

## **A comprehensive assessment of multilayered safety in flood risk management – the Dordrecht case study**

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**Abstract** In the year 2009, the concept of Multilayered Safety (MLS) was introduced in the Netherlands as a possible way to manage the flood risk. MLS consists of three layers: (1) Prevention (dikes, room for the river, etc.); (2) Spatial Solutions (flood-proofing houses, elevating houses, re-locating, etc.); and (3) Crisis Management (evacuation, warning, etc.). The main characteristic of MLS is the combination of probability- and loss-reducing measures. Combining measures can be technically tricky as it becomes more difficult to oversee the combined effect of those measures. Thus, in the first part of the study a framework was developed to gain insight into the combined effect of flood management measures of different types. MLS will only become a reality if it is more cost-efficient than the standard approach. This was investigated in the second part of the study. The Island of Dordrecht in the Netherlands was used as a case study. This area has about 120 000 inhabitants and is threatened by flooding from the North Sea and the River Waal, or a combination thereof. The cost-effectiveness of measures has been evaluated by comparing investment costs and the reduction in economic risk and risk of loss of life. As the cost-efficiency is found to be dependent on the initial safety level, it is concluded that in the Netherlands MLS only has the potential to supplement the existing flood protection. In areas with high levels of protection, as in Dordrecht, MLS is fit to add to, rather than replace, the prevailing prevention approach. However, MLS does introduce the option to better customize flood risk management to local circumstances. Additionally, this characteristic makes MLS an alternative where the prevention approach falls short of providing sufficient safety.

**Key words** flood risk; flood risk management; multilayered safety; consequence-reducing measures; prevention; Dordrecht, The Netherlands