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Modeling the Downstream Impacts of River Regulation on the Grand Lake Meadows Complex using Delft3D FM Suite

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Abstract : Numerical modelling has been used to investigate the long-term impact of a large dam on downstream wetland areas, specifically in terms of changing sediment dynamics in the system. The Mactaquac Generating Station (MQGS) is a 672MW run-of-the-river hydroelectric facility, commissioned in 1968 on the mainstem of the Wolastoq|Saint John River in New Brunswick, Canada. New Brunswick Power owns and operates the dam and has been working closely with the Canadian Rivers Institute at UNB Fredericton on a multi-year, multi-disciplinary project investigating the impact the dam has on its surrounding environment. With focus on the downstream river, this research discusses the initialization, set-up, calibration, and preliminary results of a 2-D hydrodynamic model using the Delft3d Flexible Mesh Suite (successor of the Delft3d 4 Suite). The flexible mesh allows the model grid to be structured in the main channel and unstructured in the floodplains and other downstream regions with complex geometry. The combination of grid types improves computational time and output. As the movement of water governs the movement of sediment, the calibrated and validated hydrodynamic model was applied to sediment transport simulations, particularly of the fine suspended sediments. Several provincially significant Protected Natural Areas and federally significant National Wildlife Areas are located 60km downstream of the MQGS. These broad, low-lying floodplains and wetlands are known as the Grand Lake Meadows Complex (GLM Complex). There is added pressure to investigate the impacts of river regulation on these protected regions that rely heavily on natural river processes like sediment transport and flooding. It is hypothesized that the fine suspended sediment would naturally travel to the floodplains for nutrient deposition and replenishment, particularly during the freshet and large storms. The purpose of this research is to investigate the impacts of river regulation on downstream environments and use the model as a tool for informed decision making to protect and maintain biologically productive wetlands and floodplains.

Keywords : hydrodynamic modelling, national wildlife area, protected natural area, sediment transport.
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