



Scientific review of marine plastic pollution in South Africa

Land-based sources and pathways of marine plastics in a South African context

Outline

Green HD-PE microspheres

Introduction

What is plastic?

Status quo

The plastics industry in South Africa

The South African recycling industry

Sources:

- Informal Settlements
- Wear
- Industry
- Other

Pathways:

- Processes
- Air
- Waterways
- Sinks
- Soil

Cycles

Chemicals in Plastics

Uncertainties

Evidence gaps

Implications

Plastic overview

“...include synthetic (fossil fuel derived) and or natural organic (biomass derived) polymers that have the abilities to be formed into desired shapes and forms”

Some Advantages

- Low **cost**
- Contributes to **food security**
- Safe **transport** of liquid and gasses
- Make vehicles **lighter** and more fuel efficient
- Medical, electronic and scientific **equipment**
- **Versatile** manufacturing – small sizes

Plastic overview

Type of polymer	Density (g/cm ⁻³)	Common uses
Natural rubber	0.29	Vehicle tyres
Polyethylene* - low density	0.91 - 0.93	Plastic bags, outdoor furniture
Polyethylene* - high density	0.94 - 0.97	Bottles, pipes
Polypropylene	0.85 - 0.94	Rope, bottle caps, gear, strapping
Polystyrene – expanded	0.016 - 0.36	Cool boxes, floats, cups
Polystyrene	0.96 - 1.05	Utensils, containers, microbeads
Polystyrene - high impact	1.04	Shelves, printed graphics
Polyamide – Nylon	1.12 - 1.14	Fishing nets, rope
Polycarbonate (bisphenol-A)	1.2	CDs, glass alternative, lenses
Polyurethane	1.2	Foams
Metacrylate (acrylic)	1.19	Alternative for plate glass
Cellulose acetate	1.28	Cigarette filters, fabric fibre
Cellulose nitrate	1.35	Printing inks, nail polish, foil
Polyvinyl chloride	1.38	Film, pipe, containers
Polylactic acid (biodegradable)	1.21 - 1.43	Packaging, cups
Polyethylene terephthalate	1.34 - 1.39	Bottles, strapping bands
Melamine	1.57	Flooring, dinnerware, dry boards
Distilled water	1.00	
Brackish water	1.005 – 1.012	
Sea water	1.025 – 1.027	



Circular economy
Leaks

SA Plastic industry

- **Market** size: R67 billion
- Provides **income** to more than 58 100 people
- 44.8% of plastic globally, 44.8% locally used for **packaging**
- Demand is affected by **population growth**
- 1 492 000 tons of **virgin plastic**
- 313 780 tons of **recycled plastic**
- 27.11 kg **per person**
- Zero plastic to **landfill** by 2030

SA Recycling industry



70% post-consumer
LDPE, LLDPE, PET, HDPE, PP

Recycling challenges: Transport & cleaning

Recycle rates:

SA 2018: 46.3%

Europe 2018: 31.1%

6.7%

Recovery rate:

4.9%

Volume:



Land-based sources

Contribute to marine plastic pollution:

11th, adding 90 000 and 250 000 tonnes, 56% mismanaged waste

Informal Settlements



Informal waste dump in Vanderbijlpark area, close to Vaal river

91% low income households
Direct discharges to soil and rivers
Lack of infrastructure and services

Wear

Microfibres

Tyre wear

A microscopic view of a white surface covered with numerous small, dark, irregularly shaped particles, likely microbeads or debris. A few larger, distinct particles are visible, including a blue one near the top center and a green one near the bottom center. A vertical scale bar is visible in the center of the image.

Microbeads used in sandblasting

Industry

Packaging

Operation Clean Sweep: primary pellets, flakes, and powders



Other

Glitter

Plastic snow

Plastic foil

Pathways



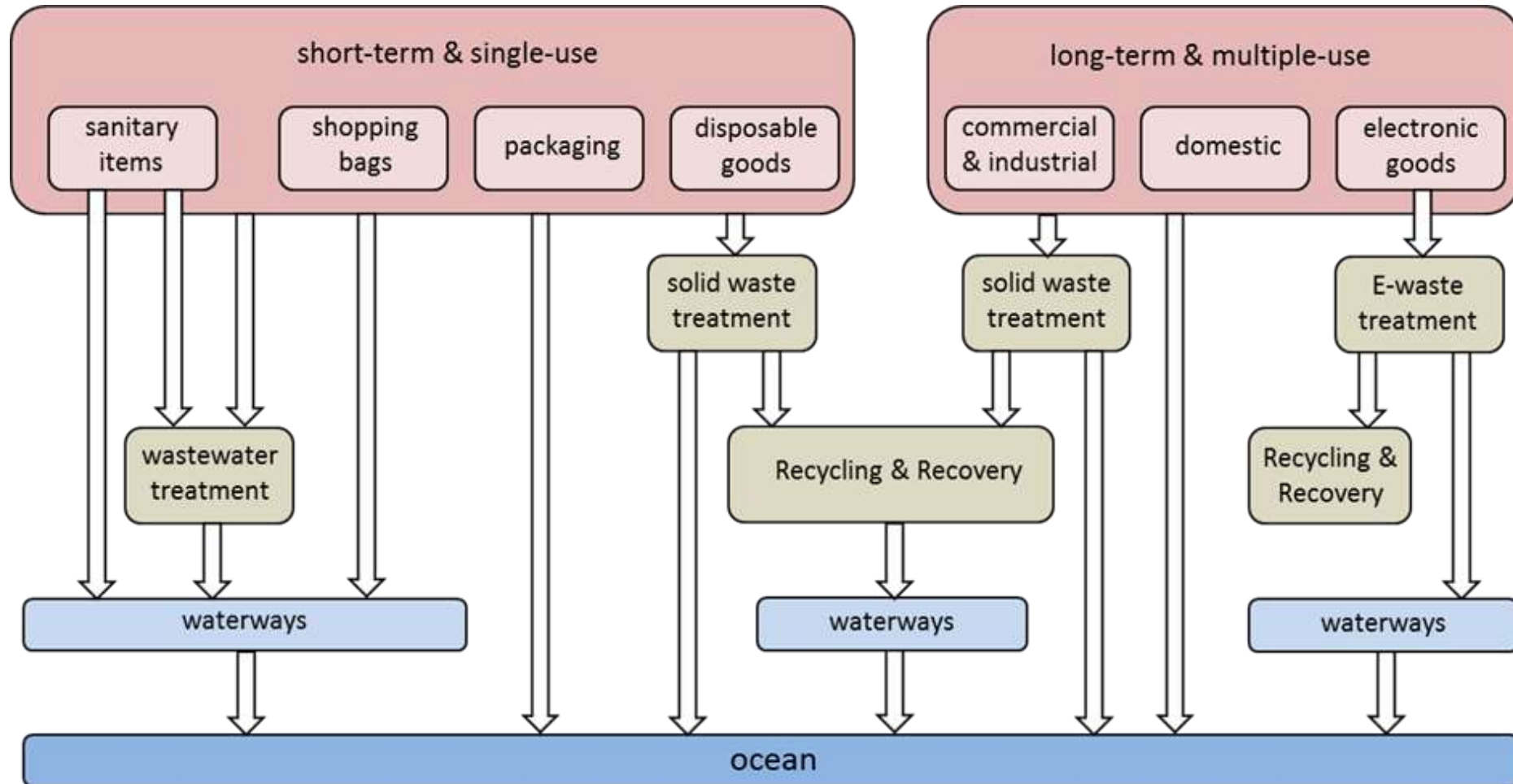
Three main drivers of plastic transport and cycling:

- Breakdown
- Biofouling
- Sorption

Transport and movement:

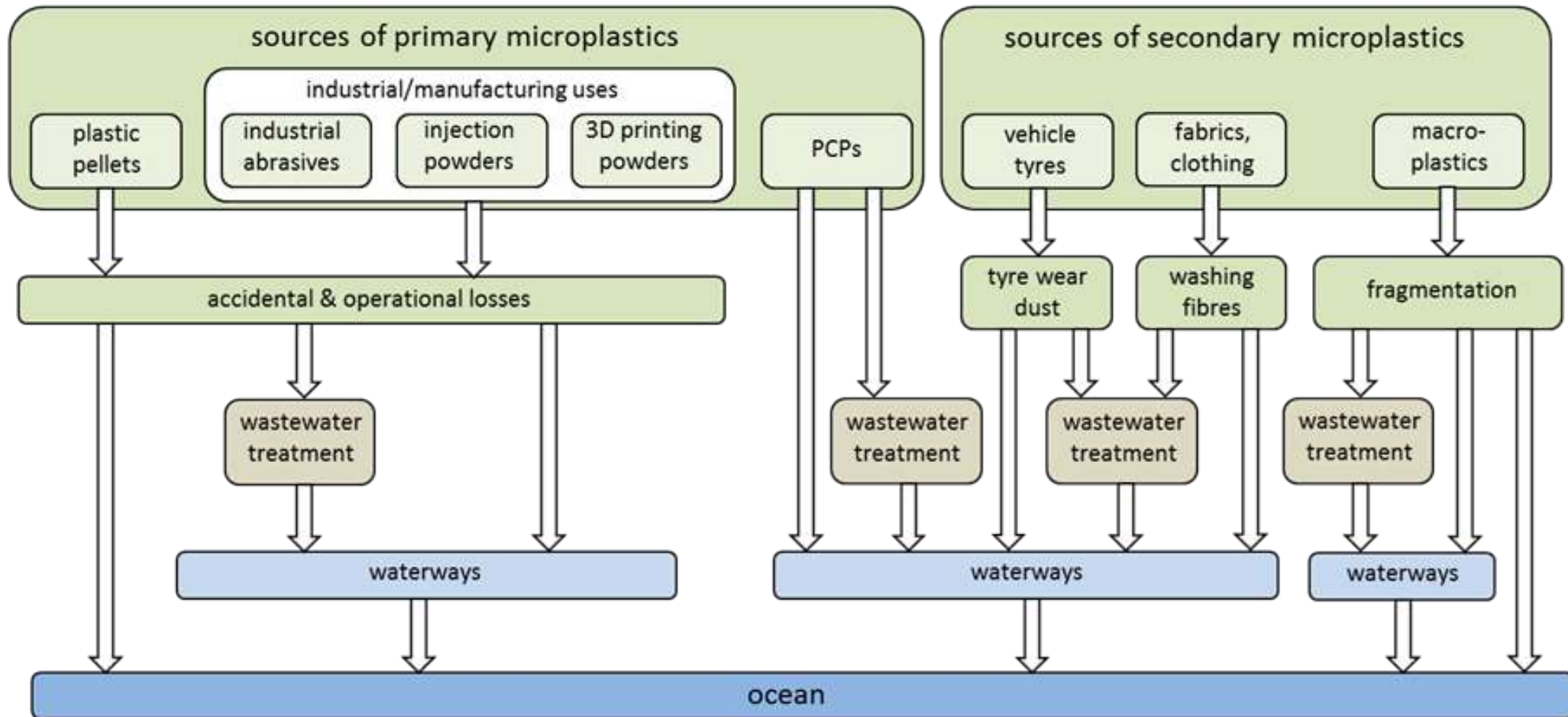
- Air
- Land
- Waterways

Generic land-based Sources and Pathways of Macroplastics



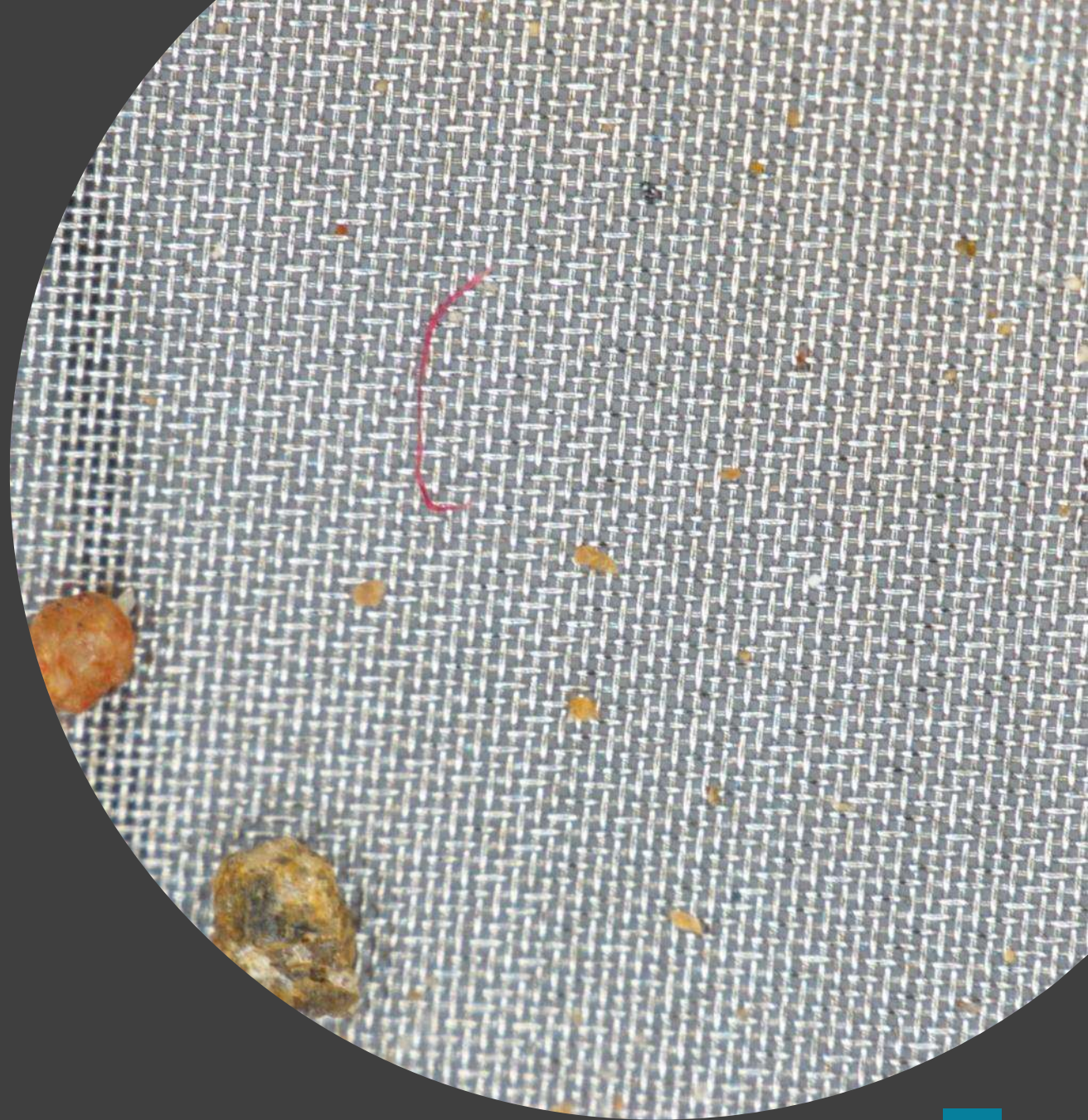
Reproduced with permission: Peter Kershaw

Generic land-based Sources and Pathways of Microplastics



Air

- Found everywhere
- $> 11\,000$ particles / m^2 / day
- Namaqualand



Waterways



Rivers are the main contributors to the marine plastic load



Point Sources

- Wastewater treatment plants
- Sewers
- Pipelines to the seas



Sinks

Sediments of rivers, weirs, impoundments, and estuaries



Soil

Waste dumps, sludge, discard, return to beaches



Cycles

Plastic now considered part of biogeochemical cycle

- Additives
- Pollutants
 - Freshwater
 - Soils
 - Contamination
 - Air?
- Table?



Chemicals in plastic

Illegal dumping: cattle eating plastic

Uncertainties

- Inland data scarce
- Association with socio-economic conditions and behaviour
- Sinks
- Mobility (missing plastics)
- Fibres and beads
- Aerial transport to sea
- Polymer composition
- Additives and pollutants
- Microbial resistant genes



Evidence gaps

- Ecotoxic effects
- WWTP effectiveness and sludge management
- Rubber and tyre wear
- Microbeads (where do they go?)
- Nanoplastics
- Aerial transport
- Pollutants
- Seasonal effects
- Sinks

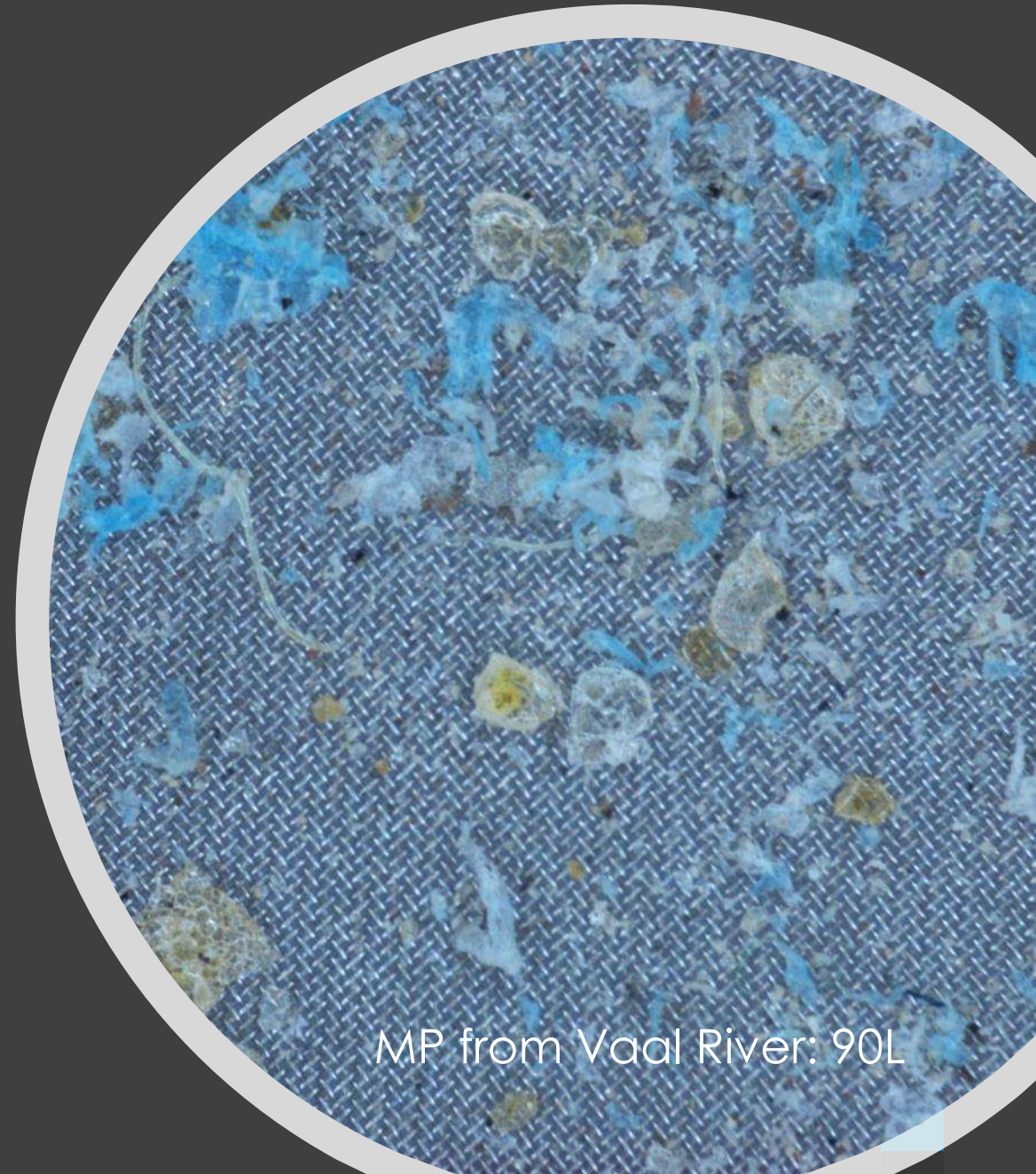


Implications

- Prevent leakage to the environment
- Improve waste removal and waste management
- Development of standardised waste monitoring methods
- Move towards a circular economy
- Risk communication and education

Improvements to MS

- A number of edits and typo's
- Table on additives and accumulated pollutants
- Reduction in repetitions
- New references (toxic effects..)
- Reference to following articles in this series



MP from Vaal River: 90L

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THANK YOU