

November 25, 2022
Project No.:1358010

Mark Phillips
Director of Protective Services
Squamish-Lillooet Regional District
Box 219, Pemberton, BC V0N 2L0

Dear Mark

**Re: Jason Creek Debris-Flow Risk Assessment, Reid Road Area, Electoral Area C –
Rev 1**

At the request of the Squamish-Lillooet Regional District (SLRD), BGC Engineering Inc. (BGC) is completing a quantitative landslide hazard and risk assessment for Reid Road Area, Electoral Area C. BGC's scope includes detailed assessment of steep creek and landslide hazards originating from the Jason and Mungye creek watersheds along Reid Road, north of Pemberton, BC. BGC's scope does not include rock slope stability assessment outside of the Jason and Mungye creek watersheds, for example in the rockfall covenant area (restrictive covenant #T59223) east of the Jason Creek watershed.

The purpose of this letter is to communicate the findings of BGC's quantitative life-safety risk assessment on the Jason Creek upper fan in support of hazard and risk communication to fan residents. This information is being provided in advance of BGC's full hazard and risk assessment, which will be delivered in late 2022. The larger report considers both Jason and Mungye Creeks and assesses risk for all properties along Reid Road and the intersection with Pemberton Portage Road. Methods and limitations will be included in the full report.

In summary, BGC identified two debris-flow triggering mechanisms in the Jason Creek watershed:

- **Precipitation-triggered debris flows** that originate in the watershed in response to periods of high rainfall and antecedent moisture conditions¹.
- **Rockslide-triggered debris flows** that originate in the watershed in response to partial or full failure of unstable rock masses.

BGC observed two locations of unstable rock masses with the potential to trigger large debris flows on the east side of Jason Creek. These areas show signs of recent movement (open cracks and displacement observed on InSAR analysis between May 2017 and June 2022). Debris flows that originate from either precipitation- or rockslide-triggering can travel downslope and impact the developed areas of the fan in a matter of seconds to minutes with little to no time to move out

¹ Antecedent moisture condition refers to how wet or saturated the soil is prior to a period of heavy rainfall.

of harms' way. Debris flows can also occur in a series of pulses that each take seconds to minutes but collectively persist over an hour or more.

Based on the information collected and reviewed to date, BGC interprets that rockslide-triggered debris flows are relatively rare and historically have occurred at return periods² greater than approximately 1,000-years. In absence of additional monitoring, BGC cannot assess if the future probability of debris flows is increased/increasing above historic rates.

BGC assessed life safety risk to inhabited buildings³ on the fan from debris flows originating in the Jason Creek watershed (Table 1). Life safety is expressed as the annual probability of death of an individual (PDI) in a building. Many jurisdictions in Canada and internationally use a risk tolerance threshold of PDI < 1:10,000 for existing development (e.g., District of North Vancouver, Town of Canmore, Cowichan Valley Regional District, District of Squamish). To put 1:10,000 PDI into perspective, an individual's annual risk of loss of life depends on several factors including their age, occupation, general state of health, and other environmental factors. Statistics Canada (2009)⁴ reports the average Canadian mortality rates by cause. Between 2000 and 2009, the age-standardized risk of loss of life by all causes was approximately 1:200 per year, the average risk from accidental causes was about 1:4,000 per year, and the average risk from automobile accidents was about 1:13,000 per year.

In Table 1, the inhabited buildings on properties highlighted in orange exceed the tolerable threshold, while that in red exceeds the threshold by an order of magnitude (i.e., >1:1,000, a factor of 10 or more). BGC has assessed that 1781 Reid Road (PID 1608908) is at **imminent risk** from debris flows during periods of high rainfall. The debris-flow risk at the remaining properties highlighted in orange in Table 1 exceeds levels normally considered tolerable for existing development in other jurisdictions in Canada.

In jurisdictions with land use or zoning bylaws and that have adopted risk tolerance criteria, new development or redevelopment is not permitted without mitigation works to reduce risk to below the PDI of 1:10,000 threshold. For existing development, where risk exceeds the threshold, the risk levels would be disclosed on public record and may be included, for example, in a covenant. In some instances, weather and/or slope stability monitoring have been carried out as a temporary means of managing risk until more permanent solutions can be implemented. Further, in some jurisdictions, mitigation works to reduce risk to within tolerable levels would be required as part of building permit applications. Finally, understanding the risk levels provides a basis for prioritization of available resources for risk management and mitigation and is often a requirement to

² Return period is a way to communicate the probability of an event occurring in a given year (annual exceedance probability) and does not indicate that an event will recur at regular or set intervals.

³ BGC digitized building footprints using publicly available aerial imagery and 20 cm resolution orthophoto dated July 2022. BGC classified buildings into inhabited or non-inhabited based on site observations collected in July 2022 supplemented with interpretation where access to properties was not provided.

⁴ Statistics Canada. (2009). *Mortality, Summary List of Causes*. Government of Canada, Catalogue no. 84F0209X.

demonstrate for grant applications that could support funding and implementation of management or mitigation activities.

Table 1. Life safety (PDI) to inhabited buildings on Jason Creek upper fan. Highlighted properties have PDI that exceeds risk tolerance thresholds applied in other jurisdictions.

Risk Level (PDI Range)	Parcel ID	Address
>1:1,000	1608908	1781 Reid Road
1:1,000 to 1:10,000	1585134	1802 Reid Road
	1609068	1794 Reid Road
	1609076	1788 Reid Road
	1609084	1782 Reid Road
<1:10,000	30102065	1791 Reid Road
	30102073	1793 Reid Road
	1608886	1815 Reid Road
	1609050	1812 Reid Road
	1609092	1770 Reid Road
	1608916	1771, 1773 Reid Road

Debris flows could impact the properties highlighted in orange in Table 1 with little warning during periods of high rainfall, but BGC assessed that the probability and expected consequences of such impacts are lower than at 1781 Reid Road. Debris flows could also impact the properties not highlighted in Table 1, but BGC assessed the risks to be within levels normally considered tolerable for existing development in other jurisdictions.

The results presented are calculated at inhabited buildings. A person(s) outside of a building on other locations on the properties can be at risk of injury or fatality during a debris flow from Jason Creek due to the depth, speed, or force of the flow. Economic damages associated with flooding, sedimentation, and erosion can be expected at properties on Jason Creek fan. BGC has not assessed economic damages as part of this scope. Finally, BGC’s assessment is based on the current topography and layout of structures on the fan. Any changes to the fan surface (e.g., sedimentation and erosion from a debris flow, construction of mitigation measures, etc.) or the location(s) of buildings may change the risk. Assessment of risk levels could also change with additional monitoring or repeat evaluation of the unstable rock slopes in the watershed.

1.0 CLOSURE

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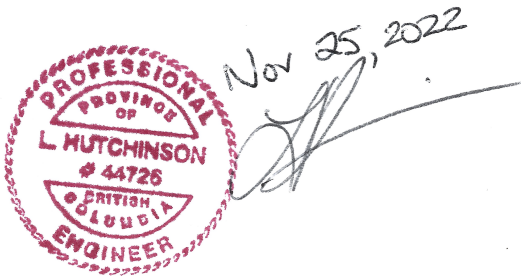
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Yours sincerely,

BGC ENGINEERING INC.

per:

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