

Flood protection in Hamburg

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The city of Hamburg is the second largest city in Germany. Around 1.8 million people live in this metropolitan area which is a center for trade, transport and services and an important location for industry. Furthermore, the port of Hamburg is the largest seaport in Germany.

Hamburg is located at the Elbe estuary, 110 km away from the North Sea and is seriously threatened by storm surges from there. In addition, high waters coming downriver must not be neglected, not only the Elbe River but a lot of bigger and smaller rivers in Hamburg (s. Fig. 1). In the river marshes both risks may occur at the same time. About 45% of the city is located in low lying areas that would be flooded by storm surges without dykes regularly. That is a surface area of 342 km² (Fig. 1) with 326.000 inhabitants living there.

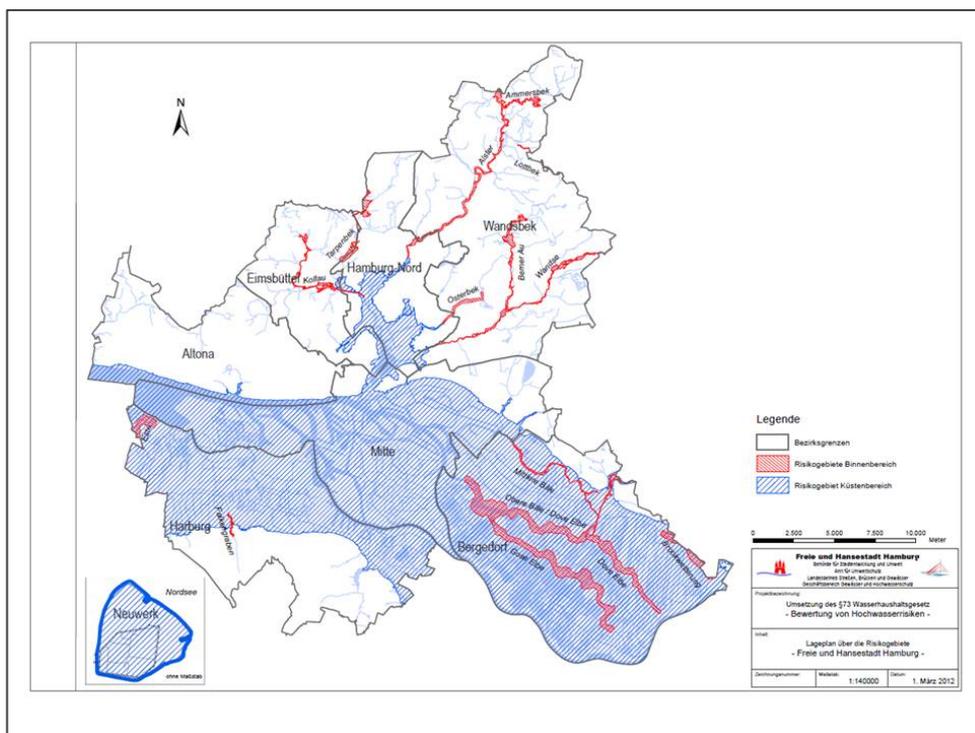


Figure 1. Risk Area in Hamburg (Free and Hanseatic City of Hamburg, BSU and LSBG).

The warning time of storm floods is extremely short; this is a clear difference to the high waters coming down our big rivers. Those high water levels can be predicted days before and allow adequate preparation.

There were two very high storm surges in Hamburg, the catastrophe in 1962 is still on everybody's mind in Hamburg and second in 1976 when nobody died but the Harbour area was flooded and lots of precious goods were destroyed. In the last decade there were four high water floods caused by heavy rainfalls in 2002, 2006, 2011 and 2013. It can be seen that Hamburg must be protected against both: storm surges and heavy rainfall.

The structure of Coastal Protection in Hamburg is based on three columns: Technical, preventive and operative Protection (Fig. 2), which is comparable with the structure of flood protection.

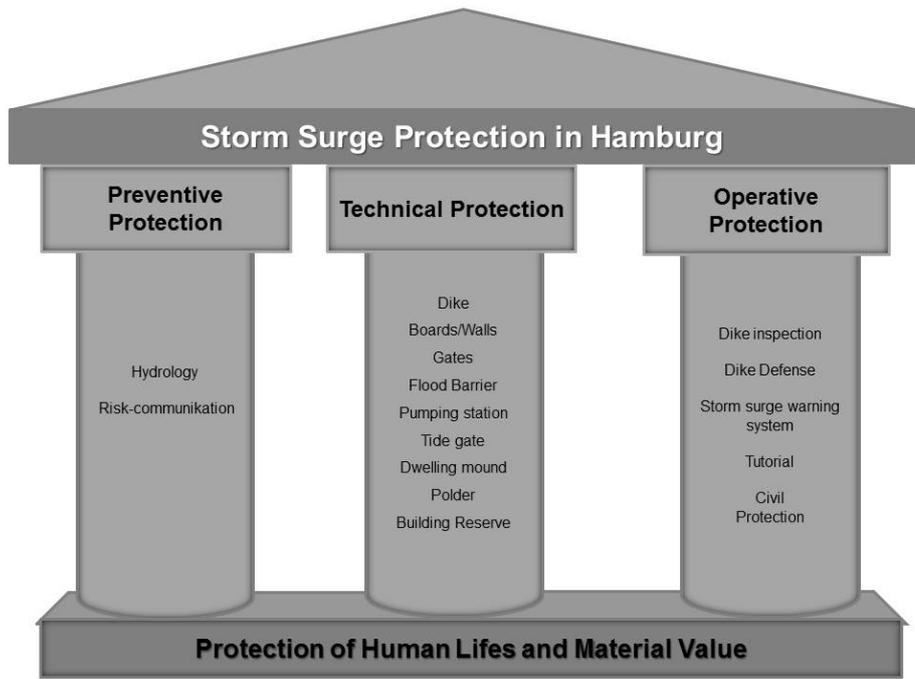


Figure 2. Structure of Coastal Protection in Hamburg (Free and Hanseatic City of Hamburg, LSBG).

The technical protection in Hamburg is divided into three parts, the public flood protection, consisting of flood protection walls and sea dikes, the private flood protection, mainly applied as individual object protection in the HafenCity, and the flood protection in the harbor area. The public flood protection contains more than 100 km of dikes and sea walls. Since the water level in the Elbe estuary is influenced by the tides in the North Sea the dikes along the Elbe in Hamburg are coastal protection.

The ‘storm surge protection facilities’ comprise coastal protection construction as well as property of objects, protected by special constructive measures sometimes in front of the public dike line — called main dike line. Buildings in front of the dike line are in the old harbour for example the so called ‘Speicherstadt’ and the new HafenCity.

The guiding principle of coastal protection in Hamburg is to achieve a very high safety standard for the whole city. This will be ensured by the design level used for dimensioning storm surge protection facilities. The uncertainties of climate change scenarios and the growing risk due to the growing city necessitate a new flexible protection system. Such a concept has to involve a definition of the safety standard, the physics and hydrodynamic of storm surges and a good adaption strategy which helps to deal with future requirements. Heightening of the primary flood protection structures like sea dikes and barriers in city areas often causes problems due to a small availability of space. In order to face the challenges of rising sea levels, adaptation strategies are needed that fulfill both criteria of a very high safety standard on the one hand and a small demand of space on the other hand.