Information Note 15/2022 **November 2022**

Landslide Potential Index

Key Message: The Geotechnical Engineering Office (GEO) estimates the number of landslides that can be triggered by a rainstorm based on rainfall characteristics and spatial distribution of slopes in Hong Kong, which is used to derive the Landslide Potential Index (LPI). Analysing the past landslide records, the LPI can indicate the potential of a rainstorm in triggering landslides, which helps to enhance GEO's work in managing landslide risk.

Introduction

The GEO receives an average of about 300 landslide reports each year, most of which were triggered by rainstorms. The rainfall intensity of a rainstorm is usually described by its return period[1]. However, return period is not an ideal measure of potential severity of a rainstorm in triggering landslides because return period is reported for rainfall recorded at a raingauge station, which only indicates the rainfall intensity at that particular location instead of the entire area being affected. Besides, rainfall distribution in Hong Kong can be highly uneven, thus the rainfall intensity of a particular raingauge station may not be representative of the rainfall intensity in other parts of Hong Kong.

In fact, rainstorms with the same rainfall intensity may have significantly different potential in triggering landslides because such potential also depends on factors including the number of slopes that exist within the area being affected and their respective conditions. If there are plenty of man-made slopes or natural hillsides within the area being affected, the chance of landslides, thus the risk, will remarkably increase while return period cannot account for this factor. In order to better represent the landslide risk induced by rainstorms, the GEO derives the LPI by estimating the potential number of landslides based on rainfall intensity, rainfall location and spatial distribution of slopes in Hong Kong.

Landslide Potential Index

The GEO analysed historical rainfall and landslide records and correlated them with the slope distribution data in Hong Kong to establish a statistical model between rainfall intensity and landslide frequency[2]. By converting real-time rainfall data of a rainstorm into rainfall intensity distribution, the GEO can make use of the rainfall-landslide frequency correlation model and the spatial distribution of slopes to estimate the potential number of landslides[3] and

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1 Return period is defined as the average time interval between the recurrences of a rainstorm with the same or higher rainfall intensity. The more extreme the rainfall intensity, the lesser the probability of recurrence and hence the longer the return period.

2 Landslide frequency is calculated based on landslide reports received by the GEO, which included landslides on both man-made slopes and natural hillsides.

3 Since the rainfall-landslide frequency correlation does not take into account all the governing factors (such as complex geological conditions, conditions of individual slopes, local rainfall), the estimated number of landslides may differ notably with the actual number. Notwithstanding the difference, there is an obvious trend between the estimated and actual number of landslides. The GEO will regularly review and

derive the LPI of that rainstorm.

Figure 1 shows the LPI of every rainstorm that prompted Landslip Warnings since 1985. As can be seen from the figure, there were three rainstorms with LPI greater than 100 that occurred in Hong Kong over the past 36 years. The LPI of the rainstorm that occurred on 7 June 2008 was 126, which is the highest on record. The rainstorm caused two fatalities and 347 landslides[4]. Another rainstorm that occurred on 20 August 2005, of LPI of 106, caused one fatality in a landslide at Fu Yung Shan Tsuen. The GEO received 229 landslide reports. As for the rainstorm that occurred on 23 July 1994, it triggered a serious landslide at Kwun Lung Lau causing five fatalities and three injuries. The LPI of that rainstorm was 103 and the GEO received 214 landslide reports. The above incidents indicate that the landslide risk is extremely high when the LPI is greater than 100.

There were nine rainstorms with LPI ranging from 51 to 100 that occurred in the above-said period. Most of these triggered more than 100 landslides and four of them (i.e. about half) resulted in fatalities, indicating that landslide risk is very high.

As for the other 74 rainstorms where the LPI were from 10 to 50, each rainstorm triggered about 40 landslides on average and four of them (about 6%) resulted in fatalities, indicating that the landslide risk level is high.

Based on the above observations, landslide risk can be generally described as follows according to the LPI:

Table 1 – Risk Description based on Landslide Potential Index

Landslide Potential Index	**Risk Description**
>100	Extremely high
51 – 100	Very high
10 – 50	High
<10	Low

Announcement of Landslide Potential Index

The GEO will post the LPI of each intense rainstorm in the "Hong Kong Slope Safety Website" (http://hkss.cedd.gov.hk) when it ends (typically when the Landslip Warning is cancelled) to inform the public of its severity. Members of the public can also view the LPI of other previous intense rainstorms in the website.

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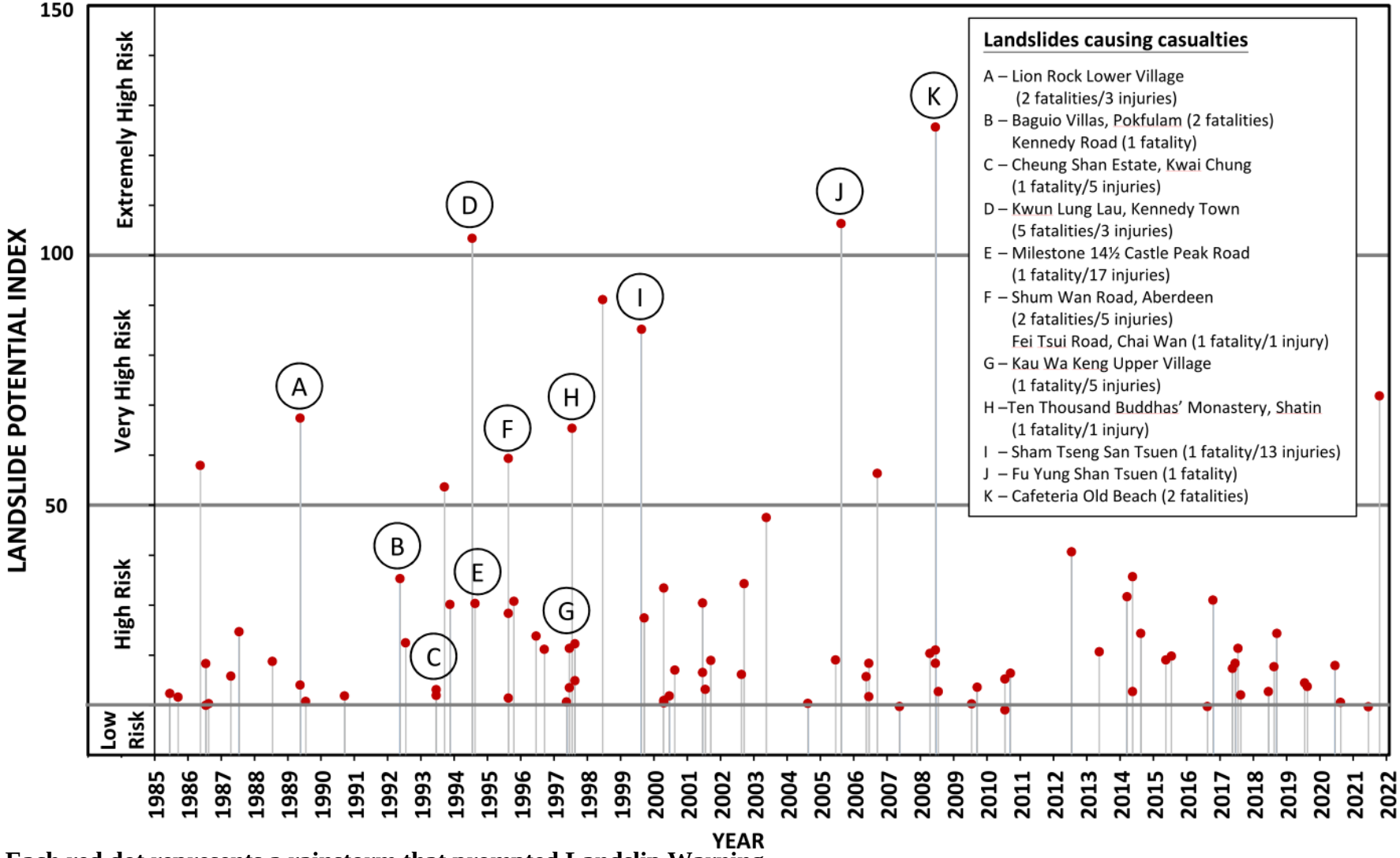
incorporate the latest data to enhance the model and improve the accuracy of the estimates.

[4] The number only refers to the 347 landslide reports received by the GEO. The rainstorm triggered over 2 000 natural terrain landslides in Lantau Island.

Figure 1: Landslide Potential Index of every rainstorm that prompted Landslip Warning between 1985 and 2021



Note: Each red dot represents a rainstorm that prompted Landslip Warning