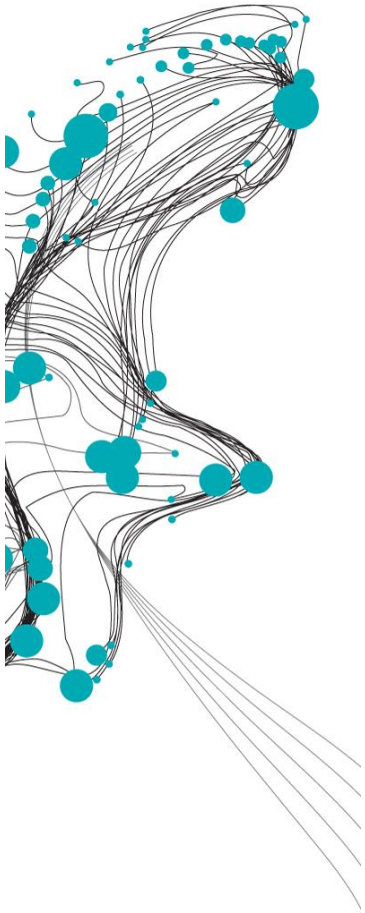
Analysing the morphological consequences of the preferred design of the Overijsselse Vecht using SOBEK 3



The river Overijsselse Vecht in water board Vechtstromen is being redesigned to meet the guidelines according to inter alia the Water Framework Directive WFD and Natura 2000. The preferred design is a redevelopment of the canalised Vecht into a half-natural lowland river including measures like meandering, widening the main channel, floodplain forests and high water channels. Hydraulic simulations were performed by the water board to check the prerequisites for a minimal water depth of 0.5 m and maximum water levels during the representative high water discharge. However, knowledge about morphological processes between Emlichheim and Vilsteren was missing and is analysed in this study.

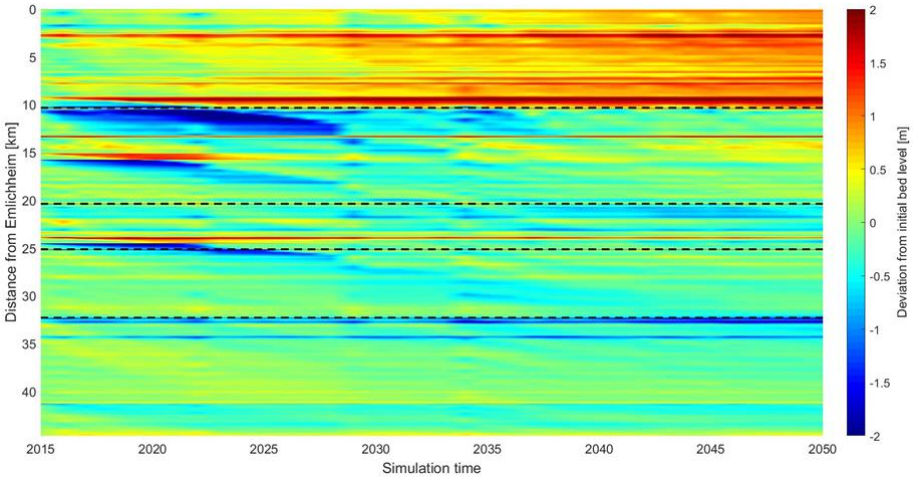


Figure 1: Deviation from initial bed level for the current situation

The morphological behaviour of both the current situation as the preferred design is simulated with SOBEK 3 models, which are based on existing (hydraulic) SOBEK 2 models. After calibration of the roughness coefficients, sediment inflow at Emlichheim and a transport parameter in the sediment transport formula of Engelund and Hansen, the models are simulated over a period of 35 years (2015–2050) and the behaviour on short-term, intermediate-term and long-term is investigated.

In general, the Vecht is a morphological active river, which yearly transports on average between 1200 and 15000 m^3. Looking at short-term morphological behaviour, the Vecht (in current and preferred situation) shows to be sensitive for discharge peaks larger than approximately 120 m^3/s. This is caused by fluctuations of the flow width of the floodplains. Decreasing floodplain widths (in flow direction) induce increasing flow velocities causing erosion pits. After discharge peaks, erosion pits fill up and are almost unrecognizable during low discharges. This recovery is caused by less fluctuating main channel widths, which also mainly determines the bed development on the intermediate-term. The development of bed levels (over 35 years) is studied at low discharges, see Figure 1. Both the current situation and preferred design show sediment deposition upstream (0-10 km), which propagates in downstream direction over time. In the current situation there are more locations with stronger erosion compared to the preferred design. This is caused by both a small sediment inflow from upstream and a larger sediment transport capacity due to a larger velocity caused by smaller main channel widths in the current situation. After 68 years (long-term), bed levels more upstream tend to move towards a dynamic equilibrium. Without dredging, all bed levels of the Vecht are expected to increase with approximately 1 to 2 meters after approximately two hundred years.

The prerequisites according to a minimal water depth of 0.5 meter is met at all locations of water board Vechtstromen. After 35 years of bed level development, without dredging activities, bed levels increase significantly resulting in an exceedance of the maximum water levels up to 30 cm. To keep the maximum water level at the normative level it is recommended to dredge on a regular basis.

During peak discharges, the flood channels and floodplain forest induce small effects in bed levels which will disappear after the peak discharge. The impact of these measures on the water levels and water depths are negligible and induce no additional maintenance of the river bed.

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