Reducing Microplastics in the Delaware River Estuary

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Background

•Plastic is perhaps the most prevalent debris found in our waterways.[1]

•Plastic debris less than five millimeters in length are called microplastics.

•Plastics in the aquatic environment are of increasing concern because of their persistence and effect on the environment, wildlife, and human health.[2,3,4,5]

•Few microplastics studies have been conducted in the Delaware watershed. Projects have been completed in the Delaware Bay[6] and non-tidal Delaware River[7], but these studies left the upper portion of the tidal Delaware River understudied.

•This reach of the river is largely urbanized and is likely a major contributor to microplastic loading in the Delaware Estuary.

•Understanding the inputs from major tributaries into the Estuary and quantifying microplastics in the river are vital first steps towards understanding the potential problems posed by this contaminant of emerging concern.

•Data on microplastic concentrations can be used to target cleanup efforts in high plastic loading watersheds.

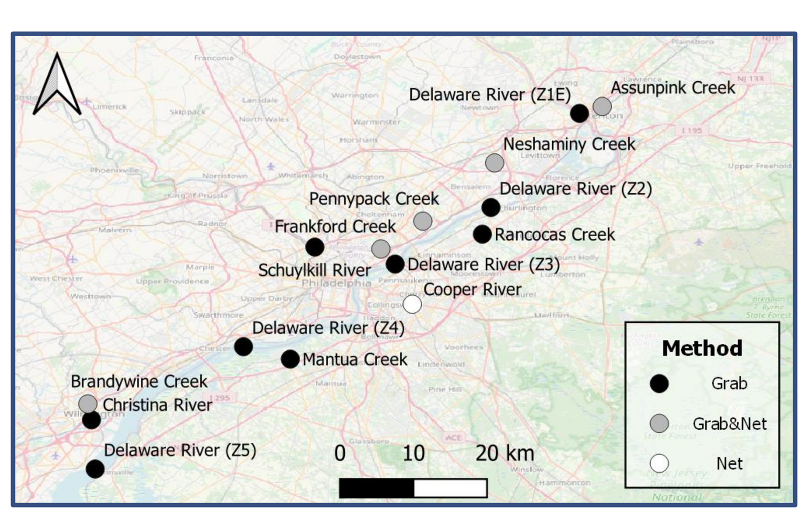
Objectives

Objectives of this work included:

- Increasing the understanding of the distribution of microplastics in the Delaware River Estuary through monitoring and modeling.
- Reducing plastic loading to the Estuary via targeted cleanup efforts.
- Improving public awareness of the issues associated with microplastics through outreach and education.

Methods

Ten-liter grab samples were collected at nine tributary locations and five mainstem locations. Tributary samples were collected at bridges directly into amber glass sampling jars using a weighted sampler. Mainstem samples were collected surface and bottom via boat in the main channel of the river.



Sampling Locations

Net samples were collected at a subset of stations by deploying two 153-µm, mesh plankton nets at each site. Nets were anchored to weights and floats were affixed to nets to keep them on the surface. Nets were deployed for ~5 hrs at each site. Streamflow was estimated to calculate the volume of water sampled.

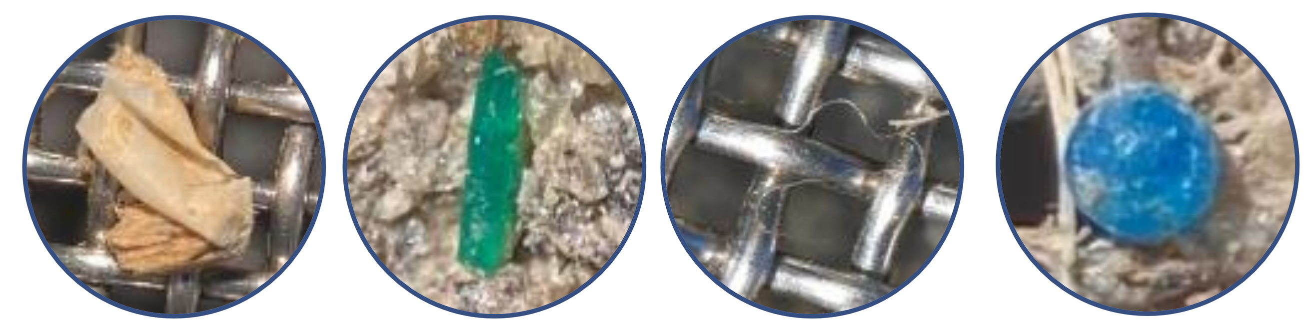
Simple Grab Sampler

Niskin Grab Sampler

Lab analysis was completed by Temple WET Center, generally following NOAA methods[8]. Data recorded included particle count, particle size, particle shape, particle color, and particle composition via FTIR spectroscopy.

Net Sampler

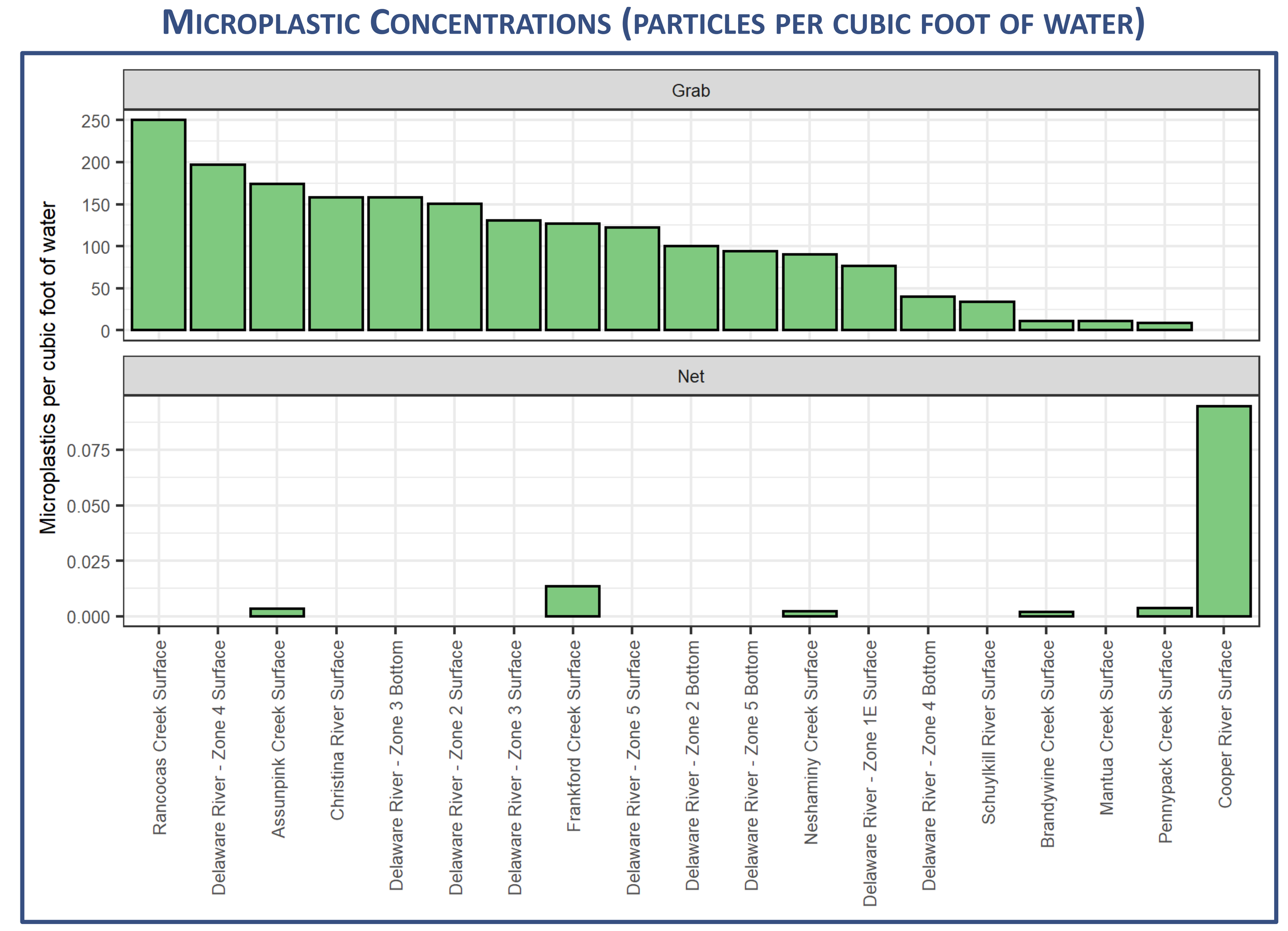
Sampling Results



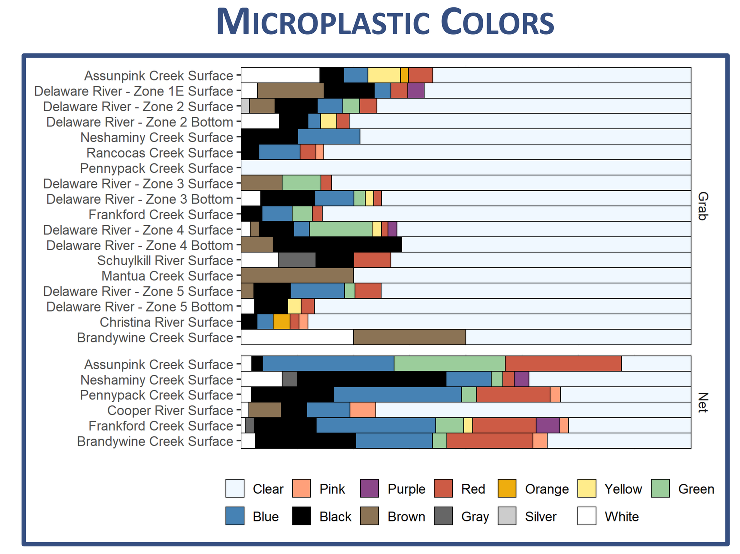
Various microplastic particles collected during sampling

Microplastic particles were found in each sample. A large discrepancy was seen in plastic concentrations depending on collection method with grab samples showing higher concentrations of plastics than net samples. Inter-site differences may have been driven by variable flow conditions during sampling. Plastics were found in a variety of sizes, shapes, colors, and compositions. Small fibers (likely derived from clothing materials) were dominant, particularly in grab samples.

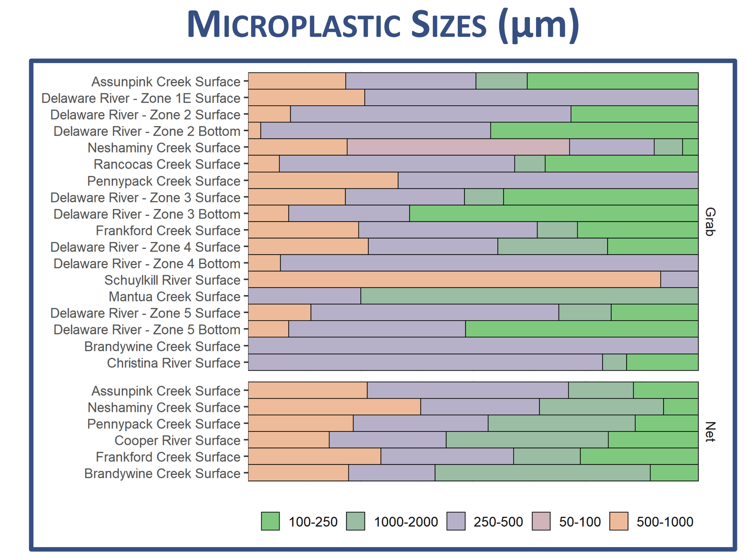
Microplastic Concentrations (particles per cubic foot of water)



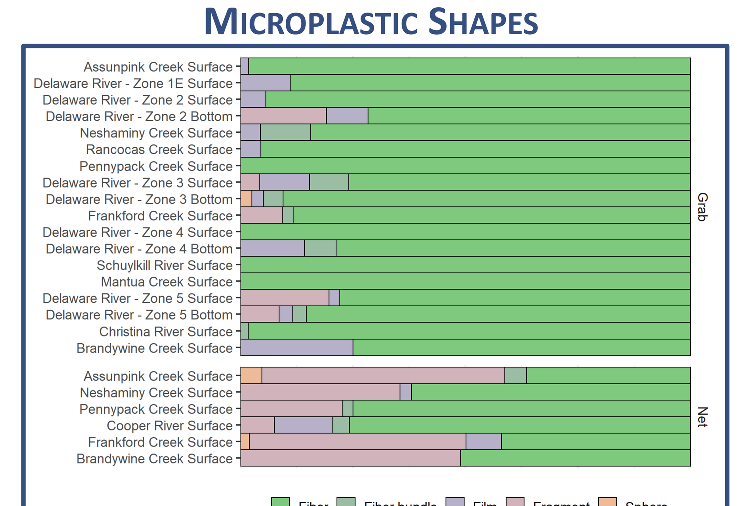
Microplastic Colors



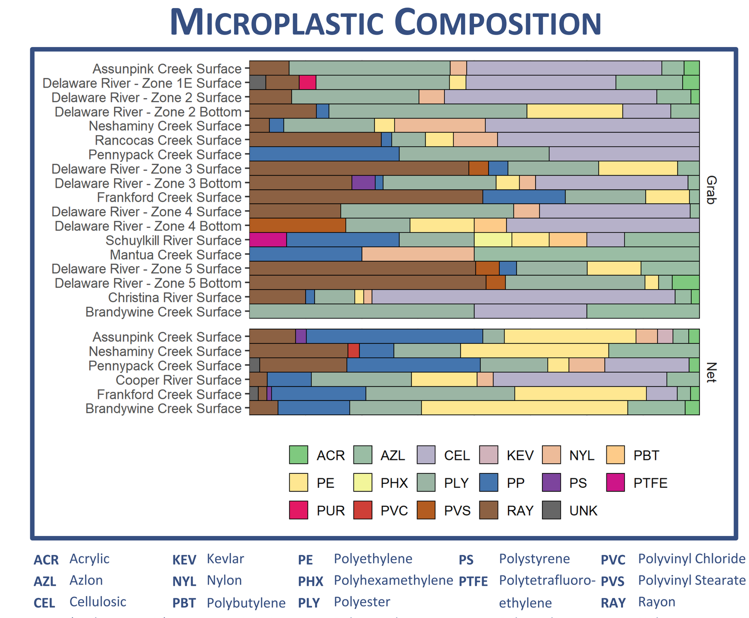
Microplastic Sizes (µm)



Microplastic Shapes

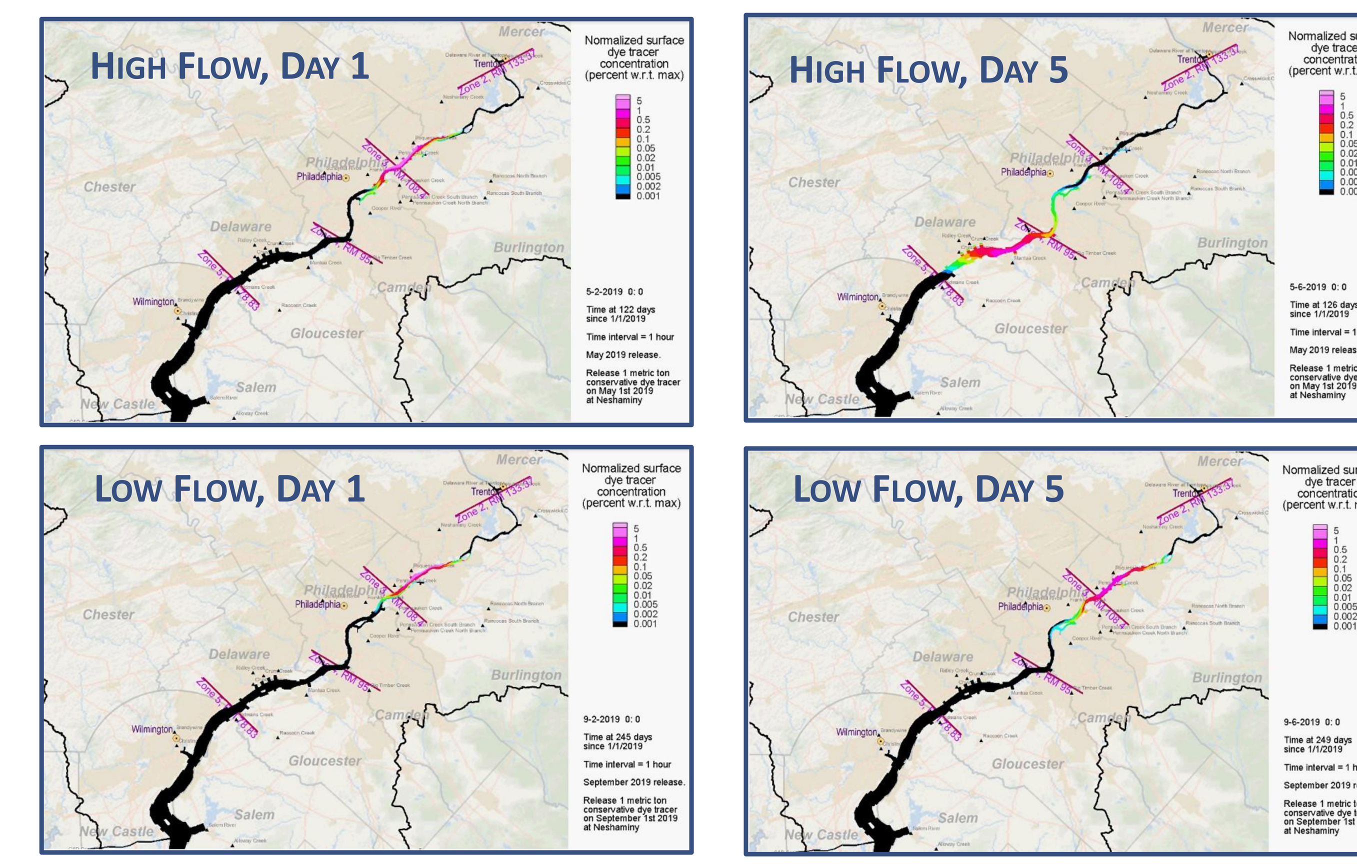


Microplastic Composition



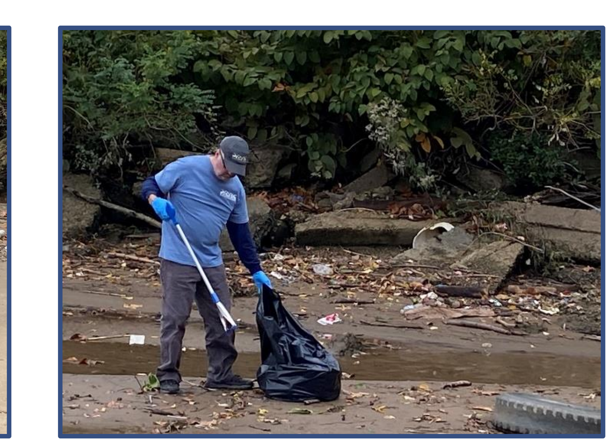
Modeling Simulations

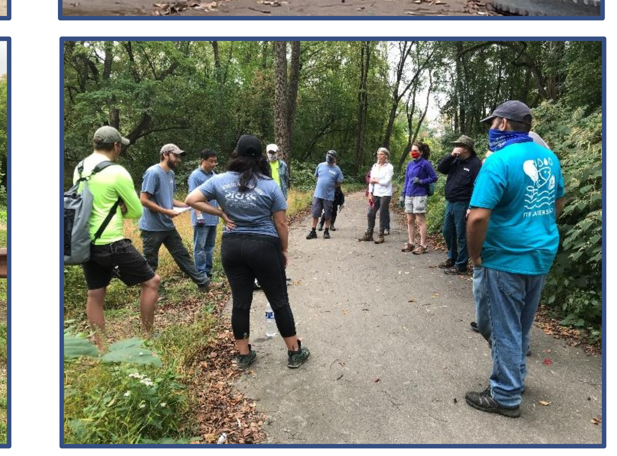
Quasi-instantaneous plastic release was simulated by mass release of 1 metric ton of conservative tracer over 24-hours using a 3D hydrodynamic model. The model results below show distribution of particles released from Neshaminy Creek 1 day and 5 days after the release under high-flow and low-flow conditions.



Plastic Cleanup Efforts

Targeted cleanup efforts occurred at two locations, Frankford Creek and the tidal Delaware River at Palmyra Cove. Large volumes of trash were removed during both efforts, reducing plastic loading to the Estuary. Volunteers were educated on the topic of microplastics by DRBC staff.





Acknowledgments / References

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