

## FAQ

### How is it possible for a dike to fail?

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There are several possible causes for a dike failure. The most common are:

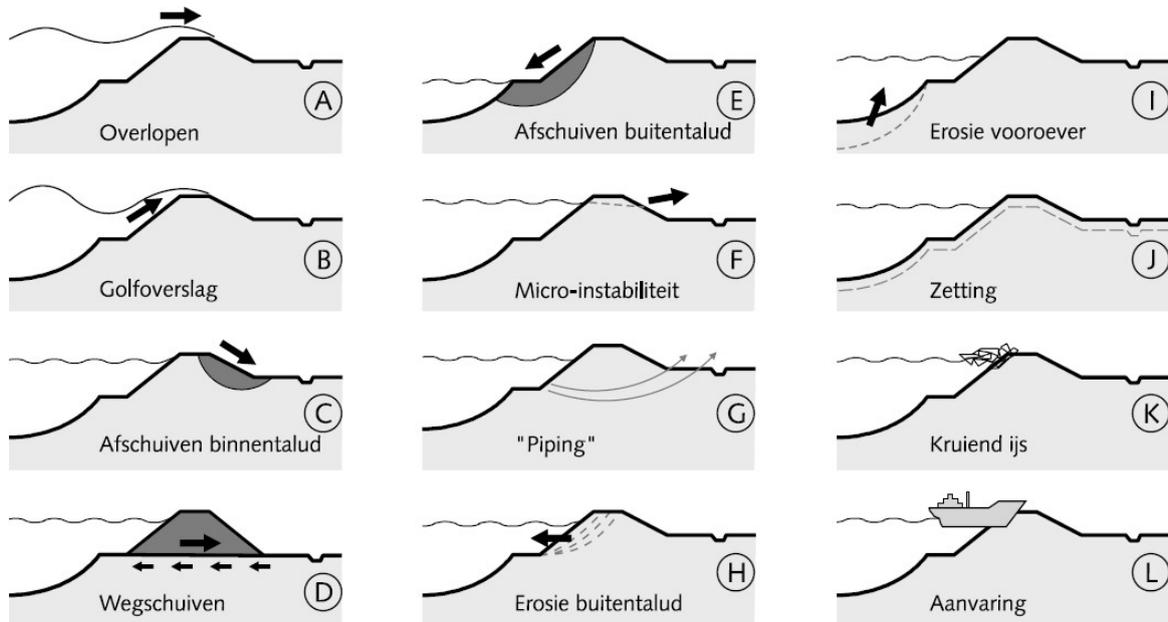
- The dike is not high enough: the water flows over the dike because the dike is simply too low or waves break over it. This can in itself cause major flooding but there is often worse to come: the water that passes over the dike erodes the dike on the land side, making the dike smaller and lower. As soon as there is a breach, in other words a place where the erosion is so extensive that an opening is created, the water flows in fast. A breach will usually also widen quickly and so the area behind the dike will be flooded quickly.
- The dike is unstable: the dike body sags on the land side, often due to a combination of saturation – making the dike body heavier and reducing the strength of the soil – and high water pressure from the underlying sand layers that are in contact with the high water. Dike saturation often occurs after a few days of high water, which is why it is carefully monitored. The first slope failure can reduce the height of the dike immediately. Alternatively, it may only damage the dike slope, making it easier for the inside of the dike to wash away until a breach occurs here, too.
- Backward erosion piping: the difference in water level between the two sides of the dike results in a groundwater flow which becomes so strong at a given moment that sand grains below the dike are washed away. If this continues, a kind of pipe can eventually form under the dike, getting larger until the dike body above it subsides. The dike will therefore be too low again and a breach may occur.
- Damage to the revetment resulting in erosion: the outside of a dike is protected by a covering of rock, clay and/or grass. Damage to this revetment caused by waves, strong currents or objects can easily spread and result in a breach.
- Liquefaction: loosely packed sand may be present under the foreshore of a sea dike or a dike in the tidal area. The cavities between the grains in this sand are relatively large. In specific circumstances, sand can turn fluid quite suddenly. Usually at low tide. Any dike on the bank may then subside, with an immediate breach in the dike as a result.

Once there is a breach in the dike, the water can flow in freely. The responsibility of the Dutch water authorities and Rijkswaterstaat is to prevent this by making sure that the dikes are high and strong enough. The research institute Deltares conducts research to ensure that this is done as well as possible and that all dikes are strong enough, without the costs becoming excessive.

The figures here show twelve causes of dike failure, most of which are covered by the five categories described here.

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[Figuur:  
 Overflow      Shearing of outer slope      Erosion of forebank  
 Overtopping      Micro-instability      Settlement  
 Shearing of inner slope      "Piping"      Drifting ice  
 Shifting      Erosion of outer slope      Collision]