Managing the risks of microplastics when they don’t reach the ocean

Dr Mike Williams| 6th August 2024

I would like to begin by acknowledging the Wurundjeri people as the Traditional Owners of the land that we're meeting on today, and pay my respect to their Elders past and present.

Plastics in the terrestrial environment

Direct discharge

- Plastic products in the environment (tyre dust, artificial turf, pavements etc.)
- Micro- and nanoplastic (up to 150,000 t/yr land and ocean)

Mismanaged waste “leakage”

- Litter, uncontained industrial sites
- Macro- and mesoplastics (up to 10,000 t/yr)

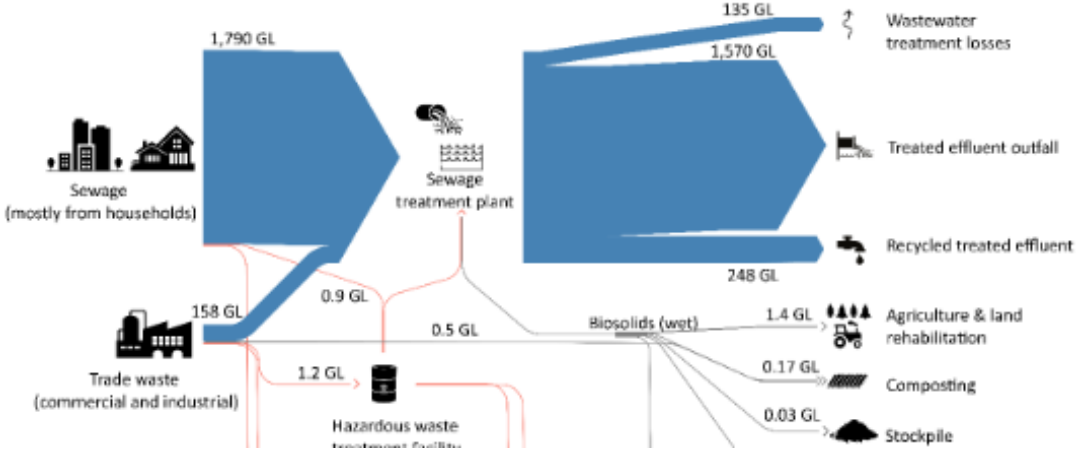
Managed waste “leakage”

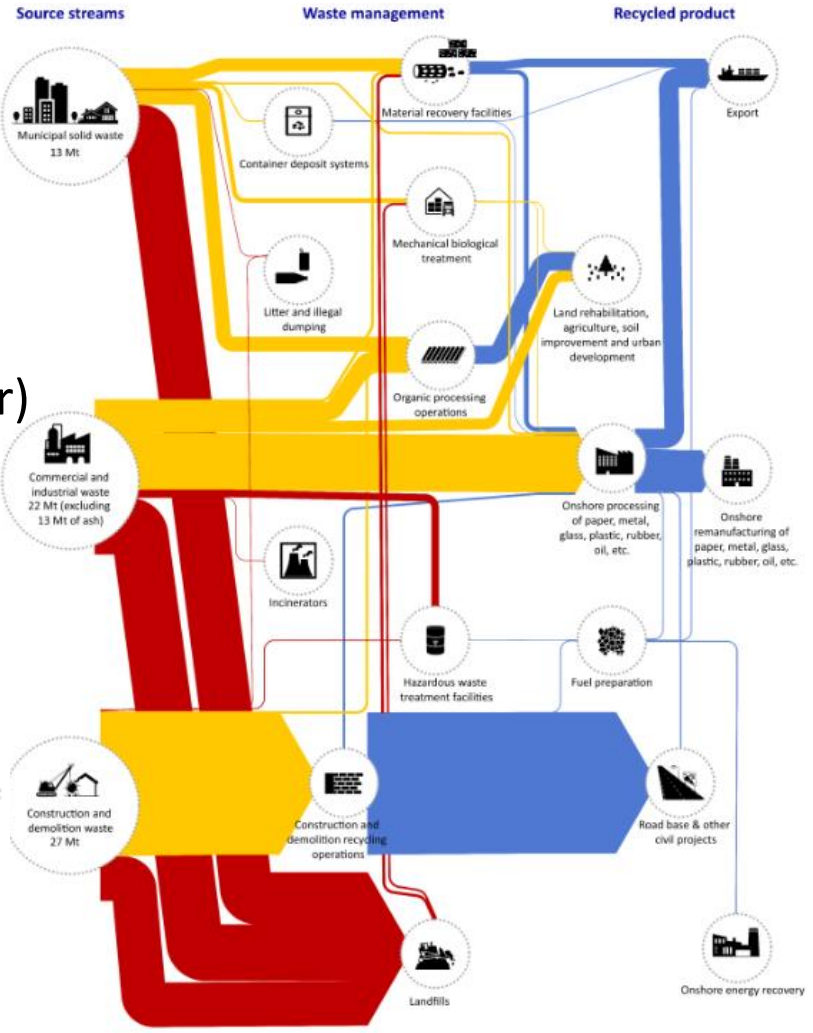
- Organic wastes, wastewater
- Microplastics (up to 1000 t/yr)

https://www.dcceew.gov.au/sites/default/files/documents/apff-national-report_0.pdf

Managed waste sources

Biosolids (~1.7 Mt/year)
Composts (~5.6 Mt/year)
Construction, industrial waste etc. (>30 Mt/year)
Wastewater (~1500 GL/year)





Based on 2019 data: https://environment.gov.au/protection/waste/national-waste-reports/2020

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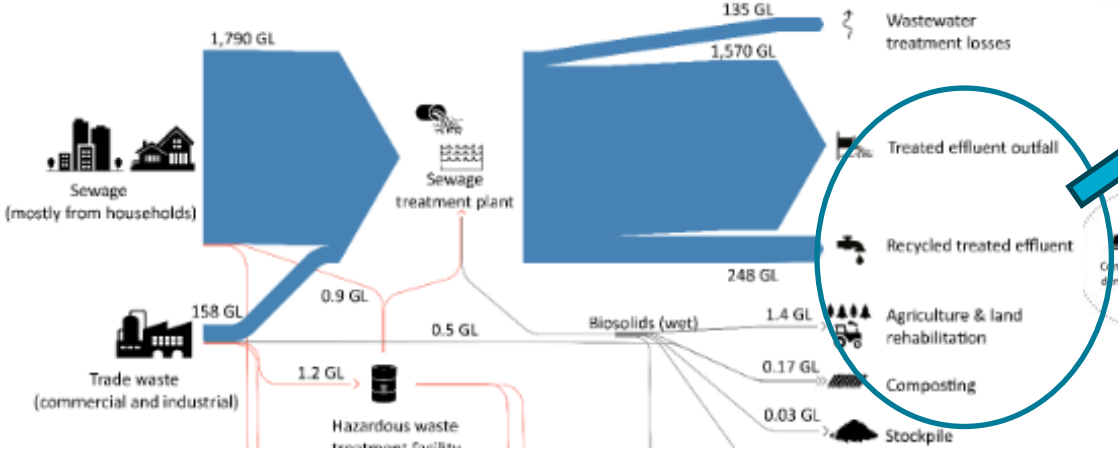

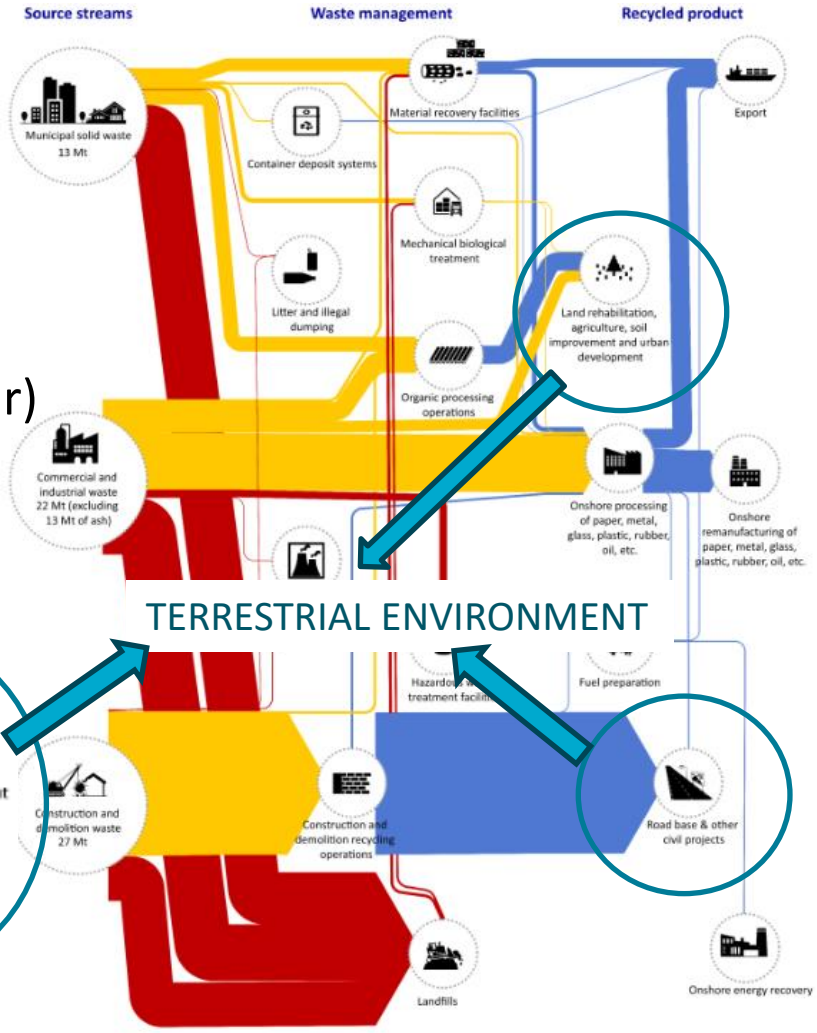

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Microplastics in organic wastes

Biosolids

- ~1.4 Mt/yr to agricultural land
- Estimated up to 1000 t/yr MPs
- Measured 140-8000 t/yr[#] OR $2x10^{10}$-$4x10^{12}$ MPs/yr[*]

Other organic waste?

- Compost (~5.6 Mt/yr)
- Construction/industrial wastes (>30 Mt/yr)

[#]Okoffo et al. (2020) *ES&T* 54, 15132-15141; *Ziajahromi et al. (2024) *Water Research* 250, 121071

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Managing risks

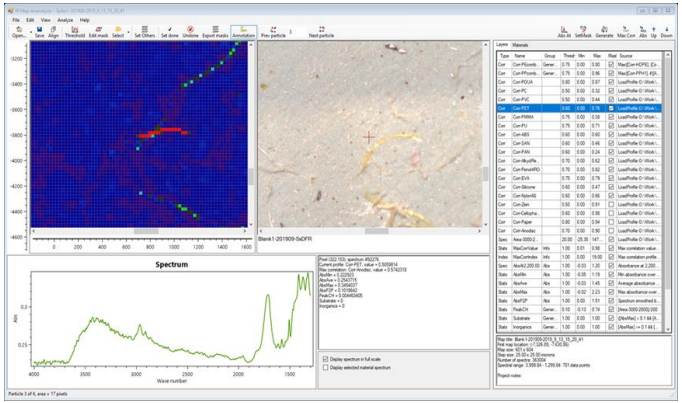
How many?

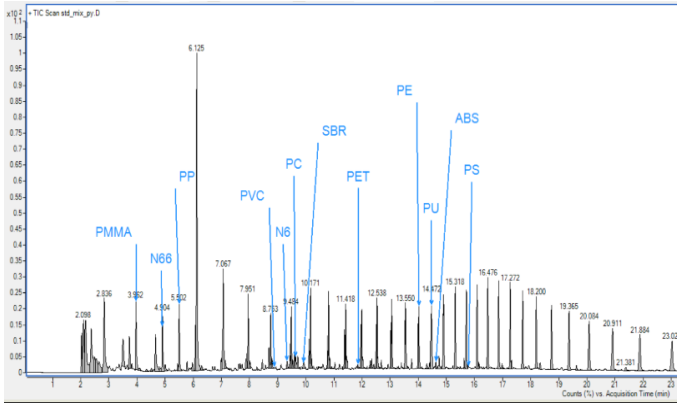
Impacts?

Risk reduction

Managing risks

How many?





What	IR Spectroscopy	Mass Spectrometry
Polymer	++	+
Number/Morphology	+	-
Mass	-	+
Sensitivity	+++	+
Time	+	++
Cost	+++	++

Managing risks

How many?

Standardisation

- Sample collection, preparation, analysis

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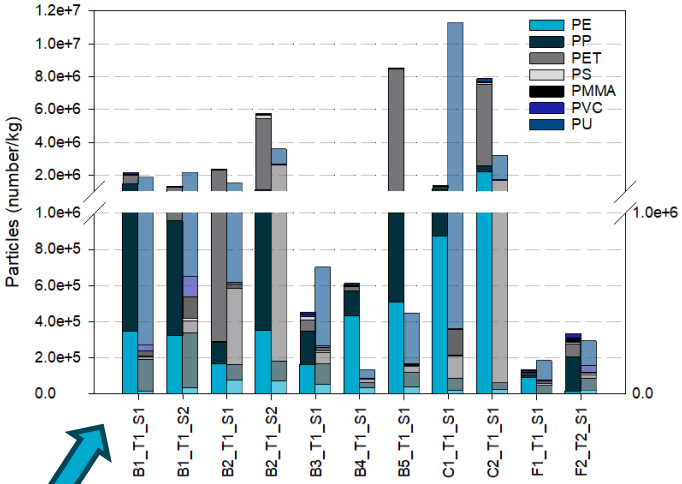

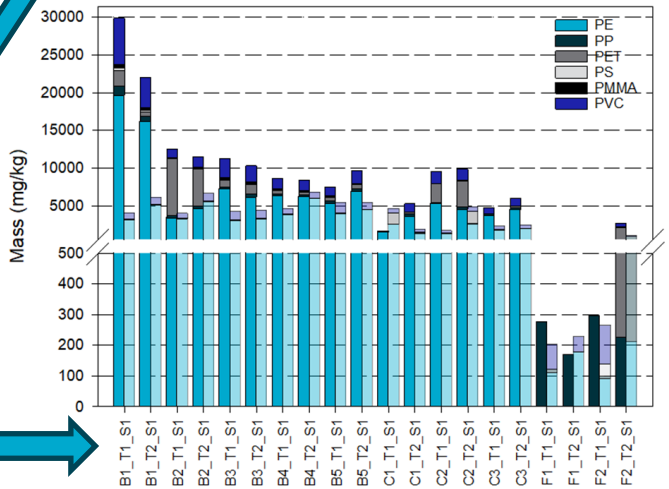

Managing risks

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Standardisation

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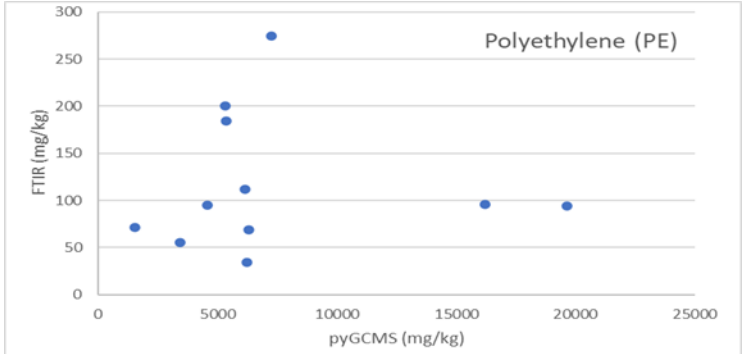
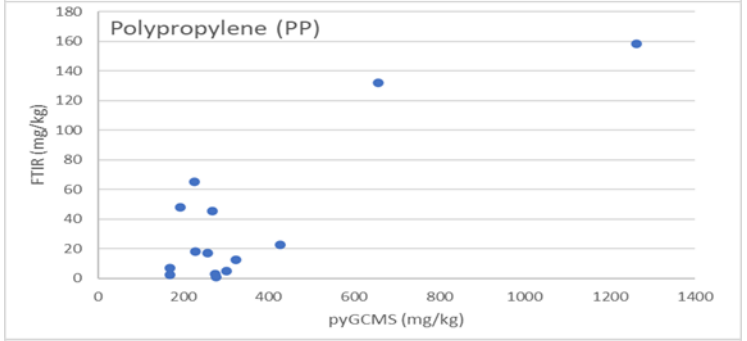
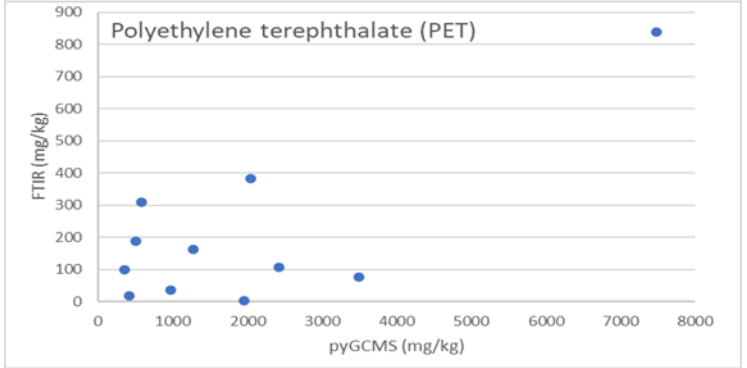
Mass estimation?

- Polymer shape/density







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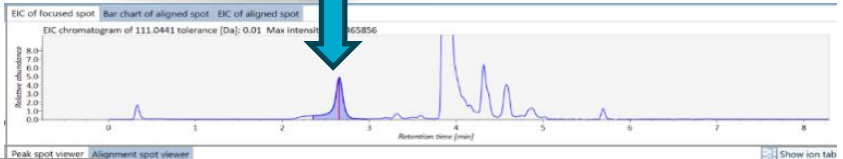
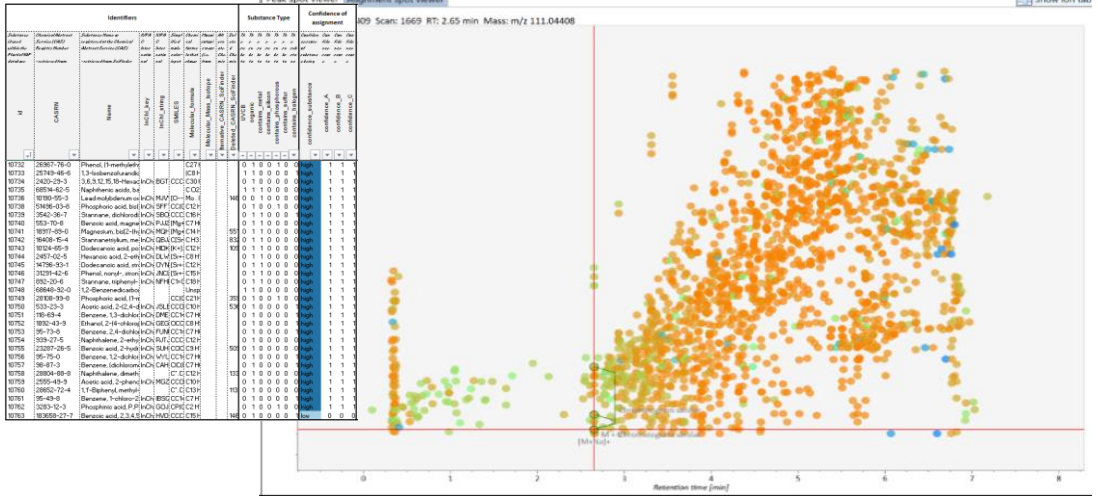
Chemical additives?

- Plasticisers, flame retardants, lubricants etc.?





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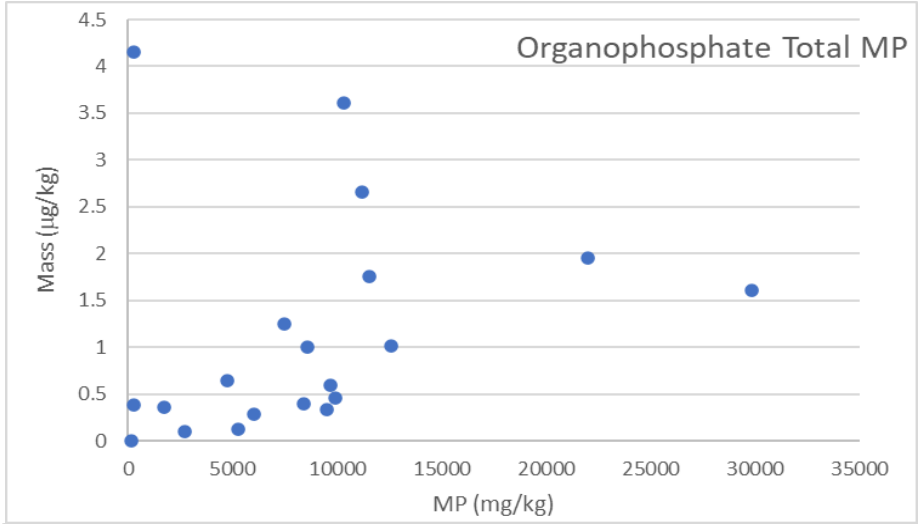

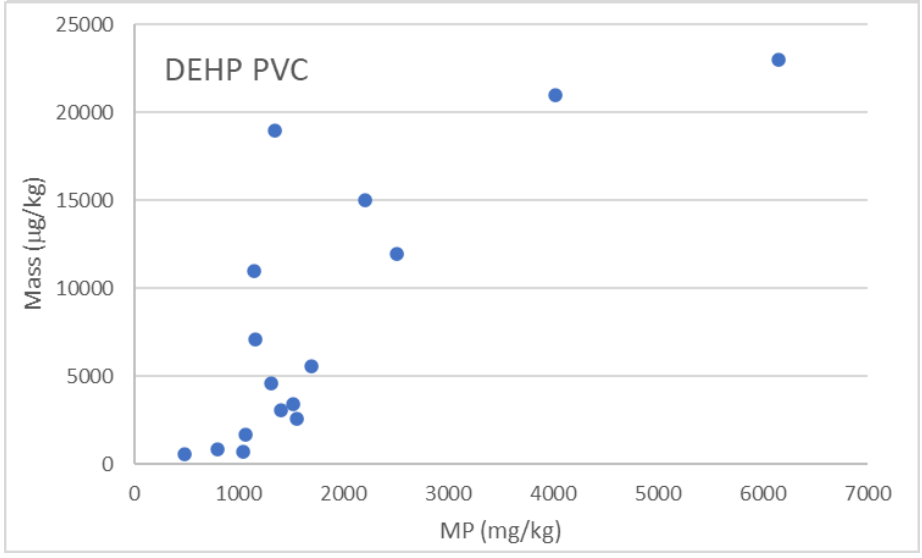

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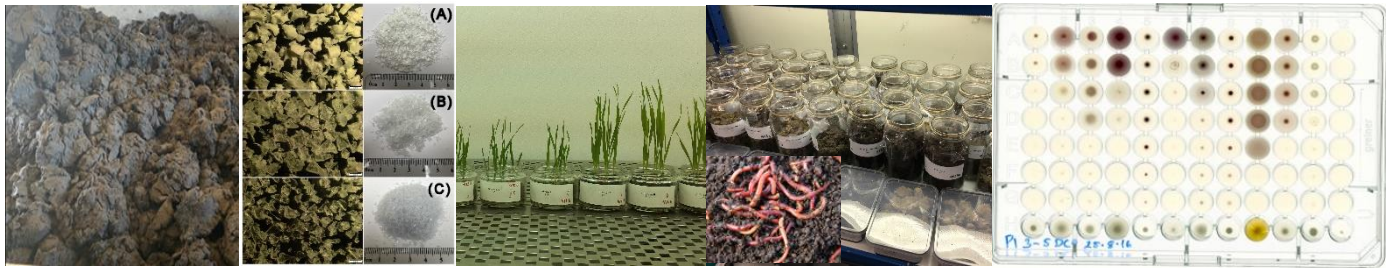

- ~1% in soil may[$] or may not[#] have an effect on terrestrial organisms
- Toxicity from microplastic or from chemicals released from microplastic?
- Weathering, polymer type, particle size shape affect interaction with organisms, transport, release of chemicals…

[$]Huerta-Lwanga et al. (2016) *ES&T* 50,2685-2691,
[$]Qi et al. (2018) *STOTEN* 645, 1048;
[#]Judy et al. (2019) *Env. Pollut. 252, 522-531*

Managing risks

How many?

Impacts?

Risk reduction

- Standardised, cost-effective tools for baseline load/impacts
- Evidence-based
- Minimising loads = $$
- Source control?

Summary

How many?

- Standardisation for baseline
- What (MP number/shape/mass, chemical additives)?
- How often (cost)?

Impacts?

- What is being impacted (organisms, crops etc.)?
- Effect of ageing/fragmentation (nanoplastics)?
- MPs or chemical additives?

Evidence-based risk reduction

Environmental sustainability of circular economy

Thank you

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