UNSW SYDNEY
Water Research Laboratory
School of Civil and Environmental Engineering

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Dear Senate Select Committee on PFAS,

A brief overview of my expertise: I'm a Professor and Deputy Head of School (Research) in the School of Civil and Environmental Engineering at the University of New South Wales Australia. I'm actively working to develop destructive PFAS treatment technologies, as well as investigating the factors that control the fate of PFAS in the environment. My research has been funded by the Australian Research Council as well industry. I currently serve on the Independent Monitoring Committee of Orica's Botany Bay groundwater remediation project, helping the public with the complexities of this project through the Orica Botany Liaison Committee. Furthermore, I also provide independent consulting advice at a range of PFAS contaminated sites in Australia.

Per- and polyfluoroalkyl substances (PFAS) constitute a class of over 14,000 chemicals that have been used extensively in a range of consumer and industrial products since the 1950s, including in fire-fighting foam, given their exceptional interfacial properties and stability. **As such PFAS contamination to the environment is through a wide range of activities, including firefighting activities, stormwater, landfills, wastewater treatment plants and land application of biosolids.** PFAS originally embodied in consumer and industrial products is not well known. We certainly have quantified a few PFAS in these products however identifying others is akin to finding a needle in a haystack, requiring analytical chemical instruments that cost ~$1M and requiring 10s to 100s hours for each commercial product. There are thousands of products on, or previously on, the market that contain PFAS. Chemical manufacturers would likely know, or have a much better idea, of the range of PFAS they put into products. However, chemical manufacturers typically don't share this information as it is suggested it is commercial in confidence. **Given the negative human health and ecosystem impacts related to PFAS, and that many of these PFAS are being phased out, it is recommended that industry be compelled to provide much more information related to the range and mass of PFAS that have been historically used to help better direct health and ecosystem investigations.**

Over the last 25 years an increasing body of research has raised concerns related to the human health and (eco)toxicological impacts of some PFAS. For example, the World Health Organization now lists **two PFAS as carcinogens or possible carcinogens: perfluorooctanoic acid (PFOA) as a Group 1 carcinogen and perfluorooctanesulfonic acid (PFOS) as a Group 2B carcinogen.** Furthermore international governmental agencies (e.g., European Union European Environment Agency and US Center for Disease Control) articulate a wide range of negative health outcomes associated with PFAS (e.g., https://www.eea.europa.eu/publications/emerging-chemical-risks-in-europe and https://www.atsdr.cdc.gov/pfas/health-effects/index.html).

Our study published earlier this year in *Nature Geoscience* investigated the global extent of PFAS in our surface and groundwaters (https://www.unsw.edu.au/newsroom/news/2024/04/pfas-forever-chemicalsabove-drinking-water-guidelines-in-global-source-water). To do this we developed an extensive global dataset from 273 international studies since 2004 which include data for over 12,000 surface water, and 33,900 groundwater samples. As PFAS are not naturally occurring, any PFAS found in the environment was introduced from a wide range of consumer and industrial products, including aqueous film forming foams (i.e., firefighting foam). **Our study found that while Australia has no PFAS manufacturing facilities there are a number of highly contaminated PFAS sites from firefighting activities. We show that a significant fraction of sampled surface and groundwater throughout the world exceeds PFAS drinking water guidance values,** with the extent of exceedance depending on the jurisdiction and PFAS source. Note this is PFAS in environmental water and not typically drinking water. **Our study could not adequately quantify the future PFAS environmental burden as not enough PFAS are typically quantified when sampled**. Currently only three PFAS are regulated in the *Australian Drinking Water Guidelines* (i.e., PFOA, PFOS and perfluorohexanesulfonic acid (PFHxS)), with a fourth likely be to be added (i.e., perfluorobutane sulfonic acid (PFBS)). As such water utilities typically only quantify these three or four PFAS in drinking water, when PFAS is quantified. Of note is that a wider range of PFAS (e.g., 28 PFAS) are quantified at Department of Defense firefighting sites but these data are typically only available in locked PDF files making independent analysis and interpretation difficult.

In Australia to date PFAS has typically only been quantified in drinking water when there is a suspected PFAS source to a drinking water source, however **results from our study, and Sydney Water's recent discovery of PFAS in drinking water at the Cascade filtration plant in the Blue Mountains, suggest that PFAS is likely to be found in drinking water even when there is no suspected source.**

Regulators worldwide have often proposed or regulated a much wider range of PFAS in drinking water than that of Australia. One of the most restrictive recommendations for drinking water is Health Canada's, with the sum of all PFAS being less than 30 ng/L whereas the European Union recommends the sum of all PFAS being less than 500 ng/L or the sum of 20 select PFAS being less than 100 ng/L. **The recent NHMRC review of PFAS drinking water guidance limited their scope to only five PFAS** (PFOS, PFHxS, PFOA, PFBS and hexafluoropropylene oxide dimer acid (GenX)) from the outset of their review (https://www.nhmrc.gov.au/health-advice/environmental-health/water/PFAS-review/questions-and-answers), recommending that four be subject to drinking water criteria. The rationale for limiting the scope to five PFAS is following US EPA health advisories. Of note is that the US EPA also now includes perfluorononanoic acid (PFNA) in their drinking water guideline recommendations (i.e., a total of six PFAS). A range of PFAS is also subject to the Stockholm Convention for the protection of human health and the environment from persistent organic pollutants (POPs) (i.e., PFOS, PFHxS, PFOA and potentially all long chain perfluoroalkyl carboxylic acids). The new NHMRC draft drinking water guidelines do not include or consider all PFAS on the Stockholm Convention list.

Given this it is recommended that the NHMRC consider a much wider range of PFAS for drinking water guidelines which would be consistent with the European Union and Health Canada. Ultimately the NHMRC may determine there is inadequate information for drinking water guidelines, but at the very least additional PFAS should be considered. **More governmental funding should be made available to facilitate investigation of the human health and ecosystems impacts of PFAS in addition to better understand the environmental fate of PFAS. Additionally, it is recommended that a much wider range of PFAS are quantified in our source and drinking waters** (i.e., beyond the three or four typically quantified), especially given the limited additional cost associated with quantifying additional PFAS.

Communication of human health and ecosystem impacts of PFAS in comparison to regulatory guidance is challenging, particularly as guidance differs throughout the world. **Adoption of an open and transparent approach is recommended such that the public trusts governmental agencies.** For example, recent governmental communication (e.g., August 2024) would suggest that drinking water from the Cascade filtration plant is safe for human consumption, however draft NHMRC guidance suggests that over one's lifetime it would not be safe for human consumption. New research is continually becoming available, and undoubtedly PFAS guidance will change with time, as such **governmental agencies need to develop a communication plan of openness and transparency to ensure public confidence. At the moment many of the public are afraid to consume drinking water even though PFAS would be below all international drinking water standards/guidelines**.

A range of technologies can effectively remove PFAS from drinking water (e.g., activated carbon, ion exchange resins) but these technologies have finite sorption capacity and are not destructive, simply concentrating and relocating PFAS. Given this, disposal of spent activated carbon and anion exchange resin stockpiles represents a future legacy challenge. Destructive PFAS technologies are currently costly with a significant carbon footprint (e.g., incineration of activated carbon with PFAS) or only in development. **As such, much more research funding is needed to develop cost effective PFAS treatment technologies.**

In summary PFAS is pervasive in the environment with unknown human and ecosystem impacts. Please let me know if you have any questions. While PFAS is the focus of this inquiry, additional focus should also be on society's use, fate and impacts of anthropogenic chemicals more generally.

Yours sincerely,

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