Submission
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INQUIRY INTO INQUIRY INTO PFAS CONTAMINATION IN WATERWAYS AND DRINKING WATER SUPPLIES THROUGHOUT NEW SOUTH WALES

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Australia's National
Science Agency

Inquiry into the extent, regulation and management of PFAS

Select Committee on PFAS (per-and polyfluoroalkyl substances

CSIRO Submission 24/082

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Executive Summary

PFAS are considered contaminants of critical concern due to their persistence, widespread distribution in the environment, and potential for adverse impacts on human health and the environment. It is a global issue that requires a concerted and global effort.

As Australia's national research agency, CSIRO's primary focus has been on providing evidence-based research on detection, quantifying pathways of exposure, ecotoxicological assessment and monitoring, and effectiveness of treatment technologies and practices for per- and polyfluoroalkyl substances (PFAS).

CSIRO does not have a role with establishing or operationalising federal or state regulatory frameworks, but when requested does contribute appropriate science outcomes that can underpin their establishment and revision in addition to open publishing of relevant science more generally. We partner across the breadth of regulatory agencies, industry and community groups to understand and fill knowledge gaps and advance technologies that would assist with defining, prioritising and controlling risks from chemicals such as PFAS.

There now exists an extensive body of data and information in Australia on PFAS, non-disclosed and publicly available, presented in numerous federal and state government agency reports, human and environmental risk assessments, industry, and consultant reports, and peer-reviewed scientific publications. Accelerating the integration and mapping of this data would enhance our understanding of PFAS distribution and scale across Australia, enable robust human and environmental risk assessments, and make informed and effective management decisions at local and regional scales.

There remain significant knowledge gaps in PFAS distribution and scale (i.e., waters, soils, sediments and biota) across Australian geographic and climate conditions. Most research to date has focused on contaminated sites (point sources), however, PFAS contamination can often extend beyond these sites into larger parts of the environment (e.g., due to atmospheric transport, product release, or via multiple sources within catchments). There is uncertainty in the longevity of sources of PFAS once in the environment and their release rate from soils and other impacted materials. The establishment of PFAS anthropogenic background in media across (soils, waters, atmosphere and biota) is needed to support site / regional risk assessments and clean-up levels.

There is also likely an underestimation of the future impacts of PFAS in Australia, as current monitoring programs and assessments focus on the three main regulated chemicals – perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), and perfluorohexanesulphonic acid (PFHxS). PFAS in the environment can be preset in many chemicals of which we have little understanding of fate and effects in the environment. CSIRO is focused on the development of ultrahigh resolution non-targeted techniques and advanced systems biology (multi-omics) ecotoxicology approaches for the early detection of PFAS in samples and understanding their impacts for rapid response and management practices.

Remediation costs of PFAS are high, driven by the low guideline and regulatory levels. Non-destructive technologies, such as filtration through materials that capture PFAS (e.g., activated carbon, ion exchange resins, membranes) or Australian-developed foam fractionation, can treat water to meet health-based guidance values. These technologies are well-established and widely commercially available. However, they generate a concentrated waste stream that needs to be managed (e.g., landfilling, destruction). Destructive technologies such as thermal technologies can break down PFAS but are very expensive and not widely available yet. Unfortunately, best practices are still in development for most remedial technologies, especially destructive ones.

A greater investment and coordination in PFAS research and development, linking government agencies, across Australia is needed to prioritise key areas and accelerate innovation and solutions to ensure the protection of environmental health and communities.

CSIRO response to the Terms of Reference (ToR)

CSIRO, as Australia's national science agency, welcomes the opportunity to provide input to the Senate Select Committee on PFAS: Inquiry into the extent, regulation, and management of PFAS.

CSIRO has addressed the ToR (a-k) outlined by the Senate Select Committee on PFAS.

CSIRO's primary focus has been on providing evidence-based research on detection, quantifying pathways of exposure, ecotoxicological assessment and monitoring, and effectiveness of treatment technologies and practices for PFAS.

(a) The extent of data collection on PFAS contamination of water, soil, and other natural resources.

PFAS are considered contaminants of critical concern due to their persistence, widespread distribution in the environment, and potential for adverse impacts on human health and the environment. Since the 1940-50s, thousands of PFAS have been used worldwide in various consumer, commercial, and industrial products and applications.

An understanding of the distribution and scale of PFAS contamination in Australia is rapidly growing [e.g.,1-5]. There now exists an extensive body of data and information in Australia on PFAS, non-disclosed and publicly available, presented in numerous federal and state government agency reports, human and environmental risk assessments, industry, and consultant reports, and peer-reviewed scientific publications. Accelerating the integration and mapping of this data is needed to enhance our understanding of PFAS distribution and scale across Australia, enable robust human and environmental risk assessments, and make informed and effective management decisions at local and regional scales.

There remain significant knowledge gaps in PFAS distribution and scale (i.e., waters, soils, sediments and biota) across Australian geographic and climate conditions. Most research to date has focused on contaminated sites (point sources), however, PFAS contamination can often extend beyond these sites into larger parts of the environment (e.g., due to atmospheric transport, product release, or via multiple sources within catchments). There is uncertainty in the longevity of sources of PFAS once in the environment and their release rate from soils and other impacted materials. For example, soils have been shown to not only leach PFAS into groundwater and to wash off in surface water flows, but also shown to retain and leach PFAS over long periods.[6] The relative leachability across the PFAS compounds as well as associated field measurement is important so high risk compounds can be prioritised for further assessment and management.[7,8]

PFAS have been identified in Australia at varying levels in waters, soils, sediments, atmosphere, wastes, and biota.[9] Australian wildlife and their young have been found to contain PFAS in their tissues and blood samples following exposure to PFAS in their surrounding environment e.g., dolphins, little penguins, platypus, tiger snakes, freshwater turtles.[10-15] These findings suggest PFAS can be bioaccumulated and maternally transferred in wildlife from the environment. In Australia, most PFAS data for wildlife is derived from deceased animals or collected blood samples, providing only concentration levels and body condition data that lacks key health information.

CSIRO's research seeks to close this gap by evaluating PFAS burdens in conjunction with health and fitness measures using a systems biology and multi-omics ecotoxicology approach. This approach aims to identify major molecular pathways with a significant association to survival, reproduction and fitness. However, its application has so far been restricted to reptiles and amphibians. Additional research is required to encompass wildlife that is nationally important and holds cultural significance for indigenous communities.

PFAS are human-made chemicals, and hence there is no naturally occurring background (baseline) concentration within the environment. Given PFAS now have widespread distribution (e.g., trifluoroacetic acid (TFA) from certain synthetic pesticides, pharmaceuticals, and cooling gases in refrigeration is now well distributed in the environment), there are increasing calls to determine anthropogenic baseline levels for PFAS. This baseline will aid in setting of site-specific levels for remediation/cleanup activities, mitigation strategies and assess risks to the environment, wildlife, and human health (e.g., as per the Victorian Environmental Protection Agency[16] and the Queensland Department of Environment, Science, and Innovation[17] baseline PFAS monitoring programs).

There is likely an underestimation of the future impacts of PFAS in Australia, as current monitoring programs and assessments focus on the three main regulated chemicals – PFOS, PFOA, and PFHxS. PFAS in the environment can consist of many chemicals of which we have little understanding of fate and effects in the environment. Recent advancements in ultra-high resolution non-targeted PFAS analysis now provides a powerful tool to detect a larger number of PFAS (and other contaminants of concern) in complex mixtures occurring in samples [e.g.,18-20]. The use of ultrahigh resolution non-targeted techniques could enable the early detection of PFAS in samples for rapid management and response scenarios. It can also provide a chemical profile (fingerprint) of samples for future examination of emerging contaminants, ensuring that assessments can account for the presence and extent of all PFAS found in samples, identification of sources, and effective remediation or management.

(b) Sources of exposure to PFAS, including through environmental contamination, food systems and consumer goods.

Our understanding of PFAS sources of exposure in Australia has significantly increased in the past 10 years. Sites exposed to aqueous film-forming foams (AFFF) containing PFAS, wastewater treatment plants and landfills are focal points for PFAS contamination. From there, release or discharge of PFAS into the environment can lead to contamination of waters and foods, two major sources of exposure to humans.

PFAS are components and impurities of innumerable commercial and consumer products, which may become sources of exposure.[1] Direct contact with PFAS personal care products or cleaning products may lead to absorption through the skin.[21] PFAS-containing dust may be inhaled from carpets, fabrics, upholstery, cleaning products, plastics, paints[22]. Ingestion of PFAS may occur after exposure of food to grease-resistant packaging [23] or through pharmaceuticals, a significant number of which can be classified as PFAS.[24] Occupational exposure may occur at chemical production facilities that use PFAS, such as chrome plating, electronics, and textile manufacturing.[25]

After these products reach the end of their life, the associated PFAS typically end up in landfills or in wastewater treatment plants.[26] In landfills, PFAS can leach into groundwater, contaminating drinking and irrigation water. In wastewater treatment plants, PFAS (e.g., PFOS, PFOA, PFHxS) do not break down and are disposed of in biosolids or discharged in wastewaters. Land application of biosolids and irrigation with wastewater can lead to the contamination of agricultural topsoils.[9,27] This can result in PFAS entering food crops and livestock. Discharges from wastewater treatment plants, may impact groundwater and surface waters an important source of drinking and irrigation water.[27,28] Contaminated drinking water and food are major sources of PFAS exposure in humans.[28,29] PFAS can also be present in the atmosphere, but exposure through inhalation may only be significant in specific locations, such as near point sources with high PFAS emissions. However, PFAS concentrations in rain and snow have been reported to be high enough to create a measurable background concentration on the Earth's surface.[30,31]

The Australian Pesticides and Veterinary Medicines Authority (APVMA) evaluates, registers and regulates agrochemicals, including organofluorine compounds in Australia. Several organofluorine compounds have been registered and/or approved for use as insecticides, fungicide, and herbicides in Australia (e.g., fipronil, bifenthrin, flutriafol, and trifluralin).[32] The half-lives of these substances are generally reported to be in months to years. These substances can undergo abiotic/biotic degradation to release shorter chain PFAS such as TFA ($-CF_3$) or mineralised to fluoride. Organofluorine agrochemicals, not registered/approved in Australia, with more than eight perfluorinated carbon atoms (e.g., sulfluramid and flursulamid insecticides)[33] have been reported in the literature with the potential to degrade in the environment to regulated PFAS (e.g., PFOS).

(c) The health, environmental, social, cultural, and economic impacts of PFAS

CSIRO's primary focus has been on providing evidence-based research on detection, quantifying pathways of exposure, ecotoxicological assessment and monitoring, and effectiveness of treatment technologies and practices for PFAS.

Human health: The published literature indicates that most people will encounter PFAS in their lives and are likely to have PFAS in their bodies from everyday use of items such as cookware, textiles, cosmetics, and plastics.[34] These chemicals have been found in Australian recreational waters, drinking water, and foods [e.g.,4,5,9,16,17,27-29]. Higher levels are likely to be found in individuals residing and environments close to regions where AFFF containing PFAS were used for fire-fighting purposes (e.g., airports and fire-fighting training facilities, fuel processing and storage).

There is increasing evidence that long-term exposure to some PFAS can be harmful to human health.[28,29,35] While this evidence is still developing, there is increasing global concern about the persistence and mobility of these chemicals in the environment. The National Health and Medical Research Council (NHRMC) and Food Standards of Australia and New Zealand (FSANZ) are the main bodies responsible for development of PFAS guidelines for drinking and recreational water, and food intake, respectively. Unless located near PFAS contamination areas, the concentrations in waters and foods are typically below the regulated levels. However, further research is needed to accurately map out the distribution and scale of PFAS contamination in waters and foods across

Australia. There is also increasing international concerns about the much wider range of PFAS than those subjected to current regulations.

Environmental: The Department of Climate Change, Energy, the Environment and Water (DCCEEW), working with all states and territories, has developed the PFAS National Environmental Management Plan (PFAS NEMP)[9]. This document(s) provides nationally agreed guidance and standards on the investigation, assessment, and management of PFAS wastes and contamination in the environment, including prevention of the spread of contamination. This guidance includes soil criteria for investigation (human health-based and ecological guidance values), terrestrial and aquatic biota guideline values, reuse of wastes (e.g., biosolids) and site-specific guidance on principles and approaches to remediation and management. CSIRO's evidence-based research has informed the PFAS NEMP [e.g.,10, 37-39]. There remain significant knowledge gaps in PFAS distribution and scale (waters, soils, sediments and biota) across Australian geographic and climate conditions, and effects on biota (especially Australian native and/or culturally relevant species) exposed to PFAS throughout their lifetime (chronic effects). The impacts on aquatic ecosystems, and terrestrial and semi-terrestrial wildlife that rely on them are further compounded by the bioaccumulation of PFAS throughout the food web. Research by CSIRO on wildlife, employing advanced ecotoxicology through systems biology and multi-omics-based approaches, indicates that chronic exposure to PFAS mixtures may be affecting Australian reptiles. [12,13,37,39]. Specifically, multigenerational effects on freshwater turtles suggesting population effects in areas with high PFAS levels.[10]

Social/cultural: CSIRO provides evidence-based research on the distribution and scale of PFAS in waters, soils, sediments and biota at sites and regions than can be used by stakeholders to assess environmental risks and target remediation and management practices. Residents near contaminated sites can face higher costs associated with managing PFAS contaminated water sources (e.g., having to pay for alternative water supplies, switching from bore water to town water). Properties and houses near to PFAS impacted areas can be subject to depreciation and/or face difficulty in selling and renting. Producers in PFAS-affected areas can suffer reputational harm and income loss from being unable to sell or export crops and/or livestock. PFAS contaminated areas such as waterways maybe be closed or restricted from recreational activities such as fishing[40]. First Nations people can feel a disconnection to Country, uncertainty around long-term health outcomes, access to culturally significant sites, waters, and foods.[41]

Economic: Accurate estimates of the economic impacts of PFAS in Australia are lacking. Some international and global estimates of costs have been published. There are positive economic impacts that need to be balanced against negative impacts. PFAS are manufactured outside of Australia, generating about $6bn annually in profits.[42] The major economic benefit of PFAS, however, does not stem from manufacturing, but from their use in other products and applications. PFAS are used in many industries and a global valuation estimate does not exist. One example with critical use of PFAS is the semiconductor industry. While the industry is screening for replacement chemicals, there are some processes (e.g., plasma etch/wafer clean applications) for which there are no known viable substitutes. This industry generates around $1000bn in annual revenue and directly provides over 500,000 jobs worldwide.[43] Likewise, there are critical uses in the medical and pharmaceutical industries, for which there are currently no known replacement chemicals.

In contrast, remediation costs of PFAS are high, driven by the low guideline and regulatory levels that are required to be achieved. The estimated costs for cleaning up for ~ 1 kg of perfluoroalkyl acids (i.e., fully fluorinated PFAS that include the regulated PFOA, PFOS, and PFHxS) from water, biosolids, and landfill leachate are on the order of double-digit million dollars per year.[44] Meeting the new drinking water regulations in the U.S. (i.e., 4 ng/L for PFOS and PFOA) is estimated to cost up to US$1.5 bn per year for monitoring, communication, and if necessary obtaining new or additional water sources or installing and maintaining treatment technologies.[45] In the UK, remediation costs for between 2,900 and 10,200 high-risk sites were estimated to be between $61bn and $237bn.[46] In addition to remediation costs, there has been a noticeable decline in property and house prices in PFAS impacted areas, making it difficult for residents to sell or improve their properties.[41] One study estimated that the global societal cost of using PFAS, including health care costs, totals about $26tn annually.[42]

(d) Challenges around conducting and coordinating health and exposure research into PFAS, including the adequacy of funding arrangements and the influence of the chemicals industry over the evolving body of scientific evidence on the health effects of PFAS, including in respect to First Nations communities.

Australian research funding is increasing (state and federal Government departments and industry) primarily due to increased regulatory pressure (setting of national and state levels), the potential for litigation and expensive remediation costs, increased community concerns and expectations, recognition that if not managed correctly will lead to large numbers of contaminated sites for future generations to manage (legacy sites), and international obligations recognising PFAS as a global contaminant of concern (e.g., US EPA and ECHA).

CSIRO sees an opportunity for further investment in research and development targeting PFAS risks and treatment, linking agencies across Australia to address priority concerns. No such scaled funding program exists but would greatly advance solutions to the PFAS challenge facing Australia.

Incorporating environmental PFAS and effects data in longitudinal studies is essential. While measuring PFAS concentrations is a key part of any risk assessment, understanding its effects is crucial. Although PFAS effects have been demonstrated in short-term ecotoxicological exposure studies, understanding the effects on aquatic and terrestrial biota exposed to PFAS throughout their lifetime is limited.

A 2024 study by CSIRO on short necked turtles found PFAS exposure impacted the metabolic processes, reproductive success, and hatchling fitness.[10] High PFAS levels were found in turtle tissues from contaminated areas, with gravid females producing eggs with depleted nutrients and minerals, affecting reproductive strategies within the population. Higher rates of hatchling deformities, such as abnormal scales, were linked to changes in skeletal developmental proteins. There was also an absence of juvenile turtles at contaminated sites that suggested reduced recruitment and long-term population declines. Additional research is essential to understand how PFAS exposure can affect Australian wildlife (especially native and culturally significant species) and ecosystems on a geographical and climatic scale, across Australian states and territories. This includes considering sub-lethal exposures and extending beyond traditional endpoints by employing systems biology (multi-omics) techniques that encompass comprehensive resilience, fitness, and health metrics.[47]

(e) The effectiveness of current and proposed federal and state and territory regulatory frameworks, including the adequacy of health-based guidance values, public sector resourcing and coordination amongst relevant agencies in preventing, controlling and managing the risks of PFAS to human health and the environment.

CSIRO does not have a role with establishing or operationalising federal or state regulatory frameworks, apart from assisting with science outcomes that can underpin their establishment and revision. As Australia's national research agency, it is CSIRO's role to partner across the breadth of regulatory agencies, industry and community groups to understand and fill knowledge gaps and advance technologies that would assist with defining, prioritising and controlling PFAS risks.

CSIRO's primary focus has been on providing evidence-based research to inform regulation [e.g.,37-39], quantifying pathways of exposure [e.g.,6-8], future proof risk assessments (e.g., sensors, chemical profiling "fingerprints", and revolutionising ecotoxicology through a systems biology and multi-omics based approaches) [e.g.,10,12, 20,47,48], and develop and evaluate mitigation approaches for rapid response scenarios (e.g., sealants, adsorbents) [e.g.,49-51], destructive technologies (e.g., thermal) [e.g.,52,53], and nature-based solutions (e.g., phytoremediation, entomo-remediation (insects), microorganisms)[e.g.,54-56] for PFAS.

(f) The role, liability and responsibility of government agencies and industry in the production, distribution, contamination, and remediation of PFAS, including obligations under the Stockholm Convention on Persistent Organic Pollutants and other relevant principles and international conventions.

Australia does not manufacture PFAS but has been using PFAS for a long time in a wide range of consumer products and industrial applications. The PFAS National Environmental Management Plan (NEMP) has several guiding principles; with one being the polluter pays i.e., those who generate pollution and waste should bear the cost of containment, avoidance, or abatement.[9] The definition of PFAS (e.g., from small molecules such as TFA to large polymers) and clean up level will significantly influence the number of sites and remediation costs. The total removal of PFAS from the environment will be difficult due to widespread distribution in the environment from multiple sources and critical role many PFAS play in the transition to clean energy (Li-ion batteries), medical devices, semiconductor, pharmaceutical, and agrichemical industry globally with no known replacement chemicals (at present).

In Australia, PFAS regulation is mainly focused on PFOS, PFOA, and PFHxS, and their direct and indirect precursors. This focus is due to their presence in a wide range of consumer products and industrial applications, detection in humans and environmental biota, and adequate/sufficient toxicity data to establish causality. In general, these PFAS can act as indicators for the presence of a broad range of PFAS. CSIRO has a focus on development of ultrahigh resolution chemical profiling techniques to enable early detection of PFAS in samples for environmental assessments and rapid management and response scenarios. It can also provide a chemical profile (fingerprint) of analysed samples for future examination of emerging contaminants, ensuring that assessments can account for the presence and extent of all PFAS found in samples (future proofing assessments), as well as the attribution to known sources.

The Australian Industrial Chemicals Introduction Scheme (AICIS) regulates the import and manufacture of industrial chemicals such as PFAS in Australia.[57] Importers and manufacturers must comply with legal obligations under the Industrial Chemicals Act 2019[58]. They enforce import and export controls on PFAS (e.g., PFOS, PFOA, PFHxS) under the Rotterdam and Stockholm Conventions [59,60]. Australia does not automatically adopt the conventions controls for these chemicals but must take measures to eliminate or reduce their release into the environment. Since 2003, AICIS has recommended restricting PFAS containing AFFF to essential use only. The Australian Department of Defence commenced phasing out PFAS containing AFFF in 2004, Fire and Rescue NSW stopped using PFAS containing AFFF in 2007, and the SA Government banned the use of fluorinated AFFF in 2018.

Many articles and products imported into Australia can contain PFAS (known and unknown) (e.g., water- and stain-resistant products), and green assurances do not always indicate the absence of PFAS.

(g) The adequacy and effectiveness of government engagement with and support for communities disproportionately affected by PFAS contamination, including fair and appropriate compensation schemes.

CSIRO does not have a role in such government engagement with communities nor decisions on compensation. As Australia's national research agency, it is CSIRO's role to partner across the breadth of regulatory agencies, industry and community groups to understand and fill knowledge gaps and advance technologies that would assist with defining, prioritising and controlling risks from PFAS.

(h) The effectiveness of remediation works on specific sites and international best practices for remediation and management of contaminated sites.

Our understanding of PFAS treatment technologies and practices has significantly improved over the past 10 years. Treatment technologies exist to reduce PFAS movement into the environment (e.g., sealants, adsorbents) and remove PFAS to below regulatory levels (e.g., water filters, resins), but these do not destroy PFAS. Destructive technologies for PFAS are expensive and still in the development/validation phase, including their best practices.

Many well-established remediation approaches that work for other environmental contaminants, such as biodegradation or UV-light irradiation, have proven ineffective or highly inefficient for PFAS. Several new technologies, or what were niche technologies until recently, such as electrochemical or plasma treatment, have been developed.[53,61] However, there is rarely a single remediation technology that resolves all PFAS problems at sites.

Generally, one can distinguish between two types of treatment: destructive and non-destructive technologies.[53,61] Non-destructive technologies, such as filtration through materials that capture PFAS (e.g., on activated carbon, ion exchange resins, membranes) or Australian-developed foam fractionation,[62] can treat water to meet health-based guidance values. These technologies are well-established and widely commercially available. However, they generate a concentrated waste stream that needs to be managed (e.g., landfilling, destruction).[61] Destructive technologies can break down PFAS all the way into small, naturally occurring molecules such as carbon dioxide, fluoride, and water.[52,53,63] However, PFAS destruction is very expensive and not widely available yet.[53] Currently, the only off-the-shelf technology for PFAS destruction for large volume waste streams is thermal destruction, such as hazardous waste incineration.[52,64] A combination of non-destructive PFAS removal with subsequent PFAS destruction in the concentrated waste stream is often the most sustainable and cost-efficient approach to dealing with PFAS.[61] Unfortunately, best practices are still in development for most remedial technologies, especially destructive ones. International best practices therefore do not exist. In some cases, this has led to a stark contrast in remedial guidance and legislation across jurisdiction's, such as for the incineration of materials containing PFAS in Germany (preferred)[65] versus the U.S. (currently prohibited for the U.S. Department of Defense).[66]

(i) International best practices for environmental and health risk assessments, reduction, and management of PFAS contamination and exposure.

There are increasing calls to regulate or phase out PFAS at an international level.

The European Chemicals Agency (ECHA) is currently evaluating a submission by European Union (EU) Countries (Germany, Denmark, the Netherlands, Norway, and Sweden) to restrict the “manufacture, placing on the market, and use of PFAS” in Europe.[67] The persistent organic pollutants regulation in the EU restricts the use of PFOS, PFOA, PFHxS and related compounds. The EU REACH list of Substances of Very High Concern included other PFAS chemicals (e.g., PFHpA, PFBS), as having probable serious effects to human health and the environment, to be replaced with safer alternatives. In 2021, the EU criteria for drinking water were established at a limit of 0.1 μg/L for the sum (n=20) of PFAS (including PFOS, PFOA, and PFHxS), and 0.5 μg/L for total PFAS.

In 2024, the United States Environmental Protection Agency (US EPA) designated PFOS and PFOA as hazardous substances which enables US government entities to hold responsible parties for contamination to pay for cleanup costs.[68] The US EPA recently released new enforceable national limits (maximum contaminant levels) for five PFAS: PFOA, PFOS, PFNA, PFHxS, and HFPO-DA (also known as “GenX Chemicals”).[69] The standard also sets a limit for mixtures of any two or more of four PFAS: PFNA, PFHxS, PFBS, and HFPO-DA in drinking water. The US EPA estimates that ~6-10 % of the 66,000 public drinking water systems in the USA may need to take action to reduce PFAS to meet these new standards. The USA has initiated or is considering numerous bills or restriction on PFAS manufacture and use to protect human and environmental health. In 2021, Maine was the first US state to bring into law a phase out of the sale and use of products containing intentionally added PFAS by 2030, except for “currently unavoidable” uses.[70] The law was modified in 2024 to a phase out of products by 2032 and ban of PFAS in key products such as cookware, textiles, children’s products, cosmetics, and menstrual products by 2026 instead of 2030, and in artificial turf, outside apparel for extreme weather conditions and fluorinated containers by 2029. Minnesota state has since introduced in 2023 a law to restrict the uses of PFAS by 2032, ban PFAS in products such as cookware, dental floss, and menstrual products by 2025, and require companies to disclose if they are using PFAS in any product.

(j) Areas for reform, including legislative, regulatory, public health and other policy measures to prevent, control and manage the risks of PFAS to human health and the environment, including the phasing out of these harmful substances.

Several areas to consider for regulatory/policy measures, include:

- Strategic investment and coordination in PFAS research and development, linking government agencies, across Australia to prioritise key areas and accelerate innovation and solutions to ensure the protection of environmental health and communities.
- A restriction or phase out of some PFAS in products, especially in textiles, clothes, cooking utensils, and cosmetics to reduce human exposure and accumulation into the environment. Some PFAS may be readily replaced while maintaining desired properties but others with no readily available replacement or safety concerns will be more complex. Regrettable substitutions need to be avoided, where PFAS are substituted for another PFAS or potentially hazardous chemical. Higher costs in some products may result due to chemical replacements or substitutions.
- Future proofing risk assessments and management outcomes through non-targeted screening to account for the presence and extent of all PFAS in samples.
- Establishment of Australian PFAS anthropogenic background levels in media (i.e., soils, waters, atmosphere and biota) across geographic and climatic conditions to support site / regional risk assessments and clean-up levels.
- Expand research on Australian wildlife (especially native and culturally significant species) including sub-lethal exposures and beyond traditional endpoints by employing systems biology (multi-omics) techniques that encompass comprehensive resilience, fitness, and health metrics.
- PFAS's role in a move to a more circular economy and transition to net zero. These chemicals could enter recycling or alternative waste streams, or be introduced in new products (e.g., electrolyte in Lithium-ion batteries).
- Development of best practice for remediation technologies (e.g., use and long-term management of treatment wastes e.g., resins, adsorbents used for water treatment), especially destructive ones.

(k) Any other related matters.

CSIRO recognises the scale of the problem, and the urgent need to prioritise and act so Australians and their environments can be safe. Greater efforts are required to truncate the risks posed by PFAS. Working in partnerships with others, CSIRO acknowledges its role in seeking to accelerate and expand its efforts to help.

CSIRO extends an invitation to the committee to visit laboratories and sites across Australia (Canberra, Adelaide and Brisbane) where we can demonstrate our capability in the detection of PFAS in environmental matrices, assessment of ecological risks, and treatment technologies.

Abbreviations

AFFF - Aqueous Film-Forming Foams

AICIS - Australian Industrial Chemicals Introduction Scheme

APVMA - Australian Pesticides and Veterinary Medicines Authority

CSIRO – Commonwealth Scientific and Industrial Research Organisation

DCCEEW - Department of Climate Change, Energy, the Environment and Water

ECHA - European Chemicals Agency

FSANZ - Food Standards of Australia and New Zealand

HFPO-DA (GenX) - Hexafluoropropylene Oxide-Dimer Acid

N/A - No Response

NHMRC - National Health and Medical Research Council

PFAS - Per- and polyfluoroalkyl Substances

PFAS NEMP - PFAS National Environmental Management Plan

PFBS - Perfluorobutanesulfonic Acid

PFHxS - Perfluorohexanesulphonic Acid

PFNA - Perfluorononanoic Acid

PFOA - Perfluorooctanoic Acid

PFOS - Perfluorooctanesulfonic Acid

TFA - trifluoroacetic Acid

US EPA - United States Environmental Protection Agency

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