Greater collaboration is needed across the water sector to harmonise and standardise measurement approaches, generate and publish PFAS in drinking water monitoring data across UK, and develop improved remediation solutions to meet stricter action standards for PFAS in drinking water. Sector bodies could help coordinate this effort.

Ensure that, as far as possible, the pollutor pays for the delivery of wholesome water. Based on evidence relating to sources of PFAS use in the UK, the use of PFAS is widespread across virtually all production sectors. The chemicals and related industries, water sector, and government should work together to provide a fair funding system so that polluters, rather than water consumers, pay for the monitoring and remediation activities

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It is likely that the greatest risks of harm from PFAS exposure to wildlife and humans would be if toxic PFAS were ingested orally in harmful concentrations in food and drinking water. Therefore, to prioritise the minimisation of human exposure in the short term, regulators should first focus on investigating the evidence for the most common sources of and pathways to direct oral exposure to PFAS. This policy position focuses on contaminated drinking water as the most risky route of exposure to PFAS in the general population and the corresponding regulatory options that could improve management of PFAS in the environment.

Evidence for PFAS in UK waters and in UK Drinking Water

Following presentations at an RSC expert-led event on PFAS in water in November 2022, and the RSC's independent research, there is clear evidence to show that PFAS are present in UK surface and groundwaters.[16] However, environmental monitoring for PFAS has been patchy and inconsistent, using varied criteria for which PFAS are measured, and different analytical methods and limits of detection. Data from the Environment Agency (England & Wales), and more recently from research by Stéphane Horel presented in Le Monde (and other media outlets), indicate that there is widespread PFAS presence in water in the UK and

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status of PFAS monitoring in the UK and existing regulation related to PFAS. Defra are also looking at the whole landscape of PFAS policy for England; some matters will be within devolved environment policy in Scotland, Wales, and Northern Ireland.

GB REACH is the primary method of regulating industrial chemicals in the GB market, but many PFAS fall outside the scope of the REACH registration process. The HSE notes in its RMOA that IIn UK REACH, there are 36 individual PFAS registered with the potential that 40 others could be registered by the final registration deadline. This does not provide the whole picture with respect to the PFAS market in GB as it is likely that some PFAS are manufactured or imported below the UK REACH registration threshold of 1

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Applying the TWI of 4.4. ng/kg bw/week in the context of drinking water intake, one would assume that a 70kg adult drinks 2 litres of water per day, equivalent to 14 litres of water a week. For a 70 kg adult, the TWI represents a weekly intake of 4.4 ng/kg bw/week x 70 kg = 308 ng/week. For an assumed weekly intake of 14 litres of water, this would equate to a safe level of 22 ng/L per day for a sum of the four PFASs: PFOS, PFOA, PFHxS and PFNA.

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Since 2021 when the DWI introduced the list of 47 PFAS for testing, water companies and laboratories have invested in improved analytical testing capabilities and standardised methods. However, methods for testing for PFAS in water are constantly evolving, and there are accredited analytical methods for only a limited number of substances. Currently, methods often vary from lab to lab, and data is not always comparable. The government could support the development of standardised and accredited methods for testing PFAS in the environment.

There are two main approaches to testing water for PFAS, by targeting PFAS as a group or as individual substances. The grouped approach evaluates the total amount of PFAS (or a reliable indicator for total PFAS, such as organic fluorine). The individual approach evaluates the concentration of specific well-defined substances. Both have pros and cons (see Table 3).

	• Limits total amount of PFAS in water, capping total risk • More manageable amount of testing required	

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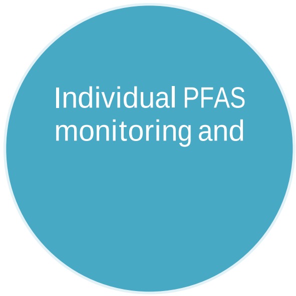
report. There are two options for this standard: sum of PFAS, which looks for the sum of concentrations of a defined list of PFAS, or total PFAS, which looks for the total amount of PFAS present without identifying individual substances.

If using the sum of PFAS method, there are two further options for determining the list of substances. First, the regulator could use the current DWI list of 47 PFAS, which would align this standard with the current testing regime. Alternatively, the list of 20 PFAS from the EU sum of PFAS standard could be used. It could be useful, given the persistence and mobility of PFAS in rivers and seas and the EU being our closest geographical neighbour, to harmonise these standards as much as possible.

Water companies that measure levels in drinking water above 100 ng/L using sum or total PFAS methods would be required to remediate immediately to 100 ng/L or less, according to the actions currently prescribed in DWI rules for Tier 3.

Final drinking water should meet all requirements for individual and total PFAS in order to meet a definition of ‘wholesome’ for the consumer. Such an approach to regulation would assure the best protection for human health now and for future generations, and it would contribute to meeting the sustainable development goals for water quality.



Requirements for final drinking water to be considered wholesome

Conventional water treatment systems are not always equipped to remove PFAS effectively, nor is it proven that existing strategies are effective. Also, PFAS-containing sewage sludge from wastewater treatment plants is often spread on land or transferred to landfill, where PFAS are rereleased into the environment. Commonly used methods for filtering PFAS out of drinking water supplies include activated carbon, ion exchange, and membrane filtration, which result in PFAS-laden waste that must be treated or disposed of without rereleasing PFAS into the environment. Also, there is currently limited available information to judge their effectiveness and cost in water treatment facilities, and further information is urgently needed.

Within a reasonable timeframe, water treatment plants should be required to have technology in place that can adequately remediate water to the lowest levels defined by new statutory standards. It is understood from our research that new technologies are available for this purpose; however, concern remains about the cost of implementation, especially as water companies are being made to address a problem that stems from outside sources. Companies should also prepare plans for the management and appropriate disposal of filter or other wastes that may contain concentrated PFAS, in order to lessen the risk of PFAS re-entering the environment.

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Although it is out of scope for this policy position to have a full discussion of the available remediation technologies, it is important to support the continued research, development, and commercialisation of new methods for remediating and destroying PFAS such that they do not pollute the environment. Currently, UK investment in new technologies is difficult to obtain for entrepreneurial SMEs. There are opportunities for collaboration between industry, academia, and the water sector to innovate in this space. Regulatory tools and new standards can also be used to incentivise change ə for example, producers and users of PFAS could be made to pay a levy per unit of PFAS used, which could encourage them to look for alternatives to PFAS and fund effective end of life management of PFAS in the waste and water systems.

Final thoughts on policy implementation

The actions laid out in this policy position are not linear. Some, such as a national PFAS inventory, will take time to develop. Others can and should be implemented at the earliest opportunity. Importantly, a precautionary approach requires that we do not wait to take action where possible, based on the scientific evidence we have today. Our approach is focused on human consumers and drinking water. Stricter controls of factory emissions at source will also enhance the quality of water for wildlife and make the downstream remediation of water by the water sector to meet drinking water standards an easier challenge.

Additionally, PFAS are mobile in water, so pollution in the UK could originate internationally in addition to known domestic sources. These policy options are described in the context of the UK, but we would advocate that these policy options can be applied in any jurisdiction. If all of the world adheres to stricter action standards, the global burden of PFAS pollution in water and as measured in human beings and wildlife will reduce over the years ahead.

The UK has an opportunity to be a leader in this area by taking decisive regulatory action now. We would like to see the formation of a collaborative PFAS action group involving government, academia, PFAS manufacturing, product manufacturing industry, and the water sector ə to develop joint funding solutions, reduce factory emissions using the best available technology, improve monitoring of PFAS in water, and increase the use of water remediation technologies to assure new standards for drinking water can be met.

The Royal Society of Chemistry would be happy to discuss any of the issues raised in our statement in more detail. Any questions should be directed to the RSC Policy & Evidence Team at policy@rsc.org. This document was prepared by Stephanie Metzger with support from Camilla Alexander-White and Geena Goodwin of the RSC Policy & Evidence Team. Our position was developed following an RSC engagement event in November 2022 with members of the RSC and the wider international scientific community. Special thanks to Sue Bullock, Daniel Brown, Rebecca Miller, and Mike Padgham of TSG Consulting for providing scientific evidence and to expert reviewers Dr. David Megson, Dr. Stephen Mudge, and Prof. Tom Welton.

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members include those working in large multinational companies and small to medium enterprises, researchers and students in universities, teachers and regulators. There are numerous ways in which chemical scientists are working towards a sustainable, clean and healthy planet, and this position

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