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A Comprehensive Field and Laboratory Approach to Investigating PFAS Occurrence and Partitioning

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Per- and polyfluoroalkyl substances (PFAS) are emerging contaminants that have been linked to thyroid disease, decreased response to vaccines, increased risk of cancer, and other health effects. Concerns over PFAS in drinking water has led to extensive investigations of PFAS in surface water and groundwater systems over the past decade. However, increasing evidence indicates soils represent a vast reservoir of PFAS owing to atmospheric deposition and retention in the unsaturated zone. The potential for soils to act as a long-term source to underlying groundwater is unknown. To better understand the occurrence and mobility of PFAS in soils, a three-phase study was undertaken to investigate (1) the occurrence of PFAS and relationship to protein, organic carbon, latitude, soil type, and other potential explanatory variables in shallow soils across the State of New Hampshire in areas not known to have direct PFAS impacts, (2) PFAS solid/water distribution coefficients for representative soils and biosolids using batch and column experiments under a variety of conditions, and (3) PFAS leaching to the saturated zone at two PFAS-contaminated field sites. In phase one, forested or otherwise undeveloped lands in the State of New Hampshire were gridded into 100 equal-area cells and a sample was randomly collected from each cell and analyzed for 36 targeted PFAS. At 50 of these sites, samples were subjected to the total oxidizable precursor assay, and at all sites pH, total organic carbon, moisture content and other potential explanatory variables were analyzed. In phase two, over 1,000 samples were analyzed to better understand PFAS mobility in soils and biosolids. Batch experiments included 5-point sorption isotherms with representative soils and biosolids, and a series of experiments were conducted to determine the impact of pH, ionic strength, sodium azide (used to inhibit microbial activity), adsorption versus desorption, and batch versus column experimental setup on PFAS partitioning. Finally, two site investigations were conducted for phase 3 to compare laboratory-derived solid/water distribution coefficients to the field. Preliminary findings will be discussed along with implications for fate and transport of PFAS.