



## First policy brief about Drinking Water and the Zero Pollution Action Plan

Deliverable 8.4

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<b>ABSTRACT</b>	This report will present the project activities and expected outcomes to relevant policymakers and will build the first linkages to the Drinking Water Directive and the Zero Pollution Action Plan.		

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## Abbreviations

APE	Aqua Public Europa
ARGs	Antibiotic Resistant Genes
ARLEM	Euro-Mediterranean Regional and Local Assembly
BAT	Best Available Technology
CECs	Contaminants of Emerging Concern
DBP	Disinfection Byproducts
DG	Directorate-General
DSS	Decision Support System
DWD	Drinking Water Directive
EQSD	Environmental Quality Standards Directive
EU	European Union
EWA	European Water Association
GW	Groundwater
GWD	Groundwater Directive
ICT4water	ICT for Water cluster
M2P	MAR2Protect
MAR	Managed Aquifer Recharge
MPPs	Microplastic Particles
NOM	Natural Organic Matter
Q	Quarter
R&I	Research and Innovation
THM	Trihalomethanes
UNWWQA	United Nations World Water Quality Alliance
US-EPA	United States Environmental Protection Agency
UWWTD	Urban Wastewater Treatment Directive
WDN	Water Delivery Network
WFD	Water Framework Directive
WHO	World Health Organization
ZPAP	Zero Pollution Action Plan

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## Executive summary

This report summarizes the outreach communication of the first over the three policy briefs of Toolkit for Adaptable, Resilient Installations Securing High Quality Drinking Water (ToDrinQ) Project, developed within the context of the ZeroPollution4water cluster, and the policy brief itself. The cluster's objective is to address groundwater contamination and ensure safe drinking water by leveraging advanced monitoring, treatment, and policy alignment strategies. The cluster comprises seven EU-funded projects—NINFA, SafeCrew, Mar2Protect, H2OforAll, ToDrinQ, UPwater, and intoDBP and this joint policy brief aims to leverage the importance of the recommendation. The first policy brief aimed to spotlight the seven projects that just started and their potential. This joint policy brief was supported by an outreach campaign mobilizing the cluster and its partners to reach diverse stakeholders through general channels and more targeted dissemination efforts, such as ARLEM Meeting and Green Week Event. Further dissemination and future updates of this policy brief are planned to integrate ongoing project outcomes.

## Introduction

This report results from Task 8.3 Dissemination and EU policy recommendations, aiming at transferring the knowledge generated to targeted stakeholder audiences to maximise the impact of the project. This report looks at the first policy briefs of ToDrinQ project developed in cooperation with the ZeroPollution4water Cluster. It is structured in three parts: the first part focuses on the contribution of ToDrinQ, the second one is the policy brief and its specific annex, focusing on the IntoDBP and H2OforAll projects. The third part summarises the dissemination and communication of the policy brief.

This policy brief represents a collaborative effort conducted within the ZeroPollution4Water cluster's policy working group. Its purpose is to showcase and solicit feedback on the various initiatives under seven EU-sponsored projects aimed at safeguarding surface and groundwater resources, ensuring the safety of drinking water, and supporting other applications. The projects in focus are NINFA, SafeCrew, Mar2Protect, H2OforAll, ToDrinQ, UPwater, and intoDBP, all of which are in progress. Because most of the projects were at their first steps, the policy brief is more descriptive. In the case of ToDrinQ, the available deliverables during the writing stage did not provide sufficient material to produce a specific section on similarly to H2oForAll and intoDBP. These two projects - H2oForAll and intoDBP - have already started cross-activities like workshops (e.g. Water Knowledge Europe in October 2023, Technical workshop on legislative aspect and prevention measures in March 2024) to discuss legislative and technical aspects. Consequently, the next policy briefs will be sharper in terms of regulatory and implementation recommendations.

The dissemination of the ZeroPollution4Water Cluster's policy brief was supported by a comprehensive campaign, coordinated with the Cluster's Working Group Communication. General outreach included Water Europe's communication channels, which featured the brief in its external newsletter and mobilized partners from EU-funded projects to amplify its reach. A dedicated session at Water Innovation Europe 2024 attracted over 116 participants, including DG Research and Innovation officers, and was followed by additional outreach through a post-event newsletter. Targeted dissemination included presentations to Water Europe's Policy Advisory Committee, events with local and regional authorities, engagements with MEPs, and communication with the EU Commission and its expert groups. This approach ensured that the policy brief reached a diverse audience, supporting Europe's zero-pollution water quality objectives. Further communication is expected in the coming months.

Finally, this policy brief is designed as a dynamic document, intended to be updated regularly to reflect new results and recommendations from the various projects. The next update is planned between Q4 2024 and Q1 2025.

## 1. ToDrinQ contribution

The joint policy brief, developed by the seven projects, was initiated in Q4 2023 and completed in Q1 2024. At that time, the ToDrinQ project was still in the early stages of its research, as most of the project involved. As a result, it was decided to create a joint policy brief highlighting the potential impacts of all seven projects, with a detailed annex dedicated to the two most advanced projects, intoDBP and H2OforAll.

The cluster's policy working group agreed to develop a new policy brief annually to incorporate new findings from the projects and enhance dissemination and outreach efforts. The next update cycle will begin in December 2024 and aim to be completed by the end of Q1 2025.

A key goal for the upcoming update is to integrate more detailed findings from ToDrinQ, especially following the review period covering 01-12-2022 to 31-05-2024. The main targeted document will be the Water Resilience Strategy. This document should also include a section on the implementation of the water acquis, including the new Drinking Water Directive, and the Environment Quality Standards Directive.

As mentioned in the reporting document, it is too early to develop recommendation on preventive and mitigating strategies and measures and effective risk assessment and risk management strategies. The recommendations will mainly focus on encouraging digital tools in water quality management and the development of support. The anticipated recommendations will focus on the following areas:

Enhance Water Quality Monitoring:

- Promote the integration of real-time monitoring technologies (hard and soft sensors such as BactoSense) to enable faster detection of contaminants and optimize treatment processes.
- Support funding and incentives for the deployment of portable sensors in water utilities to improve responsiveness to water quality issues.

Support the Adoption of Advanced Treatment Technologies:

- Encourage the use of innovative treatment processes, such as MABR and novel adsorbents, to reduce reliance on traditional, more resource-intensive methods.
- Establish guidelines for PFAS removal using emerging adsorbent technologies to align with the tightening of EU standards on water quality (first outcomes on adsorbents identification)

Promote Decision Support Systems:

- Advocate for the use of decision support tools (DST) to optimize the design and operation of drinking water treatment plants, especially in regions with fluctuating water quality.
- Encourage Member States to adopt risk-based management platforms that leverage open-source solutions like FIWARE for better integration and interoperability.

Support holistic approach:

- Encourage the adoption of standardized data models and platforms to facilitate the sharing of best practices and data among EU Member States.
- Encourage better synergies between the implementation of the Drinking Water Directive and the EU Water reuse regulation.
- Support research and innovation in technologies that can mitigate the effects of climate change on water sources, focusing on reducing micro-pollutants and disinfection by-products (DBPs).

Lastly, the next policy brief should also build upon the two scientific articles related to ToDrinQ on [Designing an adsorption stage for PFAS removal in drinking water production using innovative adsorbent\(s\)](#) and [Early Warning System for nutrient run-off in inland water bodies: A methodological framework utilizing earth observation Data](#).

The anticipated timelines are outlined as follows:

- Q1 2025: The Cluster Policy Brief will incorporate the outlined recommendations, aiming to address the Water Resilience Strategy.
- Q1 2026: A new policy brief will be developed in collaboration with the cluster and expanded with insights from new projects. Its purpose will be to provide further information on the implementation of EU legislation. From ToDrinQ, the aforementioned recommendations will be considered in the development of this collective policy brief.
- End of the Project: A dedicated policy brief will be published to present the project's outcomes to policymakers. This document will specifically focus on the implementation of the Drinking Water Directive and advancements in digital water.

## 2. Policy brief: Preventing groundwater contamination and securing drinking water quality

The text below has been disseminated as a policy brief by the cluster across 2024. The policy brief is composed of the policy brief is composed of:

- A presentation of the cluster
- A presentation of the challenges that it aims to deal with
- A section spotlighting the legislation that could benefit from the cluster activities.
- A presentation of the project involved
- A specific section dedicated to the first outcomes of intoDBP and H2OforAll

### 2.1 *The Policy brief of the Cluster*

This policy brief aims to present and gather inputs from the different activities of the seven EU-funded projects related to the protection of surface and groundwater, to safe drinking water provisions and other uses. The projects are: [NINFA](#), [SafeCrew](#), [Mar2Protect](#), [H2OforALL](#), [ToDriNQ](#), [UPwater](#), [intoDBP](#). It is built upon the first cluster meeting organised in October 2023 in Brussels<sup>1</sup>.

The policy brief is composed of two parts: the first one lists the benefits of each project for the Zero-Pollution Strategy, and the second one compiles the first insights from the IntoDBP and H2OforAll projects.

### 2.2 *The Cluster*

The [ZeroPollution4Water](#) cluster is an initiative originating from the coalition of seven different projects (see Section 4) funded from two Horizon Europe 2022 calls which aim to:

Prevent groundwater contamination and protect its quality against harmful impacts of global and climate change.

Secure drinking water quality by protecting water sources against pollution, providing innovative monitoring and treatment solutions, and ensuring safe drinking water distribution.

Focusing on the European Union's zero-pollution ambition and the European Green Deal, the cluster aims to leverage the cooperation and synergies among these seven projects to develop advanced prevention and mitigation strategies, effective risk assessment and management systems, and innovative monitoring and treatment solutions for drinking water and groundwater management. It also aims to develop new technologies ready for the market to prevent or tackle water pollution.

#### 2.2.1 *Responding to the challenges of diffuse pollution of surface and groundwater*

**This cluster aims to unite efforts towards enhancing the prevention of surface and groundwater pollution, ultimately contributing to the development of Water-Smart Societies.** Diffuse pollution remains a significant pressure, affecting 35% of the EU's groundwater bodies, while quality standards for substances like pesticides and herbicides are exceeded in 15% of the studied groundwater bodies<sup>2</sup>.

<sup>1</sup> Water Project Europe 2023, ZeroPollution4Water Cluster, 19 October 2023, Brussels.

<sup>2</sup> [https://cordis.europa.eu/programme/id/HORIZON\\_HORIZON-CL6-2022-ZEROPOLLUTION-01-01](https://cordis.europa.eu/programme/id/HORIZON_HORIZON-CL6-2022-ZEROPOLLUTION-01-01)

Moreover, climate change exacerbates pressure on groundwater quality, by reducing aquifer recharge and related resources, as well as by triggering additional withdrawals.

In its outlook on drought policies, the EU Commission stresses the increasing challenge of water scarcity in Europe and the need to improve drought management, including the protection of drinking water sources<sup>3</sup>. As 65% of drinking water in Europe is supplied by groundwater bodies<sup>4</sup>, it is paramount to protect these sources against pollution and pressures.

In May 2021, the EU Commission adopted the [Zero Pollution Action plan \(ZPAP\)](#), a key milestone of the European Green Deal. This plan addresses air, water, and soil pollution, aiming to reduce them to levels no longer considered harmful to health and natural ecosystems, while also respecting the planet's boundaries. The goal is to create a toxic-free environment by 2050. To accelerate pollution reduction, the plan includes binding intermediate targets to achieve substantial reduction in pollution at the source by 2030.

Additionally, the behaviour of microplastic particles (MPPs) and their presence in [drinking water](#) is of major importance due to their universal and daily consumption. As part of the effort to enhance water quality, the Plan's targets also include reducing plastic litter at sea by 50%, as well as reducing microplastics released into the environment by 30%. This is particularly relevant in countries where desalination plants are on the rise.

The main question is: *How can the water sector and water-related activities adopt and implement the Zero-Pollution Strategy?*

### 2.2.2 Contributing to the Zero Pollution Strategy and the implementation of the water-related legislation

**This Cluster supports the implementation of the updated Water Acquis and other EU water-related directives.** The EU Commission has developed diverse policies such as the ZPAP under the [Green Deal](#). Rather than introducing new requirements that involve developing new standards and actions, the EU Commission views the ZPAP as a 'unifying call to action' for practitioners, especially policy makers to synergize the revision of related legislation and its implementation. The ZPAP is a tool to align actions to develop and deliver an ambitious and yet practical agenda to reduce pollutant emissions into the environment. Existing EU legislations are key mechanisms for delivering the objectives of the ZPAP.

The European institutions have also launched a major revision of the water-related *Acquis Communautaire*:

- The [Water Framework Directive \(WFD\)](#) and [particularly the Environmental Quality Standards Directive EQSD](#) and [Groundwater Directive \(GWD\)](#)
- The [Drinking Water Directive \(DWD\)](#)
- The [Urban Wastewater Treatment Directive \(UWWTD\)](#)

Table 1 summarizes the main recommendations highlighted by the Water Europe Zero Pollution Working group white paper "Towards a Zero-Pollution strategy for contaminants of emerging concern in the urban water cycle".

In this context, the "zero" in ZPAP is political rather than science-driven, implying the need to continually strive to further reduce emissions. However, the need for zero pollution activities to consider

<sup>3</sup> European Commission. Directorate General for Environment., Stock-Taking Analysis and Outlook of Drought Policies, Planning and Management in EU Member States: Final Report. (LU: Publications Office, 2023), <https://data.europa.eu/doi/10.2779/21928>.

<sup>4</sup> European commission, *water, groundwater*, Brussels. [https://environment.ec.europa.eu/topics/water/groundwater\\_en](https://environment.ec.europa.eu/topics/water/groundwater_en)

feasibility/economics of potential measures is recognised in alignment with, for example, the use of Best Available Technology (BAT).

Table 1: Towards a zero-pollution strategy for contaminants of emerging concern in the urban water cycle

### Towards a zero-pollution strategy for contaminants of emerging concern in the urban water cycle

In 2022, the Zero Pollution Working group released a white paper *Towards a Zero-Pollution Strategy for Contaminants of Emerging Concern in the Urban Water Cycle*. The main recommendations are:

- Achieving the EU’s ambition of zero pollution requires the elaboration of policies that address the effects of pollution mixtures on public health and ecosystems. These policies should be built upon comprehensive data about exposure to pollutants, considering variations in time and place, and their effects on human and ecosystem health.
- Achieving a zero-pollution environment calls for a combination of ‘at-source’ measures and the removal of compounds during water and wastewater treatment. Lowering emission at-source can be achieved by reducing the production volume and use of harmful chemicals. This should be enabled by extending the registration of chemicals, including their production volumes.
- A broader classification into different groups of chemicals, based on their toxicity and use, is needed to support the development of regulations. Environmental quality standards are required for prioritised pollutants in water bodies. To enforce these standards, smart monitoring policies must be developed and implemented.
- Many urban discharges to receiving waters, including urban stormwater runoff, combined sewer overflows and unplanned discharges, remain unregulated. Incentives for tackling pollution from these unregulated flows are needed and can be created by including them in future regulations. Improving governance processes to support and optimise stakeholder activities is also needed to achieve a zero-pollution environment.
- Stimulating investments from public and private actors to restore the natural functions of groundwater, surface water, and marine and coastal waters in a systemic way.

**Moreover, the cluster will be keen to provide recommendations on Managed Aquifer Recharge (MAR).** Current legislation does not prevent the possibility of offering aquifers with reused water or water from rivers. Indeed, recharging aquifers is a necessary tool to combat hydric stress, and in certain cases where the watersheds bring pollutants, it can also be beneficial in reducing pollution concentration in aquifers.

**This cluster can also play an important role in the ongoing review of the Nitrates Directive, and Sewage Sludge Directive.** These directives aim to reduce nitrate pollution from agricultural activities. Nitrate pollution, particularly in groundwater, is far from being controlled and is also causing negative impacts on several water sources used for water supply.

**Lastly, the European Union is now working on the [Water Resilience Initiative](#).** This initiative aims to build a state-of-the-art framework for water management in Europe. Research and Innovation at various levels,

including technological and non-technological approaches (e.g. legislative, planning, governance, institutional, participatory approaches) are key to provide solutions and support several objectives of the European Union, including tackling pollution<sup>5</sup>. The cluster can therefore make a significant contribution to this initiative, particularly by enhancing the resilience of the water cycle and fostering related research and innovation activities (cf. Section 4).

**The source protection for drinking water supply is particularly relevant for several European expert groups** (e.g. Zero pollution stakeholder platform, EU drinking water, groundwater expert groups), other networks (e.g. Water Europe working group on zero-pollution, ICT4water cluster, Water4all, UNWWQA, Eureau, APE, EWA), as well as for local authorities and European policymakers.

**This policy brief is a living document that will be periodically revised to incorporate the new outcomes of the different projects and recommendations.**

Due to the confidentiality of some of the data, the projects might not disclose information that confirm or will confirm some recommendations. The projects can be contacted via [loic.charpentier@watereurope.eu](mailto:loic.charpentier@watereurope.eu) to obtain the relevant contact and information in the respect of this confidentiality framework.

Table 2 summarizes the main recommendations extracted from the first deliverables of intoDBP and H2OforAll projects.

*Table 2: Recommendations of the Cluster*

Recommendations
<ul style="list-style-type: none"> <li>• Adopt management strategies and tools (e.g. DSS), based on detailed knowledge of groundwater resources uses and renewal rate, to effectively mitigate the effects of climate change (with special focus on drought and extreme events)</li> </ul> <p><b>RECOMMENDATION EXTRACTED FROM THE FIRST DELIVERABLES OF INTODBP AND H2Oforall (C.F. SECTION 4):</b></p> <ul style="list-style-type: none"> <li>• Develop a flexible regulatory framework for DBPs including iodinated and nitrogen containing DBPs (I-DBPs and N-DBPs).</li> <li>• Safety Data Sheet – accessibility of information and better coverage.</li> <li>• Invest in R&amp;I projects to develop cost-effective technologies for real-time data acquisition and removal of micropollutants, pathogens and DBPs.</li> <li>• Gain better knowledge about the situation and impact of new Contaminants of Emerging Concern (CEC) (e.g. through mapping) in terms of social aspects and potential policy measures to take.</li> <li>• Incorporate in future R&amp;I calls: living labs, strong training and awareness-raising programmes for society and all stakeholders particularly focused on CECs.</li> <li>• Clarify and improve data requirements and management, particularly regarding the identification and monitoring of different antibiotic-resistant genes (ARG's) and their impact on health.</li> </ul>

<sup>5</sup> European Commission. Directorate General for Research and Innovation., Horizon Projects Supporting the Zero Pollution Action Plan. (LU: Publications Office, 2022), <https://data.europa.eu/doi/10.2777/87880>.

- Invest in drinking water infrastructures, their design and operation to improve the resilience of our system.
- Improve the planification of wastewater reuse at basin level, including with aquifer recharge.
- Support biobased and nature-based mitigation solutions with a risk assessment.

Minimise the pollution of micropollutants, including microplastics, pathogens and DBPs in the drinking water networks.

### *2.2.3 The EU projects involved in the ZeroPollution4Water Cluster*

List of projects that compose the cluster described below: [ToDrinQ](#), [NINFA](#), [SafeCREW](#), [Mar2Protect](#), [H2OforALL](#), [UPwater](#), [intoDBP](#).

## NINFA



### **Taking action to prevent and mitigate pollution of groundwater bodies)**

The NINFA project deals with groundwater (GW) management solutions in the context of global and climate change. Contaminants like pharmaceuticals (CEC), antibiotic resistance genes (ARG), hydrocarbons, heavy metals, and microplastics (MP) infiltrate GW from sources, such as wastewater treatment plants (WWTPs) and urban runoff during storms, are impacting interconnected water bodies like rivers, wetlands, and oceans. Although efforts exist to monitor and protect GW, gaps remain in understanding cumulative stressors and developing cost-effective monitoring and decision-making tools for sustainable governance and management. Addressing these challenges is crucial for safeguarding GW quality and resilience in the face of ongoing environmental changes. NINFA overall goals:

- Developing cost-effective groundwater modelling and monitoring strategies.
- Test cost-effective pollution prevention and abatement technologies.
- Create a holistic Decision Support System (DSS) with integrated early warning mechanisms.

*Table 3: Benefits of the Project NINFA*

Benefits of the project
<ul style="list-style-type: none"><li>• Development of cost-effective monitoring strategies and water treatment trains of technology</li><li>• Creation of a digital platform (NINFA Platform) with a Decision Support System (DSS) which contains all information related to modelling, risk assessment, monitoring, prevention, and management of GW.</li><li>• Development of integrated tools for water resource management optimization and climate change mitigation.</li></ul>

### **Contribution to the ZeroPollution4Water Cluster**

- Test different approaches from very different case studies (The Netherlands, Spain, France, Egypt, Mexico, and Colombia)
- Develop knowledge on a holistic GW platform that combines modelling, risk analysis, monitoring, mitigation technology and a user-oriented Decision Support System.

## SafeCREW



### Climate-resilient management for safe disinfected and non-disinfected water supply systems

The SafeCREW project deals with management solutions for water supply systems with and without disinfection in the context of climate change. This includes analytics (both regulated and novel disinfection by-products (DBPs), natural organic matter (NOM), toxicity, interaction with materials), water treatment (removal of DBPs and selectively NOM as DBP precursors), online monitoring (trihalomethanes (THMs), selective and rapid detection of microorganisms) and management strategies (risk management, modelling, guidelines). This project aims to guarantee safe drinking water despite climate change impact by:

- Full seasonal monitoring of microbial and chemical parameters, which will be performed in source waters from surface water and bank filtration sites to conduct reliable risk management and derive the minimum disinfection requirements.
- A combined risk management approach for microbial, chemical, and toxicological risks, which will be developed using novel tools (online THM sensor, novel DBP analysis, identification of DBP-NOM precursors) as well as virtual tools (soft sensors, modelling).

Table 4: Benefits of the Project SafeCREW

Benefits of the project
<ul style="list-style-type: none"> <li>• Generate advanced knowledge to provide input to the implementation and future revisions of the EU Drinking Water Directive (DWD) and its associated watch lists (e.g. emerging substances, consideration of relevant new DBPs).</li> <li>• Provide inputs for the certification of materials in contact with water as stressed for future progress regarding article 11 DWD.</li> <li>• Develop, apply and promote the use of integrated risk-based approaches for optimal drinking water supply systems (DWSS) management, in line with DWD articles 7-8.</li> <li>• Increase the preparedness of the EU drinking water sector towards water quality challenges by providing novel monitoring, modelling, and treatment approaches to minimise the exposure of DW consumers to DBPs.</li> </ul>

#### Contribution to the ZeroPollution4Water Cluster

- Test new analytical and treatment approaches at different case studies sites (Germany, Italy, Spain).
- Identify precursor NOM compounds for regulated and relevant non-regulated DBPs and develop passive sampling methods.
- Clarify polymer lining materials interaction in drinking water distribution with disinfectants and DBPs.
- Develop knowledge on occurrence, persistence, toxicity, and removal of regulated and currently non-regulated DBPs.

## MAR2PROTECT

**Preventing groundwater contamination related to global and climate change through a holistic approach on managed aquifer recharge.**



MAR2PROTECT (M2P) will provide a holistic approach to preventing groundwater contamination from the impacts of global change and climate change, based on a new-generation Managed Aquifer Recharge, tested in seven cases studies in Europe and Beyond. The core of this innovative Managed Aquifer Recharge is M-AI-R Decision Support System that will incorporate technological and societal engagement information using an Artificial Intelligence-based approach to improve groundwater quality and quantity. M2P project overall goals:

- Prevent Managed Aquifer Recharge-related groundwater contamination.
- Prevent groundwater diffuse pollution from agriculture.
- Develop and validate innovative real-time integrated sensing systems and innovative analytical methods for the monitoring of pollutants, generating a better understanding of pollution sources and pathways in groundwater.
- Predict the impacts of global and climate change on groundwater quality in a specific context.
- Develop groundwater management strategies through the development of a Decision Support System, based on Artificial Intelligence techniques.
- Increase the active role of societal actors in the prevention of water contamination and managing groundwater.
- Facilitate the use of the MAR2PROTECT results (solutions, scientific and policy insights) by scientists, authorities, technology developers and policymakers in the prevention of water contamination and in groundwater management.
- Promote the market uptake of technologies and societal engagement actions by end users.

Table 5: Benefits of the Project MAR2PROTECT

Benefits of the project
<ul style="list-style-type: none"> <li>• Provide tailored advice and recommendations to the project members at each demo site based on an analysis of the policy landscape and options that regulate and enable actions, at the local and national levels.</li> <li>• Provide recommendation on the implementation and revision of the groundwater directive and its list of contaminants.</li> <li>• Demonstrate both technical and non-technical solutions to provide best practices for the implementation of the aforementioned directives.</li> <li>• Develop an innovative Living Lab methodology and approach to encourage inclusive governance and enhance the proactive role of civil society in the prevention of water contamination and groundwater management.</li> </ul>

### Contribution to the Zero Pollution4Water Cluster

- Develop nine technologies for the removal and subsequent (bio)degradation of salinity and emerging micropollutants from wastewater and surface water before their use for Managed Aquifer Recharge. These technologies aim to achieve a >95% removal and >70 % (bio)degradation of pharmaceuticals, pesticides, perfluorinated alkyl substances, nutrients, and salinity.
- Co-develop policy recommendations within the cluster activities.

## H2OforAll

**Innovative Integrated Tools and Technologies to Protect and Treat Drinking Water from By-products (DBPs)**



**H2OforAll**

The H2OforAll project focuses on disinfection byproducts (DBPs) that result from the interaction of disinfectants like chlorine with natural organic materials in water. It aims to:

- Understand & monitor disinfection by-products (DBPs) and their spread through drinking water distribution systems.
- Develop breakthrough water treatments to remove DBPs or avoid their formation during water disinfection processes, paying attention to their life cycle analysis, costs, and risks.
- Establish preventive measures for water protection engaging public and stakeholders.

*Table 6: Benefits of the Project H2OforAll*

Benefits of the project
<ul style="list-style-type: none"> <li>• Foster protection of the EU drinking water supply chain quality for safe human use via a better understanding of DBPs toxicity and environmental impact.</li> <li>• Better prevention of DBPs formation via water treatments and digital monitoring tools.</li> </ul> <p>More information included in the Section 3.</p>

### **Contribution to the ZeroPollution4Water Cluster:**

- Sensors (combining spectroscopy with auxiliary sensors to monitor water quality)
- Sensing infrastructure with real time monitoring capabilities and intelligently placing in the water distribution network.
- Modelling considering the topology, topography, water consumptions, type of materials, age – case-study Águas de Coimbra.
- Better understanding and assessment of DBPs formation and evolution.
- DBPs toxicity and risk assessment using multi-criteria decision-making techniques.
- New technologies for source water treatment, disinfection and DBPs removal from drinking water.

## ToDrinQ

### **Toolkit for aDaptable, Resilient INstallations securing high Quality drinking water**



The ToDrinQ project addresses the impact of climate change and increased pollution on drinking water quality. The project will support evidence-based treatment plant design and enhance operational awareness and response in the overall water system. The overall objectives of ToDrinQ are:

- Support the implementation of the revised drinking water directive.
- Enhance scientific and technical knowledge on drinking water quality protection, monitoring, and treatment.
- Increase the resilience of drinking water systems in terms of both increased robustness and adaptability.
- Ensure high-quality drinking water, minimising the concentration of (in)organic micropollutants, pathogenic micro-organisms and disinfection by-products (DBPs).

*Table 7: Benefits of the Project ToDrinQ*

Benefits of the projects
<ul style="list-style-type: none"> <li>• Contribute to a better implementation of the new drinking water directive, especially related to risk-based management.</li> <li>• Develop real-time monitoring strategies for early warning on pollution and rapid interventions in drinking water supply.</li> <li>• Develop new treatment processes for removal of organic matter and organic micropollutants.</li> <li>• Develop decision support systems for better design and operation of drinking water supply.</li> <li>• Raise awareness and provide recommendation to the water utilities and the local and European policy makers to improve drinking water system.</li> <li>• Adopt solutions and technologies to enhance competitiveness of the EU water sector and increase the EU's position and role in the global water scene.</li> <li>• Contribute to the EU Green Deal and the UN Sustainable Development Goal 6.</li> </ul>

#### **Contribution to the ZeroPollution4Water Cluster**

- Provide new solutions and technologies to reach the objective set up by the call of proposals for these research projects.
- Provide new knowledge to minimize the formation of disinfection by-products (DBPs) in drinking water.
- Provide recommendations to EU and local policymakers to improve the implementation of the relevant European legislation.
- Raise awareness and provide information on advanced and cost-effective drinking water treatment, including disinfection processes and process operation.

## UPwater

### Understanding groundwater Pollution to protect and enhance WATER quality



The UPWATER project addresses the widespread issue of groundwater pollution by identifying effective regulatory and legislative preventive measures and developing cost-efficient methods to measure pollutants, identify their sources and to mitigate the pollution. UPWATER aims to:

- Validate these methods in three case studies in different EU climates.
- Develop hydrogeological models for decision-making scenarios, considering multiple stressors and climate change projections.
- Adopt preventive measures, scale-up bio-based solutions, and update chemical priority lists.
- Provide policy recommendations at EU and local/regional levels.

Table 8: Benefits of the Project UPwater

Benefits of the projects
Develop a framework for multi-criteria selection and prioritization of policy options, within a participatory framework, to prevent groundwater pollution, combining technological and non-technological measures.
Develop a software toolkit for the source apportionment method and release software toolkits for groundwater quality modelling.
Promote passive sampling methods as a mean to control.
Scale-up bio-based solutions to demonstration scale.

#### Contribution to the ZeroPollution4Water Cluster

- Recommendations at local level on policy options to improve water governance and prevent groundwater pollution processes that can be applicable to a wide number of sites.
- Recommendations at the EU level to improve the European policies dealing with groundwater, including proposals to update the list of pollutants subject to monitoring and control under the European regulations and directives (REACH, Groundwater Directive, Nitrate Directive, and others).

## intoDBP

### Innovative tools to control organic matter and disinfection by-products in drinking water



The IntoDBP project focuses on disinfection by-products (DBPs) formed during water disinfection. It develops innovative tools for water quality management, emphasizing cost-effective sensors and analytical methods. IntoDBP aims to:

- Develop a comprehensive approach from source to tap for an optimum drinking water (DW) surveillance strategy, based on state-of-the-art sensors combinations (UV-VIS, fluorescence, and toxicity) to measure and predict DBP formation and process anomalies in Drinking Water Treatment Plants (DWTPs).
- Foster Artificial Intelligence (AI) sensor deployment methodologies and algorithms in water delivery networks (WDN) to increase response reliability and forecast DBP transformations in urban networks.
- Develop a new transformative approach to simultaneously remove precursors and disinfect drinking water.
- Create a new open and ready-to-use workflow as a tool to enable forecasting the effects of climate extremes events on inputs of precursors of DBPs to drinking water sources.
- Increase the understanding of human exposure, taking into consideration gender dimension, to a wide range of DBPs in the EU population to generate and implement new models.
- Provide guidance to decision makers to formulate optimized and future-proofed climate change adaptation pathways.
- Compile and present new business opportunities.

Table 9: Benefits of the Project IntoDBP

Benefits of the project
<ul style="list-style-type: none"> <li>• Provide knowledge and recommendations for the implementation of digital tools to achieve the new objectives of the drinking water and urban wastewater treatment directive.</li> <li>• Stress new business model opportunities.</li> <li>• Support local policymakers for the assessment of risks and implementation of tools related to DBPs and drinking water, particularly in Spain, Cyprus, and Ireland.</li> </ul>

#### Contribution to the ZeroPollution4Water Cluster

- Development of new technologies, such as MITO3X® technology to minimize reagent doses and reduce the formation of DBPs during pre-oxidation and final disinfection with chloramines, or sensor combining UV-VIS, fluorescence, and toxicity.
- Creations of new models to predict long-term changes in DOM in CS sites and short-term water quality threats arising from high DOM levels in source water in CS sites.
- Policy recommendations for the implementation of new European legislation.
- Exchange on business opportunities.

## 2.3 First outcomes of the H2OforAll&IntoDBP Projects

H2OforAll and IntoDBP projects have already released some public deliverables including first research outcomes on control-at-source perspectives and digital water gap in research and innovation perspective. This Section compiles these first outcomes.

### 2.3.1 Control at source: measures, methods, and tools

H2OforAll project has run a study to focus its research activities on a selection of 28 DBPs based on the most studied and regulated, most quantitatively present in water, the most toxic and the one which is more representative of all the major families of DBPs<sup>6</sup>. The first activities of the project stressed that:

- Most DBPs are unregulated as of today.
- Known regulations on selected DBPs are from WHO, US-EPA, and EU. Other relevant bodies do not have regulations on DBPs as of today.
- For most DBPs, the estimated concentration range is regulated between 10 and 70 µg/L. However, this does not justify well the thresholds selected by international bodies for DBPs.
- Uncertainty on the specific natural occurring matter (NOM) types yielding distinct DBPs. Understanding better this relationship will help to understand the formation of DBPs and the overall risks.
- Better understand and quantify the health risks from the exposure to DBPs.
- Better regulate (at least the most important) DBPs and find consensus among policymakers globally.

The H2OforAll project explored literature to understand crucial environmental parameters impacting DBP formation in drinking water and conducted a comprehensive investigation, identifying prevalent and toxic DBPs in chlorinated drinking water and assessing their impact on human health. A key challenge lies in pinpointing the specific type of NOM responsible for generating distinct DBP compounds.

In the same vein, the intoDBP project summarises different methodologies for the sampling and analysis of DBPs, including the DBPs selection. It aims to tailor the methodology to each case study's specificities. This methodology will be better explored to identify best practices at the end of the project's activities.

The IntoDBP project also summarises the strategies for minimising DBP formation, with a particular attention to the DBPs regulated by the new Drinking Water Directive and emerging ones. The main conclusions for minimising DBPs in drinking water are <sup>7</sup>:

- Source water quality control: managing source water to lower the concentration and reactivity of natural organic matter (NOM) and bromide ion in the source water.
- Disinfection strategy selection, particularly by moving the disinfection downstream with lower dose and mixed disinfectants/oxidants as well as controlling the quality of the used reagents.
- Removal of DBPs precursors using the most efficient approach.
- Removal of already formed DBPs.
- Enhancement of the removal of inorganic precursors (e.g. bromide)

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<sup>6</sup> H2OforAll, D3.1 Understanding and assessments of DBP's, *Innovative Integrated Tools and Technologies to Protect and Treat Drinking Water from Disinfection Byproducts (DBPs)*, 2023.

<sup>7</sup> intoDBP, D4.1, *Strategies for DBP minimization*, 2023.

### 2.3.2 A perspective on Digital Water

The exhaustive list (28) of DBP compounds, along with their associated parameters, presented in H2OforAll serves as a valuable reference for researchers and industry practitioners. It acts as a cornerstone for future inquiries into the presence and impact of DBPs across diverse water sources, facilitating the creation of targeted treatment technologies and monitoring systems. Advancements in analytical techniques and sensor technologies have the potential to revolutionize DBP detection and monitoring in real time, facilitating proactive strategies for mitigation. Emphasis on emerging sensor technologies, novel analytical approaches, incorporation of artificial intelligence, and computer vision should drive future developments in this domain.

The new batch of targets for DBPs management in the Drinking Water Directive also encourages the mobilisation of digital tools, necessitating the identification of the most efficient way to place sensors and their development. Enhanced inter-connection between the ZeroPollution4Water and ICT4water clusters would be positive, especially considering the need for further research regarding modelling solutions as identified by the IntoDBP project<sup>8</sup>.

### 2.3.3 Research and Innovation Gaps

Most of the projects identified general trends that research and innovation policies will need to consider in the next programme to ensure access to drinking water in Europe:

- The increasing stress between water demand and supply and their higher risk of contamination, drought and flood, seawater intrusion and thermal pollution.
- The management of the contaminant of emerging concerns (CECs), including microplastics, antibiotic resistant bacteria and their social and environmental impact.
- The complexification of treatment strategies and their costs, including the challenge of old distribution networks.

Different recommendations have been identified by the projects during the cluster meeting to respond to this health-related challenges:

- Invest in R&I projects to develop cost-effective technologies for real-time data acquisition and removal of micropollutants, pathogens and DBPs.
- Gain better knowledge about the situation and impact of new Contaminants of Emerging Concern (e.g. through mapping) in terms of social aspects and potential policy measures to take.
- Incorporate in future R&I calls: living labs, strong training and awareness-raising programmes for society and all stakeholders particularly focused on CECs.
- Clarify and improve data requirements and management, particularly regarding the identification and monitoring of different antibiotic-resistant genes (ARG's) and their impact on health.
- Invest in drinking water infrastructure, their design and operation to improve the resilience of our system.
- Improve the planification of wastewater reuse at basin level, including with aquifer recharge.
- Support biobased and nature-based mitigation solutions with a risk assessment.
- Minimise the pollution of micropollutants, including microplastics, pathogens and DBPs in drinking water networks.

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<sup>8</sup> intoDBP, D3.1, *Review of modelling solution for intoDBP*, 2023.

### 3. WP8: Dissemination of the policy brief

The first policy brief from the ZeroPollution4Water Cluster was officially released end of April 2024. This policy brief, which aims to introduce the seven projects and the preliminary recommendations from two projects on preventing groundwater contamination and ensuring safe drinking water, was firstly made available online on both the Cluster's and Water Europe's websites, ensuring easy access for stakeholders and the general public. The official presentation of the policy brief took place in June 2024 during Water Innovation Europe 2024 and the dissemination followed two lines: a broad outreach and a more targeted communication.

#### 3.1 Outreach Campaign

The dissemination of the policy brief was supported by a broad dissemination campaign, coordinated with the Working Group Communication of the Cluster.

- **General outreach:** Water Europe as manager of the ZeroPollution4Water cluster utilized its communication channels to spread awareness, notably featuring the brief in its external newsletter on April 30, 2024, and in its community including its working groups. The working Group communication of the cluster also contributed to its dissemination. We also mobilised the partners in the different EU-funded projects to communicate further this document.
- **Dedicated presentation of the cluster and Policy Brief at Water Innovation Europe 2024:** A dedicated session take place at Water Innovation Europe 2024 with the objective to maximize our impact on the water community (more than 116 registrations for the session). For instance, officers of the DG Research and Innovation attended the session. Moreover, additional post-event newsletter was distributed on July 1, 2024, reinforcing the key messages and insights from the session. In this context, POLITICO was also informed about the session and the policy brief with the objective to amplify its visibility.

#### 3.2 Targeted Dissemination Efforts

In addition to the general outreach, targeted dissemination actions were carried out in specific forums and through bilateral engagements to maximize the policy brief's reach. These efforts included:

- **Presentation of the Policy brief to the Policy Advisory Committee of Water Europe:** it is the main organ for the advocacy programme of Water Europe. The policy brief was shared by the secretariat with solutions providers and challenge owners' members of this committee.
- **Dissemination during event with Local and Regional Authorities:** The policy brief was disseminated and mentioned during the ARLEM Meeting and Green Week Event in Carcassonne in July 2024. The document was also spotlighted during the EU Regions & Cities Week 2024.
- **Engagement with MEPs:** During the summer and fall 2024, bilateral meetings were held with select Members of the European Parliament (MEPs) to discuss water dossiers. When relevant, the brief's findings and recommendations has been mentioned and shared. The receptivity of the document was mainly by Renew members.
- **Communication with the EU Commission and its expert groups:** A Water Europe Letter to Directorate-General for Health and Food Safety (DG SANTE) connected the document's insights with DG SANTE's mission goals and policy areas in the context of the new Commission 2024-2029's mission letters. The document was also previously shared with the water team of the EU

commission and particularly with the secretariat of the European Expert Group Chemicals of the Water Framework Directive.

This strategic dissemination approach has ensured that the ZeroPollution4Water Cluster's policy brief reached a diverse and influential audience, from policymakers and EU institutions to regional stakeholders, fostering a unified effort toward a zero-pollution future for Europe's water resources. Further communication will take place during the next months with targeted audience (e.g. EU stakeholders related to the Environmental Quality standards Directive, the United National World Water Quality Alliance, Porto university Winter School in cooperation with H2OforAll project), and an update of the policy brief is expected in the coming months. The purpose of this update is to provide further recommendations based on the new outcomes of the projects on specific legislation such as the Drinking Water Directive<sup>9</sup>.

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<sup>9</sup> If the Cluster policy brief cannot master the key outcome of ToDrinQ a specific policy brief will be developed.

## Conclusion

The objective of the first policy brief aimed to spotlight the importance of the cluster, including projects such as ToDrinQ in the first two years of the projects. It is the first policy brief over the three ones that aim to be developed. These collaborative efforts of the ZeroPollution4Water Cluster underscore the importance of unified action to stress recommendation and offer a basis for further actions. The policy brief is a living document that will continue to evolve with project results. The next ones will be sharper in terms of regulatory and implementation recommendations.

Through targeted dissemination, cross-project collaboration, and engagement with policymakers, this initiative fosters the adoption of innovative solutions aligned with the EU's Zero Pollution Action Plan. The cluster's projects are generating insights and tools that address contamination sources and offer robust solutions for water monitoring and treatment (source-to-sea approach).

The revised EU Drinking Water Directive promotes a risk assessment and risk management approach for securing drinking water supply in the context of climate change and increased pollution. However, this approach is challenged by insufficient information that is available to operators, especially in real time, on compounds and organisms of emerging concern, such as pesticides, pharmaceuticals, disinfection by-products, heavy metals and pathogenic microorganisms. We argue that if drinking water treatment could leverage novel technologies and design philosophies, and more agile operational actions could be supported, drinking water supply systems could become more adaptable and robust without expensive infrastructural investments. In this context, ToDriNq develops and tests a compendium of modular, complementary, innovative solutions (the 'ToDriNq Toolkit') that provide new information and better support tools to operators and designers to adapt to (short- and long-term) changes in water quality, while obtaining high drinking water quality at the tap. ToDriNq develops novel real time sensing and water quality monitoring technologies, innovative treatment systems (especially suitable for small-scale/modular, adaptable treatment plants) and interoperable decision tools that support resilient, evidence-based treatment plant design and improved overall water system operational awareness and response.



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