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Towards a better understanding of the nature and contribution of the interflow pathway to catchment dynamics

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A detailed understanding of flow and contaminant transfer along each of the key hydrological pathways within a catchment is critical for designing and implementing cost effective Programmes of Measures under the Water Framework Directive.

The Contaminant Movement along Pathways Project ('The Pathways Project') is an Irish, EPA STRIVE funded, large multi-disciplinary project which is focussed on understanding and modelling flow and attenuation along each of these pathways for the purposes of developing a catchment management tool. The tool will be used by EPA and RBD catchment managers to assess and manage the impacts of diffuse contamination on stream aquatic ecology. Four main contaminants of interest — nitrogen, phosphorus, sediment and pathogens — are being investigated in four instrumented test catchments. In addition to the usual hydrological and water chemistry/quality parameters typically captured in catchment studies, field measurements at the test catchments include ecological sampling, sediment dynamics, soil moisture dynamics, and groundwater levels and chemistry/quality, both during and between significant rainfall events. Spatial and temporal sampling of waters directly from the pathways of interest is also being carried out.

Sixty-five percent of Ireland is underlain by poorly productive aquifers. In these hydrogeological settings, the main pathways delivering flow to streams are overland flow, interflow and shallow bedrock flow. Little is known about the interflow pathway and its relative importance in delivery of flow and contaminants to the streams. Interflow can occur in both the topsoil and subsoil, and may include unsaturated matrix flow, bypass or macropore flow, saturated flow in locally perched water tables and artificial field drainage.

Results to date from the test catchment experiments show that artificial field drains play an important role in the delivery of interflow to these streams, during and between rainfall events when antecedent conditions are favourable. Hydrochemical mixing models, using silica and SAC254 (the absorbance of UV light at a wavelength of 254 nm which is a proxy for dissolved organic matter) as tracers, show that drain flow is an important end member contributing to the stream and that proportionally, its contribution is relatively high.

Results from the study also demonstrate that waters originating from one pathway often mix with the waters from another, and are subsequently delivered to the stream at rates, and with chemical/quality characteristics, that are not typical of either pathway. For example, pre-event shallow groundwater not far from the catchment divide comes up to the surface as rejected recharge during rainfall events and is rapidly delivered to the stream via overland flow and/or artificial land drainage, bringing with it higher nitrate than would often be expected from a quickflow pathway contribution. This is contrary to the assumption often made in catchment studies that the deeper hydrological pathways have slower response times in stream hydrographs during a rainfall event, and it emphasizes that it is critical to have a strong three-dimensional conceptual model as the basis for the interpretation of catchment data.