

Shaken: Canmore's Awakening to a Reality of Steep Creek Hazards

Geohazards 7



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ABSTRACT

Some of the earliest archeological sites around Canmore date back 10,000 years. Modern development of Canmore's steep creeks and alluvial fans began with the completion of the Canadian Pacific railway in the 1880s. Shortly after, in 1886, Queen Victoria granted a coal mining charter to the town and in 1887 the first mine opened. Remnants of stone dams and cedar pipes that provided water for the coalmines and homes can be found on steep creeks throughout the community.

The last coal mine in Canmore closed on July 13th, 1979 and putting 110 miners out of work. With its roots as a blue-collar town, reliant on mining, Canmore struggled for several years. That changed in the early 1980's when the Winter Olympic Games were announced to be held in Calgary, with Canmore as the site for Nordic Events.

Subsequent to that announcement, Canmore experienced a boom. Pressure for housing for residents and accommodation for the games resulted in large areas of the community developing through the 1980s. While debris floods and debris flows have regularly occurred throughout Canmore's modern history, these processes were not well understood or quantified at the time of this boom. Studies were undertaken to inform development near steep creeks, however, this work often overlooked sediment transport, and considered clear water flows based on regional hydrological analyses. In some cases, on steep drainages, creek beds can have very low flows or even be dry for several consecutive years. In these cases consideration was given only to local overland flow and many creeks were not mapped or named.

These, 100-year, clear-water flow projections were the basis of hazard characterization. Mitigation, including light armouring and gabion baskets was designed to 'train' creek water and, for some time, and in absence of extreme runoff events, provided adequate protection. For rare and more powerful events, the flow remained largely confined to established creek beds. Vegetation began to grow around the formed channels, and mitigation built in the 1980's and 1990's was gradually swallowed by sediment or lost through erosion.

Long periods of relative quiescence contributed to complacency. As established channels naturalized it gave the impression of stability and permanency. Development continued on a number of alluvial fans. Only events on Cougar Creek in 1990 and 2005 raised any concern and, in those cases, additional light armouring of the existing channel was determined to be the solution.

In June of 2012, a debris flood on Cougar Creek caused significant bank erosion, damaged a pathway and transported several thousand cubic meters of sediment. Post event analysis used previous baseline flood assessment to estimate that approximately a 1/100 year event had occurred. Additional armouring was constructed in response.

In June of 2013, an extreme rainfall event changed the community of Canmore forever, unleashing torrents of water that exceeded previous flood hazard assessment by nearly an order of magnitude.

Heavy rain fell throughout the day on June 19th. At roughly 6:00pm the first tendrils of sediment-laden water were making their way down the Cougar Creek channel and several other creeks began to flow.

At 9:00pm, creek flow rates had increased and were approaching the 2012 levels that had caused erosion damage. Re-armouring of portions of the channel had been recently completed in response to the 2012 event. Minor erosion was noted in sections that had not been armoured.

By midnight, erosion was accelerating, and CP Rail had mobilized contractors to excavate sediment at the railway culverts. Shortly after, a surge of water and debris washed out the rail line. A local state of emergency was declared. Throughout the night rainfall continued and flow intensified. Creeks throughout Canmore began moving significant quantities of sediment, and a number of creeks avulsed from their channel.

Cougar Creek remained within its channel, rumbling the ground with the saltation of the boulder rip rap. Gases released by the pulverized rock filled the air with an acrid smell. The rate of lateral bank erosion was rapid, and the channel began to fill with material. It became clear it was only a matter of time before homes, once 40 meters away from the

creek banks, would be impacted. Homes along the Cougar Creek channel were beginning to be evacuated. An avulsion at the Trans-Canada highway split the flow down highway ditches and around a long line of vehicles, trapping people in their cars. Local engineering consultants and contractors were mobilized to creek banks to monitor key crossings, and to try to prevent avulsion of Cougar Creek at a crossing near the fan apex.

As day broke on June 20th, flows were continuing to intensify. Homes along Cougar Creek and adjacent to Stone Creek were directly impacted by peak discharges, sediment, boulders, and woody debris. Daylight permitted initiation of helicopter rescue of those trapped in their cars on the highway. Emergency response was hampered by the loss of access along the Trans Canada. The only remaining access to the east at Three Sisters Creek became compromised by erosion and was closed to the public. To the west, access was closed due to damage at Carrot Creek. Hundreds of people were evacuated to the eastern portion of the Cougar Creek fan – with the only egress being across the compromised Cougar Creek culvert at Elk Run Blvd.

The event peaked in terms of damage and emergency response near midday on the 20th. Equipment operators were working at a half dozen sites to limit damage. At Cougar Creek the focus remained on preventing avulsion or loss of the culvert at Elk Run Blvd. The workers manning equipment risked being swept into the flow – at times operating directly in water. Needing to get residents out of harm's way, a difficult decision was made to move buses across Cougar Creek.

While rain continued for two additional days, flows began to subside during the evening of June 20th. During the course of 24 hours, our community was shaken physically and emotionally by the force of water, sediment, and woody debris. We lost homes, businesses, roads, rail crossings, and utilities. Also lost was our sense of security and understanding as the community was exposed to the flashy nature of our steep creeks catchments. Through the efforts of emergency responders, no individual was hurt or killed.

Forensic analysis summarized damage on nine separate creeks in Canmore (BGC, 2013): Cougar Creek, Three Sisters Creek, Stone Creek, Stoneworks Creek, XYZ Creeks, Pigeon Creek, Stewart Creek, Echo Creek, and Stones Canyon Creek. Direct steep creek damages incurred by the Municipal, Provincial and Federal Government, including costs for emergency response, exceeded \$30,000,000. The total damages including losses due to ground water, overland flooding, business losses, impact to rail line, and insured and uninsured losses to private property, are unknown, however likely take total cost of the 2013 event significantly higher.

Later work to quantify our hazards (BGC, 2014), and a better understanding of debris flood and debris flow processes, raised awareness of how fortunate we were that the outcomes in June of 2013 had not been worse. That work also highlighted that our risk exposure remains high and that we can expect even larger events to occur in the future.

Since the 2014 studies, Canmore has embarked on a program of steep creek hazard management. The program is founded on the basis of taking acceptable risk in exchange for living in our mountainous terrain. To that end, risk thresholds for life loss have been adopted by council in the 2016 Municipal Development Plan. Creek specific emergency response plans have been developed. Risk assessment has been completed for nearly all existing development with the final studies to be completed by the end of 2018. Where risk has been found to be unacceptable, and mitigation is needed, projects are in various stages of design, permitting and construction. Canmore's Steep Creek Hazard and Risk Policy has been approved by Council to guide new development in hazard areas. This policy permits new development only where hazards have been extensively studied, and where risks are deemed acceptable.

Canmore was badly shaken by the debris floods and debris flows of 2013. Our community has awakened to the hazards and the risks and recognized the need to move on from past hazard based approaches to ensure a resilient and sustainable future for our community in the Bow Valley.