Transport of contaminants from U.D.S. to urban surfaces during flooding/network surcharge events

11 March 2025 - *Improving resilience and sustainability of urban drainage assets*

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Co-UDlabs
COLLABORATIVE URBAN DRAINAGE
RESEARCH LABS COMMUNITIES

Context: Contamination of flood / U.D.S. exceedance flows
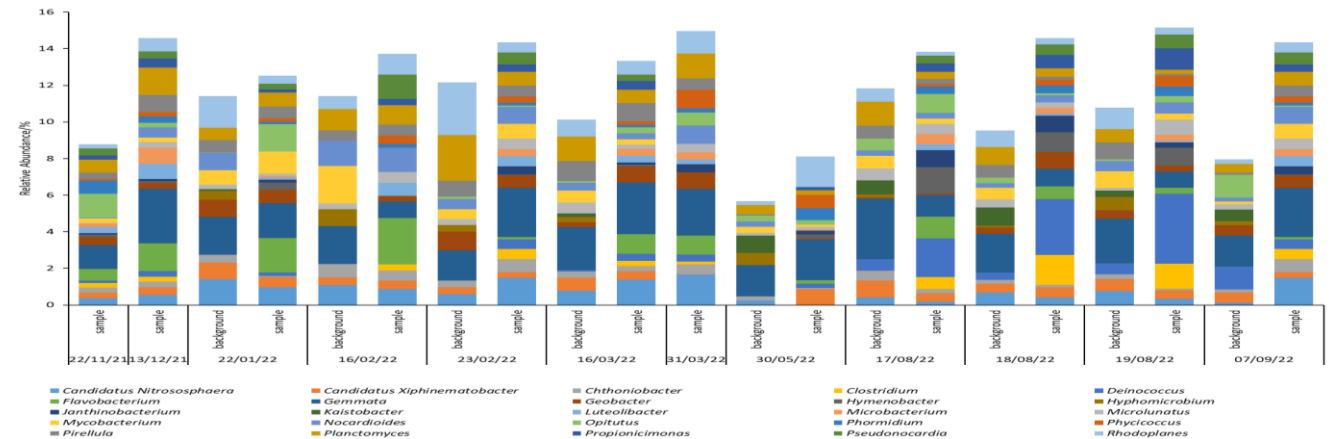

Endcliffe Park, Sheffield, October 2021

Sampling of urban floodwater reveals a diverse range of pathogens in significant quantities
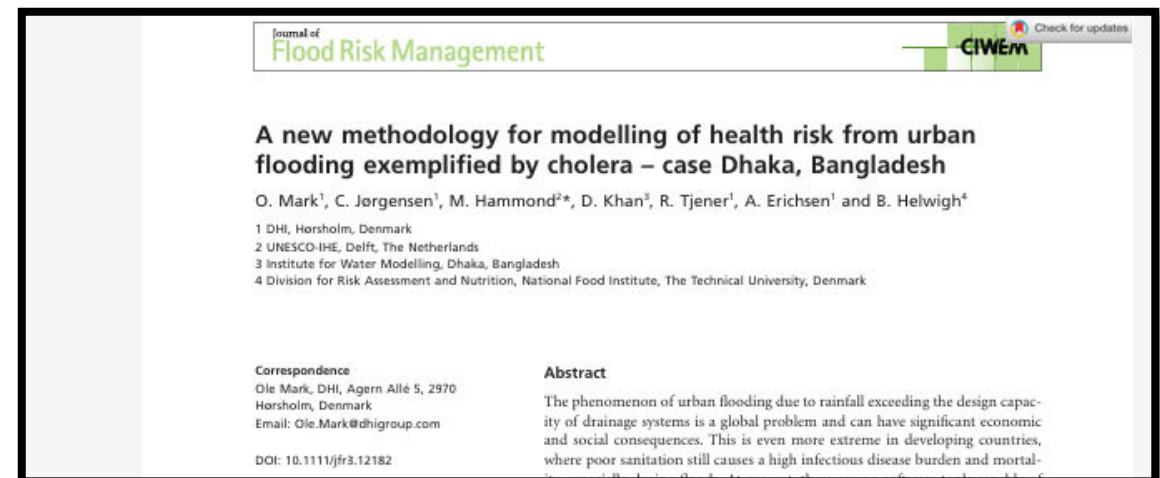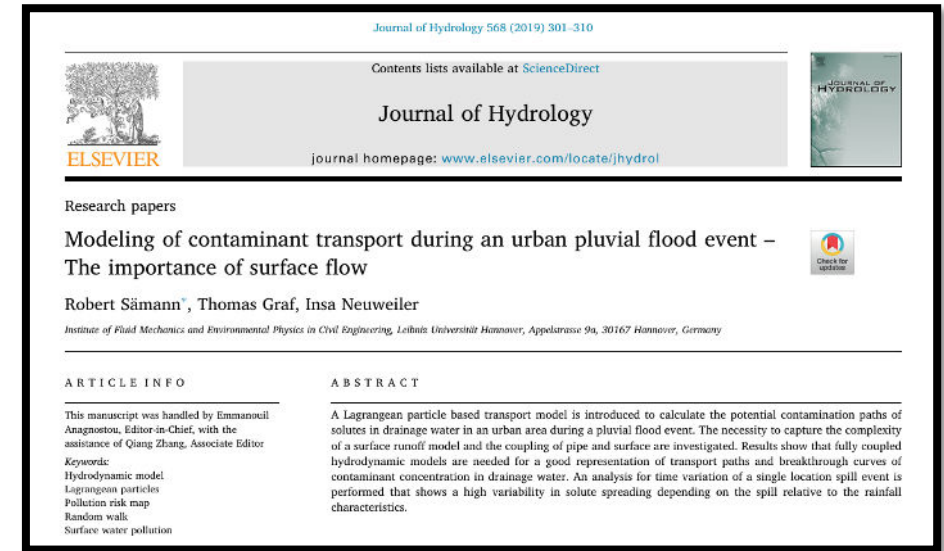
Can we understand/quantify risks?

Scutt, Sophie (2024) Investigating the public health risk of urban flooding events. PhD thesis, University of Sheffield.
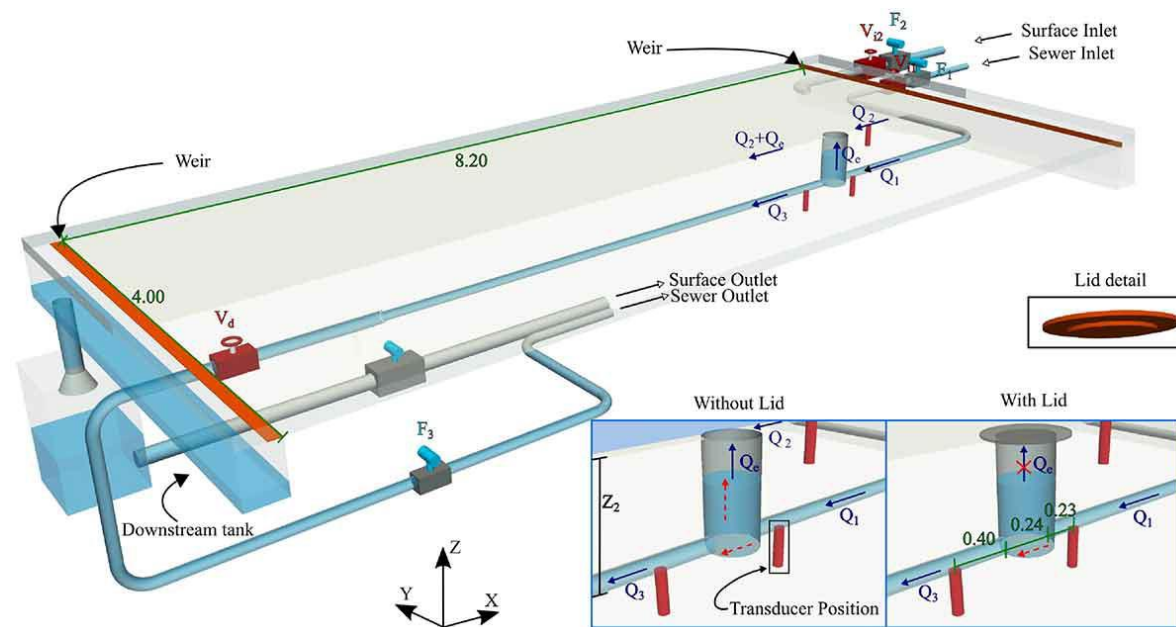
Need for Experimental Work

- Engineers commonly use modeling tools to help understand risk
  - But significant uncertainties and unknowns
  - Pollutant behavior, dispersion, many others

- Scale model experiments can provide validation datasets for testing, and increased confidence in model predictions

- **Aim : Collect experimental data to help understand the potential transport of contaminants in shallow urban floodwater**

Contents lists available at ScienceDirect

Journal of Hydrology

journal homepage: www.elsevier.com/locate/jhydrol

Research papers

Modeling of contaminant transport during an urban pluvial flood event – The importance of surface flow

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ABSTRACT

A Lagrangean particle based transport model is introduced to calculate the potential contamination paths of solutes in drainage water in an urban area during a pluvial flood event. The necessity to capture the complexity of a surface runoff model and the coupling of pipe and surface are investigated. Results show that fully coupled hydrodynamic models are needed for a good representation of transport paths and breakthrough curves of contaminant concentration in drainage water. An analysis for time variation of a single location spill event is performed that shows a high variability in solute spreading depending on the spill relative to the rainfall characteristics.

Flood Risk Management

A new methodology for modelling of health risk from urban flooding exemplified by cholera – case Dhaka, Bangladesh

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DOI: 10.1111/jfr3.12182

Abstract

The phenomenon of urban flooding due to rainfall exceeding the design capacity of drainage systems is a global problem and can have significant economic and social consequences. This is even more extreme in developing countries, where poor sanitation still causes a high infectious disease burden and mortal-
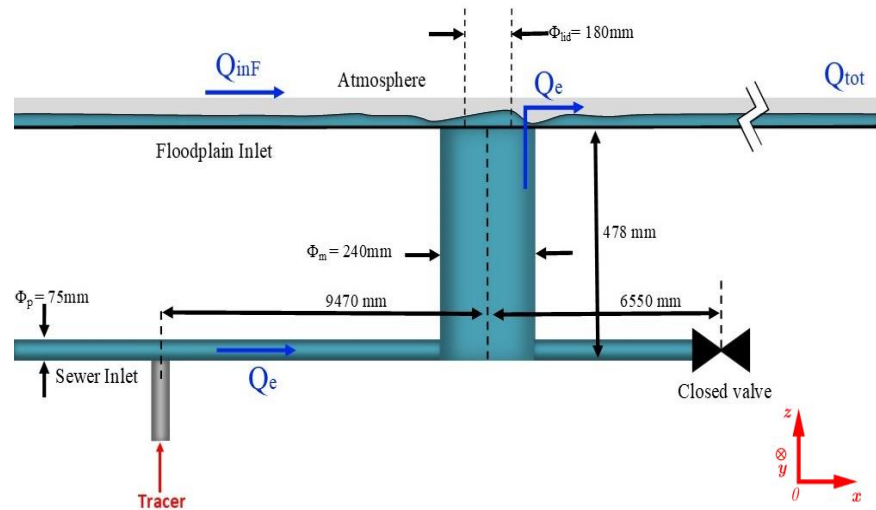
A/B Facility

- 10 years of physical modelling work looking at surface/subsurface interactions
  - Energy Losses, Model Validation, etc.
 - Co-UD Labs activities have focused on pollutant exchange and transport

M. Rubinato, R. Martins & J. D. Shucksmith (2018) Quantification of energy losses at a surcharging manhole, Urban Water Journal, 15:3, 234-241, DOI: 10.1080/1573062X.2018.1424217

Solutes

- Tested different approaches to characterise pollutant transport

- Developed O.A. dataset for modellers to validate numerical methods for quantifying pollutant transport is shallow flows

- Surface velocities also measured using SPIV

Shucksmith et al. (2025) Experiments on contaminant transport from sewer infrastructure within shallow floodwater (under review)
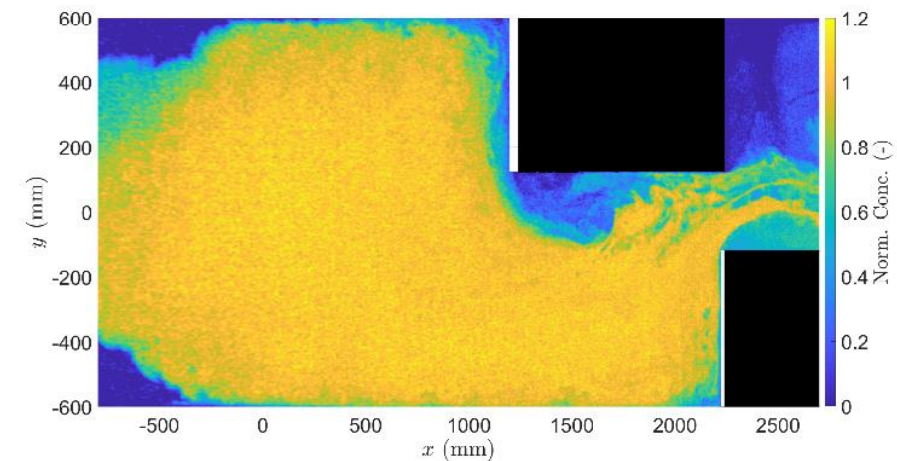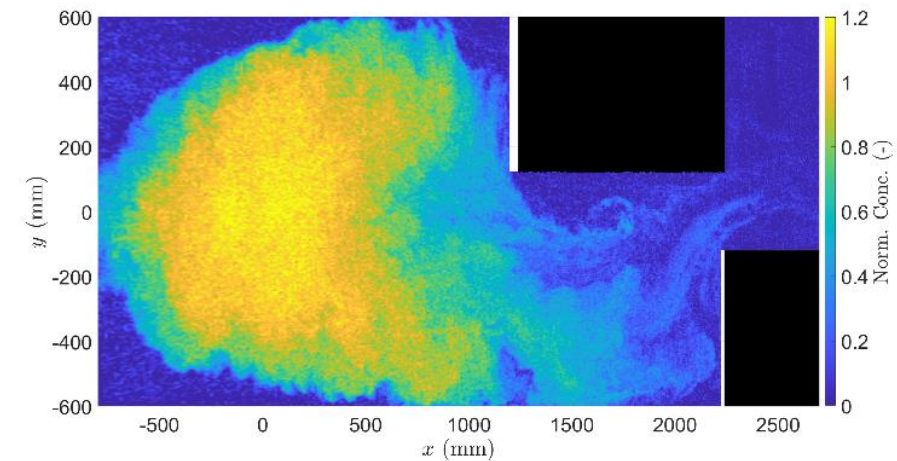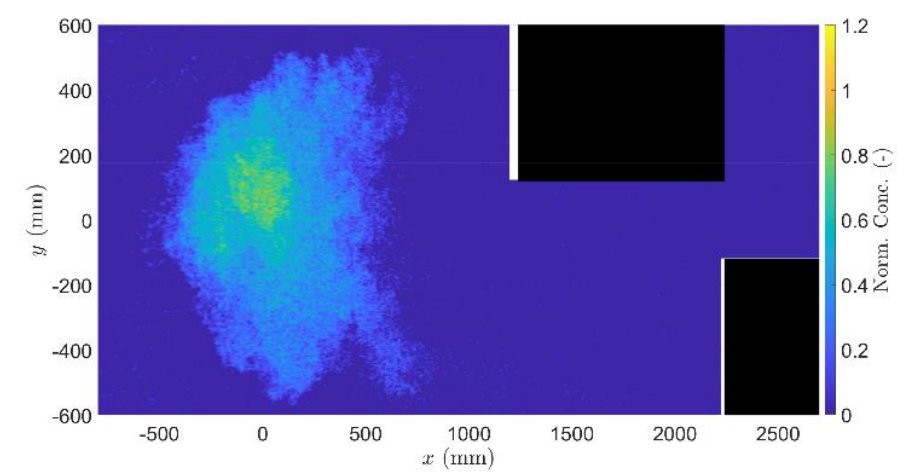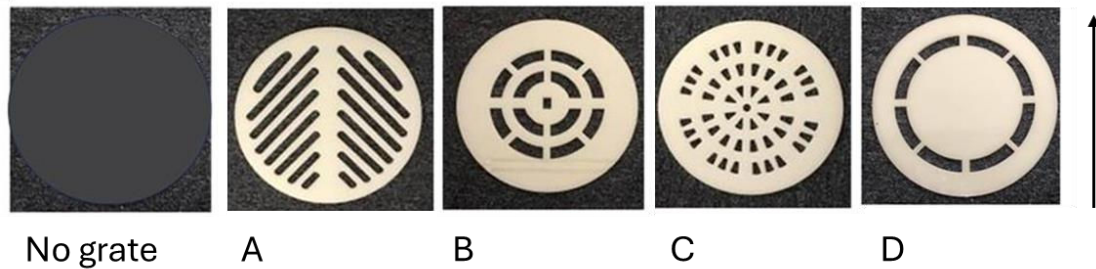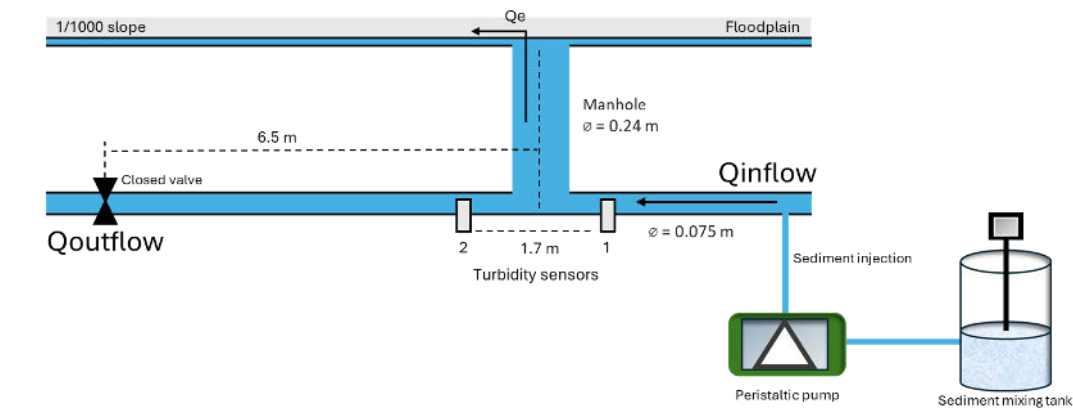
Surface Spreading of Solute

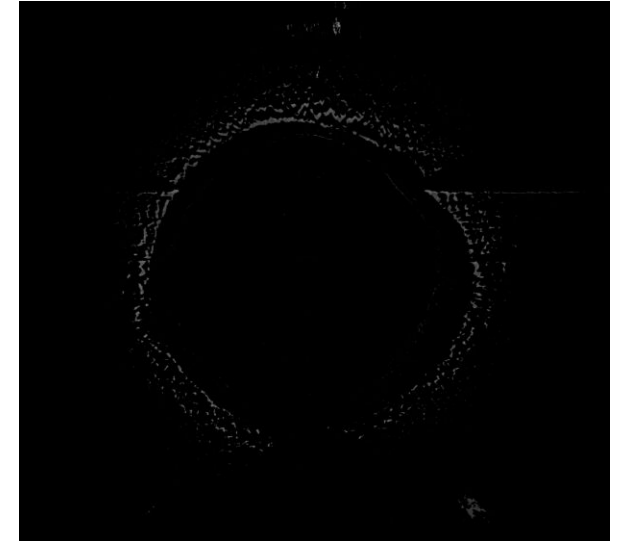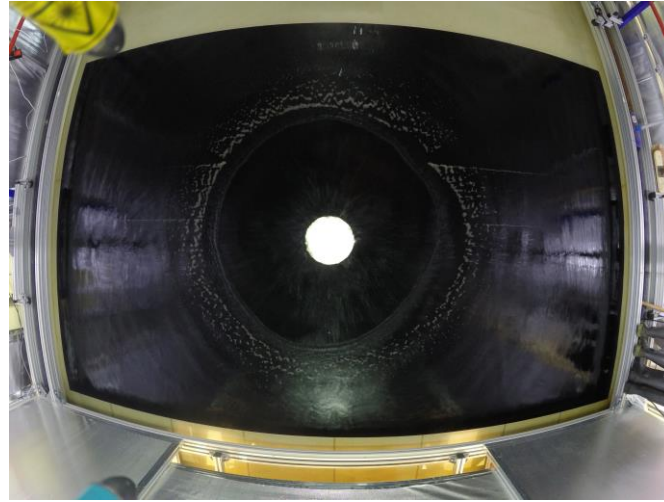Surcharge of dyed water into shallow (13 mm, Fr ≈ 0.36) surface flow

Surface inflow

ppb
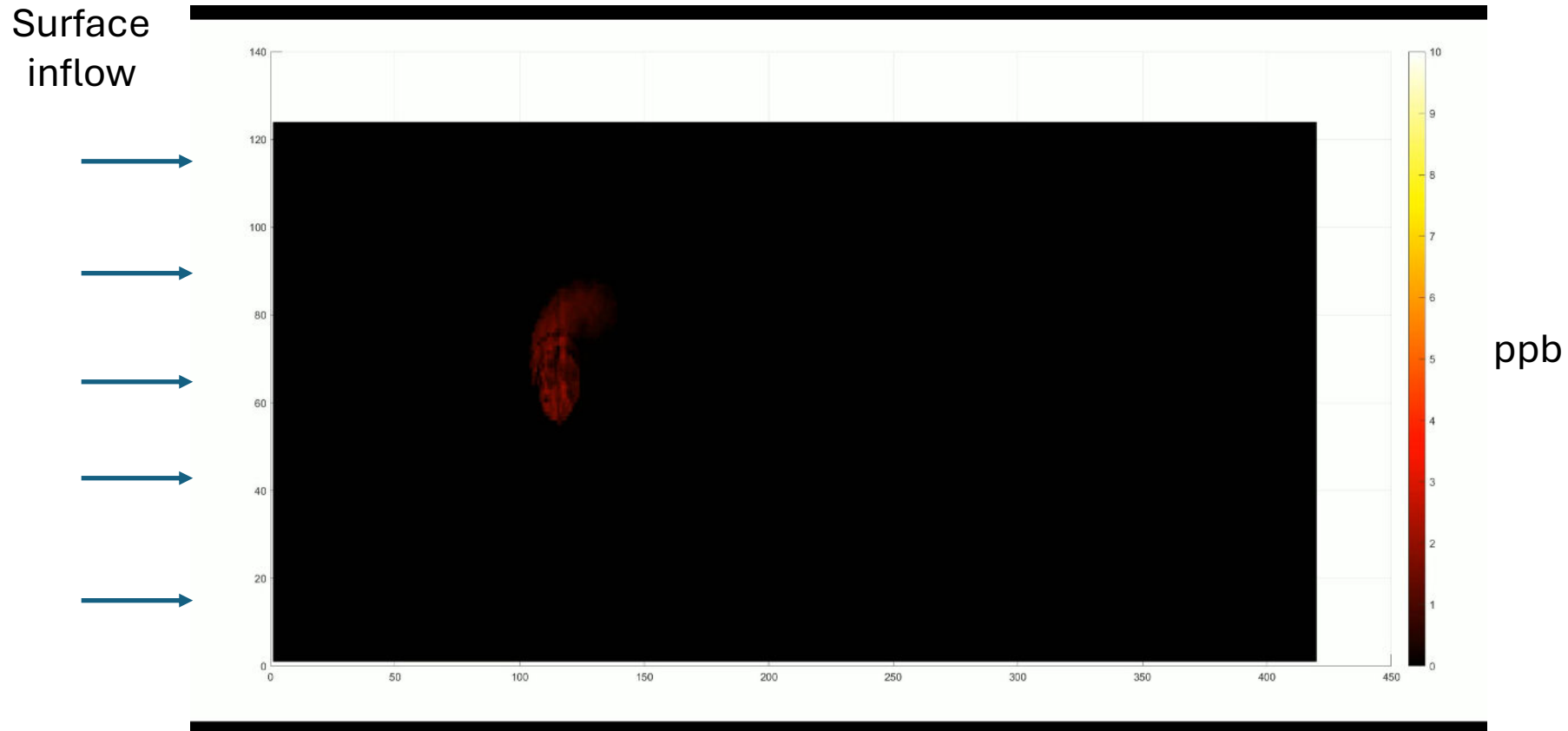
Sediments

Initial experiments to consider the proportion of suspended sediments (between 148 ≤ d ≤ 458 μm) transferring to the surface flow
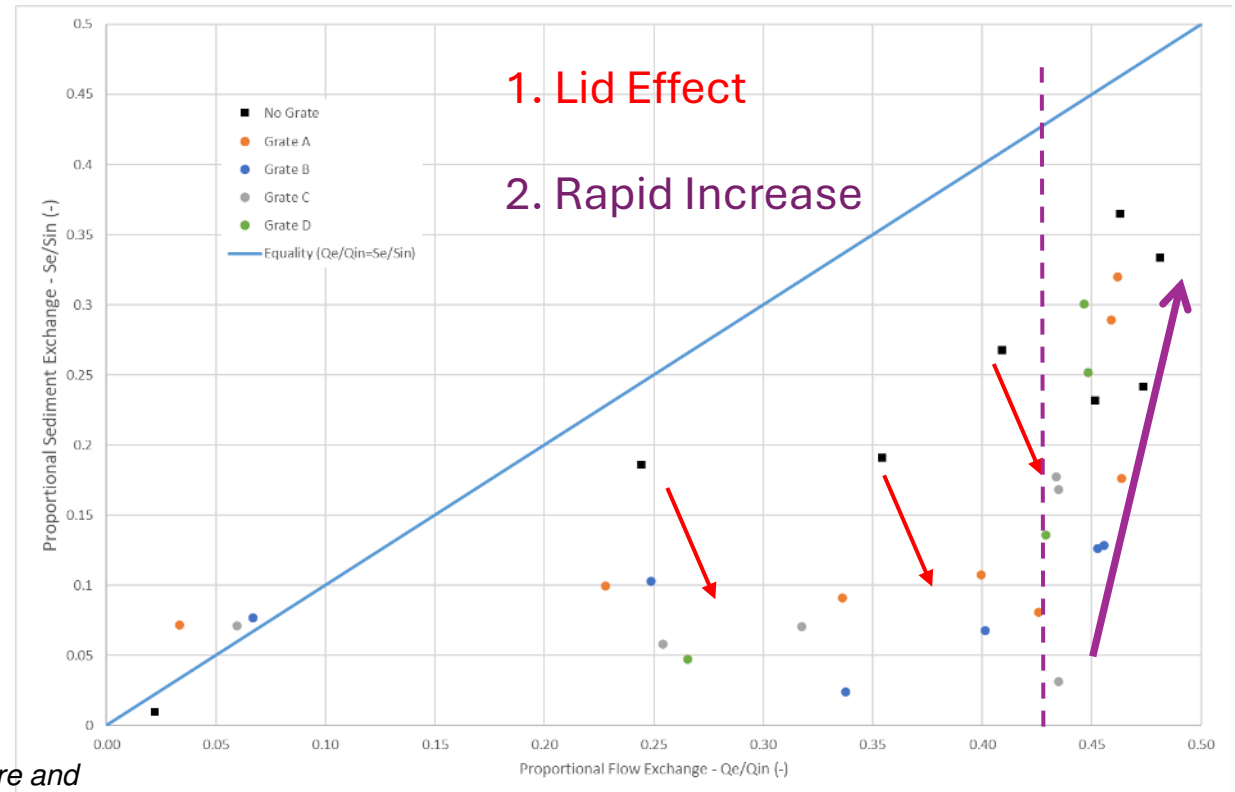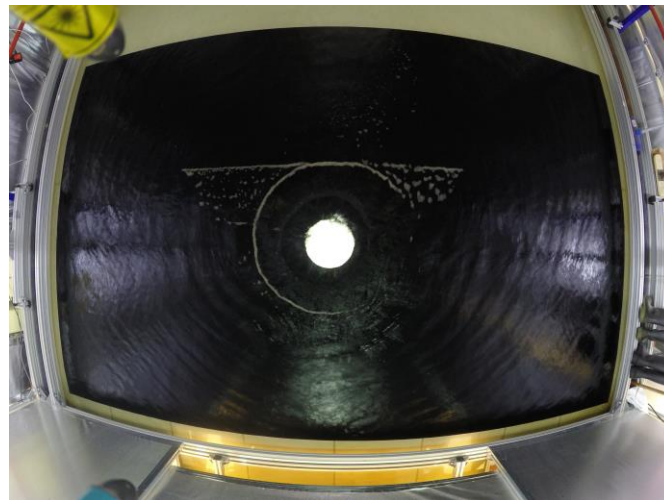
Surface Deposition (Ongoing work)

No Surface flow

With Surface flow
(approx. 20 mm
flow depth)

Conclusions

- Sewer surcharge/ overflow events can carry pathogens and other contaminants

- Understanding the transport of these materials is challenging in both field and lab conditions.
    - Transport pathways are sensitive to flow conditions and local geometrical features.

- Work in Co-UD labs has looked at soluble and sediment material transport from a manhole using a experimental scale model and has produced datasets to enable model testing and validation

Contributors

Matteo Rubinato, Ricardo Martins, William Addison-Atkinson, Kaeli Brazier, Sophie Scutt, Fabio Muraro, Andy Nichols, Emmanuel Mignot, Louis Gostrix, Clement Fagour