Addressing Microplastic Pollution through Decentralized Wastewater Treatment Systems (DEWATS) in the Philippines

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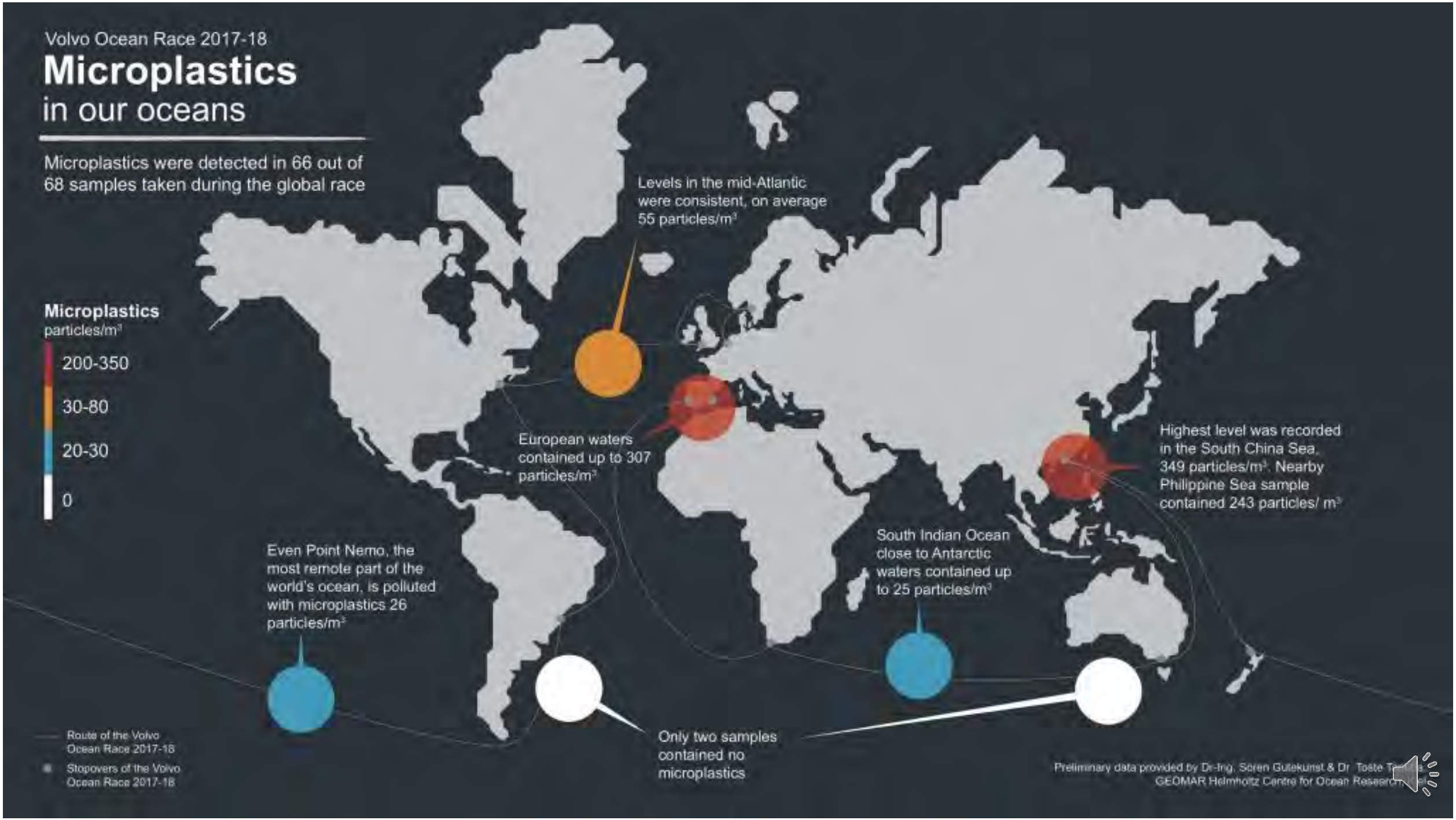
ISAP 2020
International Forum for Sustainable Asia and the Pacific
12 November 2020


Volvo Ocean Race 2017-18
Microplastics
in our oceans
Microplastics were detected in 66 out of 68 samples taken during the global race
Levels in the mid-Atlantic were consistent, on average 55 particles/m³
Microplastics
particles/m³
200-350
30-80
20-30
0
European waters contained up to 307 particles/m³
Highest level was recorded in the South China Sea, 349 particles/m³. Nearby Philippine Sea sample contained 243 particles/ m³
South Indian Ocean close to Antarctic waters contained up to 25 particles/m³
Even Point Nemo, the most remote part of the world's ocean, is polluted with microplastics 26 particles/m³
Only two samples contained no microplastics
Route of the Volvo Ocean Race 2017-18
Stopovers of the Volvo Ocean Race 2017-18
Preliminary data provided by Dr-Ing. Sören Gutekunst & Dr Toste
GEOMAR Helmholtz Centre for Ocean Research

Microplastics Occurrence
in Surface Waters and Sediments in Metro Manila Rivers

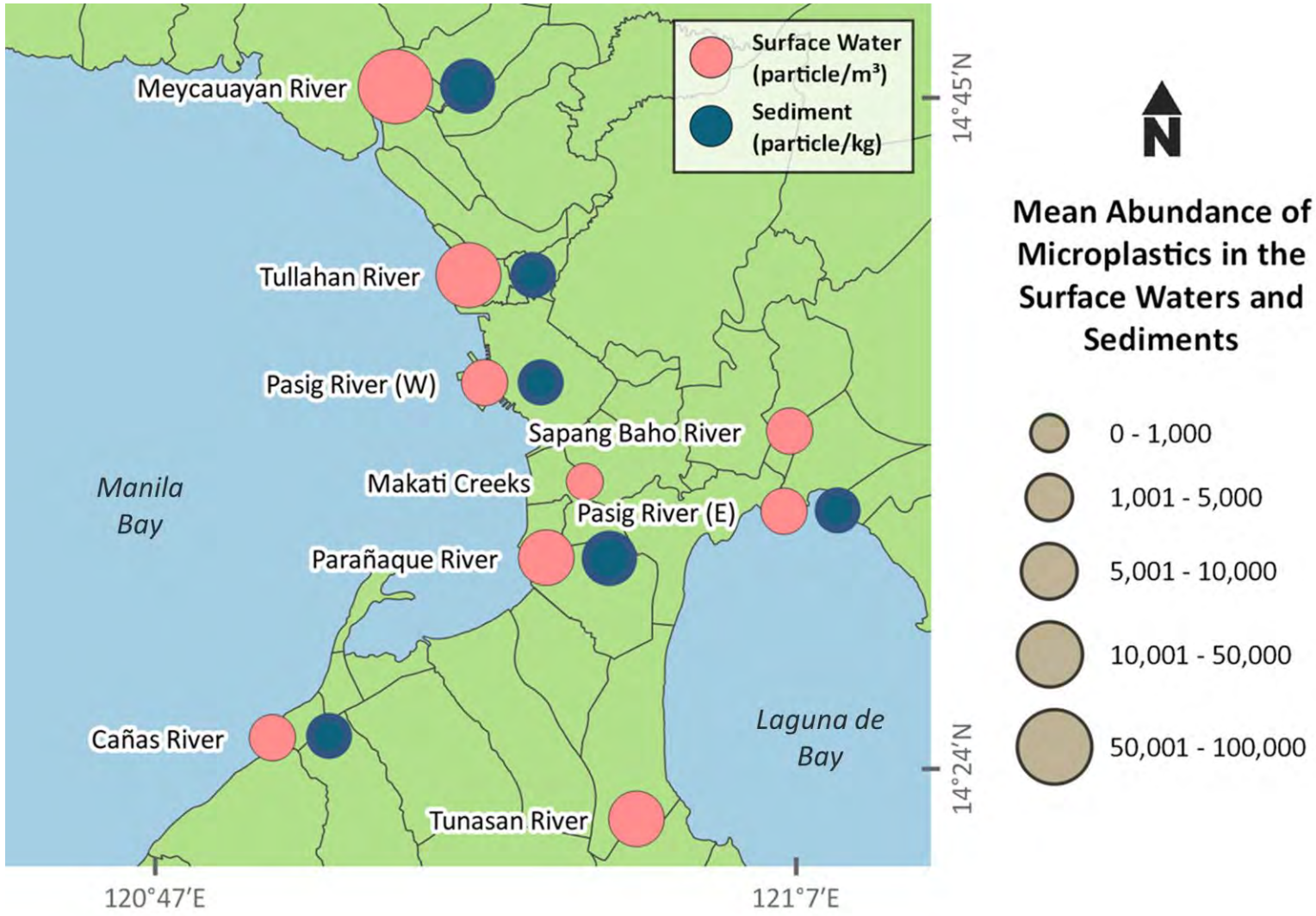
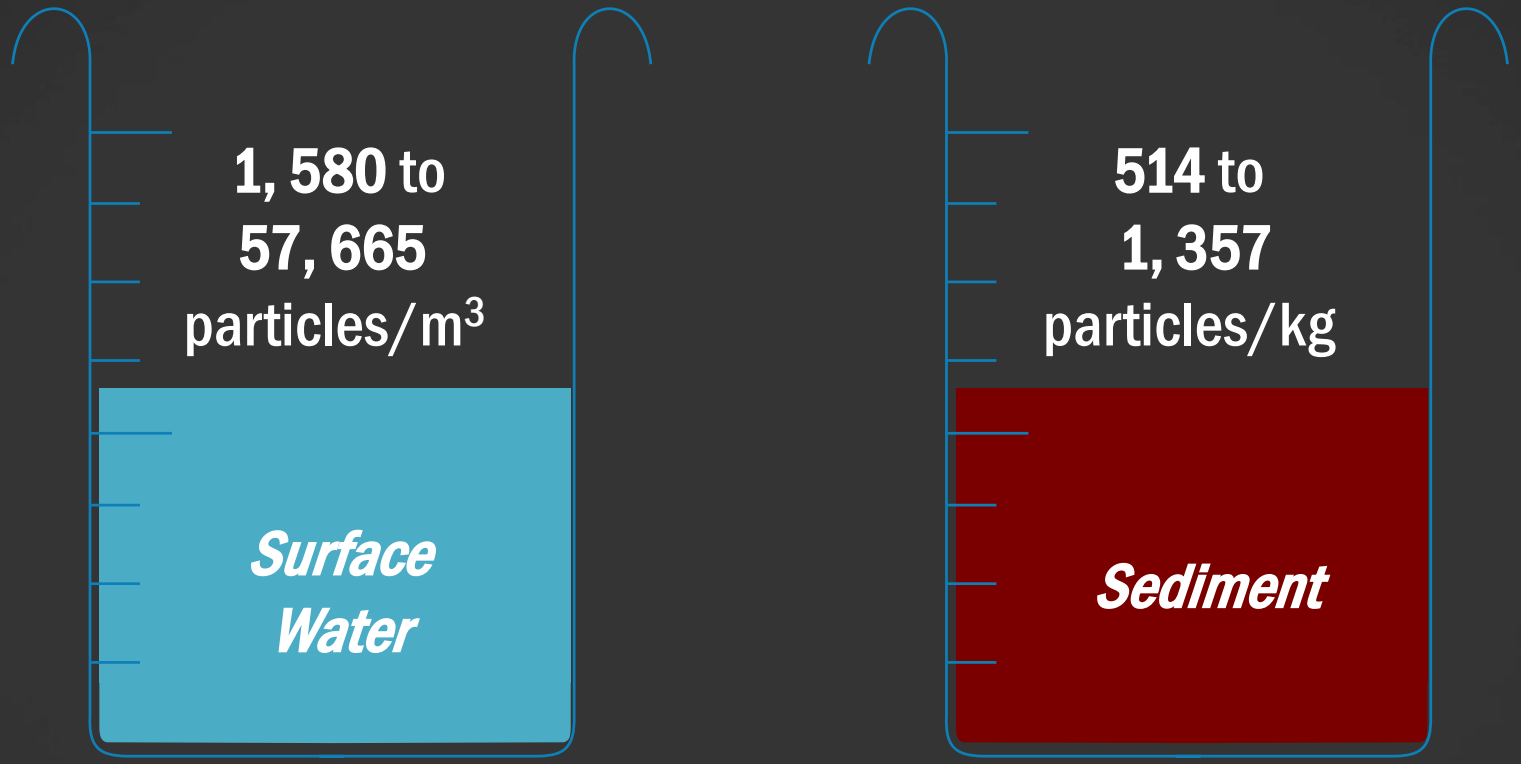


Figure taken from:
The Microplastics in Metro Manila Rivers: Characteristics, Sources, and Abatement
M. A. N. Tanchuling and E.D Osorio

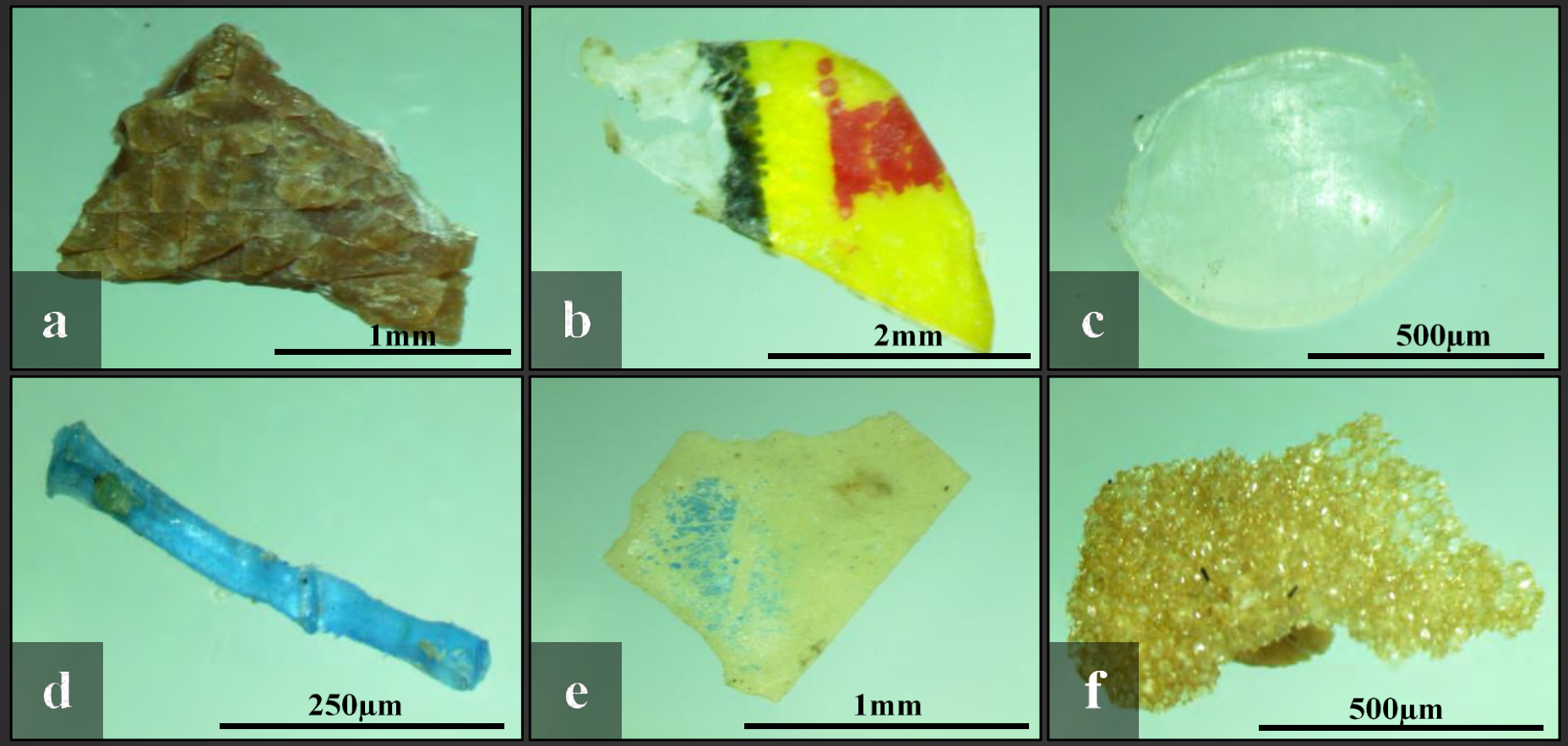
In:
Friederike Stock, Georg Reifferscheid, Nicole Brennholt and Evgeniia Kostianaia (eds.), Plastics in the Aquatic Environment - Part I: Current Status and Challenges,
Hdb Env Chem, DOI 10.1007/698_2020_659,

Microplastic Pollution



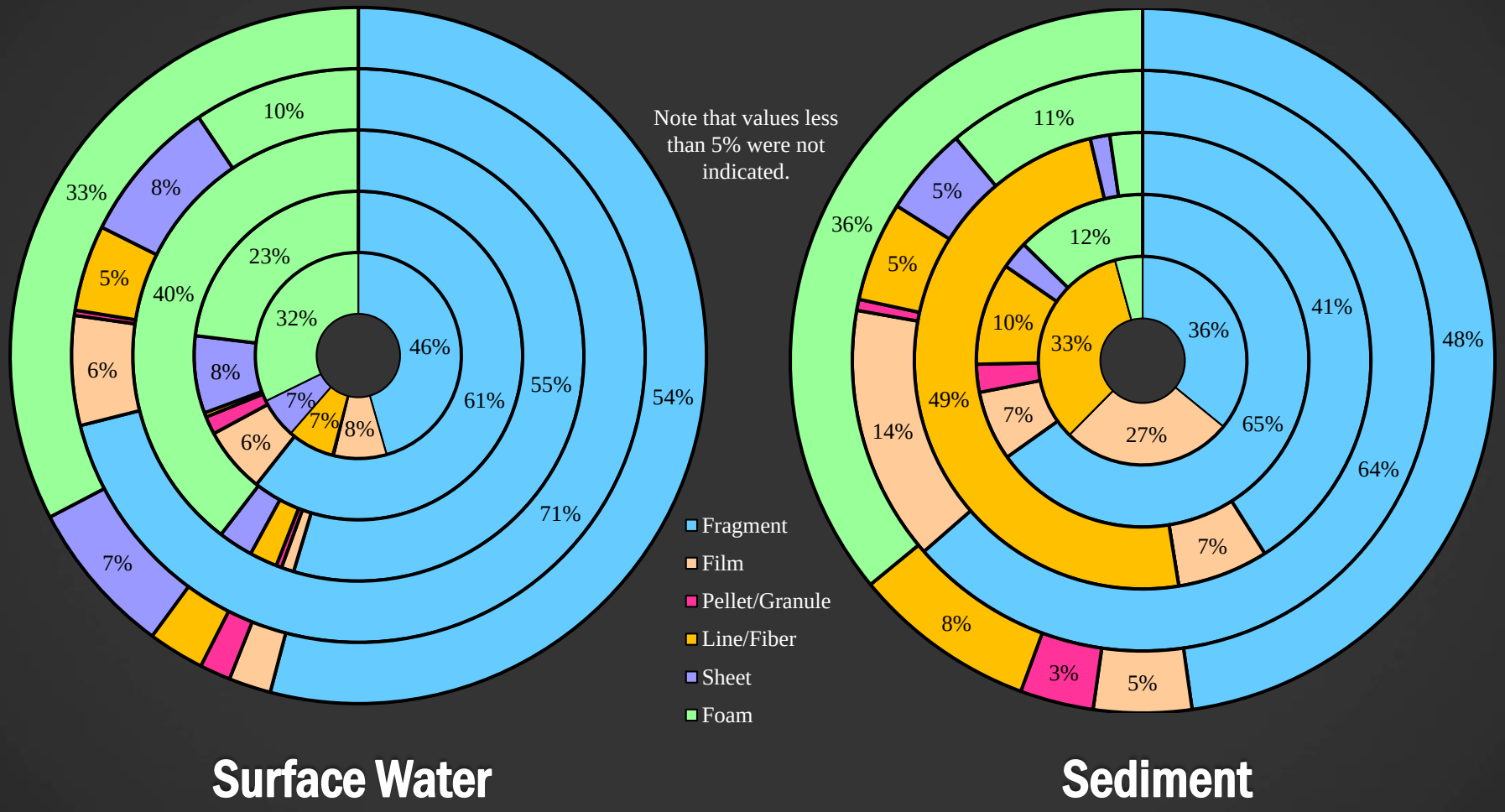
Microplastics were ubiquitously detected in **all surface water and sediment samples** extracted from the mouth of the five rivers (Cañas, Meycauayan, Parañaque, Pasig and Tullahan River) draining to Manila Bay.

Shape of Microplastics



a) **fragment** - hard, jagged, angular small piece; b) **film** - very thin, soft layer; c) **pellet or granule** - hard ovoid sphere shape or disc-shaped or cylindrical; d) **line or fiber** - elongated and thin, or fibrous appearance; e) **sheet** - irregular flat and flexible piece; f) **foam** - lightweight, porous and sponge-like plastic.

Shape of Microplastics

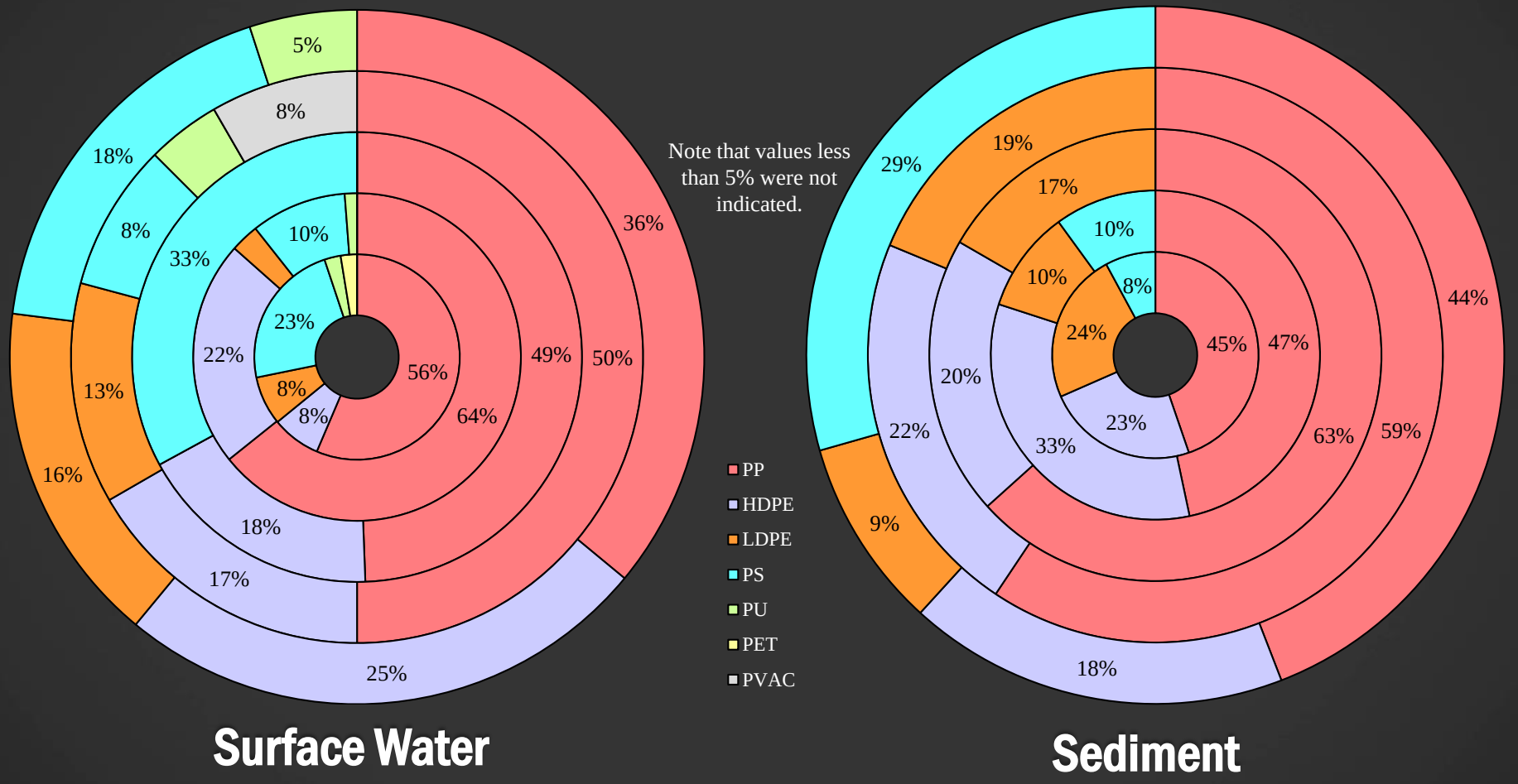


Surface Water

Sediment

Percentage distribution of different shapes of microplastics identified from the mouths of the rivers: (from innermost to outermost circle) (a) Cañas, (b) Meycauayan, (c) Parañaque, (d) Pasig, and (e) Tullahan.

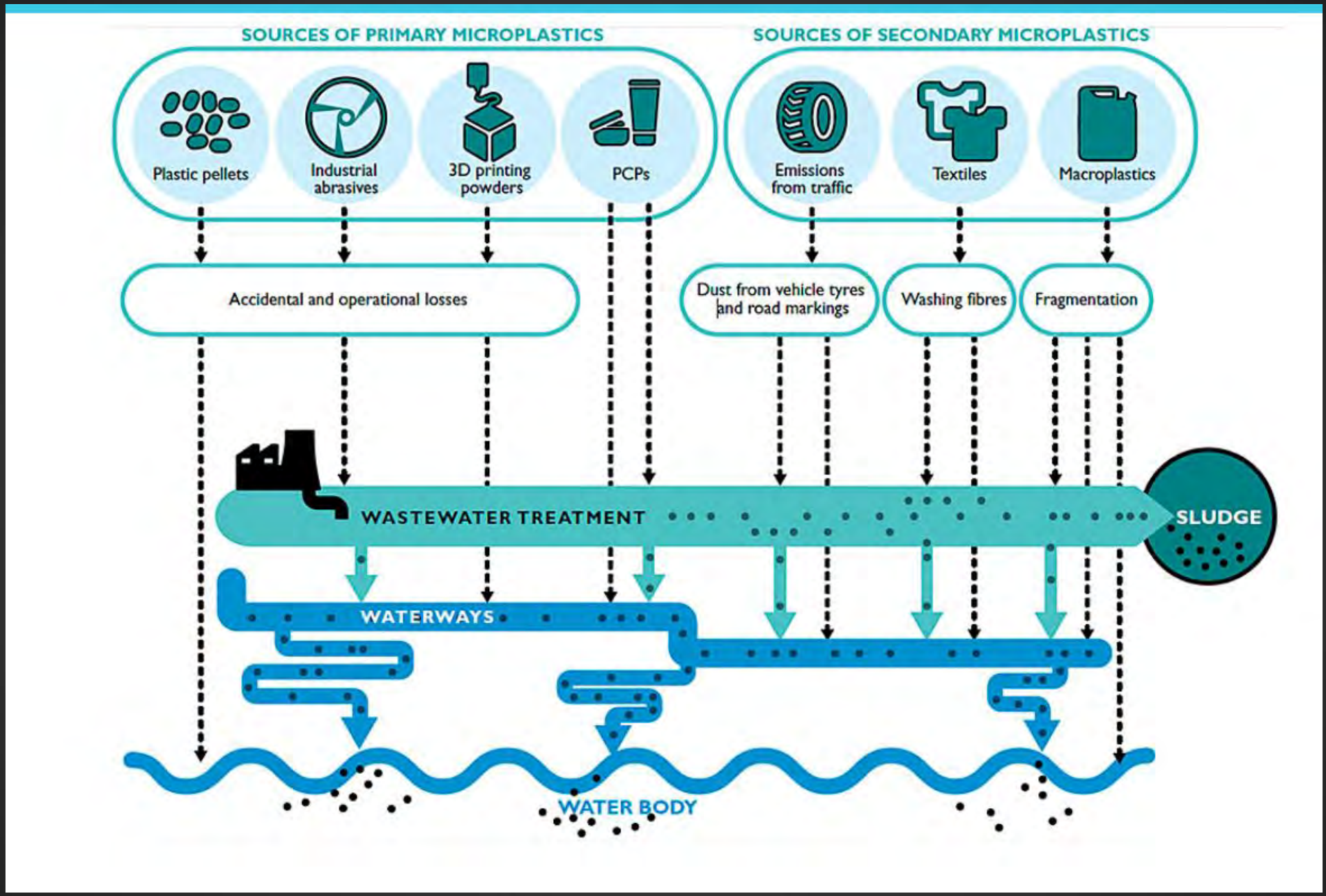
Polymer Type of Microplastics



Surface Water

Sediment

Percentage distribution of different polymer types of microplastics identified from the mouths of the rivers: (from innermost to outermost circle) (a) Cañas, (b) Meycauayan, (c) Parañaque, (d) Pasig, and (e) Tullahan.

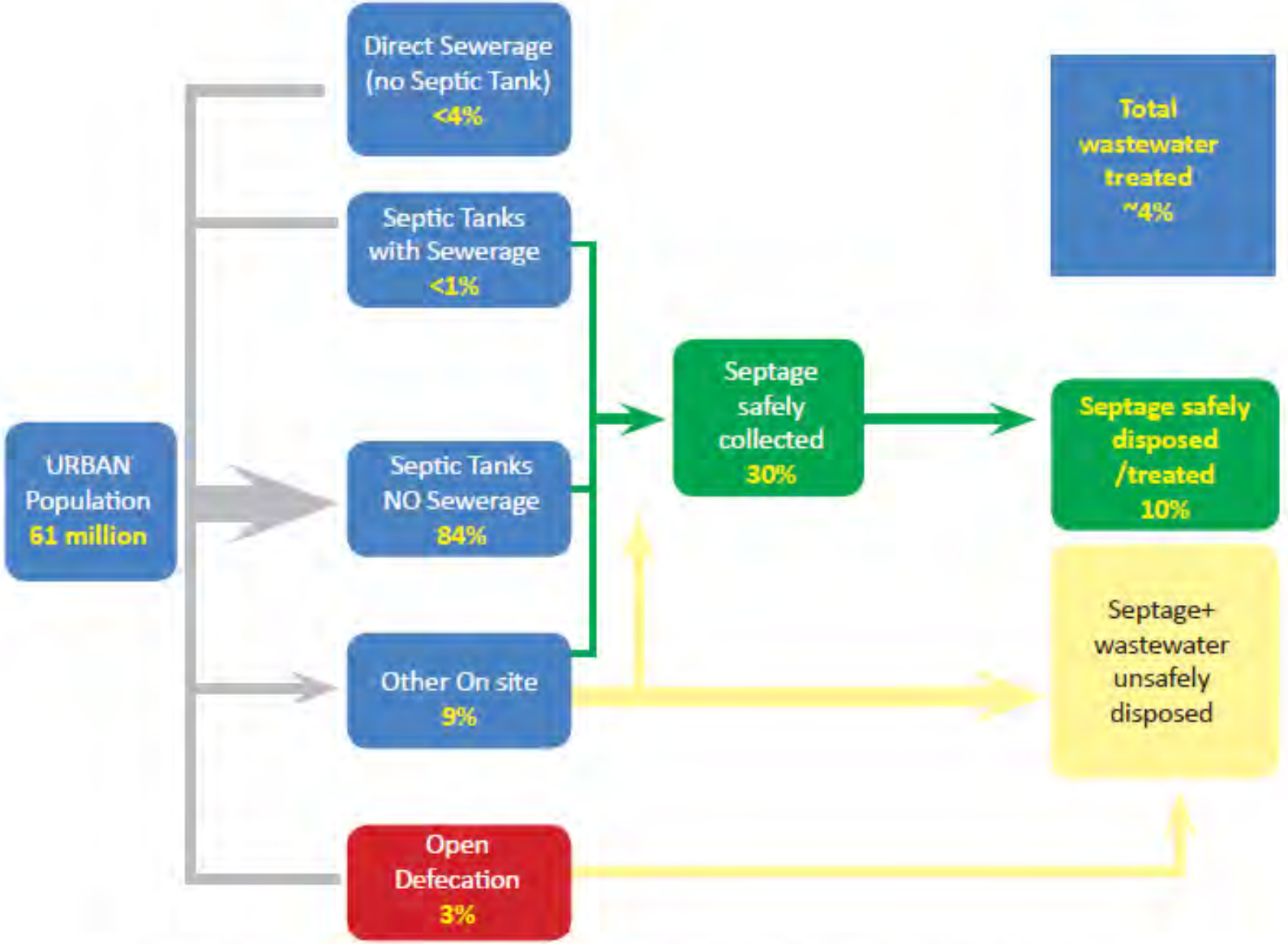

SOURCES OF PRIMARY MICROPLASTICS
SOURCES OF SECONDARY MICROPLASTICS
Plastic pellets
Industrial abrasives
3D printing powders
PCPs
Emissions from traffic
Textiles
Macroplastics
Accidental and operational losses
Dust from vehicle tyres and road markings
Washing fibres
Fragmentation
WASTEWATER TREATMENT
SLUDGE
WATERWAYS
WATER BODY

Microplastics in wastewater treatment systems

Raw wastewater	3160 particles/L
Treated wastewater	125/L
Sludge	170.9 x 10^3 particles/Kg
Removal Efficiency	72% - 99.4% using primary and secondary treatment

Source: Gatidou, 2018
https://doi.org/10.1016/j.jhazmat.2018.12.081

Wastewater flow in the Philippines



Source: East Asia and the Pacific Region Urban Sanitation Review, World Bank 2012.

Treatment systems in the Philippines

	Sewerage System	Septage system	DEWATS	Septic Tanks
Type of Area	Highly urbanized cities (HUCs)	Highly urbanized cities (HUCs) First class cities and municipalities	2nd to 6th class municipalities; schools, markets, hospitals	Individual households
Wastewater treated	Domestic and industrial wastewater	Septage from septic tanks	Domestic wastewater Sludge from DEWATS systems	Domestic wastewater
Construction period	> 5 years	3 – 5 years	< 1 year	1 – 3 months
Financial requirement	Very high	High	Low	Very low

Need for DEWATS systems

- Wastewater treatment plants may capture the microplastics content in wastewater
- Conventional and off-site centralized domestic wastewater treatment approach often require a huge investment cost and highly specialized knowledge and technical expertise for operation and maintenance
- Not a viable solution to many Local Government Units (LGUs) and Water Districts due to their limited funding and technical expertise in planning, design, construction and operations of these centralized systems.
- **DEWATS is the more appropriate strategy for many LGUs and Water Districts**

Thank you for the attention!

For inquiries, please get in touch with me at mntanchuling@up.edu.ph.