

## EXECUTIVE SUMMARY

The overall risk of natural terrain landslides in Hong Kong, as at 2004, has been assessed by the Geotechnical Engineering Office (GEO) using state-of-the-art quantitative risk assessment (QRA) methodology and Geographic Information System (GIS) techniques. The findings provide useful information for examining the nature and scale of natural terrain landslide problems in Hong Kong and formulating risk management strategy.

The work that has been carried out includes:

- (a) Review of natural terrain landslide risk in Hong Kong;
- (b) Compilation of an inventory of catchments where historical natural terrain landslides have occurred close to existing developments (denoted as Historical NTLI Catchments), where NTLI stands for Natural Terrain Landslide Inventory;
- (c) Compilation of an inventory of catchments that are bordering development areas but have not been recorded as Historical NTLI Catchments (denoted as Inventory of Supplementary Catchments). The Inventory covers Supplementary Catchments in five selected regions and six selected areas;
- (d) Formulation of QRA models;
- (e) Quantification of the overall risk to life of natural terrain landslides to the community, expressed in terms of the annual potential loss of life (PLL); and
- (f) Diagnosis of the risk distribution and characteristics.

The key results are:

- (a) A GIS Inventory of 453 Historical NTLI Catchments has been compiled, which comprises 291 catchments affecting existing building structures, 56 catchments affecting dilapidated or demolished structures, and 75 catchments affecting sensitive routes and mass transportation facilities.
- (b) The best estimated risk to life of natural terrain landslides arising from the catchments is 1.4 PLL per year. The 56 catchments that affect dilapidated or demolished structures were taken as of negligible risk (PLL = 0) in the QRA, i.e. assuming that the structures would neither be re-occupied nor re-built. Another 10 catchments were found to have negligible risk (PLL = 0) by the QRA.
- (c) The average risk-per-catchment for the 387 risk-bearing

Historical NTLI Catchments is about  $3.6 \times 10^{-3}$  PLL per year. This is comparable to that of the catchments found to have required follow-up actions in recent years based on the 'react-to-known-hazard' principle. Landslide risk is unevenly distributed among the catchments, and it is likely that a large number (e.g. the top-ranking catchments in terms of the calculated risk) of the Historical NTLI Catchments would require risk mitigation, based on experience from the 'react-to-known-hazard' cases and alignment with the risk mitigation strategy adopted for dealing with Potentially Hazardous Installations in Hong Kong.

- (d) Projection of risk from the Historical NTLI Catchments based on assessment of the Supplementary Catchments indicates that the Historical NTLI Catchments constitute about 25% to 50% of the overall risk of natural terrain landslides on existing developments in Hong Kong. The balance of 50% to 75% of the overall risk comes from Supplementary Catchments, i.e. other vulnerable catchments affecting existing developments but not included in the Inventory of Historical NTLI Catchments.
- (e) The best-estimated overall risk of natural terrain landslides on existing developments in Hong Kong is 5 PLL per year. This calculated risk to life is of comparable order as that of registered man-made slopes by the year 2010.
- (f) Sensitivity analyses of the optimistic and pessimistic scenarios show that the overall calculated risk of natural terrain landslides may range from 1 to 10 PLL per year. The range of calculated risk reflects uncertainties in the assessment. The range is within an order of magnitude, and is considered among the best that can be practically achieved by state-of-the-art QRA.
- (g) The number of Historical NTLI Catchments would increase with time, as new natural terrain landslides occur. The average growth rate would be in the order of 10 nos. per year.
- (h) The risk of natural terrain landslides in Hong Kong will continue to increase as developments take place close to steep hillside.
- (i) Identification of the other vulnerable catchments, particularly those with few historical landslide records, is a technically difficult task. Some areas requiring further work have been identified.

- (j) The global QRA covers only risk to life as expressed in PLL. Other consequences of natural terrain landslides, such as economic loss, disruption to the community and the public aversion to multiple fatalities are not reflected in the calculated risk figures. Professional evaluation based on qualitative assessment of the available landslide data, landslide characteristics, rainfall-landslide correlation, etc, indicate that consequences other than risk to life are also of concern in natural terrain landslides.
  
- (k) Hillside failures within and in the vicinity of the Year 2000 Development Lines, which are not included in this global QRA, deserve attention. Further work to assess the potential scale of the problem is being undertaken by the GEO.