BRINGING BACK THE BINNENSINGEL

QUANTIFYING THE REDUCTIONS IN PLUVIAL FLOODING AND GROUNDWATER FLUCTUATIONS FROM ADDING OPEN WATER TO A DENSE URBAN POLDER AREA

In cities located in low-lying areas on soils susceptible to subsidence, water managers constantly have to balance between pumping away enough water to prevent flooding and pumping away too much water, which accelerates subsidence. This balance is expected to become even harder to find in the future, as climate change increases the intensity of both rainfall and drought. Adding surface water to cities is a measure that can help in reducing pluvial flooding and groundwater fluctuations. This study quantifies these reductions by studying the restoration of the Binnensingel canal in the Dutch city of Vlaardingen with the use of the integral hydrodynamic model 3Di.

Firstly, a model schematisation of the study area is calibrated and validated. The groundwater part of the model is found to be sufficiently accurate with a mean absolute error of 0.04 m. The surface and sewerage parts of the model were not quantifiable due to errors in historic measurements, but were qualitatively found to be sufficiently accurate.

Secondly, a 10-hour future rainfall event with a return time of two years and a five-minute peak intensity of 89 mm is put on the model of the current study area. This causes heavy pluvial flooding for over two hours, with maximum water depths of 25-30 cm, leading to approximately one third of the buildings in the area being vulnerable to flooding. Groundwater levels fluctuate by up to 30 cm.

Thirdly, the Binnensingel canal is added to the model with different variations in length, water level and connected area and the same rainfall event is put on the adjusted model. The implementation of the canal reduces the extent of pluvial flooding only slightly by up to 2 cm in depth, 15 minutes in duration and 19 vulnerable buildings. Groundwater fluctuations are reduced only locally, within a distance of 20 m from the canal. It is found that a higher connected area or a lower water level in the canal are the most effective elements of the canal in reducing pluvial flooding and groundwater fluctuations. Their effect is amplified for longer versions of the canal.

While the results show only small effects, they do also show the potential of adding a canal to urban areas. For future research, it is recommended to study the effects of open water in times of drought.

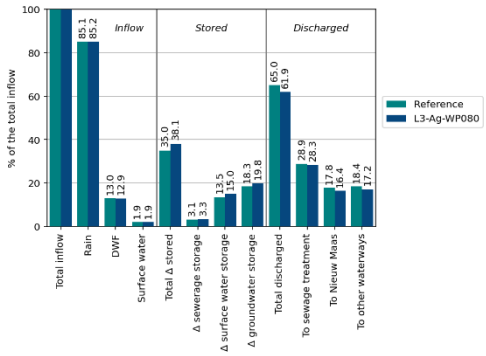

Figure 1: Water balance of the reference scenario and the scenario with a full length canal with a lowered water level and a high amount of connected area.

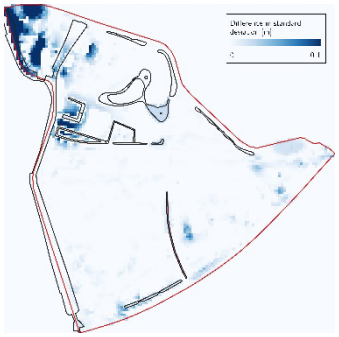

Figure 2: Map of the study area showing the difference in standard deviation in the groundwater level for every grid cell between the scenario with a full-length canal with a lowered water level and a high amount of connected area and the reference scenario. The red line outlines the study area.

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