the exact location. An example of this method is the algorithm LILA (Daniel et al., 2022).

▸ Model-based solutions

Model-based methods enhance the capabilities of data-driven approaches by integrating flow and/or pressure measurements with simulation models. The fundamental concept involves iteratively simulating a hypothetical leak (represented as a flow over time) at each point in the network using a hydraulic simulation model. During each iteration, a comparison is made between measured and simulated values. The iteration that reveals the closest alignment of real data with simulated data suggests the most probable leak location. The advancements in computational and telemetry technologies over the past decade have significantly increased interest in these solutions. Recent years have witnessed model-based methods demonstrating high effectiveness in detecting and locating leaks, even in extensive networks. For instance, in 2020, the model-based solution discussed in this article secured first place in the Battle of Leakage Detection competition (BattLeDIM) (Vrachimis et al., 2022).

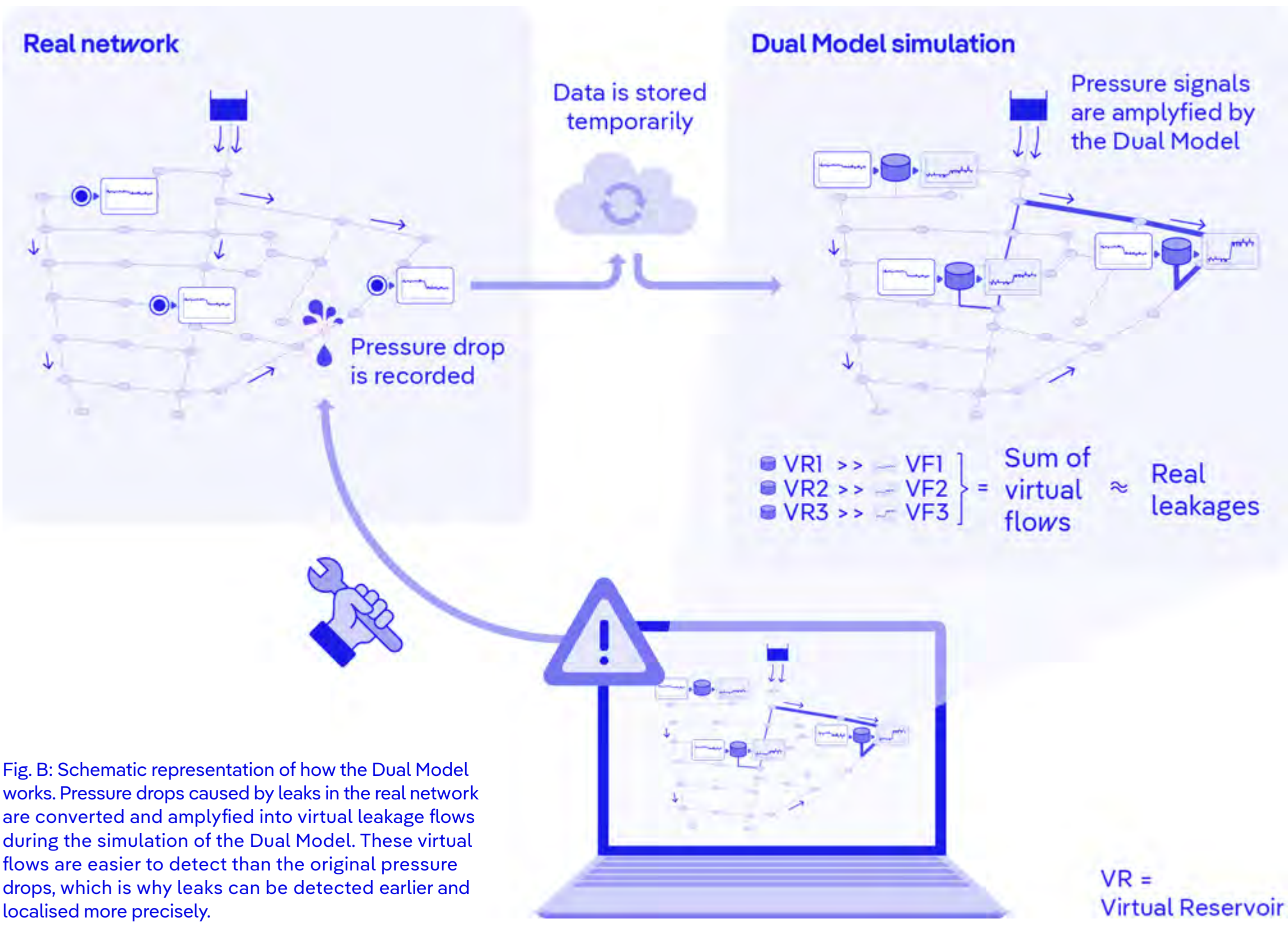


Fig. B: Schematic representation of how the Dual Model works. Pressure drops caused by leaks in the real network are converted and amplyfied into virtual leakage flows during the simulation of the Dual Model. These virtual flows are easier to detect than the original pressure drops, which is why leaks can be detected earlier and localised more precisely.

▸ The Dual Model

Among model-based approaches, the Dual Model stands out by advancing beyond traditional methods. It integrates pressure measurements from existing sensors directly into the hydraulic model of the water distribution network, eliminating the need for repeated comparisons between measured and simulated values. This integration involves representing the pressure sensors in the real network as virtual reservoirs within an EPANET hydraulic model. In simulation, the levels of these virtual reservoirs correspond to the pressure values recorded by the sensors. This transformation converts the original model (or primary model) into a dual model, wherein real pressure values, typically treated as variables, are now utilized as constraints.

"Despite the pressing issue of *w*ater scarcity exacerbated by climate change and the extensive discussions and documentation of leakage in *w*ater supply net*w*orks, there remains considerable room for improvement in leakage management."

When a leak occurs in a water distribution network, it triggers an increase in flow that is proportional to the network's pressure at that moment. This increased flow causes greater friction against the pipe walls, leading to a pressure drop. The closer a pressure sensor is to the leak, the more pronounced the pressure drop will be in the measurements. A large leak results in a substantial pressure drop, whereas a smaller or incipient leak (e.g., less than 2 L/s) results in a subtler pressure drop.

In a leak-free scenario, the differences in levels between the virtual flow of the Dual Model and that of the water distribution network model should be near zero. In this case, the primary model is considered hydraulically identical to the Dual Model. However, when a leak occurs, level drops in the virtual reservoirs create a gradient relative to the network, resulting in a flow transfer to the virtual reservoirs (referred to as virtual flows). These virtual flows can be viewed as an amplification of the pressure signal recorded by the corresponding pressure sensor in reality.

If the simulation model accurately reflects the actual network and can replicate real-world conditions, the total of the virtual flows across the water supply network model should closely align with the actual leak flow. In essence, the sum of the virtual flows generated by the simulation provides a reliable reconstruction of the real leak. This virtual leakage not only indicates the onset of the leak but also its magnitude (maximum flow and duration). This feature is a significant advantage of the Dual Model compared to other model-based solutions, which often rely on complex mathematical optimization processes. The virtual reservoirs nearest to the leak point experience a more pronounced level gradient compared to the rest of the network, resulting in higher virtual flows. This discrepancy offers valuable insights into the leak's location, helping to narrow the search area effectively.

With the virtual leak and an initial estimate of its location, a straightforward sensitivity analysis can be conducted to pinpoint its exact (or very close) location. For this purpose, a simulation of the Dual Model is performed for each pipe considered as a potential leak site. In each iteration, the virtual leak is positioned in the center of the candidate pipe. The excess flow caused by the virtual leak increases head loss in the network, thereby lowering the water level at the nodes. As the levels decrease, they align more closely with those in the virtual reservoirs —similar to a leak-free state— thereby canceling or minimizing the gradient between the water supply network and the virtual reservoirs, as well as the virtual flows. The iteration that yields the minimum sum of virtual flows indicates the pipe most likely to contain the leak.

In addition to excelling in the Battle of Leakage Detection, the Dual Model has demonstrated the ability to identify leaks as small as 2 L/s under semi-real-world conditions in an Austrian water supply network (Nordahl et al., 2022), successfully detecting abnormal flows caused by hydrant openings. ▸

As previously noted, the validity of the hydraulic model of the network is critical for the success of this method. Several questions remain regarding its reliability, such as:

- How reliable is the method if there is considerable uncertainty in the hydraulic model calibration?
- What occurs if pressure sensors coverage is suboptimal, preventing existing sensors from detecting pressure changes caused by all or most potential leaks?
- How does poor quality or imprecise measurement data impact results?

These questions are currently being explored within the framework of the iOLE project (see p. 30), which main goal is the development of a human-centred and robust intelligent online leakage detection and location platform, that works with a synergic combination of the algorithms Dual Model and LILA.

Should water utilities implement active leakage strategies?

Based on the information presented, it seems logical that an active leakage management strategy would be highly beneficial for any water utility. Yet, such strategies remain surprisingly uncommon. This raises the question: why are water utilities hesitant to adopt these methods despite their clear advantages? One key reason is the high costs and technical challenges associated with their implementation.

Effective acoustic methods require well-trained personnel and expensive equipment. Similarly, data-driven and model-based solutions necessitate an optimal set of sensors, which must be sensitive enough to detect minimal variations in pressure and flow. Additionally, for model-based approaches, a hydraulic model must accurately replicate real-world conditions, which demands precise calibration of network parameters like pipe roughness and user consumption patterns. Unfortunately, many water utilities face a common challenge: a lack of the necessary data to achieve this calibration.

Moreover, the requirement to compare and align measured values with simulated ones over time can make these methods computationally intensive. Many of these techniques also tend to produce false alarms, further decreasing their appeal to utilities. However, incorporating such solutions into network operations should be viewed as a long-term investment. When conducting a cost-benefit analysis for implementing an active leakage management strategy, it is crucial to consider the following questions: What are the potential savings from reducing non-revenue water? How significant would be the savings in repair costs related to pipe bursts? To what extent could CO_2 emissions be reduced through lowered pumping energy requirements? How will this solution enhance the reliability of the water supply? How will it help meet the standards set by the European Water Directive? How do the anticipated monetary benefits compare to the costs of implementing and maintaining the strategy? By addressing these questions, water utilities can make informed decisions about the viability and value of active leakage management strategies.

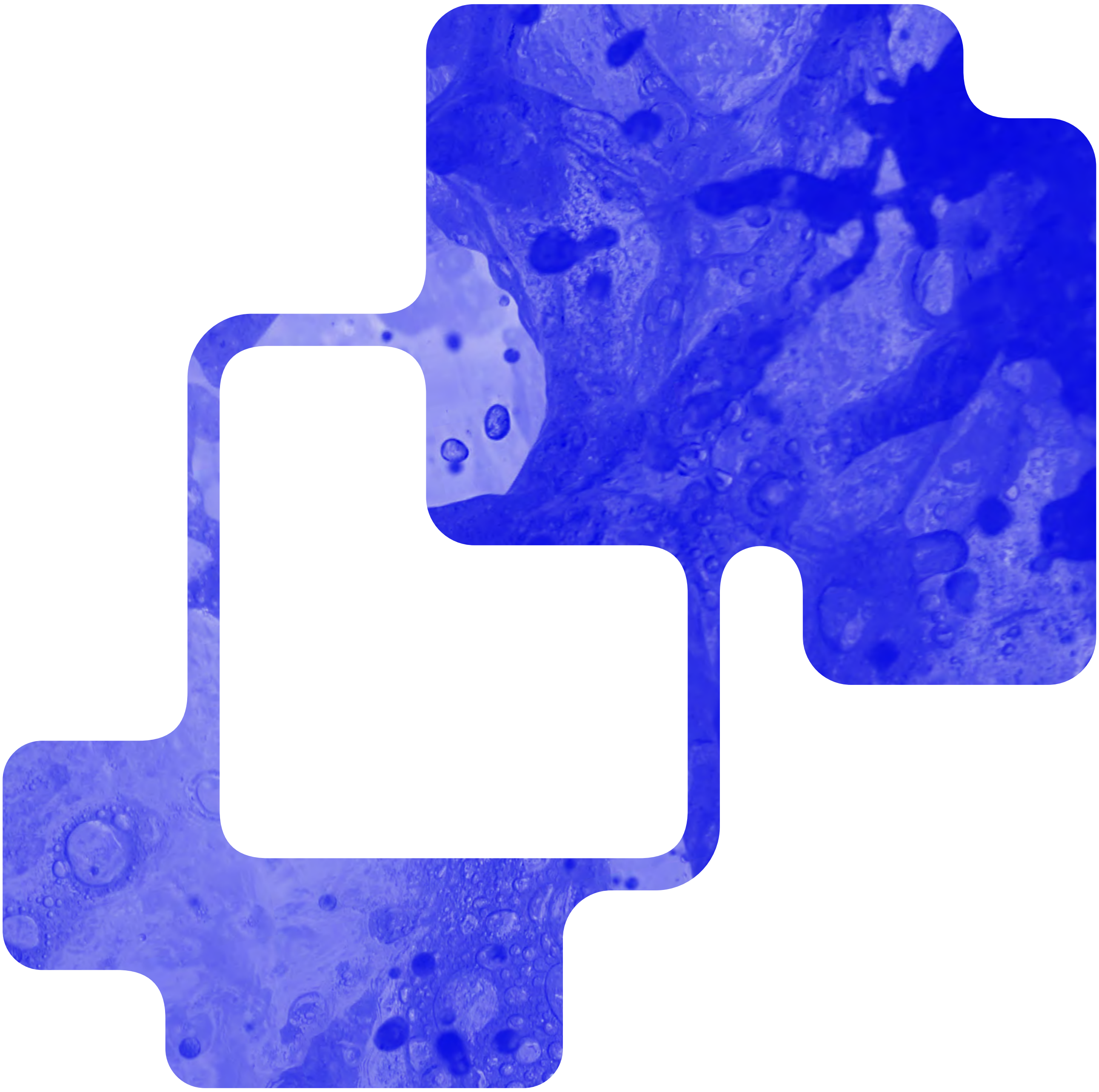
The future of leakage detection with the Dual Model

In conclusion, despite the challenges that persist, implementing an active leakage management programme presents a highly effective strategy for tackling leaks in water supply networks. This approach can yield significant cost savings and enhance operational efficiency for water utilities while ensuring compliance with the European Water Directive.

By enabling early leak detection, water utilities can minimize water waste, reduce energy expenses, limit infrastructure damage, and improve service continuity. Ultimately, this not only benefits the utilities themselves but also enhances the reliability of the water supply for their customers.

A human-centred intelligent online leakage platform as the one from the project iOLE operating with the Dual Model and LILA can efficiently booster that goal. ●

Selection of projects



City Blues

Project volume
€2,954,000 (total amount),
sponsored by Interreg Baltic Sea Region (EU)

Partners
City of Tampere; City of Malmö; City of Tartu; Universität Stavanger; Tallinn University of Technology; Aarhus Municipality

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▶ (1) BGI is a remarkable testament to versatility, addressing a wide range of planning objectives. In addition to flood protection and mitigation of urban heat islands, BGI plays a crucial role in preserving water bodies, creating social spaces, enhancing quality of life, and supporting biodiversity.

▶ (2) These solutions can be seamlessly integrated into both public and private spaces, encompassing simple solutions like swales and infiltration trenches, to more complex systems such as green roofs and façade greening. Furthermore, artificial water bodies and rainwater utilisation are key components of BGI, showcasing its multifaceted benefits for urban environments.

Of plants and puddles: How BGI helps make cities more climate resilient!

Cities and municipalities in Germany and worldwide are increasingly grappling with the challenges posed by urbanisation and its complex relationship with climate change. One significant issue is the adverse effects of expanding land sealing, which leads to more frequent flooding from heavy rainfall, erosion from river overflows, and extended heatwaves and droughts. These challenges place significant pressure on both urban residents and ecosystems.

The City Blues research project aims to address the impacts of climate change by focusing on blue-green infrastructure (BGI) solutions. These measures combine natural and artificial elements to improve residents' quality of life. Collaborating with partners from Scandinavian and Baltic cities, municipalities, and research institutions, the project is developing a comprehensive model for planning, implementing, and maintaining BGI solutions. This model is currently being tested through construction projects in five partner cities: Tampere in Finland, Malmö in Sweden, Tartu in Estonia, Stavanger in Norway, and Aarhus in Denmark.

In the project, KWB focuses on the performance and maintenance of BGI solutions, aiming to develop innovative methods for accurately assessing their effectiveness across cities and developing maintenance strategies based on this data. Ultimately, City Blues strives to craft optimised maintenance plans for BGI solutions that conserve financial and human resources, ensure their performance, and prevent failures. The project is dedicated to ensuring the long-term functionality of BGI solutions, facilitating a sustainable transformation of urban stormwater management in response to climate adaptation.

An effective maintenance strategy begins with a clear definition of the function of the BGI solution. These systems are highly versatile ▶ (1), with flood protection being a primary function in urban settings. Their performance can be described by the parameters ▶ (2) evaporation, infiltration, and stormwater retention. Due to the wide variety of BGI solutions, from infiltration swales to green roofs, each has distinct performance characteristics. For instance, green roofs prioritize water retention without any infiltration, whereas swales focus on infiltration capacity.

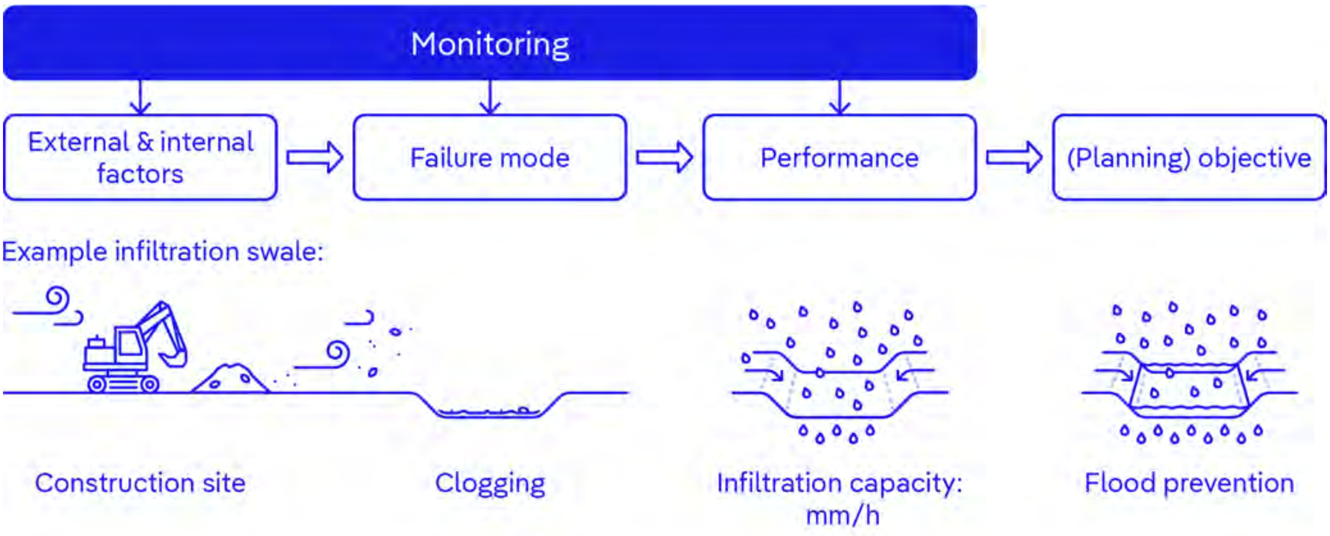

Fig. A: Structure of BGI measures using the example of an infiltration swale

In practice, the performance of BGI solutions is often influenced by multiple factors. Common issues include clogging of infiltration areas in swales and trenches. Vegetation problems, such as dead plants on green roofs, further compromise effectiveness. Structural inadequacies, like poor drainage design, may exacerbate damage. Additionally, environmental and human factors can contribute to failures: dry spells can negatively affect BGI vegetation, while waste accumulation or proximity to dusty construction sites can block drains.

Analysing the diverse instances of damage and the internal and external factors influencing different BGI solutions underscores the complexity of evaluating their performance (see Fig. A). This emphasizes the need for further investigation, leading to the following research questions for the KWB in the City Blues project:

- How do failure modes affect the performance of BGI solutions?
- How do maintenance activities influence the effectiveness of BGI solutions?
- How can this knowledge be applied to the routine maintenance practices of water utilities and municipalities?
- What monitoring approaches are best suited for assessing the condition of BGI solutions?

To address these questions, City Blues utilizes a range of monitoring approaches in partner cities. As illustrated in Figure B, these methods include surveys and citizen science, both of which are easy to implement and provide valuable insights into indicators such as plant conditions or litter accumulation within BGI solutions. These indicators help derive key performance parameters.

Ground-based monitoring approaches are also being tested. These technical approaches, such as using sensors to measure green roof runoff with flow meters and precipitation data, yield precise performance metrics like rainwater retention rates. Specialized monitoring devices like infiltrometers deliver precise measurements of infiltration capacity.

The third approach being explored is remote sensing and earth observation, which utilises non-ground-based sensors, including satellite and drone data. This innovative approach enables large-scale analyses of the study areas.

The insights gained from these monitoring campaigns will enhance the understanding of how damage incidents and external factors influence the performance of BGI solutions. To achieve this, various models, such as fault tree analysis, will be employed. Looking ahead, customised maintenance strategies for BGI solutions will be essential for municipalities and water utilities. KWB aims to make a significant impact by developing innovative monitoring approaches, collaborating with international research groups, and providing practical tools for end users.

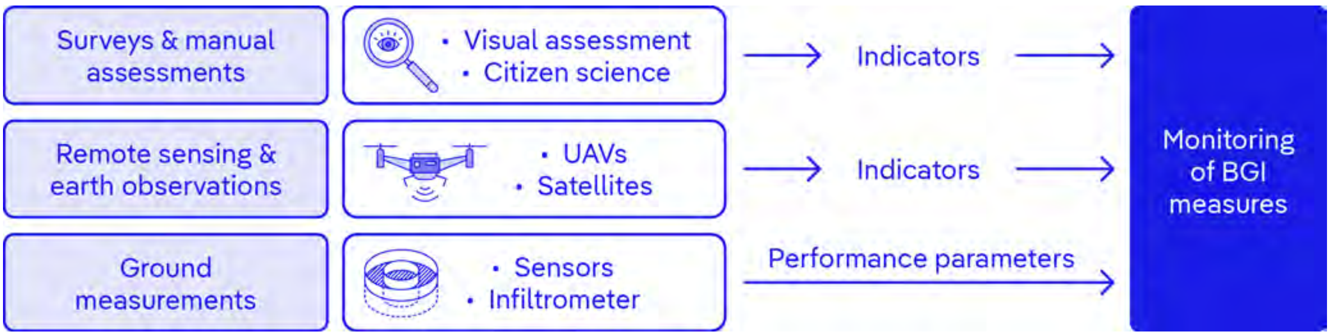

Fig. B: Various monitoring approaches for determining the status of BGI measures

BOOST-IN

Project volume
€1,799,819.30 (total amount),
financed by the European Union

Partners
Bioazul S. L.; Ecofilae SAS; Alma Mater Studiorum – Università di Bologna; National Technical University of Athens; DECHEMA Gesellschaft für Chemische Technik und Biotechnologie e.V.; Fresh Thoughts Consulting GmbH; Zentrum für Soziale Innovation GmbH; Agricultural and Environmental Solutions - Agenso; Water Europe; Bulgarian Water Association; Isle Uitilities Ltd.

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Targeted market uptake of innovative solutions for *w*ater and circular economy

Europe aims to achieve climate neutrality by 2050. The Green Deal has significantly promoted the development of circular economy technologies in recent years. Despite these technologies showing excellent results, their market uptake remains slow. This delay is primarily due to a lack of social acceptance, insufficient awareness of the technologies, inadequate business models, and an unsupportive legal framework.

To advance the market uptake of innovative technologies and solutions, the BOOST-IN project aims to change the social perception about the circular economy. Its goal is to bridge the gap between research and market uptake for innovations in the water sector, with a particular emphasis on water reuse and the recovery of energy and materials, such as nutrients.

In practice, the implementation of these innovations often faces obstacles due to a lack of financial incentives. Additionally, the legal framework can be too vague, and both professionals and end users frequently lack knowledge about the high quality of technically achievable products. BOOST-IN aims to address these issues by defining Europe-wide quality standards and establishing clear procedures for attaining end-of-waste status for recovered products, thereby facilitating their market uptake. Under the leadership of KWB, Europe-wide workshops are being conducted to develop quality standards and standardized criteria for achieving end-of-waste status for selected products.

The BOOST-IN consortium collects, analyses, and evaluates numerous innovative solutions from European research and innovation projects. Promising concepts are examined in detail for their sustainability contribution, with KWB conducting life cycle assessments of the processes. Additionally, the practical application of these concepts is supported by the development of business models and plans as well as by matchmaking between innovation providers and users. To ensure a successful market uptake, BOOST-IN will enhance and further develop the existing "Water Europe Marketplace" platform (https://mp.watereurope.eu/) as a networking and information hub for innovators, operators, and investors. The Water Europe Marketplace contains an innovation database ("Technology Evidence Base"), which was established by KWB in the EU projects NextGen and ULTIMATE. This database functions similarly to a Wikipedia article, explaining the functionality and application of each technology, supported by data and results from pilot or large-scale plant operations, and includes contact information of the respective operators. KWB will play a crucial role in selecting and inventorying innovations, enriching the Water Europe Marketplace with knowledge and networking opportunities for stakeholders.

Workshops are being organized in six European regions - Spain, Greece, Germany, France, Italy and Bulgaria - to inform experts and the public and to promote acceptance. Additionally, action plans for the market uptake of these technologies are being developed, along with recommendations for local decision-makers. In Germany, the focus is on nutrient recycling in the Lower Saxony region, which faces a significant nutrient surplus due to intensive livestock farming. Suitable options here include the combined recovery of nutrients and energy from wastewater, as well as water reuse in agriculture.

At the EU level, BOOST-IN will establish an active network of various interest groups, provide training and further education for experts, and offer recommendations for policymakers. Through these efforts, BOOST-IN will significantly contribute to the market uptake of innovative circular economy technologies and help achieve the objectives of the Green Deal.

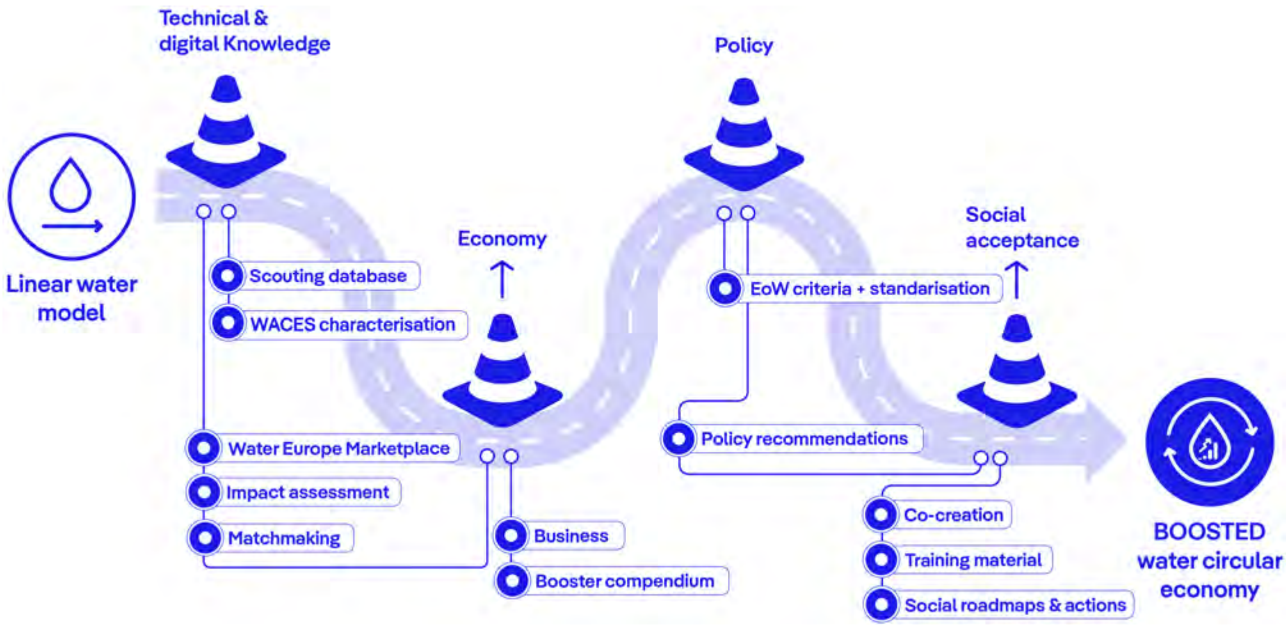

Fig. A: From a linear water model to a BOOSTED water circular economy

LASSO-2

Project volume
€70,000, financed by the Berliner Wasserbetriebe

Partner
Berliner Wasserbetriebe

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Dr. Christian Remy
Yuki Bartels

While the basic principles of N_2O production in wastewater treatment plants are well understood, estimating actual emissions under operational conditions remains challenging. Long-term on site measurements are essential for accurately documenting emissions and formulating effective reduction strategies.

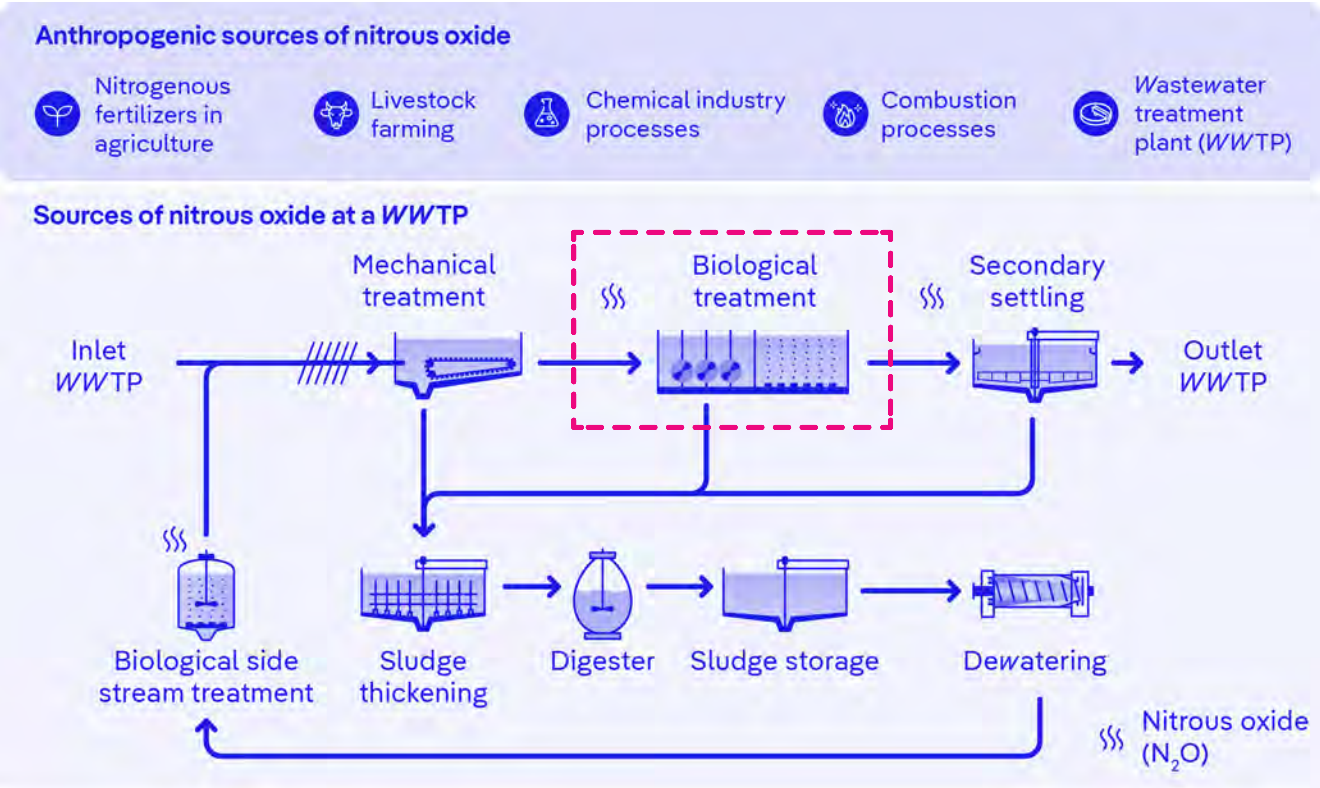
Unfortunately, not funny at all – laughing gas

Nitrous oxide (N_2O), often overshadowed by more familiar greenhouse gases like carbon dioxide (CO_2) and methane (CH_4), plays a critical role in climate change. When measured in CO_2 equivalents, N_2O is 265 times more potent than CO_2, making even small emissions significant. According to studies, nitrous oxide accounts for approximately 6 % of the global greenhouse effect, underscoring its substantial impact on climate change.

Anthropogenic N_2O emissions mainly result from the use of nitrogenous fertilisers in agriculture, animal husbandry, plastics production, and certain combustion processes. Additionally, wastewater treatment plants release N_2O into the atmosphere through technical (e.g., aeration), chemical (e.g., water composition), and biological (e.g., microbial communities) processes, influenced by seasonal temperature changes (see Fig. A).

The LASSO-1 project, led by KWB, introduced a measurement approach that precisely monitors N_2O emissions and related parameters at a single aeration tank location using a gas hood. Expert analysis of this data provided an initial evaluation of nitrous oxide emissions at a Berlin wastewater treatment plant. The subsequent LASSO-2 project further optimises the robust and reliable measurement method for nitrous oxide emissions from an aeration tank. The measurement method using a gas hood is supplemented by sensors that can measure dissolved

Fig. A: Overview of anthropogenic sources of nitrous oxide in general and at a wastewater treatment plant



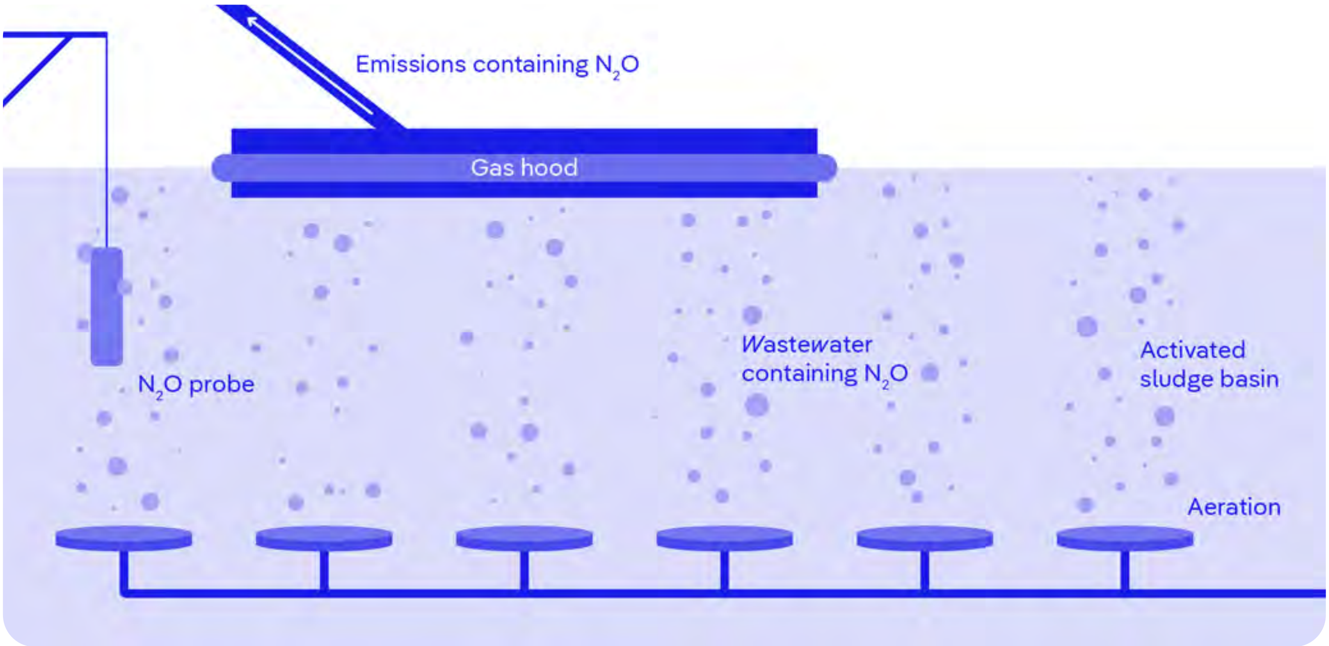


Fig. B: Setup of parallel nitrous oxide measurements in an activated sludge basin with hood for the gas phase and probe for the liquid phase

nitrous oxide in the liquid phase, i.e. directly in the water (see Fig. B). This method simplifies maintenance and setup and is therefore ideal for long-term measurement. However, the actual emission of N_2O requires air/water mass transfer equations. Comparing gas hood measurements with liquid phase measurements in LASSO-2 helps in validating these calculations.

By refining measurement technology in LASSO-2, KWB will be able to efficiently analyse other treatment plants in Berlin and beyond for N_2O emissions. The findings from this project will greatly enhance our understanding of nitrous oxide formation and support the development of strategies to mitigate emissions from wastewater treatment plants.

The long-term measurement results are pivotal to the climate protection strategy of Berliner Wasserbetriebe (BWB). Moreover, the EU's revised Urban Wastewater Directive mandates ongoing monitoring of nitrous oxide emissions at all major wastewater treatment plants, including those operated by BWB.

MiSa

Project volume
€595,000 (total amount phase 1-6), financed by Senate Department for Urban Mobility, Transport, Climate Action and the Environment

Partner
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Paul Schütz

▶ (1) In a combined sewer system, both rainwater and wastewater are channeled into a shared sewer and directed to wastewater treatment plants through pumping stations. However, during heavy rainfall, the capacity of these stations and treatment facilities is often insufficient to handle the increased volume. To mitigate flooding risks, the system includes relief structures like rainwater retention basins, combined sewer overflow channels, and rainwater overflow basins. These infrastructures temporarily store excess water, gradually directing it to wastewater treatment plants, or, if necessary, discharge it untreated into watercourses.

No pipe dream: Berlin's ambitious decoupling plans

For 150 years, combined sewer systems ▶ (1) have played a crucial role in maintaining hygiene standards in our cities while protecting properties from flooding. However, during heavy rainfall, these systems often reach their capacity limits, resulting in combined sewer overflows that degrade surface water quality, causing fish deaths and excessive algae growth.

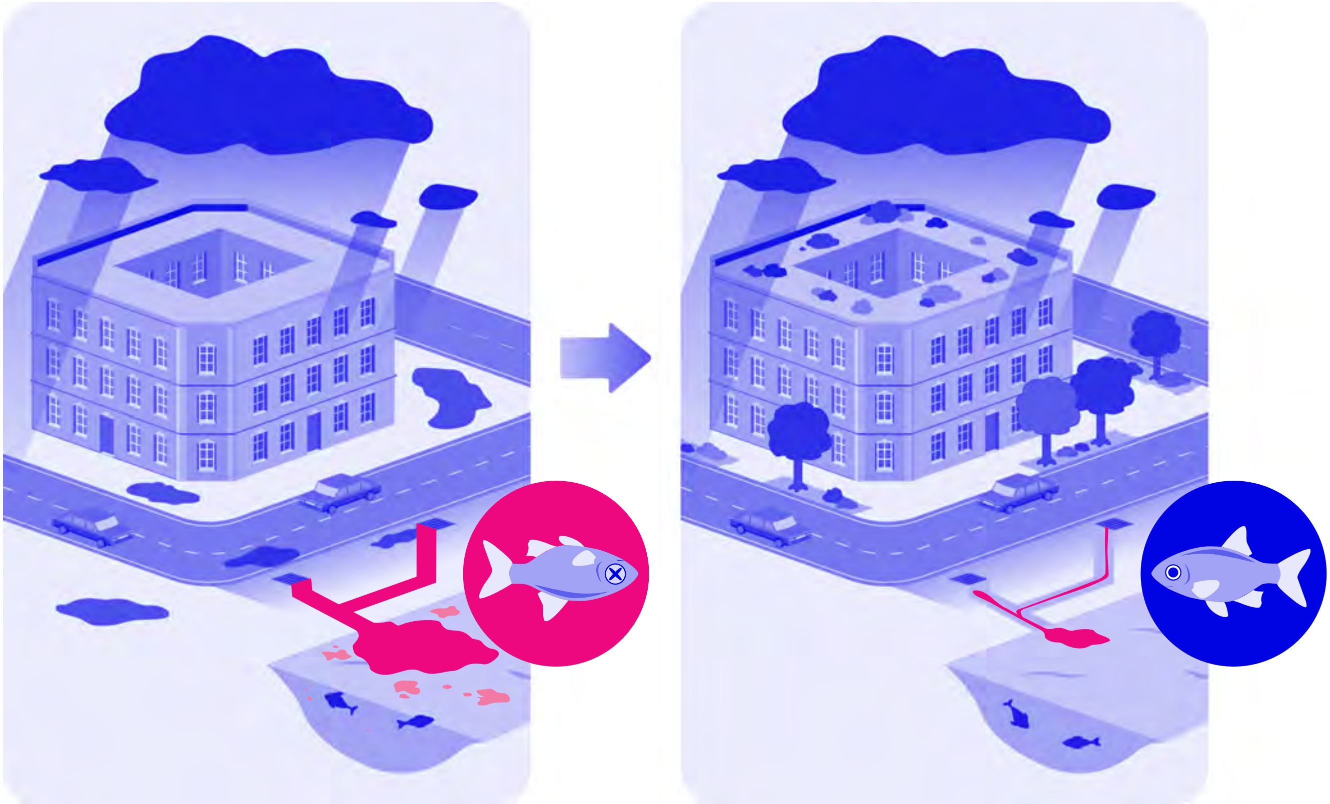
To combat these issues, significant underground storage has been incorporated into the sewer network in recent years, designed to collect large volumes of water and reduce the frequency of overflows. Despite achieving an additional storage capacity of over 300,000 m^3, these measures alone are not sufficient to handle the sudden influx of water during intense storms. To address this, Berlin aims to decouple one percent of its urban area from the combined sewer system annually. This goal will be achieved through decentralized rainwater management, which allows rainwater to evaporate, infiltrate, be temporarily stored, or utilized on-site.

KWB has been actively engaged in addressing this challenge, supporting decision-makers and administrators in strategizing decoupling initiatives. The MiSa project—short for mixed water catchment area remediation—commissioned by the Berlin Senate Department for Urban Mobility, Transport, Climate Action, and the Environment, marks significant progress. MiSa is developing a conceptual framework to assist environmental authorities in advancing a program for combined sewer rehabilitation.

Utilizing a digital tool based on a model chain that includes a sewer network and a water quality model, along with three evaluation indicators the project simulates the potential for disconnecting urban areas from the combined sewer system and assesses the expected impacts on sewers and water bodies. For the first time, land decoupling and water quality are directly linked, and measures are evaluated from the perspective of surface water. Simulations indicate that to substantially enhance water quality, a decoupling rate of 20-30 % must be achieved across all combined sewer catchment areas in Berlin — an ambitious target.

The project, now in its sixth year, is a collaboration with the Ingenieurbüro für Wasser und Umwelt. Berliner Wasserbetriebe, the Berliner Regenwasseragentur, and the districts of Friedrichshain-Kreuzberg, Charlottenburg-Wilmersdorf, Mitte, and Neukölln are key supporters. Plans are underway to extend cooperation to other districts with combined sewer systems, with no immediate end date for the project. Additionally, future phases of MiSa will integrate these results into the Berliner Wasserbetriebe's general drainage plan (GEP).

MiSa involves all partner institutions working on realistic scenarios, providing a unique opportunity to incorporate urban goals related to climate adaptation and environmental justice, particularly in times of limited resources. Thanks to MiSa, decoupling measures can be planned more precisely and efficiently, advancing Berlin's ambitious target while contributing significantly to environmental and water protection.



The decoupling of urban areas through blue-green infrastructure leads to a reduction of combined sewer overflows, thus improving surface water quality and preventing fish death.

iOLE

Project volume
€880,764 (total amount),
financed by BMBF Digital Green Tech

Partners
Smart Water Networks; Technische Universität Berlin - Einstein Center Digital Future; Urban Impact Agency

Associated partner
Gelsenwasser

Contact
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Dr. Enrique Campbell
Johannes Koslowski

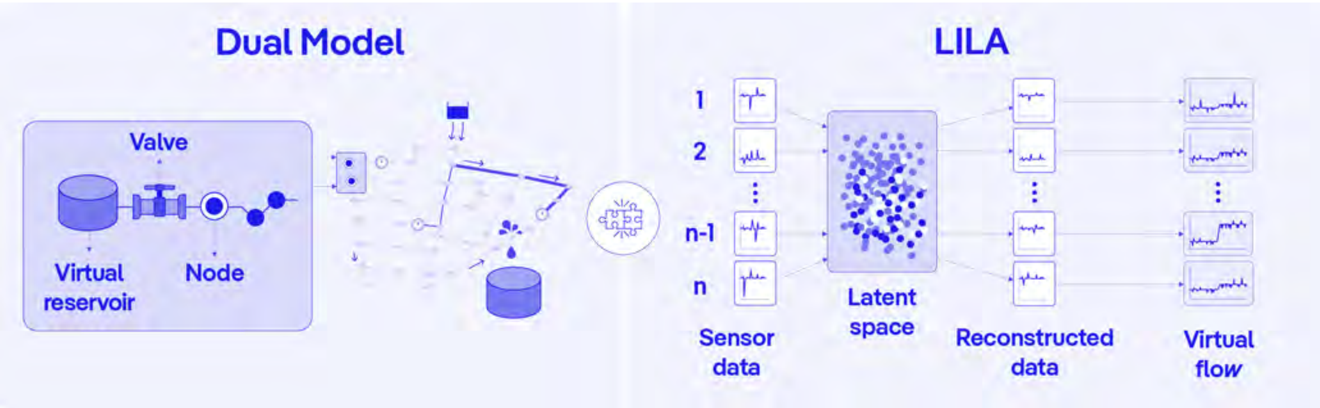
A *new* recipe for reducing *water* losses

Every year, over 120 million m³ of water is lost globally due to leaks in drinking water networks, presenting a significant challenge for water utilities. These leaks can lead to service interruptions, property damage, increased operational costs, and sanitary issues. Consequently, there is a growing need for innovative digital tools to detect these leaks. Solutions range from (i) model-based approaches that utilize hydraulic models, (ii) data-driven methods that analyse time series data, to (iii) hybrid techniques that combine both.

Despite advances in technology, water utilities still largely depend on customer-reported leaks, acoustic loggers, and step tests to identify issues, which are inadequate for ongoing monitoring. Furthermore, a reluctance to adopt new technologies hampers the implementation of effective leak detection systems. Model-based and data-driven approaches offer distinct advantages in leak detection, including (i) rapid detection times, (ii) low false positive rates, and (iii) precise leak localization. While model-based methods provide comprehensive spatial information, their effectiveness hinges on the accuracy of hydraulic models. In contrast, data-driven approaches may offer less precision. The BattLeDIM competition has compared various algorithms, yet a thorough analysis of the robustness of both methodologies remains lacking. Another crucial consideration for adopting new technologies is user-friendliness; existing studies often emphasize functionality over usability within the water utility sector.

The iOLE project—intelligent online leak detection—addresses these issues. This initiative is a collaboration between KWB, TU Berlin, Gelsenwasser, and Urban Impact Agency, supported by the Digital Green Tech funding scheme of the Federal Ministry of Education and Research (BMBF). iOLE aims to develop user-centred leak detection software, focusing on three core principles: enhancing user experience to ensure software acceptance, automating processes for practical continuous application, and integrating functions to meet the technical demands of utilities concerning robustness and functionality.

In the iOLE project, model-based (Dual Model) and data-based (LILA) algorithms are combined to detect and localise leaks quickly and robustly.



In essence, iOLE comprises three key components:

1. The best of both worlds: By merging model-based and data-driven leak detection methods, we aim to leverage their respective strengths while minimizing their weaknesses. Utilizing award-winning algorithms—LILA (data-driven) and Dual Model (model-based, see p. 14 ff.)—we strive to reduce technical barriers and enhance the robustness of leak detection. The model-based approach excels with an accurate hydraulic model, while the data-driven method proves more effective in scenarios lacking a model or with significant uncertainties. This combination allows iOLE to address a broader range of situations, making it applicable to more water utilities.

2. Robust solutions with low false alarm rates: iOLE employs both model-based and data-driven leak detection, necessitating an assessment of the robustness of each approach across various scenarios and their associated uncertainties. Our objective is to generate interpretable detection results from both methods. We categorize uncertainties into aleatoric—stemming from inherent randomness and irreducible—and epistemic, which can be mitigated as additional information is gathered. The iOLE framework will identify and classify potential uncertainty sources, followed by a sensitivity analysis using Sobol indices to evaluate the impact of each epistemic uncertainty on leak detection.

3. Human-centred software development: Enhancing user experience and incorporating feedback are crucial for increasing acceptance of iOLE solutions. We prioritize human-centred design and user experience, engaging utility operators through feedback loops in workshops and audits throughout the two-year project. Initially, we conducted a market analysis of German water utilities to assess their size, infrastructure, and leak monitoring systems. This analysis helps identify suitable stakeholders for co-design workshops and offers an overview of existing technologies. A key aspect of our approach is the development of a dashboard featuring a graphical user interface (GUI) to effectively visualize leak detection results, supporting decision-making for technical and maintenance personnel. Additionally, we aim to create an automated workflow that reduces manual interventions and ensures compatibility with existing systems, both of which will be evaluated in stakeholder workshops.

IMPETUS

Project volume
€16,224,769 (total amount), financed by the Horizon 2020 European Union Funding for Research & Innovation

Partners
Accademia Europea di Bolzano; Athens University of Economics and Business; Baltijas Vides Forums; Berliner Wasserbetriebe; Consorzio dei Comuni Bim Sarca Mincio Garda; Departament D'acció Climàtica, Alimentació I Agenda Rural - Generalitat de Catalunya; Etaireia Ydreyseos Kai Apocheteseos Proteyoysis Anonimi Etaireia (Athens Water Supply & Sewerage Company S.A.); European Science Communication; Fondazione Edmund Mach; Fundacio Eurecat; GCF - Global Climate Forum EV; Hellenic Ministry of Environment and Energy; Jelgavas Pasvaldibas Operativas Informacijas Centrs - Jelgavas Didgitalais Centrs; KWR Water B.V.; Lobelia Earth Sl; Mantis Business Innovation P.C.; Mediterranean Agronomic Institute of Chania; Mobygis srl; National Technical University of Athens; Nelen & Schuurmans B.V.; Sdsn Association Paris; Senate Department for Urban Mobility, Transport, Climate Action and the Environment; Thetis Spa; Troms Og Finnmark Fylkeskommune; Union Internationale Pour La Conservation De La Nature Et De Ses Ressources; Universitaet Bern; Universitat de Girona; Universitat Rovira I Virgili; Universitetet I Tromsoe - Norges Arktiske Universitet; Water Energy Intelligence B.V.; Zemgales Planosanas Regions

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▶ (1) A Decision Theatre is an interactive workshop format that helps decision-makers to better understand and address complex challenges through data, models and visual simulations. It serves as a platform for exploring scenarios and collaboratively evaluating the impacts of different measures.

As part of the IMPETUS project, a Decision Theatre is being used in Berlin/Brandenburg to discuss solutions for managing water scarcity. Various measures from the Berlin Senate Department for Urban Mobility, Transport, Climate Action and the Environment's "Water Masterplan" are examined, with simulations conducted to assess their potential impact on water availability during prolonged droughts. This approach helps to make well-founded decisions on the sustainable management of urban water resources.

Act locally, act globally: IMPETUS puts climate adaptation into practice

Climate change is one of the most pressing global challenges of our time, impacting many areas of life. Floods, heatwaves, water scarcity and other extremes make adaptation strategies urgently necessary. To address these challenges, the European Commission funds the IMPETUS project as part of the Horizon 2020 programme. In collaboration with 32 partner institutions across seven European pilot regions, the project aims to advance comprehensive adaptation solutions, test them locally, and examine their transferability at European level. The expertise of scientists, policymakers, companies and civil society will be pooled to create innovative and sustainable measures that combine technological, social and economic approaches. The goal is to develop locally anchored solutions with the potential to benefit all of Europe, to make a significant contribution to climate adaptation.

The seven demonstration sites of the IMPETUS project illustrate the diversity of climatic challenges in Europe and show the need for different regional approaches to adapting to climatic extremes (see Fig. A). In Berlin/Brandenburg, Germany, increasing water stress caused by population growth, structural changes, and shifting climatic conditions presents significant challenges, especially during prolonged dry periods. To tackle these issues, various complex and simplified models for groundwater and surface water are used to simulate scenarios for water availability and quality, as well as to evaluate adaptation measures. A "Decision Theatre" ▶ (1) promotes cooperation between different stakeholders to co-develop solutions.

In Catalonia, Spain, efforts are focused on combating water scarcity and coastal erosion, which are exacerbated by droughts, tourism and rising sea levels. To overcome these challenges, sand dunes are being restored as natural coastal protection and decentralised water reuse systems are being implemented in tourist areas to optimise water consumption. Climate-resilient tourism and the economic impact of future extreme events on coastal infrastructure are also being examined.

Attica, Greece, faces extreme heat, droughts, forest fires and flash floods, exacerbated by erratic rainfall, especially in densely populated areas. As part of the IMPETUS project, the region is implementing a wastewater reuse system and a digital twin to support water and risk management, enhancing resilience to extreme weather events.

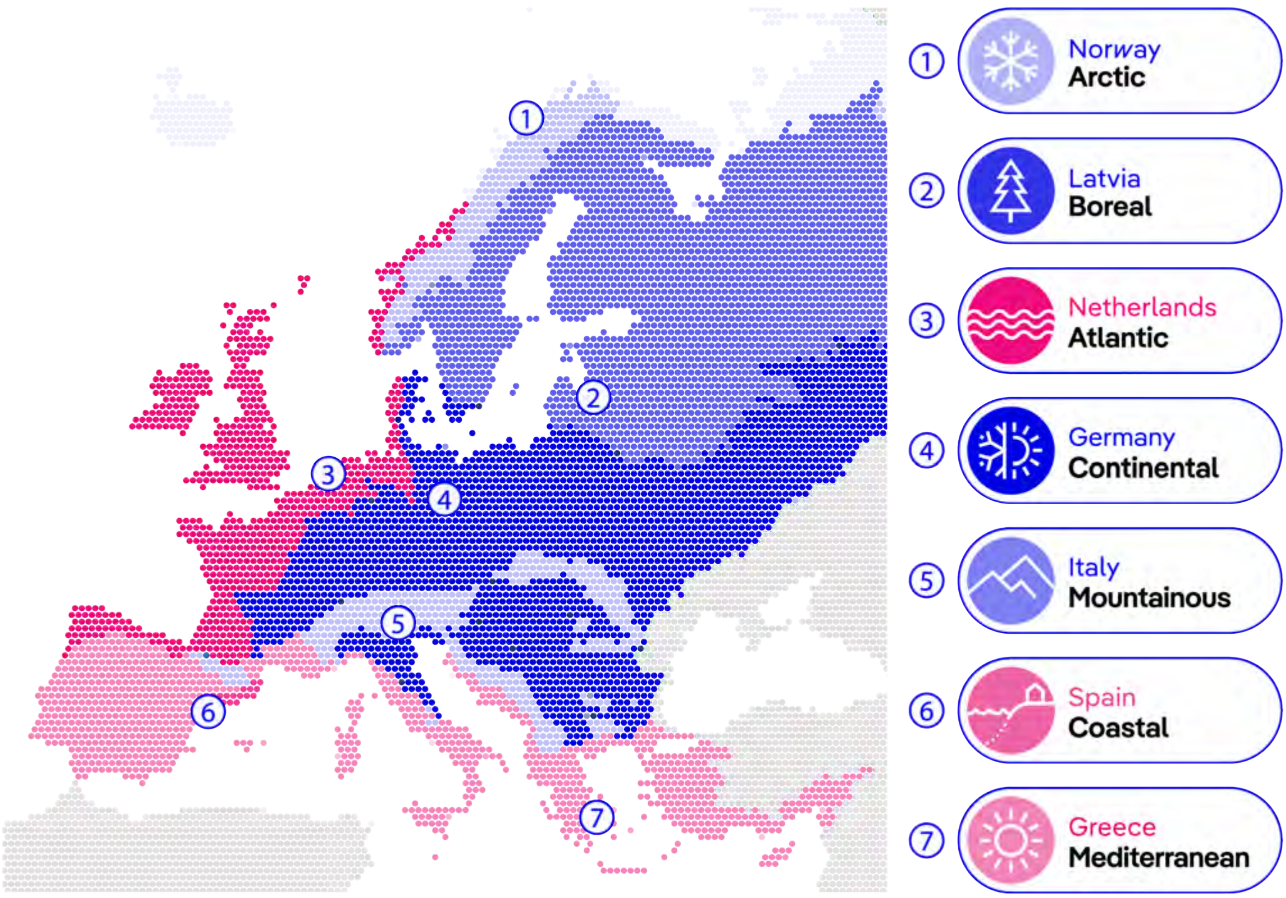
In Zeeland and Rijnmond, the Netherlands, rising sea levels and heat waves are threatening the region. A decision support tool for floods helps to identify potential flood-prone areas and plan preventive actions. Additionally, a heat stress tool pinpoints heat hotspots to guide adaptation measures aimed at protecting vulnerable populations.

Troms & Finnmark, Norway, is increasingly affected by natural hazards such as avalanches, landslides and rockfalls caused by warmer temperatures and more intense precipitation. An early warning system and hazard maps are under development to identify areas at risk and plan preventative measures with decision-makers.

Zemgale, Latvia, experiences increasing flooding from snowmelt and heavy rainfall due to its extensive river network. To mitigate these risks, a regional early warning system for floods with AI-supported forecasts and publicly accessible information is being developed. In addition, a regional climate adaptation plan is being formulated in close cooperation with local stakeholders to foster sustainable adaptation strategies in sectors such as agriculture, health and biodiversity.

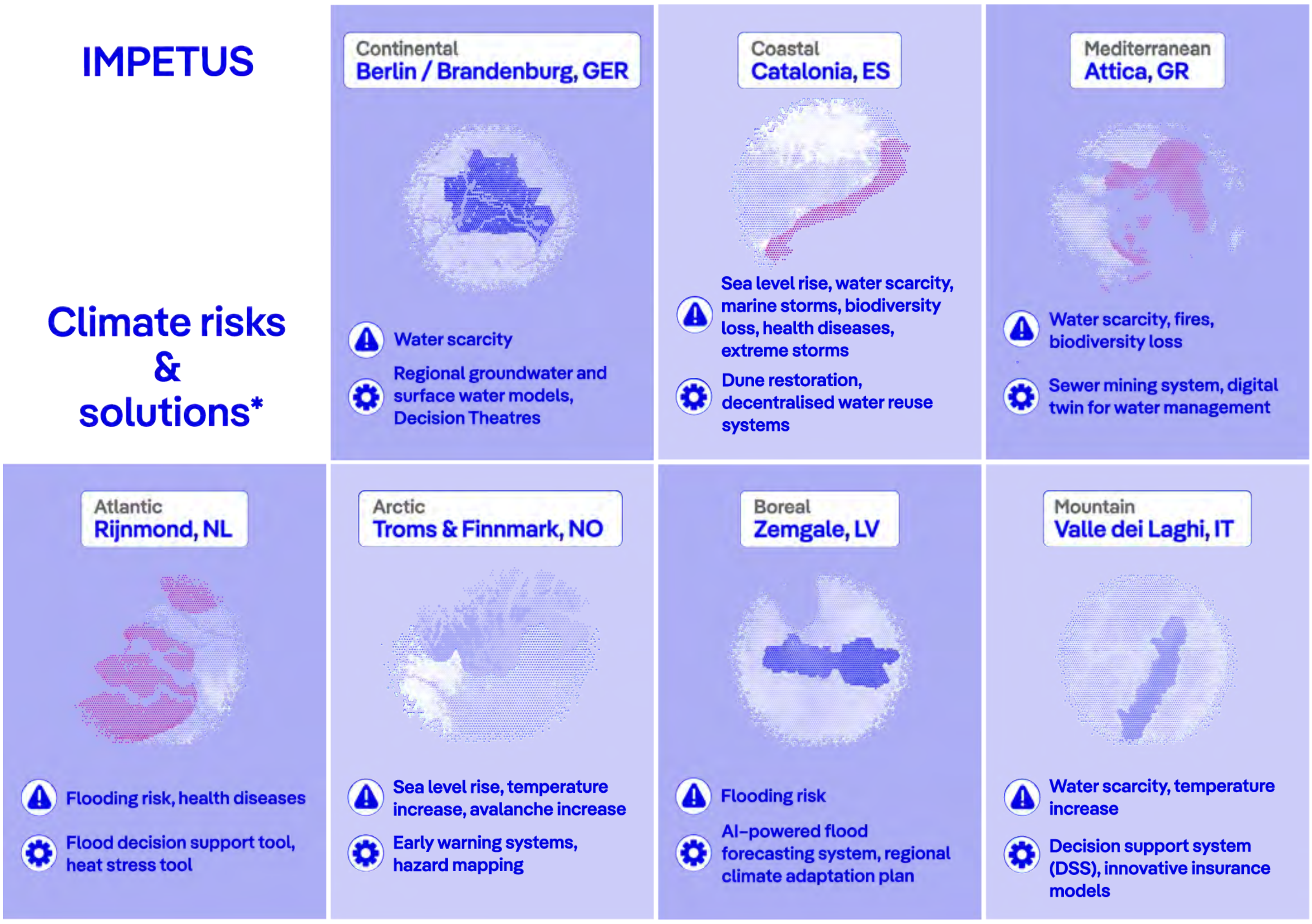
In the Italian mountain region of Valle dei Laghi, a decision support system is being developed to leverage hydrological forecasts for the sustainable management of dwindling water resources. This system aims to balance water use for irrigation, drinking water, and hydropower. Furthermore, innovative insurance models are being tested to protect agricultural enterprises from climate-related risks such as drought and flash floods.

Fig. A: Map of demonstration sites



The IMPETUS project impressively illustrates how close collaboration among research, practice, and society can yield regional solutions for climate adaptation (see Fig. B). Innovations tested in the pilot regions lay the ground for scaling to other regions facing similar challenges, and thus promote the European exchange of knowledge and experience. Through the strategic combination of technological and regulatory measures, the project provides essential momentum for sustainable climate adaptation. IMPETUS not only offers solutions to current challenges but also establishes a foundation for a resilient future across Europe and beyond.

Fig. B: Conceptual overview of demonstration sites, climatic challenges and possible solutions



*The solutions shown represent only a part of the solutions developed. A complete overview can be found on the IMPETUS website: https://climate-impetus.eu/

Swimming out

For us, "swimming out" means taking a glimpse into the future. Discover insights into the future of phosphorus recovery, as well as data governance and management in Smart Cities. In an interview with our new Managing Director, Pascale Rouault, gain a deeper understanding of the direction KWB is heading.

Explore these articles for a glimpse into what the future holds:

Halfway to phosphorus recovery?

Fabian Kraus

Sewage sludge ash

The 2017 amendment to the Sewage Sludge Ordinance in Germany obliges the wastewater sector to recover phosphorus from sewage sludge from 2029 onwards. More than half of the 12-year transition period has now passed. Where do we stand today?

“If you read the Sewage Sludge Ordinance carefully, you probably could not avoid the impression that the suggested route was burn, bury, postpone, and forget.”

The coalition agreement of the Merkel III cabinet in 2013 introduced a paradigm shift for sewage sludge disposal. The agricultural valorisation of sewage sludge was to be phased out, and phosphorus and other nutrients should be recovered. The Sewage Sludge Ordinance, amended in 2017, defined the path for achieving this goal. From 2029 onwards, wastewater treatment plants with capacities greater than 100,000 person equivalents must recover phosphorus from sewage sludge with a recovery rate of 50 %, or from sewage sludge incineration ash with a recovery rate of 80 %. For plants designed for 50,000 to 100,000 person equivalents , these limits will apply from 2032. This regulation applies to all treatment plants where the phosphorus content in the sewage sludge is greater than 20 g of phosphorus per kg of dry matter. Currently implemented large-scale processes for phosphorus recovery in digested sludge or sludge water have significantly lower recovery rates. Whether the phosphorus content can be reduced to less than 20 g of phosphorus per kg dry matter depends on various boundary conditions (see Fig. A).

If you read the Sewage Sludge Ordinance carefully, you probably could not avoid the impression that the suggested route was burn, bury, postpone, and forget. This abbreviation is certainly somewhat polemical, but it can be explained.

Burn

Due to the end of agricultural sewage sludge valorisation and the foreseeable end of co-incineration of sewage sludge in coal-fired power generation, the wastewater industry needs new ways of utilising sewage sludge. This currently leads to construction of several sewage sludge mono-incineration plants. In sewage sludge mono-incineration, the calorific value of sewage sludge is utilised for energy, and the most relevant residue in terms of mass is the sewage sludge ash. In addition to phosphorus in the form of phosphate, this also contains elements such as calcium, silicon, iron, and heavy metals. The ash has a low fertiliser effect and, due to its high heavy metal content, there are legal difficulties with using it directly as a fertiliser. The phosphorus in the ash must be converted into a plant-available form, and heavy metals must be reduced and separated from phosphate. The processes for doing this can be divided into two categories:

- Processes that modify the ash, convert the phosphate into a plant-available form, and partially separate heavy metals,
- processes that extract the phosphate from the ash and recover it as a chemical in the form of phosphoric acid or calcium phosphate, separating heavy metals in the process.

Processes in the first category produce plant-available ashes which must establish themselves on the fertiliser market, but are considered to be more cost-effective. Processes in the second category produce currently marketable products, but are considered to be more expensive. Regardless of the process, it is generally assumed that the revenues for products cannot cover the costs. Therefore, phosphorus recovery must, at least partially, be financed through fees. To begin phosphorus recovery in 2029, investments in the construction and commissioning of such recycling plants would have to be made now. However, the federal states disagree on the extent to which phosphorus recovery is eligible via wastewater fees before 2029, leading to lack of interest in investing. ▶

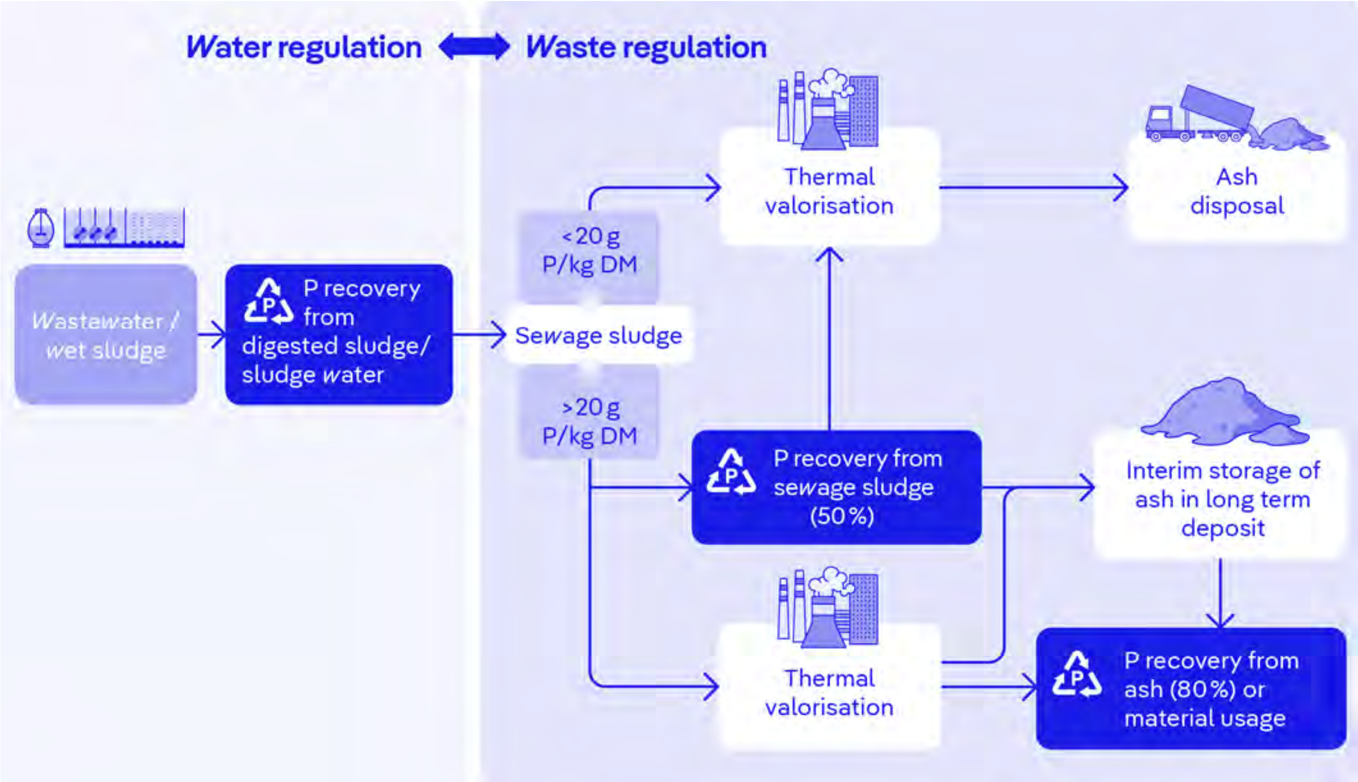


Fig. A: Possibilities of phosphorus recovery (P recovery)

Bury

Several projects for phosphorus recovery from ash have been started. Remondis Aqua AG and Hamburg Wasser have implemented the TetraPhos process in Hamburg. EasyMining and Gelsenwasser are implementing the Ash2Phos process in Schkopau, Saxony-Anhalt. The companies Emter and sePura are implementing a modified AshDec process in Altenstadt, Bavaria. SeraPlant, which has since gone bankrupt, implemented the Glatt process in Haldensleben, Saxony-Anhalt. According to estimates, in 2029 Germany will have an annual capacity of recovering phosphorous from around 60,000 tonnes of ash, whereas the national ash production would be up to 600,000 tonnes. This means phosphorus recovery capacity will be available for about 10 % of sewage sludge ash.

What about the remaining 90 %? The Sewage Sludge Ordinance allows temporary interim storage of sewage sludge ash prior to recovery if capacity for phosphorus recovery is insufficient. Most likely, this interim storage exception will become the rule. Since this ash must be accessible, such interim storage must be designed differently than a normal landfill. For instance, banning the ash from being mixed with other waste and instead depositing ash in the upper section of a landfill or in a separate landfill area, must be realised. With costs of around €200 to €500 per tonne of ash, this interim storage is significantly more expensive than landfilling, which costs around €50 to €80 per tonne of ash. In addition, the costs for phosphorus recovery from the temporarily stored ash (currently around €200 to €300 per tonne of ash) must be factored in from 2029. This means that from 2029, considerable additional costs of up to ten times this amount can be expected for "ash disposal".

Postpone and forget

It can be assumed that from 2029, a large proportion of the sewage sludge ash produced in Germany will be deposited in temporary storage facilities at considerable cost, which will postpone the recovery of phosphorus from this ash. As both temporary storage and phosphorus recovery will be subject to wastewater fees from 2029, the costs incurred will be passed on to those paying these fees. To not overburden them, it will be more economical for sewage sludge producers to recover phosphorus directly from the ash without temporarily storing it. This assumes that the corresponding recovery processes and business models are more cost-effective than interim storage.

Capacity for phosphorus recovery from ash will therefore be successively built up from 2029, but only to the extent necessary to treat the ash produced by the mono-incineration plants. Overcapacity to quickly process the temporarily stored ash is not expected, as the phosphorus recovery plants require a secure long-term supply. Once there is sufficient recycling capacity (2035-2040), a small amount of the temporarily stored ash will begin to be gradually removed by mixing it with the sewage sludge ash produced during regular operation. Once these temporary interim storage facilities receive ash for around five years, they are expected to be dismantled around 2050-2060 or even later.

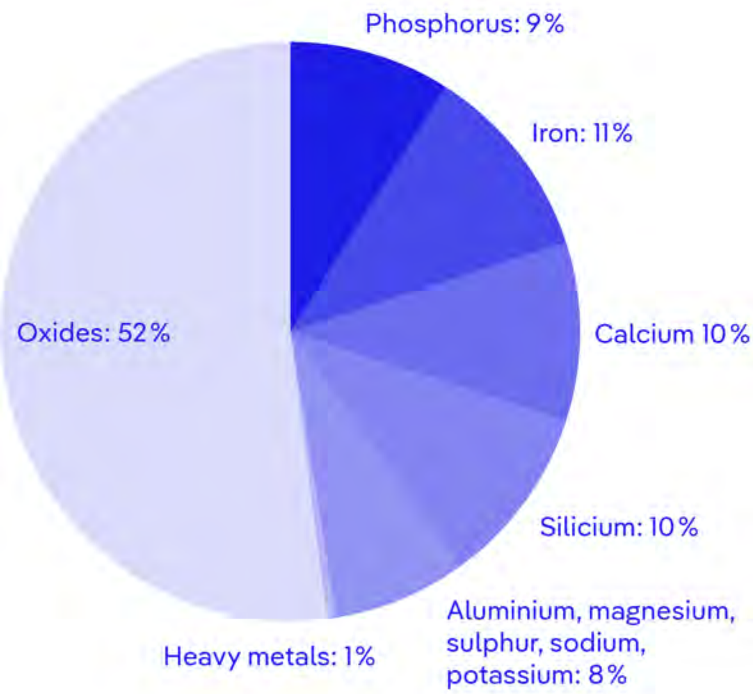


Fig. B: Average elementar composition of sewage sludge ash

For ashes produced in the year 2029 + X and recovered in the year 2060 ± Y, costs for phosphorus recovery would have to be factored into fees in 2029. How can we forecast the costs of phosphorus recovery from ashes 30 years ahead? Although the technology will become more efficient through further development and synergies, the price indices for operating resources, energy, and personnel will rise, which means postponing recovery could lead to cost calculation errors.

What happens if the costs for the dismantling of ash from interim storage facilities and reclamation in 2060 ± Y exceed the reserves from 2029 + X? Can the fee payers in 2060 be held liable for what was not paid for a generation earlier? It is obvious that at some point a cut will have to be made and certain temporarily stored ashes can no longer be recovered.

What does this mean for current development?

Firstly, it is essential to create the possibility of passing on the costs incurred for phosphorus recovery before 2029 to the fees. For phosphorus recovery to begin in 2029, planning and construction processes would have to be carried out in advance, and these costs must be covered. The initial implementation of new processes shows that the commissioning of such recovery plants is a lengthy undertaking. An operator who chooses a process that has not yet been established at an industrial scale is taking a financial risk. On the other hand, interim storage and future recovery also pose financial risks due to unpredictable costs.

What can KWB do?

We have been researching, evaluating, and supporting the field of phosphorus and nutrient recovery for almost 15 years. In over 10 research projects with a total volume of more than 40 million euros, various phosphorus recovery processes were investigated and piloted. A common thread runs through all these projects: KWB carries out the final, independent life cycle assessments and, where necessary, cost estimates.

As a non-profit research institute, we assess the technical feasibility of processes and provide forecasts on the CO_2 footprint and its changes during the energy transition as well as on economic efficiency. We also prepare forecasts on the pollutant load of possible phosphorus recovery products and their market opportunities. We use our expertise to support wastewater and sewage sludge disposal companies and local authorities in their investment decisions. Finally, together with our partners, we research new approaches and processes that show sewage sludge producers and local authorities an economical and environmentally friendly way to recover phosphorus in the future. ●

The “how” of the Smart City

Municipalities' digital transformation and data governance

Nikolaus de Macedo Schäfer

Administration in the Smart City

Every sensory activity within a city helps derive behavioral patterns related to interaction, consumption, and communication among urban dwellers. The Smart City, serving as a hybrid between the analog and digital realms, leverages this vast array of information to both optimize traditional services and generate innovative applications.

"In urban development, data collection and utilization face three main challenges that a well-structured, administration-focused data governance framework can address: Explainability, data availability and quality, and protection laws."

The data collected or utilized in a Smart City encompasses not only a technical aspect but also a social dimension. The methods of data collection, processing, and application have significant impacts on both the individual and societal level within the city. Therefore, planning decisions driven by data-based systems should consider not only their economic benefits but also the broader interests of the public good. Safeguarding the common good should be achieved not only through technological solutions but also through active and collaborative engagement with diverse stakeholders, much like traditional urban development does (Federal Institute for Research on Building, Urban Affairs and Spatial Development, 2022).

Requirements for data use by the administration

In Smart City initiatives, it is common to develop centralized strategies and formats to facilitate access to and processing of urban data. Discussions around data use often focus on technical feasibility and necessary human resources. However, this narrow perspective overlooks critical challenges, whose early resolution is essential for the success of data-driven urban projects.

Normative and organisational requirements play a significant role in the potential failure of such projects. These arise from the diverse data interests of stakeholders, each with different viewpoints on value creation and risk regarding the collection and (re)use of data. Effective data governance reconciles these conflicting interests by establishing decision-making rules, criteria, indicators, processes, roles, responsibilities, guidelines, and standards (von Grafenstein, 2022).

So far, research on data governance has predominantly targeted the private sector. IT service providers and companies with data-driven products have been the primary audience for best practice recommendations concerning organizational structures, data quality standards, and exchange protocols. However, these insights offer limited guidance for the novel processes and structures required in the public sector, which operates under more stringent requirements.

When utilizing data, public administration must uphold its role as the executor of democratically sanctioned political oversight and maintain accountability to the public (Bogumil, 2021). In line with this constitutionally mandated duty, the administration is obliged to transparently disclose the methods, processes, and criteria involved in its decision-making. ▸

Challenges in data governance

In urban development, data collection and utilization face three main challenges that a well-structured, administration-focused data governance framework can address.

Explainability: Efficient data management demands the ability to extract and comprehend information. However, not all stakeholders possess the necessary data expertise. Therefore, decisions and their data foundations must be tailored to specific audiences to prevent conflicts of interest. Legal requirements also support this need: the GDPR and the principle of the rule of law mandate transparency and traceability in data processing (Art. 12 ff. GDPR; Wischmeyer 2018).

Data availability and quality: Technical or organizational issues can hinder data access. Proprietary models, for instance, may restrict access to crucial information. In the municipal sector, this issue arises when administrative tasks could benefit from private company data, yet access is denied. Conversely, accessible data may remain unused, despite its potential benefits for administrative functions. Non-standardized data, such as air quality data collected by citizens, further complicate legal compliance in administrative contexts (de Macedo Schäfer et al. 2023).

Protection laws: Protection laws can create conflicts by limiting data usage. Challenges occur when data cannot be collected or reused due to data protection constraints or when business secrets prevent algorithm transparency. This results in general uncertainty around data handling, fueled by compliance risk concerns (cf. Frank et al. 2022). Moreover, individuals affected by data collection fall into various protection groups with distinct requirements, necessitating careful consideration in the technical and organizational design of data processing. Therefore, administrations should incorporate protection laws from the design phase. Often, there is a gap between perceived protection needs and actual legal protections. Thus, early involvement of all relevant stakeholders is crucial.

Our contribution

To assist German municipalities in proactively addressing their challenges, KWB is developing the project "Data & Smart City Governance using the Example of Air Quality Management," in collaboration with the Humboldt Institute for Internet and Society. Using the case study of the Berlin administration, we are creating and testing data governance concepts that balance municipal and private sector interests while promoting the common good.

Through our work, we identified normative, organizational, and technical obstacles to the integration of data-driven services into existing administrative processes. By combining interdisciplinary research with potential solutions, we crafted a digital data governance handbook. The generalized heuristics developed in this project are applicable to other municipalities and projects, guiding users through three phases to securely enhance their action processes with data.

“In an increasingly digital economy and urban society, the "ho*w*" of the Smart City is becoming pivotal. Only *w*ith robust data governance can cities harness the benefits of digitalization *w*hile protecting the social and individual rights of citizens.”

By offering a detailed breakdown of the process for implementing administrative measures (e.g., introducing a parking management zone), we enable the identification of data integration points in subsequent internal discussions. This involves systematically documenting the required work steps, interim results, legal foundation, and involved actors for designing, reviewing, and realizing the administrative measure.

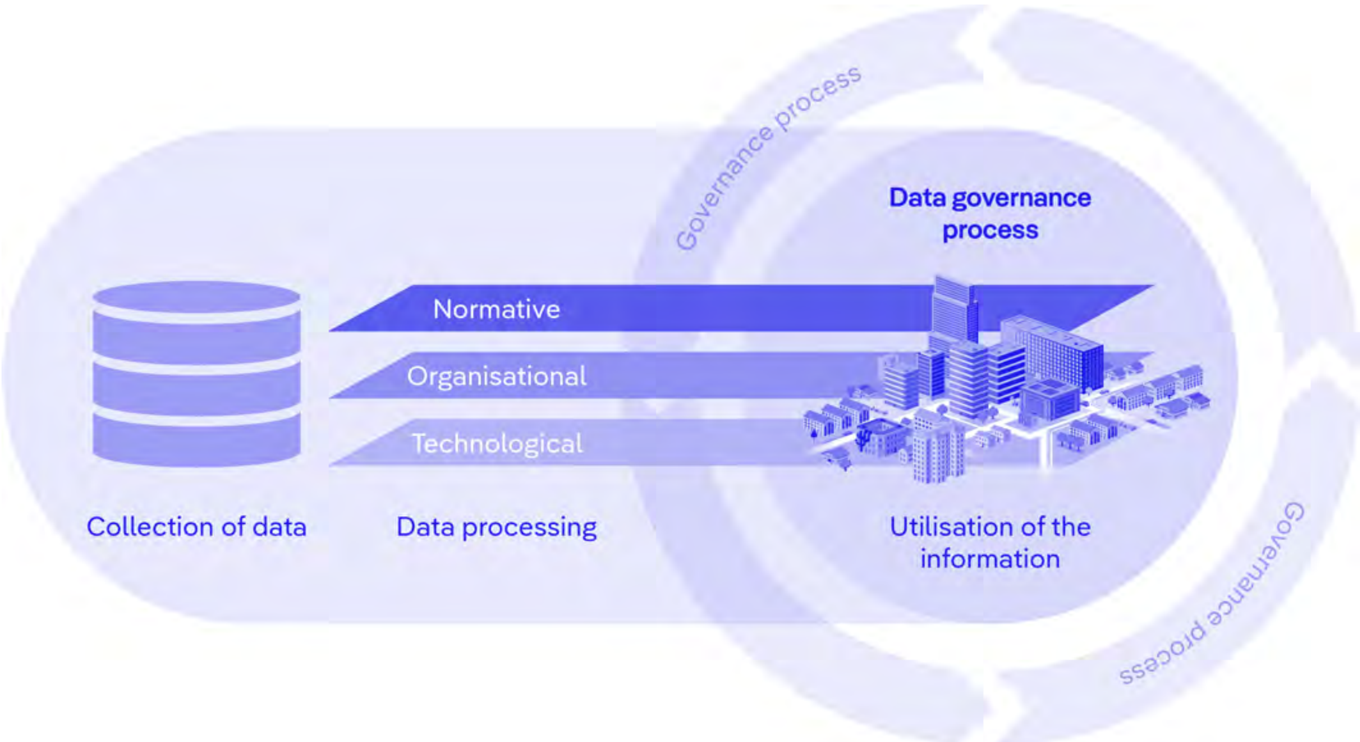
For each identified integration point, appropriate data sets and sources are evaluated based on the technical and organizational measures required for their lawful use. This includes identifying potential considerations for data usage, assessing legal risk scenarios, and establishing the necessary technical infrastructure. Such evaluation supports informed decisions on data integration and its value-risk assessment.

The discussed technical and organizational measures for data usage are reintegrated into the process model and complemented by innovative participation formats after an optimization loop. These formats aim to ensure an early resolution of conflicts over data interests among involved actors, which were identified in a previous step. To ensure the sustainability of these practices, we advocate for formal involvement in the action process, as participation that exceeds the legally required minimum often occurs selectively due to the perceived effort and limited benefits.

Outlook

The future of urban development hinges on effective administration of data-driven projects. This involves establishing clear and transparent guidelines for data usage, ensuring data quality and availability, and safeguarding personal information. These steps are essential to build trust within urban communities and ensure the success of data-driven initiatives.

In an increasingly digital economy and urban society, the "how" of the Smart City is becoming pivotal. Only with robust data governance can cities harness the benefits of digitalization while protecting the social and individual rights of citizens. Such an approach will not only enhance quality of life but also bolster citizens' trust and engagement in urban development. ●



Intervi*ew* *w*ith Dr. Pascale Rouault

Since April 2024, Dr-Ing. Pascale Rouault has been the new Managing Director of KWB. Pascale is already well-known to many employees, having been part of the KWB team between 2007 and 2022, most recently serving as an authorised officer and department head. After gaining valuable experience as Head of Water Management and Neighbourhood Development at HAMBURG WASSER, she has returned to lead KWB.

We sat down with Pascale on 31 October 2024 to discuss her first six months as Managing Director and her vision for KWB's future.

Hello Pascale, you've now been Managing Director of KWB for just over six months. How are you doing?

I'm doing really well. I received a very warm welcome back at KWB—from the team, shareholders, supervisory board members, and partners both in and outside Berlin. I was able to jump straight into the work. Together, we're tackling fascinating, meaningful, and diverse projects with a focus on the entire urban water cycle, while addressing current and future challenges in water management. We are pursuing many innovations and approaches to make the water sector more resilient and efficient, and we have an excellent team to support this mission. Since spring, we've also been working from beautiful new offices. What more could I ask for?

What challenges have you faced in your first six months as Managing Director? And what achievements from this period are you most proud of?

I stepped into the role during the aftermath of our office relocation, which consumed a significant amount of energy and required considerable dedication from the team. It was a fantastic team effort that has definitely been worth it—we now feel very comfortable in our new offices, housed in an energy-efficient building in Berlin-Schöneberg.

Given these circumstances, it was clear that the arrival of a new Managing Director, bringing fresh visions, ideas, and expectations, would present an additional challenge for employees. The repeated changes in leadership since June 2023 required a great deal of flexibility. My challenge was to navigate this transition with sensitivity, to be patient, and to differentiate between what was part of the normal adjustment process and what was related to the move. It was important to identify the right moment to introduce initial changes and ensure everyone was involved.

During this time, I was able to review the projects and meet all the new employees. A lot had happened in the two years I was away from KWB! However, because I already knew the organisation so well, I was able to quickly get back into the business operations and make decisions efficiently, helping to ease the daily work processes for everyone.

I am proud that the motivation, creativity, and commitment of our employees have remained strong throughout this period of transformation. The numerous new project ideas and applications submitted demonstrate the immense potential of the water sector. We feel ready to take the next steps.

What, in your view, defines the identity of KWB, and in which areas could KWB play a significant and decisive role for Berlin, Germany, and Europe?

One of KWB's unique strengths lies in its diverse work across all aspects of the (urban) water cycle. This allows us to comprehensively examine the impacts of major changes, such as climate change, population growth, the energy crisis, increasing environmental demands, and the shortage of qualified labour. We develop holistic solutions to address these challenges.

KWB's research is organised into six groups: "Water Treatment and Reuse," "Energy & Resources," "Groundwater," "Stormwater & Surface Waters," "Smart City & Infrastructure," and "Hydroinformatics." ▶

Early on, we began focusing on digitalisation, particularly artificial intelligence (AI), and now leverage its potential in areas such as small water bodies, climate adaptation, stormwater management, infrastructure maintenance and operation, and drinking water supply. The Berlin Technology Foundation is a strong partner in these efforts, helping us develop tailored solutions. Our focus—both directly and indirectly—is on protecting drinking water resources, ensuring both quality and quantity. Technology assessment is another one of our key priorities, allowing us to evaluate energy efficiency and integrate circular economy principles.

KWB's main mission is applied research. From Berlin, we work closely with stakeholders across the Berlin-Brandenburg metropolitan region, throughout Germany, and across Europe. These stakeholders include municipalities, water suppliers, wastewater companies, and government ministries. The strength of our work lies in the fact that our results can be directly implemented. We have the privilege of witnessing the real-world impact of our research. Many of our projects are strongly tied to Berlin, where we collaborate extensively with our shareholder, Berliner Wasserbetriebe, and the Berlin Senate Department for Mobility, Transport, Climate Action and the Environment, our direct partners in water management. Additionally, we maintain close and regular communication with the Senate Department for Economics, Energy and Public Enterprises; the Senate Department for Urban Development, Building and Housing; the State Office for Health and Social Affairs Berlin; the Senate Chancellery; and Berlin's district administrations. In the past, we have contributed to the foundations of numerous decisions and solutions in Berlin, such as the introduction of the quaternary treatment of wastewater, stormwater management, and phosphorus recycling, to name just a few.

We are committed to fostering long-term, trusted, and productive collaborations with our partners. Together, we are already tackling future challenges and opportunities for our city and region. Through our involvement in EU projects, we bring valuable expertise and research funding to Berlin, while also enabling other European cities and countries to benefit from our knowledge and experience.

The private sector also benefits greatly from our work. Companies gain insights from our research, access to technology evaluations, and sustainable solutions, helping them enhance their competitiveness and strengthen their position in the market.

Research and consulting: In which areas do you see the greatest potential for KWB? How do you handle uncertainties and risks?

We simply need consulting contracts to fund our research. Unfortunately, research grants often fail to cover the actual costs of conducting research. The uncertainties and risks lie mainly in bringing our consultancy services to the market. We cannot, and do not want to, invest heavily in expensive marketing. Instead, we seek strong partnerships and rely on word-of-mouth recommendations.

"In the past, we have contributed to the foundations of numerous decisions and solutions in Berlin, such as the introduction of the quaternary treatment of wastewater, stormwater management, and phosphorus recycling, to name just a few."

This approach can be challenging for a research organisation. However, our goal is to shape our consultancy and services in a way that enables more people, municipalities, and regions to benefit from our research findings. This, in turn, allows us to further develop these results and adapt them to practical needs. This principle applies across all areas of our research. By doing so, we can sustainably support the economy throughout the entire water cycle.

Pascale Rouault moderating the *W*asser*W*erkstatt on the topic of water reuse on April 16th 2024

As a non-profit organisation, we publish all our research outcomes, including models that are freely accessible on GitHub. However, these results are not always directly applicable for everyone. Our consultancy services bridge that gap by enabling the implementation of solutions or models tailored to new locations or applications. A good example of this is our SEMA tool, designed to predict the ageing of sewer systems. Developed in collaboration with Berliner Wasserbetriebe, it aims to make sewer rehabilitation planning more efficient and cost-effective. We are currently adapting the tool for other cities, including Lausanne in Switzerland.

"*W*e must anticipate future challenges early and develop solutions for them."

Our team faces new challenges as consultancy work requires a different kind of collaboration. Consulting contracts are often short-term and must be carefully coordinated with ongoing research projects, demanding excellent time management. While our researchers are accustomed to investigating every detail thoroughly, consultancy projects often require focusing on targeted solutions within limited timeframes. Additionally, new legal and organisational issues must be addressed, and our internal processes and structures need to be adjusted to meet these demands. For me, it's about guiding this transformation and learning from the experience.

KWB offers a wide range of services and consultancy options. Which ones are you particularly focused on, and why?

Our services are diverse. Currently, we advise municipalities, utilities, and private companies on sewer rehabilitation strategies, phosphorus recovery, achieving climate neutrality through greenhouse gas assessments, and implementing Smart City concepts. For microbial and chemical risk assessments, we use our QMRA tool, which is applied in managing river bathing water quality. ▶

I don't have a specific area of focus. My priority is ensuring that our offerings provide valuable support to the water sector and that our clients are satisfied with the services we deliver. It's important to me that the results of our projects are brought to market promptly. Research can take years to complete, and it would be unfortunate if excellent products and insights were only accessible to a limited audience.

What strategy are you pursuing, and what actions are you taking to ensure the sustainable development of KWB?

In recent months, we have engaged in in-depth internal discussions about the roles, tasks, and priorities of the KWB, while developing ideas for its future vision in 2035. These strategies cannot come solely from me—they must involve everyone. This includes employees, managers, stakeholders, and supervisory boards. Furthermore, we must engage with other key partners in the city who play an important role in KWB's development. Listening attentively to the administration, businesses, and, most importantly, the citizens is critical to understanding their needs, aspirations, and concerns. Only through this inclusive approach can we strengthen our role as a non-profit, neutral research institution, both in Berlin and beyond. At the core of our mission is our contribution to Berlin across areas such as the environment, economy, education, urban planning, and health.

In terms of our research, we are currently exploring numerous new ideas, projects, and potential partnerships. Often, these project concepts may initially appear somewhat obscure, as they are not yet making headlines. However, we must anticipate future challenges early and develop solutions for them. Past experience has shown that the issues we address today often become pivotal and widely relevant five or ten years down the line—this is the nature of science. A good example is the concept of the "sponge city." Back in 2008, I initiated my first project on this topic, the KURAS project, which was funded by the Federal Ministry of Education and Research. Working closely with many partners, we developed the fundamental principles for implementing the sponge city concept. At the time, it was difficult to convey to the general public why this topic was so important and to demonstrate how critical it is for cities to adapt to climate change. Thanks to efforts like those of the Berlin Rainwater Agency, the concept is now widely recognised, though its implementation remains a challenge. Another example is per- and polyfluorinated chemicals, better known as PFAS. When we began researching PFAS more than five years ago, the issue was largely unknown in Germany. Today, these "forever chemicals" are a widely discussed topic.

"Taking risks is our capital. Without the willingness to take these risks, research would not be possible!"

One of our key priorities moving forward is to expand our work on groundwater, strengthening our efforts to secure and protect Berlin's drinking water resources for the future. Additionally, we aim to deepen our collaboration with universities and local partners to tackle water management challenges more efficiently. I also hope to increase our public visibility, ensuring that policymakers and the wider public better understand the vital role KWB plays in addressing current and future water-related challenges.

What skills do you consider essential to succeed as Managing Director? What long-term goals have you set for yourself in this position?

There is no one-size-fits-all formula for success. Listening, encouraging, motivating, making decisions, strategic thinking, and effective communication are all essential skills. My long-term goals include ensuring the financial stability of KWB and addressing forward-thinking research questions. The water sector is under mounting pressure, and I want KWB to play an even greater role in protecting our water resources and making our cities more liveable. I am also committed to raising public awareness about the value of water and the importance of safeguarding it for future generations.

Pascale Rouault welcomes the guests to our housewarming party on May 30th 2024

How do you foster a positive work culture and a productive environment within your team?

We're fortunate that the topics we work on are ones that intrinsically motivate us all. Every day brings new learning opportunities, and we're constantly curious about fresh discoveries and research findings. To create a productive environment and work more efficiently, we continuously refine our processes. I place a great deal of trust in our team members and maintain close communication with them. I'm committed to fostering a solution-oriented culture and open, straightforward communication, which I strive to role model in my daily work.

Can you give an example where taking a risk paid off?

Recently, we decided to bring a computer scientist onto our team and financed the position from our own resources at first. Typically, we only hire new team members when their roles are secured and funded through projects or contracts. This decision paid off almost immediately: we achieved significant progress that benefited all our researchers. As a result, we were able to provide our clients with better tools and more reliable models, and we advanced our research projects.

Taking risks is our capital. Every topic we explore and every idea we develop carries risks. Without the willingness to take these risks, research would not be possible!

What advice would you give to young women in leadership roles?

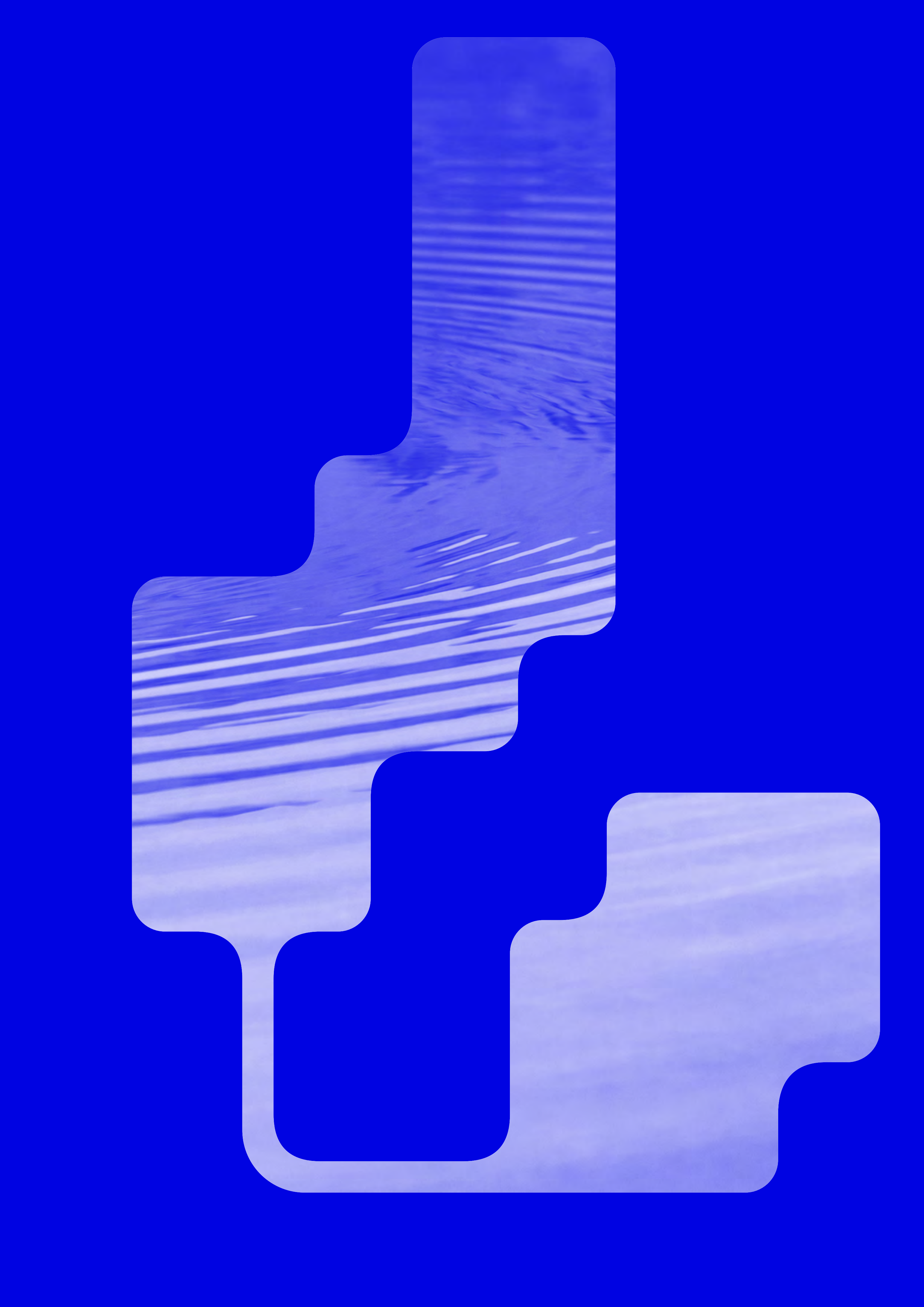
Never let yourself believe that you've become a leader because of your gender, even if you might hear that from time to time. Beyond that, just focus on doing a great job—though I'm sure they already know that.

What motivates and inspires you in your daily work as a managing director?

The list is long, but to keep it short: the exceptionally dedicated team and the interactions with project partners and stakeholders are a constant source of motivation. It's inspiring to know that I can contribute to improving the quality of drinking water and urban life. Every day brings new knowledge, and seeing the positive impact our work has on the city fills me with pride! ●

Docking

After swimming out, we return to land. In the following pages, you'll gain insight into our event series "*W*asser*W*erkstatt." If you missed the housewarming party for our new office, you can relive the highlights here. You'll also find an overview of our team, current projects, and publications.



WasserWerkstatt

Since November 2023, the popular event series "WasserWerkstatt" is back! For years, we have been bringing together key players from the water sector to foster the exchange of ideas. We are once again hosting regular talks, discussions, and networking opportunities on topics related to the water industry. Fortunately, we have access to the Audimax at the Technologiestiftung Berlin, which can accommodate up to 100 participants. Over the past 12 months, attendees of four events have gained valuable insights into topics such as Berlin's small water bodies, water reuse, PFAS, and Water 4.0.

The “WasserWerkstatt” event series is now part of the "Water Innovation Challenge Berlin," organised by the Berlin School of Economics and Law, the Startup Incubator Berlin, the Berlin Chamber of Commerce and Industry, the university network "Zukunft findet Stadt," and Berlin Partner for Business and Technology.


PFAS


erkstatt
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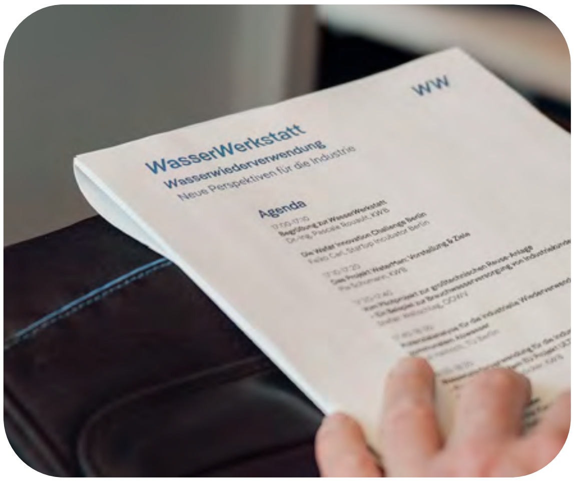
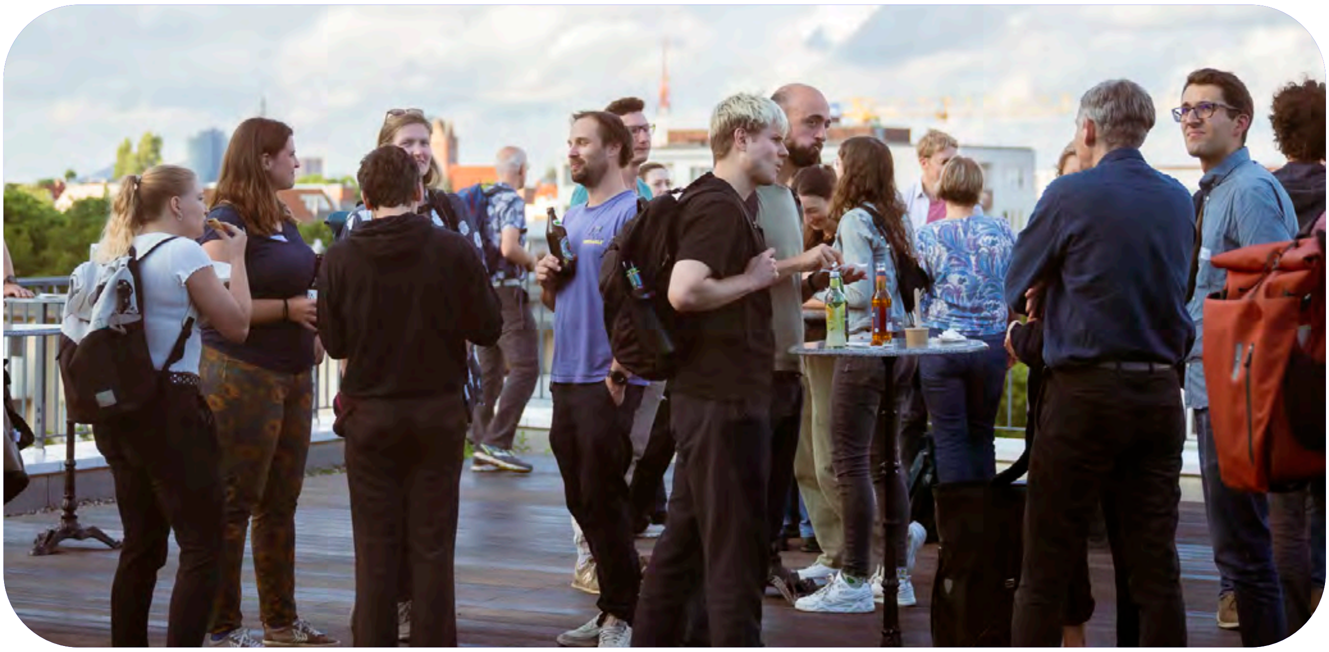
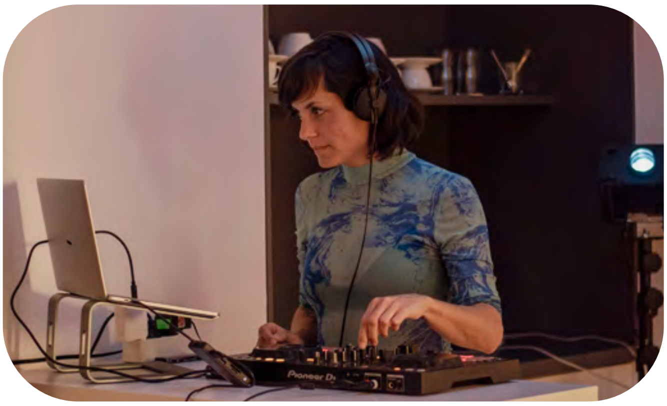

WasserWerkstatt
Wasserwiederverwendung
Neue Perspektiven für die Industrie
Agenda



Housewarming party

After more than 20 years, we moved from our old location on Cicerostraße and, in February 2024, relocated to Grunewaldstraße in Berlin-Schöneberg, right beneath our shareholder, Technologiestiftung Berlin. Our new office space, which we designed ourselves, is not only visually appealing but also energy-efficient and sustainable. It features flexible workstations and fosters an excellent working atmosphere. Naturally, we celebrated this milestone in style in May 2024. Here are a few highlights from our housewarming party!




KWB

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Antoine Daurat
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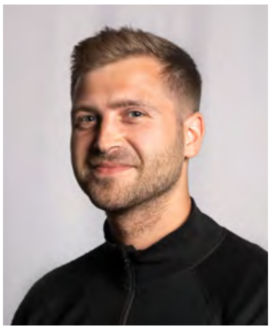
Procuration, Commercial
Manager, Group Leader
Administration



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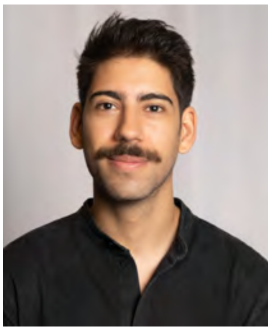

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Trainees

KWB is supported by a wealth of up-and-coming talent from a wide range of specialisations. Not only are we proud of being able to provide them with support (such as by assisting them with their numerous final projects), we're also benefiting from their future-oriented ideas.

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Project overview 2024

Title	Subject	Funding sources	Duration	Project management	Department
ABLUFT 3	Evaluation and transfer of the co-treatment of exhaust air in the aeration system	BWB	Dec. 23 - Nov. 25	Ulf Miehe	Process Innovation
AD4GD	An Integrated, FAIR Approach for the Common European Data Space	EU Horizon Europe	Sep. 22 - Aug. 25	Malte Zamzow	Urban Systems
AMAREX	Adaptation of stormwater management to extreme events	BMBF	Feb. 22 - Jan. 25	Andreas Matzinger	Urban Systems
BOOST-IN	Boosting the uptake of innovative Solutions in the context of Water and Circular Economy	EU Horizon Europe	Jan. 24 - Dec. 26	Anne Kleyböcker	Process Innovation
City Blues	Bluegreen nature-based solutions for climate change adaptation and citizen well-being	EU INTERREG	Nov. 23 - Oct. 26	Paul Schütz	Urban Systems
DASAM	Data-driven sewer asset management in Germany and Israel	BMBF	Oct. 23 - Sep. 26	Nicolas Caradot	Urbans Systems
Data Governance	Data & Smart City governance using the example of air quality management	City of Berlin	Nov. 22 - Mar. 25	Nicolas Caradot	Urban Systems
DeWaResT	Decentralized wastewater treatment and water reuse for regions with seasonal drought stress	BMBF	Aug. 21 - Jan. 24	Jeannette Jährig	Process Innovation
DigiWaVe	Digital solutions for resource-efficient and safe water reuse in urban areas	BMBF	Sep. 23 - Aug. 25	Jonas Hunsicker	Process Innovation
FlexTreat	Flexible and reliable concepts for sustainable water reuse in agriculture	BMBF	Feb. 21 - Oct. 24	Michael Stapf	Process Innovation
GeoSalz	Dynamics of saline intrusion for early identification of endangered drinking water wells and quantification of the hydraulic potential	BWB	Aug. 21 - Jul. 24	Christoph Sprenger	Groundwater
IMPETUS	Dynamic information management approach for the implementation of climate resilient adaptation packages in European regions	EU H2020	Sep. 21 - Sep. 25	Nasrin Haacke	Groundwater, Process Innovation
iOLE	Intelligent online leakage detection	BMBF	Sep. 23 - Aug. 25	David Steffelbauer	Urban Systems, Hydroinformatics
IWIQ	Concept phase real laboratory: Integrated water and heat recovery in the neighborhood	City of Berlin/BWB	May 24 - Oct. 24	Ulf Miehe	Process Innovation
LASSO 2	Further investigation of nitrous oxide emissions from biological wastewater treatment	BWB	Oct. 23 - Sep. 25	Christian Remy	Process Innovation
LIWE	Large-scale implementation of tertiary treatment and phosphate recovery in Lidköping, Sweden	EU LIFE	Jul. 18 - Jun. 27	Fabian Kraus	Process Innovation

Title	Subject	Funding sources	Duration	Project management	Department
MaWaSta	Feasibility study on water reuse in Stahns-dorf	BWB	Aug. 24 - Apr. 25	Jan Schütz	Process Innovation
ProClean-Lakes	Integrated emerging approaches for joint protection and restoration of natural lakes in the spirit of European life heritage support	EU Horizon Europe	Jun. 24 - May 28	Malte Zamzow	Urban Systems
PROMISCES	Prevention Recalcitrant Organic Mobile Industrial chemicalS for Circular Economy in the Soil-sediment-water systems	EU H2020	Oct. 21 - Mar. 25	Veronika Zhiteneva	Process Innovation
Raindrop	Optimization of rainwater drainage	BML Öster-reich; Länder Steiermark, Salzburg, Kärnten, Nieder-österreich, Stadt Villach, Linz Service GmbH	Mar. 24 - Feb. 26	David Steffelbauer	Urban Systems/ Hydroinfor-matics
ReCreate	Reliability and effectiveness of integrated alternative water resources management for regional climate change adaption	EU Horizon Europe	Jan. 24 - Dec. 27	Anne Kleyböcker	Process Innovation
R-Rhenania	Production of modified phosphate from sewage sludge ash for Bavaria	BMBF	Jul. 20 - Jun. 26	Fabian Kraus	Process Innovation
SafeCREW	Climate-resilient management for safe disinfected and non-disinfected water supply systems	EU Horizon Europe	Nov. 22 - Apr. 26	Christoph Sprenger	Process Innovation
SEMA Berlin 3	Investigation of the extension of the technical service life of pipe liners and further development of the SEMAplus posture simulator for the risk of posture damage by the extent of damage	BWB	Dec. 22 - Nov. 24	David Steffelbauer	Urban Systems
Smart Water	Agile planning of stormwater management with a focus on urban green and blue	City of Berlin	Nov. 22 - Sep. 26	Andreas Matzinger	Urban Systems
ULTIMATE	Industry Water-Utility Symbiosis for a Smar-ter Water Society	EU H2020	Jun. 20 - May 24	Anne Kleyböcker	Process Innovation
WaterMan	Promoting water reuse in the Baltic Sea Region through capacity building at local level	EU INTERREG	Jan. 23 - Dec. 25	Elisa Rose, Pia Schumann	Process Innovation
Zukunft	The future of water in Berlin-Brandenburg	BWB	Apr. 24 - Dec. 24	Ulf Miehe	Process Innovation

Abbrevations of funding sources:

BMBF	The Federal Ministry of Education and Research
BWB	Sponsoring Berliner Wasserbetriebe
BML Österreich	The Federal Ministry Republic of Austria Agriculture, Forestry, Regions and Water Management
EU H2020	EU Horizon 2020

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Imprint

Publisher
Kompetenzzentrum Wasser
Berlin gGmbH
Grunewaldstraße 61-62
10825 Berlin

Managing Director
Dr.-Ing. Pascale Rouault

Editors
Moritz Lembke-Özer
(Chief editor)
Dr. Veronika Zhiteneva
Ulrich Banse

Editorial deadline
01.11.2024

Translation
Moritz Lembke-Özer
Dr. Veronika Zhiteneva

Realisation & Design
Sonja Sterling (Lead)
Gergana Georgieva

Print
Burger Druck GmbH

Jasper AI and DeepL
were used for editing
and translating.

www.kompetenz-wasser.de/en

Kompetenzzentrum Wasser Berlin

KWB