Poly- and Perfluoroalkyl Substances (PFAS) from Source to Sink in the River Liffey

Leila Bowe, Belinda Huerta, Enrique Jacobo Díaz-Montaña, Christopher Newton and Fiona Regan

Environ 2024
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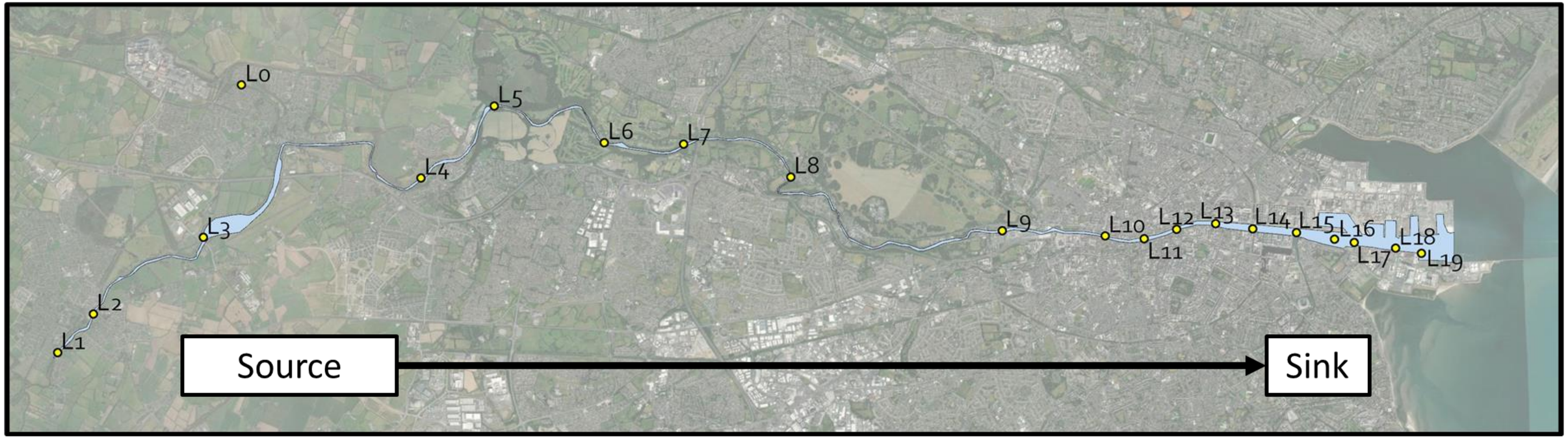
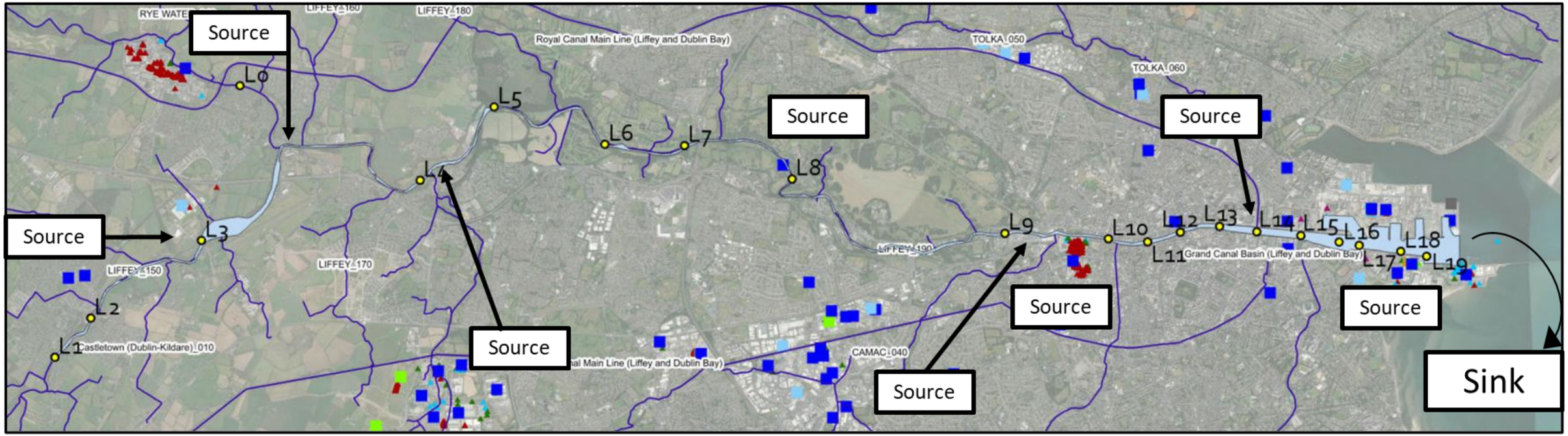
PROJECT OVERVIEW



PROJECT OVERVIEW

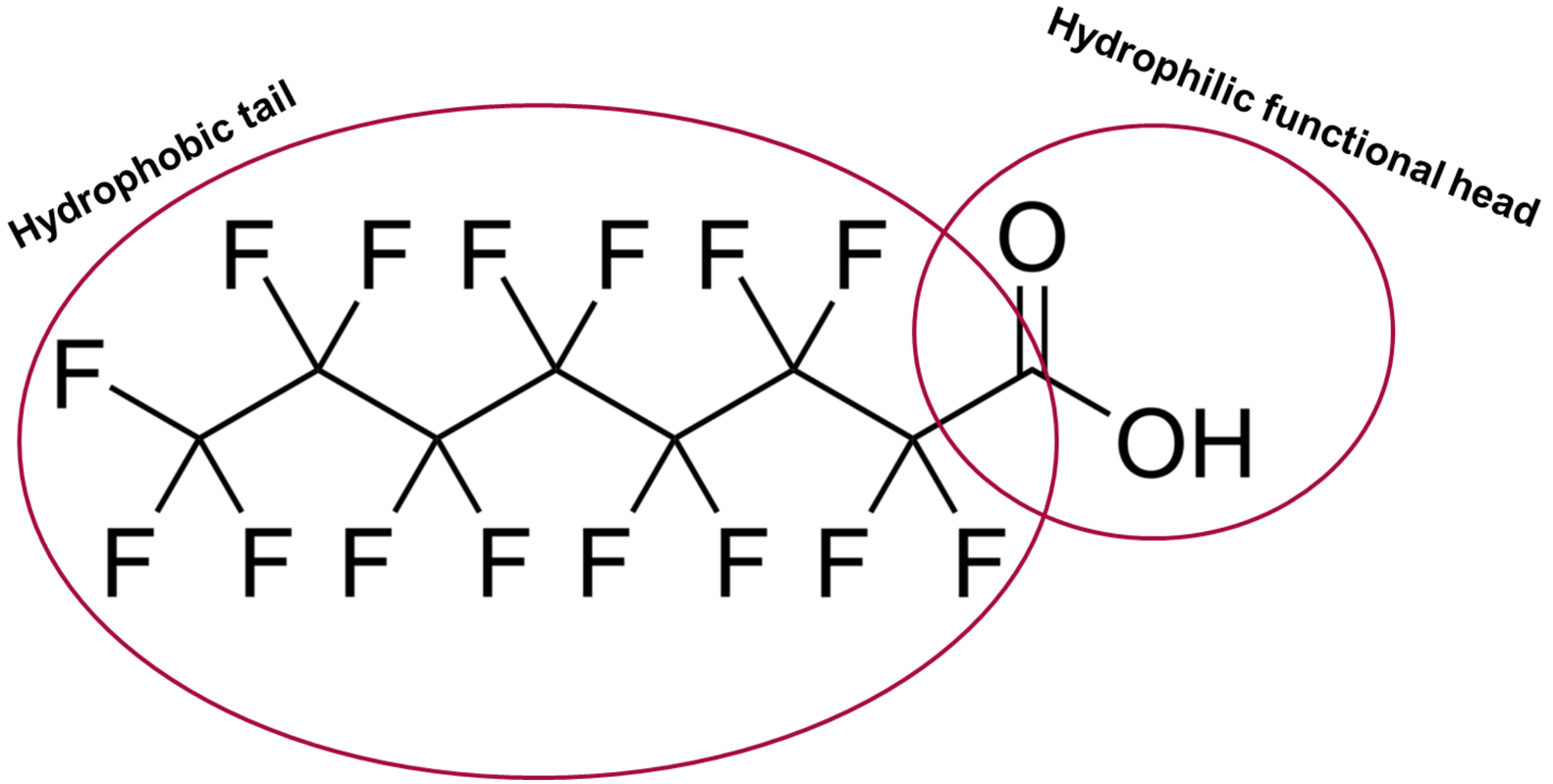


OVERVIEW

- Introduction
- Problem
- Literature Review
  - PFAS sources in Ireland
- Methodology
  - Source identification
- Results
- Conclusion
- Implementation
- Acknowledgments

INTRODUCTION

What are PFAS?



- Human-made
- 4700+ chemicals
- Environmental and human health issues
- Persistent
- Bioaccumulative

Figure I: Molecular structure of PFOS

PROBLEM

First Problem

- Ubiquitous in the aquatic environment
- Detected in water, air, soil, plants and biota

Second Problem

- Where is it in Ireland?
- Scale up a risk assessment methodology to investigate Irish PFAS sources

LITERATURE REVIEW

PFAS sources in Ireland

Anthropogenic sources

- Personal care products
- Non-stick pans
- Detergents
- Waterproof clothing
- Food and drink packaging

Civil sources

- AFFFs (fire-fighting foams)
- Airports
- Fire stations
- Military bases

Municipal sources

- Incinerators
- Recycling facilities
- Landfills (lined and unlined)
- Solid Recovered Fuel (SRFs)
- Compost facilities
- Wastewater treatment facilities
- Biosolids

Industrial sources

- Chemical manufacturing plants
- Pharmaceuticals facilities
- Paper and wood processing plants
- Information and technology facilities
- Data centres

References: Glüge et al (2020). An overview of the uses of per- and polyfluoroalkyl substances (PFAS). Environmental Science: Processes & Impacts, 2345-2373
CDM Smith (2023). CL:AIRE Technical Bulletin 22. An overview of the uses of PFAS to assist with identification of sites of concern

PFAS in the environment

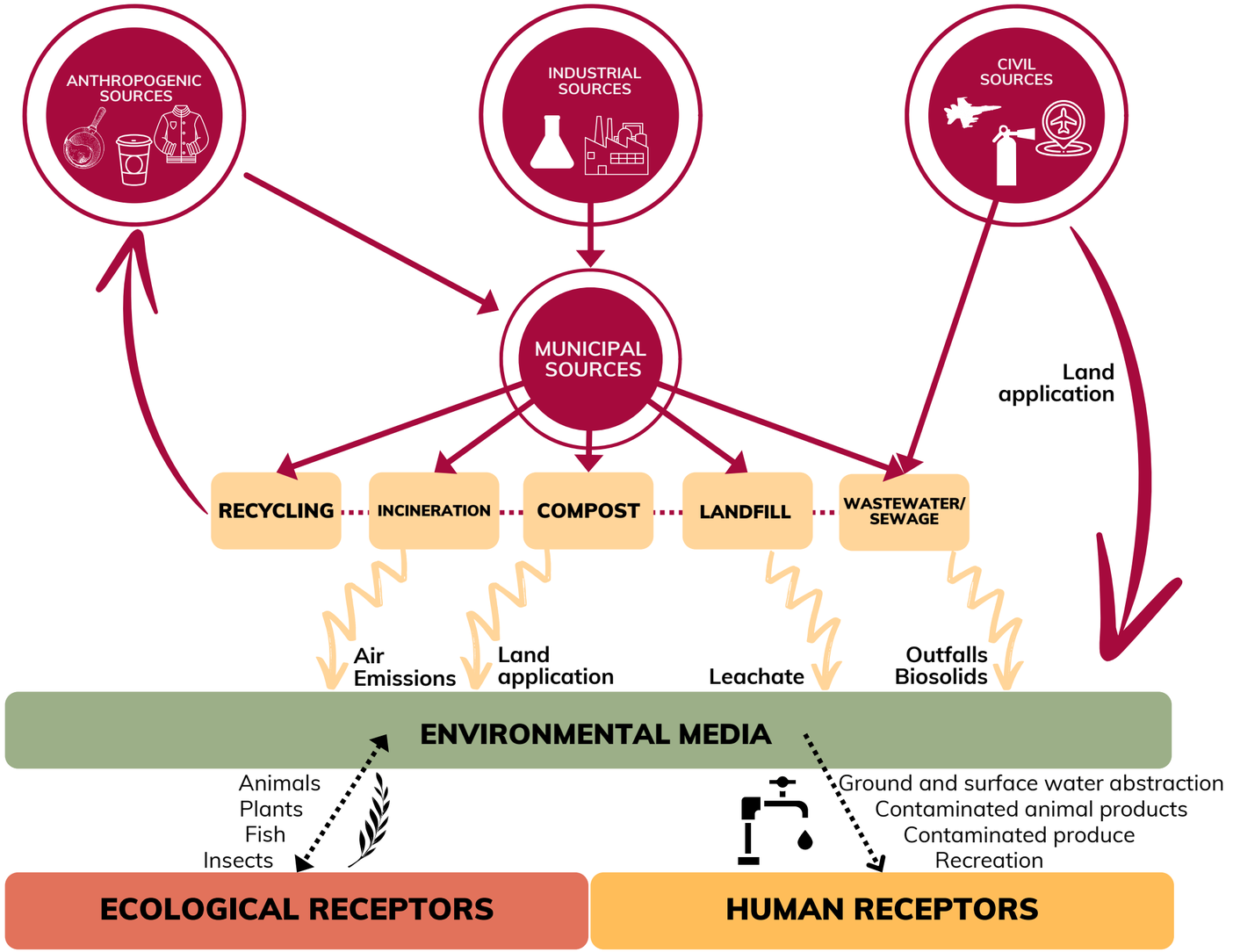
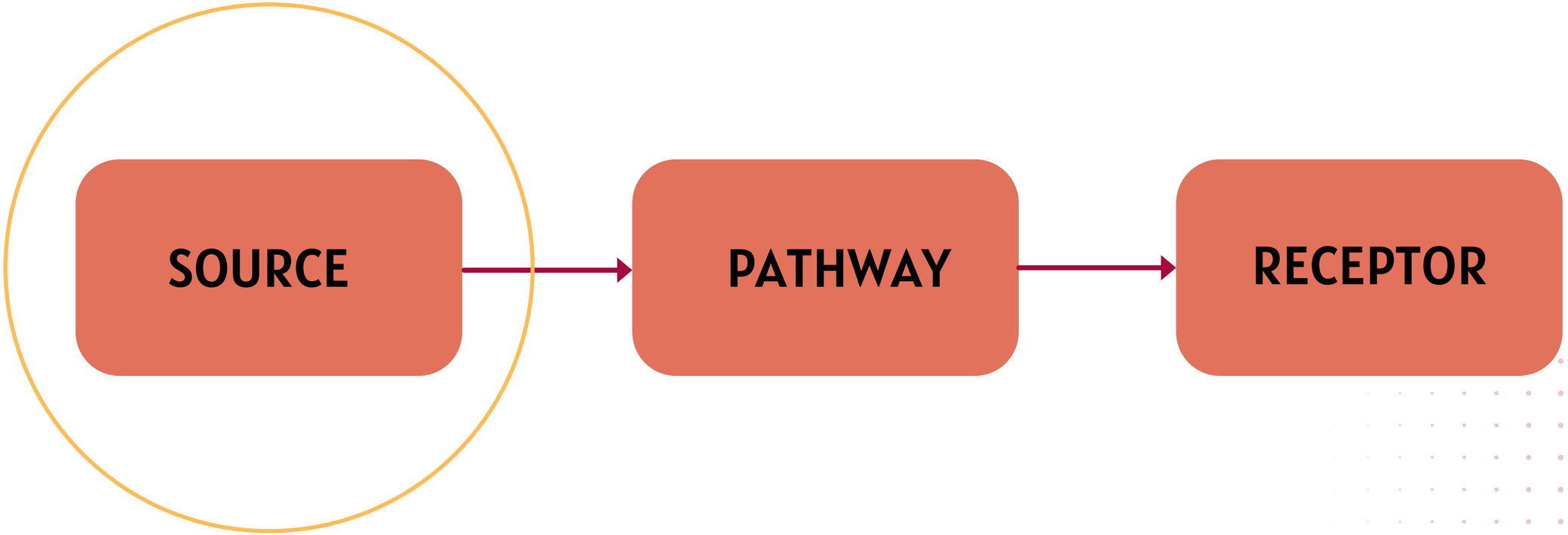


Figure 2: Movement of PFAS through the waste stream and environment

METHODOLOGY

Risk Assessment



METHODOLOGY

Source identification

- Geographical proximity
- Chemical footprint
- Dimensional calculation
- Dimensional modelling

IMPLEMENTATION

PFAS sampling along the River Liffey

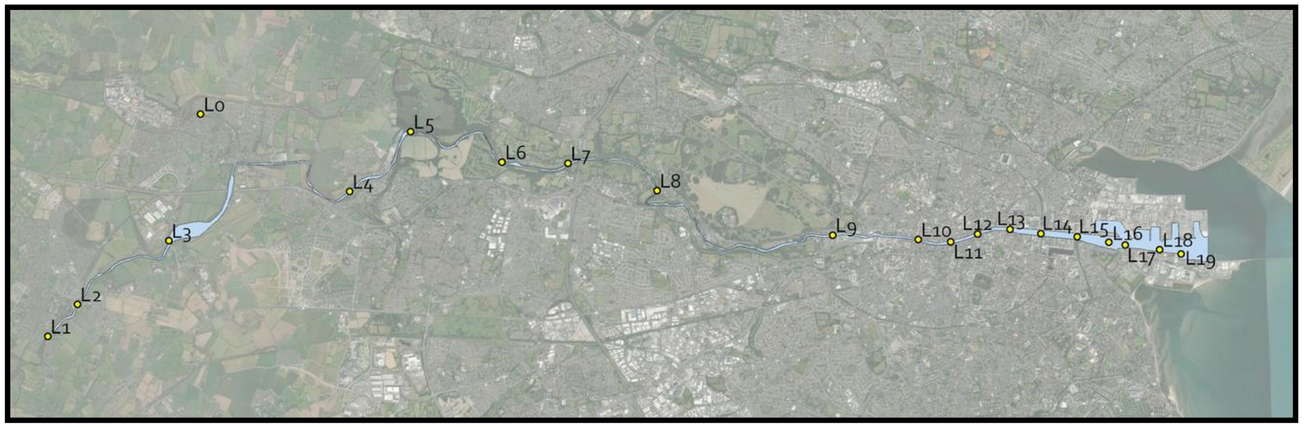


Figure 3: Sampling Locations along River Liffey

PFAS acronym	PFAS name
PFPeA	perfluoropentanoic
PFHxA	perfluorohexanoic
PFOA	perfluorooctanoic
PFNA	Perfluorononanoic
PFDA	Perfluorodecanoic
PFUdA	perfluoroundecanoic
PFDoA	perfluorododecanoic
GenX	perfluoropropoxypropanoic
PFBS	perfluorobutanesulfonate
PFOS	perfluorooctanesulfonate
PFDS	perfluorodecanesulfonate
PFPeS	perfluoropentylsulfonate
PFHxS	perfluorohexasulfonate
FOSA	perfluorooctanesulfonamide
PFNS	perfluorononylsulfonate

Table I: I5 PFAS compounds tested for

IMPLEMENTATION

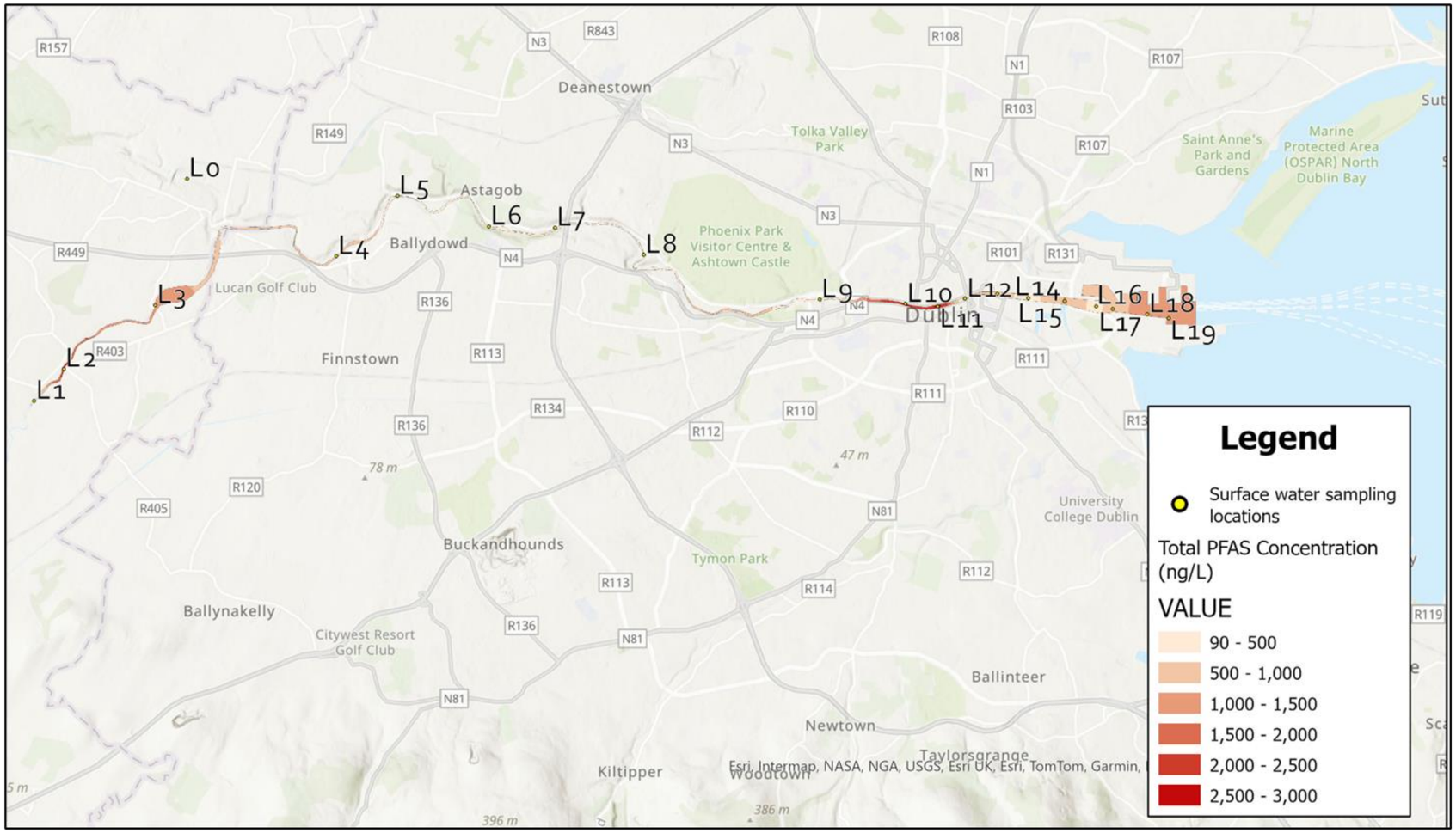


Figure 4: Total Concentrations of PFAS along the River Liffey

INVEST pFASST

DCU Ollscoil Chathair Bhaile Átha Cliath Dublin City University

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IMPLEMENTATION

Step 1 – Geographical Proximity

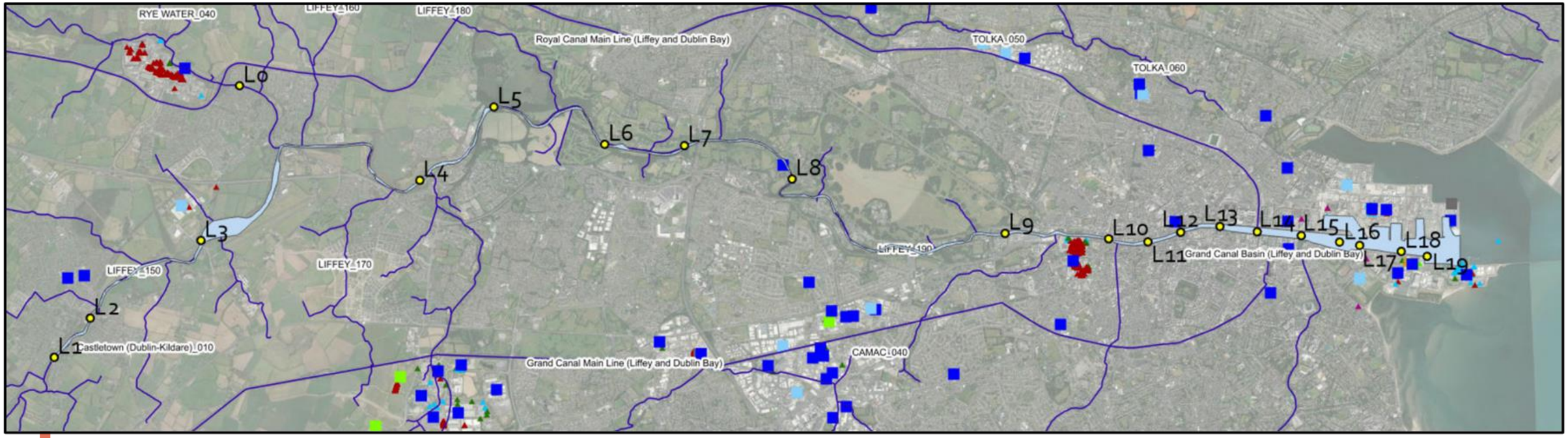


Figure 5: Potential sources of PFAS in Liffey Catchment (EPA Maps, 2022)

- Industrial Emissions Licence
- Waste facilities
- Pollutant release transfer registers
- Annual Environmental Reports

IMPLEMENTATION

Step 2 – Chemical footprint

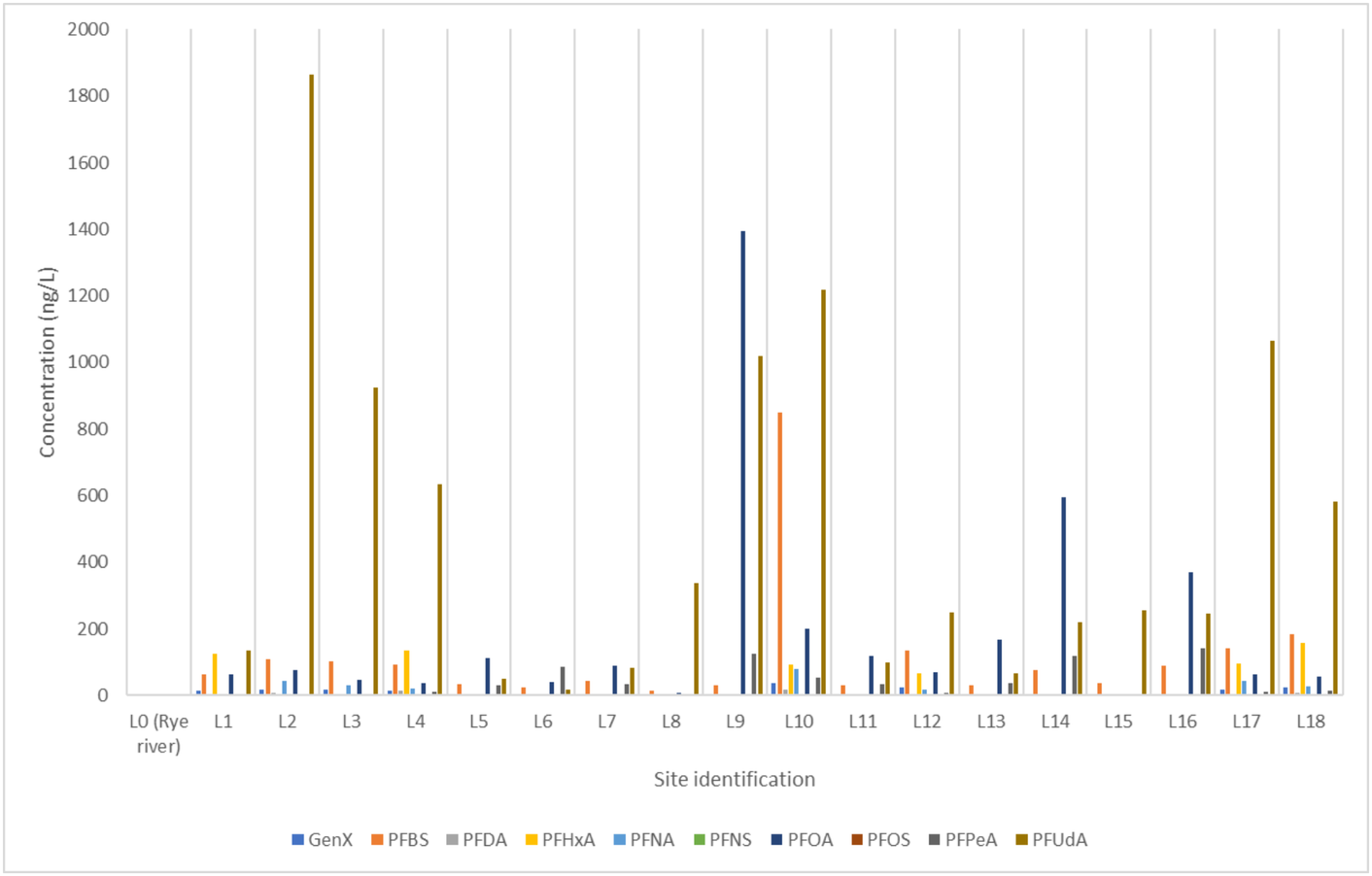


Figure 6: Speciated PFAS concentrations along River Liffey

IMPLEMENTATION

Step 2 – Chemical footprint

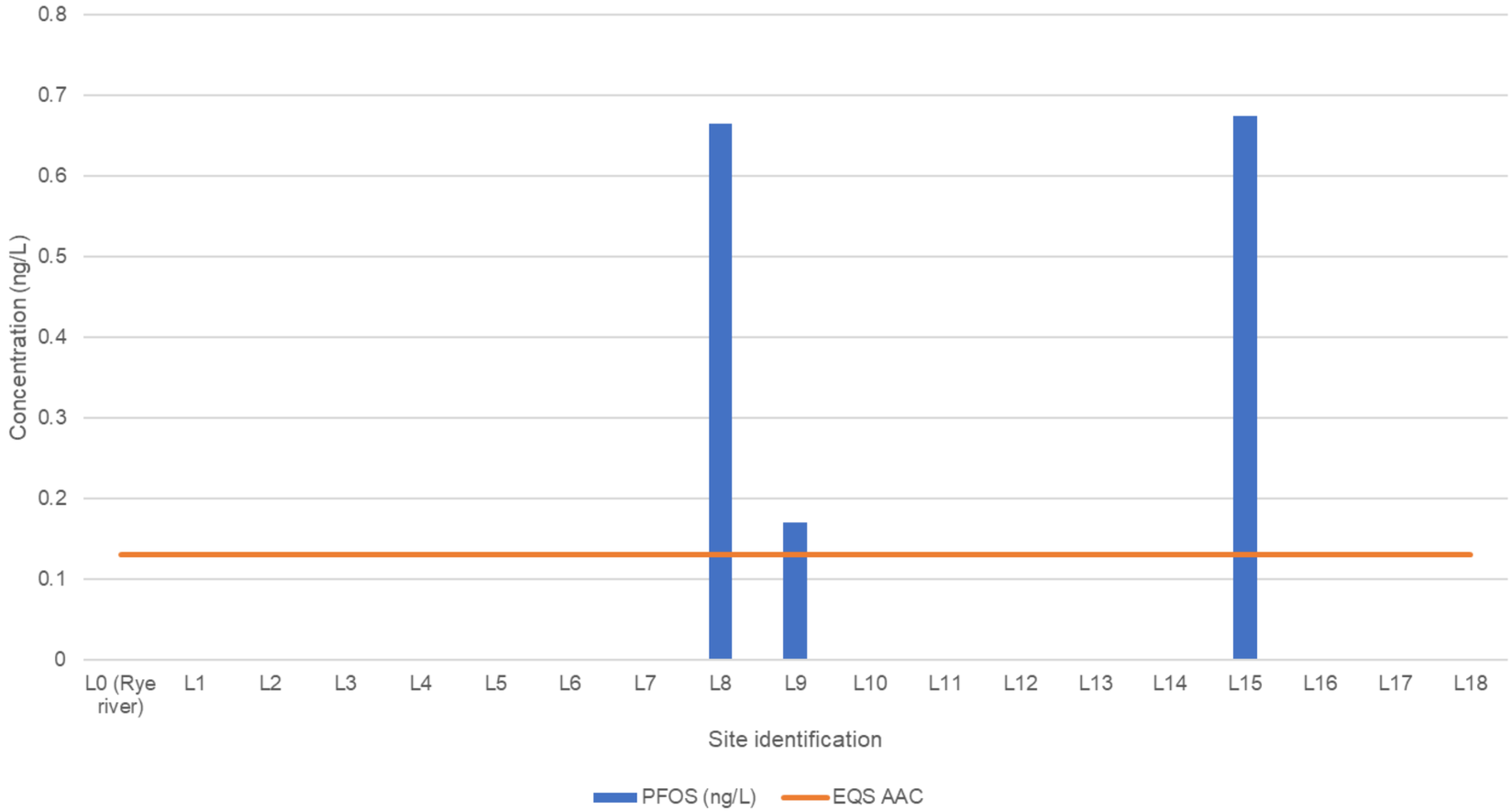


Figure 7: PFOS concentrations compared to EQS AAC

IMPLEMENTATION

Step 3 – Dimensional Calculation

River Liffey background concentration

Total PFAS concentration

$$T = \frac{FC + fc}{F + f}$$

Outfall concentration

Outfall flow rate

River Liffey flow rate

Equation I: Mass Balance Equation

IMPLEMENTATION

Step 4 - Dimensional Modelling

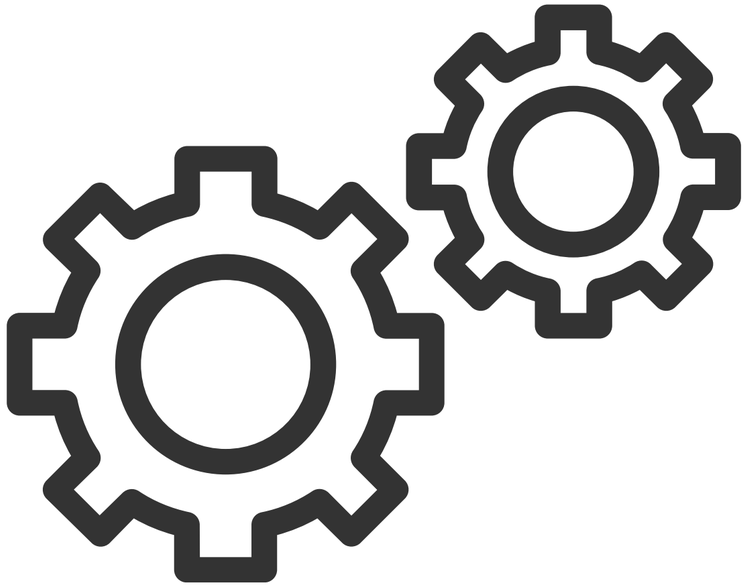
Environmental factors

- River flow
- Stormwater flows
- Rainfall data
- Temporal data

+

Chemical factors

- Dispersion rates
- Sorption
- Bioavailability
- Solubility
- Bioaccumulation



RESULTS
Source identification

22 stormwater overflow outlets in 2.5km
1 per ~115m

Figure 8: Total PFAS Concentrations and stormwater overflows

RESULTS
Source identification

41 stormwater flow outlets in 30km

1 per ~730m

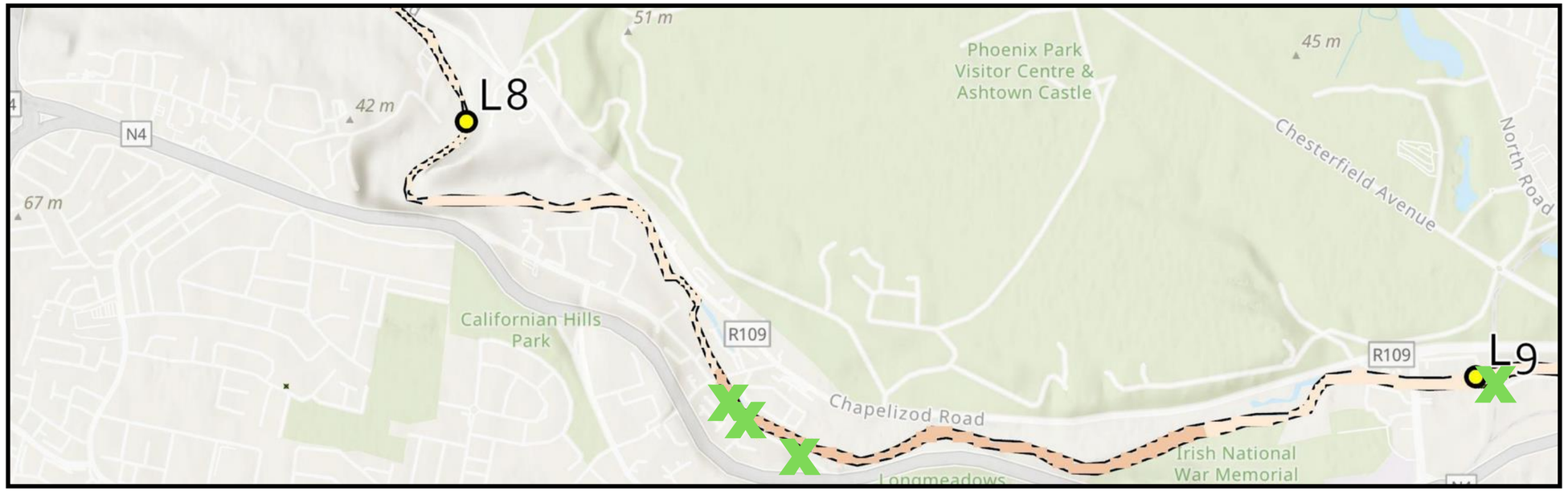


Figure 9: Total PFAS Concentrations and stormwater overflows

CONCLUSION

Geographical proximity

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Chemical footprint

Additional sampling ↓ Environmental and chemical factors

Dimensional calculations

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Dimensional modelling

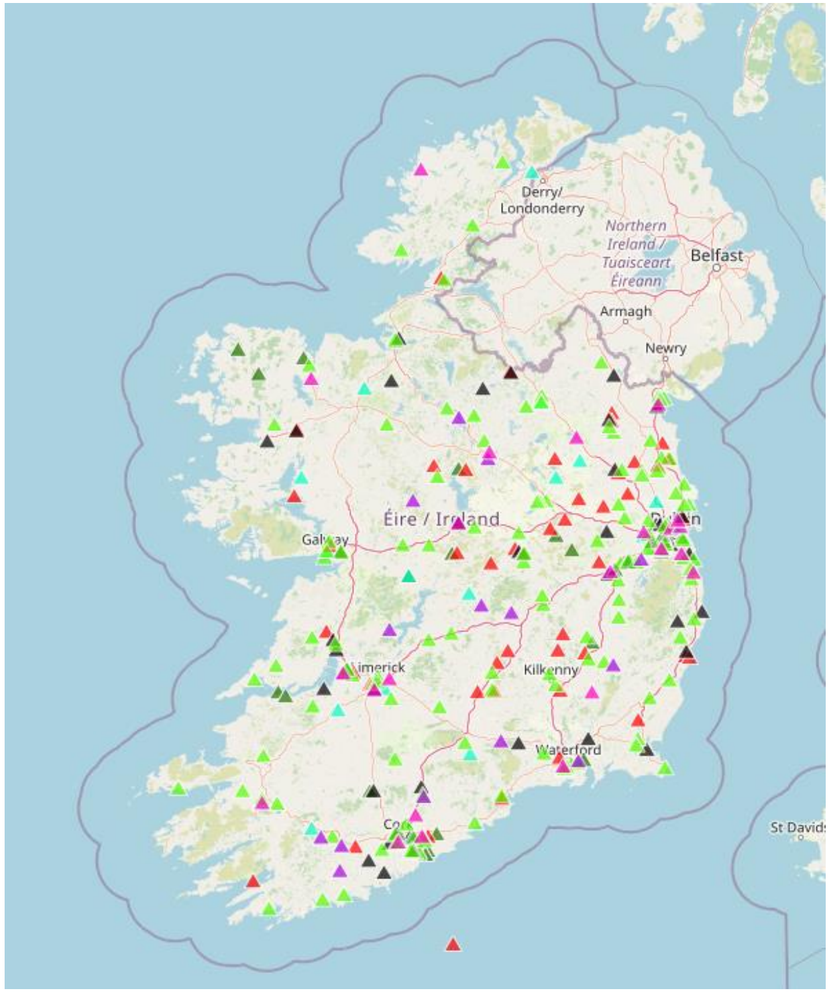

Figure 10: Pollutant release transfer register locations (EPA Maps, 2022)

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