Flood and Coastal Erosion Risk Management Research Programme

Improving surface water flood mapping: estimating local drainage rates

Project Summary SC120020/S

This project has developed new guidance to estimate local drainage rates when mapping and modelling surface water flood risk. The information can be used to validate and update the national maps – called the Risk of Flooding from Surface Water – which use a national average drainage rate. The guidance provides simple approaches for Lead Local Flood Authorities to use to check if the national maps represent surface water flood risk in their area. The approaches can also be used to see how the flood maps may change with more or less drainage, and to test scenarios like future climate change.

This research project proposes and tests approaches to estimate locally specific drainage rates. This will help users estimate the impact of any changes in drainage on the extent of potential flooding – and potentially inform investment decision-making.

The guidance can be used to find out how sensitive the flood risk maps are to a change in the drainage rate and thus help users to better interpret the Risk of Flooding from Surface Water maps. The approaches will also support activities necessary to keep the published maps up-to-date.

Background

Surface water flooding results from run-off generated from rainfall falling on land. Around 3 million properties in England are in areas at risk of flooding from surface water.

In 2013, the Environment Agency published maps showing areas at risk of flooding from surface water across England called collectively the ‘updated Flood Map for Surface Water’. This national scale flood modelling is combined with appropriate locally produced mapping (where it exists), and is published as the Risk of Flooding from Surface Water. This underlying modelling used a consistent default urban drainage capacity. In some places, use of local drainage rates could improve the results. However, performing local detailed modelling of surface water and urban drainage can be expensive and resource intensive. This project provides an assessment of alternative, simpler approaches to validate the national drainage rate and estimate local drainage rates.

Lead Local Flood Authorities and other flood Risk Management Authorities use the Risk of Flooding from Surface Water maps and model data to identify communities vulnerable to flooding from heavy rainfall and the likely extent of any impact which might occur.

The national flood model assumes a default drainage capacity (or ‘drainage rate’) of 12mm per hour to account for surface water captured by property drainage, highways drainage and public sewers. Some local variants were applied at the request of Lead Local Flood Authorities with locally specific information available. Lead Local Flood Authorities also have an annual opportunity to incorporate new or revised mapping into the Risk of Flooding from Surface Water.

Method

Two independent approaches were investigated and tested to estimate drainage rates for any given area. The first was an empirical method based on observed relationships between catchment characteristics and drainage rate. The second was a statistical method based on revisiting the original statistical model used to develop the national default drainage capacity value. A ‘rainfall proxy’ method was also developed to enable a quick insight to be made into how sensitive small (5km × 5km) areas are to the drainage rate parameter.

Results

The results from tests of the empirical method, based on observed relationships between catchment characteristics and drainage rate, were inconclusive. A single drainage rate, averaged over a catchment, is the result of multiple factors acting together and it was therefore concluded it was unlikely that reliable catchment descriptors could be identified to estimate a drainage rate.

The statistical method used local information about the level of service of a drainage system, critical duration rainfall, percentage run-off and rainfall depth, duration and frequency. The method adapted the Monte Carlo approach (repeated random sampling) used to derive the national default drainage rate. The results were also mostly inconclusive as several parameters could not be defined independently of the modelled storm durations, which were based on the 12mm per hour default rate. A commonly used approach, which overcomes some of these issues, is to define the sewer capacity losses by using a rainfall exceedance probability event that corresponds to the capacity of the sewer system. This sewer capacity hydrograph can be defined for different duration events. The effect of using locally defined parameters was found to be modest in the 6 test catchments (a change of 2mm per hour).

Overall, the range of sewer capacities calculated using locally defined parameters confirmed that the default 12mm per hour rate is robust and generally applicable to sewer capacity nationally.

Discussion

The report presents some options to users who want to review or revise the national drainage rate for local surface water modelling, but cannot determine without further testing which method is most suitable or appropriate for a given area. This information can be used to help understand whether changing the drainage rate, or carrying out further work to change it, would be worthwhile in terms of the impact it has on the flooded area or depth.

The report provides guidance on how to use a rainfall proxy method to visualise the impact of revised drainage rates through maps. This uses the flood maps from the 9 rainfall scenarios produced from the national modelling (1, 3 and 6 hour duration storms for the 3.3%, 1% and 0.1% annual rainfall probabilities). These are available to Lead Local Flood Authorities on a 5km × 5km grid square basis.

Test results showed some variation in the suitability of the rainfall proxy method but, if validated, the method can give a quick insight into the sensitivity of small (5km × 5km) areas to the drainage rate parameter. This can be a useful first step in any future appraisal for further detailed modelling; it can also support sensitivity analysis. Guidance is provided within the main report and separately in a user guide on how to apply the rainfall proxy method.

Conclusions

The methods investigated could provide simple and relatively low cost options for amending the drainage rates. However, the limited number of tests performed for this project were inconclusive in demonstrating that these approaches were robust enough to confidently recalculate drainage rates.

An alternative approach is proposed using the existing flood mapping scenarios to instead test how sensitive an area is to changes local drainage capacity using total net rainfall as a proxy. This could inform whether further detailed modelling and potential changes to the national maps are justified. Guidance is supplied to support Lead Local Flood Authorities in identifying potential suitable rainfall proxies to use.

This summary relates to information from project SC120020 reported in detail in the following outputs:

Report title: SC120020/R Improving surface water mapping: estimating local drainage rates, accompanied by:

Monte-Carlo Analysis spreadsheet: SC120020/1 Appendix C_Sewer Capacity-MC Analysis Tool (v0.2-March 2015).xls

Rainfall Calculator spreadsheet: SC120020/2 Appendix D_Effective Rainfall Matrix Calculator (v0.3 March 2015).xls

User Guidance: SC120020/3 Improving surface water mapping: estimating local drainage rates user guidance

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