Best Water-Related Presentation at Environ 2024 Winner: Leila Bowe, Dublin City University

Poly- and Perfluoroalkyl Substances (PFASs) from Source to Sink in the River Liffey (INVEST pFASST project)

Widespread use of PFASs globally has raised concerns about potential legacy environmental contamination and subsequent impacts on human health.[1] PFAS compounds are persistent and bio-accumulative, and their toxicity and long-range transportation has meant that they are ubiquitous in the environment and have been detected globally in several sample types[2]. Research in Ireland has indicated the presence of PFASs in a variety of media, including surface water.[3]

The INVEST-pFASST project, funded by the EPA, aims to address data gaps in identifying potential sources of PFAS, pathways and receptors in the Irish context. Ultimately, the aim is to develop a methodology to differentiate between PFAS point sources and background concentrations and examine PFAS source trends and contamination hot spots in Ireland to conduct a nation-wide risk assessment.

As part of this work, surface water samples were taken from 20 sites along the River Liffey, between the headwaters and the River Rye tributary to the receiving waters of Dublin Bay, as shown in Figure 1. It was found that concentrations of up to 2 µg/L of individual PFAS compounds were detected along the river.

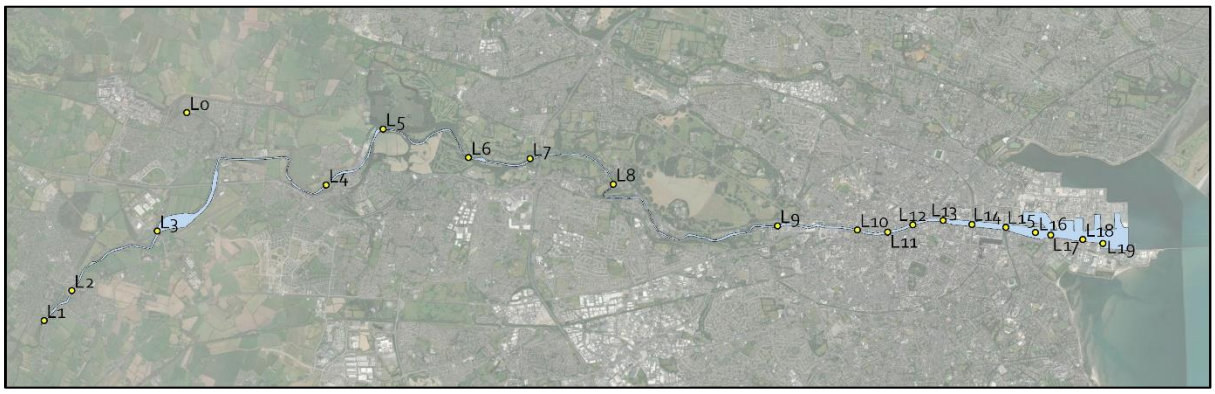

Figure 1: Sampling locations along River Liffey

To examine the nature and distribution of these PFAS compounds and identify potential links to upgradient sources, a 4-step hierarchical process was used.

1. **Geographical proximity** - Primary and secondary sources of PFASs in the catchment of the River Liffey include civil (airports and fire stations), anthropogenic (wastewater treatment facilities and waste facilities) and industrial pressures (chemical manufacturing plants, paper processing facilities and industries with emissions licences). Figure 2 shows how PFASs can move through the environment to from source to sink.

[1] Harrard, S et al. (2020). Furthering Understanding of Emissions from Landfilled Waste Containing POPBFRs and PFASs (FUEL). Wexford, Ireland: Environmental Protection Agency

[2] Buck, R et al. (2011). Perfluoroalkyl and Polyfluoroalkyl Substances in the Environment: Terminology, Classification, and Origins. Integrated Environmental Assessment and Management - 7(4), 513-541

[3] Huerta, B et al. (2022). Development and application of an LC-MS method to the determination of poly- and perfluoroalkyl substances (PFASs) in drinking, sea and surface water samples. Royal Society of Chemistry - Analytical Methods, 14(21) 2090-2099

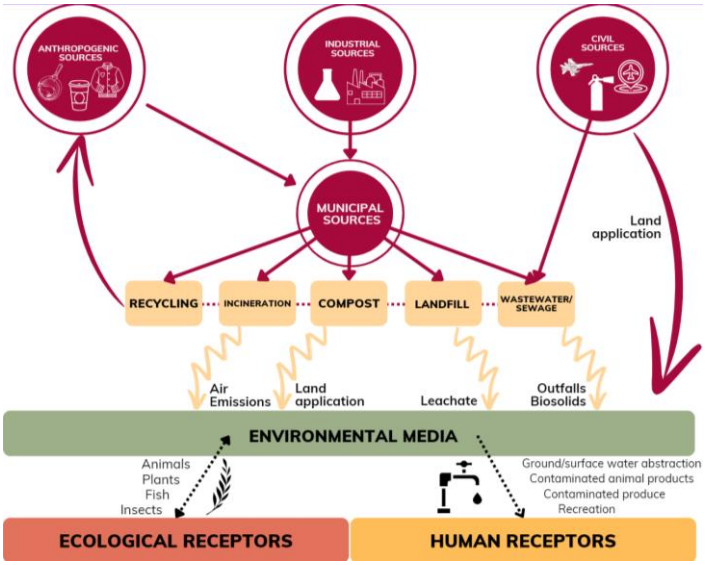

Figure 2: Movement of PFAS through waste streams into the Irish environment

This step involved assessing whether elevated PFAS concentrations are within proximity to known sources and whether there are feasible pathways for the compounds to enter the environment, such as runoff, outfalls and stormwater drains. EPA Maps were used to identify Integrated Pollution Control (IPC) emission points and Pollutant Release and Transfer Register (PRTR) facilities.

2. Chemical footprint – Step 2 involved identifying unique compounds and distinguishable compound ratios of the 4700+ PFAS compounds. Longer chained PFBS was identified in 19 locations, as shown in Table 1.[4]

Table 1: Number of locations where individual PFAS compounds were detected

Compound	FOSA	GenX	PFBS	PFDA	PFDoA	PFDS	PFHxA	PFHxS	PFNA	PFNS	PFOA	PFOS	PFPeA	PFPeS	PFUdA	∑PFAS
Number of locations detected	0	11	19	16	0	0	6	0	17	2	19	3	20	0	19	20

3. Dimensional calculation – To infer the concentration of an upgradient source, such as a stormwater outfall, a mass balance equation could be used[5].
4. Dimensional modelling programs and cluster analysis can allow for further refining of the potential source, but would require additional parameters and targeted sampling.

With the data obtained, it was found that there is a trend of elevated Total PFAS concentrations being lined to a higher number of stormwater overflows. To refine the source, further data inputs and targeted sampling will be required.

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[4] European Union Environmental Objectives (Surface Waters) (Amendment) Regulations (2019). S.I. No. 77 of 2019

[5] Sligo County Council, (Undated). Guidance on Applying for a Discharge Licence to Surface Waters. Website: https://www.gov.ie/pdf/?file=https://assets.gov.ie/242998/f771c419-4cf7-4b76-af56-dbf69398e381.pdf#page=null. Accessed 17/04/24