Griffith UNIVERSITY
Australian Rivers Institute

ABN: 78 106 094 461
Sir Samuel Griffith Centre (N78)
Nathan Campus
Griffith University
The Circuit, Nathan, QLD 4111
https://www.griffith.edu.au/australian-rivers-institute

Thursday 8th of December 2022

Committee Secretary
Standing Committee on Climate Change, Energy, Environment and Water
PO Box 6021
Canberra ACT 2600
CCEEW@aph.gov.au

Public Submission to the House of Representatives Standing Committee on Climate Change, Energy, Environment and Water: *Inquiry into and report on the impact of plastic pollution, including microplastics.*

The **Australian Rivers Institute (ARI)** takes this opportunity to provide a submission to the above Inquiry. As the focal point for water-based research at Griffith University, ARI brings together disciplines to create evidence-based research solutions which can inform governments, resource managers, the water industry and the community about the preservation and management of catchment, river, estuarine and coastal ecosystems.

Tackling waterways pollution is a key research focus area which has encompassed plastic waste including microplastics. Our submission responds to the following Terms of Reference:

- the environmental impacts of plastic pollution particularly in oceans and waterways
- the effectiveness of Australia's plastics management framework under the National Plastics Plan and related policies to reduce plastic pollution particularly in oceans and waterways
- the effectiveness of the Australian Government's engagement with states, territories, industry and non-government organisations to reduce plastic pollution particularly in oceans and waterways
- the effectiveness of community campaigns to reduce plastic pollution particularly in oceans and waterways and encourage the use of alternative materials

Submission prepared on behalf of the Australian Rivers Institute by:

Professor Frederic Leusch, School of Environment and Science, Griffith University and Leader ARI Toxicology Research Program, Australian Rivers Institute.

Acknowledgements

I would like to acknowledge the input of the following colleagues in preparation of this submission:

Dr Shima Ziajahromi, Advance Queensland Fellow, Australian Rivers Institute, Griffith University

Prof Chengrong Chen, Professor in Environmental Science, School of Environment and Science, Griffith University

Hsuan-Cheng Lu, PhD candidate, School of Environment and Science, Griffith University

Kushani Perera, PhD candidate, School of Environment and Science, Griffith University

Dr Peta Neale, Research Fellow, Australian Rivers Institute, Griffith University

David Wiseman, Senior Research Development Manager, Australian Rivers Institute, Griffith University

Background

The Standing Committee is no doubt aware of the increasing production, use and waste associated with plastics, and the long-term impacts that plastic products have once released into our environment. But there is also a less visible plastic threat to our environment in the form of microplastics. These are plastic particles smaller than 5 mm that come in a variety of sizes, shapes, and polymer types, and are mostly invisible to our eyes. Microplastics are divided into primary and secondary microplastics depending on their origin:

- Primary microplastics are produced as small particles for industrial and/or domestic use such as pellets used in plastic production or microbeads used in consumer products.
- Secondary microplastics are derived from the breakdown of larger plastic products such as microfibres from synthetic polyester and nylon clothing, fragments of polyethylene, polypropylene and polystyrene food and product packaging, and rubber particles from tyre wear.

Microplastics are now found in all environments, and within all living organisms

The National Plastics Plan (2021) identifies microplastics as an issue of increasing concern for the Australian Government. There is clear evidence of accumulation and adverse effects in small aquatic organisms, at the base of the food chain (Koelmans et al. 2022), as well as accumulation in large fish and mammals due to trophic transfer (Kahare-Rapport et al. 2022). Microplastics have now been found in all environments, including remote polar regions (Mishra et al. 2021), and in food products such as sea salt and beer (Kosuth et al. 2018). There is also clear evidence of human exposure, from food, water, and air (Cox et al. 2019; Jenner et al. 2022), and microplastics have been found in human blood (Leslie et al. 2022) and feces (Yan et al. 2022). The adverse effects of this exposure in humans are still uncertain, although studies with human cells and rodents suggest impacts on gut microbiota and chronic cellular inflammation (Campanale et al. 2020). Microplastic particles smaller than 1 μm may even be able to penetrate inside human cells, where they may cause oxidative stress and interfere with proper cellular function (Lin et al. 2022).

Wastewater is a key pathway for microplastics entering the aquatic environment

The Plan identifies wastewater as a key pathway for microplastics entering the aquatic environment. Wastewater treatment plants are not equipped to remove microplastics, and while wastewater treatment retains 80-95% of microplastics in raw sewage (Liu et al. 2021, Ziajahromi et al. 2021), this causes two problems: 1) the remaining 5-20% of microplastics in treated wastewater still account for billions of microplastics discharged into waterways daily, and 2) microplastics are not degraded by wastewater treatment, but instead are concentrated in the sludge. Sludge, once properly treated into biosolid, can be a valuable source of nutrients for agricultural applications. But the presence of large numbers of microplastics in biosolids raises concerns that its application on land may pollute agro-ecosystems with microplastics.

The voluntary phase out of microbeads has been very successful

The most effective way of reducing microplastic pollution is to tackle it at the source, prior to its release in wastewater systems. An example where this has worked very well is the voluntary industry-led phase out of microbeads from 99.3% of rinse-off cosmetics, personal care, and cleaning products sold in Australia. Initiated in 2015 by State and Federal Environment Ministers, the phase out has now led to microbeads being almost inexistent when monitoring for microplastics in wastewater.

But other microplastics, especially microfibres, are still present

However, monitoring of waterways identifies secondary microplastics, particularly microfibres, are still present and constitute a significant microplastic threat. These originate from garments with synthetic fibres, such as polyester. Everyday billions of microplastic fibres are released via wastewater treatment plants throughout Australia, accumulating in fresh and marine water sediments, and concentrating in the aquatic food chain. Once released in the environment, microplastics - like macroplastics - have very long persistence and will continue to breakdown to smaller sizes, which likely makes them even more harmful to exposed organisms.

Washing machines can release millions of microfibres every wash

A single cycle in a washing machine can shed up to 1,500,000 fibres per wash (De Falco et al. 2019), and clothes washing thus releases vast amounts of microfibres to the Australian environment, via wastewater discharges. Tackling the issue of microfibre release from washing machines should be a priority to tackle microplastics in the Australian environment, and microfibre filters on washing machine are a key step towards this. The Plan indicates that the Australian Government will work with industry to phase in microfibre filters on all washing machines sold in Australia by 2030. *This is an excellent initiative and needs to be fast-tracked.*

Millions of microfibres are also released into indoor air by clothes dryer

We know from recent monitoring studies that microplastics are present in the air. In fact, recent modelling suggests that airborne exposure contributes more than 50% of our daily exposure to microplastics for humans (Cox et al. 2019, Perera et al. 2022). By far the dominant type of airborne microplastics are microfibres. These likely originate from textiles made from synthetic fibres, such as rugs, chairs, and of course clothing (including clothes drying): a domestic tumble dryer can release up to 120,000,000 fibres per year into indoor air (Tao et al. 2022). Thus, *phase-in of microfibre filter on clothes dryers would also be warranted* to reduce microfibre air concentrations in the home environment, as already demonstrated in an Australian proof of concept study (O'Brien et al. 2020).

Public engagement will be key to the success of these measures

Engagement with the public to explain the threat of microplastics is essential for public support. In the roll out of microfibre filters for example, it will be key to plan and educate the public on how to use and clean these filters properly. Indeed, if a user were to rinse the filter in tap water after each use, that would completely negate any potential benefit from use of the filter, as all trapped microplastic fibres on the filter would be released into the same water drain they were prevented from entering in the first place. Strong public engagement on plastic straws has helped support efforts by government and industry to reduce plastic straw use in Australia. A similar concerted effort is needed to effectively reduce microfibre pollution with washing machine and clothes dryer filters.

Stormwater is also an important pathway for microplastics into the environment

Another increasingly recognised pathway for microplastics into the environment that is not mentioned in the Plan is stormwater runoff (Lu et al. 2022). Stormwater can contain both secondary microplastics (tyre wear and road wear particles) as well as airborne microplastics (including microfibres) that have been deposited, and then washed off the surface. Constructed wetlands have been shown to be effective at retaining some of the microplastics from raw stormwater (Lu et al. 2022, Ziajahromi et al. 2020), but it is currently unclear whether those same wetlands act as secondary sources under intense hydraulic pressure, releasing some of the accumulated microplastics during flood events for example. In addition, *filters could be installed in stormwater drains to reduce the amount of microplastics released into the environment* – the practice of using stormwater filters is not uncommon, but its effectiveness in reducing microplastic load needs to be further evaluated. If effective, it would be beneficial to ensure these are more widespread.

Recommendations

Based on our microplastics and microfibres research, we highly recommend that:

1) A public engagement campaign be developed to raise awareness of the threat associated with microplastics and microfibres to our environment and human health

2) The timeline for the phase-in of microfibre filters on washing machines be brought forward from 2030 to as early as possible

3) Concurrent phasing in of microfibres filters on clothes dryers to reduce airborne microfibres

4) A public education strategy be developed to ensure that cleaning of the microfibre filters is done in a way that does not release the captured microfibres back into wastewater

5) Assessment of the effectiveness of stormwater filters to remove microplastics, and if effective wider deployment of these devices to pre-treat stormwater

6) Secondary microplastics are derived from the breakdown of macroplastics. The issue of microplastics requires a whole of plastic assessment, including where necessary a shift away from certain plastic products.

References

Campanale C, Massarelli C, Savino I, Locaputo V, Uricchio VF (2020). A Detailed Review Study on Potential Effects of Microplastics and Additives of Concern on Human Health. *Int J Environ Res Public Health*. 2020 Feb 13;17(4):1212. doi: 10.3390/ijerph17041212

Cox KD, Covernton GA, Davies HL, Dower JF, Juanes F, Dudas SE. (2019) Human Consumption of Microplastics. *Environ Sci Technol*. 53(12):7068-7074. doi: 10.1021/acs.est.9b01517

De Falco F, Di Pace E, Cocca M, Avella M (2019) The contribution of washing processes of synthetic clothes to microplastic pollution. *Sci Rep* 9, 6633. doi: /10.1038/s41598-019-43023-x

Jenner LC, Rotchell JM, Bennett RT, Cowen M, Tentzeris V, Sadofsky LR. (2022) Detection of microplastics in human lung tissue using μFTIR spectroscopy. *Sci Total Environ*. 831:154907. doi: 10.1016/j.scitotenv.2022.154907

Koelmans AA, Redondo-Hasselerharm PE, Nor NHMN, de Ruijter VN, Mintenig SM, Kooi M (2022) Risk assessment of microplastic particles. *Nature Reviews Materials* 7: 138-152. doi: 10.1038/s41578-021-00411-y

Kosuth M, Mason SA, Wattenberg EV (2018). Anthropogenic contamination of tap water, beer, and sea salt. *PLoS One* 13(4):e0194970. doi: 10.1371/journal.pone.0194970

Leslie HA, van Velzen MJM, Brandsma SH, Vethaak AD, Garcia-Vallejo JJ, Lamoree MH (2022) Discovery and quantification of plastic particle pollution in human blood. *Environment International* 163:107199. doi: 10.1016/j.envint.2022.107199

Lin S, Zhang H, Wang C, Su XL, Song Y, Wu P, Yang Z, Wong MH, Cai Z, Zheng C. (2022) Metabolomics Reveal Nanoplastic-Induced Mitochondrial Damage in Human Liver and Lung Cells. *Environ Sci Technol*. 56(17):12483-12493. doi: 10.1021/acs.est.2c03980

Liu W, Zhang J, Liu H, Guo X, Zhang X, Yao X, Cao Z, Zhang T. (2021) A review of the removal of microplastics in global wastewater treatment plants: Characteristics and mechanisms. *Environ Int*. 146:106277. doi: 10.1016/j.envint.2020.106277

Lu HC, Ziajahromi S, Locke A, Neale PA, Leusch FDL (2022) Microplastics profile in constructed wetlands: Distribution, retention and implications. *Environmental Pollution* 313,120079. doi: 10.1016/j.envpol.2022.120079.

Mishra AK, Singh J, Mishra PP (2021). Microplastics in polar regions: An early warning to the world's pristine ecosystem. *Sci Total Environ*. 784 147149. doi: 10.1016/j.scitotenv.2021.147149

O'Brien S, Okoffo ED, O'Brien JW, Ribeiro F, Wang X, Wright SL, Samanipour S, Rauert C, Toapanta TYA, Albarracin R, Thomas KV. (2020) Airborne emissions of microplastic fibres from domestic laundry dryers. *Sci Total Environ.* 747:141175. doi: 10.1016/j.scitotenv.2020.141175

Perera K, Ziajahromi S, Bengtson Nash S, Manage PM, Leusch FDL (2022) Airborne Microplastics in Indoor and Outdoor Environments of a Developing Country in South Asia: Abundance, Distribution, Morphology, and Possible Sources. *Environ Sci Technol.* doi: 10.1021/acs.est.2c05885

Tao D, Zhang K, Xu S, Lin H, Liu Y, Kang J, Yim T, Giesy JP, Leung KMY (2022). Microfibers Released into the Air from a Household Tumble Dryer. *Environ. Sci. Technol. Lett.* 9(2): 120-126. doi: 10.1021/acs.estlett.1c00911

Yan Z, Liu Y, Zhang T, Zhang F, Ren H, Zhang Y (2022). Analysis of Microplastics in Human Feces Reveals a Correlation between Fecal Microplastics and Inflammatory Bowel Disease Status. *Environ Sci Technol*. 56(1):414-421. doi: 10.1021/acs.est.1c03924

Ziajahromi S, Drapper D, Hornbuckle A, Rintoul L, Leusch FDL (2020). Microplastic pollution in a stormwater floating treatment wetland: Detection of tyre particles in sediment. *Science of The Total Environment* 713:136356. doi: 10.1016/j.scitotenv.2019.136356.

Ziajahromi S, Neale PA, Telles Silveira I, Chua A, Leusch FDL (2021). An audit of microplastic abundance throughout three Australian wastewater treatment plants. *Chemosphere*. 263:128294. doi: 10.1016/j.chemosphere.2020.128294