AORA Position Statement
PFAS In Compost Products
Version 1: September 2023

What are PFAS?
Per- and polyfluoroalkyl substances (PFAS) are a group of manufactured chemicals that have gained significant attention due to their potential impacts on human health and the environment. These compounds are unique because of their strong carbon-fluorine bonds, making them resistant to degradation and extremely persistent in the environment.

Chemical Properties and Uses
PFAS are widely used in various consumer and industrial products due to their special properties. They are known for their water and oil repellent characteristics, heat resistance, and non-stick qualities. As a result, PFAS have been used in products like non-stick cookware, stain-resistant fabrics, carpets, food packaging, personal care products such as dental floss and shampoo, firefighting foams, and more. However, their widespread use and persistence has raised concerns about their potential long-term effects.

Behaviours and Main Risks
PFAS can enter the environment through various pathways, including industrial releases, firefighting operations, and the use and disposal of consumer products. Once released, they can travel long distances and contaminate water sources and soil, and harm plants and animals.

One of the main health concerns is that PFAS can accumulate in the bodies of living organisms and persist in the environment for years. There is currently no consistent evidence that exposure to PFAS causes adverse human health effects. However, based on the evidence from animal studies potential adverse health effects cannot be excluded.

Researchers and regulatory agencies are diligently studying and addressing the potential risks associated with PFAS to protect human health and our natural environment. Efforts are being made to better understand these substances and develop measures to manage and mitigate their impact.

PFAS in Compost Products
Compost products may contain trace concentrations of PFAS, mainly through their inclusion in certain compost feedstocks. Feedstocks can be materials like biosolids from wastewater treatment plants, agricultural wastes contaminated with pesticides, or domestic 'FOGO' (Food Organics, Garden Organics).

PFAS are commonly found in feedstocks at low concentrations due to their widespread presence across various environmental media. Most of the contaminant mass flow of PFAS into compost is via diffuse ambient contamination, rather than being due to producers accepting contaminated feedstocks. When feedstocks are composted, the diffuse PFAS present in them may end up in the final compost product. It should though be emphasised that the organics recycling industry does not use, manufacture, or handle PFAS in any of its processes.

The ubiquity and persistence of PFAS in the environment makes it challenging to avoid their presence in compost feedstocks and the resultant products. These chemicals can persist in the soil and water for many years, contributing to a continuous source of exposure.

How are PFAS controlled?
The PFAS National Environmental Management Plan (the NEMP) Version 2.0 was developed by the Heads of Environment Protection Agencies (EPAs) Australia and New Zealand (HEPA), to provide guidance on managing PFAS contamination. This plan outlines assessment and management strategies to protect human health and the environment from PFAS exposure.

The NEMP 2.0 includes assessment criteria to determine safe concentrations of PFAS in soils. However, the guidelines are evolving as more research and knowledge about PFAS becomes available. While Version 2.0 provides valuable guidance, it is expected to be updated in the future (PFAS NEMP 3.0) to account for the latest scientific findings and understanding of PFAS behaviour. This update will include further guidance on the management of PFAS in recycled organics products.

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AORA Position Statement: PFAS In Compost Products

Version 1: September 2023

How are PFAS controlled? Cont…

The legislation, regulations and guidelines related to PFAS management are relatively new, and the understanding of PFAS behaviour and its potential impacts is continuously evolving. Due to the inherent uncertainty associated with contaminants like PFAS, regulators tend to take a cautious approach when developing risk models and setting guideline values. This conservatism ensures that robust protective measures are in place until a more comprehensive understanding of PFAS risks is achieved.

What PFAS concentrations are in compost?

Recent chemical data provided by reputable compost producers in Australia suggests that PFAS concentrations in compost products can vary but are typically found at trace concentrations. According to a recent study conducted by Sivaram et al. (2022), the total concentration of PFAS in commercial composts, garden soils, and potting mixes produced and sold across Australia ranged between 1.3 and around 12 micrograms per kilogram (µg/kg).

The available findings support the theory that achieving a 'PFAS-free' commercially produced compost is technically impossible. As previously mentioned, the widespread presence of PFAS in the environment means that it is highly likely that some level of PFAS contamination will be present in compost products.

While efforts can be made to minimise PFAS concentrations, the complex nature of compost feedstocks makes it challenging if not impossible to eliminate these contaminants. Therefore, it is essential that producers focus on responsible organics recycling practices and proper waste management to mitigate PFAS exposure, rather than trying to offer a 'PFAS-free' label on their product. Furthermore, it is important that compost users have the context they need to make good decisions and can identify to what extent PFAS may pose a risk.

Comparative PFAS Concentrations

To put 'typical' PFAS concentrations in commercial compost products into context, it is useful to compare these concentrations against soils for various land uses, other types of compost, virgin feedstocks, consumer and other products, per Table 1.

Table 1: Comparison of Typical PFAS Concentrations: Examples from Various Literature and Guidelines

Example Sample Media	Max Conc. µg/kg	Media Specific PFAS Compounds
PFAS in Soils		
PFAS Source Site[1]	<6,500	Total PFAS
Urban Land[2]	<30	PFOS & PFHxS
Mixed Use Land[2]	<16	PFOS & PFHxS
Agricultural Land[2]	<9	PFOS & PFHxS
Natural Land[2]	<2	PFOS & PFHxS
Guideline Value[3]	<10	PFOS & PFHxS
PFAS in Compost Products		
Wastewater Biosolids[4]	<910	Total PFAS
Contaminated Compost[5]	<75	Total PFAS
Commercial Compost[6]	***<12***	***Total PFAS***
Guideline Value[7]	<1	PFOS & PFHxS
PFAS in Other Products		
Popcorn Packaging[8]	<18,200	FTOH
Cosmetic Products[9]	<10,500	Total PFAS
Fast-food Packaging[10]	<7,180	Total PFAS
PTFE Film / Sealant Tape[11]	<1800	PFOA
Carpet in Childrens Daycare[12]	<471	Total PFAS
Talcum Powder[13]	<35	PAPs
Sunscreens[13]	<19	Total PFCA

[1]Høisæter, Å., Pfaff, A., & Breedveld, G. D. (2019). Leaching and transport of PFAS from aqueous film-forming foam (AFFF) in the unsaturated soil at a firefighting training facility under cold climatic conditions. Journal of contaminant hydrology, 222, 112-122. This data reflects soil sampled from a PFAS source zone at firefighting training grounds in Norway.

[2]EPA Victoria (2022). Summary of PFAS concentrations detected in the environment in Victoria. Publication 2049. This data reflects soil sampled from ambient land uses (not PFAS source sites) and adjacent to freshwater bodies or 'riparian' samples.

[3]Heads of EPAs Australia and New Zealand (HEPA 2020). PFAS National Environmental Management Plan 2.0. Residential with garden/accessible soil (HIL A) and Sum of PFOS and PFHxS.

[4]Moodie, D., Coggan, T., Berry, K., Kolobaric, A., Fernandes, M., Lee, E., Reichman, S., Nugegoda, D., & Clarke, B. O. (2021). Legacy and emerging per-and polyfluoroalkyl substances (PFASs) in Australian biosolids. Chemosphere, 270, 129143. This data reflects biosolids produced in Australian wastewater treatment facilities, intended for agricultural use.

[5]Costello, M. C. S., & Lee, L. S. (2020). Sources, fate, and plant uptake in agricultural systems of per-and polyfluoroalkyl substances. Current Pollution Reports, 1-21. This data reflects USA municipal organic solid waste composts FOGO, containing recyclable food packaging and other plastics contamination.

[6] Sivaram, A. K., Panneerselvan, L., Surapaneni, A., Lee, E., Kannan, K., & Megharaj, M. (2022). Per-and polyfluoroalkyl substances (PFAS) in commercial composts, garden soils, and potting mixes of Australia. Environmental Advances, 7, 100174. This data reflects commercial composts, garden soils, and potting mixes produced and sold across Australia.

[7] Department of Environment and Science, Queensland (DES 2021). Model operating conditions ERA 53(a)—Organic material processing by composting.

[8] Ramírez Carnero, A., Lestido-Cardama, A., Vazquez Loureiro, P., Barbosa-Pereira, L., Rodríguez Bernaldo de Quirós, A., & Sendón, R. (2021). Presence of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) in Food Contact Materials (FCM) and Its Migration to Food. Foods (Basel, Switzerland), 10(7), 1443. Maximum concentration provided is for Total fluoro-telomer alcohols (FTOH).

[9] Whitehead, H. D., Venier, M., Wu, Y., Eastman, E., Urbanik, S., Diamond, M. L., ... & Peaslee, G. F. (2021). Fluorinated compounds in North American cosmetics. Environmental Science & Technology Letters, 8(7), 538-544.

[10]Schwartz-Narbonne, H., Xia, C., Shalin, A., Whitehead, H. D., Yang, D., Peaslee, G. F., ... & Diamond, M. L. (2023).Per-and Polyfluoroalkyl Substances in Canadian Fast Food Packaging. Environmental Science & Technology Letters, 10(4), 343-349.

[11] Begley, T. H., White, K., Honigfort, P., Twaroski, M. L., Neches, R., & Walker, R. A. (2005). Perfluorochemicals: potential sources of and migration from food packaging. Food additives and contaminants, 22(10), 1023-1031. This data reflects perfluorochemicals in consumer products.

[12] Wu, Y., Romanak, K., Bruton, T., Blum, A., & Venier, M. (2020). Per-and polyfluoroalkyl substances in paired dust and carpets from childcare centers. Chemosphere, 251, 126771.

[13] Fujii, Y., Harada, K. H., & Koizumi, A. (2013). Occurrence of perfluorinated carboxylic acids (PFCAs) in personal care products and compounding agents. Chemosphere, 93(3), 538-544.

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Version 1: September 2023

Comparative PFAS Concentrations Cont...

As the table suggests, typical maximum concentrations of PFAS in commercial composts are similar to those recorded in soils on agricultural land, and the current guideline value for soil in residential gardens. This highlights the generally low level of risk associated with these materials.

When compared against common everyday products such as food and drink packaging, cosmetic and topical products and home furnishings, the data suggest that a typical maximum concentration for PFAS in composts of 12 μg/kg represents a very low risk in comparison to other sources and exposure scenarios. While PFAS are likely present in most compost products at low concentrations, these are considered acceptable levels and ultimately represent a very limited risk.

Comparative PFAS Exposure Pathways

When using compost for different applications and end uses, exposure pathways and their associated risks will differ. However, for all land uses where dairy, meat, fruit, vegetables or other foods are grown with the use of compost and other inputs, it is important that compost producers regularly test PFAS levels regardless, to ensure they are within safe limits.

When compost is used on grazing land for the dairy industry, there may be minimal direct human exposure to PFAS, as the compost is applied to the soil and not directly consumed. There can however be indirect exposure through the consumption of dairy or meat products from animals that grazed on compost-treated land. For horticultural land uses, where compost is used for growing fruits, vegetables, or other crops, there is the slightly reduced potential for direct human exposure to PFAS, through the consumption of the grown produce.

While compost sourced from reputable producers typically contains trace levels of PFAS, monitoring PFAS and implementing responsible recycling organics and land-use practices is essential to mitigate potential health and environmental impacts. Ongoing developments in the state of knowledge and best practice will also further support the effective management of PFAS in compost across various land uses.

Compost is Safe

The composting industry is actively evolving to manage the PFAS challenge. New or updated legislation and guidance is being developed, considering the latest scientific understanding of PFAS behaviour and associated risks. These developments are essential for accurately assessing PFAS impacts in compost and establishing reasonable guidelines for its use.

Compost products produced in accordance with Australian Standards AS4454 remain suitable for use and fit for purpose for most urban and agricultural applications and end uses. As the regulatory landscape continues to evolve, it is expected that new or updated national guidelines will be developed, specifically tailored to compost. These guidelines will be informed by scientific research and will more accurately reflect the risks associated with PFAS in compost and address current over-conservatism. This will help foster best practice composting practices and ensure safe use of compost products in various applications.

Based on our current research and knowledge, it is safe to use compost to apply to land (agricultural or urban), to grow vegetables and flowers (professional or private) and to use on sporting/recreational fields.

When produced and managed responsibly, compost contains acceptably low concentrations of PFAS, posing minimal risk. As we continue to advance our understanding and improve regulatory standards, the composting industry will work to further mitigate any potential risks associated with PFAS.

It is important to emphasise that the organics recycling industry does not use, manufacture, or handle PFAS in any of its processes. Allowing the widespread unregulated use of PFAS for industrial and consumer applications and then regulating its detectability at the end of the organic recycling chain is unreasonable.

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