A plastic storm: The role of stormwater in the microplastic load of an urban river system

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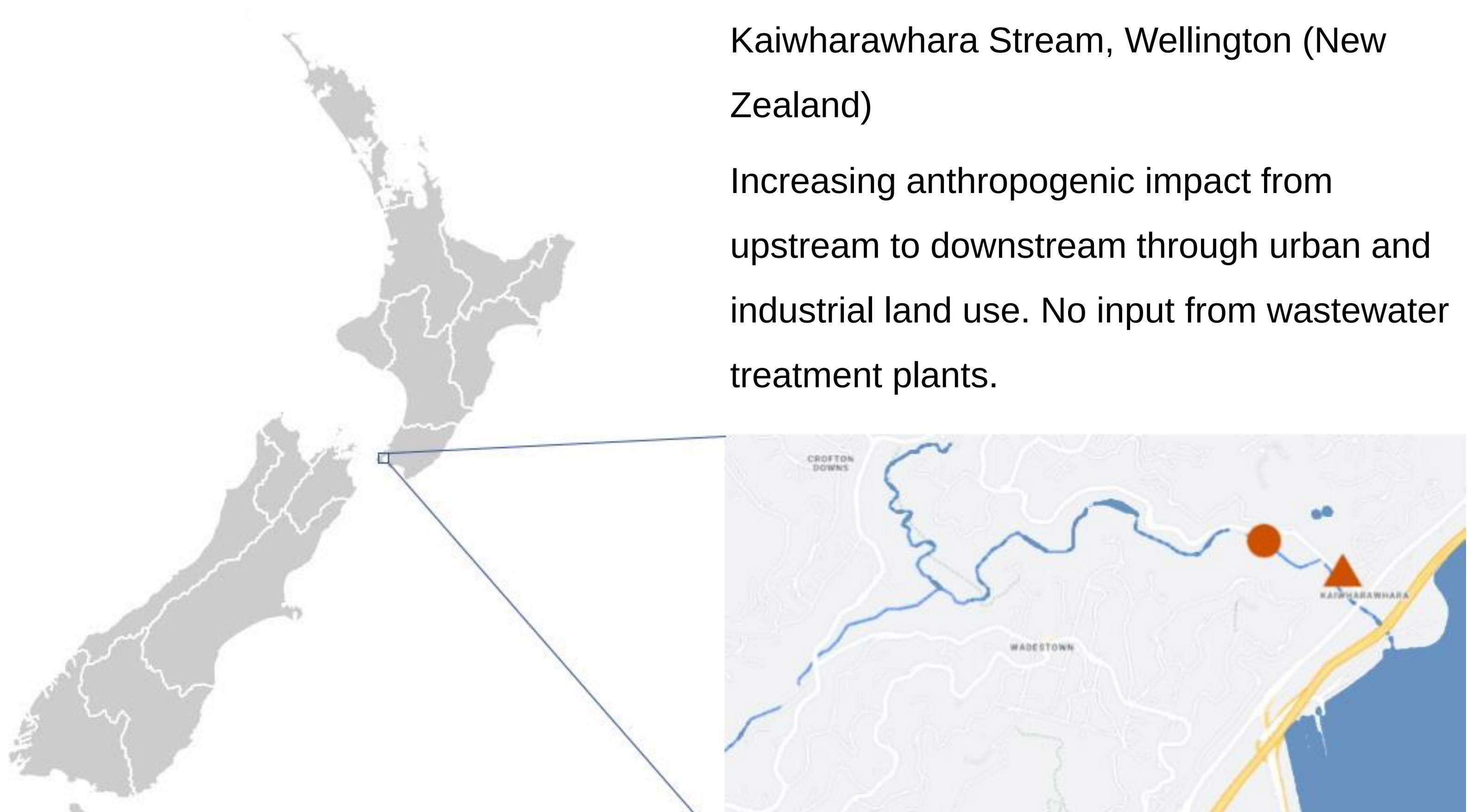
Introduction

Urban river systems worldwide have been shown to contain significant levels of microplastic contamination, with stormwater suggested to be a major source. This study aims to understand the dynamics of riverine microplastic load during storm events.

Objectives:

- Determine riverine microplastic abundance during dry weather (base flow)
- Establish riverine microplastic abundance at multiple time points throughout a storm event and investigate relationships between abundance and river flow
- Determine polymer types, sizes and shapes of microplastics present in storm samples

Methods



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Study site

Kaiwharawhara Stream, Wellington (New Zealand)

Increasing anthropogenic impact from upstream to downstream through urban and industrial land use. No input from wastewater treatment plants.

River water sampling

▲ Four **base flow** samples, each containing 100L river water, were collected with a stainless-steel bucket during dry weather in February, May, August and October 2021.

● During a 30 hrs **storm event** in August 2021, 11 samples, each comprising 10 L river water, were collected using a pre-programmed autosampler (Teledyne ISCO, Inc 3700).

Microplastic extraction & identification

Wet peroxide digestion

Density separation using NaI

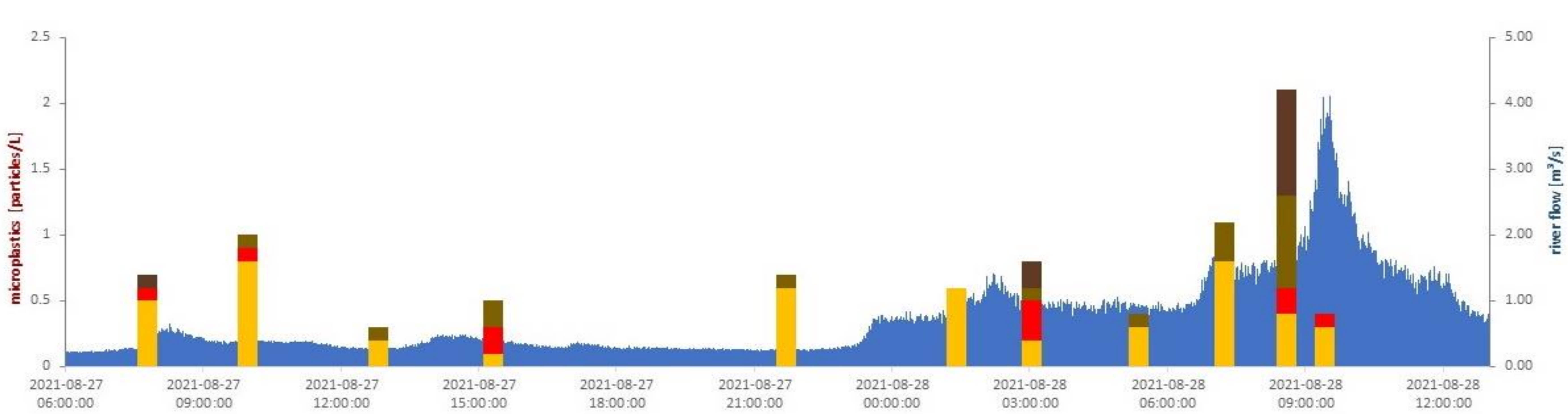
Supernatant filtered onto Whatman GF 8 microfibre filter

Manual isolation of suspected microplastics under stereomicroscope

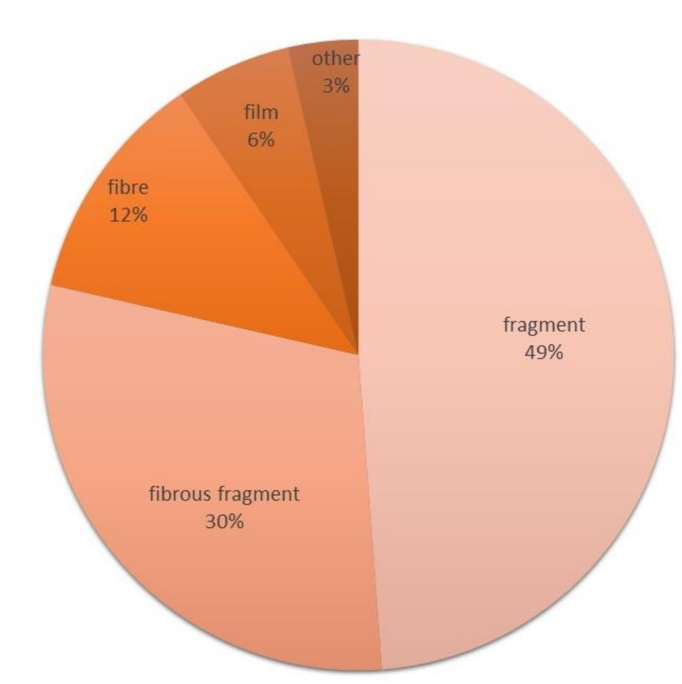
Chemical polymer identification using Fourier transform infrared spectroscopy (FTIR)

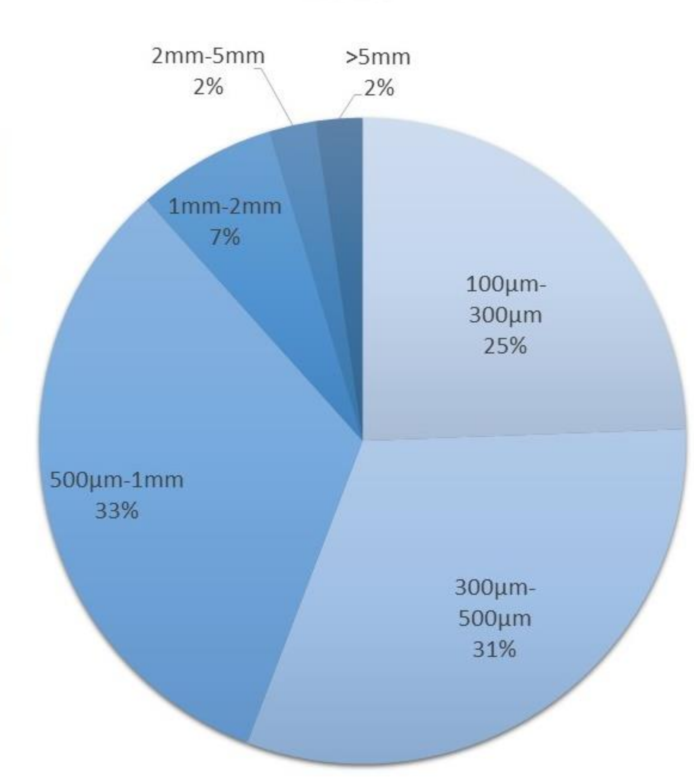
Results

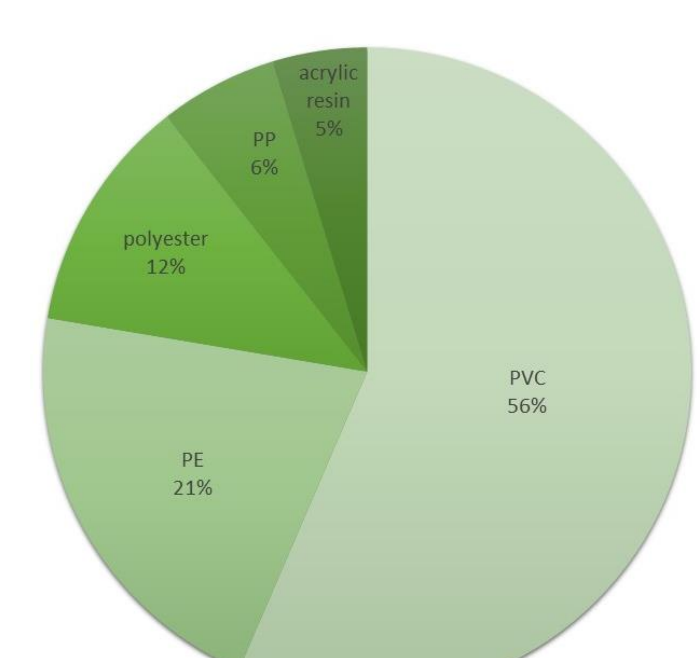
- All samples contained microplastic particles.
- **Base flow** samples contained **0.01 – 0.04 particles/L**.
- During the **initial storm period**, riverine microplastic abundance was at **0.3 - 1.1 particles/L**, followed by a **peak** in abundance (**2.1 particles/L**) ahead of peak river flow
- The most abundant polymer type was **PVC** (56%), followed by **LDPE** (21%), **polyester** (12%), **PP** (6%) and **acrylic resin** (5%).
- **Fragments** were the most abundant shape (49%), while the majority (89%) of microplastic particle were **< 1mm** in size.



Microplastic quantities and polymer types over storm hydrograph







Top to bottom: Shape, size, and polymer type distribution across storm samples

Conclusions & outlook

- Our study demonstrated that storm events result in a significant increase of the riverine microplastic load compared to that during dry weather.
- Elevated levels of mobile plastic particles followed the pattern of river flow during the storm event, however a peak in numbers was observed ahead of peak river flow, i.e., peak storm intensity.
- The most abundant particle shapes were fragments, indicating urban litter and construction materials as potential sources.
- As part of this project, investigations into the quantities and types of microplastics present in stormwater runoff prior to entering the river, as well as quantities in the river sediment, will further enhance the understanding of the complex dynamics between microplastic input and potential re-mobilization.
- These results can help inform mitigation measures preventing microplastic contamination, resulting from storm events, to urban waterways and beyond.

We acknowledge Taranaki Whānui Ki Te Upoko o Te Ika who hold mana whenua for this rohe and have responsibilities as kaitiaki of the Kaiwharawhara Stream.

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