

POLICY BRIEF



Digital tools for better Water Framework Directive
implementation: How the EU Digital Water Action Plan can
strengthen implementation of the WFD



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Introduction

URBAN M₂O is developing digital solutions to improve urban water quality management and support evidence-based implementation of EU water legislation. The project combines AI-enhanced virtual sensors, which estimate water-quality parameters from available monitoring data and models, interoperable data management and DUWT to detect pollution, integrate data across the urban water cycle and support better operational and strategic decisions. By translating monitoring data into valuable information for authorities, URBAN M₂O demonstrates how digital technologies can help identify pollution hotspots, assess risks and target measures more effectively across three case studies in Denmark, Switzerland and Spain.

Urban M₂O has reviewed¹ the EU legislation governing water monitoring and identified a recurring problem: monitoring obligations and practices are organised by water type and jurisdiction, with different parameters, thresholds, methods, identifiers and data systems. The same urban water cycle is therefore represented through datasets that are difficult to find, combine and reuse. This delays analysis, increases costs and weakens modelling:

- Across domains, parameter coverage is uneven: some interfaces have few shared parameters, while national requirements may match, set lower limits, or add additional indicators to EU requirements.

- Technical limits (trace detection and slow microbiological analysis), variability, non-harmonised methods, high costs, calibration needs and heavy data workloads restrict current monitoring.

With the deployment of digital tools, there is new opportunities raising:

- Monitoring is expected to retain core parameters while expanding towards system function, reuse, ecological health, resilience, public-health risks and integrated risk-based approaches.
- Promising pathways include multi-analyte and lower-cost sensors, real-time pathogen and antimicrobial resistance detection, IoT-enabled adaptive sampling, standardised protocols, automation and digitalisation.

The Water Framework Directive (WFD) is the cornerstone of EU water policy, yet its implementation remains fragmented as relying on multiple legislative frameworks each with its own monitoring requirements, parameters, reporting systems and governance

arrangements². This fragmentation limits data interoperability, increases administrative burden and prevents authorities from exploiting the full value of the information already being

The Digital Water Action Plan should transform fragmented monitoring obligations into an integrated digital implementation framework for the EU water acquis.

¹ URBAN M₂O, Deliverable 1.1 – User Stories, 2026
<https://doi.org/10.11583/DTU.32144794>

² UrbanM₂O works on 7 water matrices and multiple EU directives, highlighting the complexity of the current monitoring landscape.

collected across the urban water cycle³. The revision of the EQSD further reinforces this challenge by expanding monitoring obligations for substances such as PFAS, pharmaceuticals, pesticides, microplastics and antimicrobial resistance, increasing both the volume and complexity of environmental data that must be managed.

The Digital Water Action Plan (DAP), announced under the European Water Resilience Strategy⁴, provides an opportunity to address this

URBAN M₂O has co-developed 18 User Stories (concise descriptions of practical needs and intended uses of water quality data and digital tools by specific user categories) together with more than 110 stakeholders from 12 countries. They demonstrate that the technologies required to support the DAP already exist and shall respond to users' operational needs and different levels of digital maturity. The

challenge. Rather than creating additional reporting obligations, it should simplify the implementation of EU water legislation by enabling interoperable data systems, trusted digital monitoring and decision-support tools⁵. Combined with the upcoming review of the WFD, it offers the opportunity to embed digital technologies into the Directive's implementation framework, making monitoring more efficient, improving the design of Programmes of Measures and strengthening River Basin Management Plans.

remaining challenge is to set the policy and regulatory framework that enables their widespread deployment in support of the WFD and the wider EU water acquis. Based on the project's experience, this policy brief recommends how the DAP can accelerate the deployment of interoperable digital tools across Europe and how the WFD - if revised - should recognise digital technologies as enablers of more effective implementation.

³ EUR-Lex, [7th Implementation Report \(2024\), COM/2025/2 final](#), February 2025

⁴ European Commission, [European Water Resilience Strategy](#), COM(2025) 280 final, 4 June 2025.

⁵ European Commission, [Call for evidence, Water sector – accelerating digitalisation for better management and sustainability](#), 2026.

Recommendation	Priority action for the Digital Water Action Plan	Contribution to WFD implementation
1. Make WFD implementation a flagship use case for the Digital Water Action Plan	Focus digitalisation on regulatory and environmental decisions, not only operational efficiency	Supports Articles 5 (pressures), 8 (monitoring), 11 (Programmes of Measures) and 13 (RBMPs).
2. Establish an interoperable European water-data framework	Harmonise identifiers, vocabularies, metadata and exchange formats across water matrices	Improves pressure analysis, status assessment and River Basin Management Plans in line with all the EU Water acquis monitoring requirement
3. Create a trusted framework for digital monitoring and AI-generated evidence	Define validation, uncertainty, documentation and oversight requirements	Allows digital tools to complement regulatory monitoring
4. Connect digital twins and urban data to river-basin planning	Link city- and utility-level modelling with basin-authority systems	Better source identification and design of measures
5. Support user-centred and modular digitalisation	Provide pathways for authorities and utilities at different levels of digital maturity	Easier uptake by authorities and utilities
6. Introduce a digital implementation provision in the WFD	Explicitly recognise digital tools and interoperable data in the Directive	Long-term implementation beyond projects

Table 1: Summary of recommendations and their benefits

Recommendations

URBAN M₂O can help operationalise digitalisation and the DAP, to support the achievement of the WFD objectives.

1. Make WFD implementation a flagship use case for the Digital Water Action Plan

The DAP should explicitly position the digital implementation of the EU water acquis (with the Water Framework Directive as its central reference framework) as one of its primary objectives. Digitalisation should not focus solely on operational efficiency but also on strengthening environmental decision-making. Particularly, integrated monitoring, interoperable data and digital decision-support

tools should facilitate the implementation of Articles 5, 8, 11 and 13 of the WFD by improving pressure assessments, monitoring programmes, Programmes of Measures and River Basin Management Plans. The DAP should promote digital solutions that connect operational and environmental data across the urban water cycle, enabling more coordinated implementation of the EU water acquis.

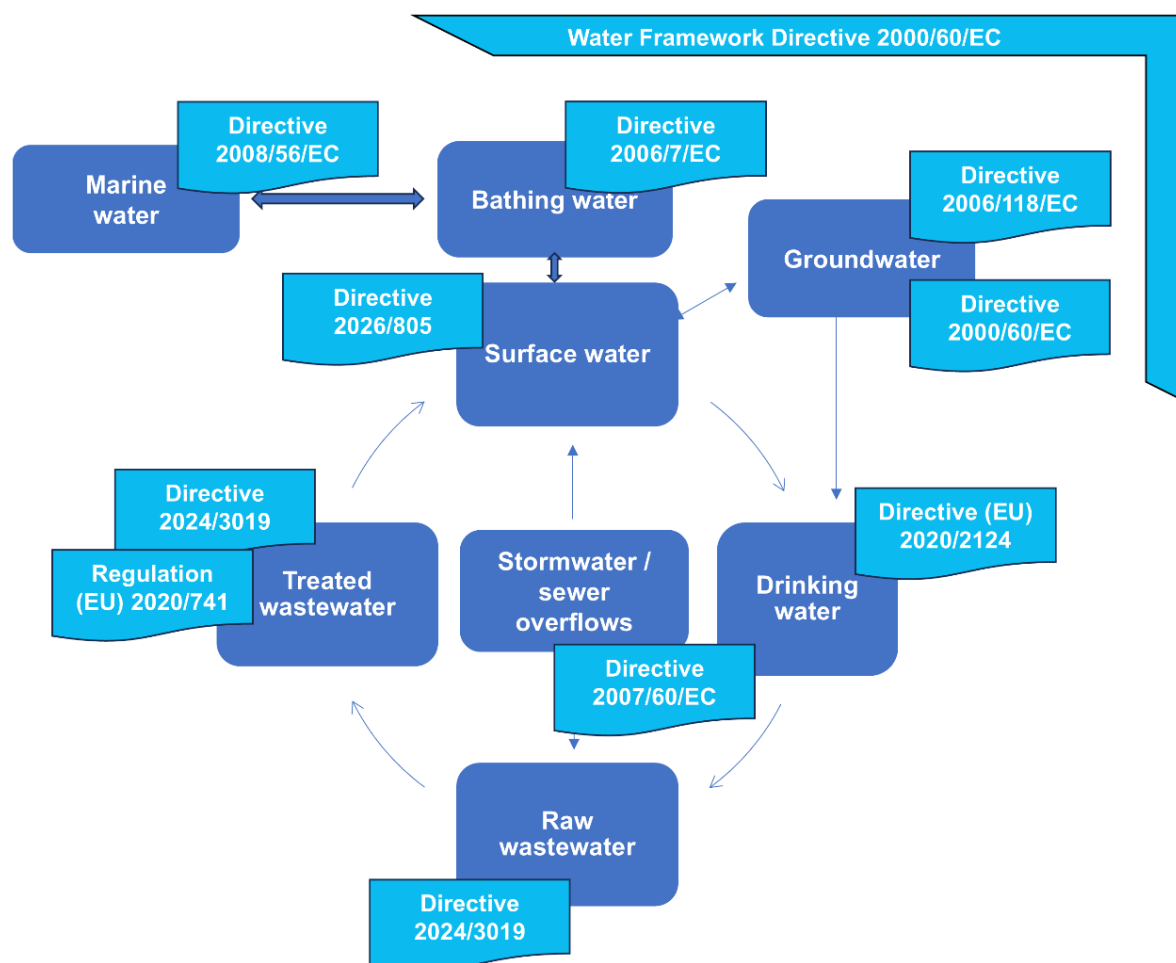


Figure 1: Overview of European legislation governing the different water matrices within the urban water cycle.

2. Establish an interoperable European water-data framework

The DAP should promote integrated monitoring across the EU water acquis, enabling data collected under different legislative frameworks to serve multiple regulatory purposes. Today, monitoring requirements remain organised by water matrix and individual directives, resulting in duplicated monitoring efforts, fragmented datasets and limited interoperability between authorities. As monitoring obligations expand under the revised EQSD, this fragmented approach will become increasingly costly and inefficient.

The DAP should promote harmonised monitoring parameters, interoperable data standards and FAIR data management so that multi-purpose sensors and shared data

infrastructures can support compliance with multiple pieces of EU water legislation, including the WFD, the Urban Wastewater Treatment Directive, the Drinking Water Directive, the Bathing Water Directive and the Water Reuse Regulation. Rather than monitoring separately for each directive, digital solutions should enable “monitor once, use many times”, strengthening implementation of the WFD while supporting the broader EU water acquis. By enabling monitoring data to be reused across regulatory and operational decisions, this approach can also support more circular urban water management, including water efficiency, reuse, pollution prevention and resource recovery.

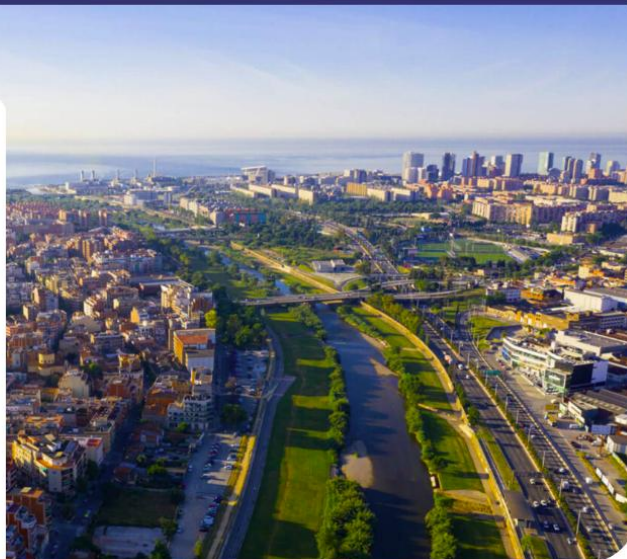
CASE STUDY

Sant Adrià de Besós, Spain The Water-Scarce City



📍 **Location:** Sant Adrià de Besós, Spain

✓ **Challenge Addressed:** Facing critical water scarcity due to climate change, the city must rely on alternative water sources (like groundwater and urban runoff). However, these sources are themselves threatened by pollution from the Besòs River, ageing sewer networks, and industrial discharge.



3. Create a trusted framework for digital monitoring and AI-generated evidence

The DAP should establish a European framework for the validation and use of digital monitoring technologies, including AI-enhanced virtual sensors, predictive models and DUWT. While these technologies can significantly improve the temporal and spatial coverage of monitoring, their uptake remains limited by the absence of common criteria for validation, uncertainty assessment and regulatory acceptance. Most of the stakeholders are still relying on traditional and resource intensive approaches, like grab samples transported and analysed in a laboratory.

The DAP should define common principles to ensure that digital tools are fit for purpose, transparent and scientifically robust, allowing them to complement conventional monitoring without replacing established regulatory methods. A harmonised framework would strengthen confidence among competent authorities, accelerate the deployment of innovative monitoring solutions and enable digital evidence to support the implementation of the WFD and the wider EU water acquis.

CASE STUDY

Copenhagen, Denmark The Blue–Green Climate City



Location: Copenhagen, Denmark

✓ **Challenge Addressed:** Managing the impacts of intense rainfall, which threatens the water quality of the city's harbour and lakes due to Combined Sewer Overflows (CSOs). At the same time, the city's extensive network of Nature-Based Solutions (NBS) for flood control creates potential new pollution pathways to groundwater.



4. Connect digital twins and urban data to river basin planning

The DAP should recognise DUWT as implementation tools for the WFD. By combining real-time monitoring, predictive modelling and scenario analysis, Digital Twins enable authorities to identify pollution hotspots, test the environmental impact of alternative measures and optimise monitoring strategies before investments are made.

To unlock this potential, the DAP should ensure interoperability between city, utility and river basin information systems so that local digital evidence can support River Basin Management Plans and Programmes of Measures. Connecting urban data with basin-scale planning would improve coordination across governance levels and enable more targeted, cost-effective implementation of the WFD.

5. Support user-centred and modular digitalisation

The DAP should promote user-centred digitalisation, recognising that water authorities, utilities and river basin managers have different operational responsibilities, digital capabilities and information needs. URBAN M₂O's process demonstrates that there is no one-size-fits-all digital solution for the water sector. Instead, the DAP should support modular and interoperable digital tools that can be progressively deployed

according to local priorities and levels of digital maturity.

By combining technology deployment with capacity building, sound data governance and long-term operational support, the DAP can accelerate the uptake of digital solutions across Europe while reducing implementation gaps between Member States and ensuring that no authority is left behind.

6. Embed digital implementation in the future Water Framework Directive



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The forthcoming revision of the WFD provides an opportunity to mainstream digital implementation across the Directive. Without modifying its environmental objectives, the revised framework should explicitly recognise interoperable digital tools, harmonised data systems and AI-supported decision-support technologies as means to improve monitoring, reporting and River Basin Management Plans. Introducing common principles for digital interoperability, data governance and the use of digital evidence would strengthen the

consistency and efficiency of WFD implementation, provide a long-term legal foundation for the DAP and support a more coordinated and effective application of the wider EU water acquis. The revised Directive should therefore include explicit provisions encouraging the use of interoperable digital tools and digital decision-support systems to support monitoring, reporting and river basin planning across the Union.

CASE STUDY

Zürich, Switzerland The Urban Water Test Lab



 **Location:** Zürich, Switzerland

 **Challenge Addressed:** Leveraging its status as a data-rich "urban observatory" to tackle complex pollution from emerging contaminants. The city must manage increased CSO discharges due to urban growth and climate change while also assessing the risks that new Nature-Based Solutions pose to groundwater, Switzerland's primary drinking water source.

