FACTUAL REPORT ON HONG KONG RAINFALL AND LANDSLIDES IN 2002

GEO REPORT No. 180

T.H.H. Hui & T.T.M. Lam

GEOTECHNICAL ENGINEERING OFFICE
CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT
THE GOVERNMENT OF THE HONG KONG
SPECIAL ADMINISTRATIVE REGION

FACTUAL REPORT ON HONG KONG RAINFALL AND LANDSLIDES IN 2002

GEO REPORT No. 180

T.H.H. Hui & T.T.M. Lam

**This report was originally produced in May 2003
as GEO Special Project Report No. SPR 2/2003**

First published, February 2006

Prepared by:

Geotechnical Engineering Office,
Civil Engineering and Development Department,
Civil Engineering and Development Building,
101 Princess Margaret Road,
Homantin, Kowloon,
Hong Kong.

PREFACE

In keeping with our policy of releasing information which may be of general interest to the geotechnical profession and the public, we make available selected internal reports in a series of publications termed the GEO Report series. The GEO Reports can be downloaded from the website of the Civil Engineering and Development Department (http://www.cedd.gov.hk) on the Internet. Printed copies are also available for some GEO Reports. For printed copies, a charge is made to cover the cost of printing.

The Geotechnical Engineering Office also produces documents specifically for publication. These include guidance documents and results of comprehensive reviews. These publications and the printed GEO Reports may be obtained from the Government's Information Services Department. Information on how to purchase these documents is given on the last page of this report.

R.K.S. Chan
Head, Geotechnical Engineering Office
February 2006

FOREWORD

This report presents the factual information on rainfall and landslides in Hong Kong in 2002. Most of the landslide data were obtained from the records of incidents reported to the Geotechnical Engineering Office (GEO). Supplementary information was collected from the Agriculture, Fisheries and Conservation Department, Architectural Services Department, Drainage Services Department, Fire Services Department, Highways Department, Housing Department, Lands Department, Water Supplies Department and the GEO's landslide investigation consultants. The Hong Kong Observatory provided weather and rainfall information. The Special Projects Division carried out a review of the available rainfall records and rainfall analysis, and prepared Section 2 of this report. All contributions are gratefully acknowledged.

K.K.S. Ho
Chief Geotechnical Engineer/Landslip Investigation

Table of Contents
Table of Contents
Table of Contents

ABSTRACT

This report presents the factual information on rainfall and landslides in Hong Kong in 2002. Rainfall information was obtained from the Geotechnical Engineering Office (GEO) automatic raingauge system and from the Hong Kong Observatory (HKO). Most of the landslide data was obtained from the records of incidents reported to the GEO. Supplementary information was collected from the Agriculture, Fisheries and Conservation Department, Architectural Services Department, Drainage Services Department, Fire Services Department, Highways Department, Housing Department, Lands Department, Water Supplies Department and the GEO's landslide investigation consultants.

Rainfall at the HKO's Principal Raingauge at Tsim Sha Tsui in 2002 amounted to 2490 mm, which was about 12% higher than the mean rainfall of 2214 mm recorded between 1961 and 1990. Red Rainstorm Warnings were issued on 15 September 2002 and 18 October 2002, and 17 Amber Rainstorm Warnings were issued between 23 March 2002 and 21 October 2002.

Three Landslip Warnings were issued between 10 August 2002 and 17 September 2002. A total of 167 incidents that occurred in 2002 was reported to the Government. Of these, 138 were classified as genuine landslides. Of the 138 genuine landslides, nine were major failures (i.e. events with a failure volume of 50 m^3 or more, or where a fatality has occurred).

No fatalities were reported but a rockfall incident resulted in one minor injury. The consequences resulting from the landslides included the permanent evacuation of three squatter dwellings and the temporary evacuation of two squatter dwellings and a total of seven village houses. Fourteen landslides resulted in closure of sections of roads and another 14 landslides resulted in closure of sections of pedestrian pavements, footpaths and other forms of minor foot and vehicular access.

CONTENTS

1. INTRODUCTION

This report presents a summary of the factual information on rainfall and landslides that occurred in 2002. Rainfall information was obtained from the Geotechnical Engineering Office (GEO) and the Hong Kong Observatory (HKO). Most of the landslide data were obtained from the records of incidents reported to the GEO. Supplementary information was collected from the Agriculture, Fisheries and Conservation Department (AFCD), Architectural Services Department (Arch SD), Drainage Services Department (DSD), Fire Services Department (FSD), Highways Department (HyD), Housing Department (HD), Lands Department (Lands D), Water Supplies Department (WSD) and the GEO's landslide investigation consultants.

In this report, a landslide is defined as the detachment or excessive displacement of soil or rock, and includes failure of fill slopes, cut slopes, retaining walls, natural hillsides and disturbed terrain, rockfalls and boulder falls. A 'major' landslide is defined as a failure with the estimated volume of the detached or displaced mass $\geq$50 m^3, or where a fatality has occurred. A 'very minor' landslide is defined as a failure that is small in scale (i.e. $\leq$5 m^3 for failure involving soil or $\leq$0.1 m^3 for rockfall/boulder fall) and does not give rise to notable consequences (e.g. casualty, 'near-miss', evacuation of buildings or squatter dwellings, road closure, nuisance to the public, etc.). Landslides that are not classified as 'major' landslides or 'very minor' landslides are taken as 'minor' landslides. This report presents rainfall and landslide information throughout the year rather than emphasising any one specific rainstorm or landslide.

Diagnosis of landslides occurred in 2002 and recommendations for improving the performance of the slope safety system will be presented separately in a review report of landslides in 2002.

2. RAINFALL

2.1 The Raingauge System

The GEO, in cooperation with the HKO, operates an automatic raingauge system that transmits real-time rainfall data through telephone lines to the GEO and HKO at five-minute intervals. During 2002 this system comprised 86 GEO raingauges and 24 HKO raingauges. The locations of all the raingauges are shown in Figure 1. The raingauges are of the tipping-bucket type, tipping every 0.5 mm of rainfall.

2.2 Rainfall Records

The data from the raingauge system are checked, verified and stored by the GEO in an Oracle database, from which they can be extracted and analysed. This report presents a selection of rainfall parameters for the year, for individual months and individual storms. Further analyses can be carried out for specific tasks if required.

The weather in 2002 was described by the HKO, in the Monthly Weather Summary for December 2002 (HKO, 2003), as follows:

"The year 2002 was the second warmest year on record. The mean temperature of 23.9 degrees was 0.9 degree above normal. The first few months of the year was warmer than usual because fewer cold surges had come to affect Hong Kong. In May and June, the monsoon trough which normally brings a lot of rain to Hong Kong was quite inactive, resulting in more days with sunny weather and hence higher temperatures. While the first half of the year was exceptionally warm, the temperature of the second half of the year was near normal."

"The tropical cyclone season started much later than usual, with the first tropical cyclone warning signal issued on 3 August. Only three tropical cyclones affected Hong Kong this year, about half the normal figure. All three of them had originated in the South China Sea. During the year, none of those tropical cyclones originating over the western North Pacific entered the South China Sea to affect Hong Kong. This was due largely to the development of an El Nino in the year, which was characterized by above normal sea surface temperatures in the equatorial eastern and central Pacific. The associated change in atmospheric steering flow caused tropical cyclones over the western North Pacific to turn towards the north before entering the South China Sea."

"January was warmer than normal. It was warmer and sunnier than usual in February. A monthly mean temperature of 21.5 degrees made March 2002 the warmest March on record. The monthly total rainfall of 238.7 millimetres [note: as recorded at the HKO] was more than three times the normal amount for March."

"April was warmer, sunnier and drier than usual. It was warmer and slightly drier than normal in May. Warmer weather continued into June with a mean temperature of 28.8 degrees, which ranked the second highest for June. The weather became cloudier than usual in July."

"With the approach of Severe Tropical Storm Kammuri, the first Tropical Cyclone Warning Signal of the year was issued in early August. Kammuri missed Hong Kong and eventually made landfall near Shanwei. In mid-August, Severe Tropical Storm Vongfong moving across the South China Sea to the southwest of Hong Kong led to the issuance of the Standby Signal No. 1. August as a whole was slightly drier than normal."

"It was rainy in September. The monthly rainfall of 723.0 millimetres [note: as recorded at the HKO] was about 2.4 times the normal amount and ranked the fourth highest for the month [of September]. The approach of Severe Tropical

> Storm Hagupit necessitated the issuance of the No. 8 Southeast Gale or Storm Signal in Hong Kong. Hagupit passed at about 150 km to the south-southwest of Hong Kong and made landfall near Yangjiang."
>
> "October was cloudier and wetter than usual. Total bright sunshine duration of the month was the second lowest on record. The Red Rainstorm Warning issued on 18 October was the latest such warning ever issued in a year."
>
> "November was drier than usual. The monthly rainfall was 34 per cent below the normal amount."
>
> "December was cloudier and wetter than usual. On 19 December, thunderstorms associated with a cold front affected the New Territories and necessitated the issuance of Thunderstorm Warning, the first time in December for over 30 year."

The cumulative rainfall for 2002 recorded at the HKO amounted to 2490 mm, which was about 12% higher than the mean rainfall of 2214 mm recorded between 1961 and 1990. As shown in Figure 2, the cumulative rainfall for 2002 is compared with the highest, the lowest and the mean rainfall.

Figures 3a, 3b, 3c and 3d show the total monthly rainfall distribution in 2002.

Figure 4 shows the total annual rainfall distribution during 2002, together with the locations of reported landslides.

2.3 Rainstorms in 2002

The maximum 24-hour, five-hour and one-hour rolling rainfall (five-minute basic units) for the thirteen storms during 2002 in which rainfall exceeded 50 mm at the HKO are given in Table 1, together with the maximum amounts at any of the GEO raingauges. Also included are the 4-day and 15-day antecedent rainfall at the HKO, and the numbers of reported landslides. Similar data from selected previous major rainstorms are included for comparison.

Figures 5 to 17 show isohyets of maximum rolling 24-hour rainfall during these thirteen storms, together with landslide locations and the locations and values of maximum rainfall for durations from five minutes to 48 hours.

Only two storms generated significant numbers of landslides. The storms of 14 - 18 September 2002 and 9 - 11 August 2002 generated 38 and 14 reported landslides respectively. No other storms produced more than four reported landslides.

There were 19 storms that generated more than 50 mm of rainfall in 24 hours if all the GEO raingauges are considered (including the thirteen storms summarised in Table 1). Rainfall parameters for these 19 storms are shown in Appendix A, Table A1.

2.4 Warnings Issued by the Hong Kong Observatory

Table 2 gives details of the Thunderstorm, Flood, Landslip, Tropical Storm and Rainstorm Warnings issued by the HKO and the GEO in 2002. Red Rainstorm Warnings were issued on 15 September 2002 and 18 October 2002 and 17 Amber Rainstorm Warnings were issued between 23 March 2002 and 21 October 2002. Three Landslip Warnings were issued between 10 August 2002 and 17 September 2002.

3. LANDSLIDES

3.1 Landslide Occurrence in 2002

The number of landslides reported to the GEO and other Government departments in 2002 is summarised in Table 3.

A total of 167 landslides that occurred in 2002 was reported to the Government (see Figure 4). These include 137 landslides reported to the GEO and 30 landslides reported only to other Government departments (i.e. AFCD, Arch SD, DSD, FSD, HyD, HD, Lands D and WSD). Of these 167 landslides, 138 landslides were classified as genuine landslides (see summary in Appendix B). The remaining reported incidents either did not involve landslides (e.g. tree fall, etc.) or were incidents of no geotechnical concern (e.g. very minor surface erosion or washout incidents) and were therefore not considered in the analysis below.

Of the 138 genuine landslides, nine (6.5%) were major landslides (see Table B1 in Appendix B), 112 were minor landslides and 17 were very minor landslides with negligible consequence.

Selected notable landslides are presented in Section 4 and illustrated in Plates 1 to 7. For those landslide incidents attended to by the GEO, the information about the landslides was recorded on GEO Incident Reports (and on Landslip Cards for major landslides). For those landslide incidents attended to by other Government departments (i.e. AFCD, Arch SD, DSD, FSD, HyD, HD, Lands D and WSD), landslide incident reports were prepared by the respective departments to document the key information. The above information, together with the scanned images of all incident reports and Landslip Cards prepared by the GEO and other Government departments, has been uploaded onto the Slope Information System (SIS), which can be accessed by the general public. Further details of these failures can be found in the incident files of the District Divisions and Landslip Investigation Division of the GEO.

Where possible, the dates and times of the landslides were assessed by geotechnical engineers. Some incidents were not reported to the GEO or other Government departments until several days or weeks after they had occurred. For these landslides, it is difficult to determine the exact times of occurrence. Of the 138 genuine landslides, the timing of occurrences was determined to within one day for a total of 81 incidents.

It should be noted that there were almost certainly other landslides which were not reported, many of which would have occurred in remote areas with no immediate consequences.

3.2 Consequence of Landslides

3.2.1 General

The consequence of landslides in terms of number of landslide incidents affecting various types of facility (e.g. buildings, roads, squatter dwellings, etc.) in Hong Kong, Kowloon and the New Territories is shown in Table 4. It should be noted that a failure may affect more than one type of facility. Significant consequences of landslides (e.g. casualties, evacuation of squatter dwellings and buildings, closure of roads, etc.) as classified with respect to type of slope failure, are listed in Table 5. Table 6 shows the distribution of the different facility groups affected by major landslides. Further descriptions of selected notable landslides are presented in Section 4.

3.2.2 Buildings

Four landslides affected buildings, and one of these was major. Two of these landslides resulted in the temporary evacuation of a total of seven village houses. Landslide incident No. 2002/09/0092 is described in Section 4.

3.2.3 Roads and Transport Facilities

Twenty-five landslides (two of which were major) affected sections of roads. Fourteen landslides resulted in the closure of sections of roads. Landslide incidents Nos. 2002/11/0164, 2002/08/0064, 2002/03/0012, 2002/07/0056 and 2002/05/0030 are described in Section 4.

3.2.4 Squatters

Five landslides affected squatters and none of these landslides was major. These landslides led to the permanent evacuation of three squatter dwellings (i.e. squatter huts with squatter control survey number given by the Housing Department) and the temporary evacuation of two squatter dwellings.

3.2.5 Construction Sites

Five landslides affected active construction sites. Three of these were major. Landslide incident No. 2002/08/0076 is described in Section 4.

3.2.6 Catchwaters and Reservoirs

Two landslides affected catchwaters. Neither of these was major.

3.2.7 Other Areas

Other areas affected by landslides included pedestrian pavements, footways, minor footpaths, minor access facilities, carparks, parks, playgrounds, gardens, backyards, open areas, etc. Forty-eight landslides affected pedestrian pavements, footways, minor footpaths and access facilities, two of which were major. Fifty landslides affected carparks, parks, playgrounds, gardens, backyards, open areas, etc. and one of these was major. Fourteen landslides resulted in closure of sections of pedestrian pavements, footpaths and other forms of foot and vehicular access.

3.3 Types of Slope Failures

3.3.1 General

Landslides reported to the GEO and other Government departments have been classified into five types of slope failures, i.e. fill slopes, cut slopes, retaining walls, natural hillside and disturbed terrain. The numbers of different types of slope failures are shown in Table 7.

3.3.2 Fill Slopes

There were five fill slope failures, comprising 3.6% of all landslides reported. One of these failures was major.

3.3.3 Cut Slopes

There were 96 cut slope failures, comprising 69.6% of all landslides reported. These were classified further according to the types of material involved, i.e. soil, soil/rock and rock.

There were 41 landslides on soil cut slopes, five of which were major. There were 44 soil/rock cut slope failures, two of which were major. Landslide incidents Nos. 2002/09/0092, 2002/08/0064, 2002/08/0076 and 2002/03/0012 are described in Section 4.

There were eleven landslides on rock cut slopes, none of which was major. Landslide incident No. 2002/05/0030 is described in Section 4.

3.3.4 Retaining Walls

There were eight failures of retaining walls, comprising 5.8% of all landslides reported. One of these incidents was major. Landslide incident No. 2002/07/0056 is described in Section 4.

3.3.5 Natural Hillside

There were 29 natural hillside failures, comprising 21% of all landslides reported. None of these failures was major. Landslide incident No. 2002/11/0164 is described in Section 4.

3.3.6 Disturbed Terrain

There were no failures in disturbed terrain reported.

3.4 Landslide Volume Distribution

Tables 8 and 9 show the distribution of landslide volumes for all the reported landslides. Seventy-five landslides (about 54.4%) involved less than 5 m^3 of material. Nine of the reported landslides (about 6.5%) involved a failure volume of 50 m^3 or more. Of these nine major failures, one was on a fill slope, five were on soil cut slopes, two were on soil/rock slopes and one involved a retaining wall.

4. NOTABLE LANDSLIDES

4.1 General

Out of the 138 genuine landslides reported to the Government in 2002, seven are described in more detail below. These seven landslides have been selected mainly on the basis of their failure volumes, consequence or technical interest.

4.2 The 15 September 2002 Landslide on Slope No. 7SE-C/CR323 behind Houses Nos. 11 to 16 Ngau Pei Sha New Village, Sha Tin (Incident No. 2002/09/0092)

(A major failure on a cut slope resulted in temporary evacuation of six 3-storey village houses, Plate 1)

At about 4:30 a.m. on 15 September 2002 when a Landslip Warning and a Red Rainstorm Warning were in force, a landslide (Incident No. 2002/09/0092), with a failure volume of about 50 m^3, occurred on slope No. 7SE-C/CR323 behind houses Nos. 11 to 16, Ngau Pei Sha New Village, Sha Tin. The landslide debris piled up behind the village houses Nos. 14 and 15 and reached the top of the first storey. Houses Nos. 11 to 16 were temporarily evacuated. No casualties were reported as a result of the landslide.

The failed portion of slope No. 7SE-C/CR323 comprised a 4.5 m high, 70° steep soil cut with chunam cover and a 300 mm thick, 2 m high concrete retaining wall at the slope toe. Adversely-orientated relict joints (some with kaolin infill) were exposed on the landslide scar. A section of surface channel at the slope crest above the failure area was found to be blocked with vegetation at the time of the incident.

4.3 The 28 November 2002 Rockfall from the Ground above Slope No.11SW–D/C639 at Yip Hing Street, Wong Chuk Hang (Incident No. 2002/11/0164)

(A rockfall from the ground above a 36-m high cut slope resulted in minor injury to the driver in a vehicle parked at the slope toe. The incident also caused damage to two vehicles and temporary closure of Yip Hing Street, Plate 2)

At about 2:30 p.m. on 28 November 2002 during a period of relatively dry weather, a rock block, with an estimated volume of about 0.3 m^3, fell from the ground about 10 m above the crest of cut slope No. 11SW-D/C639 (Incident No. 2002/11/0164). The source area of the detached rock block is located on a 30^o steep vegetated hillside below a catchwater and above the 36-m high cut slope. There is evidence to suggest that rock blocks had been dumped (illegally) on the hillside some time before the incident. The impact of the detached rock block against the ground generated several smaller fragments of flyrock. One of the flyrock fragments smashed through the side window of a vehicle parked at the slope toe. As a result, the driver, who was the only passenger in the vehicle, was slightly injured. The incident also resulted in damage to the concerned vehicle as well as another vehicle parked at the slope toe. Yip Hing Street was temporarily closed after the incident.

4.4 The 9 August 2002 Landslide on Slope No. 2SE-C/C199 at Yau Tam Mei Tsuen Road, Yuen Long (Incident No. 2002/08/0064)

(A major landslide occurred on a soil/rock cut slope. The incident resulted in temporary closure of one lane of Yau Tam Mei Tsuen Road, Yuen Long, Plate 3)

On the morning of 9 August 2002, when the Amber Rainstorm Warning was in force, a major landslide (Incident No. 2002/08/0064), with a failure volume of about 100 m^3, occurred on slope No. 2SE-C/C199 at Yau Tam Mei Tsuen Road, Yuen Long. The westbound lane of Yau Tam Mei Tsuen Road was temporarily closed following the incident. No casualties were reported as a result of the incident.

The landslide mass was mobilised along daylighting relict joints and foliation planes with adverse orientations. The relict discontinuity surfaces were observed to be coated with thick accumulations of iron and manganese oxides.

4.5 The 10 August 2002 Landslide on a Cut Slope within An Active Construction Site at Victoria Road, Pokfulam (Incident No. 2002/08/0076)

(A major landslide occurred on the soil portion of a soil/rock cut slope located within the works area of a road improvement project, Plate 4)

At about 7:00 a.m. on 10 August 2002, shortly after the cancellation of an Amber Rainstorm Warning, a landslide (Incident No. 2002/08/0076), with a failure volume of about 80 m^3, occurred on a cut slope overlooking Victoria Road. The failed cut slope, with a maximum height of about 22 m, was being formed as part of a road improvement project. The landslide debris was deposited on the slope toe within the works area. No casualties were reported as a result of the incident.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

The landslide scar was about 11.5 m long by 10.5 m wide and about 1.5 m deep. Surface channels on the berm and at the slope crest were found to be blocked with soil and construction debris at several locations at the time of the incident.

4.6 The 23 March 2002 Rockfall from Slope No. 11NW-A/C61 at Castle Peak Road, Kwai Chung (Incident No. 2002/03/0012)

(A rockfall occurred on the exposed rock cut portion of a soil/rock cut slope. The incident resulted in temporary closure of one lane of Castle Peak Road, Plate 5)

At about 10:15 a.m. on 23 March 2002, when the Amber Rainstorm Warning was in force, a rockfall (Incident No. 2002/03/0012), with a failure volume of about 0.1 m^3, occurred on the rock cut portion of slope No. 11NW-A/C61 overlooking Castle Peak Road, Kwai Chung. Some rock fragments were deposited on Castle Peak Road resulting in temporary closure of one lane of the road. No casualties were reported as a result of the incident.

The exposed rock cut portion of the slope was covered with unplanned vegetation comprising small trees and shrubs. The slope was previously upgraded about two years before the rockfall incident.

4.7 The 29 July 2002 Landslide on Slope No. 6SE-D/FR133 below Castle Peak Road, Yau Kom Tau, Tsuen Wan (Incident No. 2002/07/0056)

(A landslide occurred on a retaining wall below Castle Peak Road. The incident resulted in complete closure of the road temporarily. The retaining wall is located within the works area of a road widening project, Plate 6)

At about 1:30 p.m. on 29 July 2002, when the Amber Rainstorm Warning was in force, a landslide, with a failure volume of 55 m^3 (Incident No. 2002/07/0056), occurred on retaining wall No. 6SE-D/FR133 below Castle Peak Road at Yau Kom Tau, Tsuen Wan. Bursting of a pressurised fire hydrant pipe was involved in this incident. Also, an area (about 18 m long by 2 m wide) including a section of Castle Peak Road and the adjoining pedestrian footpath collapsed in the incident, and resulted in complete closure of the road temporarily. No casualties were reported as a result of the incident.

4.8 The 22 May 2002 Rockfall from Slope No. 11NE-A/C284 at Shatin Pass Road, Tsz Wan Shan (Incident No. 2002/05/0030)

(A rockfall occurred on a rock cut slope. The incident resulted in temporary closure of Shatin Pass Road, Plate 7)

At about 8:30 p.m. on 22 May 2002, a rockfall (Incident No. 2002/05/0030), with a failure volume of about 7 m^3, occurred on slope No. 11NE-A/C284 at Shatin Pass Road, Tsz Wan Shan. The incident involved the detachment of several sizeable rock blocks from a height of about 7 m above the slope toe. The rock blocks were deposited on Shatin Pass Road resulting in temporary closure of the road. No casualties were reported as a result of the incident.

The rockfall involved the detachment of rock blocks in a planar sliding mode along an adversely orientated, steeply inclined basal release surface, which is probably a sheeting joint of about 10 m in length.

5. CONCLUSIONS

Rainfall at the HKO's Principal Raingauge at Tsim Sha Tsui amounted to 2490 mm in 2002, which was about 12% higher than the mean rainfall of 2214 mm recorded between 1961 and 1990. Three Landslip Warnings were issued between 10 August 2002 and 17 September 2002. Red Rainstorm Warnings were issued on 15 September 2002 and 18 October 2002. A total of 167 incidents was reported, of which 138 were genuine landslides. Of the 138 genuine landslides, nine were major landslides, 112 were minor landslides and 17 were very minor landslides with negligible consequence.

An incident involving a small rockfall resulted in one minor injury. Other more notable consequences of landslides in 2002 included the permanent evacuation of three squatter dwellings (one incident) and the temporary evacuation of two squatter dwellings (two incidents) and a total of seven village houses (two incidents). Fourteen landslides resulted in closure of sections of roads and another 14 landslides resulted in closure of sections of pedestrian pavements, footpaths and other forms of minor foot and vehicular access.

6. REFERENCES

Hong Kong Observatory (2003). Monthly Weather Summary December 2002. Hong Kong Observatory, Hong Kong, 34 p.

Wong, C.K.L. (1998). The New Priority Classification Systems for Slopes and Retaining Walls. Geotechnical Engineering Office, Hong Kong, 117 p. (GEO Report No. 68).

LIST OF TABLES

Table 1 - Rainfall and Landslides in 2002, Compared with Selected Previous Major Rainstorms

Date of Rainstorm Event[1]	Maximum Rainfall (mm)[2]								Number of Landslides[6]
	Hong Kong Observatory (HKO)					GEO Raingauges[3]			
	24-hr	5-hr	1-hr	Antecedent[5]		24-hr	5-hr	1-hr	
				4 days	15 days				
14-18 Sep 2002[4]	204	114	46	269	366	438 (N20)	240 (N20)	104 (N20)	38*
9-11 Aug 2002[4]	151	65	44	46	234	220 (N13)	156 (N32)	101 (N32)	14*
23-24 Mar 2002	126	115	55	0	1	185 (H01)	171 (H01)	83 (H01)	3*
11-12 Jun 2002	110	89	32	27	43	181 (N13)	144 (N13)	72 (N10)	4*
10-11 May 2002	85	57	34	23	23	174 (N43)	78 (K02)	74 (K02)	3*
22-23 Sep 2002	79	74	24	83	577	159 (N50)	151 (N50)	73 (N50)	2
11 Sep 2002	77	26	7	3	13	117 (H03)	50 (N36)	21 (H17, H21)	1
29-30 Jul 2002	75	38	37	65	159	98 (H08)	51 (K01)	50 (K01)	3
19 Aug 2002	65	22	16	7	253	122 (N29)	64 (N07)	61 (N07)	0
29-30 Mar 2002	61	55	44	3	160	105 (N16)	86 (N16)	67 (K01)	1
30-31 Oct 2002	60	19	9	3	111	125 (N43)	50 (N41)	26 (N43)	1
17 Jul 2002	59	30	23	0	54	185 (N09)	145 (N09)	67 (N09)	0
18-19 Oct 2002	52	50	25	0	0	223 (N30)	217 (N20)	139 (H29)	1
Selected Previous Major Rainstorms (for comparison only)									
28-29 May 82	394	153	44	1	11	430	237	111	238
17 Jun 83[4]	347	274	69	2	77	460	303	101	155
20-21 May 89[4]	388	149	37	28	42	566	224	51	378
7-9 May 92[4]	324	196	110	65	71	385	244	110	314
15-16 Jun 93[4]	155	129	54	18	275	285	195	111	123
4-5 Nov 93[4]	107	31	9	8	8	742	350	94	394
1-4 Jul 97[4]	110	49	18	183	380	799	296	125	150
8-9 Jun 98[4]	429	164	48	58	181	562	223	98	96
22-26 Aug 99[4]	313	143	51	11	175	565	249	121	269

Notes:
(1) Rainstorms in which rolling 24-hour rainfall at the Hong Kong Observatory, Tsim Sha Tsui, exceeded 50 mm are arranged in order of the intensity of 24-hour rainfall.
(2) The maxima are calculated using 5-minute rainfall as the basic unit, except those recorded at the HKO for the previous major rainstorms. They are the rolling rainfall amounts using one-clock hour rainfall as the basic unit. The 1-hour maximum rainfall at the HKO refers to clock hours.
(3) The maxima are selected from the 86 GEO raingauges for the rainstorms. The GEO raingauge reference number is shown in brackets.
(4) Landslip warnings were issued for these events.
(5) The " N days (e.g. 4 or 15 days) antecedent rainfall" is the total rainfall in N days prior to the start of the corresponding 24-hr maximum rainfall period.
(6) Reported totals are for genuine landslides attributed to the events. Numbers marked with the "*" are those reported to GEO and other Government departments. The rest are those reported to GEO only.

Table 2 - Warnings Issued by the Hong Kong Observatory in 2002[1]

Month	Monthly Total Rainfall (mm)	Dates on which Warnings were in Effect				
		Thunderstorm	Flood	Landslip[2]	Tropical Storm	Rainstorm
January	25	-	-	-	-	-
February	4.6	-	-	-	-	-
March	238.7	23, 24, 29-30, 30-31, 31	-	-	-	23 (Amber)
April	12.4	6, 10	-			-
May	275.6	10, 11, 12, 14, 16, 16-17, 19, 20-21, 22-23, 30, 31	20-21		-	10 (Amber), 11 (Amber), 20-21 (Amber), 22-23 (Amber)
June	237.6	1, 1-2, 2, 3, 9, 10, 11, 12, 16, 19, 20, 23, 27, 29	-	-	-	11 (Amber)
July	320.8	1, 1-2, 2, 3, 4, 6, 9, 13, 14, 16, 17, 18-19, 19, 20, 20-21, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31	3	-	-	17 (Amber), 29 (Amber)
August	365.9	2, 3, 5, 6, 7, 8, 9, 10, 19, 30, 31	9	10 (11:00-15:00)	3-5 (Signal 1, Kammuri), 17-20 (Signal 1, Vongfong)	6 (Amber), 9 (Amber), 10 (Amber)
September	723	1, 2, 3, 10, 12, 13, 14, 14-15, 15-16, 16-17, 17, 17-18, 22	-	15 (03:45-20:30), 17 (01:30-12:45)	10-12 (Signal 1-8, Hagupit)	14-15 (Amber), 15 (Amber, Red), 16-17 (Amber), 17 (Amber)
October	199	6, 18, 21	-	-	-	18 (Amber, Red), 21 (Amber)
November	23.3	-	-	-	-	-
December	64.1	19, 20	-	-	-	-
Total	2490	85 days	4 days	3 Warnings	3 Warnings	19 days

Notes:
(1) Warning Information in this Table was based on HKO Warnings and Signals Database.
(2) Landslip Warnings were issued after consultation between GEO and HKO.

Table 3 - Number of Landslides Occurred in 2002 Reported to the GEO and Other Government Departments

Department	Total Number of Landslides	Genuine Landslides
Agriculture, Fisheries and Conservation Department	2 (2)	1 (1)
Architectural Services Department	18 (5)	14 (5)
Drainage Services Department	0 (0)	0 (0)
Fire Services Department	1 (1)	1 (1)
Geotechnical Engineering Office, Civil Engineering Department	137*	112
Highways Department	12 (8)	9 (5)
Housing Department	2 (0)	2 (0)
Lands Department	7 (4)	6 (3)
Water Supplies Department	9 (1)	9 (1)
Legend: 2 (1) 2 incidents of which 1 has been previously reported to the GEO		
Note: * denotes number of landslides reported to the GEO discounting false alarm, duplicate cases, etc.		

Table 4 - Number of Landslides Affecting Different Facilities

Affected Facility	Hong Kong Island	Kowloon	New Territories and Outlying Islands	All
Squatters	0 (0)	0 (0)	5 (0)	5 (0)
Buildings	0 (0)	0 (0)	4 (1)	4 (1)
Roads	8 (0)	4 (0)	13 (2)	25 (2)
Transportation Facilities (railways, tramways, LRT, etc.)	0 (0)	0 (0)	0 (0)	0 (0)
Pedestrian Pavements/Footways	3 (1)	2 (0)	1 (0)	6 (1)
Minor Footpaths/Access	12 (0)	4 (0)	26 (1)	42 (1)
Construction Sites	3 (1)	2 (2)	0 (0)	5 (3)
Open Areas	7 (0)	6 (0)	15 (0)	28 (0)
Catchwaters	0 (0)	0 (0)	2 (0)	2 (0)
Others (e.g. carparks, parks, playgrounds, gardens, backyards, etc.)	5 (0)	1 (0)	16 (1)	22 (1)

Legend:

5 (0) Five landslides of which none was major failure (i.e. failure volume ≥ 50 m^3)

Note: A given landslide may affect more than one key type of facility.

Table 5 - Landslide Consequence Related to Type of Slope Failure

Type of Failure		No. of Squatter Dwellings Evacuated		No. of Blocks, Houses or Flats Evacuated or Partially Closed	No. of Landslides Closure			Deaths	Injuries
		Permanent	Temporary		Roads	Pedestrian Pavements	Footpaths, Back Lanes, Private Access		
Fill Slope		0	1	0	0	0	0	0	0
Cut Slope	Soil	3	1	6	1	1	2	0	0
	Soil/Rock	0	0	0	8	3	1	0	0
	Rock	0	0	0	3	0	0	0	0
Retaining Wall		0	0	0	1	0	0	0	0
Natural Hillside		0	0	1	1	0	7	0	1[(2)]
Disturbed Terrain		0	0	0	0	0	0	0	0

Notes: (1) A failure may give rise to more than one key type of consequence.
(2) Minor injury resulting from a rockfall from the natural hillside where rock blocks had been dumped (illegally) some time before the incident (see Section 4.3)

Table 6 - Distribution of Facility Groups Affected by Major Landslides

	Facility Group Affected by Major Landslides				
	Group No. 1	Group No. 2	Group No. 3	Group No. 4	Group No. 5
All Major Landslides	1	4	1	2	1
Major Landslide on Man-made Slope	1	4	1	2	1
Major Landslide on Hillside	0	0	0	0	0

Notes: (1) The facility group is classified in accordance with that adopted for the New Priority Classification Systems (Wong, 1998).
(2) A given landslide may affect more than one key type of facility.

Table 7 - Numbers of Landslides As Classified by Types of Slope Failure

Type of Failure		No.	Percentage (%)
Fill Slope		5 (1)	3.6
Cut Slope	Soil	41 (5)	29.7
	Soil/Rock	44 (2)	31.9
	Rock	11 (0)	8.0
Retaining Wall		8 (1)	5.8
Natural Hillside		29 (0)	21.0
Disturbed Terrain		0 (0)	0
Total		138 (9)	100

Legend:

5 (1) Five landslides of which one was a major failure (i.e. failure volume ≥ 50 m^3)

Note: Where a landslide involved more than one type of failure, the predominant type has been adopted in the above classification.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Table 8 - Landslide Volume Distribution with Respect to Geographical Locations

Volume of Failure (m^3)	Hong Kong Island	Kowloon	New Territories and Outlying Islands	All
<5	29	9	37	75 (54.4%)
≥5 to <10	2	1	17	20 (14.5%)
≥10 to <20	0	3	15	18 (13.0%)
≥20 to <50	4	4	8	16 (11.6%)
≥50 to <200	2	2	5	9 (6.5%)
≥200 to <500	0	0	0	0 (0%)
≥500 to <1000	0	0	0	0 (0%)
≥1000	0	0	0	0 (0%)
Total	37	19	82	138 (100%)

Legend:

75 (54.4%) Denotes 75 landslides, which amount to 54.4% of the 138 genuine landslides reported to the Government

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Table 9 - Landslide Volume Distribution with Respect to Types of Slope Failure

Volume of Failure (m^3)	Fill Slope	Cut Slope			Retaining Wall	Natural Hillside	Disturbed Terrain	Total
		Soil Slope	Soil/Rock	Rock				
<5	0	17	27	10	3	18	0	75 (54.4%)
≥5 to <10	1	7	7	1	3	1	0	20 (14.5%)
≥10 to <20	0	8	4	0	0	6	0	18 (13.0%)
≥20 to <50	3	4	4	0	1	4	0	16 (11.6%)
≥50 to <200	1	5	2	0	1	0	0	9 (6.5%)
≥200 to <500	0	0	0	0	0	0	0	0 (0%)
≥500 to <1000	0	0	0	0	0	0	0	0 (0%)
≥1000	0	0	0	0	0	0	0	0 (0%)
Total	5 (3.6%)	41 (29.7%)	44 (31.9%)	11 (8.0%)	8 (5.8%)	29 (21.0%)	0 (0%)	138 (100%)

Legend:

75 (54.4%) Denotes 75 landslides, which amount to 54.4% of the 138 genuine landslides reported to the Government

LIST OF FIGURES

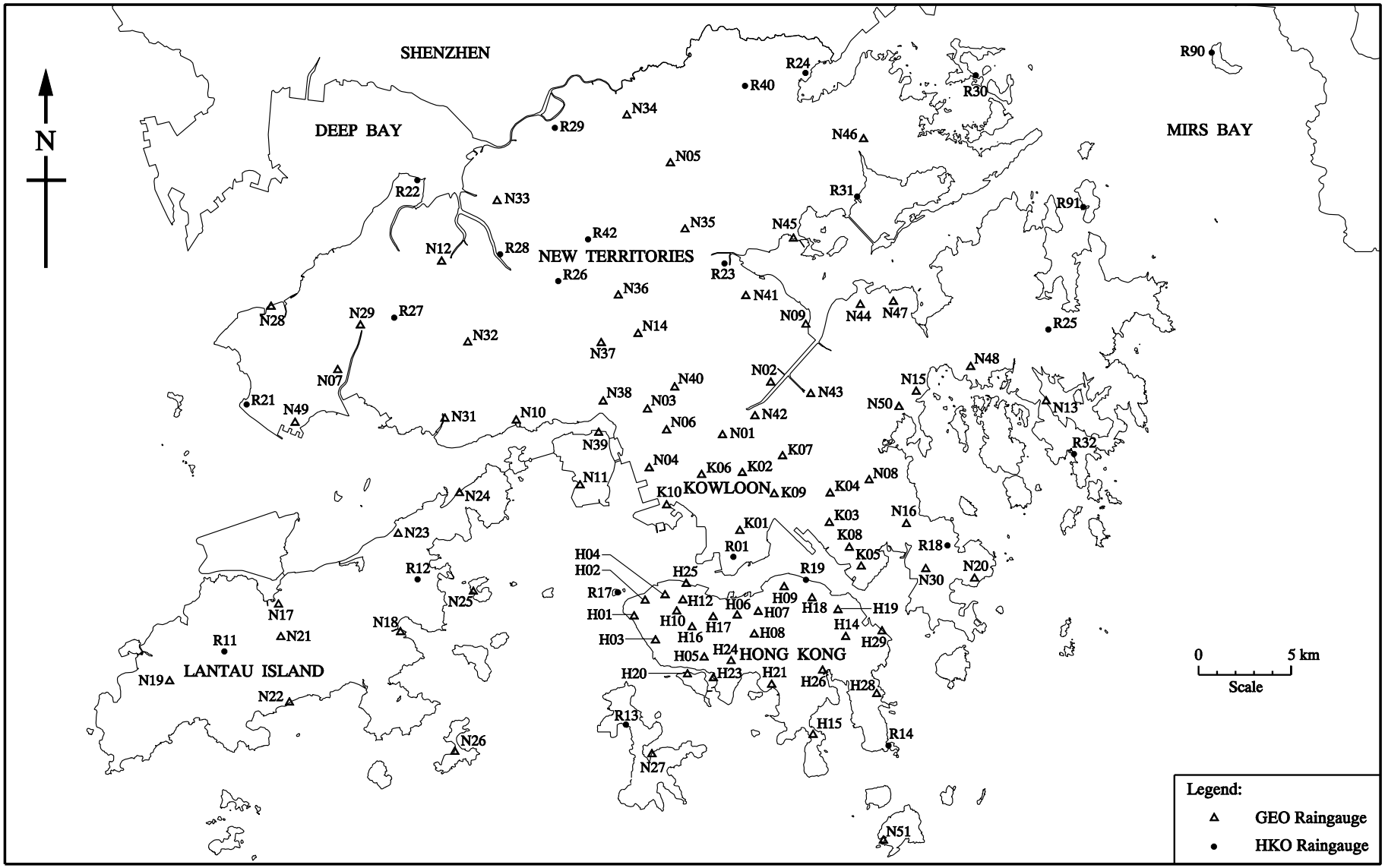


Figure 1 - Locations of GEO and HKO Automatic Raingauges

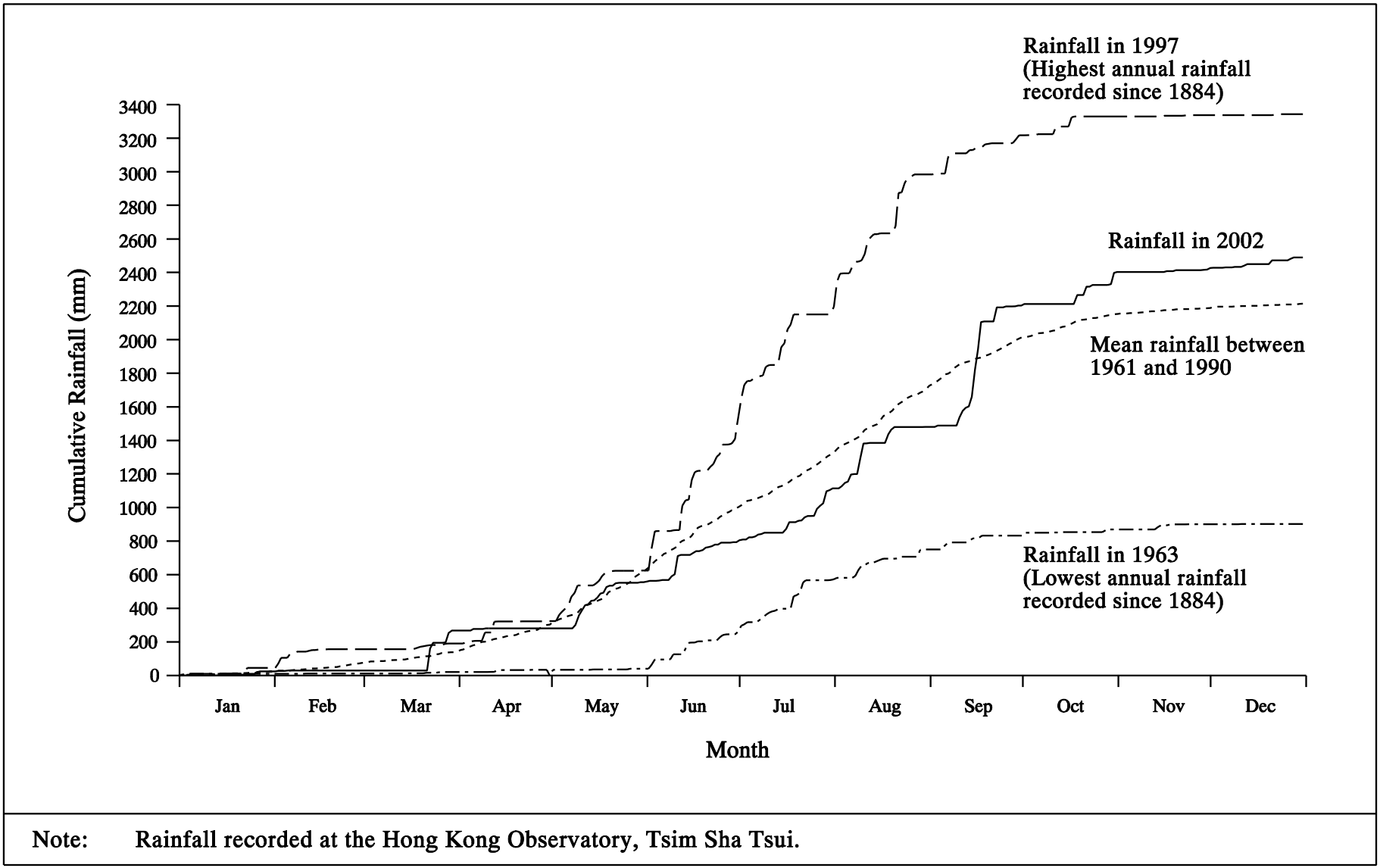
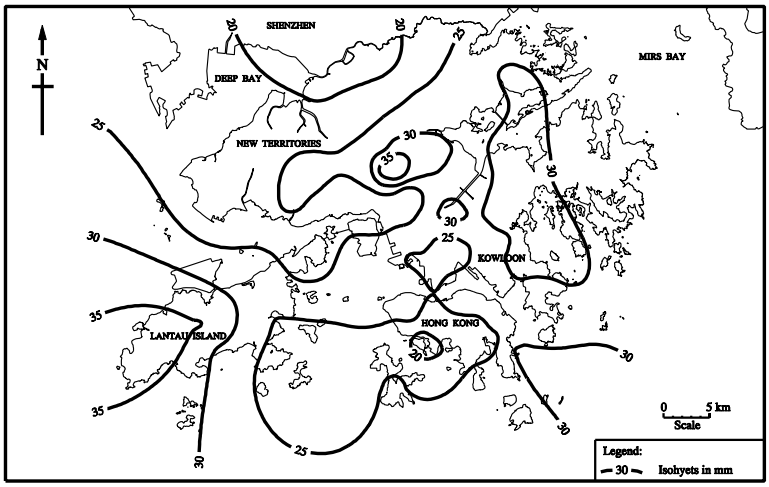
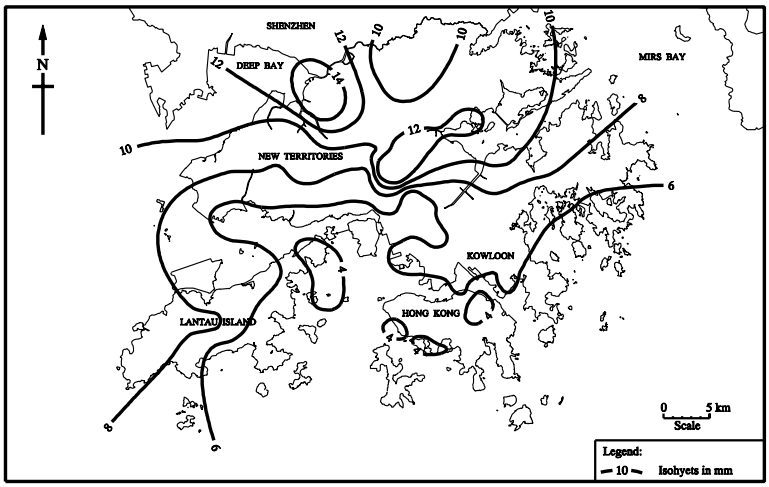


Figure 2 - Cumulative Rainfall for 2002 at the Hong Kong Observatory and Its Recorded Highest, Mean and Lowest Cumulative Rainfalls

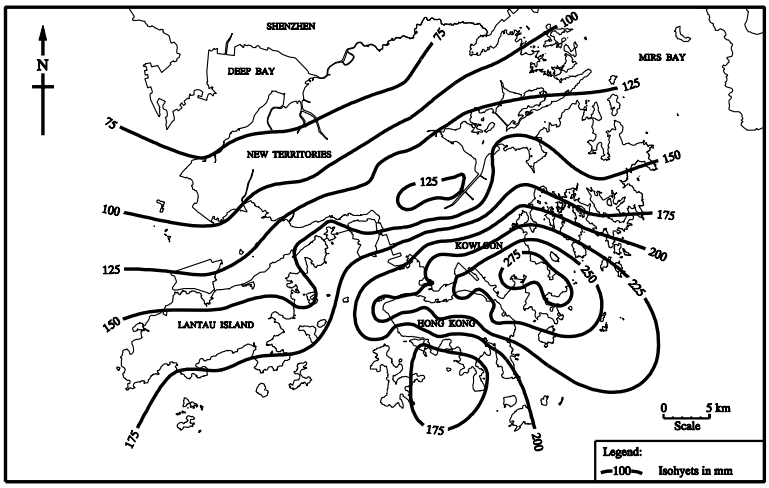
Table of Contents
Table of Contents
Table of Contents
Table of Contents
Table of Contents



January 2002



February 2002

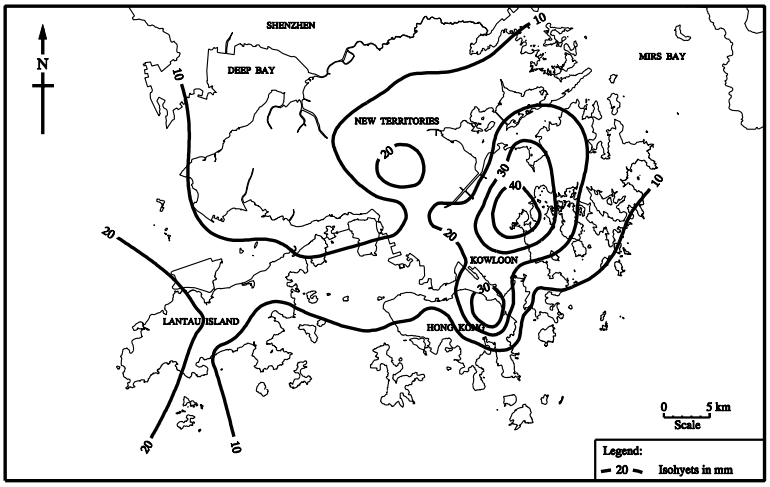


March 2002

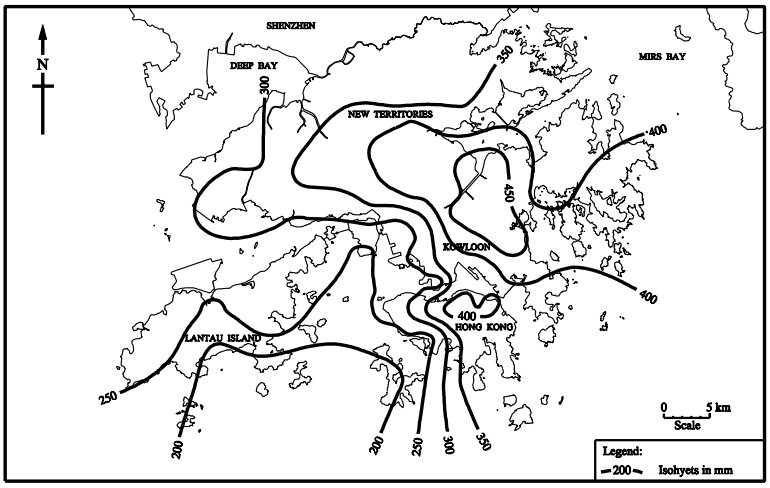
Note: Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.

Figure 3a - Total Monthly Rainfall Distribution in 2002

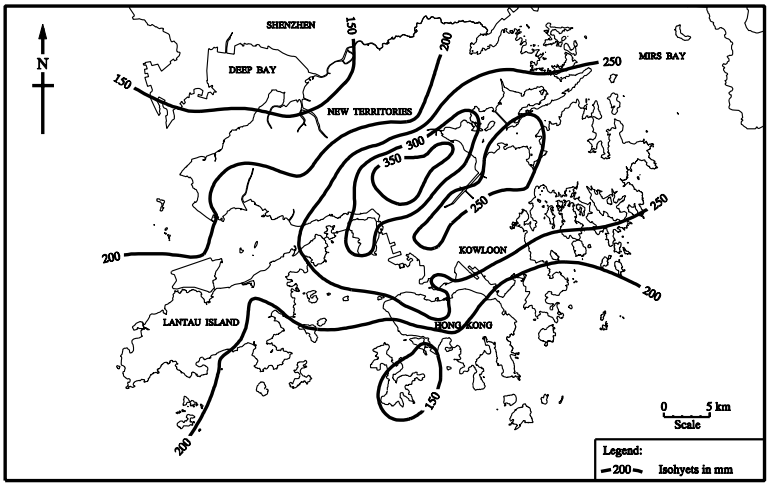
Table of Contents
Table of Contents
Table of Contents
Table of Contents



April 2002



May 2002

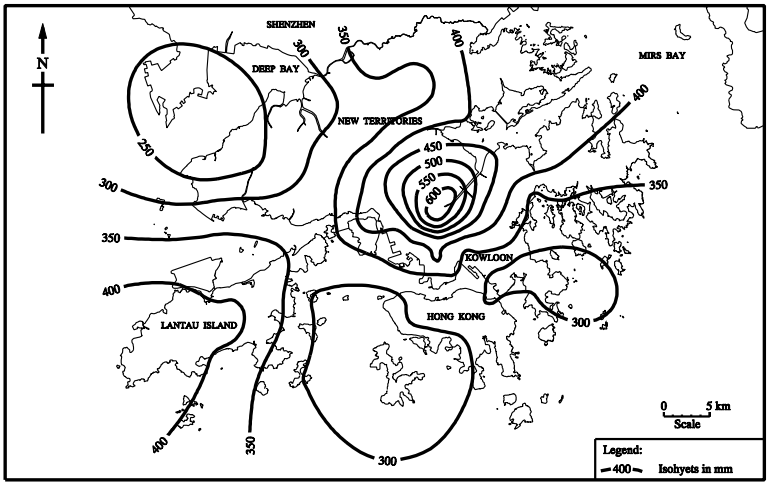


June 2002

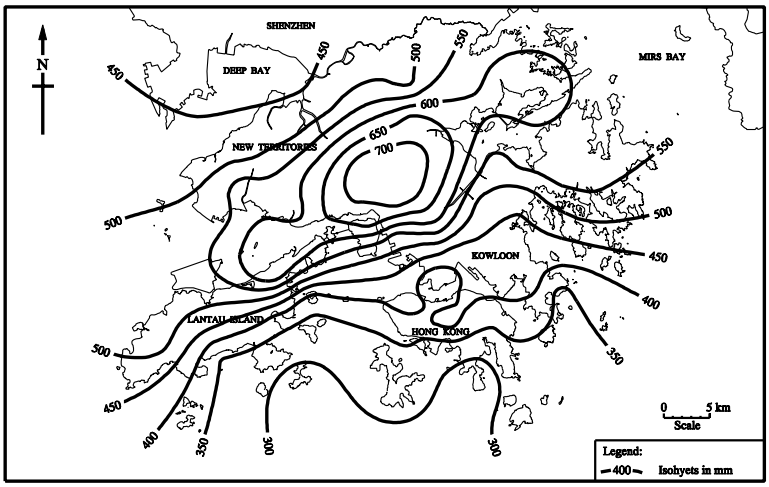
Note: **Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.**

Figure 3b - Total Monthly Rainfall Distribution in 2002

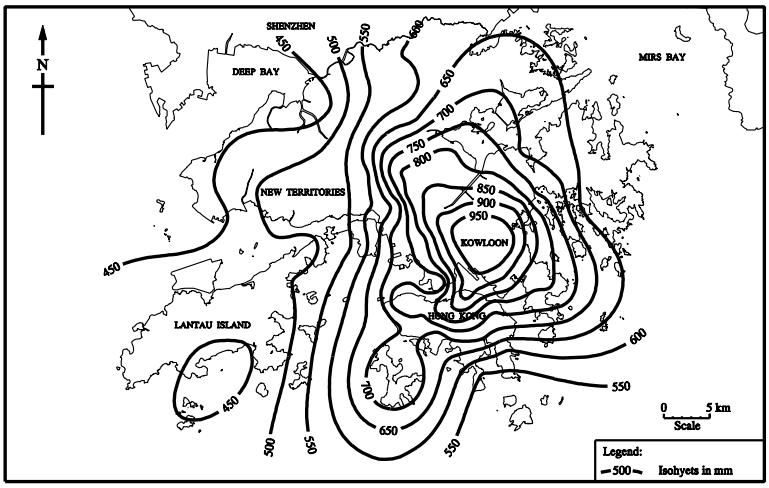
Table of Contents
Table of Contents
Table of Contents
Table of Contents



July 2002



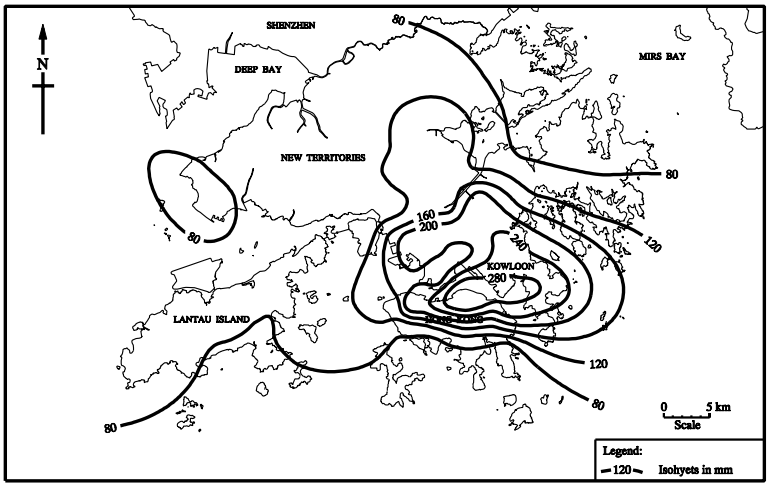
August 2002



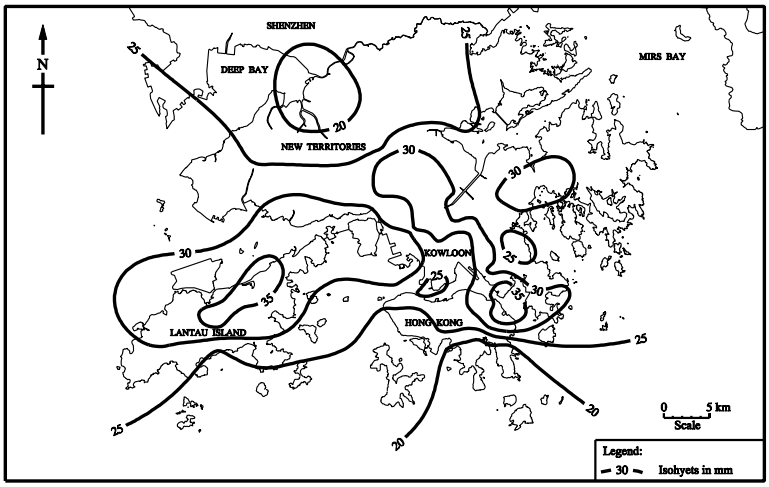
September 2002

Note: **Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.**

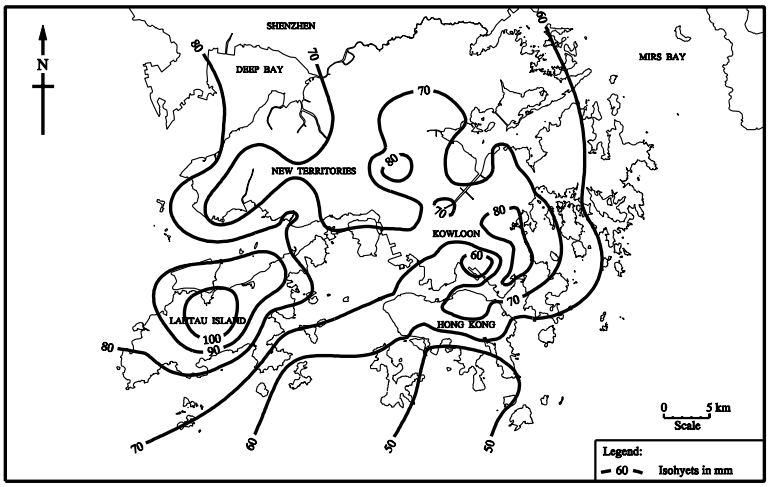
Figure 3c - Total Monthly Rainfall Distribution in 2002



October 2002



November 2002



December 2002

Note: Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.

Figure 3d - Total Monthly Rainfall Distribution in 2002

Table of Contents
Table of Contents
Table of Contents
Table of Contents

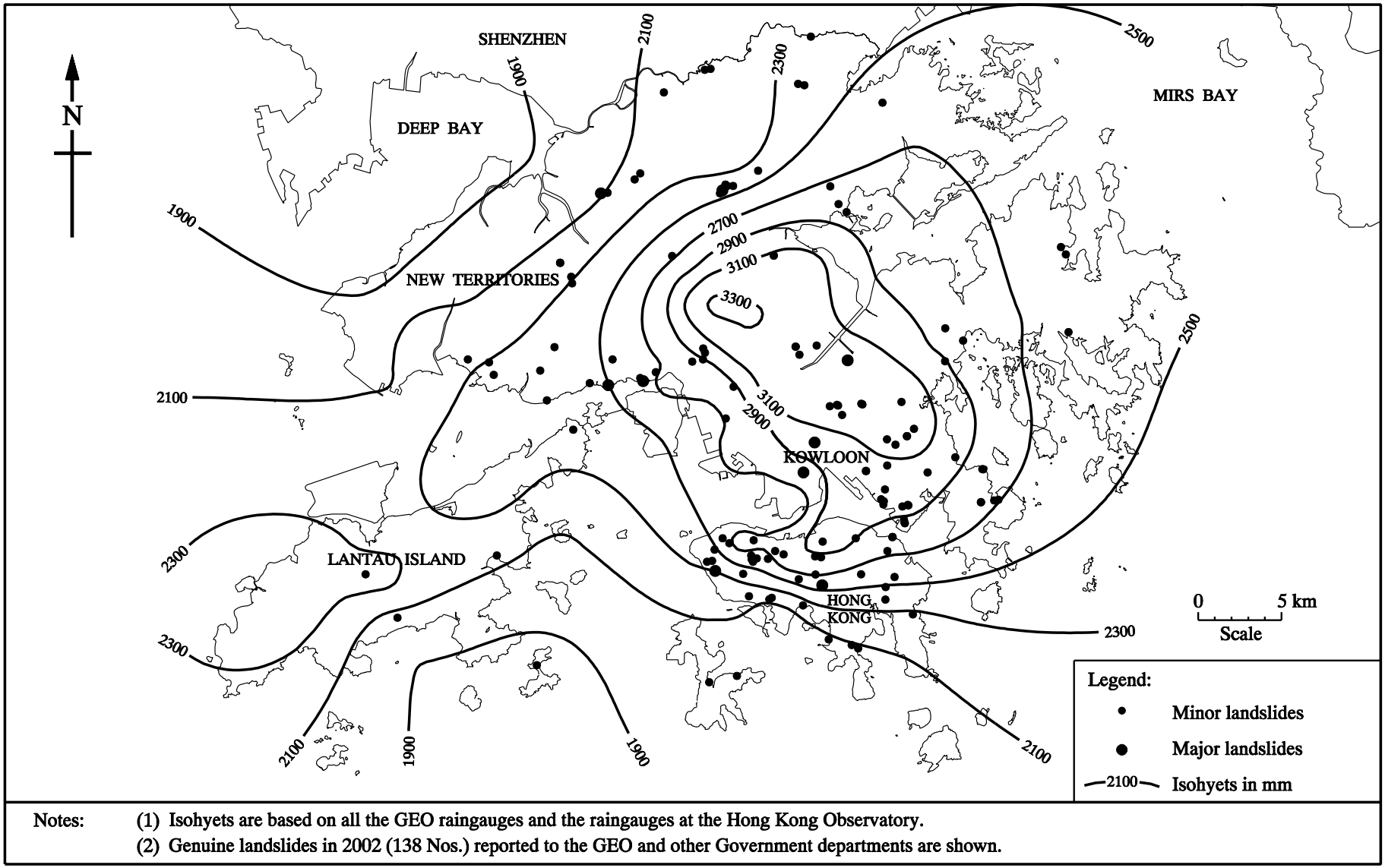
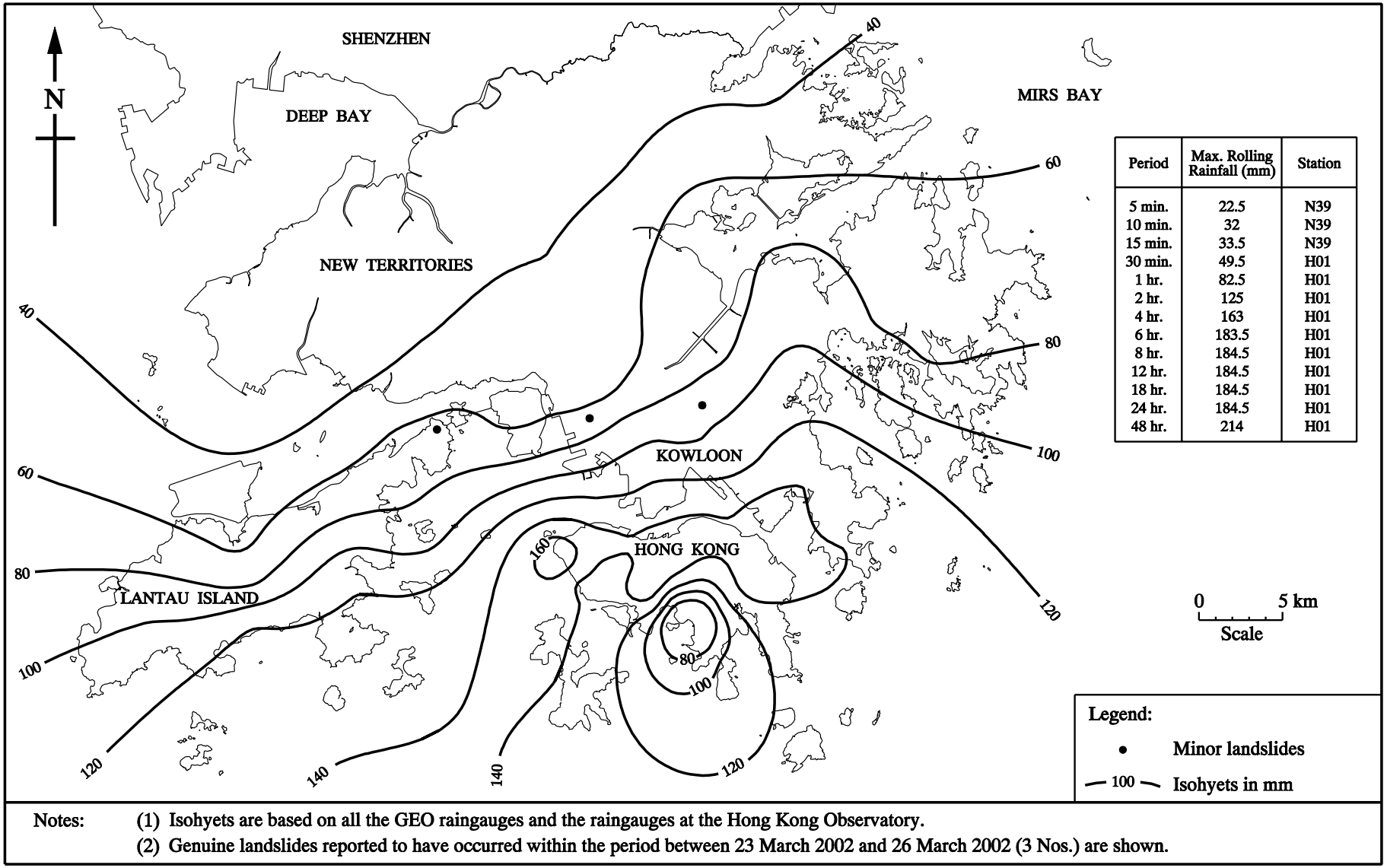


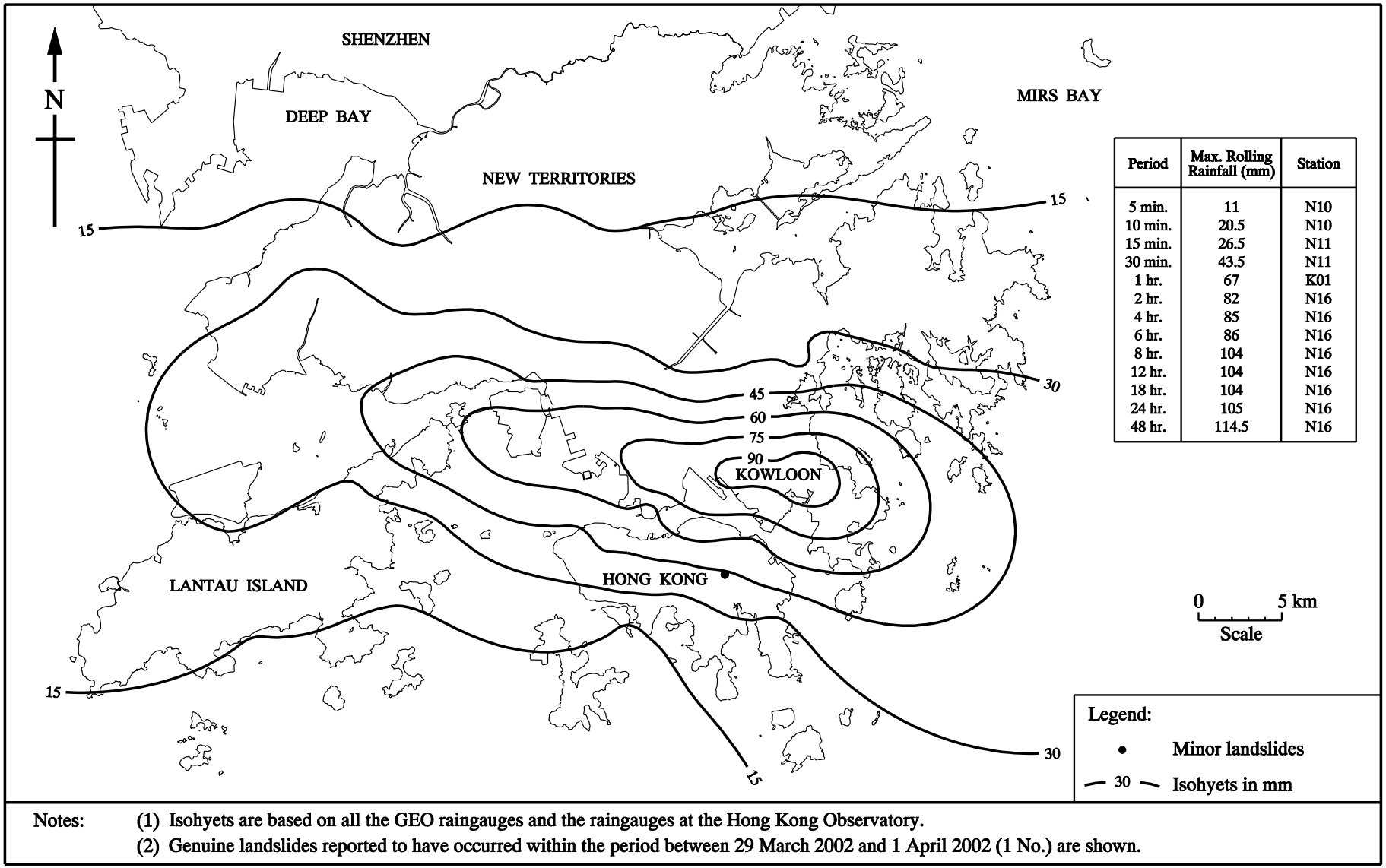
Figure 4 - Total Annual Rainfall Distribution and Locations of Landslides in 2002



Period	Max. Rolling Rainfall (mm)	Station
5 min.	22.5	N39
10 min.	32	N39
15 min.	33.5	N39
30 min.	49.5	H01
1 hr.	82.5	H01
2 hr.	125	H01
4 hr.	163	H01
6 hr.	183.5	H01
8 hr.	184.5	H01
12 hr.	184.5	H01
18 hr.	184.5	H01
24 hr.	184.5	H01
48 hr.	214	H01

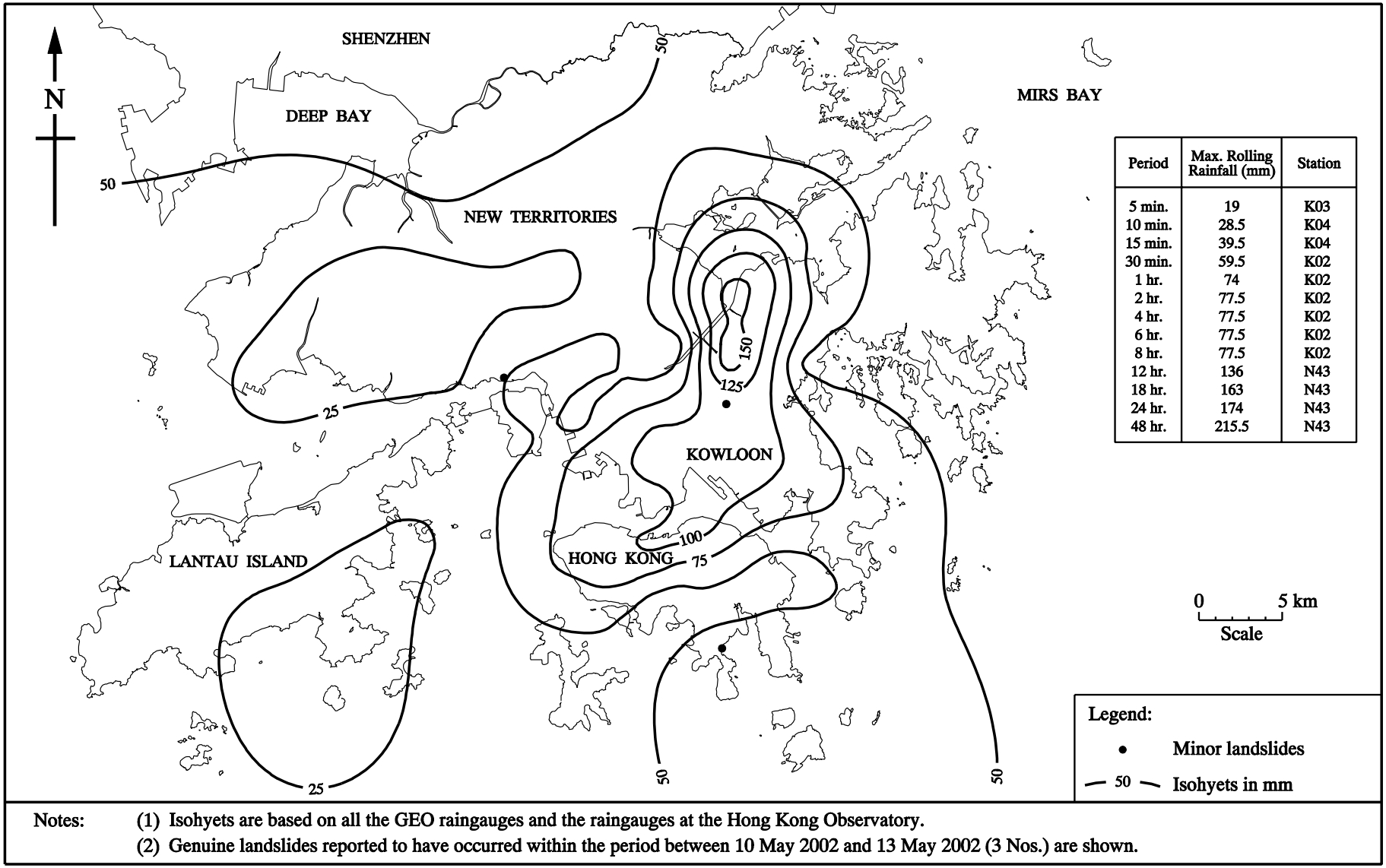
Notes: (1) Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.
(2) Genuine landslides reported to have occurred within the period between 23 March 2002 and 26 March 2002 (3 Nos.) are shown.

Figure 5 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 23 March 2002 and 23:55 on 24 March 2002 and Locations of Landslides



Period	Max. Rolling Rainfall (mm)	Station
5 min.	11	N10
10 min.	20.5	N10
15 min.	26.5	N11
30 min.	43.5	N11
1 hr.	67	K01
2 hr.	82	N16
4 hr.	85	N16
6 hr.	86	N16
8 hr.	104	N16
12 hr.	104	N16
18 hr.	104	N16
24 hr.	105	N16
48 hr.	114.5	N16

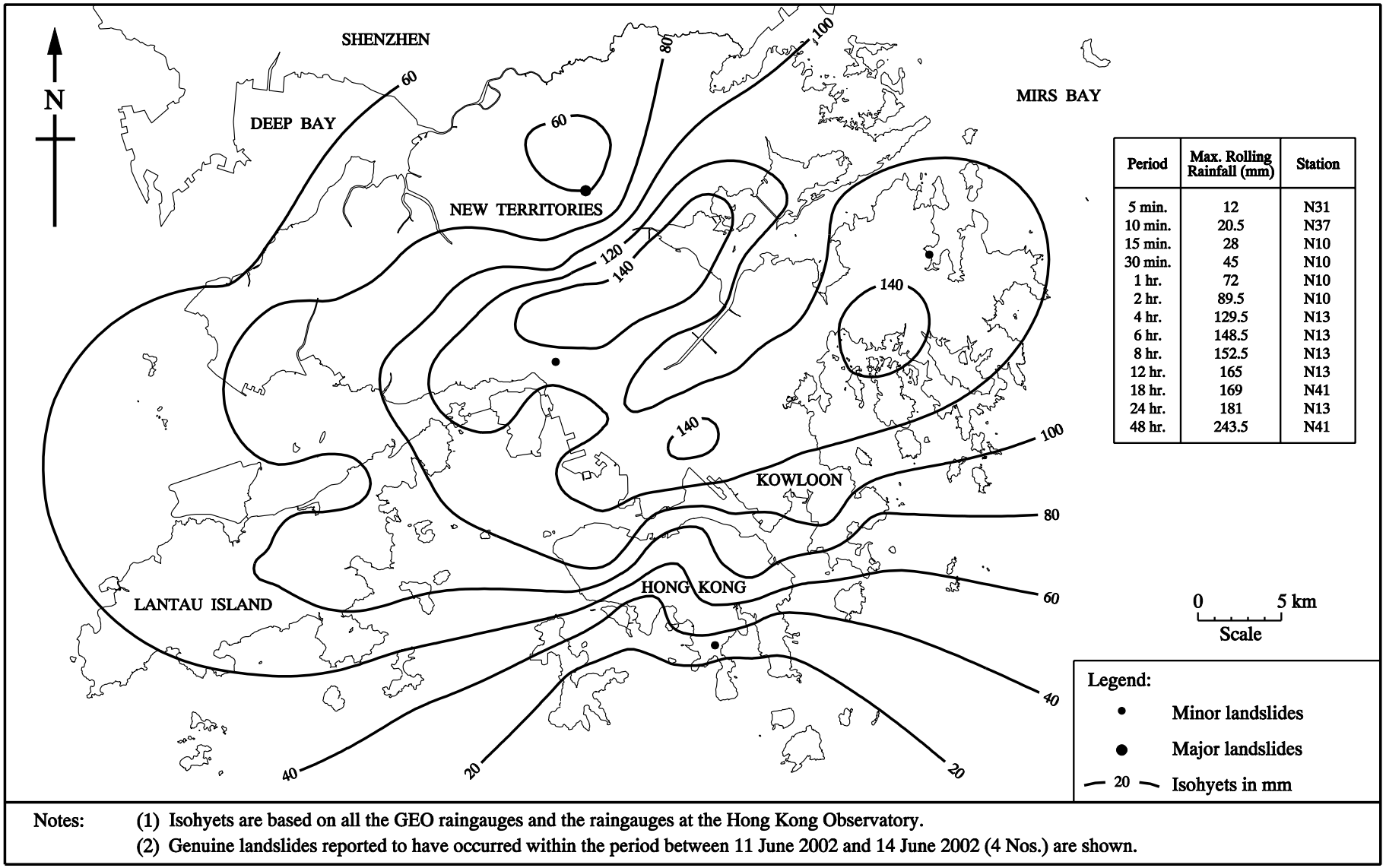
Figure 6 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 29 March 2002 and 23:55 on 30 March 2002 and Locations of Landslides



Period	Max. Rolling Rainfall (mm)	Station
5 min.	19	K03
10 min.	28.5	K04
15 min.	39.5	K04
30 min.	59.5	K02
1 hr.	74	K02
2 hr.	77.5	K02
4 hr.	77.5	K02
6 hr.	77.5	K02
8 hr.	77.5	K02
12 hr.	136	N43
18 hr.	163	N43
24 hr.	174	N43
48 hr.	215.5	N43

Notes: (1) Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.
(2) Genuine landslides reported to have occurred within the period between 10 May 2002 and 13 May 2002 (3 Nos.) are shown.

Figure 7 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 10 May 2002 and 23:55 on 11 May 2002 and Locations of Landslides

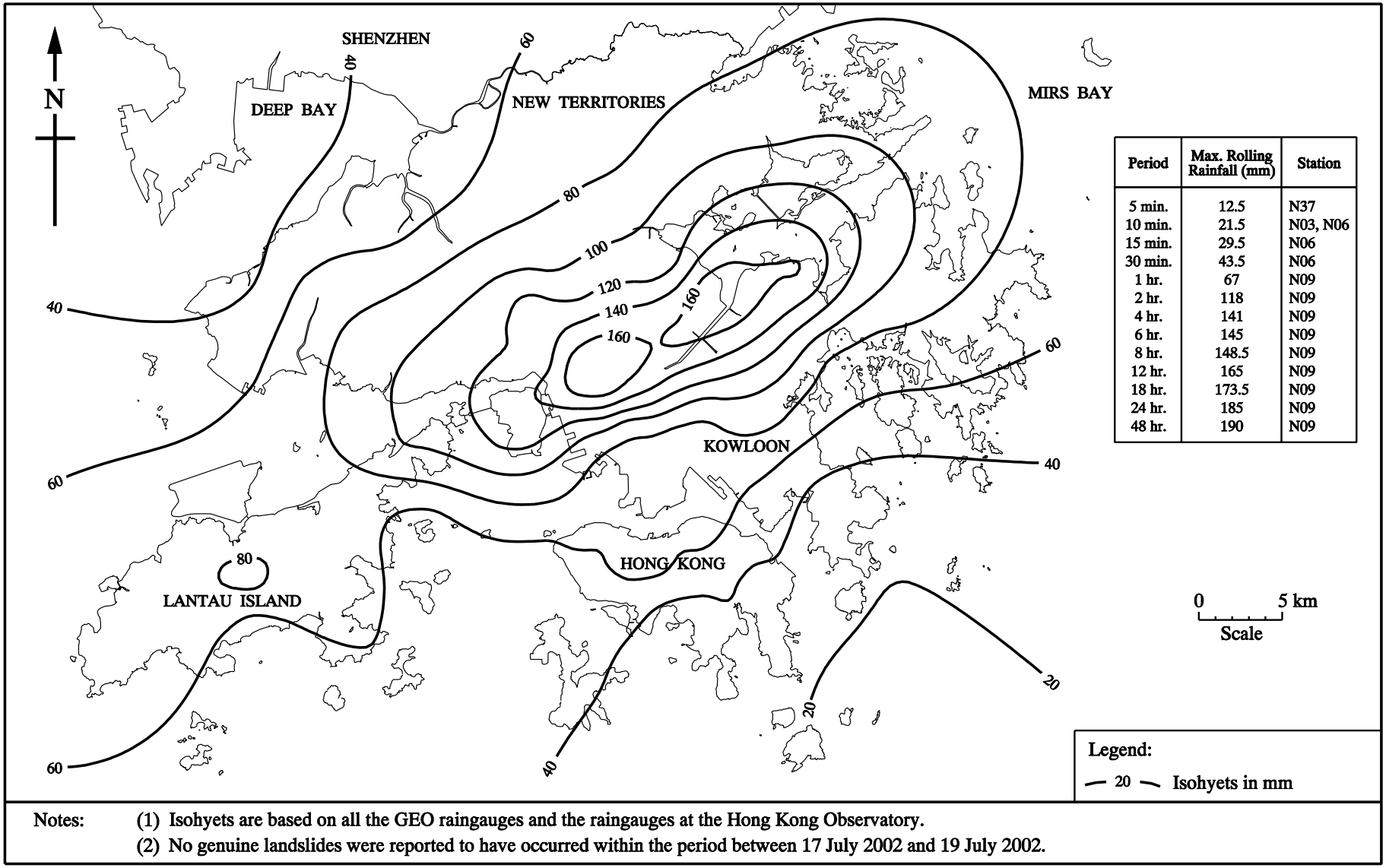


Period	Max. Rolling Rainfall (mm)	Station
5 min.	12	N31
10 min.	20.5	N37
15 min.	28	N10
30 min.	45	N10
1 hr.	72	N10
2 hr.	89.5	N10
4 hr.	129.5	N13
6 hr.	148.5	N13
8 hr.	152.5	N13
12 hr.	165	N13
18 hr.	169	N41
24 hr.	181	N13
48 hr.	243.5	N41

Notes: (1) Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.
(2) Genuine landslides reported to have occurred within the period between 11 June 2002 and 14 June 2002 (4 Nos.) are shown.

Figure 8 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 11 June 2002 and 23:55 on 12 June 2002 and Locations of Landslides

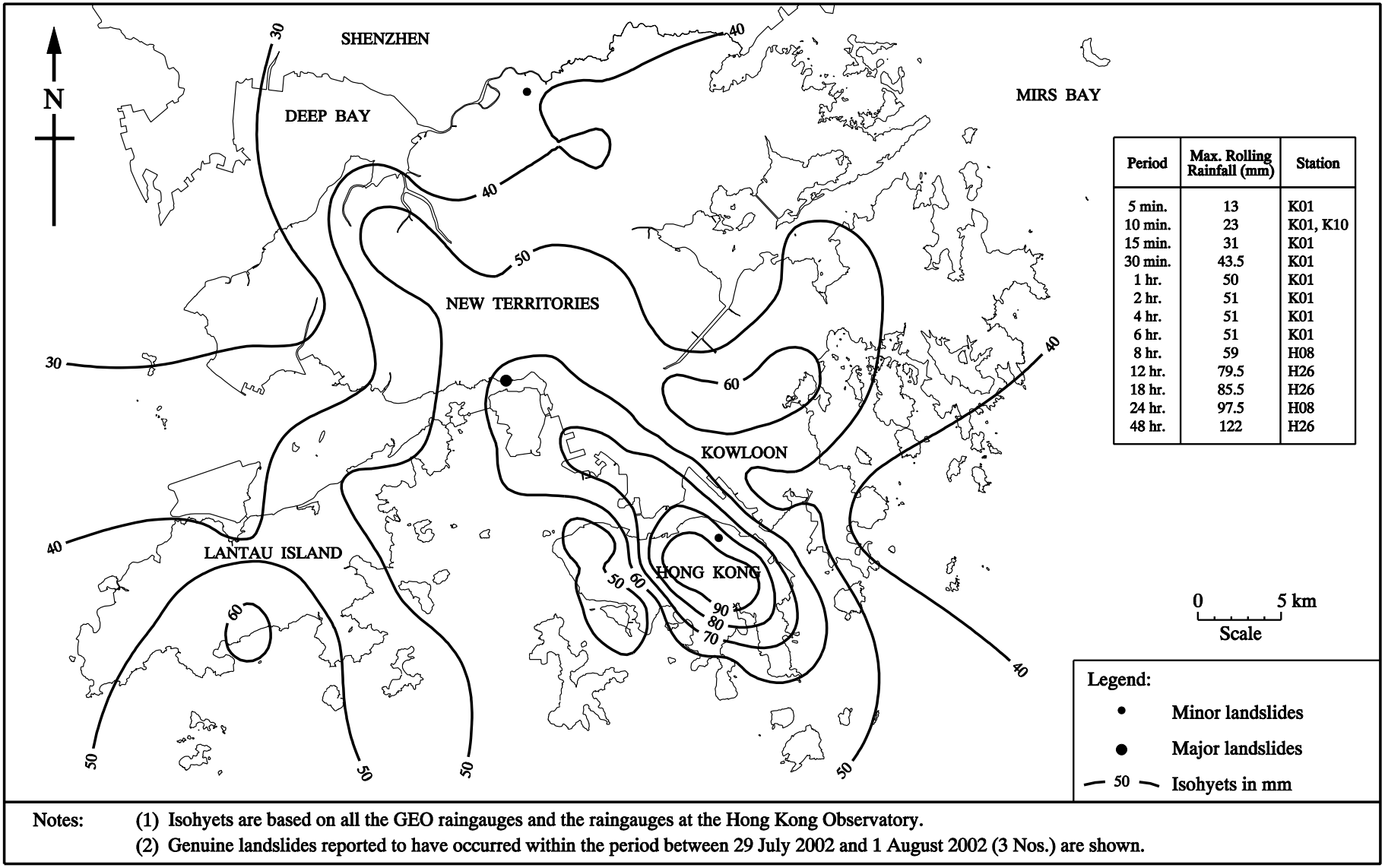
Table of Contents
Table of Contents
Table of Contents
Table of Contents
Table of Contents



Period	Max. Rolling Rainfall (mm)	Station
5 min.	12.5	N37
10 min.	21.5	N03, N06
15 min.	29.5	N06
30 min.	43.5	N06
1 hr.	67	N09
2 hr.	118	N09
4 hr.	141	N09
6 hr.	145	N09
8 hr.	148.5	N09
12 hr.	165	N09
18 hr.	173.5	N09
24 hr.	185	N09
48 hr.	190	N09

Notes: (1) Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.
(2) No genuine landslides were reported to have occurred within the period between 17 July 2002 and 19 July 2002.

Figure 9 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 17 July 2002 and 23:55 on 17 July 2002 and Locations of Landslides

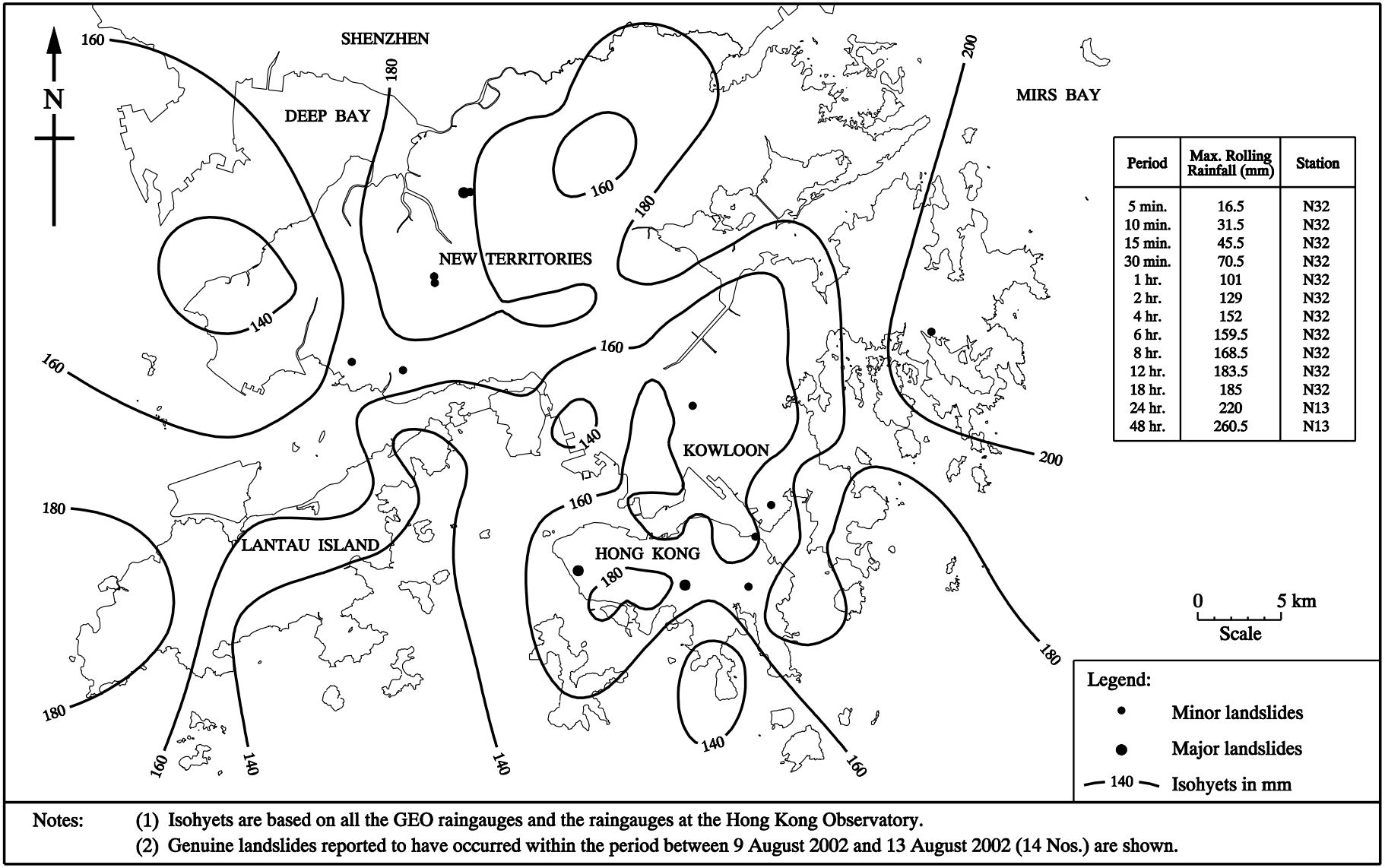


Period	Max. Rolling Rainfall (mm)	Station
5 min.	13	K01
10 min.	23	K01, K10
15 min.	31	K01
30 min.	43.5	K01
1 hr.	50	K01
2 hr.	51	K01
4 hr.	51	K01
6 hr.	51	K01
8 hr.	59	H08
12 hr.	79.5	H26
18 hr.	85.5	H26
24 hr.	97.5	H08
48 hr.	122	H26

Notes: (1) Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.
(2) Genuine landslides reported to have occurred within the period between 29 July 2002 and 1 August 2002 (3 Nos.) are shown.

Figure 10 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 29 July 2002 and 23:55 on 30 July 2002 and Locations of Landslides

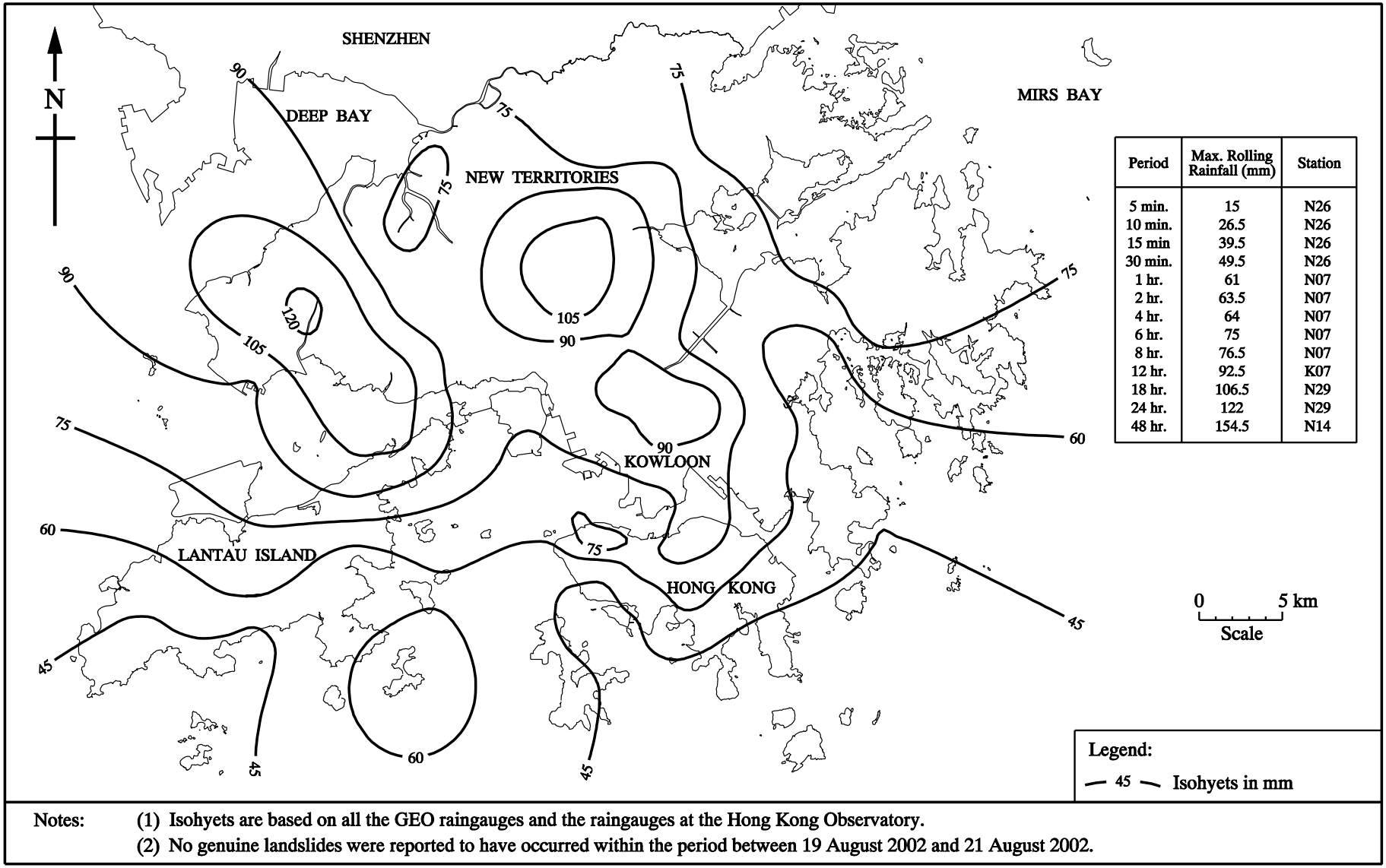
Table of Contents
Table of Contents
Table of Contents
Table of Contents
Table of Contents



Period	Max. Rolling Rainfall (mm)	Station
5 min.	16.5	N32
10 min.	31.5	N32
15 min.	45.5	N32
30 min.	70.5	N32
1 hr.	101	N32
2 hr.	129	N32
4 hr.	152	N32
6 hr.	159.5	N32
8 hr.	168.5	N32
12 hr.	183.5	N32
18 hr.	185	N32
24 hr.	220	N13
48 hr.	260.5	N13

Notes: (1) Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.
(2) Genuine landslides reported to have occurred within the period between 9 August 2002 and 13 August 2002 (14 Nos.) are shown.

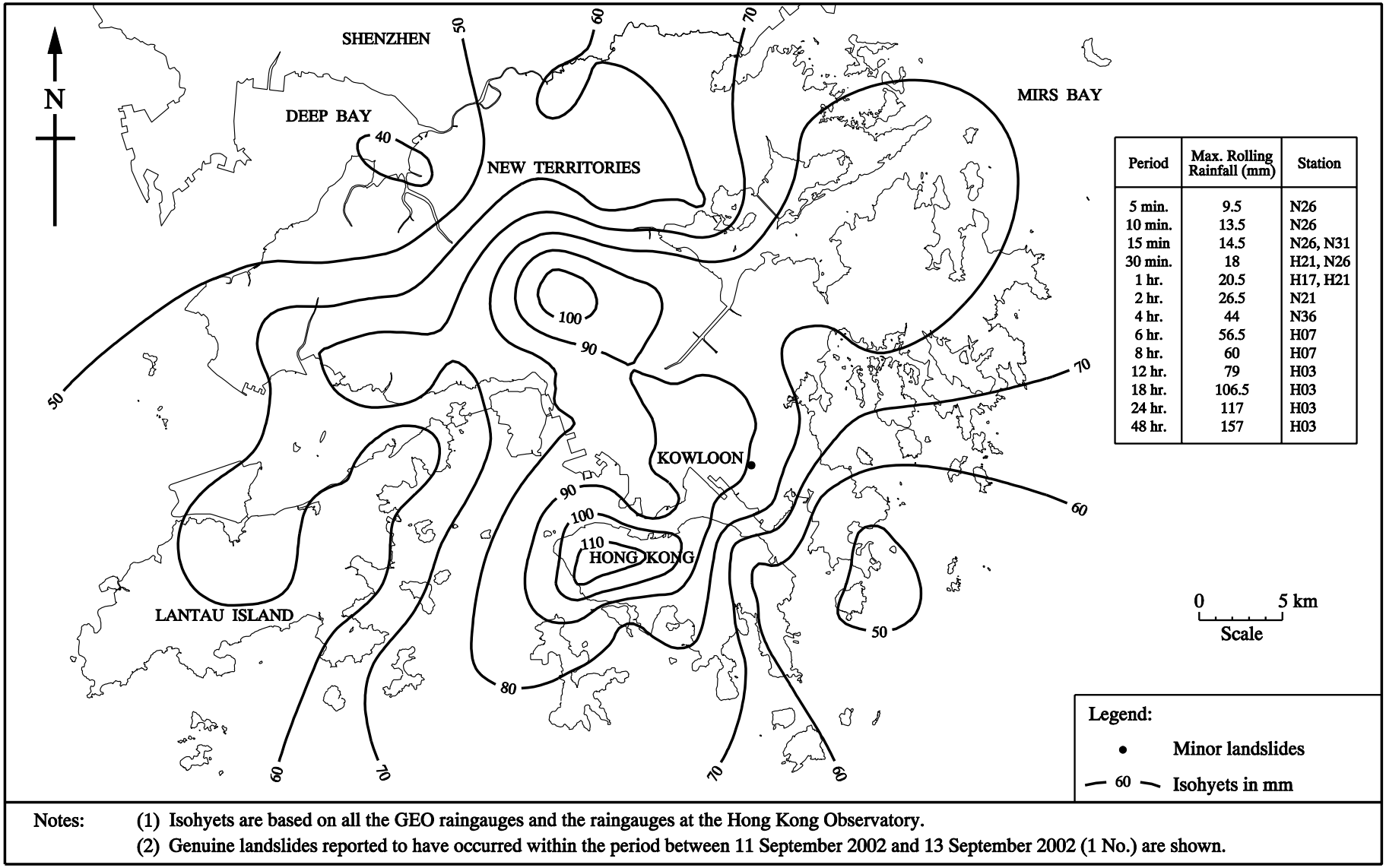
Figure 11 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 9 August 2002 and 23:55 on 11 August 2002 and Locations of Landslides



Period	Max. Rolling Rainfall (mm)	Station
5 min.	15	N26
10 min.	26.5	N26
15 min	39.5	N26
30 min.	49.5	N26
1 hr.	61	N07
2 hr.	63.5	N07
4 hr.	64	N07
6 hr.	75	N07
8 hr.	76.5	N07
12 hr.	92.5	K07
18 hr.	106.5	N29
24 hr.	122	N29
48 hr.	154.5	N14

Notes: (1) Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.
(2) No genuine landslides were reported to have occurred within the period between 19 August 2002 and 21 August 2002.

Figure 12 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 19 August 2002 and 23:55 on 19 August 2002 and Locations of Landslides



Period	Max. Rolling Rainfall (mm)	Station
5 min.	9.5	N26
10 min.	13.5	N26
15 min	14.5	N26, N31
30 min.	18	H21, N26
1 hr.	20.5	H17, H21
2 hr.	26.5	N21
4 hr.	44	N36
6 hr.	56.5	H07
8 hr.	60	H07
12 hr.	79	H03
18 hr.	106.5	H03
24 hr.	117	H03
48 hr.	157	H03

Notes: (1) Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.
(2) Genuine landslides reported to have occurred within the period between 11 September 2002 and 13 September 2002 (1 No.) are shown.

Figure 13 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 11 September 2002 and 23:55 on 11 September 2002 and Locations of Landslides

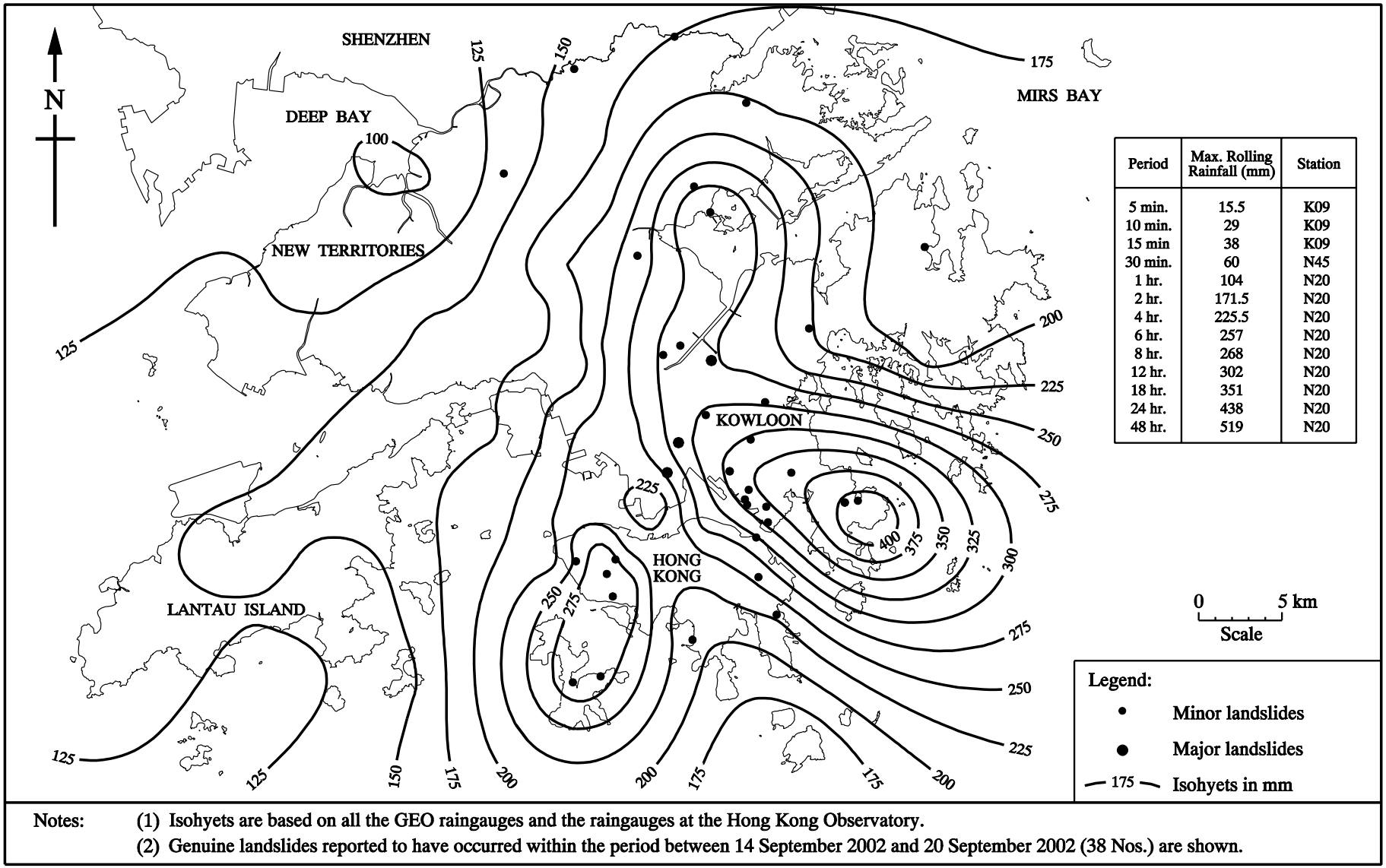


Figure 14 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 14 September 2002 and 23:55 on 18 September 2002 and Locations of Landslides

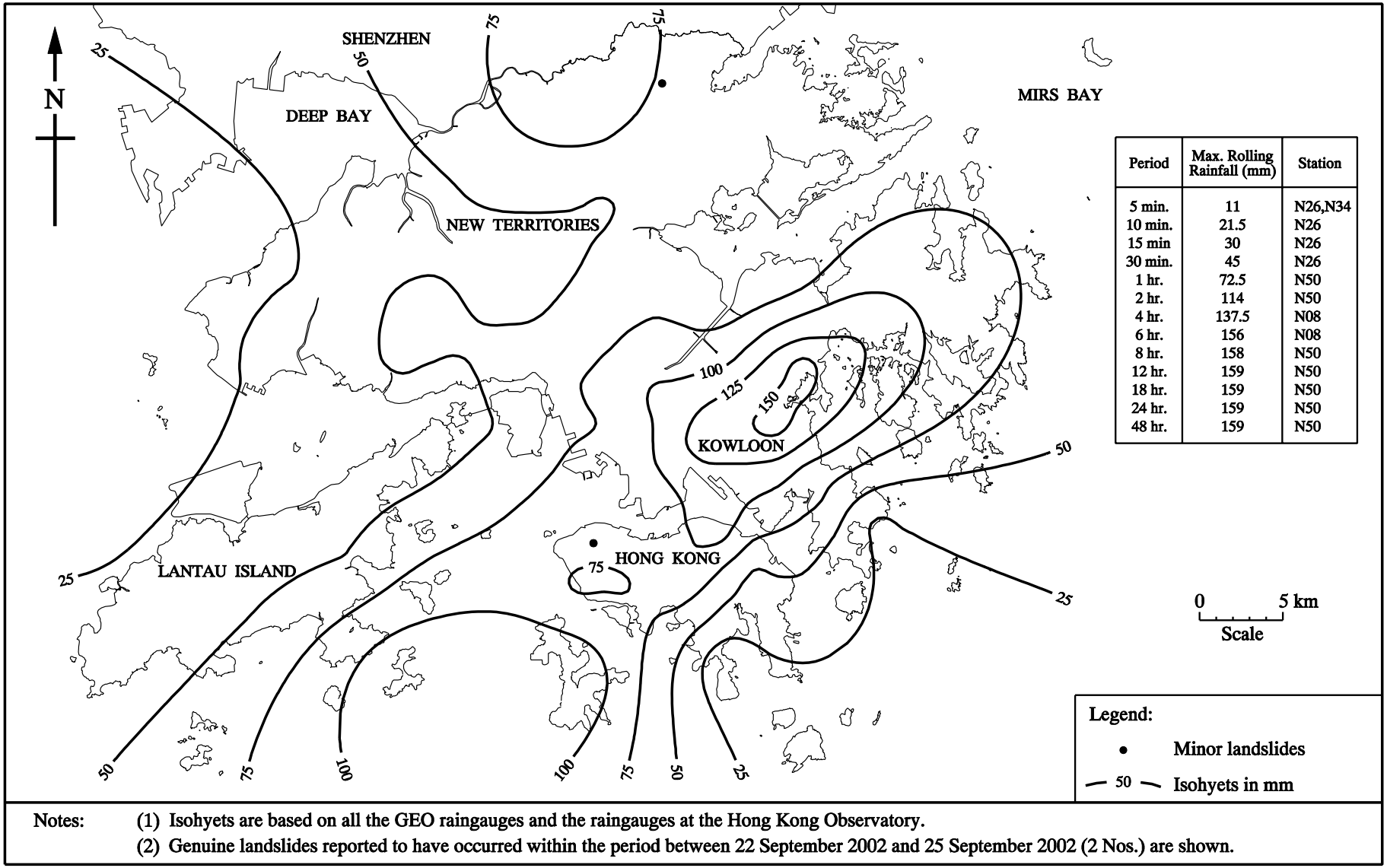
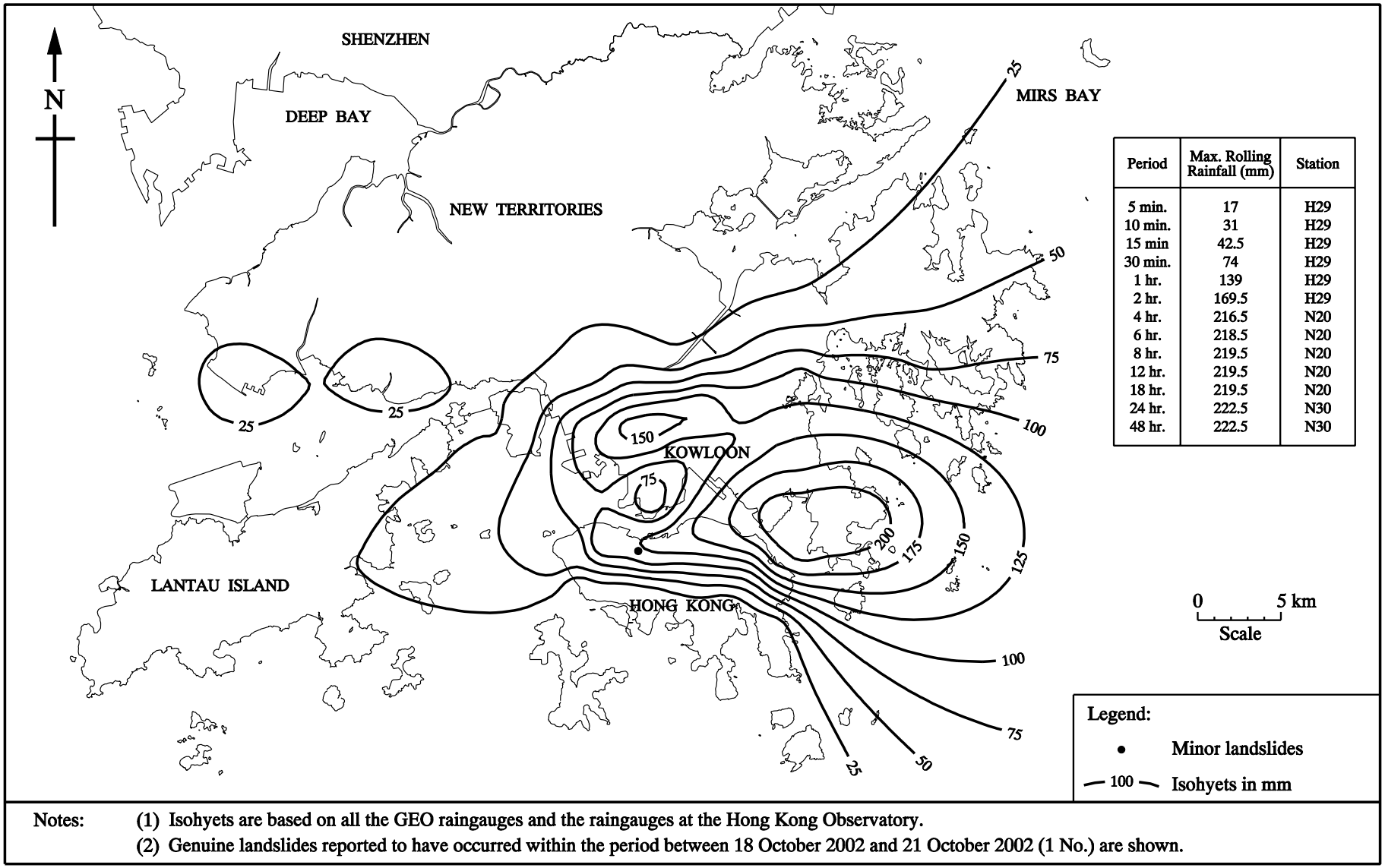


Figure 15 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 22 September 2002 and 23:55 on 23 September 2002 and Locations of Landslides

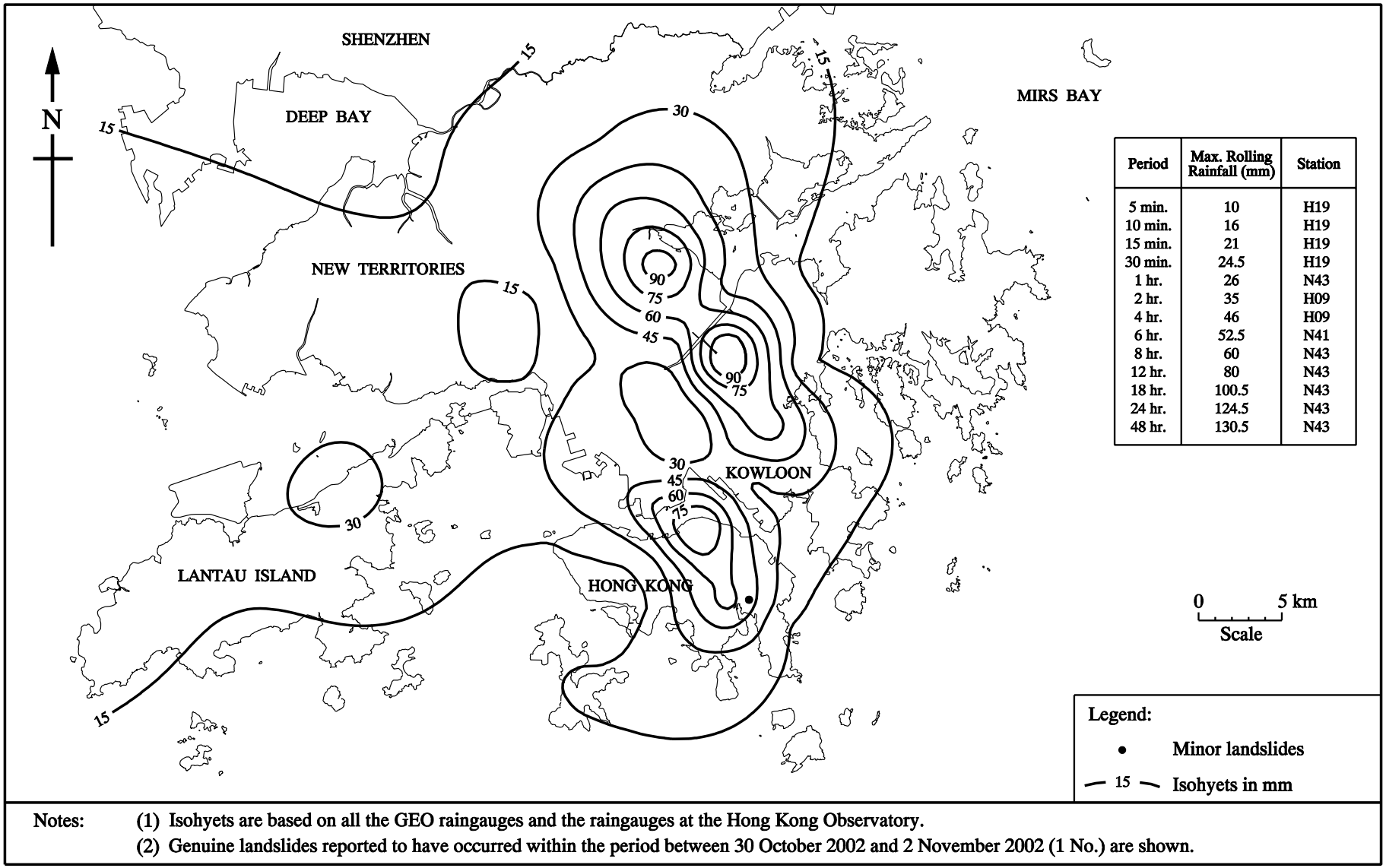
Table of Contents
Table of Contents
Table of Contents
Table of Contents
Table of Contents



Period	Max. Rolling Rainfall (mm)	Station
5 min.	17	H29
10 min.	31	H29
15 min	42.5	H29
30 min.	74	H29
1 hr.	139	H29
2 hr.	169.5	H29
4 hr.	216.5	N20
6 hr.	218.5	N20
8 hr.	219.5	N20
12 hr.	219.5	N20
18 hr.	219.5	N20
24 hr.	222.5	N30
48 hr.	222.5	N30

Notes: (1) Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.
(2) Genuine landslides reported to have occurred within the period between 18 October 2002 and 21 October 2002 (1 No.) are shown.

Figure 16 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 18 October 2002 and 23:55 on 19 October 2002 and Locations of Landslides



Period	Max. Rolling Rainfall (mm)	Station
5 min.	10	H19
10 min.	16	H19
15 min.	21	H19
30 min.	24.5	H19
1 hr.	26	N43
2 hr.	35	H09
4 hr.	46	H09
6 hr.	52.5	N41
8 hr.	60	N43
12 hr.	80	N43
18 hr.	100.5	N43
24 hr.	124.5	N43
48 hr.	130.5	N43

Notes: (1) Isohyets are based on all the GEO raingauges and the raingauges at the Hong Kong Observatory.
(2) Genuine landslides reported to have occurred within the period between 30 October 2002 and 2 November 2002 (1 No.) are shown.

Figure 17 - Maximum Rolling 24-hour Rainfall Distribution for the Period between 00:00 on 30 October 2002 and 23:55 on 31 October 2002 and Locations of Landslides

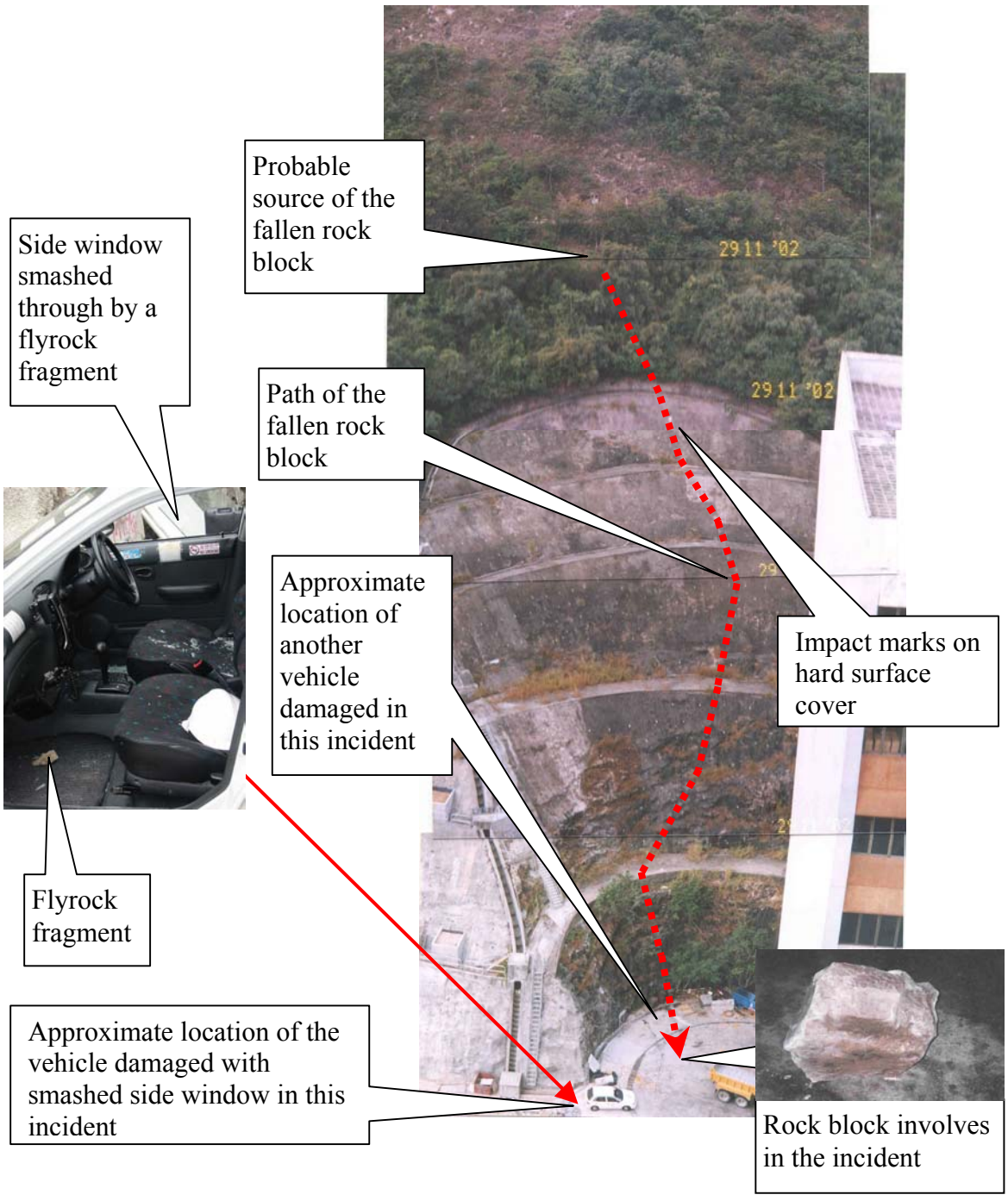
Table of Contents
Table of Contents
Table of Contents
Table of Contents
Table of Contents

LIST OF PLATES

(Photograph taken on 15.9.2002)

Description: A major failure on a cut slope resulted in temporary evacuation of six 3-storey village houses.

Plate 1 - The 15 September 2002 Landslide on Slope No. 7SE-C/CR323 behind Houses Nos. 11 to 16 Ngau Pei Sha New Village, Sha Tin (Incident No. 2002/09/0092)



(Photograph taken on 29.11.2002)

Description: A rockfall from the ground above a 36-m high cut slope resulted in minor injury to the driver in a vehicle parked at the slope toe. The incident also caused damage to two vehicles and temporary closure of Yip Hing Street.

Plate 2 - The 28 November 2002 Rockfall from the Ground above Slope No. 11SW-D/C639 at Yip Hing Street, Wong Chuk Hang (Incident No. 2002/11/0164)

Table of Contents
Table of Contents
Table of Contents
Table of Contents

(Photograph taken on 9.8.2002)

Description: A major landslide occurred on a soil/rock cut slope. The incident resulted in temporary closure of one lane of Yau Tam Mei Tsuen Road, Yuen Long.

Plate 3 - The 9 August 2002 Landslide on Slope No. 2SE-C/C199 at Yau Tam Mei Tsuen Road, Yuen Long (Incident No. 2002/08/0064)

(Photograph taken on 16.8.2002)

Description: A major landslide occurred on the soil portion of a soil/rock cut slope located within the works area of a road improvement project.

Plate 4 - The 10 August 2002 Landslide on a Cut Slope within An Active Construction Site at Victoria Road, Pokfulam (Incident No. 2002/08/0076)

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Table of Contents
Table of Contents
Table of Contents

(Photograph taken on 23.3.2002)

Description: A rockfall occurred on the exposed rock cut portion of a soil/rock cut slope. The incident resulted in temporary closure of one lane of Castle Peak Road.

Plate 5 - The 23 March 2002 Rockfall from Slope No. 11NW-A/C61 at Castle Peak Road, Kwai Chung (Incident No. 2002/03/0012)

(Photograph taken on 29.7.2002 by HyD)

Description: A landslide incident occurred on a retaining wall below Castle Peak Road. The incident resulted in complete closure of the road temporarily. The retaining wall is located within the works area of a road widening project.

Plate 6 - The 29 July 2002 Landslide on Slope No. 6SE-D/FR133 below Castle Peak Road, Yau Kam Tau, Tsuen Wan (Incident No. 2002/07/0056)

Table of Contents
Table of Contents
Table of Contents
Table of Contents

(Photograph taken on 23.5.2002)

(Photograph taken on 22.5.2002)

Description: A rockfall occurred on a rock cut slope. The incident resulted in temporary closure of Shatin Pass Road.

Plate 7 - The 22 May 2002 Rockfall from Slope No. 11NE-A/C284 at Shatin Pass Road, Tsz Wan Shan (Incident No. 2002/05/0030)

Table of Contents
Table of Contents
Table of Contents

APPENDIX A

RAINFALL OF SELECTED RAINSTORMS RECORDED AT GEO RAINGAUGES

LIST OF TABLES

Table A1 - Rainstorms in which Rolling 24-hour Rainfall Exceeded 50 mm at any GEO Raingauge (Sheet 1 of 3)

Rainstorm (2002)		5 min		10 min		15 min		30 min	
		Max. rainfall (mm)	Station	Max. rainfall (mm)	Station	Max. rainfall (mm)	Station	Max. rainfall (mm)	Station
1	23-24 Mar 2002	22.5	N39	32	N39	33.5	N39	49.5	H01
2	29-30 Mar 2002	11	N10	20.5	N10	26.5	N11	43.5	N11
3	9-13 May 2002	19	K03	28.5	K04	39.5	K04	59.5	K02
4	16-17 May 2002	11.5	H15	21	H15	27.5	H26	42.5	H15
5	19-25 May 2002	18.5	H15	30.5	H15	41.5	H15, N32	69	N32
6	1-3 Jun 2002	12	H25	21	H25	28	H25	38	H25
7	9-12 Jun 2002	12	N31	20.5	N37	28	N10, N40	45	N10
8	3-5 Jul 2002	14	N34	26	N34	37.5	N34	65.5	N34
9	16-19 Jul 2002	12.5	N37	21.5	N03, N06	29.5	N06	43.5	N06
10	22 Jul 2002	9	N39	11.5	N21	14.5	N21	18.5	N21
11	26 Jul - 4 Aug 2002	13	H28, K01	24	K06	33.5	N01	47.5	N01
12	6-11 Aug 2002	16.5	N24, N32	31.5	N32	45.5	N32	70.5	N32
13	18-20 Aug 2002	15	N26	26.5	N26	39.5	N26	49.5	N26
14	3-4 Sep 2002	13.5	N36	24	K06, N34	30.5	K06	41.5	N12
15	10-18 Sep 2002	15.5	K09	29	K09	38	K09	60	N45
16	22-23 Sep 2002	11	N26, N34	21.5	N26	30	N26	45	N26
17	18-19 Oct 2002	17	H29	31	H29	42.5	H29	74	H29
18	21-22 Oct 2002	13.5	N34	24	N05	31	N05	43.5	N02
19	30-31 Oct 2002	10	H19	16	H19	21	H19	24.5	H19

Table of Contents
Table of Contents
Table of Contents

Table A1 - Rainstorms in which Rolling 24-hour Rainfall Exceeded 50 mm at any GEO Raingauge (Sheet 2 of 3)

Rainstorm (2002)		1 hr		2 hr		4 hr		6 hr	
		Max. rainfall (mm)	Station	Max. rainfall (mm)	Station	Max. rainfall (mm)	Station	Max. rainfall (mm)	Station
1	23-24 Mar 2002	82.5	H01	125	H01	163	H01	183.5	H01
2	29-30 Mar 2002	67	K01	82	N16	85	N16	86	N16
3	9-13 May 2002	74	K04, N43	105.5	N43	131	N43	133	N43
4	16-17 May 2002	60.5	H26	72.5	H26	76.5	H26	77.5	H26
5	19-25 May 2002	100.5	N32	128.5	N32	147.5	N32	148.5	N32
6	1-3 Jun 2002	53.5	H15	55.5	H15	55.5	H15	55.5	H15
7	9-12 Jun 2002	72	N10	89.5	N10	129.5	N13	148.5	N13
8	3-5 Jul 2002	92.5	N01	112	N01	113.5	N34	113.5	N34
9	16-19 Jul 2002	67	N09	118	N09	141	N09	145	N09
10	22 Jul 2002	21	N38	28.5	N39	31.5	N39	31.5	N39
11	26 Jul - 4 Aug 2002	51	N01	64	N31	73.5	N19	82.5	N19
12	6-11 Aug 2002	101	N32	142	N03	222.5	N03	251	N03
13	18-20 Aug 2002	61	N07	63.5	N07	64	N07	75	N07
14	3-4 Sep 2002	51	N12	52.5	N12	54.5	N12	60.5	K06
15	10-18 Sep 2002	104	N20	171.5	N20	225.5	N20	257	N20
16	22-23 Sep 2002	72.5	N50	114	N50	137.5	N08	156	N08
17	18-19 Oct 2002	139	H29	169.5	H29	216.5	N20	218.5	N20
18	21-22 Oct 2002	53.5	H09	55.5	H09	63.5	H09	67.5	H09
19	30-31 Oct 2002	26	N43	35	H09	46	H09	52.5	N41

Table A1 - Rainstorms in which Rolling 24-hour Rainfall Exceeded 50 mm at any GEO Raingauge (Sheet 3 of 3)

Rainstorm (2002)		8 hr		12 hr		18 hr		24 hr		48 hr	
		Max. rainfall (mm)	Station	Max. rainfall (mm)	Station	Max. rainfall (mm)	Station	Max. rainfall (mm)	Station	Max. rainfall (mm)	Station
1	23-24 Mar 2002	184.5	H01	184.5	H01	184.5	H01	184.5	H01	214	H01
2	29-30 Mar 2002	104	N16	104	N16	104	N16	105	N16	114.5	N16
3	9-13 May 2002	135.5	N43	158.5	N43	163.5	N43	174	N43	215.5	N43
4	16-17 May 2002	79.5	H26	94.5	H26	96	H26	100.5	H26	101	H26
5	19-25 May 2002	148.5	N32	151.5	N36	152	N36	152	N36	199.5	N32
6	1-3 Jun 2002	55.5	H15	56	H15	70	H28	70.5	H28	71	H28
7	9-12 Jun 2002	152.5	N13	165	N13	169	N41	181	N13	243.5	N41
8	3-5 Jul 2002	113.5	N34	113.5	N34	113.5	N34	168.5	N42	189	N42
9	16-19 Jul 2002	148.5	N09	165	N09	173.5	N09	185	N09	192.5	N09
10	22 Jul 2002	31.5	N39	31.5	N39	38	N19	53.5	N39	54	N38, N39
11	26 Jul - 4 Aug 2002	82.5	N19	114.5	N19, N21	115	N19, N21	115	N19, N21	139	N19
12	6-11 Aug 2002	283.5	N03	291	N03	293	N03	294.5	N03	305	N03
13	18-20 Aug 2002	76.5	N07	99	K07	106.5	N29	122	N29	180.5	N14
14	3-4 Sep 2002	65	K06	65	K06	65	K06	65	K06	66.5	K06
15	10-18 Sep 2002	268	N20	302	N20	351	N20	438	N20	519	N20
16	22-23 Sep 2002	158	N50	159	N50	159	N50	159	N50	159	N50
17	18-19 Oct 2002	219.5	N20	219.5	N20	219.5	N20	222.5	N30	222.5	N30
18	21-22 Oct 2002	70.5	H09	70.5	H09	71	H09	71	H09	71	H09
19	30-31 Oct 2002	60	N43	80	N43	100.5	N43	124.5	N43	130.5	N43

Table of Contents
Table of Contents
Table of Contents

APPENDIX B

LIST OF LANDSLIDE INCIDENTS REPORTED TO THE GOVERNMENT

LIST OF TABLES

Table B1 - List of Major Landslide Incidents

Incident No.	Location	Slope No.	Failure			Facility Affected	Consequence
			Date (Time)	Feature Type	Scale (m^3)		
2002/07/0056	Below Castle Peak Road, along Approach Beach, Yau Kam Tau, Tsuen Wan	6SE-D/FR133	29/7 (13:30)	Masonry wall	55*	Road	2 lanes of road temporarily closed
2002/08/0064	Near Ngau Tam Mei Services Reservoir, Yau Tam Mei Tsuen Road, Yuen Long	2SE-C/C199	9/8 (05:30)	Soil/rock cut	100*	Road	1 lane of road temporarily closed
2002/08/0074	South of Electric Sub-station, Wong Nai Chung Gap Road	11SE-C/C737 (Majority) and 11SE-C/FR42	13/8 (10:30)	Soil cut	60	Pedestrian pavement	Collapse of pedestrian pavement
2002/08/0076	Victoria Road, opposite lamp post No. 39811, Pokfulam	Slope under construction	10/8 (07:00)	Soil cut	80*	Construction site	
2002/09/0092	Behind Lot No. 12-15, Ngau Pei Sha New Village, Sha Tin	7SE-C/CR323	15/9 (04:30)	Soil cut*	50	Village houses	6 village houses temporarily evacuated
ArchSD/UB-019-08008-407	Wo Hop Shek Cemetery	3SW-C/C790	12/6	Soil cut	100	Access footpath	
HD01/02	West of No. 49 and Church, Tung Tau Cottage Area, Wong Tai Sin	11NE-A/C396	15/9	Soil cut	70	Construction site	
HD02/02	Approx. 22 m from the junction of Sheung Shing Street and Sheung Lok Street, Homantin	11NW-D/C64	16/9	Soil/rock cut	60	Construction site	
HYD/NTW/2002/12/0013a	Adjacent to Tuen Mun Road, near Golden Villa and Pink Villa, Castle Road, Tsuen Wan	6SE-C/F203	Unknown	Fill	60	Stream course	

Legend:

*	Information from GEO's landslide investigation consultants and agreed by GEO's District Divisions.
#	Very minor landslide with negligible consequence (see Section 1 of the report for definition).
(1)	The man-made feature does not comply with the slope registration criteria given in GEO Circular No. 15.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Table B2 - List of Landslide Incidents in Hong Kong Island (Sheet 1 of 4)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/02/0005	Above slope No. 11SW-A/C600 behind Haking Wong Building, University of Hong Kong, Pokfulam	Natural hillside	5/2	BD	Unknown	Natural hillside	0.3 (Boulder fall)	Open area	
2002/02/0006	East of Hong Kong Stadium, So Kon Po	11SE-C/CR29	21/2	LCSD	10/2	Soil/rock cut	<0.5 (Rock fall)	Access road	
2002/04/0017#	Boa Vista, Mount Parker Road, Mount Parker	Natural hillside	31/3	Police	30/3	Natural hillside	~1	Trail	Trail temporarily closed
2002/05/0028	Footpath outside front of Buddhist Li Ka Shing Home for Elderly, Tai Hang Road, Tai Hang	Natural hillside	17/5	Police	17/5 (08:00)	Natural hillside	0.8 (Boulder fall)	Footpath	Footpath temporarily closed
2002/05/0031	Near lamp post No. 41848, Island Road, Repulse Bay	15NW-B/C114	24/5	Police	24/5 (05:20)	Soil/rock cut	~0.5 (Rock fall)	Road and pedestrian pavement	Pedestrian Pavement temporarily closed
2002/05/0033#	The footpath connecting Stanley Main Beach and Hairpin Beach, Stanley	Natural hillside	24/5	LCSD	11/5 (unknown)	Natural hillside	<0.05 (Rock fall)	Footpath	Footpath temporarily closed
2002/05/0034	No. 66-68, Kennedy Road (Vehicle Access Ramp), Wan Chai	11SW-D/C627	29/5	BD	28/5 (11:30)	Rock cut	~0.003 (Rock fall)	Private vehicle access ramp	
2002/06/0042	Opposite lamp post No. 35943, Stanley Gap Road, Stanley	15NE-A/C319	12/6	Police	12/6 (before 22:29)	Rock cut	~1 (Rock fall)	Road	Half lane of road temporarily closed
2002/07/0044	Tai Hang Road near junction with Blue Pool Road, Happy Valley	11SE-C/F23	4/7	HyD/HK	3/7 (22:30)	Fill slope	~30*	Footpath	
2002/07/0049#	Access road to 28 Barker Road, the Peak	11SW-D/C467	22/7	Public	21/7 (early morning)	Soil/rock cut	<0.1 (Rock fall)	Access road	

Table B2 - List of Landslide Incidents in Hong Kong Island (Sheet 2 of 4)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/07/0054	Behind Tai Lung Lau, No 123, Quarry Bay Street, Quarry Bay	11SE-A/C179	29/7	Police	29/7 (09:00)	Soil/rock cut	~0.12 (Rock fall)	Rear lane	Rear Lane temporarily closed
2002/07/0055	Northwest of slope No. 11SW-D/C667 Black's Link, Mount Nicholson	2.9 m high rock cut slope (1)	28/7	Police	28/7 (12:00)	Rock cut	0.24 (Rock fall)	Minor access road	
2002/08/0057	Near 11 Barker Road, the Peak	11SW-D/C445	5/8	HyD/HK	5/8 (11:00)	Rock cut	~2 (Rock fall)	Road	1 lane of road temporarily closed
2002/08/0070	Shek O Road adjacent to access road to Tai Tam Gap Correctional Institution	11SE-D/C406	10/8	HyD/HK	10/8	Soil/rock cut	0.8	Road	Half lane of road blocked and temporarily closed
2002/08/0072	Above slope No. 11SE-B/C276 at HK Museum of Coastal Defense, Shau Kei Wan	Natural hillside	10/8	LCSD	10/8 (08:25)	Natural hillside	0.023 (Boulder fall)	Display area	Partial closure of display area
2002/08/0074	South of Electric Sub-station, Wong Nai Chung Gap Road	11SE-C/C737 (Majority) and 11SE-C/FR42	13/8	WSD	13/8 (10:30)	Soil cut	60	Pedestrian pavement	Collapse of pedestrian pavement
2002/08/0076	Victoria Road, opposite lamp post No. 39811, Pokfulam	Slope under construction	16/8	HyD's consultant	10/8 (07:00)	Soil cut	80*	Construction site	
2002/08/0077	Behind football field of Aberdeen Technical School, Wong Chuk Hang Road, Aberdeen	11SW-D/C175	16/8	ED	May	Soil/rock cut	0.5 (Rock fall)	School football field	
2002/08/0085	Behind Block D, Y Y Mansion, 96 Pokfulam Road	Natural hillside	26/8	Public	Mid-August	Natural hillside	~1 (Rubble blocks)	Open area	
2002/09/0088	Above slope No. 11SW-D/C1556 at Findlay Road, the Peak	Natural hillside	24/7	HyD/HK	July	Natural hillside	<0.1 (Boulder fall)	Open area	

Table B2 - List of Landslide Incidents in Hong Kong Island (Sheet 3 of 4)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/09/0089	No. 10A, Tregunter Path, the Peak	Natural hillside	10/9	Police	10/9 (07:00)	Natural hillside	0.06 (Boulder fall)	Road	
2002/09/0098	Hung Fuk Court, Tin Wan	11SW-C/FR344	15/9	Public	15/9 (07:00)	Fill	~30	Sitting-out area	Sitting-out area temporarily closed
2002/09/0100	Near No. 61, Mount Kellett Road, the Peak	Natural hillside	15/9	Public	15/9 (early morning)	Natural hillside	~5	Construction site	
2002/09/0112	Behind No. 4-12, Ling Shing Road, Chai Wan	11SE-D/C14	17/9	GEO, CED	16/9	Soil/rock cut	0.06 (Boulder fall)	Open area	
2002/09/0114#	Opposite No. 13, Big Wave Bay Road, Shek O	15NE-B/C72	17/9	FEHD	17/9 (before 09:30)	Soil cut	<1	Open area	
2002/09/0119	South Bay Road, Repulse Bay	15NE-A/C100	16/9	HyD	16/9	Rock cut	0.5 (Rock fall)	Road	
2002/09/0121	Behind Lift Tower of HK Museum of Coastal Defence, Shau Kei Wan	11SE-B/C280	17/9	Arch SD	16/9 (23:25)	Soil/rock cut	~2	Rear area behind lift tower	
2002/09/0123	Slope below Wei Lun Hall, University of Hong Kong, 6C Sassoon Road, Pokfulam	Natural hillside	17/9	HyD's consultant	17/9	Natural hillside	~10	Construction site	
2002/09/0133	Peak Tramway near Barker Road Station (above slope No. 11SW-D/CR1981), the Peak	Natural hillside	19/9	Public	18/9 (mid-night)	Natural hillside	<0.01 (Boulder fall)	Footpath	
2002/09/0141	No. 6, Po Shan Road, Mid-levels	11SW-A/CR399	27/9	Public	22/9 (08:00)	Soil/rock cut	6*	Private access road	
2002/10/0150	Near No. 44, Kennedy Road, Wan Chai	11SW-B/C205	21/10	HyD/HK	18/10 (14:00)	Soil cut	0.4	Pedestrian pavement	

Table of Contents
Table of Contents
Table of Contents

Table B2 - List of Landslide Incidents in Hong Kong Island (Sheet 4 of 4)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/10/0151	Behind No. 6, A Kung Ngam Road, SKH Holy Nativity Church Social Service Centre, Shau Kei Wan	Natural hillside	22/10	Public	Unknown	Natural hillside	2.3 (Boulder fall)	Sitting-out area	
2002/10/0153	Below No. 7-13, Crown Terrace, Pokfulam	11SW-C/C484	24/10	Police	Unknown	Soil/rock cut	~2	Open area	
2002/10/0155	Shek O Road, Mount Collinson	11SE-D/C105	30/10	Public	30/10	Soil/rock cut	1 (Rock fall)	Road	1/2 lane of road temporarily closed
2002/11/0158	Footpath beyond the crest at the south-eastern end of slope No. 11SE-A/C211, Yee King Road, Tai Hang	Natural hillside	5/11	Public	Unknown	Natural hillside	~25*	Footpath	Footpath temporarily closed
2002/11/0164	Above Yip Hing Street, Wong Chuk Hang, Aberdeen	Natural hillside*	28/11	HyD/HK	28/11	Natural hillside	0.22 (Boulder fall)	Road	1 minor injury, 2 cars damaged and road temporarily closed
ArchSD/HK/ 2002/06/0001	Victoria Prison & Victoria Immigration Office, Central	11SW-B/R54	-	-	6/6	Masonry wall	30	Open area	

Legend:

* Information from GEO's landslide investigation consultants and agreed by GEO's District Divisions.
\# Very minor landslide with negligible consequence (see Section 1 of the report for definition).
(1) The man-made feature does not comply with the slope registration criteria given in GEO Circular No. 15.

Table of Contents
Table of Contents
Table of Contents
Table of Contents

Table B3 - List of Landslide Incidents in Kowloon (Sheet 1 of 3)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/07/0051	Jat's Incline near junction of Shatin Pass Road, Tsz Wan Shan	7SE-C/C547	26/7	Police	26/7	Soil/rock cut	3 (Rock fall)	Road	1 lane of road temporarily closed
2002/08/0073	Shatin Pass Road, Tsz Wan Shan	11NE-A/C497	12/8	Public	12/8 (16:00)	Rock cut	0.3 (Rock fall)	Road	
2002/08/0086	Wilson Trail near Ko Chun Court, Lam Tin	2.9 m high rock cut slope (1)	27/8	DLO/KE	9/8	Rock cut	1 (Rock fall)	Country park trail	
2002/09/0110	Wilson Trail near Tseung Kwan O Chinese Permanent Cemetery	11SE-B/C106	17/9	Police	17/9	Soil/rock cut	7	Road	1 lane of road temporarily closed
2002/09/0113	Squatter hut survey No. RKT/1A/C/376, Cha Kwo Ling Village, Lam Tin	1.8 m high rubble retaining wall (1)	17/9	Lands D	17/9 (07:00)	Rubble retaining wall	2	Open area	
2002/09/0115	Lok Wah Street (eastern end), Tsz Wan Shan	11NE-A/C13	17/9	LIC	17/9 (12:00)	Soil cut	30	Open area	
2002/09/0120a	Slope below St Catherine's School for Girls, Kung Lok Road, Kwun Tong	11NE-C/C74	17/9	Police	17/9 (09:45)	Soil/rock cut	0.1*	Pedestrian pavement	Pedestrian pavement temporarily closed
2002/09/0120b							0.2		
2002/09/0131	Cha Kwo Ling Tsuen, Fan Wa Street, Lam Tin	11NE-D/C18	17/9	Public	16/9 (23:00)	Soil/rock cut	30	Open area	
2002/10/0143	Access road to Tseung Kwan O Chinese Permanent Cemetery	11SE-B/C107	27/9	DO/KT	Unknown	Soil/rock cut	20	Hiking trial	
2002/10/0144	Slope at the junction of O King Road and Pik Wan Road, Tseung Kwan O	Slope awaiting registration	2/10	GEO, CED	Unknown	Soil cut	2	Open area	

Table of Contents
Table of Contents
Table of Contents

Table B3 - List of Landslide Incidents in Kowloon (Sheet 2 of 3)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/10/0156	Margaret Trench Medical Rehabilitation Centre, Rehab Path, Lam Tin	11NE-D/C373	31/10	CED's LPM consultant	17/9	Soil/rock cut	15	Backyard of Temple	
2002/11/0157	Behind Sau Hong House and Sau Lok House, Sau Mau Ping Estate Phase III, Sau Ming Road	Slope awaiting registration	16/9	HD's management company	12/9	Rock cut	0.1 (Rock fall)	Footpath	
2002/12/0167	Abandoned quarry site at Cha Kwo Ling, above Cha Kwo Ling Village, Lam Tin	Natural hillside	10/12	DLO	Few weeks from date of call	Natural hillside	14	Open area	
2002/12/0170	Access road to Tseung Kwan O Chinese Permanent Cemetery, Tseung Kwan O	11SE-B/C105	31/12	LIC	Unknown	Soil cut	10	Open area	
HyD/K/2002/ 05/0002	Jat's Incline, Tsz Wan Shan	11NE-A/C364	-	-	Unknown, earlier than 10/5	Soil/rock cut	0.5 (Rock fall)	Road	
WSD/2002/ 9/2/K	Access road to Yau Tong lower level fresh water service reservoir, Lam Tin	11SE-B/C205	-	-	17/9	Soil cut	30	Access road	
HD 01/02	West of No. 49 and Church, Tung Tau Cottage Area, Wong Tai Sin	11NE-A/C396	-	-	15/9	Soil cut	70	Construction site	

Table B3 - List of Landslide Incidents in Kowloon (Sheet 3 of 3)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
HD 02/02	Approx. 22 m from the junction between Sheung Shing Street and Sheung Lok Street, Homantin	11NW-D/C64	-	-	16/9 (15:00)	Soil/rock cut	60	Construction site	

Legend:

*	Information from GEO's landslide investigation consultants and agreed by GEO's District Divisions.
#	Very minor landslide with negligible consequence (see Section 1 of the report for definition).
(1)	The man-made feature does not comply with the slope registration criteria given in GEO Circular No. 15.

Table B4 - List of Landslide Incidents in New Territories and Outlying Islands (Sheet 1 of 8)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/02/0004	Footpath near Tei Tong Tsai, Tung Chung	Natural hillside	5/2	DO/IS	Unknown	Natural hillside	10	Footpath	
2002/02/0007	Behind No. 25, Pak She San Tsuen, Cheung Chau	2 m high soil cut slope (1)	20/2	DLO/IS	Unknown	Soil cut	4.0	Squatter	
2002/03/0012	Castle Peak Road, Kwai Chung	11NW-A/C61	23/3	Police	23/3 (10:00)	Soil/rock cut	0.1* (Rock fall)	Road	1 lane of road temporarily closed
2002/03/0013	No. 152, Tai Hang Hau, Sai Kung	Natural hillside	23/3	Public	15/3	Natural hillside	Sign of distress	Village house*	Basement of the village house temporarily closed*
2002/03/0014	No. 88, Sun On Village, Hiram's Highway, Sai Kung	8SW-C/C188	24/3	Police	22/3 (09:00)	Soil cut	<1	Footpath	Footpath temporarily closed
2002/03/0015	Near lamp post No. AF0650, Shatin Pass Road, Tsz Wan Shan	11NE-A/C281	23/3	Police	23/3 (16:56)	Rock cut	<3 (Rock fall)	Road	
2002/05/0024	Tuen Mun Road, Tsing Lung Tau Section Kowloon Bound, Tsuen Wan	6SE-D/C67	13/5	HyD	11/5 (17:30)	Soil/rock cut	0.3 (Rock fall)	Road	
2002/05/0030	Shatin Pass Road (near Kwun Yam Temple), Tsz Wan Shan	11NE-A/C284	22/5	FSD	22/5 (20:30)	Rock cut	7* (Rock fall)	Road	1 lane of road temporarily closed
2002/05/0035#	To Fung Shan Road near Yau Oi Tsuen, Sha Tin	7SW-B/C255	27/5	Public	26/5	Soil/rock cut	1	Lay-by	
2002/06/0038#	Adjacent to a footpath at Fu Yung Shan, Tsuen Wan	2.9 m high soil cut slope (1)	11/6	BD	11/6	Soil cut	1	Footpath	
2002/06/0039	Pak Tam Road, Sai Kung	8NE-C/C10	12/6	Police	12/6 (08:00)	Soil/rock cut	<1 (Rock fall)	Road	1 lane of road temporarily closed

Table B4 - List of Landslide Incidents in New Territories and Outlying Islands (Sheet 2 of 8)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/07/0046	Behind No.44, Tung Wan Tau, Mui Wo, Lantau Island	10SW-C/CR311	12/7	DO/IS	3/7 (mid-night)	Soil/rock cut	8	Open area	
2002/07/0050	San Kok Shan Tsuen, Lo Wai, Tsuen Wan	1.5 m to 2 m high masonry wall (1)	23/7	DO/TW	22/7	Masonry wall	1	Footpath	
2002/07/0052	Tung Chung Road, Lantau Island	1.2 m high rock cut slope (1)	26/7	Police	26/7 (21:00)	Rock cut	0.4 (Rock fall)	Road	
2002/07/0056	Below Castle Peak Road, along Approach Beach, Yau Kam Tau, Tsuen Wan	6SE-D/FR133	29/7	HyD's consultant	29/7 (13:30)	Masonry wall	55*	Road	2 lanes of road temporarily closed
2002/08/0058#	Access road to Lo Ma Chau Police Post, Yuen Long	2NE-D/C52	5/8	HyD/NTE	1/8 (06:00)	Rock cut (failure at soil/rock interface)	2	Access road	
2002/08/0059#	Near No. 64, To Fung Shan Road, Yau Oi Tsuen, Sha Tin	7SW-B/C255	6/8	Public	Unknown	Soil/rock cut	4	Open area	
2002/08/0061	No. 44, Pun Shan Chau Tsuen (within Lot No. 340 in DD 22), Tai Po	Natural hillside	6/8	Public	6/8 (11:30)	Natural hillside	30	Village access road	1 lane of access road temporarily closed
2002/08/0062	Kam Shan Village, Lei Pui Street, Kwai Chung	Natural hillside	6/8	HyD	6/8 (morning)	Natural hillside	20	Footpath	
2002/08/0063	Adjacent a footpath near Lo Wai Village, Tsuen Wan	Natural hillside	7/8	Public	6/8	Natural hillside	2	Footpath	Footpath temporarily closed
2002/08/0064	Near Ngau Tam Mei Services Reservoir, Yau Tam Mei Tsuen Road, Yuen Long	2SE-C/C199	9/8	Public	9/8 (05:30)	Soil/rock cut	100*	Road	1 lane of road temporarily closed

Table B4 - List of Landslide Incidents in New Territories and Outlying Islands (Sheet 3 of 8)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/08/0065a	No. 350, Yau Tam Mei Tsuen, near Ngau Tam Mei Services Reservoir, Yuen Long	Unregistered	9/8	Public	9/8 (06:00)	Soil cut	5	Open area	
2002/08/0065b		2 m high soil cut slope (1)						Chicken shed	
2002/08/0066	Lo Tsing San Village, So Kwun Wat, Tuen Mun	Natural hillside	9/8	DO/TM	9/8 (15:45)	Natural hillside	15	Squatter	
2002/08/0080	Ka Loon Tsuen, Milestone 14½, Castle Peak Road, Tsuen Wan	2.8 m high masonry wall (1)	20/8	Public	Before 12/8	Masonry wall	2	Footpath	
2002/08/0083	Siu Sau Village, Tuen Mun	6SW-C/C674	27/8	Public	Around mid-August	Soil cut	0.5	Open area	
2002/08/0084	Near Saigon Beach Resort, Sai Kung	8SW-A/CR277	28/8	HyD/NT	Unknown	Soil cut	2.5	Storage shed	
2002/09/0087	No. 185 (Previously No. 20), Sung Shan New Village, Shap Pat Heung, Yuen Long.	6NE-C/C56	29/8	DO/YL	9/8 (08:30)	Soil/rock cut	5	Open area	
2002/09/0091	Near No. 99, Sung Shan New Village, Shap Pat Heung, Yuen Long	Natural hillside	2/9	DO/YL	9/8 (10:00)	Natural hillside	4	Footpath	
2002/09/0092	Behind Houses Nos. 11-16, Ngau Pei Sha New Village, Sha Tin	7SE-C/CR323	15/9	FSD	15/9 (04:30)	Soil cut	50*	Village houses	6 village houses temporarily evacuated
2002/09/0095	Opposite No. 202, Sha Lan Villas, Sha Lan Road, Tai Po	7NE-A/C85	15/9	Public	15/9 (02:00-04:00)	Soil cut	< 1	Garden	
2002/09/0096	Bride's Pool Road, Wu Kau Tang Bound, near Hang Mei, Tai Po	3NE-D/C103	15/9	Police	15/9 (09:00)	Soil/rock cut	15	Road	2 lanes of road temporarily closed

Table B4 - List of Landslide Incidents in New Territories and Outlying Islands (Sheet 4 of 8)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/09/0099	No. 28-31, Sheung Wo Che Village, Sha Tin	7SE-A/CR292	16/9	Public	15/9 (08:50)	Soil cut	4	Squatter	1 squatter dwelling temporarily evacuated
2002/09/0101	Above slope No. 11NE-B/C431 below house No. B1, Flamingo Garden, Fei Wan Road, Fei Ngo Shan	2 m high brick wall (1)	16/9	Public	15/9	Brick retaining wall	8	Open area	
2002/09/0103	No. 44A, Pun Shan Chau Village, Tai Po	Slope awaiting registration	16/9	Public	15/9 (05:00)	Soil cut*	10	Village access road	1 lane of access road temporarily closed
2002/09/0104	150 m from Lo So Shing Primary School, Sok Kwu Wan, Lamma Island	2 m high soil/rock cut slope (1)	16/9	Police	14/9	Soil/rock cut	~1.5 (Rock fall)	Footway	Footway temporarily closed
2002/09/0108	Tai Hang Hau Village, No. 90B, Sai Kung	1.4 m high brick retaining wall (1)	17/9	Police	16/9	Brick retaining wall	6	Open area	
2002/09/0109a	Clear Water Bay Road, near Leung Fai Tin Upper Road, Sai Kung	2.5 m high soil cut slope (1)	17/9	HyD	Unknown, but occurred before 17/9	Soil cut	6	Road	1 lane of road temporarily closed
2002/09/0109b		2 m high soil cut slope (1)				Soil cut	2	Road	
2002/09/0116	Access road to Wang Che near Ho Chung Road and Sai Kung Ho Chung Golf Centre, Sai Kung	Natural hillside	17/9	Police	17/9 (10:00)	Natural hillside	10	Village access road	
2002/09/0117a	Access road near Hang Hau Wing Lung Road, near Yacht Club, Clear Water Bay Road, Sai Kung	Unregistered	17/9	Police	Unknown	Soil/rock cut	20*	Village access road	
2002/09/0117b		2.9 m high soil/rock cut slope (1)				Soil/rock cut	6*		

Table B4 - List of Landslide Incidents in New Territories and Outlying Islands (Sheet 5 of 8)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/09/0122	Scout Association of Hong Kong, Tung Tsz Road, Tai Po	3SE-C/C2	17/9	Public	15/9 (01:00)	Soil cut	45	Campus access road	
2002/09/0126	Yau Kam Tau Village, Tsuen Wan	Two stepped walls of 1.9 m and 1.5 m high	17/9	GEO, CED	Unknown	Retaining wall	5	Open area	
2002/09/0128	Tung Lo Wan Hill Road, Sha Tin	7SW-D/C215	17/9	HyD	16/9	Soil cut	5	Carpark	
2002/09/0130a	Kong Tau Tsuen, Shap Pat Heung, Yuen Long	2.5 m high soil cut slope (1)	12/9	DO/YL	9/9	Soil cut	5	Squatter	3 squatter dwellings permanently evacuated
2002/09/0130b		2.5 m high soil cut slope (1)				Soil cut	5	Drainage channel	
2002/09/0132#	Near slope No. 3SW-B/F1, Lin Ma Hang Road, Sha Tau Kok, North District	Natural hillside	18/9	HyD/NTE	15/9	Natural hillside	0.75	Open area	
2002/09/0134#	Slope below footpath leading to house No. 12A, Tai Tan Village, Sai Kung	Natural hillside	20/9	DO/TP	17/9 (18:30)	Natural hillside	1	Footpath	
2002/09/0135	Man Uk Pin Village, near Wo Keng Shan Road, Sha Tau Kok, North District	2.5 m high fill slope (1)	22/9	Police	22/9 (morning)	Fill*	7	Squatter	1 squatter dwelling temporarily evacuated
2002/09/0137	Footpath/steps leading to No. 18, Ma Tat Wan, Lamma Island	2.5 m high soil cut slope (1)	20/9	Public	20/9	Soil cut	~1	Open area	
2002/09/0139	Above slope No. 11NE-B/C808, Pik Uk Tsuen Road, Sai Kung	Natural hillside	26/9	HyD/NT	Unknown	Natural hillside	10	Open area	
2002/09/0140#	Northeast of Tam Mi Camp, Ngau Tam Mei, Yuen Long	2SE-D/C36	23/9	Public	17/9	Soil/rock cut	5	Access road	

Table B4 - List of Landslide Incidents in New Territories and Outlying Islands (Sheet 6 of 8)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
2002/10/0145#	Slope adjacent to an access road to Sheung Kok Shan Tsuen, Tsuen Wan	2.5 m high soil cut slope (1)	9/10	GEO, CED	Unknown	Soil cut	0.3	Village access road	
2002/10/0146	Lion's YMCA Junk Bay Youth Camp, 47 Mau Wu Tsai Village, Po Lam Road South, Tseung Kwan O	11NE-D/C552	11/10	Public	17/9	Soil/rock cut	10	Open area	
2002/10/0152a#	Near Gold Villa, Clear Water Bay Road, Sai Kung	11NE-B/C378	23/10	Public	Unknown	Soil cut	0.5*	Road	
2002/10/0152b#							0.5*		
2002/10/0154	Behind No. 1, Kau Lung Hang Village, Tai Po	3SW-D/C83	24/10	LandsD	Around October	Soil cut	5	Open area	
2002/11/0161	Wong Chuk Yuen Village, Shek Kong, Yuen Long	Natural hillside	19/11	LandsD	Around September	Natural hillside	45	Stream course	
2002/12/0165	Behind No. 25, Villas Horizon, Silver Stream Path, Silverstrand, Sai Kung	12NW-C/C162	2/12	BD	Unknown	Soil/rock cut	0.2 (Rock fall)	Backyard of house	
2002/12/0166	Man Uk Pin, Sha Tau Kok	Natural hillside	21/11	DO	Around September	Natural hillside	15	Footpath	Footpath temporarily closed
ArchSD/BOR/2002/09/0001	Man Kam To Control Point, Lo Wo	3NW-C/C249	-	-	17/9	Soil cut	18	Check point area	
ArchSD/BOR/2002/10/0001	Sandy Ridge Cemetery, Lo Wo	3NW-C/C253	-	-	10/10	Soil cut	10	Access	
ArchSD/UB-019-08008-407	Wo Hop Shek Cemetery	3SW-C/C790	-	-	12/6	Soil cut	100	Access footpath	
ArchSD/UB2002/01/0001	Wo Hop Shek Cemetery	3SW-C/C862	-	-	21/1	Soil cut	13	Cemetery	
ArchSD/UB2002/01/0002	Wo Hop Shek Cemetery	3SW-C/C864	-	-	21/1	Soil cut	10	Cemetery	

Table of Contents Table of Contents Table of Contents Table of Contents Table of Contents

Table B4 - List of Landslide Incidents in New Territories and Outlying Islands (Sheet 7 of 8)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
ArchSD/UB2002/01/0003	Wo Hop Shek Cemetery	3SW-C/C636	-	-	28/1	Soil/rock cut	30	Cemetery	
ArchSD/UB2002/04/0004	Wo Hop Shek Cemetery	3SW-C/C721	-	-	9/4	Soil cut	10	Cemetery	
ArchSD/UB2002/04/0005	Wo Hop Shek Cemetery	3SW-C/C779	-	-	23/4	Soil cut	40	Access road to cemetery	
HyD/TMCA/2002/03/0001	Near Route 9 Kowloon Bound Chainage 13.4, North Lantau Expressway, Lantau	10NE-A/C110	-	-	23/3	Soil/rock cut	0.12 (Rock fall)	Open area	
LD/SK/2002/04/0001	No. 5 Tan Shan Village, Tseng Lan Shue, Sai Kung	11NE-B/C274	-	-	Unknown, earlier than April	Soil/rock cut	2	Open area	
LD/TP/2002/08/0001	Wong Yue Tan, Shuen Wan, Tai Po	3SE-C/CR106	-	-	August	Soil cut	10	Building	
LD/TW/2002/09/0001	Sham Tseng West Village, Tsuen Wan	6SE-C/C293	-	-	10/9	Soil/Rock cut	3	Open car park	
HYD/NTW/2002/12/0013a	Adjacent to Tuen Mun Road, near Golden Villa and Pink Villa, Castle Road, Tsuen Wan	6SE-C/F203	-	-	Unknown	Fill	60	Stream course	
HYD/NTW/2002/12/0013b							20		
WSD/2002/4/1/MNW	Ngau Tam Mei Water Treatment Plant, Yuen Long	Natural hillside	-	-	April	Natural hillside	1 (Boulder fall)	Water treatment plant	
WSD/2002/7/1/MNW	Tai Lam Chung Catchwater Section L, CH 2400, Tuen Mun	6SE-C/CR618	-	-	26/7	Soil/rock cut	1 (Rock fall)	Catchwater	
WSD/2002/8/1/MNW#	Adjoining WSD Access Road Item NT31, Tai Lam Country Park, Yuen Long	6SW-B/C128	-	-	7/8 (10:00)	Soil/rock cut	5	Access road	
WSD/2002/8/2/MNW#	Tai Lam Chung Catchwater, Tsuen Wan	6SW-C/CR270	-	-	7/8 (15:00)	Soil cut	3	Catchwater	

Table B4 - List of Landslide Incidents in New Territories and Outlying Islands (Sheet 8 of 8)

Incident No.	Location	Slope No.	Call		Failure			Facility Affected	Consequence
			Date	From	Date (Time)	Feature Type	Scale (m^3)		
WSD/2002/8/3 /MSE	Sai Kung Sai Wan Road, Sai Kung	8SE-A/C21	-	-	9/8 (10:00)	Soil cut	0.5	Access road	
WSD/2002/8/4 /MNW#	Tai Lam Chung Reservoir Access Road, Tuen Mun	6SW-D/C626	-	-	9/8 (11:00)	Soil/rock cut	3	Access road	
WSD/2002/9/1/ NTE	Po Lo Che Road to Intake M4, Sai Kung	8SW-A/C180	-	-	16/9 (10:30)	Soil/rock cut	10	Access road	

Legend:

*	Information from GEO's landslide investigation consultants and agreed by GEO's District Divisions.
#	Very minor landslide with negligible consequence (see Section 1 of the report for definition).
(1)	The man-made feature does not comply with the slope registration criteria given in GEO Circular No. 15.

Table of Contents Table of Contents Table of Contents Table of Contents

GEO PUBLICATIONS AND ORDERING INFORMATION
土力工程處刊物及訂購資料

A selected list of major GEO publications is given in the next page. An up-to-date full list of GEO publications can be found at the CEDD Website http://www.cedd.gov.hk on the Internet under "Publications". Abstracts for the documents can also be found at the same website. Technical Guidance Notes are published on the CEDD Website from time to time to provide updates to GEO publications prior to their next revision.

部份土力工程處的主要刊物目錄刊載於下頁。而詳盡及最新的土力工程處刊物目錄，則登載於土木工程拓展署的互聯網網頁 http://www.cedd.gov.hk 的"刊物"版面之內。刊物的摘要及更新刊物內容的工程技術指引，亦可在這個網址找到。

Copies of GEO publications (except maps and other publications which are free of charge) can be purchased either by:

writing to
Publications Sales Section,
Information Services Department,
Room 402, 4th Floor, Murray Building,
Garden Road, Central, Hong Kong.
Fax: (852) 2598 7482

or

- Calling the Publications Sales Section of Information Services Department (ISD) at (852) 2537 1910
- Visiting the online Government Bookstore at http://bookstore.esdlife.com
- Downloading the order form from the ISD website at http://www.isd.gov.hk and submit the order online or by fax to (852) 2523 7195
- Placing order with ISD by e-mail at puborder@isd.gov.hk

讀者可採用以下方法購買土力工程處刊物(地質圖及免費刊物除外):

書面訂購
香港中環花園道
美利大廈4樓402室
政府新聞處
刊物銷售組
傳真: (852) 2598 7482

或

- 致電政府新聞處刊物銷售小組訂購 (電話：(852) 2537 1910)
- 進入網上「政府書店」選購，網址爲 http://bookstore.esdlife.com
- 透過政府新聞處的網站 (http://www.isd.gov.hk) 於網上遞交訂購表格，或將表格傳真至刊物銷售小組 (傳真：(852) 2523 7195)
- 以電郵方式訂購 (電郵地址：puborder@isd.gov.hk)

1:100 000, 1:20 000 and 1:5 000 maps can be purchased from:

Map Publications Centre/HK,
Survey & Mapping Office, Lands Department,
23th Floor, North Point Government Offices,
333 Java Road, North Point, Hong Kong.
Tel: 2231 3187
Fax: (852) 2116 0774

讀者可於下列地點購買1:100 000，1:20 000及1:5 000地質圖：

香港北角渣華道333號
北角政府合署23樓
地政總署測繪處
電話: 2231 3187
傳真: (852) 2116 0774

Requests for copies of Geological Survey Sheet Reports, publications and maps which are free of charge should be sent to:

For Geological Survey Sheet Reports and maps which are free of charge:
Chief Geotechnical Engineer/Planning,
(Attn: Hong Kong Geological Survey Section)
Geotechnical Engineering Office,
Civil Engineering and Development Department,
Civil Engineering and Development Building,
101 Princess Margaret Road,
Homantin, Kowloon, Hong Kong.
Tel: (852) 2762 5380
Fax: (852) 2714 0247
E-mail: jsewell@cedd.gov.hk

For other publications which are free of charge:
Chief Geotechnical Engineer/Standards and Testing,
Geotechnical Engineering Office,
Civil Engineering and Development Department,
Civil Engineering and Development Building,
101 Princess Margaret Road,
Homantin, Kowloon, Hong Kong.
Tel: (852) 2762 5345
Fax: (852) 2714 0275
E-mail: ykhui@cedd.gov.hk

如欲索取地質調查報告、其他免費刊物及地質圖，請致函：

地質調查報告及地質圖:
香港九龍何文田公主道101號
土木工程拓展署大樓
土木工程拓展署
土力工程處
規劃部總土力工程師
(請交:香港地質調查組)
電話: (852) 2762 5380
傳真: (852) 2714 0247
電子郵件: jsewell@cedd.gov.hk

其他免費刊物:
香港九龍何文田公主道101號
土木工程拓展署大樓
土木工程拓展署
土力工程處
標準及測試部總土力工程師
電話: (852) 2762 5345
傳真: (852) 2714 0275
電子郵件: ykhui@cedd.gov.hk

Table of Contents
Table of Contents
Table of Contents

MAJOR GEOTECHNICAL ENGINEERING OFFICE PUBLICATIONS
土力工程處之主要刊物

GEOTECHNICAL MANUALS

Geotechnical Manual for Slopes, 2nd Edition (1984), 300 p. (English Version), (Reprinted, 2000).

斜坡岩土工程手冊(1998)，308頁(1984年英文版的中文譯本)。

Highway Slope Manual (2000), 114 p.

GEOGUIDES

Geoguide 1	Guide to Retaining Wall Design, 2nd Edition (1993), 258 p. (Reprinted, 2000).
Geoguide 2	Guide to Site Investigation (1987), 359 p. (Reprinted, 2000).
Geoguide 3	Guide to Rock and Soil Descriptions (1988), 186 p. (Reprinted, 2000).
Geoguide 4	Guide to Cavern Engineering (1992), 148 p. (Reprinted, 1998).
Geoguide 5	Guide to Slope Maintenance, 3rd Edition (2003), 132 p. (English Version).
岩土指南第五冊	斜坡維修指南，第三版(2003)，120頁(中文版)。
Geoguide 6	Guide to Reinforced Fill Structure and Slope Design (2002), 236 p.

GEOSPECS

Geospec 1	Model Specification for Prestressed Ground Anchors, 2nd Edition (1989), 164 p. (Reprinted, 1997).
Geospec 2	Model Specification for Reinforced Fill Structures (1989), 135 p. (Reprinted, 1997).
Geospec 3	Model Specification for Soil Testing (2001), 340 p.

GEO PUBLICATIONS

GCO Publication No. 1/90	Review of Design Methods for Excavations (1990), 187 p. (Reprinted, 2002).
GEO Publication No. 1/93	Review of Granular and Geotextile Filters (1993), 141 p.
GEO Publication No. 1/2000	Technical Guidelines on Landscape Treatment and Bio-engineering for Man-made Slopes and Retaining Walls (2000), 146 p.
GEO Publication No. 1/2006	Foundation Design and Construction (2006), 376 p.

GEOLOGICAL PUBLICATIONS

The Quaternary Geology of Hong Kong, by J.A. Fyfe, R. Shaw, S.D.G. Campbell, K.W. Lai & P.A. Kirk (2000), 210 p. plus 6 maps.

The Pre-Quaternary Geology of Hong Kong, by R.J. Sewell, S.D.G. Campbell, C.J.N. Fletcher, K.W. Lai & P.A. Kirk (2000), 181 p. plus 4 maps.

TECHNICAL GUIDANCE NOTES

TGN 1	Technical Guidance Documents

Table of Contents
Table of Contents
Table of Contents