THE EFFECTS OF DIFFERENT DESIGNS OF LONGITUDINAL TRAINING DAMS ON COUNTERING BED DEGRADATION FOR DIFFERENT DISCHARGE SCENARIOS IN THE RIVER WAAL

The ongoing bed degradation in the river Waal, resulting from human interventions in the Dutch Rhine system, affects several functions in the river system. The bed degradation leads to problems regarding navigation depth, flood safety, the stability of infrastructure, nature and water supply. The Integrated River Management (IRM) programme was initiated in 2020 to anticipate climate change and its possible consequences by making the Dutch river system future-proof. The IRM programme aims to stabilise the bed level of the Dutch Rhine branches. Longitudinal training dams (LTDs) are a proposed measure for the IRM programme to achieve the desired stabilisation of the bed. Previous research demonstrated that LTDs are a promising measure in countering bed degradation. A pilot on LTDs at Tiel shows that LTDs counter bed degradation in the short-term, more time is required to measure the long-term effects. Previous studies also looked at the effects of extending the LTDs to the Midden-Waal and Boven-Waal, however, these studies did not assess different designs of LTDs or the influence of climate change, which was the objective of this study.

This research makes use of a 2D-modelling approach using the DVR model. This model is based on the computational core of Delft3D-4 and can simulate long-term large-scale morphological changes. The difference in bed level is assessed after 20 years of morphological development for different designs of LTDs to identify possible improvements regarding the design of LTDs. Next to this, different climate change projections are translated into discharge scenarios to assess the effectiveness of LTDs to cope with climate change.

The results of the model show that bed degradation in the Boven-Waal is reduced with the introduction of new LTDs in both the Boven-Waal and Midden-Waal. However, the introduction of these new LTDs results in erosion in the main channel of the Midden-Waal and Beneden-Waal. On the other hand, LTDs reduce water levels at high discharges and increase the discharge towards the Pannerdensch Kanaal during low discharges, which is desired. The LTD designs are assessed on reducing erosion, sufficient navigation depths, lowering water levels during high discharges and increasing discharge towards the Pannerdensch Kanaal during low discharges. Out of the assessed designs of LTDs, it is concluded that widening the riparian channel performs best based on the assessed criteria. LTDs in combination with climate change will reduce bed degradation in the Boven-Waal over 20 years. However, bed degradation in the Midden-Waal accelerates as a result of climate change in both cases, with and without new LTDs. Without the new LTDs, sedimentation in the Beneden-Waal is reduced as a result of climate change. The bed of the Beneden-Waal degrades as a result of LTDs and climate change slightly accelerates this degradation.

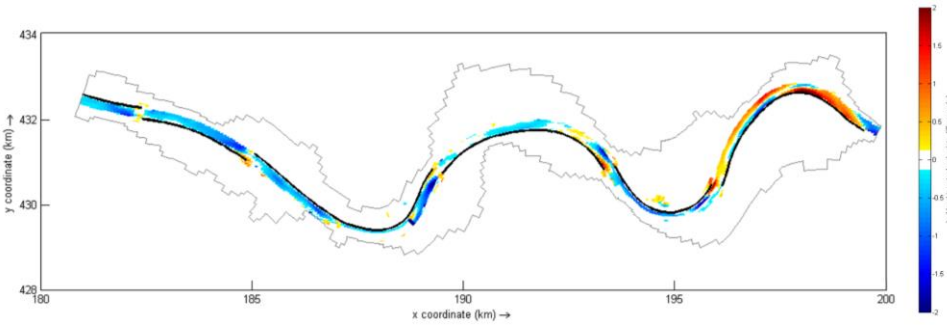

Figure 1: Bed level change in the Boven-Waal as a result of new LTDs (black lines) after 20 years of morphological simulation.

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