

The time-limited resilience of river morphology to alteration: examples from across Canada

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Natural river systems are dynamic, responding to perturbations in flow, sediment supply and/or channel gradient over a range of time scales. The perturbations commonly do not manifest change immediately, however; rivers may experience a ‘grace period’ during which pre-disturbance conditions are largely maintained. At some point, river morphology can no longer accommodate the perturbations without significant adjustment and, potentially, a new dynamic equilibrium.

This presentation explores different ways in which natural channel systems in Canada respond to perturbations in their flow regimes, sediment supplies and gradients. In each example, the response lags behind the disturbance by years to decades. Aishihik River, in southern Yukon, became regulated for hydroelectricity production in 1975. Detailed historical analyses reveal a spike in morphological adjustment more than a decade after regulation. Geomorphic change has been documented through adjustments in sinuosity (1.71 to 1.25), average frequency of meander cut-offs (0.06 to 0.21 cut-offs/year), width (38 m to 71 m) and channel pattern (single- to multi-thread). The flow regime of Nechako River was dramatically altered following construction of Kenney Dam in 1952. Detailed analysis of historical aerial photography near Vanderhoof, British Columbia, demonstrates that the morphology of Nechako River remained largely unchanged from pre-regulation conditions for approximately two decades. Deposition of fine sediments and riparian vegetation encroachment locally established a new channel pattern and sediment transport regime. German Mills Creek, in Markham, Ontario, exhibits a history of watershed urbanization and channel straightening. A reach-scale reduction in channel length from 1,380 to 680 m between 1946 and 1958 has only recently initiated significant planform adjustment through positive feedbacks driving meander restoration.

The rapidity and local severity of morphological adjustments that commonly occur years to decades after disturbance underscore the uncertainty in determining the effectiveness of natural channel design projects in typical (<5 years) post-construction monitoring programs.

Biography

Robin McKillop is a Principal and Senior Geomorphologist with Palmer Environmental, responsible for leading a team of eight geomorphologists working across Canada. Robin has 15 years of experience leveraging his knowledge of rivers, hillslope processes and glacial landforms to develop innovative and practical strategies for addressing

environmental challenges. Robin's work in southern Ontario focuses on applications of fluvial geomorphology, including erosion hazard assessment and natural channel design.