

GUIDELINE FOR LANDSLIDE SUSCEPTIBILITY, HAZARD AND RISK ZONING

progressed in 2005 and 2006 and has involved extensive consultation with those involved in landslide mapping for land use planning and the application of such mapping for planning in local government.

This Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning provides:

- Definitions and terminology.
- Description of the types and levels of landslide zoning.
- Guidance on where landslide zoning and land use planning is necessary to account for landslides.
- Definitions of levels of zoning and suggested scales for zoning maps taking into account the needs and objectives of land-use planners and regulators and the purpose of the zoning.
- Guidance on the information required for different levels of zoning taking account the types of landslides.
- Guidance on the reliability, validity and limitations of the investigation methods.
- Advice on the required qualifications of the persons carrying out landslide zoning and advice on the preparation of a brief for consultants to conduct landslide zoning for land use planning.

The guideline considers landslides occurring in natural slopes and from failure of constructed slopes including cuts, fills and retaining walls and the impact of the landslides on the area to be zoned. It is intended for use by local, state and national government officials, geotechnical professionals, land use planners and project managers.

This guideline has been developed at the same time as similar guidelines prepared by the JTC-1 *The Joint International Committee on Landslides and Engineered Slopes* and there has been an interchange of concepts and detailed inputs between the two guidelines.

Through the NDMP, Australian governments (at Commonwealth, State and Local Government levels) are also funding the development of a Practice Note Guideline (AGS 2007c) to supersede the Landslide Risk Management Guideline (AGS 2000, AGS 2002), and a series of GeoGuides on Slope Management and Maintenance (AGS 2007e).

2 DEFINITIONS AND TERMINOLOGY

2.1 DEFINITIONS

Definitions for terms used in landslide zoning and risk management are given in Appendix A. These definitions are based on IUGS (1997), with some amendments in matters of detail based on internationally adopted definitions prepared by The International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE) Technical Committee 32. These definitions should be used for all zoning, reports and land use planning documents. It is recommended that the definitions are attached to these documents so there is no misunderstanding of the terms.

Definitions of the main terms are:

- **Landslide.** The movement of a mass of rock, debris, or earth (soil) down a slope.
- **Landslide Inventory.** An inventory of the location, classification, volume, activity and date of occurrence of individual landslides in an area.
- **Landslide Susceptibility.** A quantitative or qualitative assessment of the classification, volume (or area) and spatial distribution of landslides which exist or potentially may occur in an area. Susceptibility may also include a description of the velocity and intensity of the existing or potential landsliding.
- **Hazard.** A condition with the potential for causing an undesirable consequence. The description of landslide hazard should include the location, volume (or area), classification and velocity of the potential landslides and any resultant detached material and the probability of their occurrence within a given period of time. Landslide hazard includes landslides which have their source in the area or may have their source outside the area but may travel on to or regress into the area.
- **Risk.** A measure of the probability and severity of an adverse effect to health, property or the environment. Risk is often estimated by the product of probability and consequences. However, a more general interpretation of risk involves a comparison of the probability and consequences in a non-product form. For these guidelines risk is further defined as:
 - (a) *For life loss*, the annual probability that the person most at risk will lose his or her life taking account of the landslide hazard and the temporal spatial probability and vulnerability of the person.
 - (b) *For property loss*, the annual probability of the consequence or the annualised loss taking account of the elements at risk, their temporal spatial probability and vulnerability.
- **Elements at Risk.** The population, buildings and engineering works, economic activities, public services utilities, infrastructure and environmental features in the area potentially affected by the landslide hazard.

GUIDELINE FOR LANDSLIDE SUSCEPTIBILITY, HAZARD AND RISK ZONING

- **Vulnerability.** The degree of loss to a given element or set of elements within the area affected by the landslide hazard. It is expressed on a scale of 0 (no loss) to 1 (total loss). For property, the loss will be the value of the damage relative to the value of the property; for persons, it will be the probability that a particular life (the element at risk) will be lost, given the person(s) is (are) affected by the landslide.
- **Zoning.** The division of land into homogeneous areas or domains and their ranking according to degrees of actual or potential landslide susceptibility, hazard or risk.

In this guideline use of the word 'landslide' implies both existing (or known landslides) and potential landslides which a practitioner might reasonably predict based on the relevant geology, geometry and slope forming processes. Such potential landslides may be of varying likelihood of occurrence.

The term landslip is sometimes used to describe landslides but is not the recommended term.

It is noted that the term "zoning" has particular application by planners in Australia. This document uses the term as it best describes the process and is used internationally. To avoid confusion, those preparing landslide zoning using this document should always refer to "landslide susceptibility zoning", "landslide hazard zoning" and "landslide risk zoning".

2.2 LANDSLIDE CLASSIFICATION AND TERMINOLOGY

It is important that those carrying out landslide mapping use consistent terminology to classify and describe the landslides. It is recommended that the classifications of Cruden and Varnes (1996), Varnes (1978) or Hutchinson (1988) and terminology described in IAEG (1990) be used. These are reproduced in AGS (2007c).

3 LANDSLIDE RISK MANAGEMENT FRAMEWORK

Since the publication of AGS (2000), many local government authorities have required a quantitative risk assessment approach for assessment of life loss risk for individual building developments. They have generally accepted qualitative or semi-quantitative assessment of property risk. These assessments are carried out using the risk based framework described in AGS (2000) and AGS (2002).

Figure 1 summarizes the framework for landslide risk management. This is taken from Fell *et al.* (2005) and represents a framework widely used internationally. It was the basis for the State of the Art papers and invited papers at the International Conference on Landslide Risk Management held on Vancouver in May 2005 and is consistent with AGS (2000), AGS (2002) and AGS (2007c).

It is recommended that this general framework be used for landslide susceptibility, hazard and risk zoning whether a quantitative or qualitative approach is being taken.