Cascading consequences of structural interventions in a tropical wandering gravel bed river in the Philippines

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# ABSTRACT

Riverscapes are often modified and managed through ‘command and control’ structural engineering approaches for human protection and provision. These structures not only alter flow and sediment transport patterns but also negatively affect the biodiversity of the riverscape. Since one structural intervention often leads to a subsequent need for intervention elsewhere, it is crucial to assess the holistic effectiveness of the structures within riverscapes. We investigate the impacts of the presence and removal of structures on flood and erosion dynamics in a tropical wandering gravel-bed river in the Philippines and explore the cascading impacts of structural interventions downstream. We used HEC-RAS 2D hydraulic models to assess the impact of structures on flood dynamics under different return period magnitudes (5, 10, 25, 50 and 100 year) using high resolution (0.5 m) digital elevation models. Flood structures were effective in confining flood water within the active channel for more frequent return period events but were overtopped during larger magnitude events. A multi-criteria analysis was developed to identify structures that could be removed to provide space for the river, based on their purpose, functionality, and local land-use. Hydraulic simulations were then used to investigate the effect of structure removal. The presence of the structure is associated with increased bed shear stress in the main channel and has the potential to increase sediment mobility on the bed and erosion along the banks. The cascading effect of the structure is also evidenced by reach-scale observed topographic change that was measured through high-resolution topographic mapping during a one-year period. Our results emphasise the importance of proactive and adaptive flood management in planning locations of ‘structural’ and even ‘nature-based’ interventions and the need to consider their local and non-local effects. This study provides a combination of approaches to assess where natural flood management strategies such as reconnecting floodplains can be implemented to promote physical habitat diversity and more effective flood and erosion risk management.