

13. Prevention and Mitigation Measures

In order for an event to be termed an emergency or disaster, there must first be a substantial negative effect on human lives and property. Then, a significant application of resources is required to respond and recover from the situation. Disaster prevention is achieved when such an event can be stopped before it occurs. Disasters can also be prevented when humans make decisions to avoid development or activities in places that are susceptible to landslide events. Mitigation includes prevention, but also includes those actions that reduce risks and hazards to people, property and activities when negative effects cannot be fully eliminated.

Prevention and mitigation are the most cost effective of all emergency management activities. Mitigation alone saves six dollars in response and recovery costs for every mitigation dollar invested (National Institute of Building Sciences, 2017).

Susceptibility Assessment

Landslide hazards are not evenly spread across Hennepin County. Hennepin County Emergency Management led a susceptibility assessment to identify specific areas where natural factors come together to produce a landslide threat. Important elements of the susceptibility assessment include:

- evidence of past landslide activity, both historically dated and undated
- natural risk factors include geology, soils and slope
- groundwater, springs and surface water features
- vegetation.

Landslide-triggering factors, such as precipitation, have also been assessed based on data from previous landslide events. The product of a susceptibility assessment is a geographic information system (GIS)-based depiction of areas of Hennepin County that have a higher susceptibility to landslide events. The Hennepin County Landslide Hazard Atlas is a countywide landslide susceptibility and vulnerability assessment.

Hazard Assessment

Hazard assessments build from the susceptibility assessment process by adding human factors, such as critical infrastructure, economic assets and sites of human settlement or other activity. The product of a hazard assessment is a GIS-based depiction of areas of Hennepin County that have human impacts or consequences from landslides. The Hennepin County Landslide Hazard Atlas offers a generalized countywide landslide hazard assessment. The atlas is not intended to be the final determinant of hazards at individual sites. Using this atlas, cities, landowners and others interested in landslide hazards in Hennepin County should identify susceptible areas and then assess their property to determine the need for a site-specific geotechnical study to fit their needs.

Land Use Policies and Ordinances

Prior to this atlas, local planners and government officials in Hennepin County did not have a comprehensive landslide hazard assessment that would enable the issue to be considered in policy-making. Development of effective procedures and regulations can guide safer development and human activity in areas determined to be highly susceptible to landslides. In some cases, landslide-specific land-use regulations may also have an environmental benefit, especially where landslides and mudflows deliver sediment to lakes and rivers. The information and maps contained in the Hennepin County Landslide Hazard Atlas shall be considered advisory and shall not require the development of any new policy by, or impose any new policy on, any government or private entity. This atlas is advisory in nature and provides information to help determine if policies and ordinances should be considered. Hennepin County Emergency Management encourages the use of land use ordinances as an effective disaster mitigation tool. Specific regulatory actions for consideration may be grouped into avoidance measures, protective measures and transfer of liability (Cave, 1993).

Avoidance Measures

- Requirements for geotechnical assessments for existing or planned developments
- Development of a moratorium or restrictions
- Open-space requirements adjacent to susceptible slopes
- Requirement for slope stability monitoring devices with warning and evacuation programs
- Review of permits for building and repair or expansion to evaluate if the site itself is hazardous

Protective Measures

- Vegetation requirements for susceptible slopes
- Storm water management and impervious surface restrictions
- Landslide hazard building codes for foundation, grading and drainage requirements

- Minimum structure or impervious surface setbacks based on assessments
- Dewatering wells to reduce porewater pressure
- Engineering of all slopes

Transfer of Liability, or waiver of the right to sue regulatory authority in the case of damage or death, are typical agreements between the landowner and government, and as such do not protect innocent third parties that might be harmed. They include:

- real estate landslide disclosure requirement
- landslide maintenance easements and deed restrictions
- adoption of landslide hazard mapping or independent delineation of landslide hazard areas requiring geologic/geotechnical investigation.

Minnesota Statute 513.55 General Disclosure Requirements, requires sellers to make potential buyers aware of “all material facts of which the seller is aware that could adversely and significantly affect an ordinary buyer’s use and enjoyment of the property, or any intended use of the property of which the seller is aware.” The disclosure should be made based on the “best of the seller’s knowledge at the time.” There are many important limits and exceptions to the requirement to disclose described in **Minnesota Statute 513.54 Exceptions**. Due to these limits and exceptions, and because of limited landslide awareness among those who must disclose, buyers involved in real estate transactions should not depend on disclosure as a reliable means to discover landslide risk for a particular property.

Specifying areas where a geotechnical investigation is required as a part of the normal permitting process puts the onus on the developer or landowner to contact a professional geoscientist or engineer to review the hazard and develop recommendations for both new construction and remodeling permits. Two tables from the Fraser Valley, British Columbia, Canada relate the probability of hazard occurrence to the type of development action and the kind of response required for approval.

Hazard-Related Responses to Development Approval Applications

1. Approval without conditions relating to hazards.
2. Not approvable. 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.

Alternatively, all development could be required to have a geohazards report regardless of location. This would take the onus off the city or watershed to delineate specific areas for assessment, but would instead pass costs on to the developer or homeowner.

An example of the language used in the Development Permit Area from the District of Mission on the Fraser River, Canada, from their 2017 Draft Plan (www.mission.ca/wp-content/uploads/2017-08-14-Draft-Official-Community-Plan-Bylaw.pdf) is provided on page 52 (Figure 13.1).

Prevention and Protection in the Absence of Ordinances

In cases where development encroaches on the upper or lower landslide-risk slopes, protection measures may include measures approved by geotechnical engineers that may include:

- vegetation placement and management
- designed drainage improvements (drain pipes, ditches, berms and catchment basins)
- dewatering or installation of impermeable membranes on existing slide areas to prevent oversaturation
- debris removal
- grading to lessen slope
- construction of rock buttress.

Human Trigger Avoidance

In the short-term, environmental conditions such as overly wet seasons and excessive rainfall episodes can quickly increase the chances of a landslide. Avoiding actions that can help trigger landslides is crucial during these periods of increased susceptibility.

- a. Avoid placing added weight on the top of slopes (vehicles, dirt, trees or yard debris, etc.).
- b. Do not excavate or cut into any part of the slope, especially the bottom or base.
- c. Do not irrigate, or allow water to collect or infiltrate on or near the slope.
- d. Do not locate swimming pools at the top of a slope.
- e. Ensure that water and sewer lines do not leak.

Education and Outreach

Landslide-prone cities and watersheds can make the hazard and risk easier for homeowners, planners, regulators, professionals and governing bodies to understand if they make planning resources available, particularly online.

More proactive education may be required for properties that present an immediate risk to the general public. Hennepin County Emergency Management has contacted managers of parks and public spaces identified in this assessment.

Many of the vulnerable slopes in Hennepin County have public trails or parks along their base or bluff top. Signage within these parks could illustrate the hazard for users of these facilities. These signs should be placed far enough away from the hazard to adequately warn readers before their possible unwitting entry into a hazard zone.

Reporting

Timely reporting landslides is a key part of building the local capability to understand when and how landslides occur as well as to better predict them. The slide location can be easily recorded with a cell phone, along with date and time. Photos and any information should be reported according to procedures described in the Landslide Reporting chapter of this atlas.

Figure 13.1 — Acceptability of Risk in the Fraser Valley

Geotechnical Hazards Development Permit Area

Area of Applicability

The Geotechnical Hazards Development Permit Area is applicable to the area identified on Map 16 and shall also apply to properties with slopes greater than 30%.

Exemptions

Certain types of development are exempt from submitting this Development Permit.

A development permit may not be required for construction of, addition to, or alteration of, a building or structure where the potential risk of any geotechnical hazard which may affect the site as determined by a professional engineer, with experience or training in geohazard assessments state in a site-specific report that the land is safe for the use intended and is consistent with Acceptability Thresholds for the type of construction, addition, or alteration, does not affect, or relate to, matters of health, safety or the protection of property from damage.

As this Development Permit Area is established to protect areas from the hazardous conditions, any requirement for a site-specific geotechnical report must be prepared by an engineer with experience or education in geotechnical study and geohazard assessments.

Justification

Development may occur on lands within the city where there is a potential risk of hazards such as landslides, erosion, debris flows, which can represent a danger to people and property. Steep slopes are often associated with instability; however factors such as geologic material, soils, moisture content and vegetation cover can also contribute to hazards.

Intent

The intent of this Development Permit Area is to protect residents, structures and property from the potential risk of natural hazards caused by new development.

Objectives

- To ensure adequate assessment and mitigation of hazards from steep slopes and other land that is unsuitable for development.
- To direct development away from land subject to potential hazards.
- To allow for suitable land use under potentially hazardous conditions in accordance with engineering studies.

- To minimize the impacts of development and land alteration on the natural environment, ecosystems, and biodiversity.

Guidelines

A geotechnical assessment report prepared by a professional engineer with experience in geotechnical engineering is required for parcels in this DPA to determine any risks from natural hazards due to geotechnical concerns. The DPA map identifies slopes of 30% or more; however, this DPA is not limited to those areas, and also includes areas affected by steep slopes, signs of instability, watercourse or alluvial fan hazards, or any other potential hazards identified by a professional engineer, the approving officer or building inspector. The study needs to:

- meet the levels deemed acceptable in the Hazard Acceptability Thresholds for Development Permit Approvals by Local Governments
- address the requirements in the Assistance to Developers and Building Permit Applicants Undertaking Geotechnical Studies handout
- include a completed “Appendix D” from the Guidelines for Legislated Landslide Assessments for Proposed Residential Development.

Do not develop in areas with a potential for natural hazards unless:

- a professional engineer provides recommendations for mitigation measures to reduce risk of natural hazards for both the subject site and any adjacent and/or other potentially affected areas to an acceptable level during all stages of development
- conditions related to the permitted uses, density or scale of building necessary to reduce the risk of potential natural hazards to acceptable levels.

Clustering lots away from the hazard area may be approved and the minimum size of parcels of land that may be created by subdivision may be varied by development permit to facilitate the optimum and safe use of the land, provided that the average parcel size of the clustered lots shall not be less than the minimum parcel size specified in the zoning bylaw, and provided that each lot is suitable for its intended use.