

**For discussion on
10 November 2015**

**LEGISLATIVE COUNCIL
PANEL ON DEVELOPMENT**

Review of Landslip Prevention and Mitigation Programme

PURPOSE

This paper seeks Members' views on the recommendations of the review of the Landslip Prevention and Mitigation Programme.

INTRODUCTION

The Panel on Development was briefed vide LegCo Brief (ref: DEVB(CR)(W) 1 – 150/72) dated November 2007 that the Civil Engineering and Development Department (CEDD) would launch a Landslip Prevention and Mitigation Programme (LPMitP) to dovetail with the Landslip Preventive Measures Programme (LPMP), which was due for completion in 2010. As the LPMitP is a newly launched programme with an expanded scope that covers natural hillside catchments, CEDD undertook in the above LegCo Brief to conduct a review of its progress and effectiveness in 2015.

2. The Panel on Development was also briefed vide LegCo Brief (ref: DEVB(CR)(W) 1 – 150/31) dated October 2009 that the approach to deal with landslide risks posed to squatter dwellings¹ will also include carrying out engineering works in accordance with a risk-based priority ranking system to deal with landslide risks arising from squatter slopes where non-development clearance of squatters by persuasion is not successful.

3. In June 2008, Hong Kong was struck by a record-breaking rainstorm (the most severe one experienced since rainfall records began in 1884), which triggered widespread natural terrain landslides in an unprecedented manner (>2,400 natural hillside landslides on Lantau Island which wreaked havoc to

¹ Squatter dwellings refer to those dwellings surveyed and registered by the Housing Department in their 1982 Squatter Control Survey. A squatter dwelling may contain one or more squatter structures.

the local community). In addition, a fatal landslide occurred at an old² substandard man-made slope in which two persons were killed. The consequences would have been much more serious had the rainstorm hit a more densely populated area such as Hong Kong Island. This event vindicates the need to continue our efforts to deal with the landslide risk associated with the remaining man-made slopes and expand the systematic slope safety programme to combat landslide risk posed to existing developments by vulnerable natural hillside catchments³, as indicated in the 2007 LegCo Brief.

4. We have completed a review of the LPMitP. The LPMitP is in satisfactory progress and delivering the pledged outputs in an effective manner. CEDD will continue with the implementation of LPMitP, with the following pledged annual outputs remaining unchanged:

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

JUSTIFICATIONS

5. The review has focused on the following four key areas relating to the progress and effectiveness of the LPMitP as observed since its implementation in late 2007, namely:

- (a) whether the pledged progress and delivery targets are met;
- (b) whether slopes and hillsides deserving priority action are selected;
- (c) whether there are new candidates of vulnerable natural hillside catchments identified for inclusion in the LPMitP; and
- (d) whether the professional practice in the LPMitP is in line with international best practice.

² Means pre-1977, i.e. before the establishment of the Geotechnical Control Office, renamed Geotechnical Engineering Office in 1991.

³ Vulnerable natural hillside catchments refer to those natural hillside catchments with known hazards and close to existing buildings and important transport corridors.

Meeting the Pledged Progress and Delivery Targets

6. The annual outputs of man-made slopes and natural hillside catchments under the LPMP and LPMitP are shown in **Annex A**. The pledged outputs for man-made slopes were successfully achieved in the past four years and those for natural hillside catchments were successfully achieved in the past two years.

7. The dovetailing of the LPMitP with the LPMP required a transition period to build up the output of mitigation works on natural hillside catchments. We have already reached and maintained the pledged annual output of 30 natural hillside catchments since 2013. Study and mitigation of natural terrain landslide hazards call for application of special expertise and engineering methodology that are different from upgrading man-made slopes. In addition, undertaking mitigation works on steep hillsides close to existing developments involves expanded efforts to resolve site and environmental constraints. These issues have been duly addressed in the past few years under the LPMitP, and industry practitioners including geotechnical consultants and contractors have geared up their capability to meet the new challenges.

8. Looking ahead, CEDD is poised to meet the pledged delivery targets for the LPMitP in the coming years. Whilst the average annual expenditure incurred in the implementation of the LPMitP over the past four years was about \$1,000 million, the future annual expenditure for the project may vary due to the impact of factors such as inflation, fluctuations in construction costs, the extent and complexity of the landslip prevention and mitigation works required for the selected catchments and man-made slopes, site conditions, etc.

Selecting Slopes and Hillsides Deserving Priority Action

9. In order to ensure that the most deserving man-made slopes and natural hillside catchments would be selected for priority action under the LPMitP, risk-based priority ranking systems have been adopted. The ranking systems have incorporated the local experience and insights of slope safety management in the past three decades, and were endorsed by the Slope Safety Technical Review Board⁴ (SSTRB). In addition, there are provisions for injection of slopes with known safety concerns (such as those showing

⁴ The Slope Safety Technical Review Board, which comprises three members of high international standing in the geotechnical field, 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.

significant signs of distress or affected by landslides) into the LPMitP. Hong Kong has pioneered the development and successful application of this approach in selection of slopes and hillsides for systematic follow-up action under the LPMP. Its use under the LPMitP continues to perform very satisfactorily.

10. The severe rainstorm of June 2008 has provided a useful performance test on the above priority ranking systems. During this rainstorm, landslides with significant consequences occurred on some of the high-ranking natural hillside catchments, which suggest that the corresponding ranking system is reasonable.

11. CEDD conducts systematic analysis and investigation of landslides, which are reviewed by the SSTRB on an annual basis. The findings since the launch of the LPMitP show that no serious landslides have occurred on slopes and hillsides that are known to have a major risk concern and should have been included in the LPMitP as a matter of priority. Nevertheless, it is inevitable that, depending on possible combination of severe weather conditions and other adverse circumstances, serious landslides may still occasionally occur on slopes and hillsides with relatively lower risk ranking. However, the overall positive performance based on consequence of landslides in the last seven years shows that the current approach has so far been very effective in selecting slopes and hillsides deserving priority action under the LPMitP.

12. It is noteworthy that those slopes and hillsides deserving higher priority for action under the LPMitP involve developments or major roads in close proximity to steeply sloping ground, which typically pose constraints in terms of access difficulties and the need for environmental protection. In certain cases, this may call for protracted attention to resolve public objections and address stakeholders' concerns, especially when working in squatter villages. Notwithstanding this, the overall feedback from the community (e.g. District Councils, village representatives, etc.) on the LPMitP has been exceedingly positive and Government's continued efforts to manage landslide risk in the interest of public safety are generally appreciated by the community, despite the fact that the works could bring about some disruptions and inconvenience during the construction period.

Identifying New Candidates of Vulnerable Natural Hillside Catchments

13. Whilst deserving hillsides have been effectively prioritized and selected for action under the LPMitP, CEDD has made further progress in identifying new candidates of vulnerable natural hillside catchments which

warrant inclusion in the ranking system for prioritization. Lessons learnt from the June 2008 rainstorm and further advances in the understanding of natural hillside landslide risk have highlighted the need to include additional deserving natural hillside candidates for consideration of follow-up action under the LPMitP.

14. In the 2007 LegCo Brief, about 2,700 vulnerable natural hillside catchments were identified for follow-up action under the LPMitP, pursuant to the “react-to-known-hazard” principle. Some of these catchments were subsequently dealt with under the LPMitP and some were de-registered after confirmation by field visits that the facilities affected by the catchments have been removed. Hence, the number of these vulnerable natural hillside catchments has been reduced to 2,150.

15. On the other hand, new candidates of vulnerable natural hillside catchments arise due to recent landslides and as a result of the technical advances made in the identification of vulnerable natural hillside catchments following the June 2008 rainstorm. These have altogether generated some 650 additional catchments as candidates for inclusion into the LPMitP.

16. Accounting for the above changes, there are altogether about 2,800 vulnerable natural hillside catchments included in the ranking system for action under the LPMitP.

Benchmarking with International Best Practice

17. Through sustained efforts to improve slope safety including the implementation of the LPMitP, the prevailing landslide risk in Hong Kong has remained at a reasonably low level⁵, which is comparable to that of other developed countries, since 2010. This is corroborated by the fact that the last multiple-fatality landslide incident occurred some 20 years ago when Hong Kong Island was hit by a severe rainfall (i.e. the 1994 Kwun Lung Lau landslide, which resulted in 5 fatalities). In addition, no fatal landslide has been recorded since the June 2008 rainstorm.

18. Given Hong Kong’s climatic and geographical conditions and the current state of technological development, there are many uncertainties and constraints in dealing with landslide hazards under the LPMitP. In addition, the potential impacts of extreme rainfall events and climate change on slope stability are not entirely within our comprehension and control. Under the

⁵ This is denoted as ‘As Low As Reasonably Practicable’ (ALARP) level, according to risk management terminology.

circumstances, absolute slope safety is not achievable or practical. As such, the primary aim of the LPMitP is to reduce the probability of occurrence of multiple-fatality landslides as far as possible.

19. The incorporation of systematic study and mitigation of natural terrain landslide risk into the LPMitP is a new and acute challenge to CEDD. Whilst state-of-the-art slope engineering is being adopted in dealing with natural terrain landslide hazards, the technology involved is still evolving. In this regard, the SSTRB has conducted annual reviews in order to benchmark the work carried out under the LPMitP and other aspects of the slope safety management system against international best practice. The SSTRB fully endorsed the work undertaken under the LPMitP and opined in its reports over the past few years that the programme represents the state-of-the-art worldwide in terms of management of substandard slopes and vulnerable catchments, and is an excellent investment for the safety of the citizens of Hong Kong.

20. In spite of the uncertainties and challenges, CEDD has adopted a proactive approach in consolidating the experience gained from the implementation of the LPMitP and lessons learnt from landslide investigations to make continuous improvement. For example, CEDD will continue to undertake further development work with a view to identifying new deserving candidates of vulnerable natural hillside catchments, such as those susceptible to large-magnitude mobile landslides under an extreme rainfall event, for studies of risk mitigation options and, if appropriate, follow-up action under the LPMitP.

Continuation of LPMitP

21. Based on the review, the LPMitP is found to be progressing in a satisfactory manner. However, as of 2015, there remain about 17,600 substandard man-made slopes with moderate risk or affecting squatter dwellings, and 2,800 vulnerable natural hillside catchments that would pose a hazard to the community. It is therefore considered necessary to continue with the implementation of the LPMitP for the sake of public safety.

22. The current annual output of upgrading 150 government man-made slopes, conducting safety-screening studies for 100 private man-made slopes and carrying out mitigation works for 30 natural hillside catchments will enable us to deal with approximately the worst 1% of both the remaining man-made slopes and natural hillside catchments (i.e. those at a more advanced state of deterioration with signs of distress or signs of instability).

23. If investment in slope safety is not maintained, landslide risk will progressively increase with time due to slope degradation, population increase, encroachment of more urban development on steep hillsides and potential impact of extreme rainfall, which could become more frequent and more severe due to climate change.

24. The current pledged annual delivery targets of the LPMitP are found to be appropriate in balancing the need to contain landslide risk against public disturbance, and having regard to the capacity of the geotechnical engineering profession and workforce. The SSTRB also supports maintaining the same target outputs.

25. As the pledged annual outputs will remain unchanged, no additional resources are required for the continued implementation of the LPMitP.

IMPLEMENTATION

26. The expenditure required for the LPMitP will be funded from the existing Block Allocation under Capital Works Reserve Fund (CWRWF) Head 705 Subhead 5001BX “Landslip Preventive Measures”.

27. The SSTRB will continue to undertake an overview of the LPMitP on an annual basis and benchmark our slope safety work with that of other developed countries. This will facilitate continuous improvement in the implementation of the LPMitP and other aspects of the slope safety system.

28. In conjunction with the implementation of the LPMitP, we will continue to exercise geotechnical control on new slopes by auditing their design and the standard of site supervision of their construction, undertake regular maintenance of government slopes to prevent deterioration, provide public education to maintain public awareness of landslide risk, and issue landslip warning during heavy rainfall to warn the public of the likelihood of landslides.

BACKGROUND

29. After discussion of the LegCo Brief (ref: DEVB(CR)(W)1–150/72) on “Post-2010 Landslip Prevention and Mitigation Programme” by the Panel on Development on 18 December 2007, the Programme was commenced immediately with a view to producing output in 2011. The aim is to contain the landslide risk to a reasonably practicable low level through enhancement

of man-made slopes and systematic mitigation of natural terrain landslide risk pursuant to the “react-to-known-hazard” principle, on a rolling basis.

30. LegCo Brief (ref: DEVB(CR)(W)1–150/31) on “Management of Landslide Risks on Squatter Dwellings” was submitted to the Panel on Development in October 2009. Subsequent to this, upgrading works on substandard government man-made slopes affecting squatter dwellings are carried out under the LPMitP for cases where clearance of the occupants of such dwellings by means of persuasion proves unsuccessful.

ADVICE SOUGHT

31. Members are invited to note our plan to continue with the implementation of the LPMitP in the interest of public safety. The current annual outputs are found to be appropriate in balancing risk containment and disturbance to the general public, and would remain unchanged. No additional staff resources would be required.

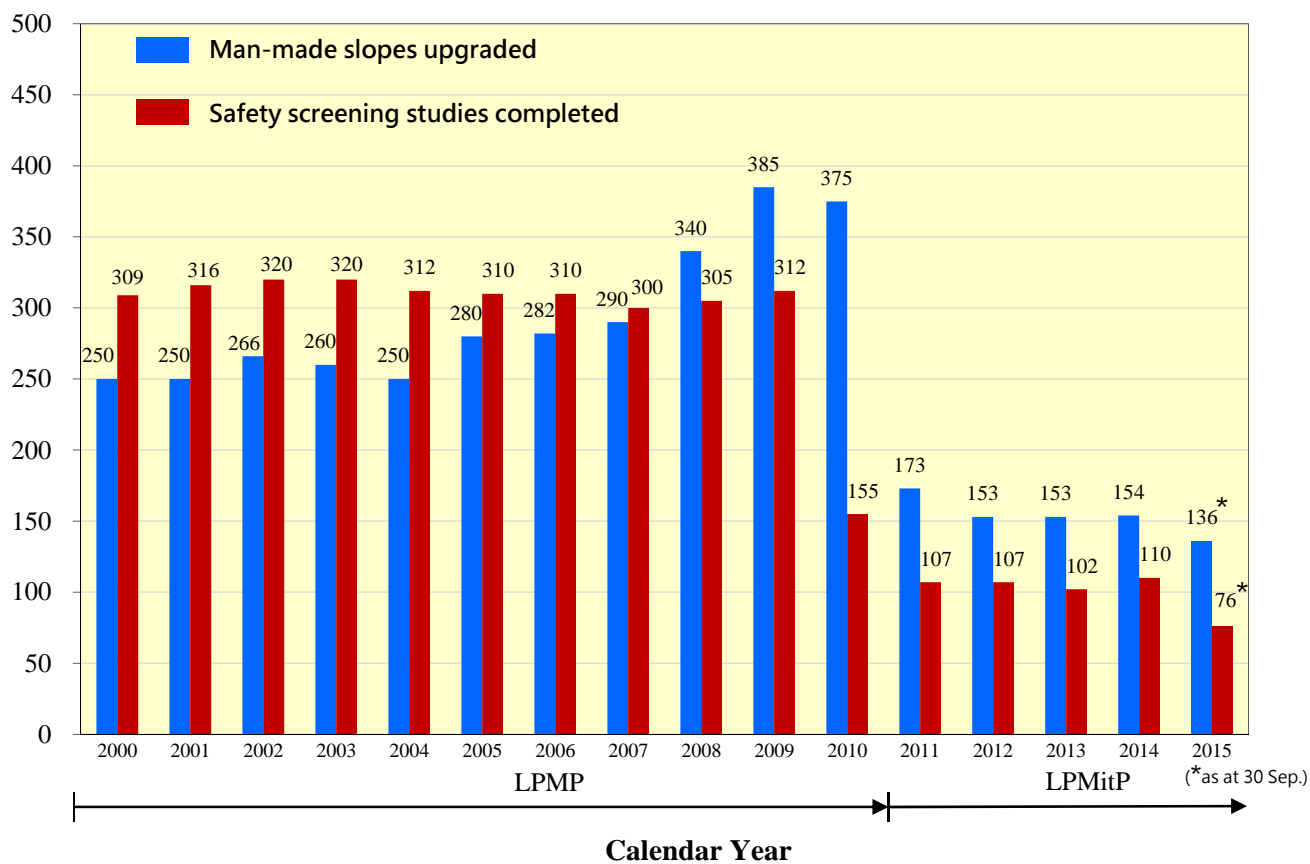
Development Bureau
Civil Engineering and Development Department
November 2015

Review of the Landslip Prevention and Mitigation Programme

List of Annex

Annex A Annual Outputs under the LPMP and LPMitP

Annual Outputs of Slope Upgrading Works and Safety Screening Studies under LPMP and LPMitP



Annual Outputs of Natural Hillside Mitigation Works under LPMitP

