How Important are Pits in Overland Flow Modelling?

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Overland flow studies in urban areas help to define flood risk and identify areas where risk mitigation measures are desired to manage or reduce the risk. The definition of flood levels can influence flood planning levels and Council decisions on upgrades to the stormwater drainage systems. But how accurate are these levels and how dependent are they on the accurate representation of pits?

Urban catchments often include a significant number of pits and pipes as part of the stormwater network. One-dimensional models offer good flexibility in representing pits, but it is difficult to represent the overland flow paths accurately. Two-dimensional models simulate the overland flow paths well, but don't always offer the best one-dimensional network representation.

Poor data on pit types, pit inlet rating curves, model grid size, and representation of pits and pipes in models can all influence the model results; assessment of risk; and development of appropriate mitigation solutions. Advances in technology and model features now allow more accurate representation of pits, and coupled with improved processing speeds which allow smaller grid sizes, a more complex and representative model set-up can be achieved.

Lending from experience with a number of recent overland flow studies we use case studies to examine the effects of the above considerations and their relative importance for determining flood risk and their influence on decision making with risk mitigation measures.

Objective

The objective is to examine the effects of pit types, pit inlet rating curves, model grid size, and representation of pits and pipes in two-dimensional overland flow models and their relative importance for determining flood risk and their influence on decision making with risk mitigation measures.

Method

Using recent two-dimensional overland flow modelling case studies, different model parameters related to pit representation were examined to assess their impacts on model results. Scenarios to be compared include i) using unlimited capacity pits; ii) using pit rating curves for a common pit type; iii) using pit rating curves for actual pit types iv) impacts of pit blockage v) pipe blockage as a surrogate for pit blockage vi) model grid size; and vii) special model features such as road cross fall tools.

Results

Older methods of representing pits with unlimited capacity tends to overestimate the amount of water entering the pipe system. So while this assists to assess the pipe capacity, it does not identify where there are deficiencies

in pit inlet capacity to get stormwater into the pipe system. Good data on pit types allows use of pit inlet rating curves to provide a more accurate representation of the actual system performance and deficiencies can be identified as being due to insufficient pit capacity, undersized pipes or downstream influences. Smaller model grid size and road cross-fall tools further assist in more accurate representation.

Conclusions

The representation of pits can have a significant impact on the results of overland flow modelling and highlights the importance in determining the best pit representation to match the quality of pit data available. This allows an improved diagnosis of system capacity issues and identification of suitable mitigation measures. Further, flood risk can be better approximated by more closely matching the system performance, providing more realistic surface flow rates and flood levels.