Milwaukee River Plume Study

Overview of the Study

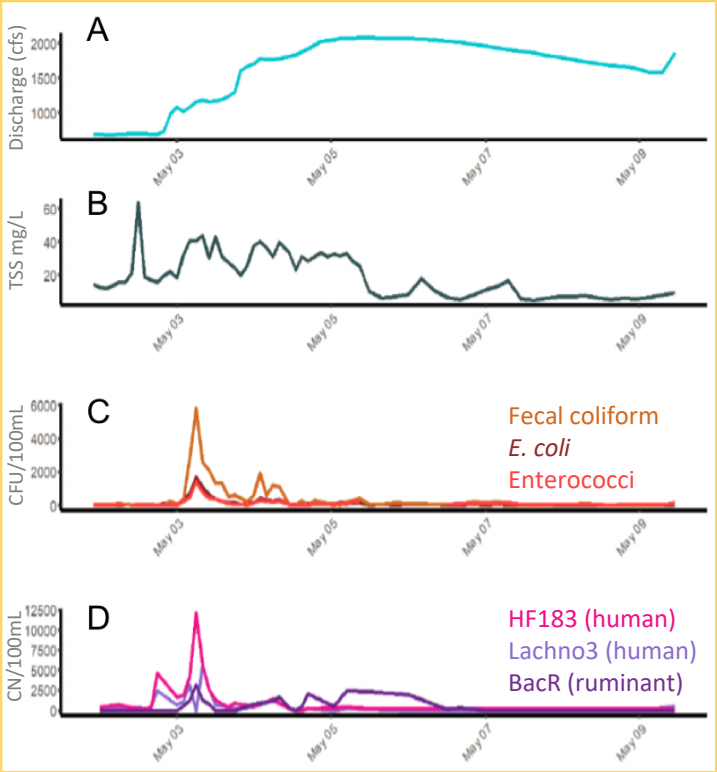
Since March 2018, we have been studying contaminant plumes from the Milwaukee River to better understand pollutant sources and their impacts on the Lake Michigan nearshore.

Research Questions

What are the sources of turbid water plumes in the Milwaukee River?

Are suspended solids (turbid plumes) coupled to bacterial pollution?

Do microbial signals provide evidence of upstream and downstream sources (i.e. Rural versus urban)?



Hydrographs representing A) Milwaukee River discharge rates, B) TSS, C) FIB, and D) MST markers during a 2018 rain event. An early peak of TSS can be seen prior to FIB and marker increases.

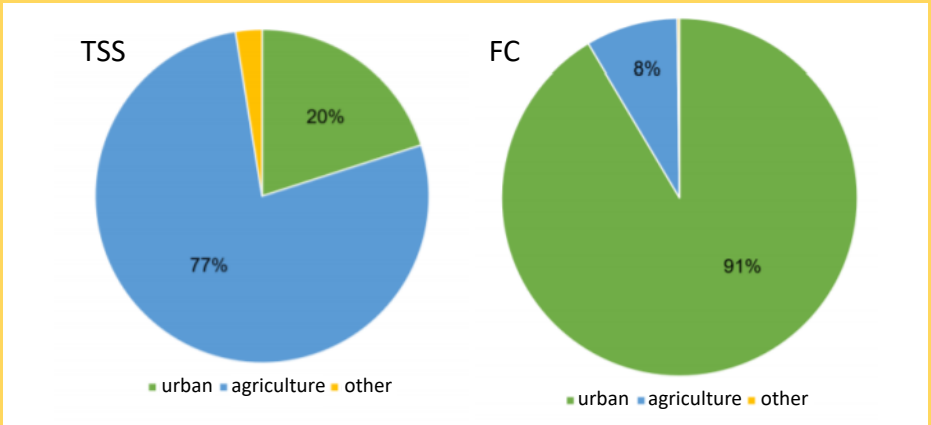


Figure shows the proportions of TSS and FC loads based on MST markers. Upstream agricultural sources contribute a majority of the TSS load measured, while downstream urban sources contribute a majority of the measured FC load.

Main Findings

Major storm events accounted for large contributions to the annual TSS load.

TSS and FIB were not coupled, indicating that there were unique sources for these contaminants.

TSS appeared prior to FIB for most storm events.

FIB loads were highly associated with human MST markers, indicating an urban source.

Ruminant fecal marker and TP from rural runoff were detectable in the downstream urban region.

Key Terms

- TSS = total suspended solids
- FIB: fecal indicator bacteria
  - EC = *E. coli*
  - FC = fecal coliform
  - ENT = enterococci
- MST = microbial source tracking
  - Lachno3 = Human marker
  - HF183 = Human marker
  - BacR = Ruminant marker
- TP = Total Phosphorus
- TMDL (Total Maximum Daily Load): amount of a pollutant that a body of water can receive while still meeting water quality standards

More Information

During 2018-2019, we collected 1,170 water and 167 sediment samples at various locations in the Milwaukee River watershed.

Mass balance calculations, MST markers, and trace elements showed the majority of TSS was linked to upstream sources and was a mix of riverbank scouring/bottom resuspension and overland runoff. Generally, TSS loads were found to be proportional to river flow.

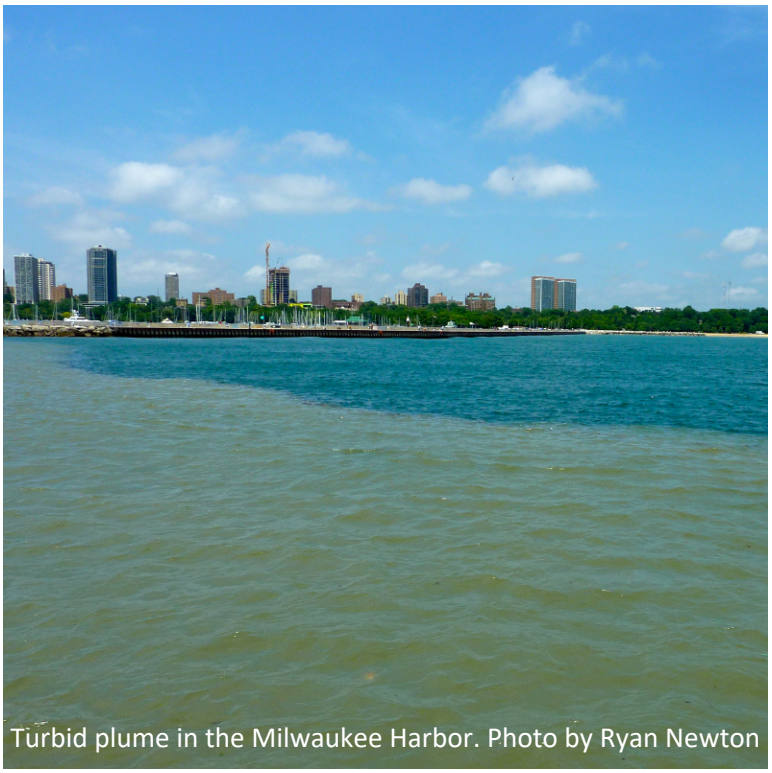
In preliminary work, we found high TP concentrations were associated with elevated TSS concentrations and ruminant fecal marker detection, suggesting substantial nutrient inputs from upstream agricultural sources.

Overall, urban contributions (i.e. those associated with human fecal marker detection) made up the vast majority of fecal coliform loads detected in the downstream Milwaukee River, accounting for 91% of total loads. The major source of human fecal marker in urban regions is leaky sewer lines.

We found the microbial community composition often changed rapidly (<2 hours) during heavy rain events or CSOs, which indicates rain events drive large microbial loads from the urban landscape into the river. Partitioning microorganisms based on their probable source environment (river water, sediment, sewer, human) allowed us to identify the timing of upstream and downstream pollutants as they passed through Milwaukee.

Management Strategies

- TSS is a priority for upstream management while downstream priorities include mitigation of FIB. Thus, TMDL mitigation efforts should consider TSS and FIB separately. Both pollutants demonstrated loads that were strongly event-dependent.
- Large storm events contribute a disproportionate amount of annual pollution load for each contaminant and addressing these storms is important as extreme events are expected to increase.
- Mitigation strategies that can increase stormwater retention and reduce pollutant sources during both minor and major event flows would benefit upstream (TSS) and downstream (FIB) regions.



Turbid plume in the Milwaukee Harbor. Photo by Ryan Newton

This study was funded by the Milwaukee Metropolitan Sewerage District.

Download full report: ***Determining Sediment and Bacterial Sources and Linkages to Inform and Evaluate Total Maximum Daily Load (TMDL) Implementation***

Research was conducted by the McLellan, Klump, and Newton laboratories at the University of Wisconsin-Milwaukee School of Freshwater Sciences.

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