

LEGISLATIVE COUNCIL BRIEF

Post-2010 Landslip Prevention and Mitigation Programme

INTRODUCTION

At the meeting of the Executive Council on 13 November 2007, the Council took note of the information below.

2. By 2010, with the completion of the current phase of the Landslip Preventive Measures Programme (LPMP), all the high-risk man-made slopes affecting major roads and developments will have been dealt with, thereby substantially reducing the overall landslide risk¹. As there are still landslide risks associated with the remaining man-made slopes and natural hillside catchments, there is a need to continue our efforts to deal with the risks which will otherwise pose a hazard to the community.

3. The Civil Engineering and Development Department (CEDD) will launch a Landslip Prevention and Mitigation Programme (LPMitP) to dovetail with the LPMP which is due for completion in 2010 in order to deal with the remaining landslide risks. The LPMitP will be implemented on a rolling and risk management basis, and the annual output is to:

- (a) upgrade 150 government man-made slopes;
- (b) conduct safety-screening studies for 100 private man-made slopes; and
- (c) implement risk mitigation works for 30 natural hillside catchments.

JUSTIFICATIONS

4 The LPMP was introduced in 1977 to deal with substandard man-made slopes affecting existing developments. When the current phase

¹ Landslide risk is a measure of the probability of slope failure and the potential damage of such a failure (e.g. loss of life or socio-economical impact associated with road blockages, evacuation, etc. due to landslides).

of the LPMP is completed in 2010, a total of about 7 000 man-made slopes will have been upgraded under the LPMP. The cumulative expenditure up to 2010 is about \$13 billion with an average annual expenditure of \$900 million from 2000 to 2010. By 2010, the overall landslide risk from man-made slopes will be substantially reduced to less than 25% of that existed in 1977, reaching a reasonably low level² that is commensurate with the international best practice in risk management. Further details about the contribution of the LPMP to slope safety in Hong Kong are set out in paragraphs 19 to 22 below.

5. Upon completion of the LPMP in 2010, there are still remaining landslide risks that pose a hazard to the community. The majority of the remaining landslide risk comes from two main groups of slopes, apart from slopes affecting squatters³:

- (a) about 15 000 man-made slopes with moderate risk (including 10 000 slopes affecting frequently used roads, footpaths, public waiting areas, etc. and 5 000 slopes formed or treated over 20 years ago with less robust technology, i.e. 'old technology' slopes); and
- (b) about 2 700 natural hillside catchments with known hazards and close to existing buildings and important transport corridors.

6. If investment in slope safety is not maintained, landslide risk will progressively increase with time due to slope degradation and encroachment of more urban development or redevelopment on steep hillsides. This will cause, in addition to risk to life, significant economic losses and social disruption as a result of road blockages and building evacuation due to landslides, thereby compromising public safety, sustainable development and Hong Kong's reputation as a modern metropolitan city and tourist hub. Therefore, the LPMitP will be implemented to deal with the remaining man-made slopes and natural hillside catchments.

(A) Man-made Slopes

7. In view of the large number of remaining substandard man-made slopes, it is neither practical nor cost effective to deal with all these slopes within a short period of time. In a value-for-money audit on 'Slope Safety

² This is denoted as 'As Low As Reasonably Practicable' (ALARP) level, according to risk management terminology. Quantitative risk assessment methodology has been used in management of landslide risk in Hong Kong. The risk standards adopted are similar to those for managing the risk of Potentially Hazardous Installations (PHI). The principle of controlling landslide risk within the ALARP level is to attain a high level of slope safety that is practically achievable and at par with that required for PHI.

³ There are about 3 000 man-made slopes affecting squatters. The current approach to manage the landslide risk to squatters is to rely on clearance, which includes compulsory clearance when immediate and obvious danger affecting squatters is identified, public education, erecting warning signs in vulnerable squatter areas and issue of Landslip Warning.

and Landslip Preventive Measures' completed in 2002, the Director of Audit recommended the formulation of a long-term plan for total retrofitting of the remaining substandard man-made slopes. Following a review, the then Secretary for the Environment, Transport and Works reported in 2005 to the Director of Audit that adopting a 'total retrofit' approach was not appropriate. In the post-2010 LPMitP, a more pragmatic and cost effective approach will be adopted to identify and rectify those potentially problematic man-made slopes of moderate risk.

8. In this regard, the annual output of upgrading 150 government man-made slopes under the LPMitP aims at dealing with, on an annual rolling basis, the worst 1% of the remaining slopes, e.g. those at a more advanced state of degradation with signs of distress or past instabilities. We will also select 100 private man-made slopes for safety-screening each year to establish prima facie evidence for service of Dangerous Hillside Orders under the Buildings Ordinance to require the private owners to upgrade their slopes. From an outcome perspective, this risk management approach is the most cost effective means to contain the landslide risk to an 'as low as reasonably practicable' level.

9. 'Old technology' man-made slopes, which were formed or treated from 1977 to the late 1980s based on knowledge and technology at the time, typically comprise slopes trimmed back to a less steep gradient without the provision of reinforcement or structural support. These slopes are more prone to degradation and less robust than those treated with modern technology (e.g. reinforced with soil nails) and will be included for action under the LPMitP.

(B) Natural Hillside Catchments

10. With advances in technology and understanding of the nature of natural terrain landslide risk, about 2 700 natural hillside catchments with known hazards to existing buildings and important transport corridors have recently been identified from interpretation of large-scale historical aerial photographs. These call for expanded efforts under the LPMitP to systematically combat the risk pursuant to the 'react-to-known-hazard' approach. However, unlike man-made slopes, it is often impractical, costly and environmentally undesirable to carry out extensive slope stabilization works on natural hillsides. Instead, natural hillside landslide risk can be mitigated in a more cost effective manner through mitigation measures such as the debris traps and barriers, which are commonly adopted in other countries.

11. Risk mitigation works will be implemented for 30 natural hillside catchments each year under the LPMitP. This will enable Government to tackle within 10 years those problematic hillsides that pose a higher risk to

the community. A risk-based priority ranking system will be used to select the most deserving natural hillside catchments with known hazards for action.

IMPLEMENTATION

12. CEDD will embark on the investigation and study phases of LPMitP to ensure delivery of the target output from 2010 onwards, given that the typical lead-time for investigation, design and construction of slope works is about two years. The total annual expenditure required for the LPMitP is \$600 million, comprising \$300 million for dealing with substandard man-made slopes and \$300 million for dealing with natural hillside catchments. The funding is to be sourced from the existing Block Allocation under Capital Works Reserve Fund (CWRF) Head 705 Subhead 5001BX "Landslip preventive measures".

13. The LPMitP has the support of the Slope Safety Technical Review Board, which comprises three members of high international standing in the geotechnical field. The Board was established in 1995 to independently review the Government's work in slope safety management and advise on the technical aspects of the slope safety system. The Board will undertake an overview of the LPMitP on an annual basis and continue to benchmark our slope safety work with that of other developed countries. Furthermore, CEDD will conduct a review of the progress and effectiveness of the LPMitP in 2015.

14. In conjunction with the LPMitP, we will continue to control the standard of new slopes by checking their design and construction, undertake regular maintenance of government slopes to prevent deterioration, provide public education to maintain public awareness of landslide risk and issue landslip warnings during heavy rainfall to warn the public of the likelihood of landslides.

OTHER OPTIONS

15. We have also explored the following options to address the landslide risk after 2010 but considered them inappropriate:

- (a) Total retrofit - The scale of the works involved will be phenomenal and the huge cost will be disproportionate to the risk reduction that can be achieved, particularly for those man-made slopes and natural hillside catchments located in more remote areas. Significant social disruption would also result from the extensive slope works.

- (b) Urgent repairs following landslides – By only undertaking urgent repair works after the occurrence of landslides, this would cut the annual expenditure to about \$50 million to \$100 million. However, this is false economy and not sustainable as the risk-to-life to the community, as well as the repair and social costs, will increase with time due to progressive slope degradation.

IMPLICATIONS OF THE PROGRAMME

A 16 The LPMitP has financial, civil service, economic, environmental and sustainability implications as set out at **Annex A**. It is in conformity with the Basic Law, including the provisions concerning human rights. They have no productivity implications.

PUBLIC CONSULTATION AND PUBLICITY

17 Based on feedback from the ongoing public education and publicity programmes, members of the public are supportive of Government's continual efforts in improving slope safety. We will brief the relevant Legislative Council Panel details of the LPMitP. We will also announce and promote the LPMitP through relevant publicity vehicles and include it as part of our ongoing slope safety publicity campaign.

BACKGROUND

18. Hong Kong is unique in terms of its combination of high seasonal rainfall, steep terrain in close proximity to dense urban development, a large stock of potentially substandard man-made slopes and high public expectation of slope safety. On average, some 300 landslides affecting the community are reported every year.

19. Following a number of landslide disasters in the 1970s which caused more than 150 fatalities, the former Geotechnical Control Office (now the Geotechnical Engineering Office of CEDD) was set up in 1977 to tackle the slope safety problem, in particular the existing high-risk substandard man-made slopes formed without geotechnical input. To do this, an on-going LPMP was launched in 1977. Under the LPMP, substandard government man-made slopes affecting major roads and developments were upgraded, in addition to conducting safety screening for private man-made slopes, in a risk-based priority order.

20. In response to the Kwun Lung Lau landslide of July 1994, the then Works Branch conducted a Slope Safety Review which recommended, inter alia, speeding up the upgrading of substandard slopes and maintenance of slopes. This led to the 5-year accelerated LPMP from 1995 to 2000. In addition, a territory-wide review conducted between 1994 and 1998 had

registered more than 40 000 sizeable man-made slopes which were not previously included in the government catalogue of man-made slopes.

21. In view of the additional number of slopes identified in 1998 and to further reduce the likelihood of casualties and damage to property suffered by the community as a result of landslides, CEDD has drawn up an expanded 10-year LPMP to deal with the high-risk man-made slopes for commencement in 2000 and completion in 2010. This has brought about substantial improvement in the safety of slopes and a significant reduction in the number of landslide fatalities in recent years. In particular, there has not been any multiple-fatality landslide incident since 1995. Slope safety in Hong Kong is now comparable to that in countries such as Australia, Canada and the United States of America.

22. In conjunction with the LPMP, CEDD has been managing landslide risk through a suite of other measures including checking the design and construction of all new slopes, managing natural hillside landslide risk, investigating serious landslides, promoting public awareness and education and providing landslip warning and emergency response to landslides. These measures, together with the LPMP and the regular maintenance of government man-made slopes by the designated departments, form the key components of the Slope Safety System, as detailed at **Annex B**.

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ENQUIRIES

23. Enquires may be directed to Dr Alex C. O. LI, Chief Assistant Secretary (Works)5 of Development Bureau on 2848-1149.

Development Bureau

November 2007

Post-2010 Landslip Prevention and Mitigation Programme

List of Annex

- Annex A Implications of Post-2010 Landslip Prevention and
Mitigation Programme (LPMitP)
- Annex B The Slope Safety System in Hong Kong

Implications of Post-2010 Landslip Prevention and Mitigation Programme (LPMitP)

Financial and Civil Service Implications

An annual provision of about \$600 million is needed from 2010-2011 onwards from the existing Block Allocation under CWRP Head 705 Subhead 5001BX for CEDD to implement the LPMitP. This is about \$300 million less than the average annual block allocation spending on the LPMP since 2000. In the event of a very large number of significant landslides in a very wet year, an additional annual expenditure of the order of \$50 million may be needed. We will seek annual provision under CWRP Subhead 5001BX Block Allocation in accordance with the established procedures.

2. Although the annual capital expenditure for the LPMitP will be 33% lower than that for the existing LPMP (\$600 million against \$900 million), it should be noted that natural hillside catchments to be covered under the LPMitP are substantially larger in area, and will involve mitigation works which are technically more complex than those for man-made slopes. Annual outputs under LPMitP cannot be realistically expanded or expedited because of the constraint in the availability of the geotechnical expertise in the industry. We therefore consider that the current staff resources in CEDD and other relevant government departments should be maintained to cope with the LPMitP. However, should there be savings in staff resources, the departments concerned will ensure that they will be gainfully deployed to other priority areas.

Economic Implications

3. The LPMitP will continue Government's investment in slope safety, and thereby sustains job opportunities for the construction sector. Control of landslide risk will minimize adverse socio-economic impacts that may be brought by landslides to the community, and reinforce Hong Kong's reputation as a modern metropolitan city and tourist hub.

Environmental Implications

4. Landslip prevention and mitigation works are generally not classified as Designated Projects under the Environmental Impact Assessment Ordinance (EIAO). For individual sites which fall partly or wholly within country parks, conservation areas, sites of special scientific interests or other sensitive areas as defined under the Ordinance, we will follow the statutory procedures to apply for Environmental Permits as

required under the EIAO prior to implementation. Past experience has indicated that suitable landslip prevention and mitigation measures can be identified and implemented with minimal adverse environmental effects. When considering landslip prevention and mitigation strategy for individual sites, due consideration will be given to options with minimal environmental effects. In addition, we will implement the required environmental mitigation measures to control dust, noise and site run-off during construction.

Sustainability Implications

5. The project will reduce the landslide risk to the public. Upgraded slopes will be vegetated and landscaped, and natural hillsides will be restored to a natural setting. Native species will be used in greening of man-made slopes and natural hillsides as far as possible. Mitigation measures will be implemented to minimize any adverse environmental impact of works on individual slopes or hillside catchments. The project is conducive to the sustainability principle of providing a living environment and pursuing policies which promote and protect the physical health and safety of the people of Hong Kong.

The Slope Safety System in Hong Kong

Strategic Components of Slope Safety System

Hong Kong is vulnerable to landslide risk from man-made slopes and natural hillsides. The Slope Safety System, administered by the Geotechnical Engineering Office (GEO) of CEDD, is aimed at controlling landslide risk to meet public expectations. The key components of the system are described below.

Checking of New Slopes

2. The GEO/CEDD checks the designs of all new slope formations and undertakes site audits during construction. Private developments are regulated through the Buildings Ordinance whereas government slope works are controlled under an administrative mandate.

Upgrading Existing Substandard Slopes and Managing Natural Terrain Landslide Risk

3. High-risk substandard man-made slopes have been systematically investigated and rectified in a risk-based priority order under the LPMP managed by the GEO/CEDD, with some smaller-sized slopes assigned to other government departments for action. Substandard government slopes are upgraded to modern safety standards. Private slopes are subjected to safety-screening studies to establish prima facie evidence for serving a Dangerous Hillside Order under the Buildings Ordinance, through which owners are statutorily required to take follow-up actions. An integral part of the work is systematic landslide investigation which helps to identify slopes with instability problems that deserve out-of-turn action.

4. With regard to natural hillsides, Government's policy is to undertake studies and risk mitigation works where significant landslide hazard becomes evident, in accordance with the 'react-to-known-hazard' approach. Natural hillside landslide risk can be mitigated through land-use planning and mitigation measures.

Maintaining Man-made Slopes Regularly

5. We have pledged to maintain all registered government man-made slopes to ensure that the man-made measures, such as drainage channels on the slopes and slope surface cover, would serve their intended functions. If not properly maintained, the slopes will be vulnerable to localised failures

and slope degradation may be aggravated. All the registered government slopes have been assigned to one of the seven slope maintenance departments, who carry out routine inspections and routine maintenance on an annual basis. In addition, the slopes are to be inspected by a professionally qualified geotechnical engineer once every 5 to 10 years. Such inspections help to identify slopes that exhibit signs of degradation and require follow-up actions.

Maintaining Public Awareness

6. Public education and publicity campaigns are launched to maintain public awareness of landslide risk and promote a proper understanding of the nature of risk. The objectives are to avoid a false sense of security by the community during periods of non-eventful years (i.e. lack of severe rainstorms and major landslides), and to avoid unrealistically low tolerability of landslide risk by the public during severe rainstorms.

Providing Emergency Response

7. Landslip Warnings are issued during periods of heavy rainfall to warn the general public of the high likelihood of landslides. The GEO/CEDD provides round-the-clock emergency services. Professional geotechnical engineers are dispatched to inspect significant landslides and provide advice on the need for road closure, building evacuation and the necessary emergency works to remove the immediate danger and avoid casualties. Recommendations are also made on the necessary follow-up actions.