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Hydrologic resilience of a Canadian Foothills watershed to forest harvest

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Recent investigations of long-term hydrometeorological, groundwater, and streamflow data from watersheds on the eastern slopes of the Canadian Rocky Mountains showed the streamflow regime was resilient to forest harvest. These watersheds had low levels of harvest relative to their size and a large area of sparsely vegetated alpine talus slopes and exposed bedrock; an area shown to generate the majority of runoff for streamflow. In contrast, watersheds located in the foothills of the Rocky Mountains are of lower relief and typically have harvestable timber throughout the watershed; therefore, these watersheds may be more sensitive to forest disturbance and have increased potential for streamflow response. This project assesses the hydrologic resilience of an Alberta Foothills watershed to forest harvest using a 23-year dataset from the Tri-Creeks Experimental Watershed (Tri-Creeks). Tri-Creeks has been the site of intensive streamflow, groundwater, snow accumulation, and precipitation observations from 1967 – 1990. During the early 1980s, forestry experiments were conducted to compare the effects of timber harvest and riparian buffers, and the effectiveness of timber harvesting ground rules in protecting fisheries and maintaining water resources within three sub-watersheds: Eunice (16.8 km2; control); Deerlick (15.2 km2; 36% streamside timber removal); and, Wampus (28.3 km2; 37% clear-cut). Statistical analyses were used to compare the pre-and post-harvest ratios of treatment to control sub-watershed runoff for: water year, monthly (April – October), snowmelt peak flow, and low flow (10th percentile streamflow) periods as an assessment of hydrologic resilience to forest harvest. The only significant post-harvest change was an increase in water yield during May at Wampus (Mann-Whitney (MW), $p<0.05$) and Deerlick (MW, $p<0.1$) Creeks. The lack of change in snowmelt peak flow timing or magnitude was not expected, particularly in Deerlick, which had 36% streamside timber removal. The streamflow regime of Tri-Creeks displayed remarkable resilience to forest harvest. We hypothesize on the processes and characteristics that result in this watershed to exhibit greater resilience compared to other forested watersheds.