# Research Experience Placement (REP) Scheme 2025

## Supervisor Project Proforma

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| **Project title:** | Tracking microplastics in the coastal zone |
| **Host Institution:** | University of Warwick |
| **Project supervisor (name, department):** | Jonathan Pearson, Engineering |
| **Project enquiries (supervisor email):** | J.M.Pearson@warwick.ac.uk |
| **Co-Supervisor, if any (name, department):** | |
| **Proposed start date and weekly hours:** (please note project must be of 6 weeks duration) | 30th June, 35 hrs / wk for 6 weeks. |

**Please provide a short paragraph or couple of sentences summarising the project to encourage potential applicants to apply** (max 75 words)**:**

Project Highlights:

- Hone novel methods to track (real-time) and analyse microplastics
- Experimental wave flume studies to investigate the behaviour of microplastics
- Training in a wide range of ecological methods using state-of-the-art technologies

**Project description** (max 700 words, 1-2 figures may be included):
Proposed projects must:

- Have a clearly defined objective.
- Be within the science remit of NERC.
- Be feasible for a student to complete within the timescale of the placement.
- Include more than purely a computer/modelling component i.e., some element of fieldwork, data collection, activity to give an understanding of the wider context including participation in lab/team meetings, networking, and training etc.
- Give scope for thought and initiative on the part of the student and should not use the student as a general assistant.
- Be based at an eligible UK research organisation (remote placements are also an option for enabling inclusivity).

Microplastics (MPs) have emerged as a growing environmental concern in coastal marine ecosystems. Estuaries play a critical role as conduits for MPs, linking terrestrial sources of plastic pollution to marine environments, while also serving as hotspots for biological activity and transformation. Despite this, the origins and ultimate fate of plastics within these systems remain poorly understood. Estuaries are exposed to plastic pollution from both point sources, such as sewage systems, and diffuse sources, including agricultural and urban runoff. It is hypothesized that sediments act as a significant sink for microplastic debris. However, the interactions between beaches and MPs, as well as the rates of MP entrapment, are influenced by a complex interplay of physical, biological, and chemical factors. Research on microbial biofilm colonization of plastic debris has demonstrated that these biofilms can cause buoyant polymers to sink. Similarly, microbial biofilms on sediments are likely to affect the infiltration and settling rates of MPs.

Likewise, controlling factors on near neutrally buoyant MP's also include density of the receiving water (salt or freshwater), and wave activity on beaches are also likely to affect infiltration rates.

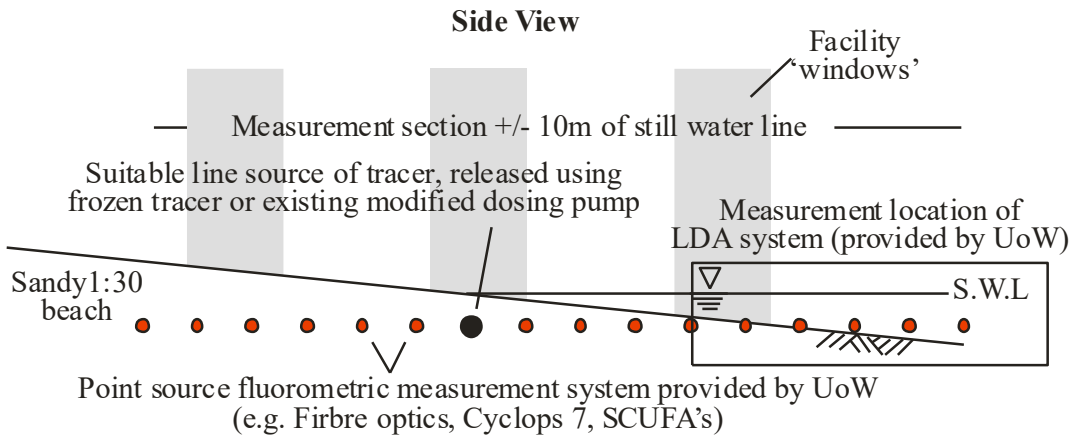


Fig 1: Schematic of facility setup

This project will explore the interactions and feedback mechanisms between beach dynamics and MPs, with a primary focus on identifying the key variables that influence the entrapment and resuspension of MPs in this nearshore ecotone. Despite these findings, the relative significance of these processes remains uncertain, highlighting the urgent need for empirical data to inform and refine predictive models. Various types of plastic particles with differing densities will be examined using cutting-edge technology and innovative methodologies. Understanding the release rates and sources of MPs is crucial for a comprehensive assessment of the risks they pose. The insights gained from this research have the potential to directly inform new policies aimed at improving water management and environmental conservation efforts.

This proposal aims to quantify these processes through a series of direct detailed hydrodynamic measurements and by quantifying their integrated effects on solute tracer & chemically impregnated MP's (developed by the applicant). This will lead directly to the determination of dispersion coefficients, an understanding of their dependence on the underlying processes and to the development of new techniques for predicting pollutant dispersion coefficients both within the beach material and water column. A technique to predict the magnitude of the measured dispersion coefficients has been tentatively suggested by Pearson et al (2002). However, it is severely limited by the availability of accurate data and robust numerical techniques to describe the magnitude and spatial distribution of wave generated turbulence. Its applicability is also limited by the monochromatic waves used in its development. As with all transverse mixing problems, it is vital to accurately define the vertical exchange processes in regions of horizontal velocity shear. The essential elements of this proposal are to contrast regular with more realistic irregular waves and measure the exchange mechanisms between the water and beach material.

Fig 2: Experimental Facility

**Project timeline:**

| | Activity | Before | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | After |
|---|---|---|---|---|---|---|---|---|---|
| | Preliminary meeting | | | | | | | | |
| | Fabrication of equipment at Warwick | | | | | | | | |
| Testing period | Instrumentation installation / Preparation of facility | | | | | | | | |
| | Regular Wave 1; Dye release + MP Release | | | | | | | | |
| | Regular Wave 2; Dye release + MP Release | | | | | | | | |
| | Regular Wave 3; Dye release + MP Release | | | | | | | | |
| | RandomWave 1; Dye release + MP Release | | | | | | | | |
| | RandomWave 2; Dye release + MP Release | | | | | | | | |
| | Remove equipment and restore facility | | | | | | | | |
| | Data analysis, Reporting | | | | | | | | |
| | Reporting | | | | | | | | |

**Candidate requirements:**

The project will be supported by a technician & PhD student. The student should be undertaking a scientific undergraduate degree, and be proficient in MS word & excel. Previous knowledge of MATLAB would be desirable.

**Background reading and references:**


1. Cook, S., Chen, H.L., Abolfathi, S., Bending, G.D, Schäfer, H., Pearson, J.M. Longitudinal dispersion of microplastics in aquatic flows using fluorometric techniques, Water Research Volume 170, 1 March 2020, 115337 - https://doi.org/10.1016/j.watres.2019.115337

2. Microplastic transport dynamics in surcharging and overflowing manholes, 2023, B Stride, C Dykes, S Abolfathi, M Jimoh, GD Bending, J Pearson. Science of The Total Environment 899, 165683 - https://doi.org/10.1016/j.scitotenv.2023.165683

3. Modelling microplastic and solute transport in vegetated flows: Dispersion of polyethylene in submerged model canopies, 2023, B Stride, S Abolfathi, MGN Odara, GD Bending, J Pearson. Water Resources Research, e2023WR034653 - https://doi.org/10.1029/2023WR034653

4. Quantifying microplastic dispersion due to density effects, 2024 B Stride, S Abolfathi, GD Bending, J Pearson, Journal of Hazardous Materials 466, 133440 https://doi.org/10.1016/j.jhazmat.2024.133440


## To be completed by institutional CENTA PoC

I confirm that:

- The host institution takes responsibility for selecting a suitable undergraduate student and ensuring their eligibility under the NERC REP student eligibility criteria.
- This REP project falls within the NERC remit, is of suitable quality and meets the REP research project criteria.
- Appropriate supervisory arrangements are in place.
- The application processes used will be inclusive and accessible.
- Reasonable adjustments will be made for students that need them whilst undertaking placements.
- The placement will be carried out in accordance with all applicable ethical, legal and regulatory requirements including but not limited to relevant provisions of the General Data Protection Regulation, the Data Protection Act 2018, the Bribery Act 2010, the Fraud Act 2006, the Equality Act 2010 and the Modern Slavery Act 2015.
- The host organisation takes responsibility for identification, protection and exploitation of any intellectual property rights arising from the work.
- All facilities, agreements about access and collaborations necessary for the work will be obtained before the work commences and can be ensured through the period of the work.
- All costs awarded by NERC for the REPs will be used and accounted for appropriately.
- A report of the project by the student will be submitted no later than one week after the end date of the placement or Friday 26th September 2025, whichever falls first.

- A PhD interview (where possible) will be offered to all students who have completed a REP within the CENTA Doctoral Landscape Award.

Signed: J M Pearson

Date: 28th April 25

Position: Reader, School of Engineering. UoW