RD1086 – Pilot Study in 2D Rainfall-Runoff Modelling Analysis for Local Catchment

Executive Summary

The objective of this R&D Study is to establish a 2D rainfall-runoff (2DRR) model for a selected local catchment with due consideration of the flooding history and the drainage basin characteristics of local villages. This study is included in the Working Paper No. 7 (WP7) under Agreement No. CE 44/2012 - Sha Tin and Sai Kung DMP Review Study. Wong Chuk Yeung, which is a problematic flooding area, is selected and a video taken by local villagers showing the flooding situation during the rainstorm event on 22 July 2010 is also available.

Lumped Conceptual Model, referred to the 1D/2D model, has long been used in Hong Kong for DMP studies. This model describes the catchment as a single entity with a single rainfall input and the runoff is assumed to have effectively entered into the drainage system. In contrast, the 2DRR model demonstrates the flow of stormwater in the catchment before entering into the drainage system.

The established 2D rainfall runoff model demonstrated its capability to replicate the flooding event dated 22 July 2010 and the results agreed satisfactorily with the anecdotal evidence regarding flood depths and overland flow paths. Sensitivity test on different runoff coefficients for unpaved area, different Manning's n values for 2D overland layer and different degrees of blockage at the vehicular bridge crossing of Wong Chuk Yeung Stream were also carried out.

There are several advantages of 2DRR modeling over 1D/2D modeling. First, it allows use of spatially distributed rainfall. It could also incorporate spatially distributed land use and storage features within the catchment (e.g. floodplain). Last but not least, it could reproduce the differing responses times from various sub-catchments and the relationship between response times and catchment wetness, rainfall intensity, etc.

2DRR modelling is particularly suitable for village areas with flooding problem caused by the lack of drainage facilities and local ponding. Furthermore, it would help developing more effective drainage improvement schemes, for example diversion of overland flow by depressing local strip of land or erecting obstruction, like planters, to alter overland flow path.

Although 2DRR has advantages over 1D/2D model, it is much more computationally demanding requiring model runtimes in the order of 2 – 7 times that of the 1D/2D model. Furthermore, it needs a high level of site survey and investigation for model establishment since structures on the topography is indeed affecting the overland flow path. Hence, it appears to be not practical to apply 2DRR modelling for the entire DMP Review Study Area in view of the additional resources required. However, application of 2DRR modelling for local catchments is practical, bearing in mind the balance between result accuracy and model complexity is a key factor to decide if 2DRR modelling is worthwhile in a particular area.