

PFAS in Soil: How “Hidden Pathways” Can threaten Groundwater

Understanding fast transport of pollution in clay soils

PFAS (per- and polyfluoroalkyl substances) consist of a large group of longer and shorter chained synthetically produced fluorine substances that have been used since the early 1950s. PFAS have been used in everything from food packaging, fire extinguishing foam to surface treatment and impregnation of textiles, carpets and in paint. The substances are called “forever chemicals” due to their characteristics as extremely stable and hardly degradable. In addition, they are very water soluble and therefore can end up in our groundwater. PFAS are undesirable in the environment, and they are under suspicion of being endocrine disrupting, carcinogenic and capable of destroying the immune system.

The project is carried out by COWI in collaboration with the University of Copenhagen. It takes place in Denmark and focuses on clay-rich soils that are common across large parts of the country. The work will run from August 2026 to June 2028.

The main goal is to improve the understanding and risk assessment of PFAS reaching the groundwater. Today, many approaches assume that PFAS move with the water in the soil matrix and relatively slowly through the soil. This project focus on transport in macropores, which are natural channels in the soil formed by cracks, plant roots, and earthworms. These channels can act like hidden pathways, allowing water and particles to move quickly from the surface down towards the groundwater.

The project looks at how PFAS can attach to small particles such as clay, iron compounds, and organic material. When PFAS bind to these particles, they can be transported through macropores much faster than expected. This type of transport is well known for pesticides but has only been studied to a limited extent for PFAS.

The project combines fieldwork, laboratory studies, and data analysis. In the field, the presence of macropores will be investigated, by tracer experiments, and water and soil samples will be collected from both contaminated and uncontaminated areas. In the laboratory, the samples will be analysed to understand how PFAS attach to particles and under which conditions they may be released.

The results are expected to provide further knowledge of how PFAS move in real soil conditions. This is important because it affects how authorities and consultants assess risks for the groundwater at contaminated sites. If fast transport through macropores is more important than previously assumed, current risk assessments may need to be adjusted.