# White Paper addressing gaps on EU policies

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LIFE SOuRCE

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# List of Abbreviations

PFAS: Per- and polyfluoroalkyl substances

CECs: Chemicals of emerging concern

DW: Drinking water

AFFF: Aqueous film-forming foams

SAFF: Surface active foam fractionation

AEX: Anion exchange

EO: Electrochemical oxidation

EU: European Union

PHYTO: Phytoremediation

GAC: Granular activated carbon

# List of Partners in Life SOuRCE

EUT: Fundació Eurecat

ENVY: Envytech Solutions AB

ESOL: ESOLVE Consultoría e Ingeniería Medioambiental S.L.

LAQ: Laqua Treatment AB

NOVA: Nova Diamant AB

SGI: Swedish Geotechnical Institute

SLU: Swedish University of Agricultural Sciences

UVA: Uppsala Vatten och Avfall AB

# 1 Introduction

## 1.1 The LIFE SOuRCE Project

**Per- and polyfluoroalkyl substances (PFAS)** constitute a large family of more than 5,000 man-made chemicals, widely recognized as *chemicals of emerging concern (CECs)* due to their persistence, mobility, and potential risks to both human health and the environment. A growing body of toxicological evidence associates PFAS exposure with **reproductive, developmental, and immunological disorders** in humans and animals. The main human exposure pathways are the intake of food and drinking water (DW), as PFAS are released into the environment during production, use, or disposal phases.

Conventional **PFAS-contaminated sites** in Europe include **landfills and areas impacted by aqueous film-forming foams (AFFF)**, where pollutants migrate into soils and water bodies, eventually reaching **groundwater and drinking water supplies**. Recent assessments estimate that more than **100,000 potential PFAS-emitting sites** exist across Europe. Since January 2020, the new **EU Drinking Water Directive (EU) 2020/2184** has introduced binding thresholds for PFAS: **0.1 µg/L for individual compounds** (up to 20 regulated substances), and **0.5 µg/L for their total concentration**.

Currently, the most widely applied remediation technology is Granular Activated Carbon (GAC). However, GAC presents significant limitations: its effectiveness drops drastically for short-chain PFAS (<C7) and, importantly, it does not destroy PFAS but generates PFAS-rich solid waste, shifting rather than solving the problem.

For this reason, the **LIFE SOuRCE project** is dedicated to demonstrating an **innovative, integrated approach**, combining four cutting-edge remediation technologies:

- **Surface active foam fractionation (SAFF)**
- **Anion exchange (AEX)**
- **Electrochemical oxidation (EO)**
- **Phytoremediation (PHYTO)**

This multi-barrier strategy is designed to address both **long- and short-chain PFAS**, while ensuring **cost-effectiveness** (targeting operation costs of ≤ 0.1 €/m³). The approach is currently being tested in two full-scale European demonstration sites: **Hovgården Landfill (Uppsala, Sweden)** and **La Tordera (Barcelona, Spain)**.

**Specific Objectives of LIFE SOuRCE**

- Decontaminate PFAS-polluted groundwater.
- Demonstrate the feasibility and cost-effectiveness of innovative PFAS remediation technologies at full scale.

- Reduce environmental impacts of remediation compared to conventional approaches (e.g., GAC).
- Minimize operational costs by lowering energy, reagent use, and treatment time.
- Develop versatile systems adaptable across different geological, geographical, and sectoral contexts.
- Validate the **technical, social, economic, and environmental feasibility** of the SOuRCE solutions.
- Establish a **business model** for commercial exploitation of the developed technologies in Europe.
- Disseminate results to ensure reproducibility, scalability, and uptake across other sectors (e.g., treatment of wastewater, soils and drinking water).
- Support implementation of EU environmental strategies and policies.
- Foster **public awareness** on the challenges posed by PFAS contamination.

**Policy Alignment**

The LIFE SOuRCE project directly contributes to the objectives of the **European Green Deal**, the **Water Framework Directive (WFD)**, the **EU Drinking Water Directive (2020/2184)**, the **REACH Regulation**, the **Priority Substances Directive**, the **Groundwater Directive**, the **Soil Framework Directive**, as well as national drinking water guidelines and the **EU POPs Regulation**.

## 1.2 Objectives

This report presents the final outcomes of *D.B.5.2 – White Paper addressing gaps on EU policies*, developed under the **LIFE SOuRCE project**. The document consolidates the main results, insights, and lessons learned from the project to identify **regulatory, technical, and socio-economic barriers**, along with **key enabling factors** for the large-scale deployment of sustainable PFAS remediation solutions across Europe.

The report provides a comprehensive analysis of the current European policy landscape, **assessing whether existing environmental, chemical, and water frameworks effectively respond to the challenges associated with PFAS contamination.** The discussion focuses on the consistency between **LIFE SOuRCE outcomes** and major EU frameworks such as the **Zero Pollution Action Plan**, the **EU Green Deal**, and the **Water Framework Directive**, offering recommendations to reinforce policy alignment and accelerate the adoption of innovative remediation technologies.

In addition to the policy dimension, the report examines the **technical, environmental, and economic implications** of scaling up the multi-barrier treatment train demonstrated during the project. This includes assessing **key performance indicators (KPIs)** such as contaminant removal efficiency, energy demand, operational costs, and waste generation, to ensure the feasibility of large-scale implementation under real operating conditions.

The document **emphasizes cross-sectoral collaboration, data transparency, and stakeholder engagement** as essential drivers for accelerating the transition towards PFAS-free and resilient water systems. Through the integration of **scientific findings and policy guidance**, the report supports **authorities, regulators, and industrial actors** in developing **coordinated and sustainable approaches** to PFAS management in Europe.

By bridging the gap between **scientific research and policy implementation**, the report positions **LIFE SOuRCE** as a central reference for future **European initiatives on PFAS management and water quality protection**.

# 2 White Paper

The following section presents the full text of the **White Paper** developed within the framework of the **LIFE SOuRCE project**, funded by the European Union's LIFE Programme. This section compiles the **main findings, analyses, and recommendations** derived from the project, addressing the **policy dimensions** of PFAS management in Europe.

The document reflects the collective work of the project partners and aims to provide an integrated perspective on the challenges and opportunities associated with PFAS remediation, policy alignment, and the transition toward sustainable water systems.

# Bridging Science and Policy for PFAS-Free Water: Insights and Recommendations from LIFE SOuRCE

## Context and background

The presence of **per- and polyfluoroalkyl substances (PFAS)** in the environment represents a significant environmental challenge due to their high persistence, mobility and potential for bioaccumulation. Widely used for decades in industrial processes and consumer products, including aqueous film-forming firefighting foams (AFFF), coatings and textiles, PFAS can persist in the environment for long periods after their release. As a result, contamination has been detected in soil, groundwater and surface waters, raising concerns regarding potential impacts on **human health and ecosystems**.

PFAS contamination has been identified across Europe, particularly at sites associated with historical or current uses of PFAS-containing products, including industrial facilities, airports, firefighting training areas and waste and wastewater management facilities. The widespread occurrence of these substances and the growing evidence of their potential environmental and health impacts have reinforced the need for effective measures to prevent emissions, monitor contamination and remediate affected environmental compartments.

At European level, PFAS have become a key priority within environmental and chemicals policy. The **European Green Deal**, the **Zero Pollution Action Plan** and relevant EU legislation on water and chemicals aim to reduce PFAS emissions, prevent further contamination and strengthen the protection of water resources. This evolving policy framework reinforces the need for **effective, sustainable and replicable remediation solutions** to address PFAS contamination and support the achievement of EU environmental objectives.

## Policy landscape on PFAS in Europe

PFAS pollution has become an **increasing priority within European environmental and chemicals policy** due to the persistence and widespread occurrence of these substances and their potential impacts on human health and ecosystems. In response, the EU is progressively strengthening its policy and regulatory framework to address PFAS across the different environmental compartments. Current measures combine prevention and restriction of PFAS emissions at source with enhanced monitoring and quality requirements for drinking water, groundwater and surface waters, as well as measures to reduce releases through wastewater.

Within **EU chemicals legislation**, several PFAS compounds, including **PFOA, PFOS, PFHxS, PFHxA** and long-chain PFAS with **9 to 14 carbon atoms**, are already restricted or subject to regulatory measures under **REACH** and the **Persistent Organic Pollutants (POPs) Regulation**. These measures aim to progressively reduce the production, use and release of PFAS and prevent further contamination at source. However, given the high persistence of PFAS, additional measures are required to address **legacy contamination already present in groundwater and other environmental compartments**.

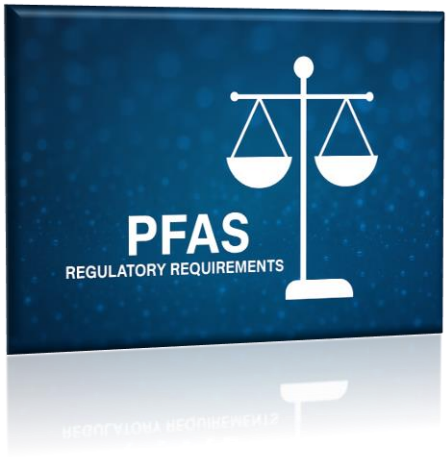
In parallel, **EU water legislation** has strengthened the monitoring and management of PFAS across the water cycle. The **Drinking Water Directive (EU) 2020/2184** establishes parametric values of **0.10 µg/L for the sum of 20 PFAS** and **0.50 µg/L for PFAS Total** in water intended for human consumption. These requirements provide a common framework for PFAS control across the EU and reinforce the need to **protect drinking water resources and reduce PFAS contamination**.

This approach has been further reinforced by **Directive (EU) 2026/805**, amending the **Water Framework Directive, the Groundwater Directive and the Environmental Quality Standards Directive**. The Directive strengthens the EU framework for addressing PFAS contamination in European waters, where PFAS have been detected at more than **70% of groundwater monitoring points**. New requirements for groundwater and surface waters reinforce PFAS monitoring and control and contribute to greater alignment between **water quality objectives and the protection of drinking water resources**.

For **groundwater**, the revised framework introduces a quality standard for the **sum of the 20 PFAS** covered by the Drinking Water Directive, as well as a specific standard for the **sum of four PFAS of greatest concern**. These standards will apply from **22 December 2027**, with the objective of achieving good groundwater chemical status for the newly regulated substances by **22 December 2039**. Member States will therefore be required to strengthen **PFAS**

**monitoring and implement appropriate measures to prevent and reduce groundwater contamination**.

The revised framework reflects a shift from the regulation of individual compounds towards a **broader group-based approach to PFAS**. **Trifluoroacetic acid (TFA)** receives consideration due to its persistence, widespread occurrence and multiple sources. For surface waters, TFA forms part of a **sum of 25 PFAS** subject to an Environmental Quality Standard, while future regulatory developments may introduce specific standards for TFA and **PFAS Total**, based on evolving scientific knowledge and monitoring capabilities.




For **urban wastewater**, the recast **Urban Wastewater Treatment Directive (EU) 2024/3019** strengthens the EU framework for the monitoring and reduction of micropollutants released into the aquatic environment. In combination with the revised EU water legislation, the Directive promotes a more comprehensive approach to pollution management based on **prevention at source, monitoring, treatment and remediation**, contributing to the reduction of PFAS emissions and the protection of European water resources.

Overall, the evolving EU regulatory framework reinforces a clear approach to PFAS management, combining **prevention and reduction of emissions at source with measures to address existing contamination**. Due to the persistence of PFAS and their widespread occurrence in European waters, restrictions on production and use need to be complemented by effective treatment and remediation solutions. **Directive (EU) 2026/805** supports this approach by promoting source-control measures and appropriate management of pollutants already present in the environment.

This evolving regulatory framework reinforces the need for **effective, sustainable and transferable solutions for PFAS treatment and remediation**. These developments support the objectives of the **European Green Deal, the Zero Pollution Action Plan, the Chemicals Strategy for Sustainability and the European Water Resilience Strategy**, promoting the prevention and reduction of pollution, the protection of water resources and the implementation of sustainable solutions to address existing contamination.

In this context, **LIFE SOuRCE contributes to the implementation of EU environmental policy** by demonstrating innovative and sustainable solutions for the remediation of PFAS-

contaminated groundwater. The project provides evidence on **treatment performance, environmental sustainability, operational feasibility and transferability**, supporting the practical implementation of current and emerging regulatory requirements. LIFE SOuRCE therefore contributes to addressing **existing and legacy PFAS contamination** and supports the achievement of European objectives for **water protection and zero pollution**.

# Member state legislation review

Following the review of the EU regulatory framework, PFAS requirements at **Member State level** were assessed, with a focus on **drinking water and groundwater**. The review considered national monitoring requirements, applicable threshold values and regulatory approaches for the **management and remediation of PFAS-contaminated waters**.

The review identifies differences in the implementation of PFAS requirements across Member States, particularly for **drinking water and groundwater protection and remediation**. These differences may affect monitoring requirements, applicable threshold values and the implementation of PFAS treatment solutions. Understanding the national regulatory context therefore provides relevant information to support the **transferability and future replication of LIFE SOuRCE solutions across Europe**.

## AUSTRIA

PFAS management at national level covers drinking water, groundwater protection and contaminated site remediation. For drinking water, the Austrian Drinking Water Ordinance (Trinkwasserverordnung – TWV, BGBl. II No. 304/2001) was amended in 2024 to implement the requirements of the Drinking Water Directive (EU) 2020/2184. The Ordinance establishes a parametric value of 0.10 µg/L for the sum of 20 PFAS, strengthening PFAS monitoring and control and supporting the protection of drinking water quality.

For groundwater, the national regulatory framework relies mainly on the Water Rights Act 1959 (Wasserrechtsgesetz – WRG 1959), the Groundwater Chemical Quality Objectives Ordinance (QZV Chemie GW) and the Water Status Monitoring Ordinance (GZÜV), which provide the basis for groundwater quality assessment and monitoring. National monitoring covering 1,892 groundwater wells and 27 PFAS indicated generally low PFAS concentrations, although localised contamination was detected. Approximately 0.74% of monitoring points exceeded 0.10 µg/L for the PFAS sum, while 11.4% exceeded the proposed EU groundwater quality standard of 4.4 ng/L, expressed as PFOA equivalents, highlighting the need for targeted monitoring and management of PFAS contamination hotspots.

For contaminated sites, the Contaminated Sites Remediation Act (Altlastensanierungsgesetz – ALSAG) provides the national framework for the assessment and remediation of contaminated areas. Overall, the Austrian regulatory framework combines specific PFAS requirements for drinking water with provisions for groundwater monitoring and contaminated-site remediation. The occurrence of localised PFAS contamination reinforces the need for targeted monitoring, source-control measures and appropriate remediation strategies to protect groundwater resources.

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## BELGIUM

PFAS management in Belgium is mainly implemented at regional level, with different approaches across Flanders, Wallonia and the Brussels-Capital Region. Flanders has established a dedicated PFAS Action Plan, while Wallonia introduced a broader PFAS strategy in 2024. In Brussels, PFAS are addressed within the regional framework for water quality and emerging contaminants, reflecting an increasingly coordinated approach to monitoring, pollution prevention and contamination management.

For drinking water, PFAS requirements have been incorporated into the regulatory frameworks of the three Belgian regions. In Flanders, the Flemish Government Decree of 20 January 2023 establishes the main requirements for water intended for human consumption. The Brussels-Capital Region adopted the Government Decree of 22 February 2024, incorporating the PFAS parameters established at EU level, applicable from January 2026. In Wallonia, the Government Decree of 20 February 2025 reinforces PFAS control in drinking water through the application of the 0.10 µg/L (100 ng/L) parametric value for the sum of 20 PFAS, in force since February 2025. The framework also introduces a target value of 4 ng/L for PFAS-4 (PFOA, PFNA, PFHxS and PFOS) at the point of distribution, to be achieved by January 2028.

The Brussels-Capital Region further strengthened its drinking water framework in 2025 through an amendment to the 2024 Decree, incorporating additional provisions for PFAS Total and trifluoroacetic acid (TFA). These measures extend the assessment of PFAS in drinking water beyond the compounds included in the PFAS-20 parameter.

For soil and groundwater, PFAS are addressed through the regional frameworks for water protection, contaminated-site assessment and remediation. Differences between the three regions in assessment criteria and management approaches influence the definition of investigation, treatment and remediation objectives for PFAS-contaminated sites.

Belgium has developed a regional approach to PFAS management, integrating drinking water requirements with measures for environmental monitoring, pollution prevention and contaminated-site management. Increased coordination between Flanders, Wallonia and the Brussels-Capital Region could improve consistency in PFAS assessment and support the wider implementation and replication of effective treatment and remediation solutions.

## BULGARIA

PFAS management at national level follows the EU regulatory framework for water and chemicals, with no dedicated national PFAS action plan currently in place. For drinking water, Ordinance No. 9 of 16$^{th}$ March 2001 on the quality of water intended for drinking and domestic purposes provides the main national regulatory framework. Amendments introduced in 2018 and 2023 implement the requirements of the Drinking Water Directive (EU) 2020/2184, including the provisions for PFAS monitoring and the applicable parametric values in water intended for human consumption.

For groundwater, the national regulatory framework includes the Water Act, Ordinance No. 1 of 10 October 2007 on the exploration, use and protection of groundwater, and Ordinance No. 1 of 11 April 2011 on water monitoring. These instruments establish the framework for groundwater protection, monitoring and assessment of chemical status. No specific national PFAS groundwater quality standards have been established beyond the applicable EU requirements, reinforcing the role of monitoring in the identification and management of potential PFAS contamination.

Overall, the Bulgarian regulatory framework reflects the progressive implementation of EU requirements for PFAS management, combining drinking water standards with provisions for groundwater protection and monitoring. In the absence of specific national PFAS thresholds for groundwater, EU quality standards and monitoring requirements provide the main reference for assessing PFAS contamination and defining appropriate management and remediation measures.

## CROATIA

The Croatian approach to PFAS currently follows the national implementation of EU requirements, without a dedicated PFAS action plan. Regarding drinking water, the requirements of the Drinking Water Directive (EU) 2020/2184 have been incorporated into Croatian legislation through the Ordinance on Water for Human Consumption (Pravilnik o vodi za ljudsku potrošnju). The regulatory framework includes the PFAS parameters established by the Directive, reinforcing PFAS monitoring and control in drinking water.

Regarding groundwater, specific national PFAS quality standards have not yet been established. Available data indicate generally low PFAS concentrations across Croatia, although localised contamination has been reported in areas associated with industrial activities and former military or firefighting sites. Targeted monitoring and risk-based assessments therefore support the identification of potentially contaminated areas and the definition of appropriate management and remediation measures.

Overall, the Croatian regulatory framework reinforces the role of monitoring and assessment in PFAS management, with EU requirements providing the main regulatory reference. The development of PFAS-specific criteria for groundwater could further support the assessment of contaminated sites, the definition of remediation objectives and the implementation of appropriate treatment solutions.

## CYPRUS

PFAS management at national level follows the EU regulatory framework for water protection, with no dedicated national PFAS action plan currently in place. For drinking water, the Quality of Water for Human Consumption Law of 2023 – Law 46(I)/2023, subsequently amended by Law 92(I)/2024, provides the main national regulatory framework. The legislation implements the requirements of the Drinking Water Directive (EU) 2020/2184, strengthening PFAS monitoring and control in water intended for human consumption.

Regarding groundwater, the national regulatory framework includes the Protection and

Management of Waters Law – Law 13(I)/2004 and the Water Pollution Control Law – Law 106(I)/2002, providing the basis for groundwater protection, pollution prevention and water quality management. Monitoring and assessment follow the requirements of the Water Framework Directive 2000/60/EC and the Groundwater Directive 2006/118/EC. No specific national PFAS quality standards for groundwater have been established, with EU requirements providing the main reference for PFAS assessment and management.

Overall, the Cypriot regulatory framework strengthens PFAS control in drinking water through the implementation of EU requirements, while specific provisions for PFAS in groundwater remain limited. The availability of additional monitoring data would contribute to a better understanding of PFAS occurrence in groundwater and facilitate the selection of suitable risk management and remediation strategies where contamination requires intervention.

## CZECHIA

PFAS management in Czechia follows the integration of EU requirements into the national water regulatory framework. For drinking water, Decree No. 252/2004 Coll. on hygienic requirements for drinking and hot water and the frequency and scope of drinking water monitoring, amended by Decree No. 371/2023 Coll., provides the main regulatory basis. The amendment implements the Drinking Water Directive (EU) 2020/2184 and incorporates the PFAS Sum parameter for 20 PFAS into the national drinking water quality framework, strengthening PFAS monitoring and control.

Regarding groundwater, PFAS monitoring falls within the broader national framework for water protection and quality assessment. Decree No. 256/2023 Coll., amending Decree No. 428/2001 Coll., incorporates the PFAS Sum parameter into monitoring provisions for water sources used for drinking water production. Monitoring applies where risk assessment or groundwater and surface water monitoring identifies a potential presence of PFAS, supporting the identification and management of affected water resources.

Overall, the Czech regulatory framework strengthens PFAS monitoring and drinking water protection through the progressive implementation of EU requirements. Although specific national PFAS quality standards for groundwater remain limited, monitoring and risk-assessment procedures contribute to the identification of potentially affected water resources. Available mapping initiatives, including the *Forever Pollution Project*, have identified several locations potentially affected by PFAS contamination, particularly in areas associated with industrial activities and the historical use of firefighting foams. These findings reinforce the relevance of targeted monitoring and appropriate management and remediation measures.

## DENMARK

PFAS management in Denmark follows a comprehensive national approach addressing prevention, monitoring and remediation. In 2024, Denmark adopted its first National Action Plan on PFAS for 2024–2027, supported by DKK 404 million. The plan strengthens measures for the protection of drinking water and the environment, including PFAS monitoring,

management and remediation of contaminated sites, and restrictions on PFAS-containing consumer products to reduce further releases at source.

For drinking water, the main national regulatory instrument is the Executive Order on Water Quality and Supervision of Water Supply Systems (Drikkevandsbekendtgørelsen). Danish legislation establishes stringent quality criteria of 0.002 µg/L (2 ng/L) for the sum of PFOA, PFOS, PFNA and PFHxS and 0.10 µg/L for the sum of 22 PFAS. These requirements strengthen PFAS monitoring and provide a high level of protection for drinking water resources.

Regarding groundwater, the Danish regulatory framework includes specific PFAS criteria supporting the protection of groundwater resources and drinking water supplies. Reference values of 2 ng/L for the sum of four PFAS and 0.10 µg/L for the sum of 22 PFAS provide the basis for assessing PFAS contamination and identifying the need for appropriate management and remediation measures.

Overall, the Danish framework provides a strong basis for PFAS prevention and management, combining stringent water quality criteria with a dedicated national action plan and measures to reduce PFAS releases at source. These provisions contribute to the protection of drinking water and groundwater resources, while supporting the identification of contaminated areas and the implementation of effective treatment and remediation measures.

## ESTONIA

PFAS management at national level reflects the implementation of EU requirements within the Estonian water regulatory framework. For drinking water, the Water Act (Veeseadus) and Regulation No. 61 of 24th September 2019 on drinking water quality and control requirements and methods of analysis, amended in 2023, provide the main national regulatory basis. The amendments implement the Drinking Water Directive (EU) 2020/2184 and introduce parametric values of 0.10 µg/L for the sum of 20 PFAS and 0.50 µg/L for PFAS Total, reinforcing PFAS monitoring and the protection of drinking water quality.

Regarding groundwater, the Estonian Water Act provides the main national framework for the protection and management of groundwater resources. The framework is complemented by Regulation No. 48 of 1st October 2019 on groundwater body status classes, procedures for determining status classes, quality indicators and threshold values, which defines the criteria for assessing groundwater chemical status. No specific national PFAS threshold values have been established for groundwater, with EU requirements providing the main reference for the assessment and management of PFAS contamination.

Overall, the Estonian regulatory framework provides a clear basis for PFAS control in drinking water and groundwater protection. Further PFAS monitoring in groundwater could support the identification of affected areas and the implementation of appropriate management and remediation measures.

## FINLAND

PFAS management in Finland reflects the implementation of EU requirements within the national water and health protection framework, supported by established water quality

monitoring. For drinking water, the main national regulatory instrument is the Ministry of Social Affairs and Health Decree 2/2023, adopted to implement the requirements of the Drinking Water Directive (EU) 2020/2184. The Decree establishes a parametric value of 0.10 µg/L for the sum of 20 PFAS, strengthening PFAS monitoring and the protection of drinking water quality.

Regarding groundwater, the Act on Water Resources Management (1299/2004) and the Government Decree on Water Resources Management (1040/2006) provide the main national framework for groundwater protection, monitoring and chemical status assessment. Specific national PFAS quality standards for groundwater have not been established. Available data indicate generally low PFAS concentrations, although localised contamination has been reported near industrial areas, airports, firefighting training areas and former military sites, reinforcing the relevance of targeted monitoring and site-specific assessment of potentially affected groundwater resources.

Overall, the Finnish regulatory framework provides a strong basis for PFAS monitoring and water resource protection. The identification of localised contamination highlights the relevance of site-specific assessment and targeted management measures, supporting the implementation of appropriate PFAS treatment and remediation solutions at affected sites.

## FRANCE

France has established a comprehensive framework for PFAS management, combining regulatory action with measures addressing monitoring, prevention and remediation. Following the first PFAS Action Plan adopted in January 2023, an Interministerial PFAS Action Plan was introduced in April 2024 to strengthen the national response. The plan covers environmental and human monitoring, analytical methods, reduction of PFAS emissions and exposure, research, substitution and public information, supporting a coordinated approach to PFAS pollution.

For drinking water, the French Public Health Code (Code de la santé publique) provides the main national regulatory basis, complemented by the Order of 11th January 2007 on quality limits and reference values for raw water and water intended for human consumption, as amended by the Order of 30th December 2022. The amended framework implements the requirements of the Drinking Water Directive (EU) 2020/2184 and introduces a quality limit of 0.10 µg/L for the sum of 20 PFAS, applicable from January 2026, strengthening PFAS monitoring and drinking water protection. Although France has not defined a national limit for 4 PFAS sum parameter, the High Council for Public Health recommends a threshold of 20 ng/L. No drinking water parameter has been established for TFA, although the Ministry of Health advises the use of the German Environment Agency's reference value of 60 ng/L pending national risk assessment.

The French regulatory framework was further reinforced by Law No. 2025-188 of 27th February 2025 on the protection of the population from risks associated with PFAS. The Law introduces additional measures to reduce PFAS exposure and strengthen drinking water protection, including the revision of health-based reference values. The framework further

enhances monitoring and public access to information, requiring Regional Health Agencies to publish PFAS monitoring programmes and regional results and supporting an annual national assessment of PFAS occurrence in drinking water.

Regarding groundwater and the wider environment, PFAS monitoring forms part of the national framework for water protection and pollution control. France has progressively expanded surveillance of PFAS in water resources and industrial discharges, strengthening the identification of contamination sources and affected areas. Law No. 2025-188 further reinforces the polluter-pays principle through a specific fee on PFAS emissions to water from certain authorised industrial installations, supporting measures to prevent and reduce PFAS pollution at source.

Regarding industrial emissions, the French regulatory framework includes specific provisions to control PFAS releases from industrial activities. The Order of 2nd February 1998 establishes a concentration limit of 25 µg/L for PFOS and its derivatives in wastewater discharged to the natural environment from certain installations subject to environmental authorisation. This requirement has applied since January 2023, strengthening measures to prevent and reduce PFAS emissions to water.

Overall, the French approach establishes a comprehensive framework for addressing PFAS throughout the water cycle, linking measures to reduce emissions with strengthened drinking water protection and environmental surveillance. The progressive development of PFAS-specific requirements provides an enabling framework for managing existing contamination and advancing the deployment of effective treatment and remediation solutions.

## GERMANY

PFAS management in Germany forms part of a comprehensive federal framework for water, soil and chemicals protection, without a dedicated national PFAS action plan. The 2022 Guidelines for PFAS Assessment (Leitfaden zur PFAS-Bewertung) provide a common reference for the assessment and management of PFAS contamination across the federal states. The guidelines address PFAS occurrence in soil and water, the assessment of contaminated sites and the appropriate management and disposal of PFAS-contaminated soil materials, supporting a consistent approach to PFAS pollution across Germany.

For drinking water, the Ordinance on the Quality of Water Intended for Human Consumption (Trinkwasserverordnung – TrinkwV) provides the main national regulatory framework. The revised TrinkwV of 20th June 2023 implements the Drinking Water Directive (EU) 2020/2184 and establishes a limit of 0.10 µg/L for the sum of 20 PFAS (PFAS-20), applicable from January 2026. A more stringent national limit of 0.020 µg/L (20 ng/L) for the sum of PFOA, PFNA, PFHxS and PFOS (PFAS-4) will apply from January 2028, reinforcing the protection of drinking water from PFAS contamination.

For trifluoroacetic acid (TFA), the Drinking Water Ordinance (TrinkwV) does not establish a specific limit. In 2020, the German Environment Agency (UBA) derived a health-based drinking water guideline value of 60 µg/L. Under a precautionary approach, UBA further recommends maintaining TFA concentrations at 10 µg/L or below, contributing to the minimisation of TFA

levels in drinking water resources.

Regarding groundwater and contaminated sites, PFAS management forms part of the German regulatory framework for soil and water protection, with implementation and remediation responsibilities largely managed by the federal states (Länder). The 2022 PFAS Guidelines provide a harmonised reference for the assessment of PFAS contamination in soil and groundwater, supporting the identification of affected sites and the definition of appropriate management and remediation measures.

Overall, the German framework provides a robust regulatory basis for addressing PFAS across drinking water, groundwater and contaminated sites. The introduction of stringent PFAS limits, complemented by national guidance for contamination assessment, facilitates the prioritisation of affected sites and the selection of effective management, treatment and remediation approaches.

## GREECE

PFAS management in Greece reflects the implementation of EU requirements within the national water regulatory framework, with no dedicated national PFAS action plan currently in place. For drinking water, Joint Ministerial Decision D1(d)/GP oik. 27829/2023 (Government Gazette B' 3525/25.05.2023) provides the main national regulatory basis. The Decision implements the Drinking Water Directive (EU) 2020/2184 and introduces parametric values of 0.10 µg/L for the sum of 20 PFAS and 0.50 µg/L for PFAS Total, applicable from January 2026, strengthening PFAS monitoring and drinking water protection.

Regarding groundwater, the national framework for water protection and monitoring implements the requirements of the Water Framework Directive 2000/60/EC and the Groundwater Directive 2006/118/EC. Presidential Decree 51/2007 provides the main regulatory basis for the protection, management and assessment of water resources, including groundwater. No specific national PFAS quality standards have been established for groundwater, with EU requirements and risk-based assessment providing the main reference for PFAS monitoring and management.

Available information indicates generally low PFAS concentrations in Greek water resources, although localised contamination has been reported in areas associated with industrial activities, airports and the historical use of firefighting foams. These findings reinforce the relevance of targeted monitoring to identify potentially affected groundwater resources and support appropriate management measures.

Overall, the Greek regulatory framework establishes a clear basis for addressing PFAS in drinking water, while groundwater remains primarily covered by the broader water protection framework. Expanding knowledge on PFAS occurrence and distribution in groundwater would facilitate the assessment of contamination risks and guide future treatment and remediation actions.

## HUNGARY

PFAS management in Hungary takes place through the implementation of EU requirements

within the national water regulatory framework, with no dedicated national PFAS strategy currently in place. For drinking water, Government Decree No. 5/2023 (I. 12.) on the quality requirements of drinking water and the inspection procedure (*5/2023. (I. 12.) Korm. rendelet az ivóvíz minőségi követelményeiről és az ellenőrzés rendjéről*) establishes the main national regulatory basis. The Decree implements the Drinking Water Directive (EU) 2020/2184 and incorporates PFAS requirements into the national drinking water quality and monitoring framework, establishing a parametric value of 0.10 µg/L for the sum of 20 PFAS, applicable from January 2026. No additional national threshold for PFAS Total has been introduced.

Regarding groundwater, Government Decree No. 219/2004 (VII. 21.) on the protection of groundwater, complemented by the Water Management Act LVII of 1995, establishes the main national framework for groundwater protection and pollution control. These provisions address the prevention of groundwater contamination and the assessment and management of affected groundwater resources. No specific national PFAS quality standards have been established for groundwater, with EU requirements and risk-based approaches serving as the main reference for PFAS assessment and management.

Available information on PFAS occurrence in Hungarian groundwater remains limited, with localised detections reported in some areas. Current monitoring coverage does not yet provide a complete overview of PFAS distribution, highlighting the relevance of further monitoring and assessment to improve the characterisation of potentially affected groundwater resources.

Overall, the Hungarian regulatory framework combines specific PFAS requirements for drinking water with broader provisions for groundwater protection and pollution prevention. Strengthening PFAS monitoring in groundwater would support a more comprehensive assessment of contamination and facilitate the prioritisation of areas for management, treatment and remediation actions.

## IRELAND

PFAS management in Ireland forms part of the national implementation of EU water legislation, with no dedicated national PFAS strategy currently in place. For drinking water, the European Union (Drinking Water) Regulations 2023 (S.I. No. 99/2023) provide the main national regulatory basis and transpose the requirements of the Drinking Water Directive (EU) 2020/2184. The Regulations introduce parametric values of 0.10 µg/L for the sum of 20 PFAS and 0.50 µg/L for PFAS Total, applicable from January 2026, strengthening PFAS monitoring and drinking water protection.

Regarding groundwater, the national regulatory framework includes the European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9/2010) and subsequent amendments, including the European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2025 (S.I. No. 51/2025). These provisions support the protection and monitoring of groundwater resources and the assessment of their chemical status. No specific national PFAS threshold values have been established for groundwater, with the broader EU water quality framework providing the main reference for PFAS

assessment.

Available monitoring data indicate generally low PFAS concentrations in Irish groundwater, although localised contamination may occur at sites associated with historical PFAS uses. These findings reinforce the relevance of targeted monitoring and site-specific assessment to identify potentially affected groundwater resources and support the definition of appropriate management measures.

Overall, the Irish regulatory framework combines specific PFAS requirements for drinking water with a broader framework for groundwater protection and monitoring. Further characterisation of PFAS occurrence in groundwater would strengthen the assessment of potentially affected areas and facilitate the selection of suitable management, treatment and remediation approaches.

## ITALY

Italy has established a comprehensive regulatory framework for PFAS management, despite the absence of a dedicated national PFAS action plan. For drinking water, Legislative Decree No. 18 of 23 February 2023 implements the requirements of the Drinking Water Directive (EU) 2020/2184. The national framework goes beyond the initial EU requirements by extending the Sum of PFAS parameter from 20 to 24 substances, including HFPO-DA (GenX), ADONA and 6:2 FTSA, thereby strengthening the monitoring and control of PFAS in water intended for human consumption.

The Italian regulatory framework was further reinforced by Legislative Decree No. 102 of 19 June 2025, amending Legislative Decree No. 18/2023. The revised framework removes the PFAS Total parameter and extends the Sum of PFAS to 30 substances, incorporating six carboxylated chloro-perfluoropolyethers associated with fluoropolymer production. It also introduces a more stringent limit of 0.02 µg/L for the sum of PFOA, PFOS, PFNA and PFHxS (PFAS-4), applicable from January 2026, together with a specific limit of 10 µg/L for trifluoroacetic acid (TFA), applicable from January 2027, further strengthening PFAS control and drinking water protection.

Regarding groundwater, the national framework established under Legislative Decree No. 152 of 3 April 2006 (Environmental Code) was complemented by the Ministerial Decree of 6 July 2016, which introduced specific PFAS threshold values for the assessment of groundwater chemical status. These include 3 µg/L for PFPeA, 1 µg/L for PFHxA, 3 µg/L for PFBS, 0.5 µg/L for PFOA and 0.03 µg/L for PFOS. For groundwater interacting with surface waters, more stringent values apply to PFOA (0.1 µg/L) and PFOS (0.00065 µg/L). These criteria strengthen the identification and assessment of PFAS-affected groundwater bodies and support the definition of appropriate management and remediation measures.

Overall, the Italian framework establishes an advanced approach to PFAS management, combining drinking water requirements that extend beyond EU provisions with PFAS-specific criteria for groundwater protection. The broader range of regulated substances and increasingly stringent parameters support the early identification of contamination and the implementation of targeted treatment and remediation measures.

## LATVIA

PFAS management in Latvia forms part of the implementation of EU requirements within the national water regulatory framework, with no dedicated national PFAS action plan currently in place. For drinking water, Cabinet Regulation No. 547 of 26 September 2023 on mandatory safety and quality requirements for drinking water and procedures for monitoring and control establishes the main national regulatory basis. The Regulation implements the Drinking Water Directive (EU) 2020/2184 and incorporates parametric values of 0.10 µg/L for the sum of 20 PFAS and 0.50 µg/L for PFAS Total, applicable from January 2026, strengthening PFAS monitoring and the protection of water intended for human consumption.

Regarding groundwater, the Water Management Law establishes the overarching national framework for water resource protection, complemented by Cabinet Regulation No. 118 of 12 March 2002 on the Quality of Surface Waters and Groundwaters and Cabinet Regulation No. 42 of 13 January 2009 on Procedures for Ascertaining Groundwater Resources and Quality Criteria. The latter defines requirements for the assessment of groundwater chemical and quantitative status, quality criteria and pollutant threshold values, supporting the identification and management of groundwater bodies affected by pollution. Specific national PFAS groundwater quality standards have not been established within this framework.

No specific national PFAS quality standards have been established for groundwater, with the evolving EU regulatory framework providing the main reference for PFAS assessment. Expanding PFAS monitoring would support a more comprehensive characterisation of groundwater contamination and the identification of priority areas for targeted management and remediation measures.

## LITHUANIA

PFAS management in Lithuania forms part of the national implementation of EU water requirements, with no dedicated national PFAS strategy currently in place. For drinking water, the Lithuanian Hygiene Standard HN 24:2023 “Drinking Water Safety and Quality Requirements”, approved by Order No. V-455 and amended by Order No. V-141 of 31 January 2023, establishes the main national regulatory basis. The revised framework implements the Drinking Water Directive (EU) 2020/2184 and incorporates the corresponding PFAS requirements into drinking water quality and monitoring provisions, strengthening the control of PFAS in water intended for human consumption.

Regarding groundwater, the Law on Water of the Republic of Lithuania (No. VIII-474) establishes the national framework for the protection and sustainable management of groundwater resources. The framework is complemented by provisions addressing groundwater monitoring, chemical status assessment and the protection of drinking water abstraction areas. No specific national PFAS quality standards have been established for groundwater, with EU requirements serving as the main reference for PFAS assessment and groundwater protection.

Overall, the Lithuanian regulatory framework integrates PFAS control in drinking water within

a broader system for groundwater and water resource protection. Strengthening PFAS monitoring in groundwater would improve the assessment of contamination patterns and support the prioritisation of appropriate management and remediation actions.

## LUXEMBOURG

Luxembourg has progressively reinforced its national approach to PFAS management, with increasing attention to monitoring, prevention and pollution reduction. In March 2026, the interministerial PFAS working group presented its first national report, outlining 40 actions focused on improving knowledge, strengthening monitoring, implementing targeted measures and raising public awareness. This framework supports a more coordinated response to PFAS contamination and exposure across environmental compartments.

For drinking water, the Law of 23 December 2022 on the quality of water intended for human consumption (Loi du 23 décembre 2022 relative à la qualité des eaux destinées à la consommation humaine) establishes the main national regulatory framework and implements the Drinking Water Directive (EU) 2020/2184. The legislation introduces a parametric value of 0.10 µg/L (100 ng/L) for the sum of 20 PFAS, applicable from January 2026, strengthening PFAS monitoring and the protection of drinking water quality.

Specific attention has been given to trifluoroacetic acid (TFA) within the national drinking water framework. Although TFA falls outside the PFAS-20 parameter and no statutory limit currently applies at national or EU level, the Luxembourg Health Directorate has established a guideline value of 12,000 ng/L (12 µg/L) for drinking water. Monitoring activities have also been expanded to improve knowledge of TFA occurrence and support the assessment of drinking water quality.

Regarding groundwater, protection and monitoring form part of Luxembourg's broader water protection framework, largely aligned with EU water legislation. No specific national PFAS quality standards have been established for groundwater, while increasing attention to PFAS monitoring and contamination assessment supports the identification of potentially affected water resources.

Overall, Luxembourg is advancing towards a more integrated approach to PFAS management, supported by strengthened drinking water requirements, expanded monitoring and targeted national actions. Increased attention to PFAS and TFA across water resources reinforces the capacity to identify contamination and supports the development of effective prevention, treatment and remediation measures.

## MALTA

PFAS management in Malta forms part of the national implementation of EU water requirements, with no dedicated national PFAS action plan currently in place. For drinking water, Legal Notice 297 of 2023 – Water Intended for Human Consumption Regulations, 2023 establishes the main national regulatory framework. The Regulations implement the Drinking Water Directive (EU) 2020/2184 and incorporate the corresponding PFAS parameters into drinking water quality and monitoring requirements, strengthening the control of PFAS in

water intended for human consumption.

The national framework establishes parametric values of 0.10 µg/L for the sum of 20 PFAS and 0.50 µg/L for PFAS Total, applicable from January 2026, strengthening PFAS monitoring and drinking water quality protection in line with EU requirements.

Regarding groundwater, the Water Policy Framework Regulations (S.L. 549.100) and the Protection of Groundwater against Pollution and Deterioration Regulations (S.L. 549.53) establish the national framework for groundwater protection, monitoring and chemical status assessment, including provisions for pollutant threshold values. No specific national PFAS quality standards have been established for groundwater, with the broader regulatory framework supporting the assessment and management of groundwater contamination.

Overall, the Maltese regulatory framework combines specific PFAS requirements for drinking water with broader provisions for groundwater protection. Strengthening knowledge of PFAS occurrence in groundwater would support the identification of potentially affected resources and guide the implementation of appropriate management and remediation actions.

## THE NETHERLANDS

PFAS management in the Netherlands combines regulatory measures with a strong scientific basis for monitoring and risk assessment, although no dedicated national PFAS action plan has been adopted. The National Institute for Public Health and the Environment (RIVM) plays a key role in supporting the national approach through the development of health- and environmental-based guidance for PFAS across water, soil, air and food.

For drinking water, the Drinking Water Decree (Drinkwaterbesluit) establishes the main national regulatory framework, incorporating the requirements of the Drinking Water Directive (EU) 2020/2184. The legislation sets a parametric value of 0.10 µg/L (100 ng/L) for the sum of 20 PFAS. Alongside this regulatory value, an additional health-based guideline of 4.4 ng/L, expressed as PFOA equivalents, has been applied since October 2022 to support the assessment of combined PFAS exposure in drinking water.

Specific guidance has also been developed for trifluoroacetic acid (TFA). In 2023, RIVM established an indicative drinking water guideline value of 2.2 µg/L (2,200 ng/L) for TFA when present without other PFAS. The combined contribution of any additional PFAS present is considered in the assessment of drinking water quality. This value serves as a health-based reference for risk assessment rather than a legally binding drinking water limit.

Regarding water resource protection, the Environment and Planning Act (Omgevingswet) and the Decree on the Quality of the Living Environment (Besluit kwaliteit leefomgeving – Bkl) establish the main national regulatory framework. The Bkl includes requirements for the assessment of quantitative and chemical status and their integration into regional water programmes. No specific national PFAS threshold values have been established within this framework.

For other aquatic environments, RIVM has developed risk-based and environmental guidance values for several PFAS, supporting the evaluation of contamination in surface waters and

related water systems. These scientific reference values complement the regulatory framework and strengthen the assessment and prioritisation of PFAS-related environmental risks.

Overall, the Dutch approach combines regulatory requirements with a strong scientific basis for PFAS assessment and management. Health-based guidance for PFAS mixtures and emerging compounds such as TFA strengthens the evaluation of potential risks and supports the selection and prioritisation of monitoring, treatment and remediation measures.

## POLAND

PFAS management in Poland forms part of the national implementation of EU water legislation, with no dedicated national PFAS action plan currently in place. For drinking water, the Act of 13 March 2026 amending the Act on Collective Water Supply and Collective Wastewater Disposal and certain other acts (Dz.U. 2026, item 605) completed the transposition of the Drinking Water Directive (EU) 2020/2184. The framework was further complemented by the Regulation of the Minister of Health of 22 May 2026 on the quality of water intended for human consumption (Dz.U. 2026, item 748), which introduces a parametric value of 0.10 µg/L for the sum of 20 PFAS and has applied since June 2026, strengthening PFAS monitoring and drinking water quality protection.

For water resource protection, the Water Law Act of 20 July 2017 (Prawo wodne) establishes the national framework for water management, pollution prevention and the assessment of water quality and chemical status. No specific national PFAS quality standards have been established for groundwater, with EU requirements providing the main reference for PFAS monitoring and assessment.

Overall, the Polish regulatory framework has taken an important step towards strengthening PFAS control through the introduction of specific drinking water requirements. Expanding PFAS monitoring and developing environmental assessment criteria would improve the identification and evaluation of contamination, supporting the selection of targeted management, treatment and remediation actions.

## PORTUGAL

PFAS management in Portugal forms part of the national implementation of EU water legislation, with no dedicated national PFAS action plan currently in place. For drinking water, Decree-Law No. 69/2023 of 21 August (Decreto-Lei n.º 69/2023) establishes the national regulatory framework and implements the Drinking Water Directive (EU) 2020/2184. The 2023 legislation incorporates parametric values of 0.10 µg/L for the sum of 20 PFAS and 0.50 µg/L for PFAS Total, strengthening PFAS monitoring and control in water intended for human consumption. The regulatory framework was subsequently updated by Decree-Law No. 149/2026, amending Decree-Law No. 69/2023.

For groundwater, the Water Law (Law No. 58/2005 of 29 December – Lei da Água) establishes the overarching national framework for water resource protection and management. More specifically, Decree-Law No. 208/2008 of 28 October, as amended by Decree-Law No. 34/2016

of 28 June, establishes the framework for the protection of groundwater against pollution and deterioration and the assessment of its chemical status. No specific national PFAS quality standards have been established for groundwater within this framework, with broader EU requirements serving as the main reference for PFAS assessment.

Overall, the Portuguese regulatory framework combines specific PFAS requirements for drinking water with broader provisions for the protection and management of water resources. Strengthening PFAS-specific monitoring and assessment criteria for groundwater would enhance the identification of contamination and support the implementation of targeted management, treatment and remediation actions.

## ROMANIA

PFAS management in Romania forms part of the national implementation of EU water requirements, with no dedicated national PFAS action plan currently in place. For drinking water, Government Ordinance No. 7/2023 on the quality of water intended for human consumption, subsequently approved by Law No. 96/2024, establishes the national regulatory framework and implements the Drinking Water Directive (EU) 2020/2184. The legislation sets parametric values of 0.10 µg/L for the sum of 20 PFAS and 0.50 µg/L for PFAS Total, reinforcing PFAS monitoring and drinking water quality protection.

For groundwater, the national regulatory framework includes Government Decision No. 53/2009 on the protection of groundwater against pollution and deterioration and Order No. 621/2014 on the approval of threshold values for groundwater bodies in Romania. Together, these instruments support the protection and monitoring of groundwater resources, the assessment of chemical status and the application of pollutant threshold values. No specific national PFAS threshold values have been established, with PFAS assessment remaining within the broader framework for groundwater quality and pollution control.

Overall, the Romanian regulatory framework combines specific PFAS requirements for drinking water with broader provisions for groundwater protection and pollution control. Strengthening PFAS-specific monitoring and assessment criteria would improve the characterisation of potentially affected water resources and support the implementation of appropriate management, treatment and remediation actions.

## SLOVAKIA

PFAS management in Slovakia forms part of the national implementation of EU water legislation, with no dedicated national PFAS action plan currently in place. For drinking water, Decree No. 91/2023 Coll. of the Ministry of Health of the Slovak Republic establishes the national requirements for drinking water quality and implements the relevant provisions of the Drinking Water Directive (EU) 2020/2184. The Decree introduces parametric values of 0.10 µg/L for the sum of 20 PFAS and 0.50 µg/L for PFAS Total, applicable from January 2026, reinforcing PFAS monitoring and drinking water quality protection.

For groundwater, the Water Act No. 364/2004 Coll. (Zákon o vodách) establishes the national framework for water resource protection, management and monitoring, including provisions

for the assessment of water status. The regulatory framework has been progressively updated, including through Act No. 277/2024 Coll., and complemented by implementing legislation. Decree No. 354/2023 Coll. further addresses raw water quality and monitoring requirements for public water supply systems, supporting the protection and assessment of water resources used for drinking water production. No specific national PFAS quality standards have been established for groundwater, with the broader national water protection framework and EU requirements serving as the main reference for PFAS monitoring and assessment.

Overall, the Slovak framework establishes a regulatory basis for PFAS control in drinking water, while the protection of other water resources remains embedded in the wider national water management system. Expanding PFAS-specific monitoring and assessment could improve knowledge of contamination patterns and facilitate the selection of effective treatment and remediation solutions.

## SLOVENIA

PFAS management in Slovenia forms part of the national implementation of EU water requirements, with no dedicated national PFAS action plan currently in place. For drinking water, the Decree on Drinking Water (Uredba o pitni vodi, Official Gazette of the Republic of Slovenia No. 61/2023) establishes the national regulatory framework and implements the Drinking Water Directive (EU) 2020/2184. The Decree introduces parametric values of 0.10 µg/L for the sum of 20 PFAS and 0.50 µg/L for PFAS Total, applicable from January 2026, strengthening PFAS control and the protection of drinking water quality.

For groundwater, the Water Act (Zakon o vodah – ZV-1) and the Decree on Groundwater Status (Uredba o stanju podzemnih voda) establish the national framework for groundwater protection, monitoring and chemical status assessment. The regulatory provisions include quality standards and threshold values for relevant pollutants to support the protection of groundwater resources. No specific national PFAS quality standards have been established, with the broader national and EU water protection framework providing the main reference for PFAS monitoring and assessment.

Overall, the Slovenian regulatory framework combines PFAS requirements for drinking water with a broader approach to water resource protection. Expanding PFAS monitoring in groundwater could strengthen the assessment of contamination patterns and potentially affected resources, contributing to the selection of effective management, treatment and remediation solutions.

## SPAIN

PFAS management in Spain forms part of a broader national approach to environmental and public health protection, with no dedicated national PFAS action plan currently in place. The Strategic Plan for Health and Environment 2022–2026 (PESMA) addresses PFAS within its actions on emerging chemical contaminants, promoting the reduction of exposure and the substitution of hazardous substances to strengthen environmental and human health

protection.

For drinking water, Royal Decree 3/2023 of 10 January (Real Decreto 3/2023) establishes the national regulatory framework and implements the Drinking Water Directive (EU) 2020/2184. The legislation sets parametric values of 0.10 µg/L for PFAS Sum and 0.50 µg/L for PFAS Total. In addition, transitional values of 0.07 µg/L for each of PFOA, PFOS, PFNA and PFHxS were introduced at national level, applicable until 2 January 2026, reinforcing the control of individual PFAS in water intended for human consumption.

For groundwater, the national regulatory framework includes the Consolidated Water Law (Texto Refundido de la Ley de Aguas) and Royal Decree 1514/2009 of 2 October, which establish the basis for groundwater protection, chemical status assessment, pollutant threshold values and the identification of pollution trends. The framework was further developed through Royal Decree 665/2023, introducing a risk-based approach for the assessment and management of point-source groundwater contamination, including generic groundwater quality values and procedures for the remediation of affected aquifers. No specific national PFAS quality standards for groundwater have been established within this regulatory framework.

Overall, the Spanish regulatory framework integrates specific PFAS requirements for drinking water with broader measures for groundwater protection and contamination management. The introduction of risk-based assessment procedures for affected aquifers strengthens the capacity to identify contamination and supports the definition of targeted monitoring, management and remediation measures.

## SWEDEN

PFAS management in Sweden has been reinforced through the adoption of a National Action Plan for PFAS in July 2026, providing a coordinated framework for reducing PFAS releases and environmental contamination. The plan defines six priority areas addressing mapping, technological development, monitoring, remediation, phase-out measures and cooperation between authorities and relevant stakeholders. Designed as an evolving framework, the plan can incorporate new scientific, technical and regulatory developments, with a formal review scheduled no later than 1 October 2029.

The national strategy places strong emphasis on reducing PFAS releases at source and preventing further environmental contamination. Measures under the action plan include the development of restrictions on PFAS use in selected consumer products, supporting a broader preventive approach. These actions complement initiatives focused on improving knowledge of PFAS occurrence, remediating contaminated areas and promoting the development of safer alternatives and treatment technologies.

For drinking water, Sweden applies specific PFAS requirements in force since 1 January 2026. The national framework establishes a limit of 4 ng/L for PFAS-4, comprising PFOS, PFOA, PFNA and PFHxS. In addition, Sweden considers the broader PFAS-21 group, extending drinking water monitoring beyond the PFAS-20 group established at European level.

For groundwater, Sweden has established PFAS-specific criteria for the assessment of chemical status. The current framework applies a value of 90 ng/L for PFAS-11 for the classification of good chemical status, pending the formal adoption of updated criteria by the Water Authorities. In parallel, SGU-FS 2023:1, subsequently amended by SGU-FS 2024:1, introduces a threshold of 4.4 ng PFOA-equivalents/L for PFAS-24, incorporating a toxicity-based approach to the assessment of PFAS contamination in groundwater.

Sweden has established a comprehensive framework for PFAS management, integrating water quality requirements with measures addressing pollution prevention, environmental monitoring, contaminated sites and technological development. The 2026 National Action Plan reinforces this approach by promoting coordinated action across environmental compartments and supporting the implementation of PFAS prevention, treatment and remediation strategies.

## Policy and governance gaps

Despite progress in PFAS regulation and improvements in environmental surveillance, important policy and governance challenges remain across Europe. Variations between national frameworks have resulted in different analytical requirements, regulatory thresholds and criteria for evaluating contaminated sites and defining remediation needs. This fragmentation reduces the comparability of information across Member States and may hinder the development of a consistent European response to PFAS contamination.

At the same time, public understanding and stakeholder participation vary considerably across countries, potentially affecting the acceptance and implementation of measures to address PFAS pollution. Improved access to information, risk communication and involvement of relevant actors can facilitate informed decision-making, reinforce public confidence and contribute to long-term strategies covering PFAS prevention, treatment and remediation.

The implementation of innovative PFAS treatment and remediation technologies may be constrained by regulatory and administrative requirements. Variations in permitting

procedures and the lack of specific guidance for managing historical PFAS contamination may create barriers to the transition from demonstration to full-scale deployment. More clearly defined regulatory pathways, supported by suitable financial instruments, could accelerate technology implementation and clarify aspects related to responsibility, cost allocation and long-term environmental monitoring.

A further challenge relates to the coordination of chemicals, water and waste policies. Treatment and remediation processes may transfer PFAS between water, solid residues and other environmental compartments, highlighting the need for coordinated management across the different regulatory areas. Greater policy integration would facilitate a life-cycle approach to PFAS management, addressing contamination from source prevention and monitoring to treatment and the appropriate management of PFAS-containing residual streams.

Addressing these challenges requires closer coordination between European and national authorities, more consistent approaches to PFAS monitoring and assessment, and suitable regulatory and financial instruments to support the uptake of effective treatment technologies. Stronger cooperation across policy areas and consistent application of regulatory measures would contribute to a more integrated and sustainable framework for PFAS management across Europe.

# Recommendations for European policymakers

Based on the results of the **LIFE SOuRCE project** and the assessment of the current European regulatory framework, a set of policy recommendations has been defined to advance PFAS management and promote more sustainable approaches to water protection across Europe.

## Harmonise PFAS monitoring and assessment criteria

The analysis conducted within LIFE SOuRCE identifies differences among Member States in the implementation of PFAS monitoring, assessment and regulatory control. The Drinking Water Directive (EU) 2020/2184 has introduced an important common basis for water intended for human consumption; however, national frameworks continue to differ in the PFAS substances covered, environmental quality criteria, and remediation trigger values.

Several Member States, including Sweden, Belgium, Germany, Italy and the Netherlands, have developed additional national PFAS values, monitoring schemes and assessment criteria extending beyond the minimum requirements established at EU level. In other countries, PFAS management remains primarily based on the common European framework. This diversity of approaches affects the consistency and comparability of environmental data and may introduce uncertainty for water utilities, contaminated-site managers and stakeholders involved in treatment and remediation activities.

Greater consistency in PFAS monitoring across environmental compartments would help reduce current differences among Member States. Harmonised approaches covering groundwater, surface water, drinking water, wastewater, soils and contaminated sites, combined with common analytical methods, quality assurance procedures and reporting

practices, would strengthen the reliability and comparability of PFAS data across Europe.

Establishing harmonised criteria for PFAS risk assessment and remediation would support a more coordinated response across Europe. Common criteria for identifying priority contaminated sites, assessing potential risks to human health and the environment, setting remediation targets and evaluating treatment effectiveness would improve consistency in decision-making. Clearer regulatory guidance would also facilitate the transition of innovative treatment technologies from demonstration to full-scale application.

Creating a centralised European PFAS information platform could strengthen access to and exchange of relevant information by integrating monitoring data, contamination inventories, treatment performance and remediation outcomes. Such a resource would facilitate knowledge sharing among Member States, improve data accessibility and contribute to evidence-based regulatory and management decisions.

Future monitoring strategies should account for the wide and continuously evolving range of PFAS present in the environment. Progressively adopting a broader group-based approach, with sufficient flexibility to include newly identified substances and relevant transformation products as analytical capabilities advance, would enhance the capacity of regulatory frameworks to address emerging PFAS-related concerns.

## Promote innovative remediation technologies

Effective management of PFAS contamination across Europe requires robust regulatory frameworks combined with effective treatment and remediation technologies capable of addressing different contamination scenarios and operational conditions. Promoting the development, demonstration and deployment of innovative solutions represents a key element of a long-term European strategy for PFAS management.

European and national authorities could support the transition of innovative technologies from pilot and demonstration activities to full-scale deployment through appropriate regulatory and financial mechanisms. Public funding, large-scale demonstration programmes, innovation procurement schemes and dedicated financial instruments would help overcome implementation barriers and facilitate the validation and replication of treatment solutions under representative field conditions.

Regulatory frameworks play an important role in supporting the deployment of innovative PFAS treatment technologies. Clear permitting procedures, harmonised criteria for treatment performance and risk-based assessment methods would increase regulatory certainty for technology developers, site owners, operators and investors. Transparent requirements for demonstrating treatment effectiveness would facilitate wider implementation of innovative solutions while maintaining a high level of human health and environmental protection.

Knowledge transfer and capacity building represent key elements for supporting the wider adoption of innovative PFAS technologies. Disseminating performance results, operational experience, best practices and lessons learned from demonstration projects such as LIFE SOuRCE would provide valuable information for decision-making and strengthen confidence

in emerging treatment solutions. Increased cooperation among research organisations, public authorities, technology providers, water utilities and remediation practitioners would promote technological development and support the replication of successful solutions under different site and operational conditions.

Supporting innovation and the wider deployment of effective treatment technologies would contribute to European objectives for water resource protection, drinking water safety and pollution prevention. Continued investment in development, demonstration and replication of remediation solutions would strengthen Europe's response to PFAS contamination and foster a sustainable and competitive environmental technology sector.

## Strengthen the Polluter Pays Principle

Effective PFAS management requires appropriate and sustainable financial mechanisms to support prevention, monitoring, remediation and environmental restoration. In line with Article 191 of the Treaty on the Functioning of the European Union (TFEU), the Polluter Pays Principle provides a key basis for allocating the costs associated with PFAS contamination to the parties responsible, strengthening environmental accountability and long-term pollution management.

PFAS contamination is commonly linked to industrial operations, firefighting activities, airports, military sites, waste management facilities and manufacturing processes involving PFAS-containing materials. The financial responsibility for site investigation, treatment and remediation may otherwise be transferred to public authorities, water utilities and consumers, placing additional pressure on public resources and potentially slowing the implementation of remediation measures.

European and national authorities should strengthen mechanisms for identifying responsible parties and ensuring appropriate allocation of investigation and remediation costs, in accordance with applicable legal and technical conditions. Clear liability rules, transparent enforcement procedures and effective cost-recovery mechanisms would reinforce environmental responsibility and encourage the prevention and reduction of PFAS releases at source.

Dedicated financial mechanisms could support the management of legacy PFAS contamination, particularly when responsible parties cannot be identified or are no longer operational. Contributions from relevant economic actors could provide resources for dedicated remediation funds supporting site investigation, treatment and environmental restoration, reducing the risk of financial limitations delaying the implementation of necessary remediation measures.

Application of the Polluter Pays Principle could promote the adoption of safer alternatives and more sustainable chemical management practices. Integrating the environmental costs associated with PFAS use and releases into regulatory and economic decisions would strengthen pollution prevention, encourage the substitution of hazardous substances and support technological innovation, contributing to the reduction of future PFAS contamination.

Effective implementation of the Polluter Pays Principle would promote a more equitable and sustainable framework for PFAS management across Europe, reinforcing environmental responsibility and reducing the financial burden placed on society. This approach would contribute to water resource protection, pollution prevention and the achievement of long-term European environmental and public health objectives.

## Improve coordination across policy sectors

The complexity of PFAS contamination requires coordinated action across multiple policy areas, including chemicals regulation, water protection, waste management, industrial emissions, public health and contaminated-site management. Improved integration across these regulatory areas would reduce fragmentation and inconsistencies, supporting a more effective implementation of PFAS prevention, management and remediation measures.

LIFE SOuRCE project highlights the importance of a life-cycle approach to PFAS management, addressing their presence and transfer across soil, groundwater, surface water, wastewater, air emissions and waste streams. Stronger coordination among European policies covering chemicals, water, industrial activities and waste would promote integrated PFAS management across the different stages of their life cycle and help prevent the transfer of contamination between environmental compartments.

Improved integration of monitoring and regulatory data strengthens decision-making for PFAS management. Information generated through chemical registration, industrial emissions control and environmental monitoring supports the management of water resources, identification of PFAS contamination sources and prioritisation of affected sites. Remediation strategies also need to address PFAS-containing residual streams, ensuring appropriate treatment and disposal to minimise the risk of transferring contamination between environmental compartments.

Enhanced cooperation among environmental authorities, water agencies, public health institutions, industrial regulators, research organisations and relevant stakeholders would promote effective information exchange and support consistent approaches to PFAS management. Cross-sector working groups and knowledge-sharing mechanisms would facilitate coordinated decision-making, transfer of experience and the replication of successful practices across Member States.

Future policy development needs to strengthen the link between pollution prevention and remediation, promoting a comprehensive approach to PFAS contamination. Actions focused on reducing PFAS releases at source, substituting hazardous substances and advancing innovative treatment technologies represent complementary components of an integrated and long-term PFAS management strategy.

Greater coordination across policy sectors supports a more consistent and effective European approach to PFAS management, facilitating the efficient use of available resources and advancing common objectives for pollution prevention, water resource protection and long-term environmental sustainability.

# Roadmap for implementation

Coordinated European response to PFAS contamination requires a structured implementation pathway integrating regulatory progress, technological development and long-term governance. A phased roadmap provides a common direction for Member States, facilitating the validation, replication and progressive deployment of effective PFAS treatment and remediation solutions across different environmental and operational contexts.

In the short term (1–3 years), priority actions focus on establishing a common basis for coordinated PFAS management across Member States. Harmonised monitoring and analytical protocols are essential to improve the consistency and comparability of PFAS data. The development of European databases and common reporting systems can strengthen access to information on PFAS occurrence, contamination sources, treatment performance and regulatory compliance. During this initial phase, pilot-scale demonstration and performance validation provide relevant evidence under representative conditions, supporting the evaluation of treatment technologies and their progression towards larger-scale implementation.

In the medium term (3–6 years), priority actions focus on the progressive integration of PFAS remediation into existing water management and regulatory frameworks. Incorporating remediation objectives into European water policies can strengthen the connection between monitoring, risk assessment and treatment implementation. Common procedures for technology validation and permitting can support the approval and replication of innovative solutions across Member States. Dedicated funding mechanisms and public–private partnerships can further facilitate the transition from demonstration to full-scale deployment in industrial, municipal and contaminated-site applications.

In the long term (6–10 years), priority actions focus on the widespread deployment of sustainable PFAS treatment and remediation solutions across Europe, supported by knowledge and experience gained from demonstration and full-scale applications. Incorporating PFAS prevention and reduction objectives into national and regional water management strategies can strengthen the long-term protection of water resources and advance European pollution reduction goals. Continuous monitoring, periodic performance assessment and regulatory review can support the evaluation of progress and facilitate the

integration of new scientific evidence, emerging PFAS and relevant transformation products into future management approaches.

**The roadmap provides a structured framework for progressing from harmonised monitoring and technology demonstration towards wider implementation and long-term PFAS management. The combination of regulatory consistency, technological innovation, financial mechanisms and continuous evaluation can strengthen Europe's capacity to address PFAS contamination and support progress towards sustainable water management and the objectives of the EU Zero Pollution framework.**

## From roadmap to real-world application

The LIFE SOuRCE project, funded by the European Union's LIFE Programme, supports the practical implementation of the proposed roadmap through the demonstration of innovative and cost-effective solutions for PFAS-contaminated groundwater at pilot sites in Spain and Sweden. Demonstration under representative conditions provides valuable evidence on the technical applicability and performance of remediation technologies in real environmental and operational contexts.

The multi-barrier treatment approach developed and validated within LIFE SOuRCE integrates complementary technologies for the separation, concentration and degradation of PFAS. Combining separation and destructive processes enables different stages of PFAS treatment to be addressed within an integrated system, supporting effective and sustainable remediation of PFAS-contaminated water.

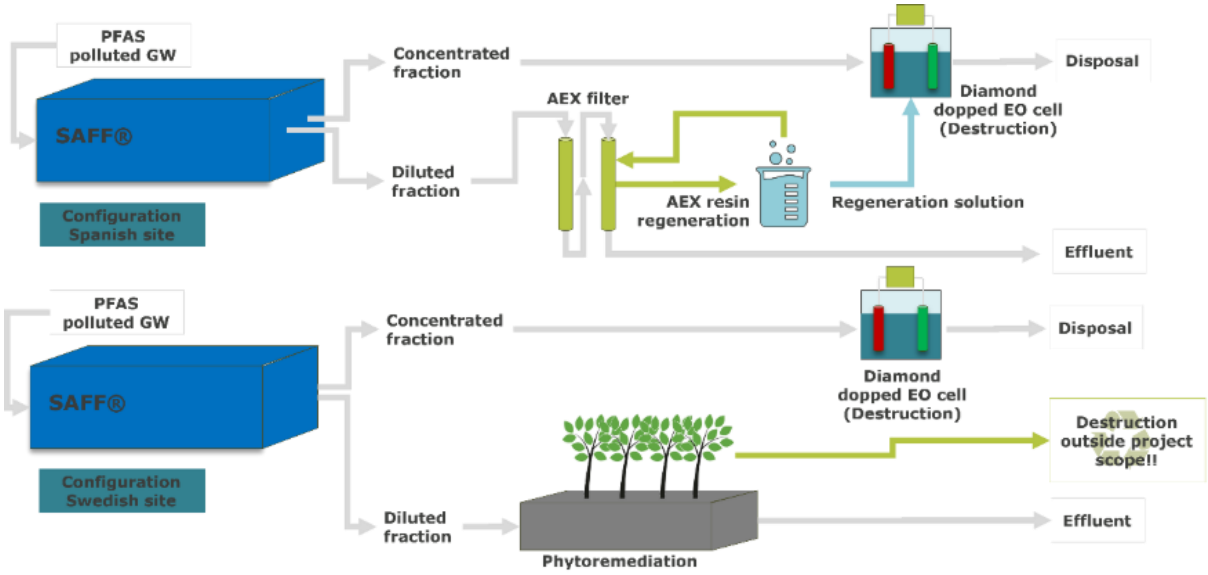
Demonstration activities provide the basis for evaluating treatment performance, operational feasibility and scalability, generating relevant technical and economic information to support future full-scale implementation. Results obtained under pilot conditions also contribute to defining operational requirements and key implementation parameters, facilitating the replication and adaptation of the treatment approach to different PFAS contamination scenarios.

Through the demonstration and validation of integrated treatment solutions, LIFE SOuRCE supports the transition from technology development to practical PFAS remediation under representative conditions. The knowledge and experience generated by the project provide a basis for the replication and wider implementation of effective treatment approaches, supporting the long-term protection and sustainable management of European water resources.

## Demonstration of the LIFE SOuRCE treatment

LIFE SOuRCE project implements an **integrated pump-and-treat system** for the remediation of **PFAS-contaminated groundwater**, combining four complementary technologies—**SAFF, AEX, PHYTO, and EO**—to maximize removal and degradation efficiency. The treatment train operates sequentially: PFAS are first **concentrated by foam fractionation (SAFF)**, then **further reduced through anion exchange (AEX)**, while **phytoremediation (PHYTO)** provides natural

polishing of residual contaminants. The concentrated stream is treated by **electro-oxidation (EO)**, where PFAS are broken down into less harmful compounds.




## Key Lessons Learned from LIFE SOuRCE

The LIFE SOuRCE project has provided relevant technical and operational knowledge on the application and scalability of innovative PFAS remediation technologies under representative field conditions. Demonstration activities conducted at the Spanish and Swedish sites confirm the potential of integrated treatment configurations combining PFAS separation, concentration, polishing and destruction, supporting the development and future implementation of effective and sustainable approaches for PFAS-contaminated water.

A key outcome of the project is the relevance of a **multi-barrier treatment strategy** for addressing different PFAS fractions. SAFF provides the initial separation and concentration step, complemented by AEX and PHYTO for the treatment of residual PFAS according to their physicochemical behaviour. EO provides the destructive treatment stage for PFAS-enriched streams, contributing to PFAS degradation and reducing the residual load requiring further management.

The demonstration activities highlight the different treatment behaviour of long- and short-chain PFAS. SAFF achieves effective separation and concentration of long-chain compounds, while short-chain PFAS require additional treatment steps to enhance removal performance. Results from the demonstration sites underline the relevance of complementary polishing technologies and process optimisation for addressing these more mobile and persistent PFAS fractions.

Operational experience highlights the importance of adapting treatment configurations to site-specific groundwater conditions and PFAS contamination profiles. Variations in PFAS composition and concentration, water characteristics and the presence of co-contaminants

affect treatment performance and operational requirements. Flexible treatment configurations, combined with continuous monitoring and optimisation of key operating parameters, support stable and effective performance under variable field conditions.

The project provides relevant insights into the application of electrochemical oxidation for PFAS destruction. EO treatment of PFAS-enriched streams promotes the degradation and mineralisation of PFAS, with the fluorine mass balance supporting the conversion of organically bound fluorine into inorganic fluoride. Operational aspects including energy demand, electrode performance and process control remain key considerations for the optimisation, long-term operation and future scale-up of the technology.

From an environmental perspective, the LIFE SOuRCE treatment approach demonstrates the benefits of integrating PFAS removal and destruction within the same remediation strategy. Concentrating PFAS into reduced-volume streams prior to destructive treatment limits the volume requiring intensive processing and reduces the generation of PFAS-containing residual streams requiring further management. This strategy contributes to resource efficiency, pollution prevention and the sustainable management of contaminated water resources.

The demonstration provides relevant evidence on the scalability and replication potential of the individual treatment technologies. The modular configuration of SAFF and AEX facilitates their adaptation to different treatment capacities and PFAS contamination profiles. PHYTO offers a complementary nature-based treatment option, with its applicability influenced by available space, environmental conditions and site-specific treatment requirements. These findings highlight the relevance of selecting and integrating technologies according to the characteristics and remediation objectives of each site.

Finally, LIFE SOuRCE underlines the importance of stakeholder engagement, regulatory integration and long-term monitoring for the effective implementation of PFAS remediation strategies. Collaboration among public authorities, water managers, technology providers, research organisations and local stakeholders supports the deployment of treatment solutions, facilitates compliance with regulatory requirements and promotes the acceptance and wider replication of innovative PFAS remediation approaches.

The experience gained through LIFE SOuRCE confirms the applicability of integrated and flexible treatment trains for PFAS remediation under representative operating conditions. The technical and operational results generated provide a solid basis for the optimisation, replication and progression of the demonstrated technologies towards full-scale implementation across Europe.

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