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Stormflow generation: a detailed investigation of hillslope pathways in a headwater catchment in Southwest England.

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The aim of this paper is to discuss the efficacy of rapid stormflow pathways in generating flow in a small headwater catchment. Traditional pathways that are thought to contribute to rapid flow include overland flow, throughflow or interflow and macropore / pipe flow. In some situations a 'pressure wave propagation' process and a 'transmissivity feedback' mechanism have also been proposed.

Holne Moor is a 65 ha catchment in the headwaters of the River Dart, in Southwest England. The area receives about 2100 mm of rainfall annually, and is underlain by granite. The soil is a well-drained humose sandy loam on the slopes with gleyed soils at the bottom of the slopes. Stream discharge, water temperature, and specific conductivity are continuously measured at the base of the catchment. Close to the perennial stream, two small v-notch weirs measure ephemeral flow in small channels. A recording rain gauge, four micro-tensiometers, and two sets of gutters have been installed at the base of slope; a shallow gutter was placed at the base of the organic horizon, and a deeper one about 15 to 20 cm below the top of the mineral soil.

Results for all the storms analysed indicate that the channel responds rapidly to rainfall and equally quickly returns to near base flow. The mid-slope weir shows a similar pattern: quick response and equally quick secession of flow. The base of slope weir also initiates quickly, but subsides much more slowly. Similarly the subsurface gutters respond quickly but continue to flow long after the rain ends. The tensiometers, located near the gutters also reacted in a similar way.

The behaviour of the weirs, gutters and tensiometers at the onset of rain is consistent with a pressure wave propagation process. A gutter experiment in Georgia (USA) responded in a similar fashion at the beginning of a storm. However, the Georgia gutters stopped flowing immediately after the rainfall ceased whereas the Holne gutters continue to flow because of saturated conditions. The midslope weir displays a flashy behaviour similar to the flume in the main channel whereas the weir at the base of slope shows a flow pattern that persists long after the river has returned to near baseflow. It is concluded that on Dartmoor the pressure wave process is active on the hillslope through a dynamic ephemeral network. Although throughflow contributed substantial amounts of discharge at the base of slope, it arrived too late to contribute to stormflow. Future work will include additional gutter locations and a detailed analysis of the ephemeral channel network.