(g) River valleys in which dams are to be constructed, including the slopes adjoining the reservoir and river valleys upstream where there is potential for blockage of rivers by landslides and breach of the landslide dam with subsequent outburst floods, and/or the creation of large waves which may overtop the dam if a large rapidly moving landslide travels into the reservoir.

It should be recognized that if the land under consideration for land use planning falls into any of the categories in Section 5.2, there will be potential land management benefits in carrying out landslide zoning.

The categories listed are not meant to be a complete list. Nether is it meant that if one or more of these categories are present that landslide zoning is essential. Those involved should assess whether zoning is necessary taking account of the factors detailed above, the development proposed and the applicable regulatory requirements.

6 SELECTION OF THE TYPE AND LEVEL OF LANDSLIDE ZONING

6.1 SOME GENERAL PRINCIPLES

Landslide zoning is carried out for regional, local and site specific planning. The outputs are usually in the form of one or more of the following: landslide inventory, susceptibility, hazard and risk zoning maps and associated reports.

The type and level of detail of the zoning and the scale of the maps depends on the purpose to which the landslide zoning is to be applied and a number of other factors:

- *The stage of development of the land use zoning plan or engineering project.* Susceptibility and hazard zoning are more likely to be used in preliminary stages of development with hazard and risk zoning for more detailed stages. However the choice depends mostly on the intended purpose of the zoning in land use management.
- *The type of development*. Risk zoning is more likely to be used for existing urban developments where the elements at risk are defined or for existing and planned road and railway developments where the elements at risk (the road or rail users) are readily predicted. However, the elements at risk often vary with time so risk zoning needs to be up-dated regularly.
- *The classification, activity, volume or intensity of landsliding*. Risk zoning is more likely to be required where the landslides are likely to travel rapidly and or have a high intensity as measured by the combination of volume and velocity (e.g. rock fall, debris flows, rock avalanches). For these situations life loss is more likely so it is useful to use risk zoning as this allows land use zoning to be determined using life loss risk criteria.
- *Funds available.* While the purpose should determine the level of zoning and the scale of the maps, the funding available may be a practical constraint. Landslide susceptibility zoning is lower cost than hazard zoning, and hazard zoning is somewhat lower cost than risk zoning, so land use planners may opt for a lesser type and level of mapping at least in a staged introduction of landslide land use planning.
- *The amount and quality of available information.* Only susceptibility zoning is performed where data on frequency of landslides either do not exist or are so uncertain as to not be relied on.
- *History of land use.* The history of the area being zoned and its evolution in terms of land use must be carefully taken into account as human activities may modify the slope instability environment and modify the susceptibility to and likelihood of landsliding and hence the hazard.
- *Degree of quantification.* Qualitative methods are often used for susceptibility zoning and sometimes for hazard zoning. It is better to use quantitative methods for both susceptibility and hazard zoning. Risk zoning should be quantified. More effort is required to quantify the hazard and risk but there is not necessarily a great increase in cost compared to qualitative zoning.
- *The required accuracy of the zoning boundaries*. Where statutory land use planning constraints are proposed large scale maps with appropriate levels of inputs should be used. In this regard it should be noted that State and Local governments may have different requirements. The largest scale required will determine the level and scale of landslide zoning.
- *Linkage to the proposed planning controls*. The use of complementary or linking processes such as planning schedules and development control plans whereby the landslide zoning initiates a more detailed assessment at site scale. In this case, the use of landslide susceptibility mapping which defines a planning control area may be sufficient to identify where a more detailed landslide risk assessment is needed.