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Assessing the relative and cumulative impacts of future urbanisation and climate change on storm runoff in a peri-urban catchment

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Urbanisation brings with it a range of impacts upon the urban water cycle, particularly during storm events where a loss of pervious surfaces (and increase in impervious surfaces) coupled with increased artificial drainage result in decreased infiltration and more rapid runoff – leading to an increased likelihood and magnitude of flooding. Such impacts are especially pronounced in peri-urban catchments where the rapid progression from rural to urban significantly alters storm runoff response, and could be further affected by climate change.

This study provides a comparative analysis between the impacts of urbanisation (and associated change in impervious cover) and climate change within a rapidly developing peri-urban catchment in the south of England over a 50 year period. A new methodology for mapping long-term change in historical urban land-use from topographic maps was applied to derive decadal changes in impervious cover. Catchment monitoring was undertaken to provide observed flow and rainfall for indicative hydrological response and hydrological model calibration. The successive impacts of decadal increases in urbanisation on storm runoff were assessed using a hydrological model suited to representing the impacts of change in impervious cover and by applying design summer and winter storm events at both 5 year and 100 year return periods. Both the comparative and cumulative impacts of climate change upon generation of storm runoff were assessed by comparing scenarios of: i) no increase in urbanisation with climate change, and ii) urbanisation with climate change, with the baseline scenario of iii) urbanisation without climate change. Predicted future changes in monthly precipitation and potential evaporation were derived from a downscaled ensemble of climate change scenarios (2070-2099) from the UK Climate Projections (UKCP09) Regional Climate Model (RCM) under A1B emissions scenario.

Results are discussed in relation to projections of future growth and climate change for developing peri-urban areas within localised catchments and for the regional Thames basin. The uncertainties in the applied modelling strategy are discussed in relation to the limitations of climate change data and the associated perturbation of design storm events in urban areas.