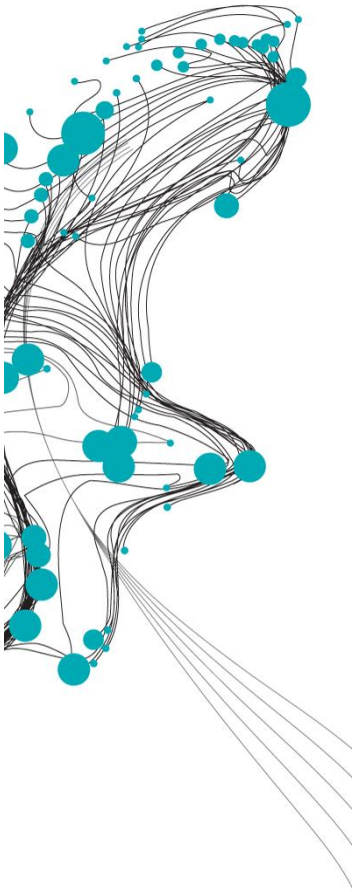
Hydraulic models in stream restoration



In the last couple of decades a lot of stream restoration projects have been carried out by regional water authorities in the Netherlands to restore ecology. During the design phase of these projects it is very common to use the one-dimensional Sobek model to forecast future water levels and flood risk. Still it is a common belief that forecasts are not always optimal and that two-dimensional models might provide better forecasts with respect to future water levels, morphological developments and developments in vegetation.

Comparison between water level forecasts for a restoration project in the Lunterse beek showed that the uncalibrated one-dimensional Sobek model performed better than the uncalibrated two-dimensional Delft3D Flexible Mesh model. It is expected that differences are caused by decisions made with respect to bed roughness and bathymetry of the models. A sensitivity analysis showed that the performance of the Delft3D Flexible Mesh model could improve by selecting different roughness values and choosing a different interpolation method to determine bed levels. Increasing experience with two-dimensional modelling in stream restoration projects should therefore lead to water level forecasts as accurate as obtained with a one-dimensional model.

Hydraulic output of the Delft3D Flexible Mesh models was used to investigate if morphological forecasts could be explained. For the Lunterse beek, maps of flow velocity and flow direction in combination with maps showing locations where the critical value of the Shields parameter is exceeded were able to support the monitored morphological developments. However, the discharge that occurred in the investigated period did not agree with the discharge that described the monitoring data best. For the Tungelroyse beek the same method was used to forecast developments in morphology, but quantitative validation data was missing. This proved that a two-dimensional model might be beneficial in forecasting developments in morphology, but more research is needed to confirm this.

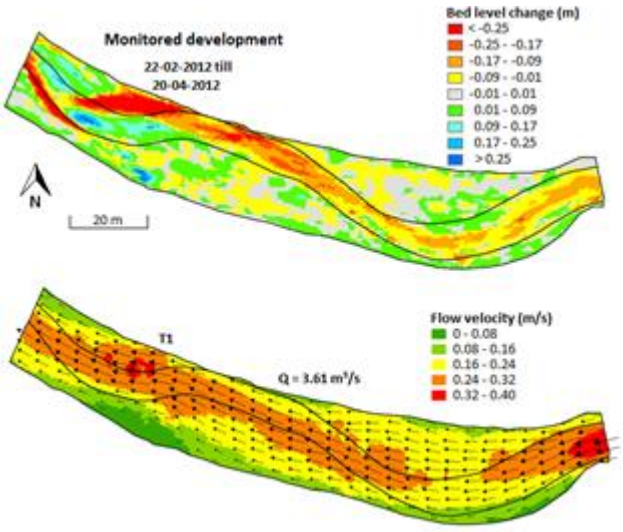


Figure 1: Comparison between monitored morphological developments and a flow velocity and direction map made using a T1 discharge event.

Maps of expected developments in vegetation were made based on flow velocity output of the Delft3D Flexible Mesh model, expecting low vegetation density for high flow velocities and high vegetation density for low flow velocities. These forecasts proved to be useful for both the Lunterse and Tungelroyse beek, though in-stream vegetation developments could hardly be analysed.

Ruud Boom

Graduation date:
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Graduation committee:
University of Twente
Dr.ir. D.C.M. Augustijn
Ir. R.P. van Denderen

HKV Lijn in Water
Dr. Ir. A.J. Paarlberg
Ir. H.J. Barneveld

Waterschap Vallei & Veluwe
Ir. C. Huising

Waterschap Peel & Maasvallei
Ing. E. Raaijmakers

UNIVERSITY OF TWENTE.