

APPENDIX B
JANUARY 16, 2025, MEMO TO RDEK BOARD





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TECHNICAL MEMORANDUM

Date January 16, 2025

Project 1127007

To Justing Cook, Planner II
Regional District of East Kootenay

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Local Government Approaches to Land Use in Natural Hazard Areas

1.0 INTRODUCTION

This memo presents a brief overview of the background, context, and nature of approaches taken to manage land use in areas subject to natural hazards. This memo is provided under Contract No. CDL 0747, dated June 17, 2024 and was requested by RDEK Staff for use in internal discussions that will guide the remaining work on this project. Where the memo cites provincial legislation and local bylaws, descriptions are limited to tools for restricting the use of land in natural hazard areas and are not exhaustive.

2.0 PROVINCIAL LEGISLATION AND GUIDANCE

In BC, assessment and regulation of development in areas affected by natural hazards is covered under various acts and guidelines. The BC **Local Government Act** (SBC 2015) requires that Official Community Plans (OCPs) contain statements and map designations respecting restrictions on the use of land that is subject to hazardous conditions (Sec 473). It also allows for OCPs to designate development permit areas (DPAs) for the protection of development from hazardous conditions. Section 56 of the **Community Charter** (SBC 2003) allows for a building inspector, on lands subject to hazardous conditions, to require a landowner to provide a report certified by a qualified professional (QP) that the land may be used safely for the use intended. Zoning powers under the *local Government Act* (s. 458) also provide a tool to zone or rezone to limit development. Other Provincial legislation relevant to restrictions on the use of hazardous land subject to hazardous conditions include the **Land Title Act** (RSBC 1996), under which the Approving Officer has discretion to refuse subdivision (s. 86(1)(c)(v)).

Local Governments must also consider applicable provincial standards and guidelines when developing bylaws and regulations; those applicable to developing floodplain management include the B.C. **Flood Hazard Area Land Use Management Guidelines**. The guidelines state that development should be discouraged in areas where there may be debris flow hazard and that consent to develop should only be granted if there is no other land available and an assessment by a QP indicates that the development may occur “safely”. Measures or thresholds

to define 'safe' are not explicitly defined. QP's carrying out assessments hold responsibilities under by the Engineers and Geoscientists Act (RSBC 1996) and consider professional practice guidelines published by Engineers and Geoscientists BC (EGBC), provincial or federal agencies. Examples of relevant professional practice guidelines include EGBC Guidelines for Flood Assessments in a Changing Climate (EGBC, 2018) and Guidelines for Landslide Assessments in BC (EGBC, 2023).

3.0 IMPORTANT CONCEPTS

Hazard: an event or situation with the potential to harm people, property or the environment. At Fairmont and Cold Spring Creeks, known hazards include debris flows¹ and floods. Hazards are often described by characteristics such as depth and velocity, for event magnitudes ranging from frequent, minor nuisance events to rare, catastrophic events.

Hazard Probability: The likelihood of an event of a certain magnitude occurring is often described by its 'return period', which is the average time between occurrences of such an event. For example, a 100-year flood (1:100 year flood) is expected to be exceeded once in a 100 year period, or twice every 200 years. This means there is a 1 in 100 chance (or 1% Annual Exceedance Probability, AEP) of it being exceeded in any given year, regardless of the last occurrence. Similarly, a 50-year event has a 2% AEP.

Risk Management: Considering risk is a common method of evaluating the safety of actions, including development. In British Columbia, management of the risks associated with debris flows (and other types of landslides) focusses on risk to life, rather than the economic risk associated with damage to infrastructure.

Risk to life: refers to the probability of death for an individual living or working within a hazard area. It can be compared to everyday risks such as a 1:100 chance of getting in a motor vehicle crash or a 1:1,000 risk of drowning. For debris flows, risk to life depends on whether a debris flow event occurs and reaches an inhabited structure, how deep and fast the debris flow is when contact is made, and the likelihood of structural failure causing a fatality. Larger debris flows, while less frequent, are deeper, faster and extend over larger areas, leading to greater loss of life when they occur. Risk to life therefore varies with the probability of a debris flow of a given magnitude and the resulting consequences to life. **Group Risk** refers to the probability of multiple fatalities in a debris flow hazard area, highlighting the impact on communities rather than just individuals.

4.0 PRECEDENTS

In 1972 a subdivision application near Squamish was rejected by the Province due to landslide hazard in the area. On appeal, the judge upheld the decision given there was sufficient

¹ In this document, the general term "debris flow" is used to encompass the full spectrum of steep stream hazards, including both debris floods and debris flows as defined by the mechanics of sediment movement during an event. Most steep streams that experience debris flows also experience debris floods, and debris flows can transition into debris floods during an event, so distinguishing between the two modes of transport is unnecessary from a hazard and risk perspective.

likelihood of a catastrophic landslide affecting more than 100 residences and resulting in loss of multiple lives. ‘Sufficient likelihood’ was described by the Judge as a return period of 1:10,000 years or AEP of 0.01%. Because catastrophic landslides have the potential to claim the lives of virtually everyone in the area affected by them, this 1:10,000 return period is analogous to a 1:10,000 risk to life in the affected area. The same is not true for hazards that are less likely to result in fatalities.

The BC Ministry of Transportation and Infrastructure’s past and current (2024) Subdivision Preliminary Layout Review requirements for Natural Hazard Assessments require that where a life-threatening event is known as a potential hazard to a building lot, the QP is to consider events having a probability of occurrence of 1 in 10,000 years and large-scale developments must also consider the total risk to the new development (Group Risk).

In 2013 a panel of risk experts was formed by the District of Squamish Council to provide opinions related to the Cheekye River debris flow hazard. The panel concluded that the 1:10,000- year event was the appropriate event for estimating the largest landslide that could affect the Cheekye Fan. The panel also recommended that staff consider the risk to existing buildings, not just new development, and that the evaluation of risk to life on the fan be determined for a full spectrum of event magnitudes and return periods because risk to individuals on various parts of the fan would be dominated by different events.

5.0 CURRENT APPROACHES IN BC AND ALBERTA

Both approaches presented below include a common reliance on QPs to provide professional reports that align with the provincial landslide assessment guidelines (EGBC, 2023). Local governments have developed tools to further support staff reliance on QPs, including assurance statements and terms of reference for QP studies.

5.1 Hazard-focussed approaches

Hazard-focused approaches relate land use decisions to the probability of the hazard occurring and reaching the area of interest. Hazard approaches do not explicitly translate the hazard of occurrence to a probability of life loss², but may imply a level of risk by adopting different criteria for hazard types with different levels of destructive potential. A debris flow hazard probability table for the Fraser Valley Regional District (Figure 5-1) indicates which of five approval categories the project falls in depending on the type of application and the hazard probability. Overview hazard studies inform the establishment of DPAs within which a study by a QP is required to ascertain the hazard probability, develop siting requirements, and plan mitigation measures as needed (per the table below right). Where there are known hazards but no DPAs, building inspectors request QP reports. Section 219 covenants (Land Title Act) are employed for all development in hazard-prone areas.

² For an example, see the **Fraser Valley Regional District (FVRD) Hazard Acceptability Thresholds for Development Approvals**.

Debris Flow/Debris Torrent

Debris flows and torrents are rapid, saturated flows of coarse debris and mud, damaged trees, stumps, and smaller organic material. These flows may be contained in steep creek channels or they may spread out on debris fan surfaces. Debris flows and torrents can be life-threatening and damage or destroy property.



Table 4

	1:50	1:50-1:200	1:200-1:500	1:500-1:10,000	<1:10,000
Minor Repair (<25%)	5	2	2	1	1
Major Repair (>25%)	5	4	2	1	1
Reconstruction	5	5	4	3	1
Extension	5	5	4	2	1
New Building	5	5	4	3	1
Subdivision (infill/extend)	5	5	5	4	1
Rezoning (for new community)	5	5	5	5	1

- 1 Approval without conditions relating to hazards.
- 2 Approval, without siting conditions or protective works conditions but with a covenant including "save harmless" conditions.
- 3 Approval, but with siting requirements to avoid the hazard, or with requirements for protective works to mitigate the hazard.
- 4 Approval as #3 above, but with a covenant including "save harmless" conditions as well as siting conditions, protective works or both.
- 5 Not approvable.

Figure 5-1 Debris flow hazard probability tables for the Fraser Valley Regional District

Advantages and disadvantages of the hazard-focused approach: Hazard probability has a strong precedent in engineering as they are often used in standards for design. Planners and professional engineers and geoscientists have familiarity with the approach and the tables provide process transparency for applicants.

The hazard-focussed approach concentrates on new development and does not directly promote the reduction of existing risk. The application types (minor repair, etc.) must be adjusted as new forms of development arise (i.e., accessory dwelling units). Applying different decision-making criteria to different hazards (e.g. more conservative criteria for more destructive hazards) lacks the flexibility of risk-focused approach that explicitly considers vulnerability. The approach may hamper creative, site-specific risk mitigation proposals as they would be invalidated by the rigid framework.

Key Point

Hazard-focused approaches place the full responsibility of determining what constitutes 'safe for the intended use' on the QP. Local government planners, who often lack the specialized expertise, must rely entirely on the QPs interpretation, with limited ability to assess or question it.

6.0 COMBINED HAZARD AND RISK APPROACHES

The City of Canmore, Alberta (Canmore) and District of Squamish (DoS) provide two examples of jurisdictions that combine hazard and risk approaches to inform land use decisions in hazard areas. Canmore experienced a significant debris flow on Cougar Creek in 2013, leading to the development of their development management approach. The DoS has been developing hazard and risk policies for over a decade, motivated by proposed major development in debris flow hazard areas on Cheekye River fan. While their approaches differ in detail, both local governments take a hazard approach to define zones of hazard on the fans and then establish risk tolerance criteria for management of development in the hazard area.

Both have similar risk tolerance criteria in their official plans:

- Group risk is within the As Low As Reasonably Practicable (ALARP) or acceptable range,
- For new development, the individual annual risk to life shall not exceed 1:100,000, and
- For existing development, the individual annual risk to life shall not exceed 1:10,000.

In both locations, the hazard mapping is based on the intensities (i.e., depths and velocities) and extents of events possible across return periods. The hazard area is divided into zones ranging from extreme- and high-hazard zones, to moderate- and low-hazard zones. Generally, the higher-hazard zones do not allow development, while moderate-hazard zones allow development if a risk assessment is undertaken and illustrates that the project can meet the established risk tolerance criteria (as above). In low-hazard zones, risk assessments may be required and development is permitted. Note that the decision trigger to require an assessment is hazard-focused, but the required assessment is risk-focused.

Advantages and disadvantages of the combined approach: the mapped hazard zones provide important information on the changing characteristics of hazard across the fan and enhance transparency, helping development applicants understanding of likely requirements. However, assessments typically require watershed scale analyses beyond a single homeowner's property. This can result in costly duplication of effort where independent applicants share similar assessment requirements. While this disadvantage can be addressed through watershed scale assessments at sufficient detail to enable QPs to focus subsequent work at a property level, applicants may still be challenged to find QPs with the appropriate risk assessment expertise. Shifting the burden to QPs to assess 'safe for the intended use' still requires capacity by the approving authority to incorporate, where possible, assessment deliverables into a maintained body of knowledge about a hazard area.

Key Point

In the combined approach, community-established risk tolerance criteria effectively define what is considered 'safe for the intended use', while risk assessments performed by QPs evaluate whether these standards are met through design of mitigation measures. This approach relieves the burden on planners to interpret QPs' assessments of 'safe for the intended use' and shifts the cost burden onto permit applicants. Setting up information management processes and tools will still be needed to enable new assessments to refine past work and maintain an up-to-date body of knowledge.

7.0 CLOSURE

We trust the above satisfies your requirements. Should you have any questions or comments, please do not hesitate to contact us.

Yours sincerely,

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Attachment(s): Limitations
References

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