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## The District of North Vancouver REPORT TO COUNCIL

November 10, 2009  
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Tracking Number: RCA -

**AUTHOR:** Fiona Dercole, Section Manager Public Safety

**SUBJECT:** Natural Hazards Risk Tolerance Criteria

**RECOMMENDATION:**

THAT Council endorse the following as District policy: That applicants for subdivisions, development approvals and building permits may be required to meet the following conditions:

1. demonstration that natural hazards risks are reduced to As Low as Reasonably Practicable (ALARP); and
2. in addition to ALARP, that:
  - A. the following risk tolerance criteria are satisfied (if a quantitative risk methodology is used):
    - i. maximum 1:10,000 risk of fatality per year for re-developments involving an increase to gross floor area on the property of less than or equal to 25%;
    - ii. maximum 1:100,000 risk of fatality per year for new developments and for re-developments involving an increase to gross floor area on the property of greater than 25%.

or
  - B. the following Factor-of-Safety (FOS) criteria are satisfied (if factor-of-safety and/or slope displacement methodology is used):
    - i. for re-developments involving an increase to gross floor area on the property of less than or equal to 25%:
      - a. under static conditions the slope stability FOS must be greater than 1.3; and

- b. under non-static conditions (e.g. for earthquake ground motions) the slope stability FOS must be greater than 1.0 or predicted ground displacement must be less than 0.15 m with a 1:475 annual chance of exceedance;
  - ii. for new developments and for re-developments involving an increase to gross floor area on the property of greater than 25%:
    - a. under static conditions the slope stability FOS must be greater than 1.5; and
    - b. under non-static conditions (e.g. for earthquake ground motions) the slope stability FOS must be greater than 1.0 or predicted ground displacement must be less than 0.15 m with a 1:2,475 annual chance of exceedance;
3. the assessment methodology should be determined by a Qualified Professional in accordance with the Guidelines for Legislated Landslide Assessment for Proposed Residential Developments in BC published by the Association of Professional Engineers and Geoscientists of BC and dated March 2006, Revised May 2008.

**REASON FOR REPORT:**

The purpose of a District policy on risk tolerance criteria is to set the maximum levels of tolerable risks to life for both existing and new developments within our community. On April 14, 2008, Council instructed staff to develop a plan to apply natural hazard risk tolerance criteria within a clearly understood public policy framework and Natural Hazard Management Plan; using the criteria of 1:10,000 risk of fatality per year for existing developments and 1:100,000 risk of fatality per year for new developments (attachment 1).

**SUMMARY:**

The proposed risk tolerance criteria is based on research, public input, dialogue with subject-matter experts, learning from experiences of other jurisdictions with similar legal frameworks and natural hazard situations, and the District's own experience applying interim risk tolerance criteria. The criteria are expressed both quantitatively and as the minimum factor-of-safety of a slope. Hazard and risk can be assessed using a variety of methodologies; the method of assessment is determined by the Qualified Professional and the decision is based on which approach is most appropriate for the site conditions. In addition to meeting the risk tolerance criteria, risks should be further reduced to as low as reasonably practicable (ALARP), meaning that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained.

**BACKGROUND:**

Risk tolerance criteria have been utilized by the District, on an interim basis, to manage landslide risk since early 2005. In February 2007, Council held a workshop to review the natural hazards management program and approved a plan which included, "establish a process to adopt risk tolerance criteria". The Natural Hazards Task Force was assembled in October 2007 "to provide a forum to gather input from an informed, broad-based community perspective regarding quantitative tolerable risk or risk acceptance criteria for landslides and other natural hazards". The task force presented their recommendations to District Council in April, 2008. Council instructed staff to develop a plan to apply natural hazard risk tolerance

criteria within a clearly understood public policy framework and Natural Hazard Management Plan; using the risk tolerance criteria proposed by the task force.

**EXISTING POLICY:**

Currently there are no District policies specifically regarding risk tolerance for natural hazards. Related policies include:

- Development guidelines for subdivision and building plan approval on sloping terrain #8-3320-3.
- Section 56, Community Charter, authorizes the Chief Building Official (CBO) to require a hazard report from a suitable Qualified Professional where the CBO considers the land is subject to a particular hazard
- Hazard trees are managed according to Tree Work Policy #13-5280-1
- BC Building Code sets criteria for building design requirements for seismic hazards.

**ANALYSIS:**Risk Tolerance

Differences exist between tolerable risks and acceptable risks. Tolerable risks can be tolerated in order to realize some benefit, are not negligible, and should be kept under review and reduced further if possible. Acceptable risks are considered broadly acceptable to the public and efforts to further reduce risks are not warranted. The ALARP principle applies to risks within the tolerable range. Under the common-law system, risk reduction should be achieved if reasonable opportunities exist. For a risk to be ALARP it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained.

The Association of Professional Engineers and Geoscientists of BC (APEGBC) *Guidelines for Legislated Landslide Assessments for Proposed Residential Developments in British Columbia (2008, p.4)* state that “It is **not** the role of a Professional Engineer or Professional Geoscientist to define levels of safety; they must be established and adopted by the *local government* or provincial government after considering a range of social values.”

The District follows the Canadian Standards Association CAN/CSA Q850-97 Risk Management: Guidelines for Decision-makers. The Risk Evaluation phase of the CSA Guidelines steer the decision-maker to “compare estimated risk against stakeholder acceptance criteria”. In the absence of a formal policy on risk tolerance criteria, the District has been utilizing risk tolerance criteria developed by other jurisdictions such as Hong Kong, Australia and the United Kingdom. These criteria and risk management frameworks are similar to the District’s proposed risk tolerance criteria.

Risk tolerance is rooted in community values and risk perception. The District’s Natural Hazards Task Force was initiated in 2007 to engage the community regarding natural hazards and risk tolerance. Risk communication is a critical component of the risk management process; it is essential that the District continues dialogue about risk tolerance and risk reduction with stakeholders – including the public, property owners, scientific

community, developers and educators. While the District now has four years of experience in applying risk tolerance criteria (on an interim basis), it is expected that risk tolerance criteria will need to be reviewed from time to time to reflect changes in community planning best practices, advances in engineering and technology, socioeconomics, and community perceptions of risk.

### Hazard and Risk Assessment

Areas of potential landslide hazard can be assessed using a risk-based approach or by means of a factor-of-safety approach. The APEGBC Guidelines (2008, p. 22) state that “the decision whether to carry out and report the results of a *landslide analysis* quantitatively or qualitatively also depends on how the adopted *level of landslide safety* is expressed, and/or the requirements of the *Approving Authority*.”

A qualitative hazard assessment or partial risk analysis should be performed by a Qualified Professional as an initial step in estimating whether a landslide hazard may be present for areas identified on the slope hazard map. If these preliminary analyses demonstrate that risks to life are likely broadly acceptable, then further risk assessment may not be required. Where a qualitative hazard assessment and/or partial risk analysis demonstrates that risks to life are likely tolerable or possibly unacceptable, the District requires that a more detailed risk assessment be performed. Where a detailed landslide risk assessment is required by the District, the Qualified Professional shall determine which approach is most appropriate for the local site conditions, based on the nature of the potential landslide hazard and its location relative to the area of existing development, re-development, or proposed new development. It is recognized that landslide hazard and risk assessment is not an exact science and that some factors in the risk estimation process are subjective by nature.

### Risk Management

Existing and ongoing quantitative risk analyses study risk to loss of life from landslide and debris flow hazards in the District. Other hazards, such as wildfire and flooding, tend to occur in such a manner and timeframe that those at risk may be able to evacuate as a risk-reduction measure. Therefore, the resulting risk life may be estimated to be relatively low. Placing a higher value on life safety is consistent with the British Columbia Emergency Response Management System (BCERMS) goals. However, risks to the environment, critical infrastructure and public health from these hazards may be higher when compared to landslide or debris flow risks. These factors should be considered as part of a broader decision-making framework and will also be addressed through the Hazard Development Permit Areas that are currently being developed with the District Planning department.

Risk tolerance criteria should not supersede industry best practices and should be considered an addition to existing requirements for issuing building and development permits. Likely the most practical method to implement a policy on risk tolerance criteria is through the District's Official Community Plan via Development Permit Area guidelines. Risk tolerance criteria can also be applied during the building permit and sub-division application process by using up-to-date hazard maps to identify landslide and debris flow hazard areas and steer qualified professionals towards the APEGBC guidelines. The Qualified

Professional should present risk reduction options along with the associated approximate costs and benefits of each mitigation option, demonstrating the ALARP principle. Society is generally less accepting of risks today as in the past. The proposed risk tolerance criteria takes this into consideration by proposing two-tiered criteria, with more stringent criteria for new development. Figure 1 below illustrates the application of the proposed policy on risk tolerance criteria.

Figure 1:

Type of Application	1:10,000 + ALARP	1:100,000	FOS>1.3 (static)	FOS>1.5 (static)
Building Permit (<25% increase to gross floor area)	X		X	
Building Permit (>25% increase to gross floor area and/or retaining walls >1.2m)		X		X
Re-zoning		X		X
Sub-division		X		X
New Development		X		X

**Concurrence:**

Planning, Permits and Bylaws and the North Shore Emergency Management Office concur with the recommendations in this report. The Municipal Solicitor has reviewed this report and provided comments in the Liability/Risk section, below.

**Financial Impacts:**

The proposed risk tolerance criteria are already being used on an interim basis; no additional financial impacts are expected if risk tolerance criteria are formally adopted. There may be financial impacts for developers/property owners in terms of retaining geotechnical engineering consultants to conduct detailed risk assessments for properties where landslide or debris hazards have the potential to result in loss of life, but these impacts already exist as part of the District's requirements for development and building permit applications. The proposed policy only further clarifies the requirements.

**Liability/Risk:**

The setting of risk tolerance criteria at the Council policy level as recommended in this Report (rather than on an ad hoc basis by staff at the operational level) will assist in reducing liability exposure because bona fide policy decisions are generally protected from liability exposure whereas operational decisions are not. The criteria will also assist in the making of good, clear, consistent and defensible policies in the future relating to natural hazard risks, and, again, such policies can reduce liability exposure.

**Public Input:**

The District's Natural Hazards Task Force facilitated two public sessions - an open house and a public meeting - to obtain input from the broader community regarding the recommended risk tolerance criteria. An electronic survey was also administered on the

District website. The results of their findings and recommendations are documented in the April 2008 report to Council (attachment 2).

**Conclusion:**

Endorsement of the proposed risk tolerance criteria will set clear requirements for applicants for subdivisions, development approvals and building permits in terms of landslide and debris flow risk management. The criteria should be applied in addition to already existing requirements.

It is anticipated that as the District’s experience applying risk tolerance criteria continues to develop, the criteria will need to be revisited and perhaps adjusted to meet the future needs of our community. Ongoing discussion with stakeholders is paramount, as risk tolerance criteria is determined more by social values than by technical advances.

Fiona Dercole  
Section Manager, Public Safety

**Attachments:**

- 1. Natural Hazards Task Force – Risk Tolerance Criteria. Report to Council, April 3, 2008.
- 1. Recommendations on Risk Tolerance Criteria for the District of North Vancouver. April 2008.

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<input type="checkbox"/> Development Services	<input type="checkbox"/> Corporate Services	<input type="checkbox"/> Library Board	<input type="checkbox"/> _____
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<input type="checkbox"/> Economic Development	<input type="checkbox"/> Human resources	<input type="checkbox"/> Other: _____	
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