

Should hazard assessment reports prepared for subdivision and building permit approval and the design of measures to protect existing residential development situated on debris flow fans consider fire and climate change effects by more consistently using a volumetric approach to hazard assessment?

Due to the scarcity of relatively flat land in and around developing areas of the province, there is pressure on local governments and the province to permit residential development on debris flow fan areas. In addition, many communities have already been established on debris flow fans. [see attached Flood Hazard Maps]

Regulations and Guidelines for Development:

- Ministry of Transportation subdivision approval
- ➔ 10% chance of occurrence in 50 years ($T_r = 475$ yrs)
- Local Government building permits
- ➔ "land may be used safely for the use intended"
- Local Government policies
- ➔ Example from Fraser Valley Regional District Planning Department

TYPE OF DEVELOPMENT APPLICATION		TYPE OF HAZARD			
		PROBABILITY OF OCCURRENCE HIGH ← → LOW			
		Annual Return Frequencies			
PROJECT		>1:50	1:50-1:100	1:100-1:200	>1:200
EFFECT ON DENSITY ↑ MAJOR INCREASE ↓ NONE ↓ DECREASE	Minor Repair, <25%				
	Major Repair, >25%		?	?	?
	Reconstruction		?	?	?
	Extension		?	?	?
	New Building		?	?	?
	Subdivision		?	?	?
	Major Rezoning		?	?	?

Figure 1. Hazard Acceptability for Development

Source: Hazards Acceptability Thresholds for Development Approvals by Local Government; Dr. Peter Cave; 1993

- Ministry of Water Land and Air Protection guidance documents
- ➔ Flood Hazard Area Land Use Management Guidelines
<http://wlapwww.gov.bc.ca/wat/flood/>
- ➔ Guidance for the Selection of Qualified Professional and Preparation Of Flood Hazard Assessment Reports
<http://wlapwww.gov.bc.ca/wat/flood/>

Hazard Assessment Reports for Debris Flows :

- ➔ Probabilistic approach commonly used whereby magnitude and frequency estimates are provided with heavy reliance on relatively short term information (200 to 300 years at best) and professional opinion
- ➔ Hazard ratings are often based on the assumption that since an event has not occurred in the last 500 years then the site is safe. However, fans without evidence of recent debris flows may be more hazardous because contributing gullies and stream channels have not been 'flushed' for some time, perhaps because of fire suppression activities.
- ➔ Reports often state that hazard assessments provided are based on the current conditions and must be re-evaluated in the future if there are significant changes in watershed (such as fires or timber harvesting) And/or on the fan areas (development activity on the fan). [How are approval authorities supposed to deal With future uncertainty now and how do they respond to changes in the future when they occur?]
- ➔ Generally local governments and many consultants are not aware of important information (Watershed Assessment, Channel and Terrain Stability Reports) available from MoF and timber licensees .
- ➔ Some reports use a more deterministic (volumetric) approach which provide estimates of volumes of debris available in the watershed gully systems and through modeling or other means determine potential debris flow velocities and depths of deposition on the fan.

Some Factors to Consider From Sever Weather Events and Recent Wildfire Activity:

Climate Change Effects

- ➔ For much of BC projected climate change will result in an increase in debris flow hazard and make it increasingly more difficult to predict future behavior based on past events

Effects of Wildfire on Terrain Stability



1.) Potential to Produce Water Repellent Soils



Water Beading on a Water Repellent Soil

Effects of Wildfire on Terrain Stability: continued

2) Loss of upper organic soil layer - increase in sediment availability



Loss of Organic Soil –Increased Run-off

3) Decrease in canopy water interception

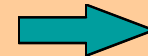


Canopy Loss

Effects 1,2 & 3 combine to produce increased overland flow, rill and sheet wash, increasing erosion and debris flow/debris flood initiation hazard.



Rill and Sheet Wash Erosion



Debris Flow Track



Kuskonook Creek Debris Flow



Damaged House: Kuskonook Creek Slide



Damaged House: Kuskonook Creek Slide



Damaged House: Kuskonook Creek Slide

Executive Summary

Purpose: The effects of wildfire on terrain and natural hazards may result in increased risk to human life, property and infrastructure (socio-economic). This Standard Operating Procedure (SOP) is to be followed by the Ministry of Forests (Districts, Region and Protection Branch) in determining whether a significant post-wildfire risk to the specified socio-economic resources or values exists, and whether other agencies, stakeholders or ministries require notification and / or assistance in managing the risk. Note that this is distinct and separate from the requirement for Protection Branch under Sections 6 and 9 of the *Wildfire Act* and Sections 16 and 17 of the *Wildfire Regulation* to rehabilitate damage related to fire suppression and control activities, although this process may provide input into the level of rehabilitation required. A flowchart illustrating the procedure is included below.

Overview Risk Analysis: The Overview Risk Analysis considers increased hazards (severe surface erosion, landslides, gully processes, flooding) associated with the natural effects of the fire. If the analysis determines the risk to the above-specified resources or values is low then the risk is assumed to be acceptable and no further work is required. Protection Branch proceeds with fulfilling its obligations for rehabilitation under the *Wildfire Act* and *Wildfire Regulation*. Guidance for carrying out an Overview Risk Analysis is to be provided by Ministry of Forests specialists.

Detailed Risk Analysis: Where the Overview Risk Analysis determines the risk to human life, property, infrastructure or any other previously identified socio-economic or environmental value is moderate or high then:

- A wildfire risk co-ordinator is appointed;
- Land jurisdiction is confirmed / determined;
- Stakeholders are identified / confirmed;
- A risk analysis individual / team is appointed;
- A Detailed Risk Analysis is completed.

The Detailed Risk Analysis is to be completed by Ministry of Forests' regional specialists and considers soil condition, burn severity, hydrology, slope stability, geomorphological processes, and the potential consequences should a hazardous event occur. If the Detailed Risk Analysis determines the risk to the identified resources or values is low, then results are communicated to Protection Branch for consideration, but no further work is required by the Ministry of Forests.

Where the Detailed Risk Analysis determines the risk to human life, property, infrastructure or other specified values is moderate or high then:

- The wildfire risk co-ordinator communicates the results of the risk analysis to stakeholders, PEP, local governments, provincial ministries, etc.
- Responsibility and lead agency is established.
- The affected stakeholder(s) can then proceed with risk evaluation and if considered necessary, risk control measures.

Risk Evaluation and Control: The lead agency / stakeholder will consider the risk analysis and determine if the assessed risk is acceptable or tolerable. If the risk is unacceptable then risk control (mitigation) measures will be considered. Additional or more refined risk analyses may be required. Possible funding sources for risk analyses and risk control measures include the Provincial Natural Hazards Mitigation Fund, administered by the Provincial Emergency Program, or Protection Branch's Incremental Rehabilitation Work Plan.

Monitoring and Research: Where directed by the lead agency or stakeholder, burned areas and risk control works will be monitored to determine the effectiveness of both the risk analysis and risk control measures. Regional specialists will advise lead agencies where research gaps exist and submit proposals to land managers for consideration.

Risk Reduction and Emergency Planning:

- ➔ Considering the effects of climate change and fires, “Should land use decisions and designs for mitigation works be based on the precautionary volumetric approach which assumes that if a debris flow has impacted the fan area in the past then it can do so again in the future?” The size of structures required to protect existing development and prescriptions to protect future development would then be based on estimated volumes of material available for transport to the fan.

- ➔ Once high hazard areas having an increase in debris flow hazard following wildfire events are identified the information should be shared with local and provincial emergency planning officials

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