2026 Great Lakes Microplastics Summit
October 7 -8

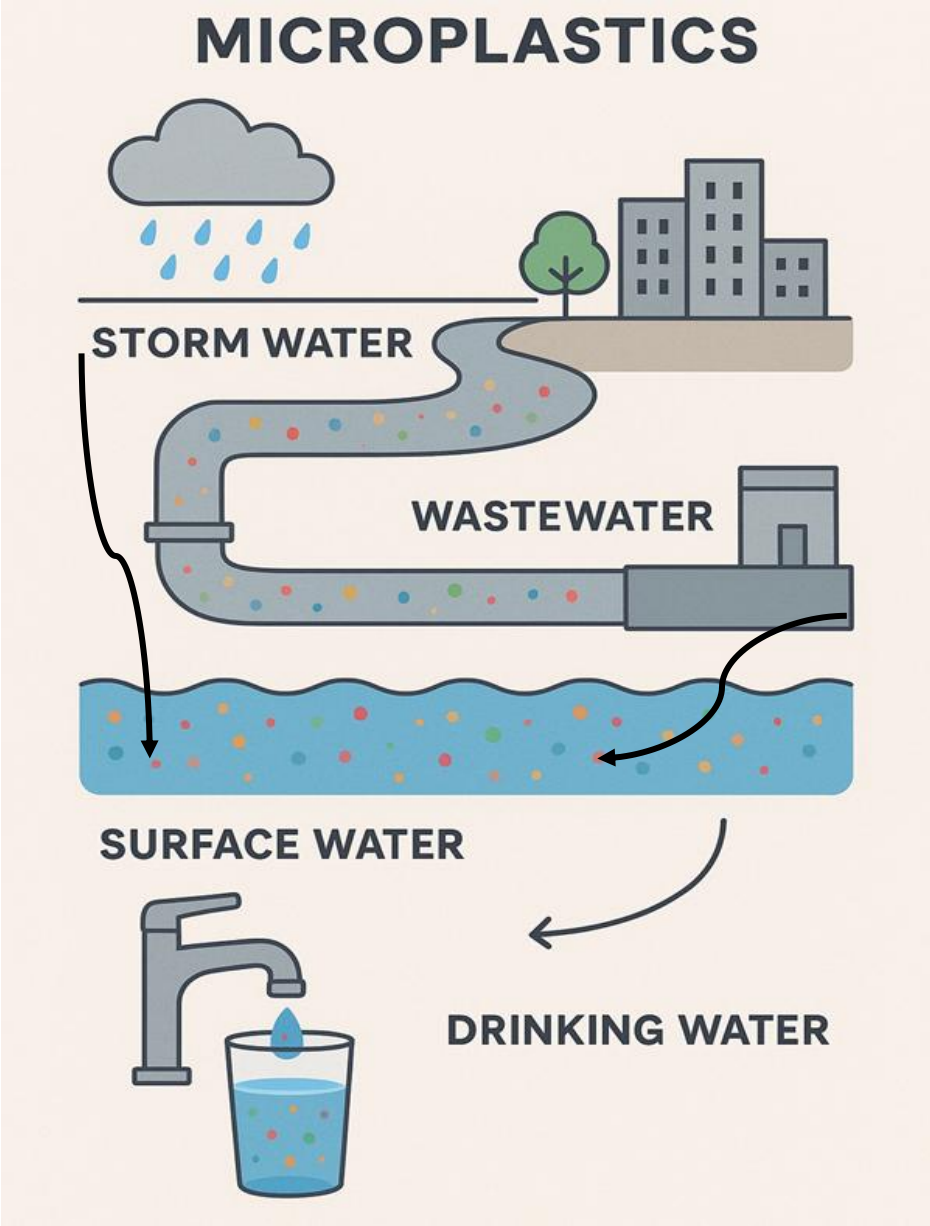
Challenges and Opportunities in Water Infrastructure for Preventing and Mitigating Microplastic Pollution

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Microplastics in water infrastructure

Stormwater runoff



Wastewater discharge

Drinking water

Our work

- Drinking water treatment
- Stormwater management
- Wastewater treatment







Microplastics analysis

- **Methods of sampling**: trawl, grab, pump and sieve, in-line filtration.
- **Sample processing**: density separation, oxidation, enzyme digestion
- **Detection methods** : visual observation, FTIR, Raman, LDIR, O-PTIR, microscope, SEM.

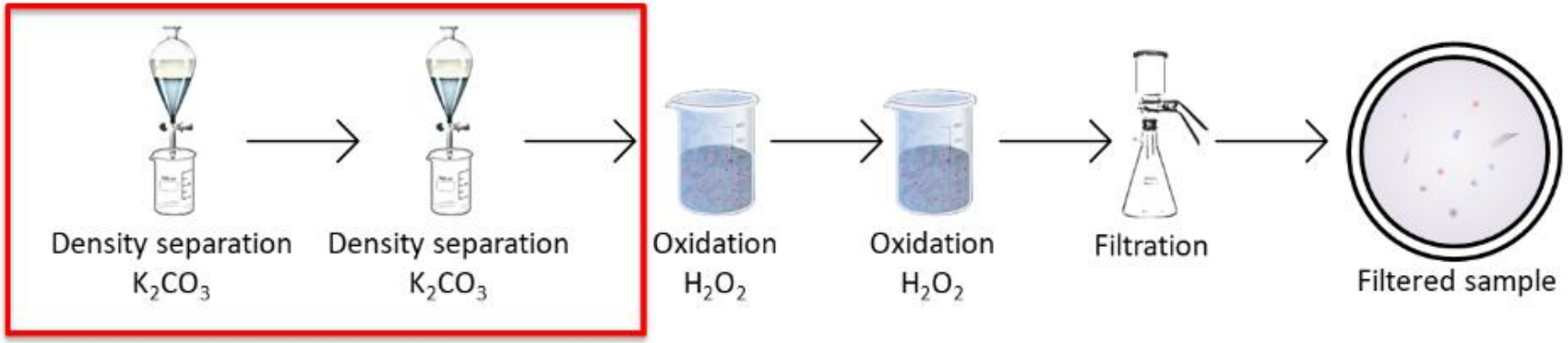


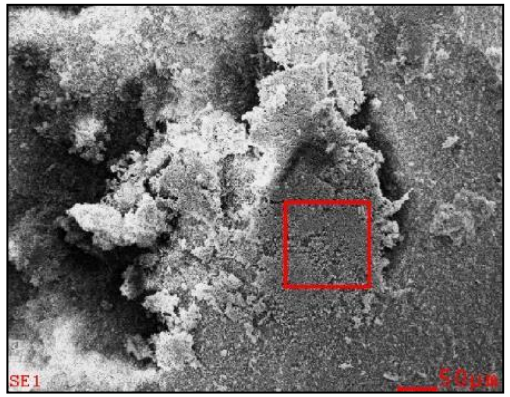


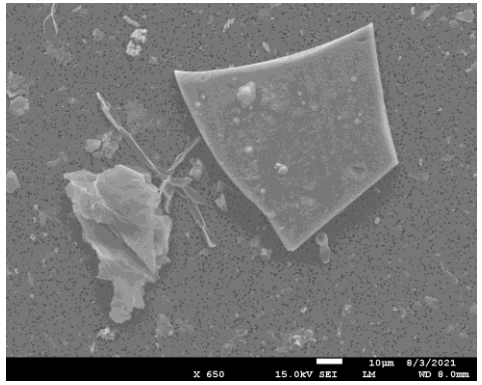


Our methods

- Sample pre-processing: minimize organic matter and non-plastic particles

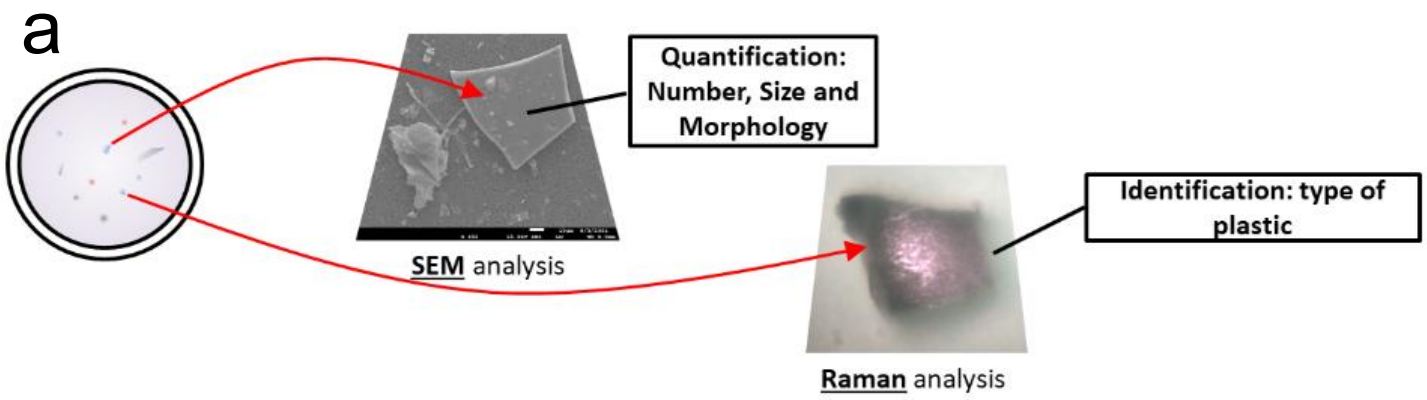


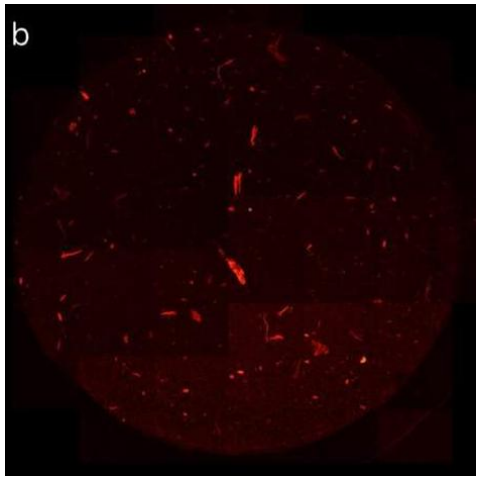




Our methods

- Microplastics detection and quantification: (a) scanning electron microscopy and mRaman, (b) fluorescence microscopy and mFTIR for Nile Red stained samples
- Detection limit: 10 µm (Raman), 20 um (FTIR)





- QA/QC: negative and positive controls from sampling through analysis

Water treatment – drinking water



Research article Get rights and content ↗

Removal efficiency of micro- and nanoplastics (180nm–125μm) during drinking water treatment

Yongli Zhang [a], Allison Diehl [a], Ashton Lewandowski [b 1], Kishore Gopalakrishnan [a 2], Tracie Baker [c] Show more

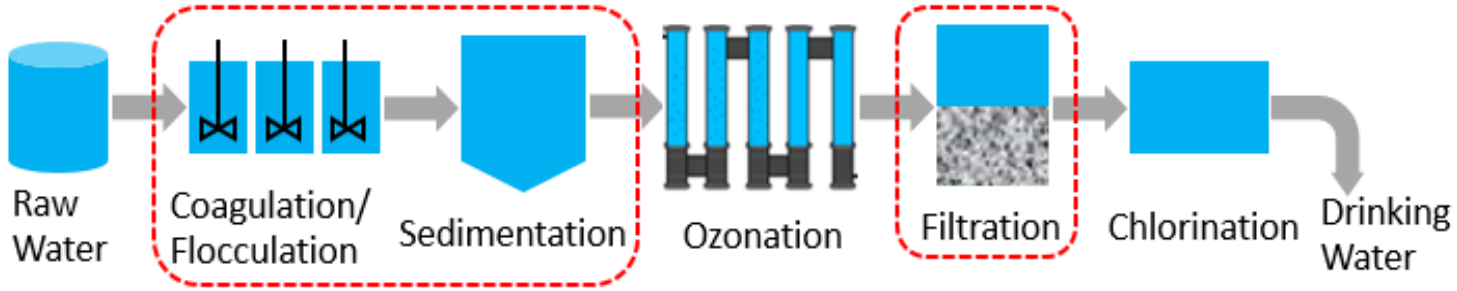
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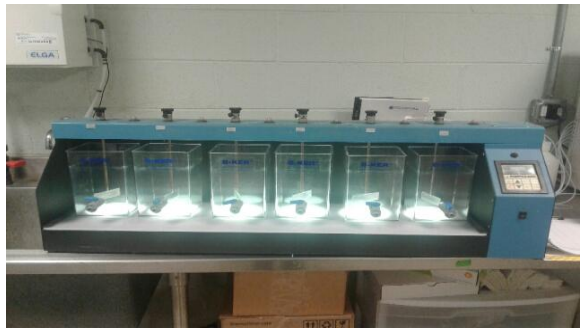
Bench-scale experiments: small microplastics 180 nm - 125 um

Fluorescent microplastics spiked in raw water

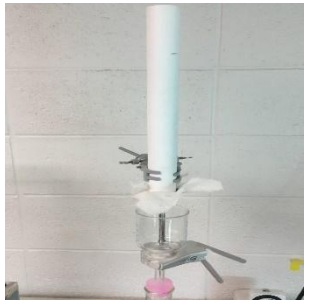
- 180 nm
- 1 um
- 10-20 um
- 45-53 um
- 106 – 125 um

Bench-scale treatment

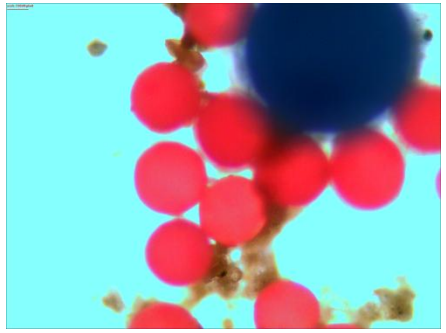




Coagulation/Flocculation Sedimentation (CFS)



Filtration



Biofouling
- CFS
- Filtration

Zhang et al., *Science of the Total Environment* (2020)

ANALYSIS

POSITIVE CONTROL

FLUORESCENT MICROPLASTICS WITH WATER (NO TREATMENT)

FLORESCENT INTENSITY PARAMETERS

NEGATIVE CONTROL

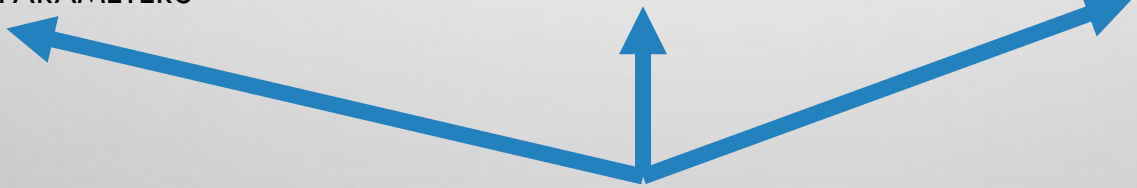
WATER THROUGH THE TREATMENT

LUT MODIFICATIONS OF IMAGE

TREATMENT

WATER WITH MICROPLASTICS THROUGH TREATMENT

FLORESCENT INTENSITY PARAMETERS



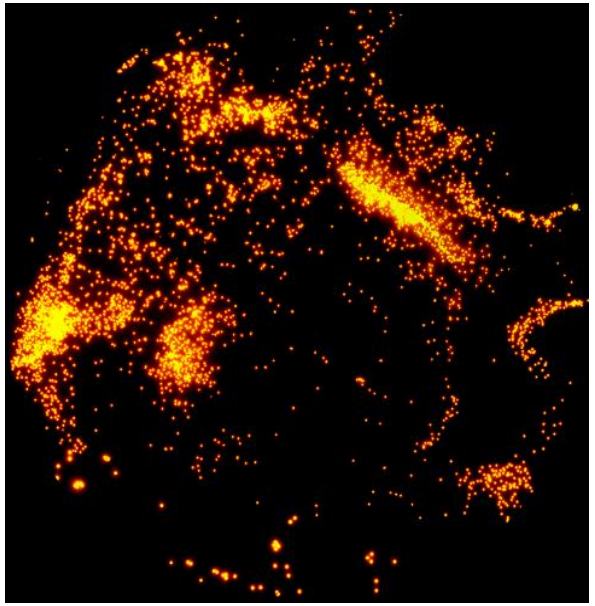
ALGORITHM DEVELOPMENT AND IMAGE ANALYSES

- REMOVAL EFFICIENCY

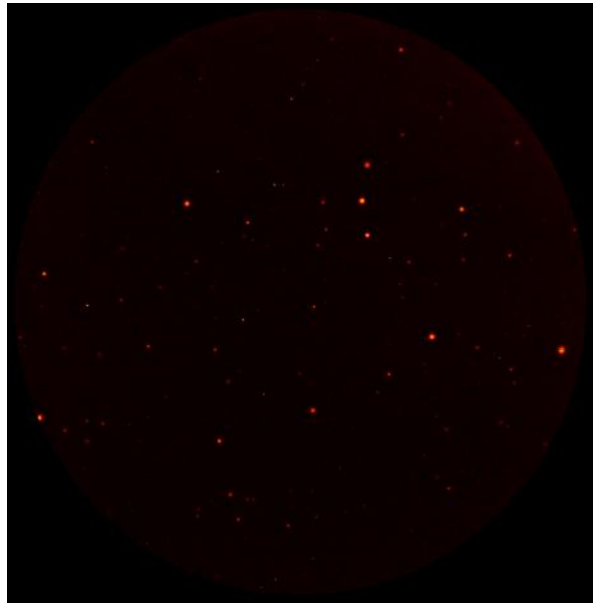
Image Analysis



Negative Control



Positive Control



Treatment

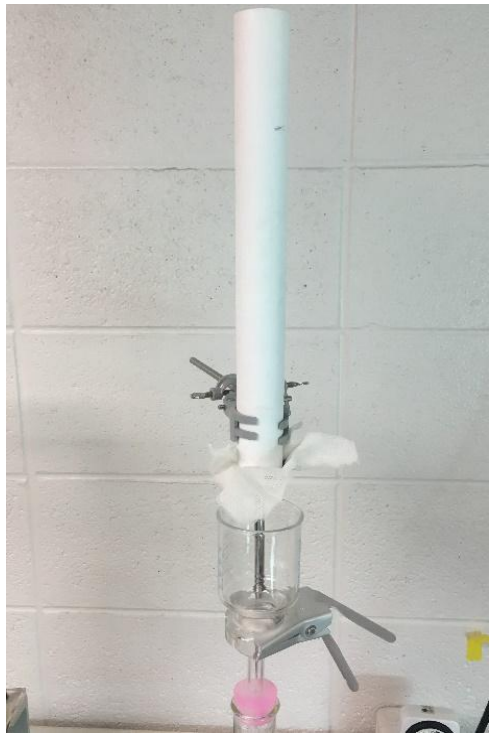
Coagulation, flocculation, sedimentation



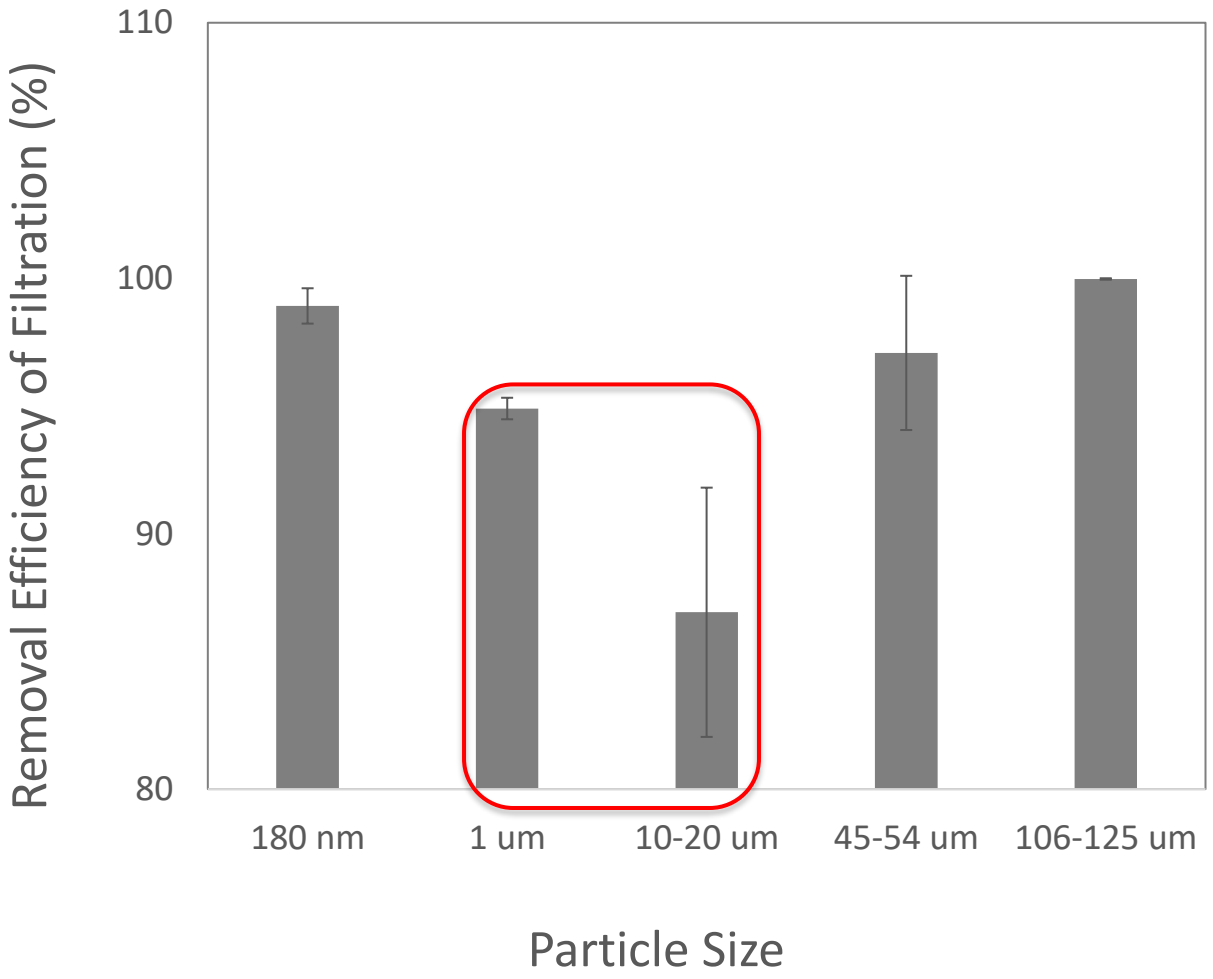
Alum (20 ppm)

Treatment	Removal Efficiency					*p*-value (ANOVA)
	180 nm	1 um	10-20 um	45-53 um	106-125 um	
CFS	Not observed	< 0.1 %	1.8 % ± 1.2 %	0.3 % ± 0.3 % *	1.4 % ± 1.2 %	0.5

Filtration

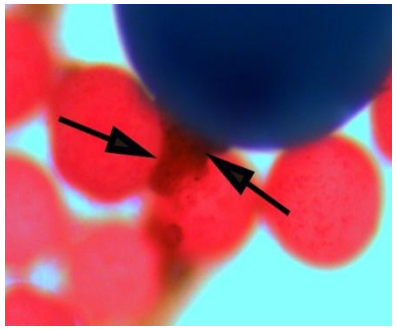


Anthracite
Porosity (0.54)

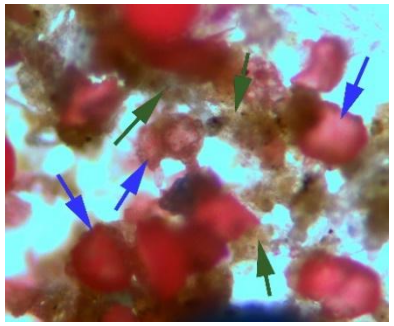


Zhang et al., *Science of the Total Environment* (2020)

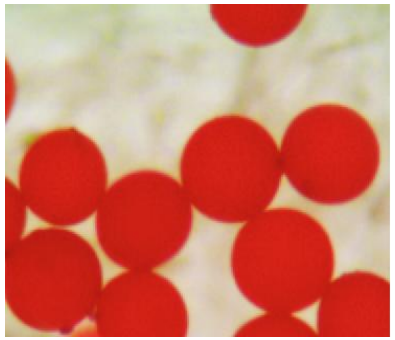
Biofouled microplastics



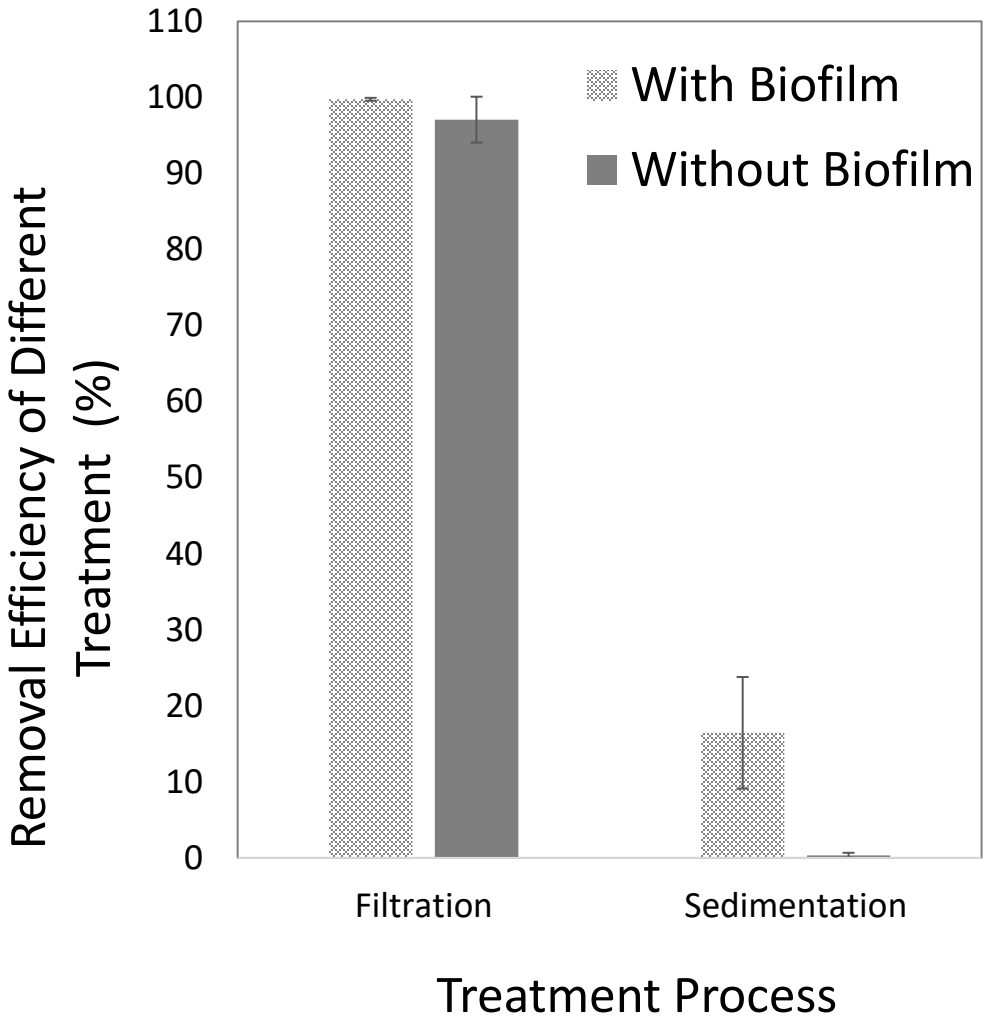
2 days



7 days



Control

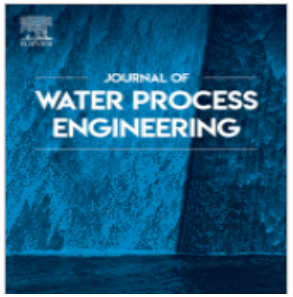


Zhang et al., *Science of the Total Environment* (2020)

Findings from bench-scale experiments

- Filtration achieved 86.5%–99.9% removal of small microplastics.
- Microplastics larger than 100 μm were almost completely removed by filtration (up to 99.9%).
- A critical particle-size range (1-10/20 μm) exhibited comparatively lower removal efficiencies.
- Biofilms readily formed on microplastic surfaces and contributed to the fragmentation of microplastics into smaller particles.
- Biofilm formation significantly enhanced the microplastic removal efficiency of CFS treatment

Water treatment – drinking water



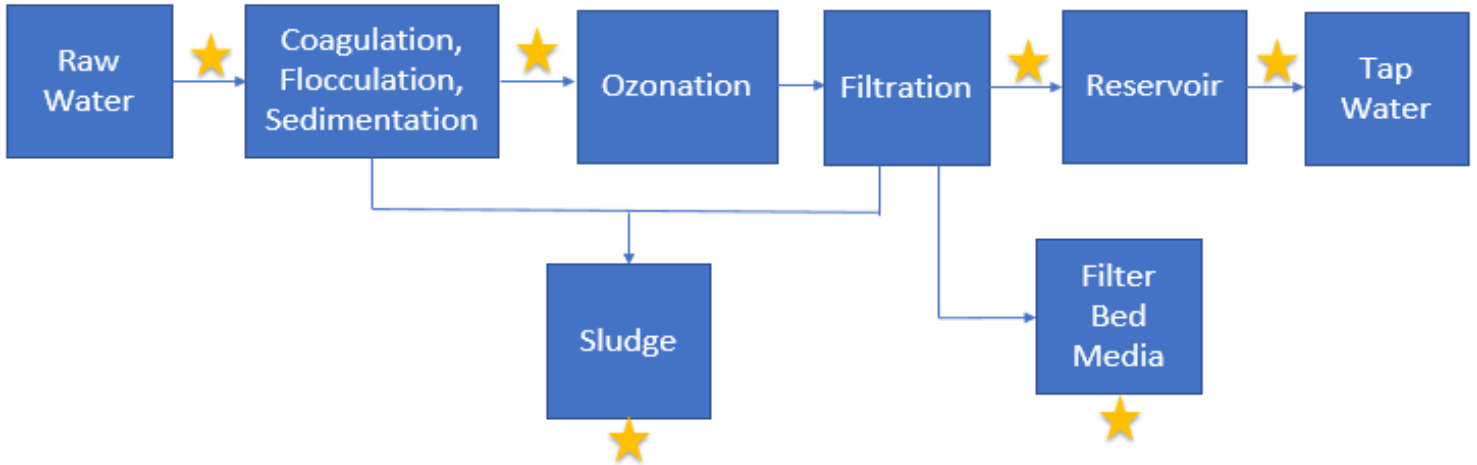
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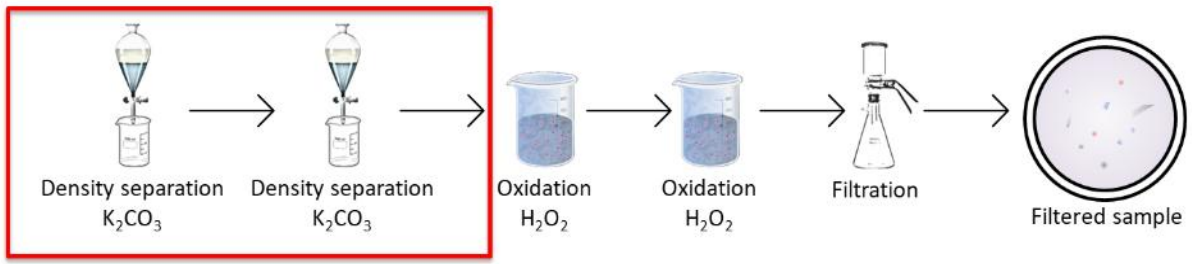
Occurrence, fate and partitioning of microplastics through drinking water treatment processes

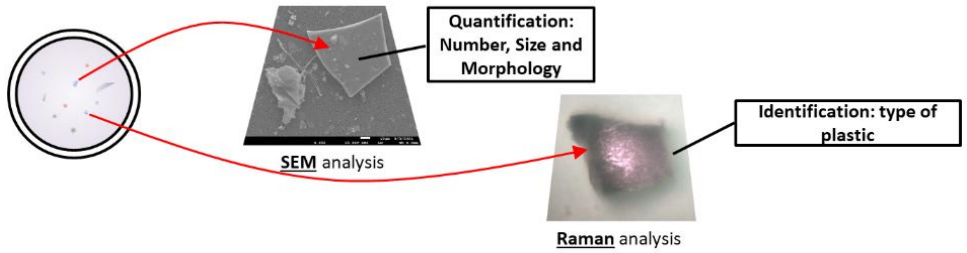
Megan Seay [a 1], Junyeol Kim [a 2], Carol Miller [a], Dienye Tolofari [b], John Norton [b], Yongli Wager [a] Show more

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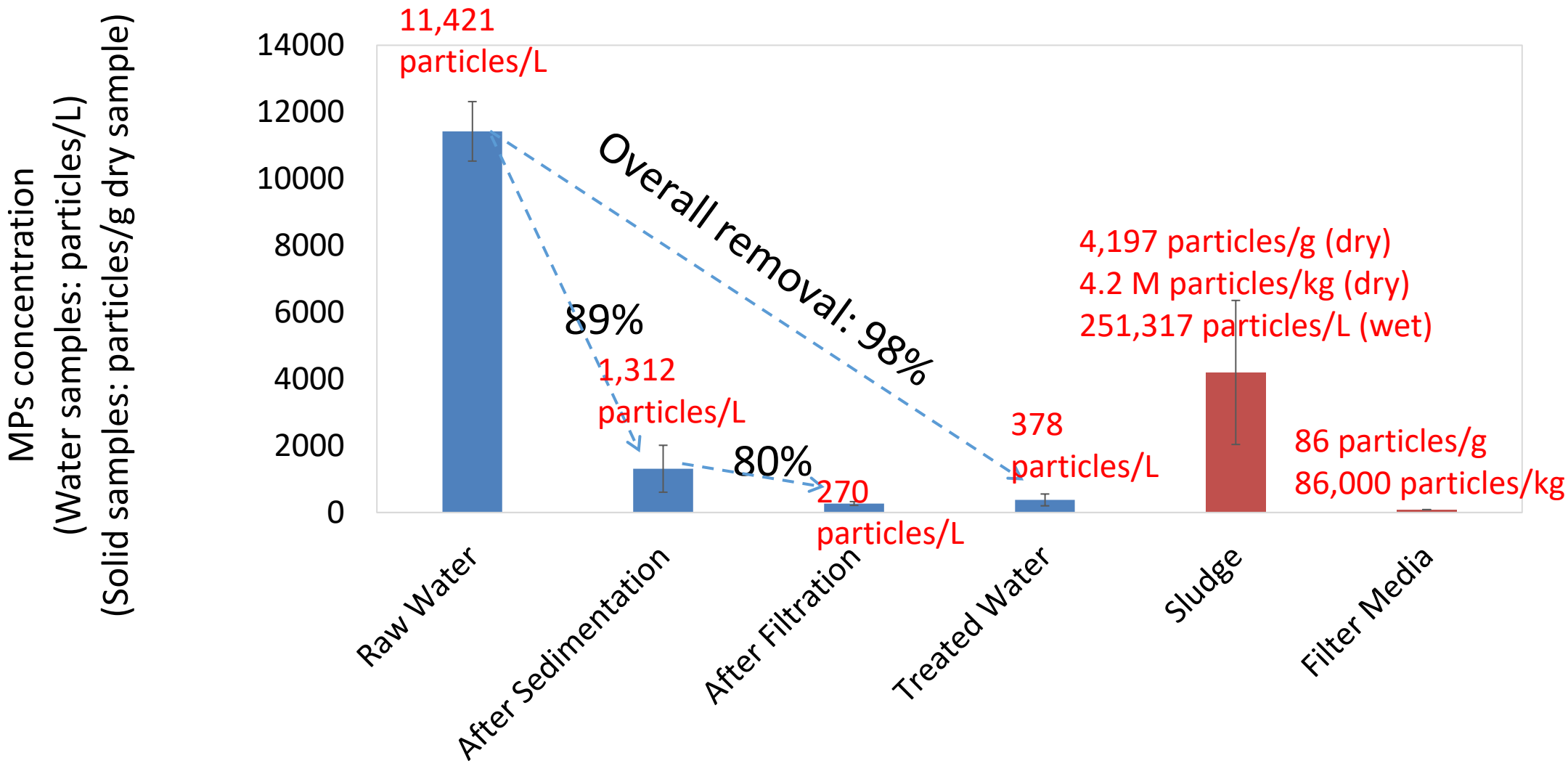








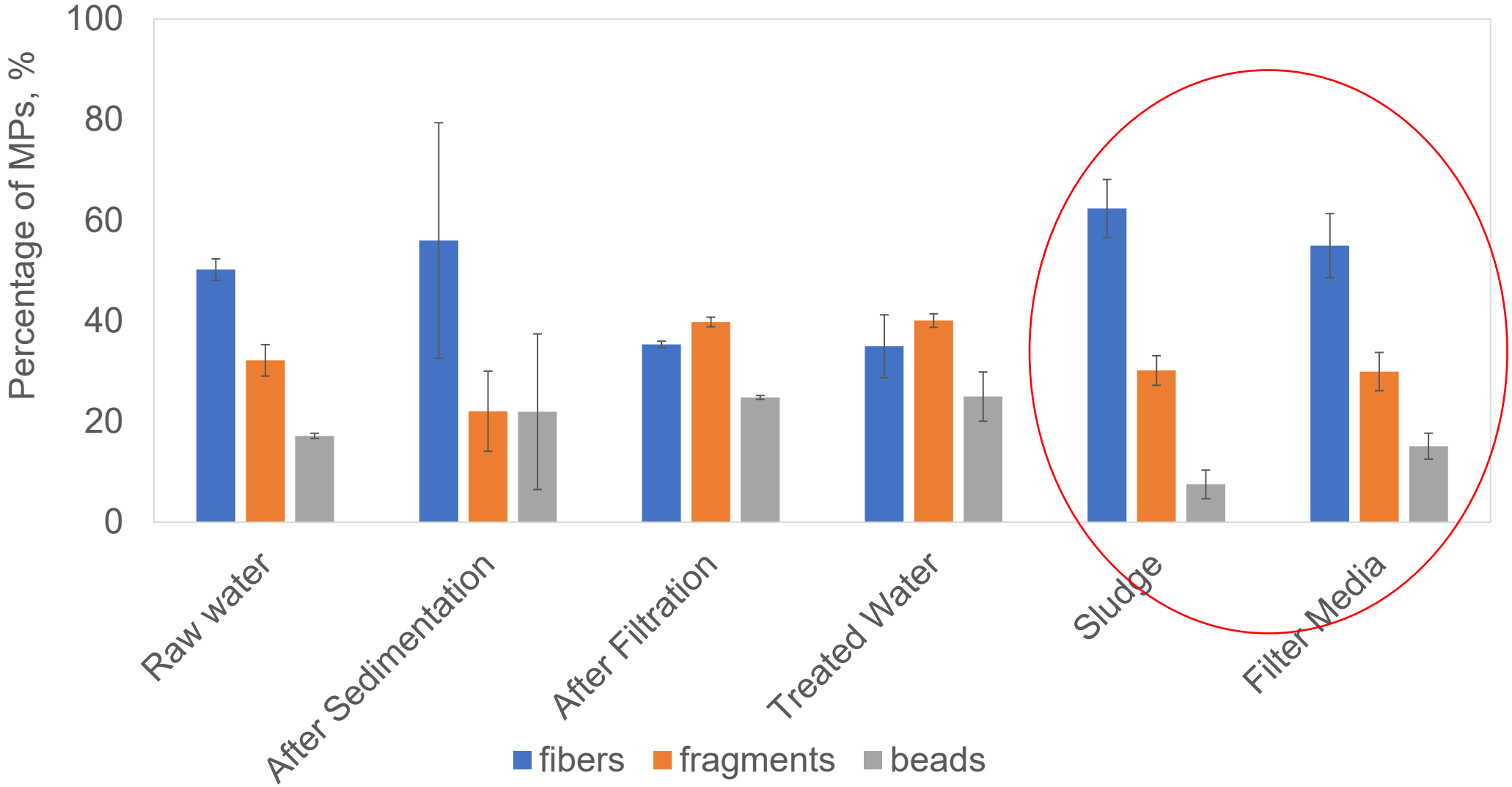
Removal efficiency



Water (blue) and solid (orange) samples

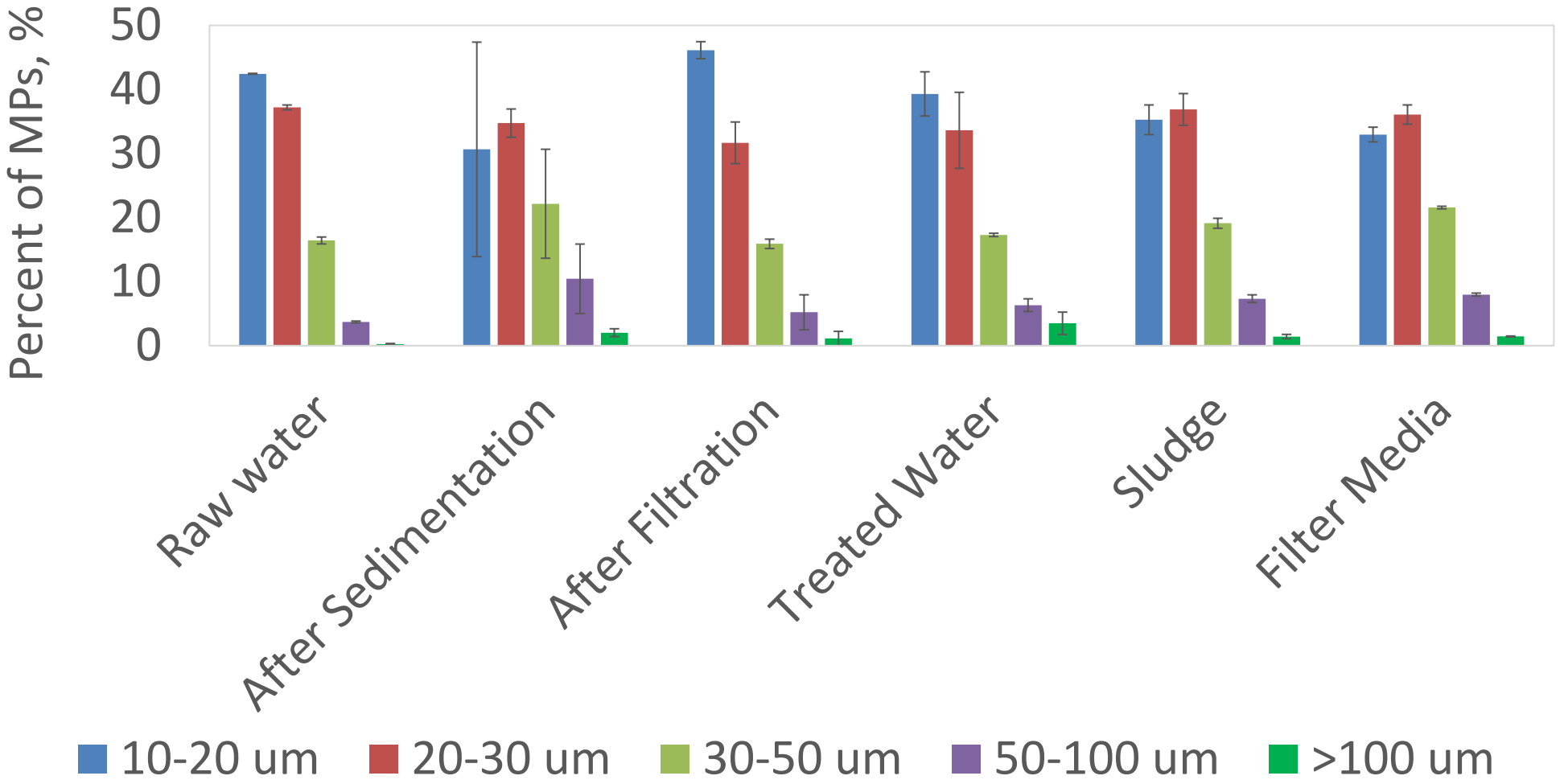
Source: Seay et al, 2025

Shape distribution



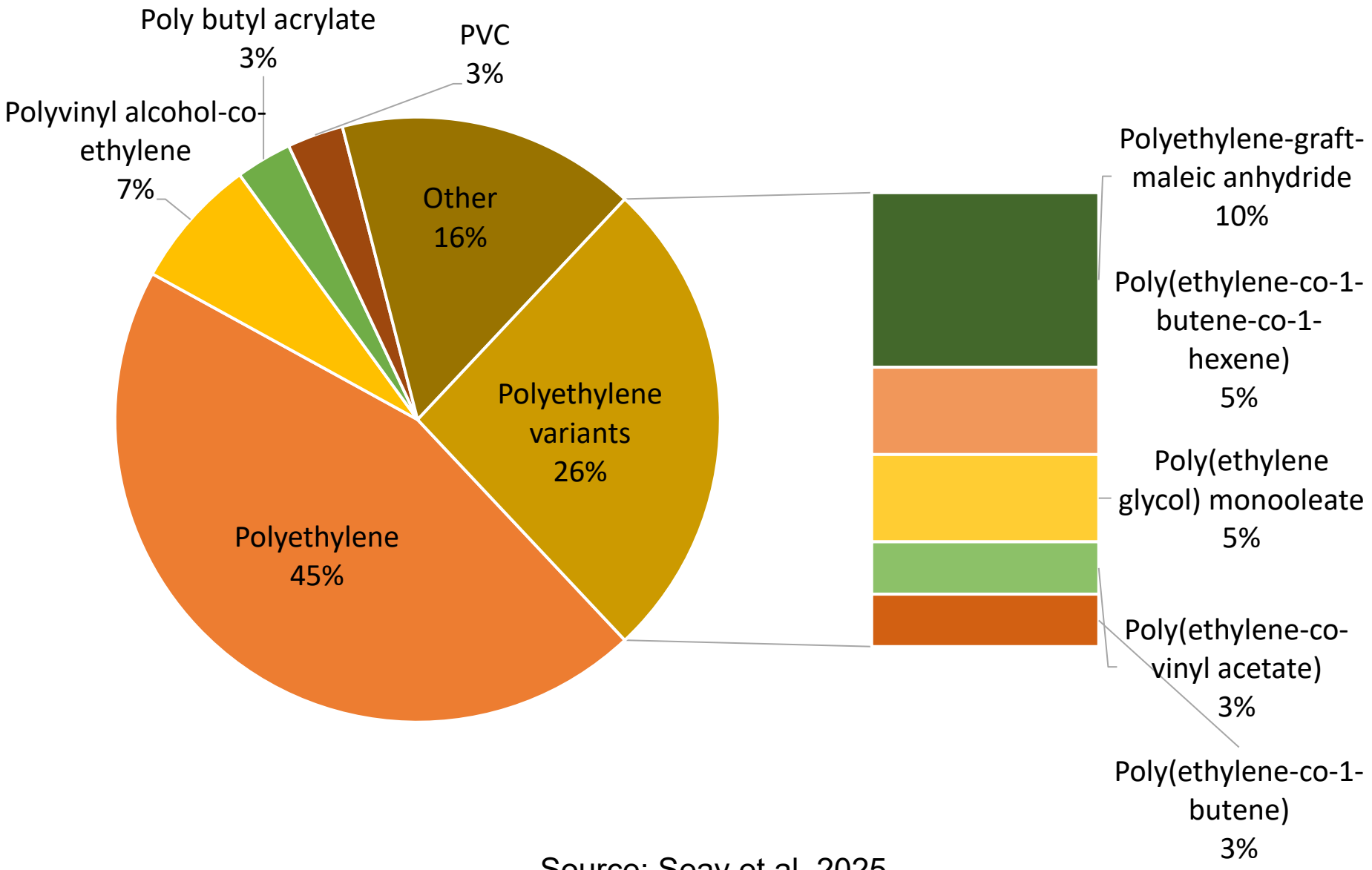
Source: Seay et al, 2025

Size distribution



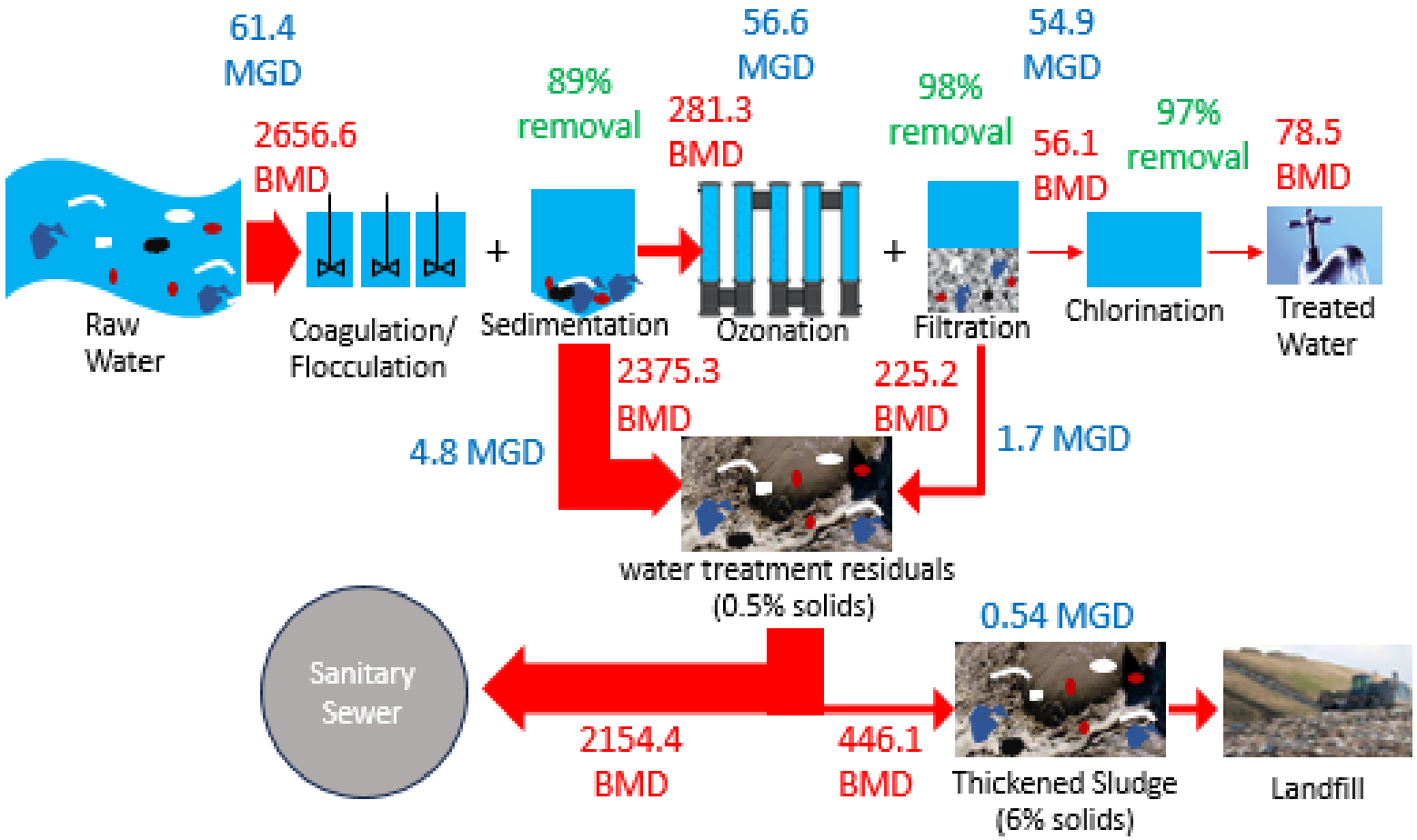
Source: Seay et al, 2025

Microplastic type



Source: Seay et al, 2025

Total microplastics loading and partitioning



Average daily MPs loading and partitioning. Blue, water flow (million gallons per day, MGD); Green, MPs removal rate (%); Red, quantity of MPs (billion MPs per day, BMD)

Source: Seay et al, 2025

Findings from the water treatment plant

- The overall removal efficiency of microplastics is high (98% removal)
- Sedimentation and filtration achieve removal efficiencies of 89% and 80%, respectively
- Most microplastics are smaller than 30 μm (>70%) and categorized as fiber and fragments (>80%)
- The majority of microplastics are concentrated in and ultimately disposed of with treatment residuals
- Proper residual disposal is key to preventing concentrated microplastics from reentering the environment

Storm water management



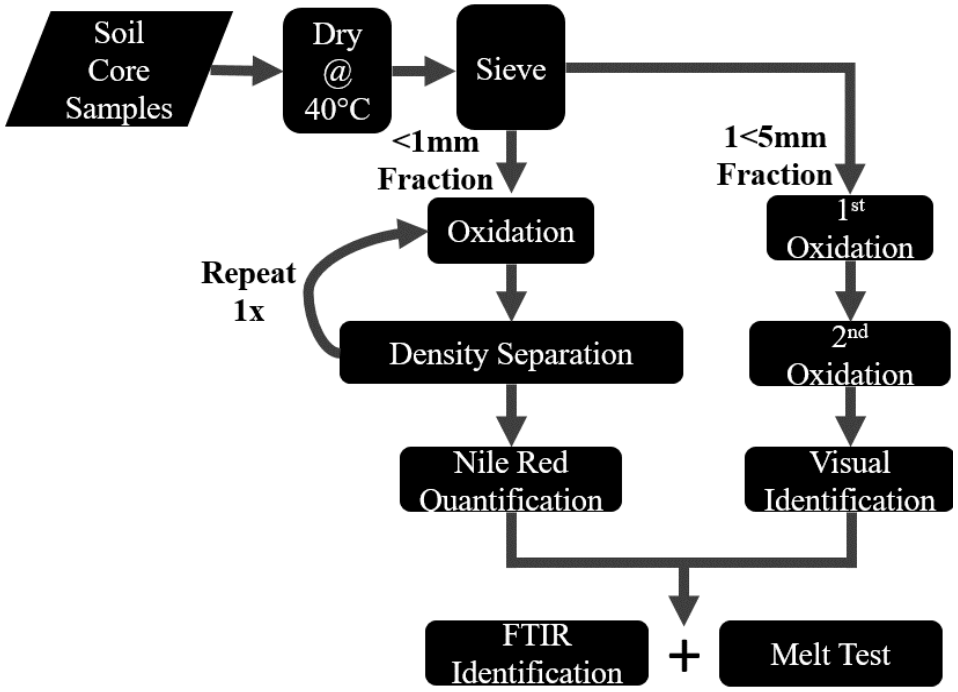
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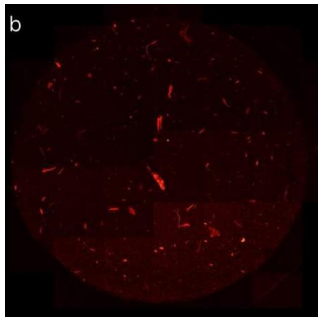
Field assessment of engineered bioretention as microplastics sink through site characterization and hydrologic modeling

Amanda R. Laramie [1], William D. Shuster, Yongli Z. Wager, Meisam Darabi Show more

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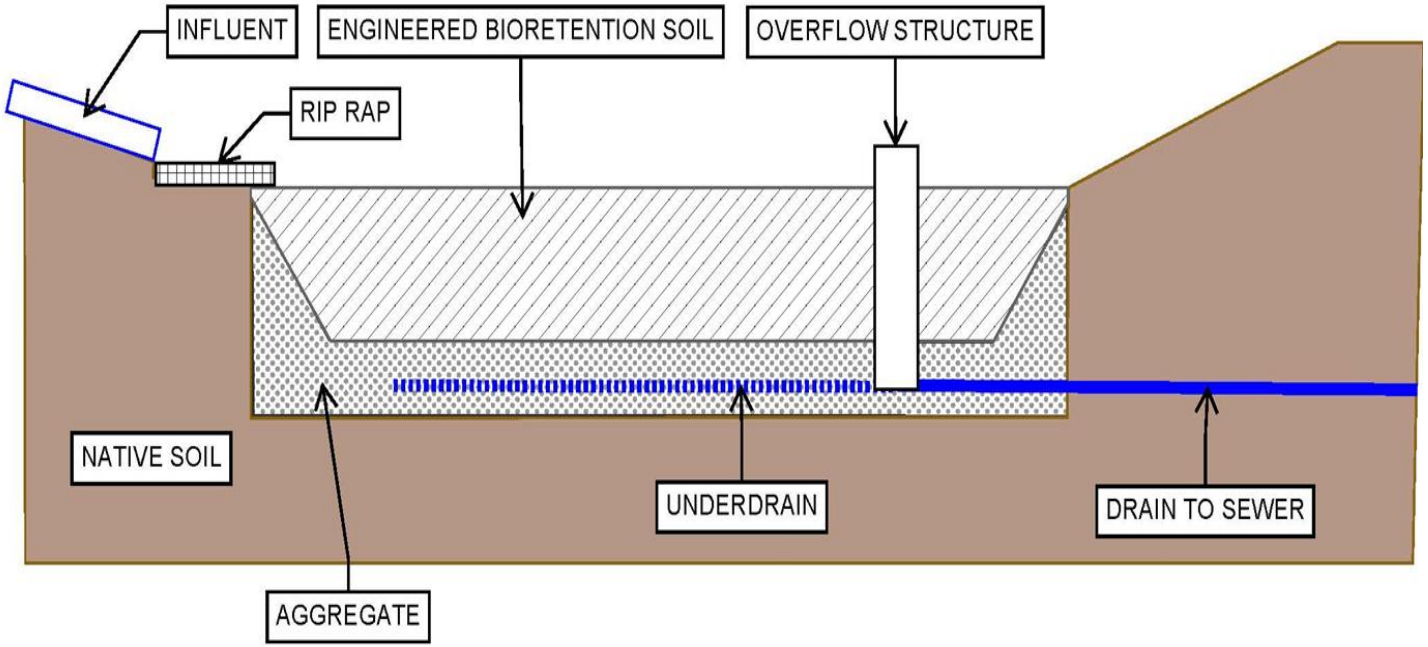


Source: Laramie et al., 2025

Study site



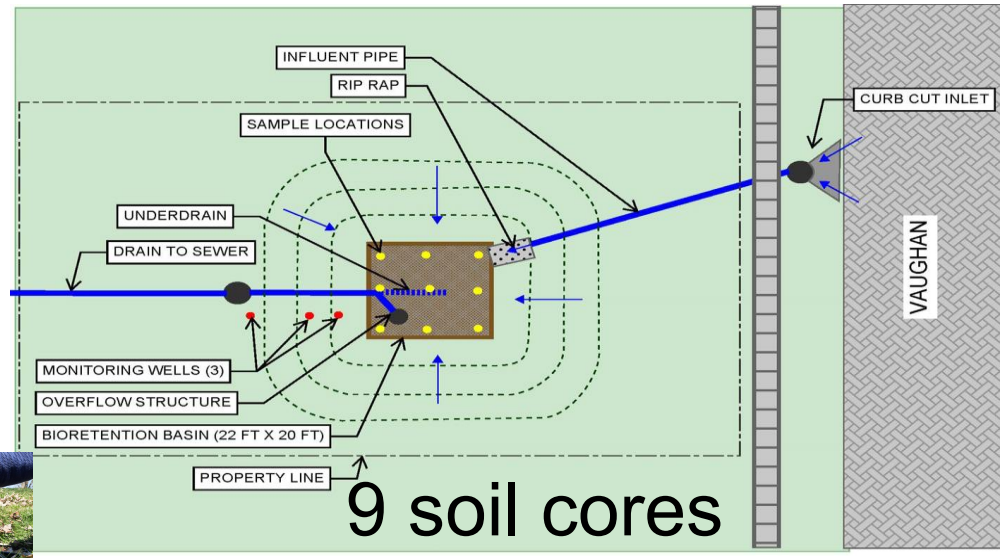
Two engineered bioretention sites, Detroit, MI

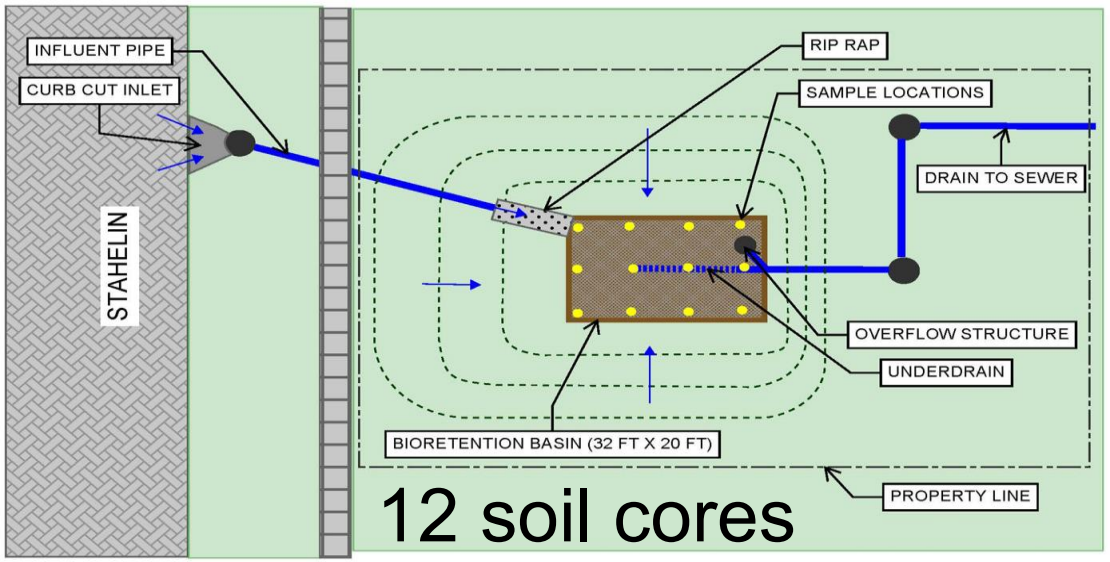


Typical bioretention cross Section, from Detroit Water and Sewer Department Stormwater Manual.

Source: Laramie et al., 2025

Field sampling





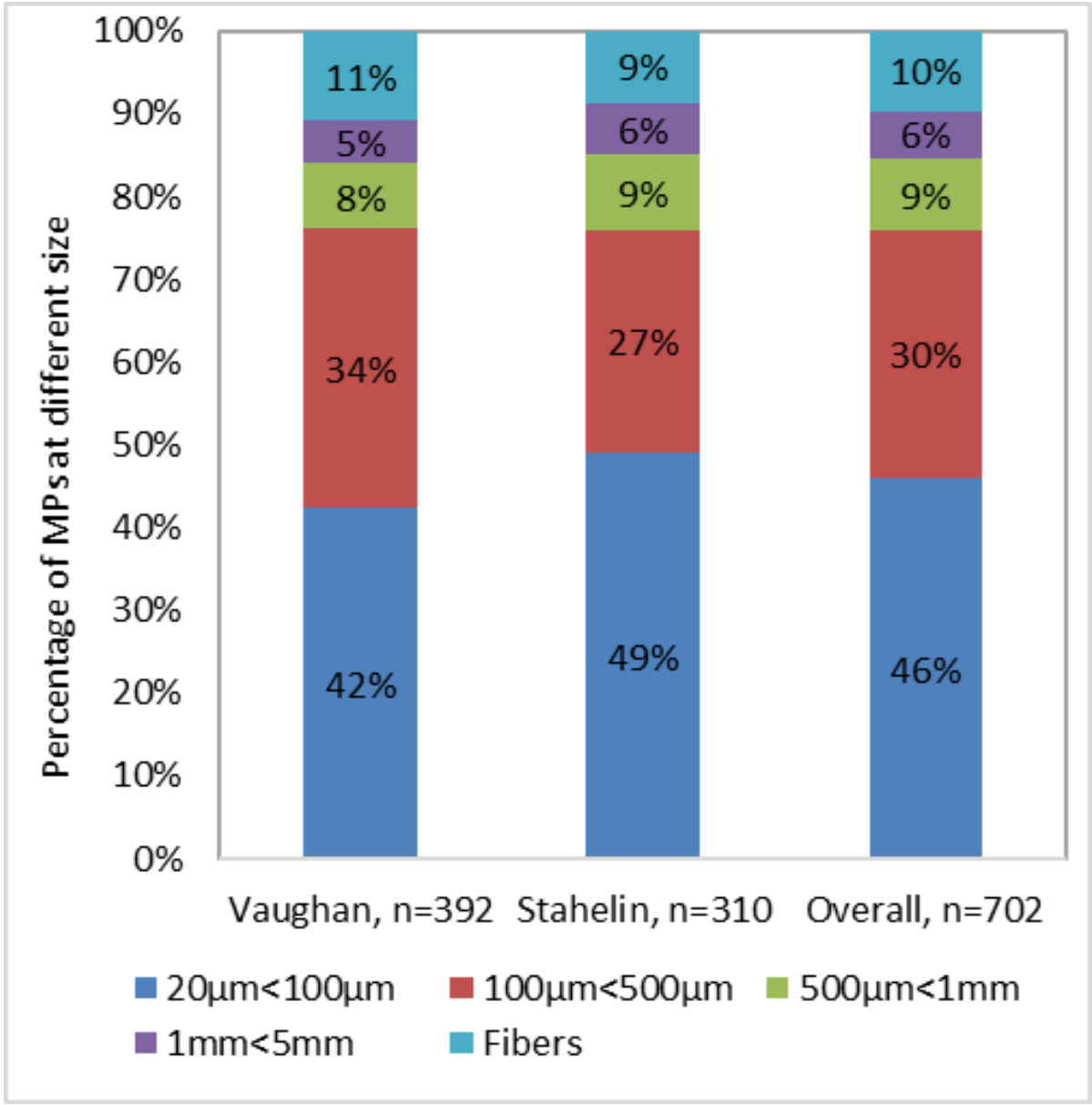


- Three soil samples outside of each practice
- Each soil core was divided into three depth increments
- Water samples from the groundwater monitoring well
- In total, 72 samples were collected and analyzed

Site survey: surface hydraulic conductivity, surface soil texture, soil bulk density

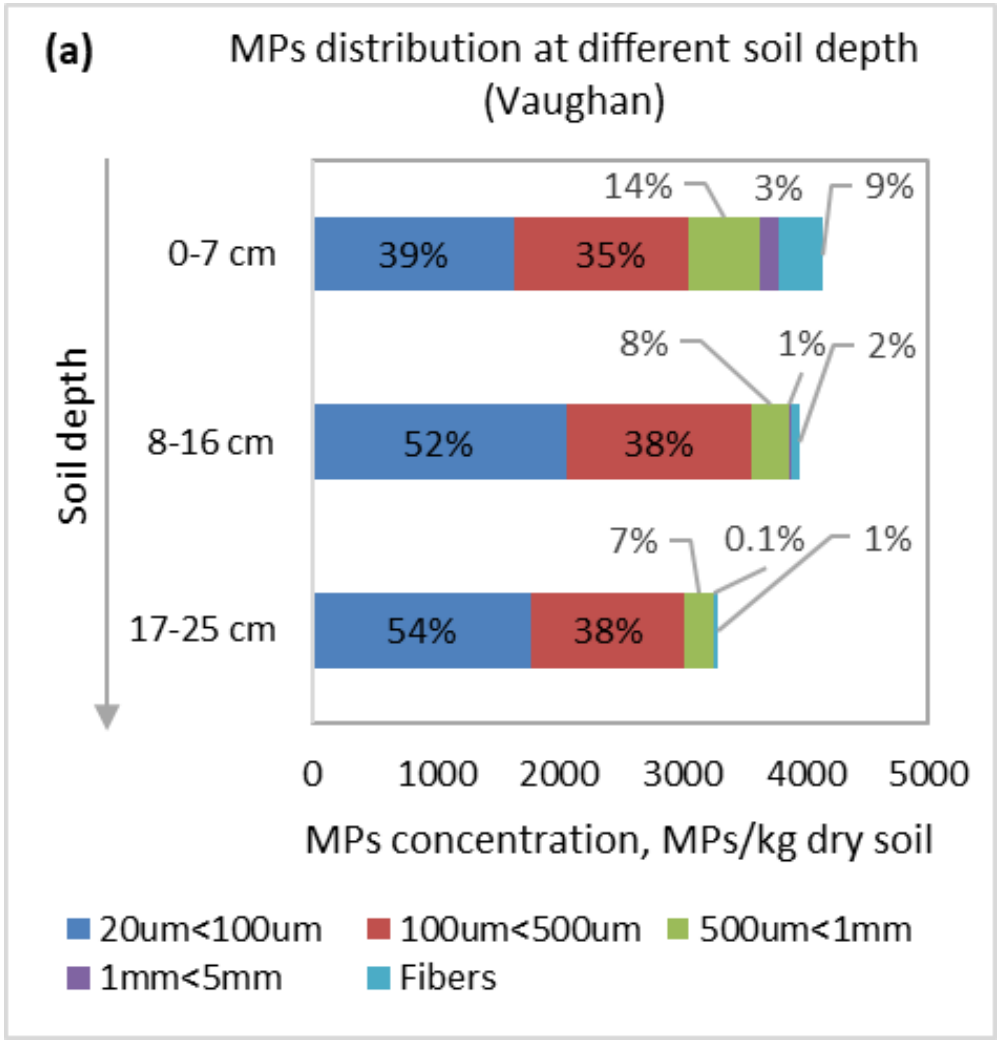
Source: Laramie et al., 2025

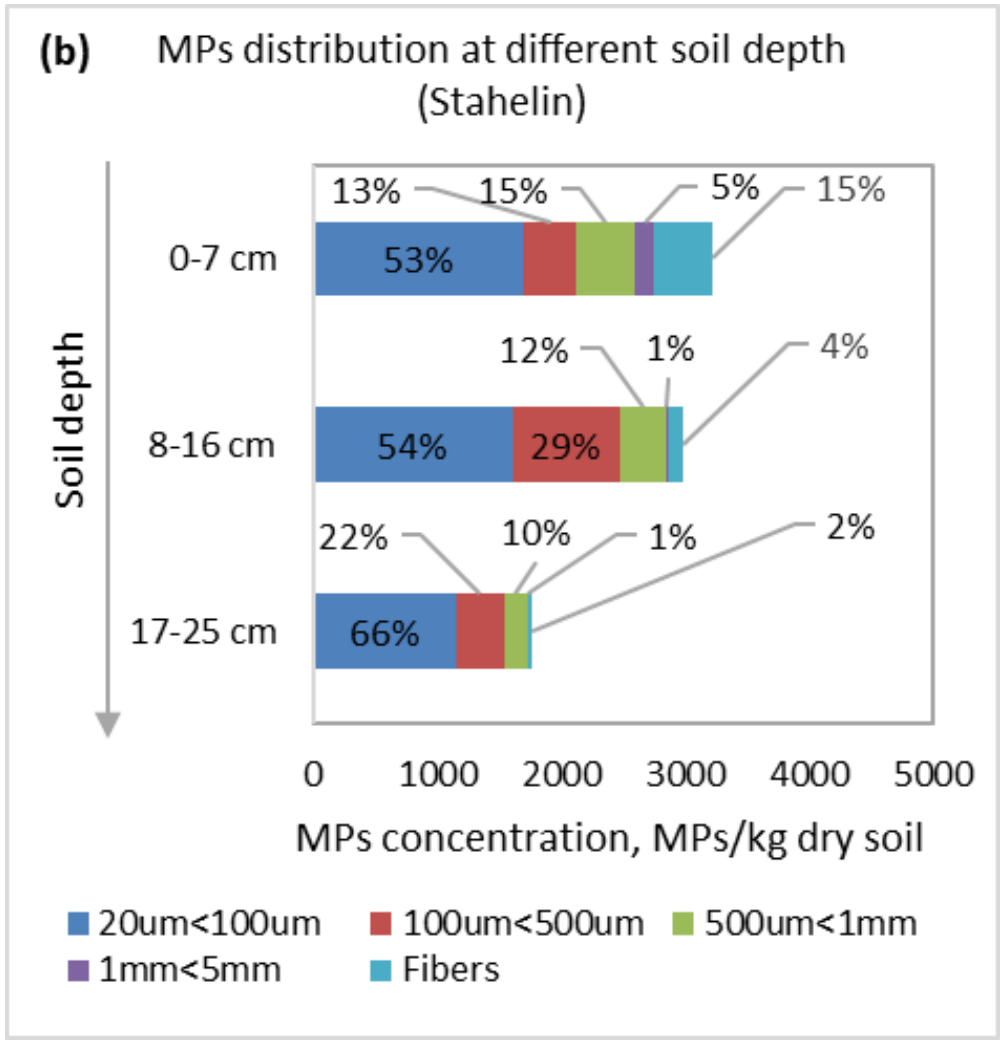
Size distribution



Source: Laramie et al., 2025

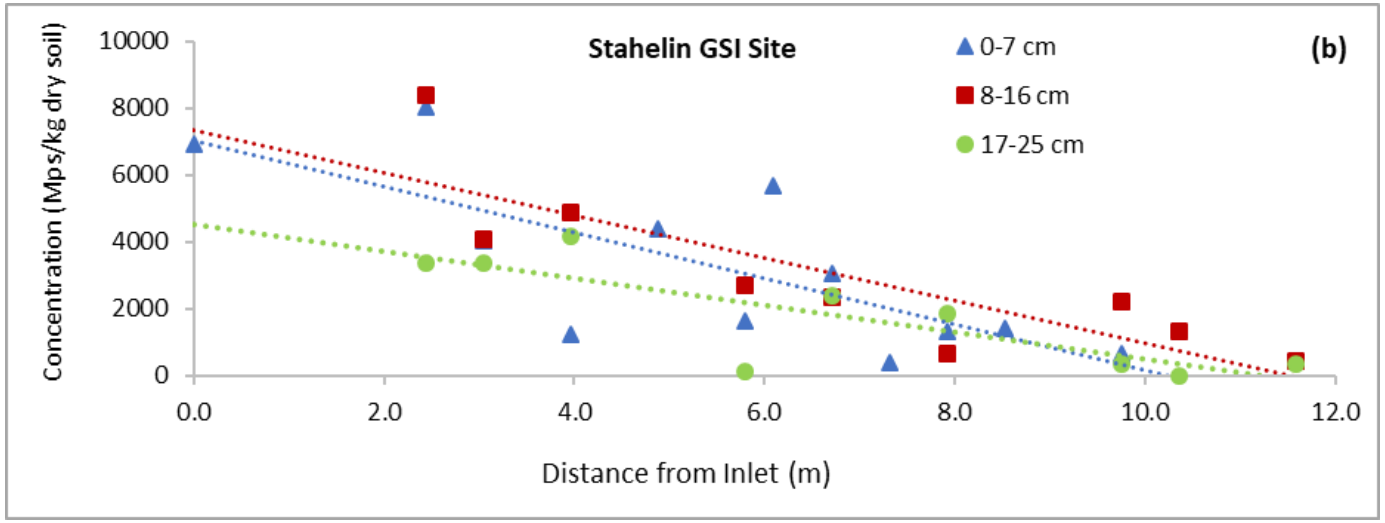
Microplastic transport in bioretention soil

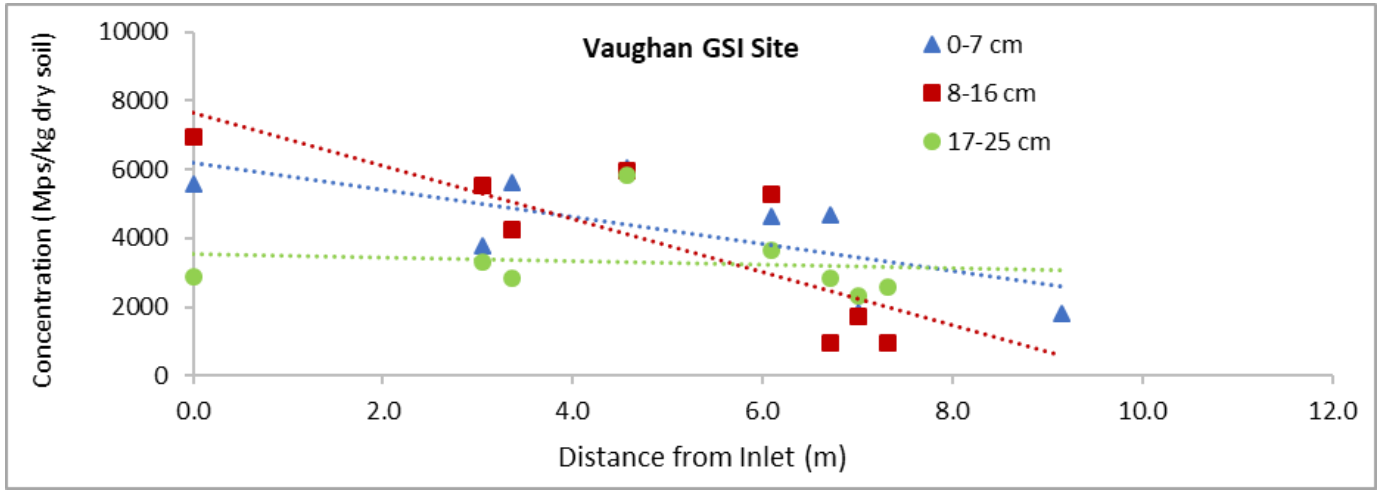




Source: Laramie et al., 2025

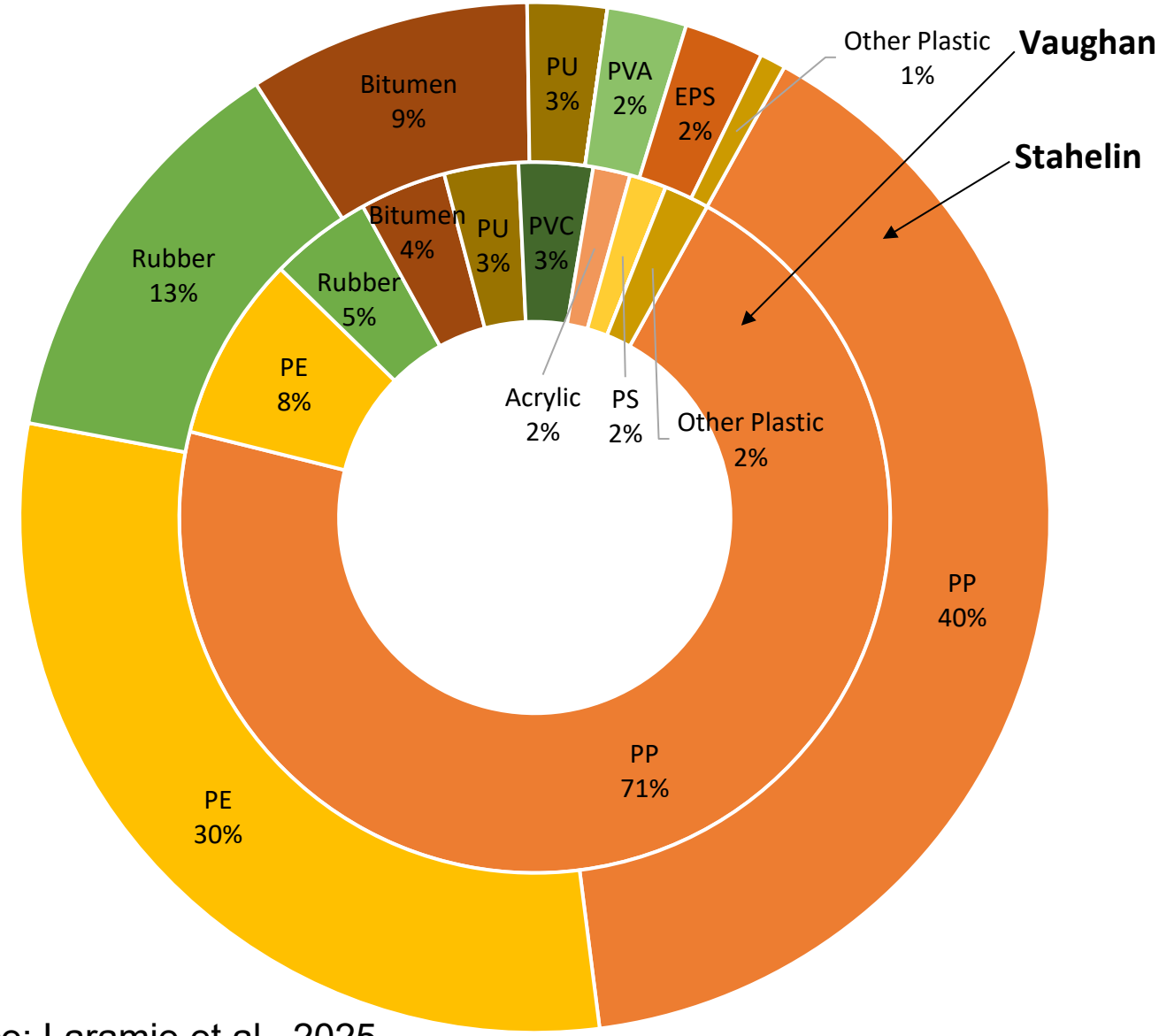
Microplastic transport in bioretention soil

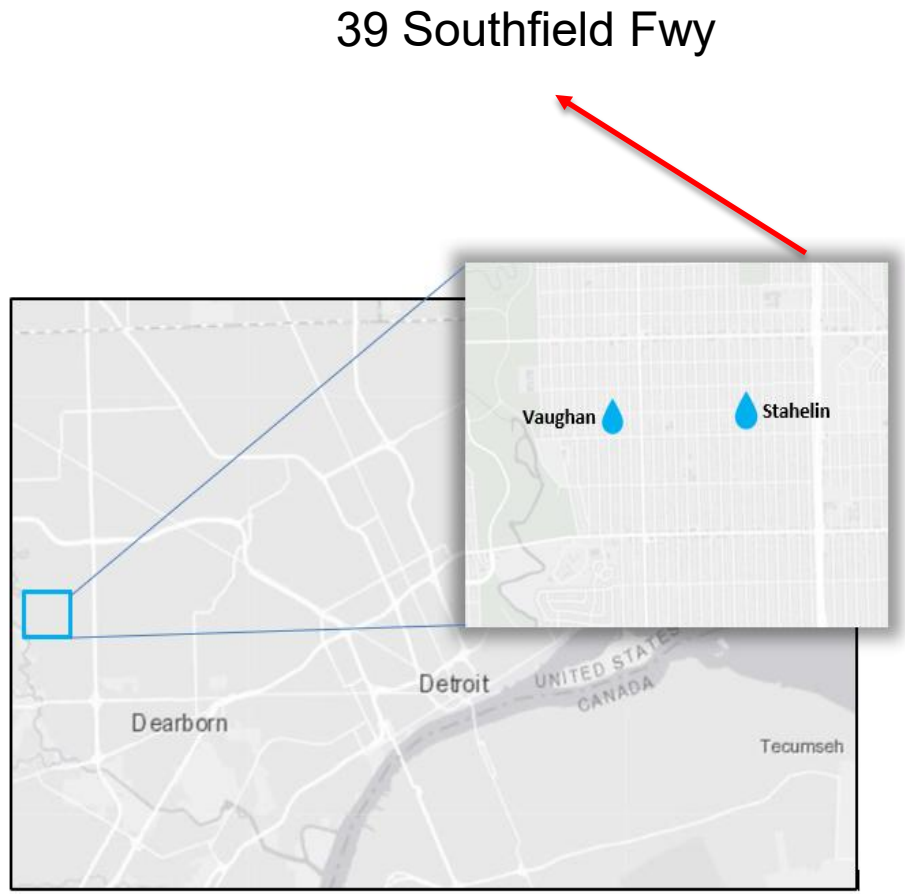




Source: Laramie et al., 2025

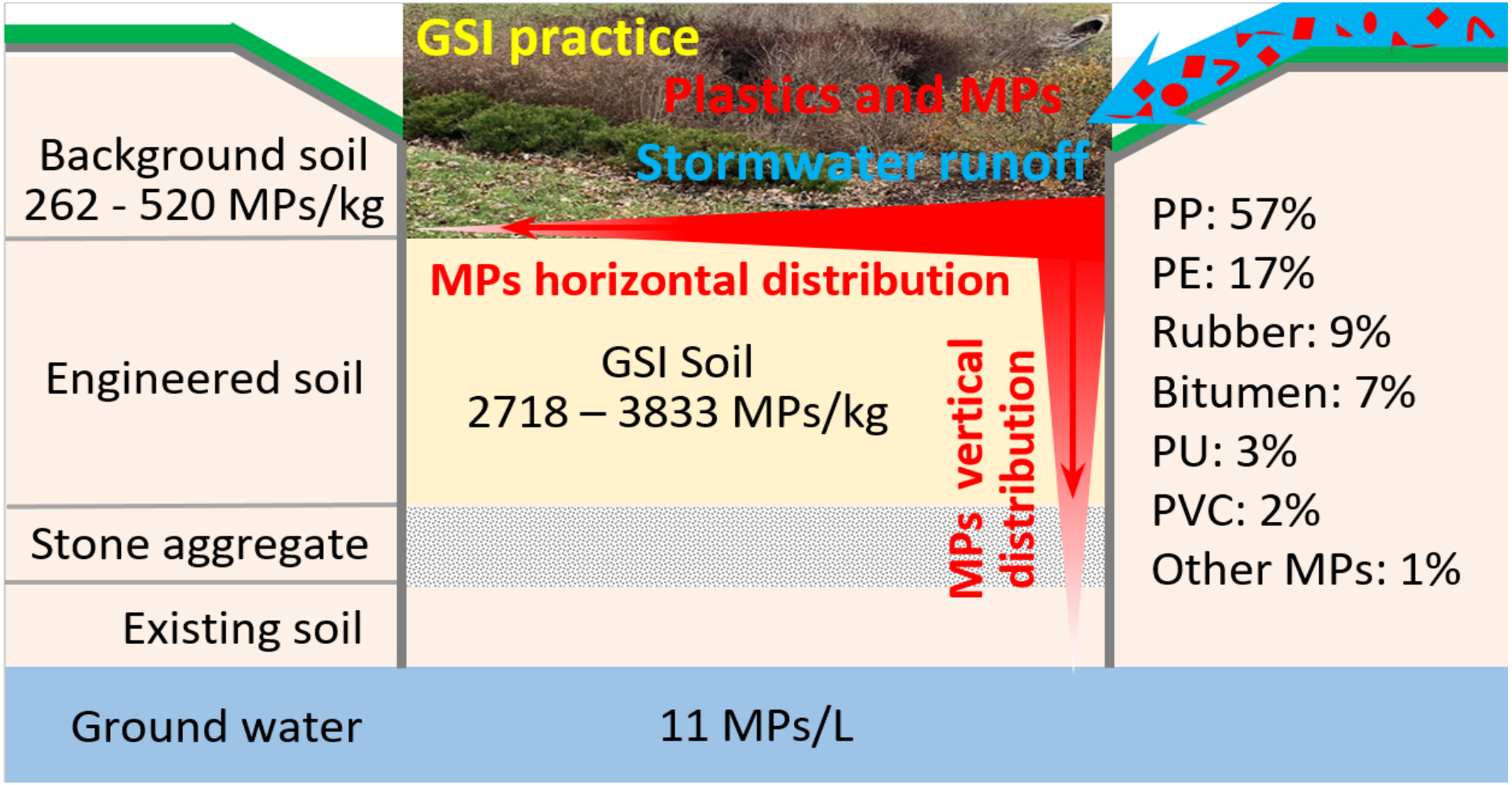
Microplastic type





Source: Laramie et al., 2025

Results summary



Source: Laramie et al., 2025

Findings from bioretention practices

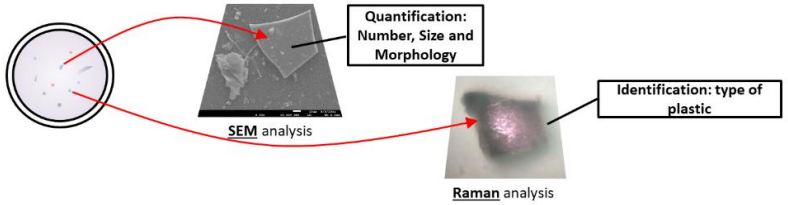
- 7 – 10 times higher of microplastics in bioretention soils than urban soils
- Microplatics decreased with the distance from the stormwater inlet and soil surface
- Minimal microplastics (11 particles/L) in groundwater nearby bioretention practices
- Properly designed and maintained bioretention systems could mitigate microplastic pollution from stormwater runoff
- A considerable portion of microplatsics (microfibers) originated from geotextiles

Source: Laramie et al., 2025

Key Takeaways

- Drinking water treatment reduces exposure, but small microplastics (<20 µm) and nanoplastics remain challenging
- Proper waste residual disposal is critical to avoid accumulated microplastics re-entering the environment.
- GSI can effectively reduce microplastic transport from stormwater to waterways

Other work





Detection method



Microplastics data tool





Microplastics monitoring







Community engagement

Acknowledgments

Research Team

Meisam Darabi
Allison Diehl
Dr. Kishore Gopalakrishnan
Dr. Junyeol Kim
Amanda Laramie
Ashton Lewandowski
Megan Seay

Collaborators

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Dr. Carol Miller (WSU)
Dr. John Norton (GLWA)
Dr. Willima Shuster (WSU)
Dr. Dienye Tolofari (GLWA)



GLPF 1151 & 2066



NIEHS P30 ES020957
P42 ES030991



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