

**HONG KONG
RAINFALL AND LANDSLIDES
IN 1987**

GEO REPORT No. 4

J. Premchitt

**GEOTECHNICAL ENGINEERING OFFICE
CIVIL ENGINEERING DEPARTMENT
HONG KONG**

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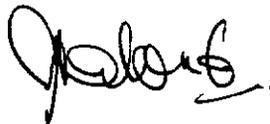
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PREFACE

In keeping with our policy of releasing information of general technical interest, we make available some of our internal reports in a series of publications termed the GEO Report series. The reports in this series, of which this is one, are selected from a wide range of reports produced by the staff of the Office and our consultants.

Copies of GEO Reports have previously been made available free of charge in limited numbers. The demand for the reports in this series has increased greatly, necessitating new arrangements for supply. In future a charge will be made to cover the cost of printing.

The Geotechnical Engineering Office also publishes guidance documents and presents the results of research work of general interest in GEO Publications. These publications and the GEO Reports are disseminated through the Government's Information Services Department. Information on how to purchase them is given on the last page of this report.



A. W. Malone
Principal Government Geotechnical Engineer
April 1995

FOREWORD

This report presents a general review of rainfall and landslides in Hong Kong in 1987. Geotechnical Engineers of GCO District Divisions provided details of the notable landslides. Supplementary landslide data were provided by the Agriculture and Fisheries Department, Architectural Services Department, Civil Engineering Office, Fire Services Department, Highways Department, Housing Department and Water Supplies Department. The Royal Observatory provided rainfall information. All contributions are gratefully acknowledged. Dr. J. Premchitt prepared this report.



(J.B. Massey)

Chief Geotechnical Engineer/Special Projects

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1. INTRODUCTION

This report reviews rainfall and landslide occurrence in Hong Kong throughout 1987. Rainfall information has been obtained from the Geotechnical Control Office (GCO) automatic rain gauge system and from the Royal Observatory (RO). Most of the landslide data have been taken from the records of incidents reported to the GCO during the year. Supplementary data have been obtained from other Government departments.

In this report, a landslide is defined as the collapse of a soil or rock mass, and includes the failure of fill slopes, cut slopes, retaining structures, natural slopes and rock or boulder falls. A major landslide is defined as a failure in which the volume of the collapsed mass exceeded 50 cu m.

The GCO received a total of 307 incident reports in 1987. Of these, 279 were classified as genuine landslides and nine of them were major. The remaining incidents were minor ground or structural movements. It is notable that 111 incidents out of the whole year's total occurred during a severe rainstorm on 29-30th July. This report will emphasize the cases of landslides reported to the GCO, since these were inspected by the GCO's Geotechnical Engineers and detailed information is available.

The arrangement of this report is similar to the previous rainstorm and rainfall - landslides reports (GCO, 1982a, 1982b; Choot, 1984 and Premchitt, 1985-1987). The report reviews rainfall and landslide occurrence throughout the whole one-year period rather than emphasizing any one specific rainstorm. This is a factual report and, apart from acknowledging that most of the landslides were initiated by heavy rainfall, it does not attempt to explain the mechanisms of failure nor to examine prediction of the magnitude of landslide events. Information and interpretation on the important aspects of landslide mechanisms and correlation between rainfall and landslides can be found elsewhere, for example Lumb (1975), Brand et al (1984) and Premchitt et al (1985). It is intended, however, that the data contained in this report may be used and interpreted by readers to further the understanding of rain-induced failures.

2. RAINFALL

2.1 The Rain gauge System

In the rugged terrain of Hong Kong, rainfall distribution over different geographical areas, as well as over different time periods, can vary dramatically during a rainstorm. The Royal Observatory has installed 165 rain gauges at strategic locations around the Territory in order to provide sufficient coverage for a meaningful analysis of rainfall distribution. These rain gauges range from a detailed automatic and instantaneous rate-of-rainfall recorder to rain gauges which are read manually once a month. The "principal" gauge is located at the Royal Observatory's headquarters in Tsim Sha Tsui, and a continuous rainfall record has been made at this location since 1884. Weather summaries and rainfall statistics are normally based on the measurements made at this principal location.

Since 1978, the GCO, in co-operation with the RO, has installed a number of automatic rain gauges which transmit the current rainfall data via telephone lines to the GCO's Emergency Control headquarters. Improvements have been made regularly and at present there are 46 GCO gauges and 21 RO gauges in this system, which provide up-to-date rainfall data every five

minutes to the operation rooms of the GCO and RO. These data are also stored on computer tape for future reference. The locations of these automatic raingauges (Figure 1) were selected to supplement the network of other types of rain gauge and to provide specific information in areas of particular geotechnical interest.

In this report, where a comparison is being made for "daily" rainfalls, the 24-hour maximum rainfall will be used instead of daily rainfall, since the latter is based on an arbitrary fixed period of midnight to midnight which does not necessarily represent the true rainstorm intensity. In addition, when a rainfall amount is quoted without reference to the location of measurement, this will be the amount measured at the RO headquarters.

2.2 Royal Observatory Records

The year's weather for 1987 was summarised by the Royal Observatory in the Monthly Weather Summary for December 1987. Their comments for the whole year are as follows :

" As a whole 1987 was unusually warm. The mean minimum temperature of 21.6°C was the highest ever recorded and the mean temperature of 23.4°C was the second highest on record. The mean sea-level pressure of 1 013.8 hectopascals for 1987 was also the highest ever recorded. Despite the unusually low contribution to the total rainfall in 1987 from tropical cyclones, the abundant rainfall earlier in the year more than made up for the deficit. The annual rainfall of 2319.3 millimetres was about 4 percent above the normal amount of 2 224.7 millimetres.

Relatively few tropical cyclones affected the South China Sea in 1987. There were only 6 tropical cyclones in the South China Sea in 1987 compared to the average of 12 per year. Five tropical cyclones necessitated the hoisting of tropical cyclone warning signals in Hong Kong. 1987 was the first year in which the Strong Wind Signal No.3 was not hoisted until late October since this signal was introduced in 1956.. "

The following are excerpts from the same report for the months in which the most intense rainfalls were recorded :

" ...March 1987 was a month of record breaking weather events. Besides being the warmest March on record, with a monthly mean temperature of 21.3°C, it was very wet with a total rainfall of 234.0 millimetres, more than four times the normal amount. Violent thunderstorms from 16 to 18 March brought 194.7 millimetres of rainfall, the highest recorded for any 3-day period in March. Rain was heaviest on 17 March and both the daily rainfall of 126.4 millimetres and the hourly rainfall of 50.1 millimetres between 9 and 10 am set new record for March. The torrential downpour resulted in 116 cases of flooding and 4 cases of minor mudslips throughout the territory...

April continued to be wetter than usual. The monthly total rainfall of 277.8 millimetres was about twice the normal. Squally thunderstorms on 5 April affected Hong Kong and hail was reported in Sha Tin and Lai Chi Kok around 5 pm...

Frequent encounters between the moisture-laden southwest monsoon and cooler air from the north maintained the wet and overcast weather in May. The total duration of sunshine for the month was 102.8 hours, only two thirds of the normal, and the month total rainfall of 460.2 millimetres, 54 percent above (average)... (On 16 May) minor landslips occurred in Kwai Chung and Mt. Nicholson. Intense thunderstorms again battered the territory on 22 and 23 May causing 66 cases of flooding throughout the territory and at least 6 cases of minor landslips...

July was characterised by a showery start, a mid-month dry spell and by the episode of torrential rain between 22 and 30 July when frequent thunderstorms occurred for 9 consecutive days. Active summer monsoon, enhanced by a stationary trough across south China was the manifest cause. As its crescendo, from 28 to 30 July, the monsoon brought to Hong Kong daily rainfall of over 80 millimetres for three days running, a record for July. During this period, there were 88 reports of flooding and 46 reports of landslips throughout the territory. 123 hectares of farmland and three hectares of fish-ponds were inundated. The most serious landslide occurred near Cho Yiu Tsuen in Kwai Chung on 30 July..."

A summary of heavy rainstorms in 1987 is given in Table 1. This table shows all periods (mutually exclusive) in which 24-hour rainfall at the R0 exceeded 50 mm. It also shows the fifteen-day antecedent rainfalls which occurred prior to the 24-hour periods. The five highest 24-hour rainfalls are 183 mm on 29-30th July, 166 mm on 5-6th April, 130 mm on 16-17th March, 119 mm on 22-23rd May and 105 mm on 16-17th May. Other detailed information in Table 1 will be discussed subsequently in separate sections.

The rainfall data as recorded at the R0, Tsim Sha Tsui, are presented in Figures 2 to 5. Cumulative rainfall since 1st January is shown in Figure 2. Daily and monthly rainfalls are shown in Figures 3 and 4 respectively. Figure 5 shows the hourly rainfall for the five highest 24-hour rainfalls of 1987.

2.3 Geotechnical Control Office Records

Rainfall data are available from the GCO's 46 automatic raingauges. Current rainfall data can be found in the GCO's Rainfall Data Acquisition Centre and past data are kept in the Civil Engineering Library. A location map of these gauges is given in Figure 1.

In addition to the general R0 rainstorm summary, data from some of the GCO raingauges are also given for the rainfall events in Table 1. The

maximum rainfall recorded anywhere in the Territory on these occasions are given for three arbitrary durations of 24 hours, five hours and one hour.

The maximum 24-hour and one-hour rainfalls within the Territory during the year were 314 mm on 29-30th July and 74 mm on 17th March respectively.

Appendix B shows hourly rainfall data obtained from GCO's raingauges for the five heaviest rainstorms over 24-hour periods ending on 17th March, 6th April, 17th May, 23rd May and 30th July.

2.4 Rainfall Distribution

Rainfall distribution within different time periods and geographical areas can be assessed by referring to detailed GCO and RO records. Records from GCO raingauges for the five heaviest rainstorms of 1987 are given in Appendix B.

Five rainfall maps, for 24-hour duration taken from RO records, are shown in Figures 6 to 10. These include all the five heaviest rainstorms of the year. All of these rainstorms were discussed in the annual RO weather summary quoted in section 2.2. Generally, rainfall was spread out fairly evenly over the Territory in these events. The distribution of rainfall had a significant effect on the occurrence of landslides, and this will be discussed further in Section 3.4.

2.5 Warnings issued by the Royal Observatory

Relevant warnings issued by the RO, and the Landslip Warnings jointly issued by the GCO and the RO, are summarised in Table 2.

In 1987, there were 67 Thunderstorm Warnings, fourteen Flood Warnings, three Landslip Warnings and five Tropical Storm Warnings. The highest Tropical Storm Warning signal number raised during the year was No. 3, which was issued on 24-25th October (Typhoon Lynn). All of these warnings were issued in the period from March to October.

Landslip Warnings were issued after consultation between the GCO and the RO on the basis of predetermined rainfall criteria. The frequency of this warning in 1987 was the least among the rainfall-related warnings issued by the RO. The three warnings were issued on 6th April, 22nd May and 30th July (Table 2). A comparison of these three days with all other notable rainfall-landslide days is shown in Table 1. On these three days, of the total reported incidents for which time of landslide occurrence is known to within one hour (Section 3.1), 22 occurred after the warning was issued, and 29 occurred before the warning was issued. Most of those which occurred before the warning resulted from the rainstorm event on 29-30th July. Those events not shown in Table 1 had rainfall of less than 50 mm in 24 hours and less than five landslides in any one day.

2.6 Comparison with Past Rainstorms

Maximum rainfall amounts of various durations recorded at the GCO and RO raingauges for heavy rainstorms in 1987 are shown in comparison with the three recent major rainstorms of May and August 1982 and June 1983 in

Table 1. The highest 24-hour rainfall recorded at the R0 in 1987 was only 50% of that for the May 1982 rainstorm. The highest one-hour rainfall recorded anywhere in 1987 was 74 mm, in comparison with more than 95 mm for the three major rainstorms listed above.

The return periods of heavy rainstorms in 1987 were estimated, and are shown in Table 3, for rainfall durations of one hour to fifteen days. No rainstorms of very long return period occurred, but the rainfall during the latter half of July is notable. It may be concluded that rainfall in the year 1987 was normal except for the heavier long-period rainfalls (more than two days) during the latter half of July. The rainfall for 1984-1986 was also considered normal in comparison with previous years. The rainstorm on 29-30th July is notable for both the amount of rainfall and the number of resulting incidents, although these were less than the corresponding figures for the three major rainstorms of 1982-83. This event was the most severe rainstorm since June 1983.

In Figure 2, cumulative rainfall for 1987 is shown in comparison with the average (1951-1980), the wettest year (1982) and the driest year (1963) since records began in 1884. The annual cumulative rainfall was close to the average amount. Figure 4 shows monthly rainfalls in 1987 in comparison with the recorded maximum (since 1884) and mean (1951-1980) monthly rainfalls. The monthly rainfall exceeded the mean values for the five months of March, April, May, July and November.

3. LANDSLIDES

3.1 Landslide Occurrence in 1987

The numbers of incidents reported to various Government departments during 1987 are shown in Table 4. The numbers of incidents affecting various types of area (building, road etc.) in Hong Kong, Kowloon and the New Territories are shown in Table 5. The number of major failures are also given in this table. There were nine major landslides in 1987.

A list containing details of all 307 incidents reported to the GCO is provided in Appendix A. A location map for all these incidents is shown in Drawing No. GCSP 15/1. Selected incidents are illustrated in Plates 1 to 24. More details of these incidents are contained in the incident files of the GCO District Divisions and the 1:5 000 incident location maps housed in the Civil Engineering Library.

Wherever possible, the dates and times of the landslides were ascertained by the Geotechnical Engineers during site inspection. Some incidents were not reported for several days or weeks, particularly those which occurred in the New Territories. Therefore, it was difficult to determine the exact times of occurrence for these incidents. Out of 307 incidents, times of occurrence were known to within one day for 234 incidents. The daily numbers of these incidents are plotted in Figure 3. Of these 234 incidents, times of occurrence were determined to within one hour for 109 incidents.

The highest daily number of incidents was 111 on 30th July and the next highest was fifteen on 22-23th May. These occasions are included in Table 1, where the number of incidents reported in the newspapers and by the Fire Services Department are also shown for comparison. For those events not shown in Table 1, there were less than five incidents in any

single day of the year.

It is likely that there were other failures which were not known to the GCO, including minor failures of no consequence, such as failures in remote areas, open spaces and construction sites. This should be borne in mind in reading the following landslide statistics.

3.2 Areas Affected by Incidents

The numbers of incidents, as reported to Government departments, which affected various categories of area are given in Table 5. It should be noted that one incident may affect more than one area category. Landslide consequences, classified according to the type of failure, are shown in Table 6.

3.2.1 Squatter Areas

A total of 128 incidents affected squatter areas. Of these, 47 occurred in Kowloon and 46 in the New Territories. Most of those occurring in Kowloon were in the Kowloon East region, and the majority of those occurring in the New Territories were in Tsuen Wan and Sha Tin.

One major failure affected a squatter area : incident MW 8/3 in Chi Kwu wan, Tsuen Wan (Plates 21 & 22; Section 4.10). Other failures in squatter areas were incidents MW 7/9 (Plate 8; Section 4.4), which resulted in injury to two persons, and incident ME 7/20 (Plates 17 & 18; Section 4.7), which resulted in injury to one person.

Incidents in squatter areas required permanent evacuation of 165 huts and temporary evacuation of 32 huts. Fifty percent of these evacuations resulted from failures of soil cut slopes (Table 6).

The main causes of the large number of failures which occur in squatter areas are indiscriminate cutting and filling on steep hillsides and the erection of flimsy huts in these areas. Another important factor is uncontrolled leakage and discharge from water supply, sewage and storm water pipes in these areas.

3.2.2 Buildings

There were 51 incidents affecting buildings. Two of these were major failures. They were incidents MW 7/12 (Plates 9 & 10; Section 4.5) and K 7/25 (Plates 11 & 12; Section 4.6). An example of a minor failure affecting a building is incident MW 8/20 (Plates 23 & 24).

Incidents in this category resulted in partial closure of five buildings and 44 flats, the latter in two housing estates.

3.2.3 Roads and Access

112 incidents affected roads and access, six of which were major failures. They were incidents MW 7/7 (Plates 6 & 7; Section 4.3), MW 7/12 (Plates 9 & 10; Section 4.5), ME 7/15 (Plates 15 & 16; Section 4.8), HK 7/18

(Plates 19 & 20; Section 4.12), MW 8/2 (Section 4.10) and MW 8/8 (Section 4.11). The incident K 9/4 (Section 4.13) resulted in injury to one person.

Due to these incidents, 81 sections of road or access were closed to traffic. 47 of them were caused by soil cut slope failures.

3.2.4 Construction Sites

There were eight incidents affecting construction sites, and two of these were major failures. They were incidents MW 7/7 (Plates 6 & 7; Section 4.3), which resulted in injury to three persons, and HK 5/10 (Section 4.2).

3.2.5 Catchwaters and Reservoirs

Incidents affecting catchwaters and reservoirs were dealt with separately by the Water Supplies Department. There were three reported cases, two of which were reported to have occurred on 31st July.

3.2.6 Country Parks and Open Areas

Seven incidents in country parks and AFD Special Areas were reported by the Agriculture and Fisheries Department. Five of these occurred on 30th July. In addition, the GCO inspected ten incidents in open areas.

3.3 Types of Incidents

The incidents inspected by the GCO have been classified into six types of failure and the number in each type is shown in Table 7. Damage resulting from these types of failure is shown in Table 6.

3.3.1 Fill Slopes

There were fourteen fill slope failures, forming four percent of all incidents reported. One of them was major: incident MW 8/3 (Plates 21 & 22; Section 4.10). This occurred in loose fill deposited on a natural hillslope.

3.3.2 Cut Slopes

There were 193 cut slope failures, forming 63% of all incidents reported. These were classified further according to types of material, i.e. soil, soil/rock and rock cut slope failures.

There were 165 soil cut slope failures. Five of these were major: incidents K 7/25 (Plates 11 & 12; Section 4.6), ME 7/15 (Plates 15 & 16; Section 4.8), HK 7/18 (Plates 19 & 20; Section 4.12), MW 8/2 (Section 4.9) and MW 8/8 (Section 4.11). An example of a minor soil cut slope failure is incident MW 5/2 (Plates 4 & 5).

There were eighteen soil/rock cut slope failures. One of them was major: incident MW 7/12 (Plates 9 & 10; Section 4.5). Examples of minor

soil/rock cut slope failures are incidents HK 3/8 (Plates 1 & 2) and ME 7/3 (Plates 13 & 14).

There were ten rock cut slope failures. One of these was major: incident HK 5/10 (Section 4.2).

3.3.3 Retaining Walls

There were 27 retaining wall failures, forming nine percent of all incidents reported. None of these was major. Examples of minor retaining wall failures are incidents ME 4/7 (Plate 3), ME 7/20 (Plates 17 & 18; Section 4.7) and MW 7/9 (Plate 8; Section 4.7).

3.3.4 Natural Slopes

There were fourteen natural slope failures, forming five percent of all incidents reported. None of these was major.

3.3.5 Rock and Boulder Falls

There were 28 cases of rock and boulder falls, forming nine percent of all incidents reported, none of which was major. Examples of rock and boulder falls are incidents MW 8/20 (Plates 23 & 24) and K 9/4 (Section 4.13).

3.3.6 Other Failures

Other failures are incidents which cannot be classified according to the above categories. These included cases of collapse of excavations, ground settlement and collapse of huts. There were 31 failures of this type, forming ten percent of all incidents reported. One of these was major: incident MW 7/7 (Plates 6 & 7; Section 4.3).

3.4 Rainfall-Landslide Relationships

The primary cause of the large majority of all failures was rainfall. Other failures were mostly isolated incidents caused by such factors as construction work, leakage of services and indiscriminate activities relating to earthworks and drainage alterations in squatter areas.

A simple relationship between rainfall and landslides is demonstrated by the plot of daily rainfall and daily number of landslide occurrences throughout 1987 in Figure 3. The majority of landslides tend to occur at times of heavy rainfall. The geographical distribution of rainfall also has a considerable influence on the occurrence of landslides in various areas. Figures 6 to 10 show the location of landslides for which dates of occurrence are known (see Section 3.1), imposed on the 24-hour rainfall maps for the corresponding time periods for the events on 17th March, 7th April, 17th May, 23rd May and 30th July. A clear relationship between landslides and rainfall distribution can be seen in these figures.

The rainstorm on 29-30th July is noteworthy (Figure 10). It had the

highest rainfall of all rainstorms in 1987. It also occurred at the end of a long period of continuous rainfall over the last week of July (Figure 3 and Table 3). This rainstorm resulted in 111 incidents, the highest number since the rainstorm of June 1983, and more than one third of all incidents which occurred in 1987. On this occasion, a 24-hour rainfall of more than 200 mm fell over most of the territory, with the heaviest falls in Tsuen Wan, Sha Tin and Sai Kung. As a result, the number of incidents occurring in the New Territories formed about 70% of all incidents resulting from this rainstorm. Three persons were injured in two separate minor incidents in the New Territories. Seven of the nine major incidents in 1987 occurred in this rainstorm, including two major failures which resulted in the evacuation of a total of 44 flats.

More detailed and comprehensive discussions on rainfall-landslide relationships and failure mechanisms can be found in Brand et al (1984) and Premchitt et al (1985), where extensive data from the past twenty years have been analysed.

4. NOTABLE INCIDENTS

4.1 Introduction

Twelve out of the 307 incidents are discussed in more detail in this section. These are presented in chronological order. The nature of the incident is referenced under the caption for each incident. These incidents have been selected mainly on the bases of size and consequences of failure.

4.2 Incident HK5/10, Fei Tsui Road, Chai Wan

(Date : 23rd May. Major rock cut slope failure affecting construction site.)

This major failure occurred in the early morning of 23rd May after a period of heavy rainfall. It occurred in a rock cut slope, catalogued as 11SE-D/C42, on the south of a Housing Authority site office. The failure was about 8 m wide, 10 m high and located at mid-height of the slope, on the second berm from the top. The cut face was steeper than 70°. The rock debris volume was estimated to be about 50 cu m. The debris accumulated in the open area at the toe of the slope. The failure scar and debris showed that the failed mass derived mostly from a large block of weathered rock, the slip planes of which were mainly controlled by the existing joints in the rock mass. After the failure, it was observed that large quantities of water were flowing down the failure scar. These appeared to come from a drain pipe from the squatter area above the slope.

As a result of this failure, a temporary structure was removed and the adjacent areas at the crest and toe of the slope were fenced off. The slope is to be stabilized as a part of future development of this area.

4.3 Incident MW7/7, Wai Tsuen Road, Tsuen Wan

(Date : 27th July. Major failure in an excavation in a construction site, three persons injured, Plates 6 & 7.)

The incident occurred at about 1715 hours on 27th July at a construction site in Wai Tsuen Road, Tsuen Wan. It occurred in a 6 m deep excavation at a time when eight workers were working in the excavation.

The first failure occurred when the unsupported southeastern face of the excavation collapsed, releasing a soil debris volume of about 45 cu m. Six of the workers escaped unhurt, while the other two suffered some injuries and were rescued by firemen and police. One of the workers who escaped injury in the initial collapse was also injured when he went to assist in the rescue. About four hours after the first slip, the northwestern face collapsed, releasing a soil debris volume of about 30 cu m. The failure also affected the existing slope supporting a road above the northern face of the excavation. As a preventive measure, the road was temporarily closed. Subsequently, the exposed faces of the excavation were provided with adequate support to prevent further failures.

4.4 Incident MW7/9, 277, Tan Kwai Tsuen, Yuen Long

(Date : 29th July. Retaining wall failure affecting squatters, two persons injured, Plate 8.)

This retaining wall failure occurred at about 2330 hours on 29th July during the initial period of heavy rainfall. It occurred in an old 3 m high masonry retaining wall. The failed section was about 8 m long. The failure also involved the collapse of a soil cut slope just below the wall and the total failed mass was about 30 cu m. The failure debris fell down the slope and broke through the roof and back wall of a hut at the toe of the slope. A temporary structure adjacent to the hut was destroyed. As a result, two persons were injured. Subsequently, the two structures were permanently evacuated and they were cleared from the site. The remedial works included removal of loose fill and provision of drainage and surface protection.

4.5 Incident MW7/12, Cho Yiu Estate, Tsuen Wan

(Date : 30th July. Major failure of a soil/rock cut slope affecting a building and road, Plates 9 & 10.)

This major landslide, the largest one in 1987, occurred at around 0210 hours on 30th July, during very intense rainfall in this area, in a soil and rock cut slope, catalogued as 11NW-A/C140. The failure was about 15 m high and 20 m wide and the debris volume was estimated to be about 1200 cu m. The debris completely blocked Lim Cho Street and part of it spilled over to Lai Cho Road below. The failure occurred entirely in the soil part of the slope, which overlay the granite. The shape of the failure scar revealed a very high degree of structural control, with some of the relict joints forming failure planes. Immediately after the failure, a large volume of water was seen discharging from a broken drain at the top of failure. This was previously joined to a down-pipe on the slope face which had been carried away in the failed mass.

As a result of this failure, 24 flats in Block 4 of the Cho Yiu Estate, which was directly adjacent to the top of failure, were temporarily evacuated. Lim Cho Street was also closed temporarily. The permanent remedial work is being carried out by consultants to the Hong Kong Housing Society.

4.6 Incident K7/25, Block 10 Jordan Valley Estate, Kowloon

(Date : 30th July. Major failure on a soil cut slope affecting a building, Plates 11 & 12.)

This major landslide occurred at about 0230 hours on 30th July, during a

heavy rainstorm. A soil cut slope, catalogued as 11NE-C/C12, was being reconstructed at the time. A soil stockpile, accumulated on the slope as the result of the reconstruction work on this slope, collapsed; the failure was about 5 m high, 8 m wide and the debris volume was estimated to be about 300 cu m. The debris overturned a 2 m high hoarding and struck the ground floor of Block 10, Jordan Valley Estate. There was no report of injury in this incident.

As a result of the failure, 20 flats on the Ground Floor and First Floor of Block 10 were temporarily evacuated. The permanent remedial work was carried out as a part of the reconstruction of the slope.

4.7 Incident ME7/20, 323 Ma Yau Tong Village, Sai Kung

(Date : 30th July. Retaining wall failure affecting squatters, one person injured, Plates 17 & 18.)

This incident occurred at about 0330 hours on 30th July during a period of intense rainfall. It occurred in a 6 m long section of a 2.5 m high rubble wall. The failure volume was estimated to be about 8 cu m. The wall supported the built-up platform of a private lot (Lot 31 in SD9) which was vacant at the time. The area had been left exposed without surface protection. Hut no. 323, directly below the wall, was completely destroyed when failure occurred. As a result, one person was injured and one nearby hut needed to be permanently evacuated. The slide debris and the collapsed huts were subsequently cleared from the area.

4.8 Incident ME7/15, Sai Sha Road, Long Keng, Sai Kung

(Date : 30th July. Major failure of a soil cut slope, affecting road, Plates 15 & 16.)

This failure occurred at about 0630 hours on 30th July during heavy rainfall. It occurred in the lower berm of a soil cut slope, about 8 m high, above Sai Sha Road. The slope failed in two adjacent areas about 5 m apart. The failed sections were 10 m and 6 m wide respectively. The total debris volume was estimated to be about 50 cu m. The failure planes were evidently largely controlled by relict joints, particularly the smaller failure which also showed failure planes with slickensides. The debris blocked one lane of the road. The area was subsequently cleared and remedial work was carried out on the slope.

4.9 Incident MW8/2, 7½ MS, South Lantau Road, Tong Fuk, Lantau

(Date : 30th July. Major failure of a soil cut slope affecting a road.)

The landslide occurred in the morning of 30th July during a period of intense rainfall. A cut slope in weathered volcanics failed, with a volume of slide debris of about 100 cu m. The failure was 10 m high and 17 m long, and the original slope angle was about 60°. The failure scar showed evidence of the influence of relict joints on the failure planes. The failure debris completely blocked the footpath and obstructed both lanes of the South Lantau Road. This was cleared and remedial work on the failure initiated.

- 4.10 Incident MW8/3, Chi Kwu Wan, Tsuen Wan
(Date : 30th July. Major failure of a fill slope affecting squatters, Plates 21 & 22.)

This landslide was reported to occur in the early morning of 30th July, during heavy rainfall. It occurred in the Chi Kwu Wan squatter area, which was built on a loose fill layer deposited on a natural hill-slope. The failure was about 13 m high, 7 m wide and the debris volume was estimated to be about 100 cu m. The original slope angle was about 45°. The debris flowed more than 30 m down the slope, and destroyed two rows of huts in the process. No injuries were reported in this incident. As a result of the failure, a total of eleven huts were permanently evacuated and cleared from the area. Remedial works, including removal of loose fill and provision of drainage and surface protection, were subsequently carried out.

- 4.11 Incident MW8/8, Tai Lin Pai Road, Kwai Chung
(Date : 30th July. Major failure of a soil cut slope affecting a road.)

This major failure occurred in the early morning of 30th July. It occurred in a construction site on a soil cut slope, catalogued as 7SW-C/C230, with old stone-pitching surface protection. The failure was about 6 m high, 25 m long and the debris volume was estimated to be about 120 cu m. The fallen debris completely blocked the footpath on the eastern side of Tai Lin Pai Road. The debris was cleared from the area and the repair works, comprising cutting back the slope to an angle of 35° and provision of surface drainage, were carried out subsequently.

- 4.12 Incident HK7/18, Victoria Road near Kung Man Village
(Date : 31st July. Major failure of a soil cut slope affecting road, Plates 19 & 20.)

This landslide occurred at about 1030 hours on 31st July, one day after a period of heavy rainfall. The slip was located at mid-height of a soil cutting alongside Victoria Road, catalogued as 11SW-A/C286. The failure was about 8 m high, 5 m wide and the debris volume was estimated to be about 70 cu m. The debris blocked the footpath and one lane of Victoria road. A ruptured water main was found near the crest of the slip scar, and leakages from this could have initiated the failure. The debris and the remaining loose material were removed within one day after the failure and the slip scar was provided with surface protection subsequently.

- 4.13 Incident K9/4, Junction of Caldecott Road & Tai Po Road, Kowloon
(Date : 17th September. Boulder fall in construction site, affecting a road, one person injured.)

This incident occurred at about 1100 hours on 17th September in a construction site which was part of the Tai Po Road Improvement (Stage II). It occurred when a boulder on a soil cut slope, at a height of 15 m above Tai Po Road was being split in order to be removed from the formed surface of the slope. A part of the boulder (about 0.5 cu m) fell down and broke through a 4.5 m high hoarding at the toe of the slope. As a result, one person was injured. Subsequently, one lane of Tai Po Road was closed pending investigation of the stability of the remaining boulders and

strengthening of the hoarding.

5. CONCLUSIONS

Rainfall amounts for various durations during 1987 can be considered normal except for the heavy long-period (more than two day) rainfalls during the latter half of July. Over the whole year, 307 landslides and related incidents were reported to the GCO District Divisions, and the damage resulting from these incidents may be summarised as follows : seven persons injured, 197 huts evacuated, five buildings partially closed, 44 flats evacuated and 81 sections of road and access closed. Most of this damage occurred during or shortly after rainstorms. The most intense and damaging storm occurred on 29-30th July, when 111 incidents occurred. A Landslip Warning was issued on this occasion. The warning was also issued for the other two severe rainstorms, on 6th April and 22nd May.

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Table 1 - Rainfall-Landslide Events in 1987 with 24-hour Rainfall Greater than 50 mm

Date	Maximum Rainfall (mm)								Landslide Consequences				
	Royal Observatory				GCO Raingauges				Number of Landslides			Persons Killed or Injured	Number Huts Evacuated Permanently
	24-hr	5-hr	1-hr	Antecedent		24-hr	5-hr	1-hr	GCO	Newspaper	FSD		
				4-day	15-day								
29 - 30/7/87	183	71	38	147	343	314	169	73	111	36	3	3 injured	49
5 - 6/4/87	166	78	42	8	47	220	80	55	12	8	-	-	1
17/3/87	126	108	50	44	44	169	137	74	14	4	-	-	1
22 - 23/5/87	119	55	28	31	225	194	111	59	15	6	-	-	6
16 - 17/5/87	105	45	23	-	119	255	130	58	4	-	-	-	-
22 - 23/7/87	99	88	40	31	61	156	84	56	4	-	-	-	-
21 - 22/9/87	97	90	55	7	15	98	87	47	-	-	-	-	-
28 - 29/7/87	87	53	24	113	241	98	56	38	4	-	1	-	14
7 - 8/5/87	85	68	39	3	33	84	68	49	1	-	-	-	4
4 - 5/6/87	82	37	14	19	253	121	107	42	12	1	-	-	3
25 - 26/7/87	79	24	17	117	147	89	60	41	1	-	-	-	-
18 - 19/6/87	62	30	19	4	140	130	88	68	-	-	-	-	-
16/3/87	58	41	19	-	1	75	46	16	3	-	-	-	-
12 - 13/4/87	57	43	32	-	199	67	54	45	-	-	-	-	-
28 - 29/10/87	57	38	10	3	10	82	53	22	-	-	-	-	-
27 - 28/5/87	56	31	15	47	272	80	45	28	-	-	-	-	-
Recent Major Rainstorms (For Comparison Only)													
29/5/82	394	153	44	1	11	430	237	111	551	498	15	48	1153
16/8/82	362	159	68	0	346	370	290	95	138	62	6	9	200
17/6/83	347	274	69	2	77	460	303	101	155	114	5	2	149
<p>Notes : (1) The events are arranged in order of magnitude of 24-hour rainfall at the Royal Observatory, Tsim Sha Tsui. (2) For the rest of 1987, there were less than 5 landslips reported to GCO on any one day. (3) Newspapers searched are South China Morning Post and Hong Kong Standard.</p>													
<p>Abbreviation : GCO = Geotechnical Control Office ; FSD = Fire Services Department ; RO = Royal Observatory</p>													

Table 2 - Type and Date of Warnings Issued by the Royal Observatory in 1987

Month	Dates of Warnings			
	Thunderstorm	Flood	* Landslip	Tropical Storm
January	-	-	-	-
February	-	-	-	-
March	16, 17, 18, 21, 25	17, 18, 25	-	-
April	5, 6, 7, 12	5, 6, 12	6 (5p.m. to 7p.m.)	-
May	3, 7, 8, 16, 17, 20, 21, 22, 23, 25, 26, 27, 31	17, 22, 23	22 (2p.m. to 5p.m.)	-
June	1, 4, 5, 6, 7	4, 19	-	18 - 19 (No. 1 signal, Ruth)
July	5, 7, 8, 9, 14 16, 19, 21 to 31	22, 28, 30	30 (5a.m.) to 31 (8a.m.)	-
August	15, 16, 17, 20, 22 23, 29, 30, 31	-	-	14 - 15 (No. 1 signal, Betty) 19 - 21 (No. 1 signal, Cary)
September	1, 2, 3, 6, 18 21, 22, 24, 25	-	-	9 - 10 (No. 1 signal, Gerald)
October	3, 8, 15, 29	-	-	23 - 26 (No. 1-3 signals, Lynn)
November	-	-	-	-
December	-	-	-	-
TOTAL NUMBER	67	14	3	5

Legend :

* Landslip warnings were issued after consultation between GCO & RO

Table 3 - Maximum Rainfalls during 1987 and Estimated Return Periods

Duration	* Rainfall (mm)	Ending Time		† Estimated Return Period (Year)
		Date	Hours	
1 hour	54.9	21/9	2400	< 2
5 hours	107.7	17/3	1300	< 2
12 hours	120.8	17/3	1800	< 2
24 hours	183.4	30/7	1500	< 2
2 days	227.0	30/7	2400	< 2
4 days	315.0	30/7	2400	2
7 days	423.7	30/7	2400	3
15 days	558.4	31/7	2400	3

Legend :

- * Rainfall at Royal Observatory, Tsim Sha Tsui
- † Gumbel equation, Peterson & Kwong (1981)

Table 4 - Number of Incidents Reported to Various Offices/Departments during 1987

Office / Department	Total Number	Types of Incident		
		Landslide	Flooding	Others
Geotechnical Control Office	307	281	2	24
Agriculture & Fisheries Department	7	7	-	-
Architectural Services Department	6	6	-	-
Civil Engineering Office	-	-	277	-
Fire Services Department	22	6	6	10
Highways Department	139	137*	-	2
Housing Department	7	7	-	-
Water Supplies Department	3	3	-	-

Legend :

* Landslides reported to HyD were referred to GCO and are included in the GCO incidents.

Table 5 - Number of Incidents Affecting Different Areas in 1987

Affected Area	Hong Kong	Kowloon	New Territories	All Districts
Squatters	35	47	46 (1)	128 (1)
Buildings	11	5 (1)	35 (1)	51 (2)
Roads	30 (1)	11	71 (5)	112 (6)
Construction Sites	6 (1)	-	2 (1)	8 (2)
Catchwaters	-	-	-	-
Country Parks / Open Areas	5	3	2	10
Legend :				
() Number of major failures				
Note : One incident may affect more than one type of area.				

Table 6 - Consequence Related to Type of Failure in 1987

Type of Failure		No. of Huts Evacuated		Closure of Part of Building	Road/ Access Blocked	Injury
		Permanent	Temporary			
Fill Slope		21	4	-	2	-
Cut Slope	Soil	84	23	3 buildings & 20 flats	47	-
	Soil/Rock	-	2	24 flats	7	-
	Rock	-	-	-	6	-
Retaining Wall		38	-	-	4	3
Natural Slope		9	2	1	3	-
Rock / Boulder Fall		5	1	1	5	1
Others		7	-	-	7	3
TOTAL		165	32	5 buildings & 44 flats	81	7

Table 7 - Number of Incidents Reported to GCO during 1987 Classified by Type of Failure

Type of Failure		Number	Percentage
Fill Slope		14 (1)	4 %
Cut Slope	Soil	165 (5)	54 %
	Soil / Rock	18 (1)	6 %
	Rock	10 (1)	3 %
Retaining Wall		27	9 %
Natural Slope		14	5 %
Rock / Boulder Fall		28	9 %
Others		31 (1)	10 %
TOTAL		307 (9)	100 %
Legend : () Number of major failures			

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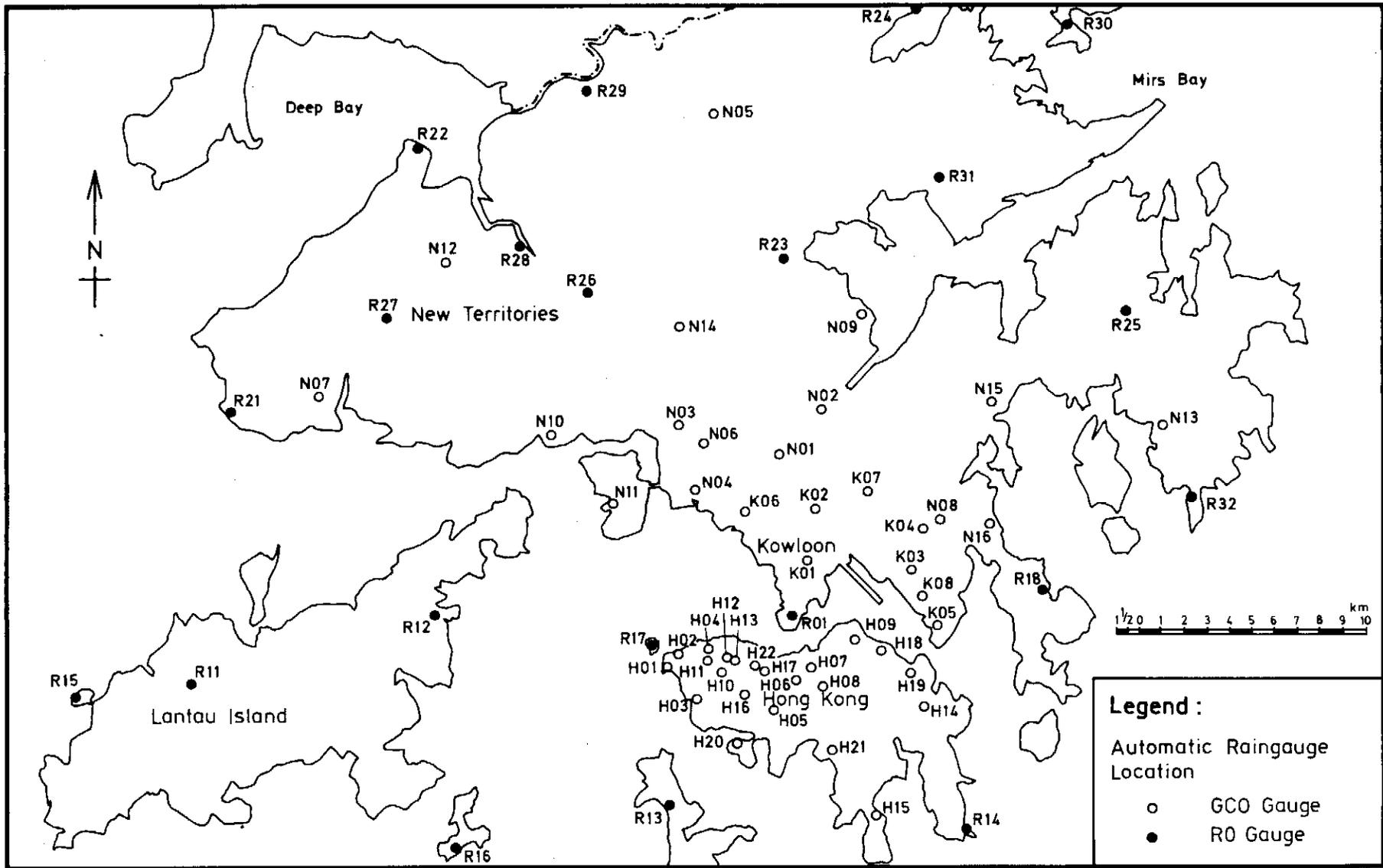


Figure 1 - Location of GCO and RO Automatic Rain gauges

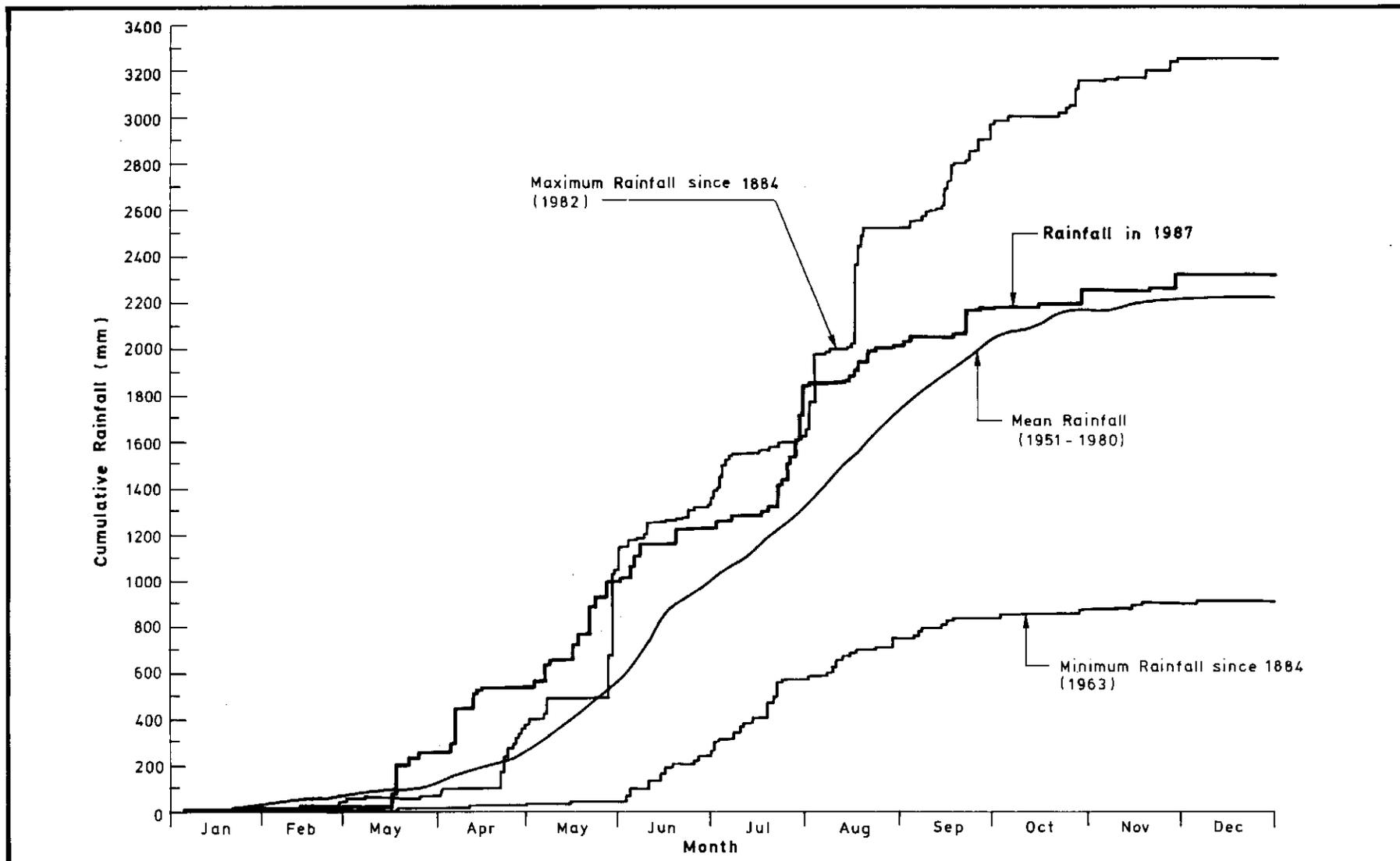


Figure 2 - Cumulative Rainfall for 1987 and the Recorded Maximum, Mean and Minimum Cumulative Rainfalls

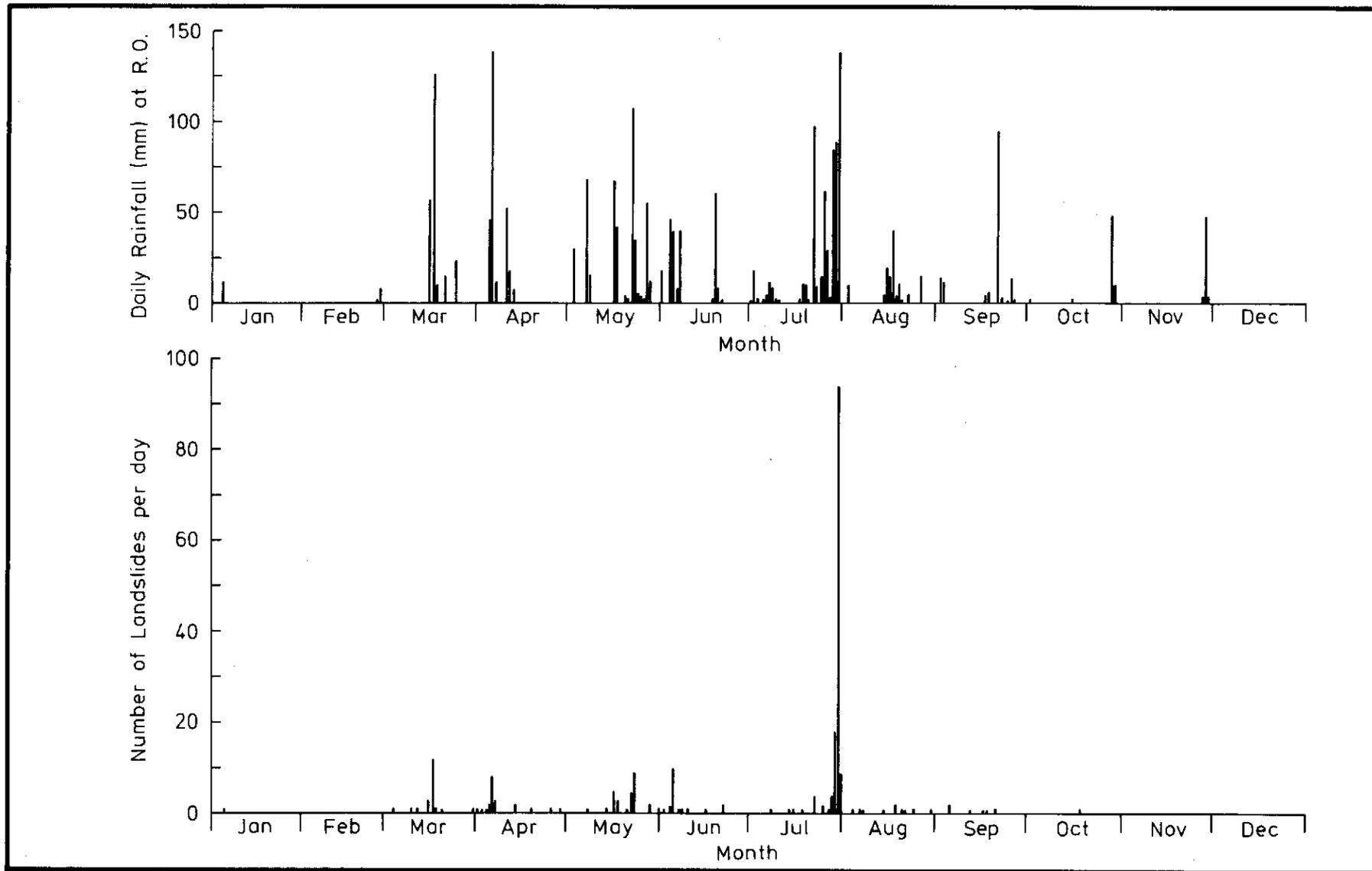


Figure 3 - Daily Rainfall and Distribution of Number of Landslides during 1987

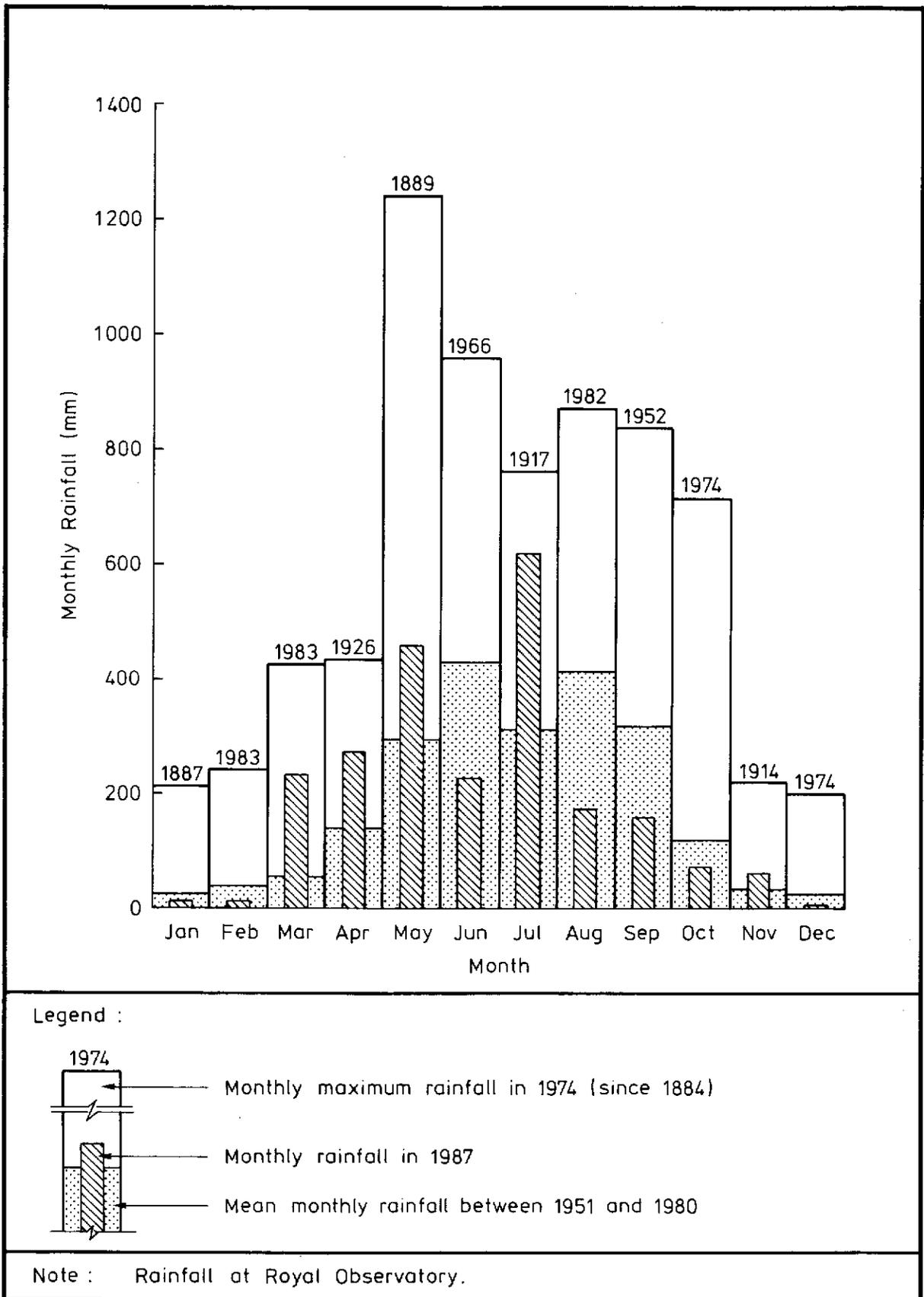


Figure 4 - Monthly Rainfalls in 1987 in Comparison with Recorded Maximum and Mean Monthly Rainfalls

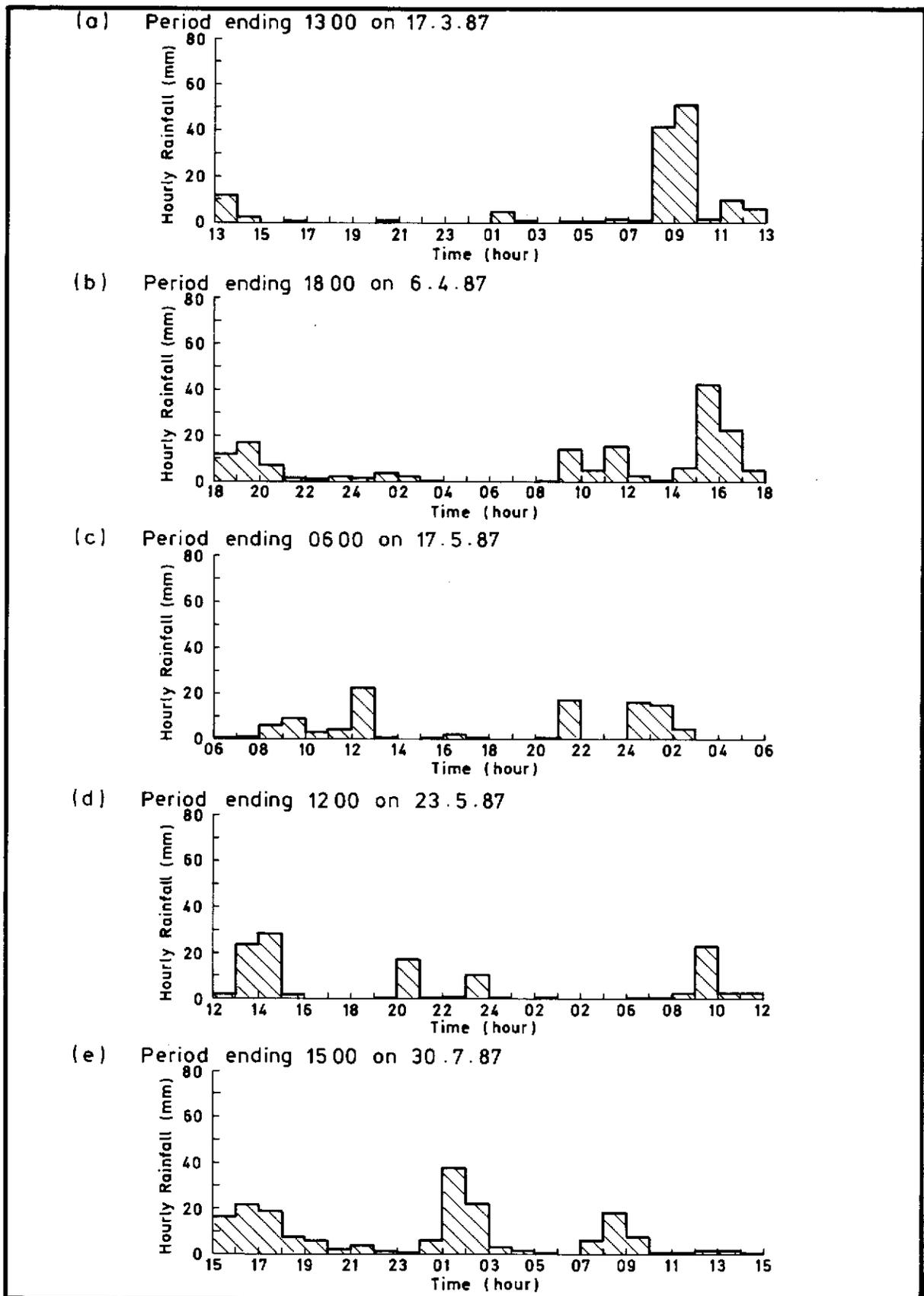


Figure 5 - Histograms of Hourly Rainfall at the Royal Observatory on 17th March, 6th April, 17th May, 23rd May and 30th July

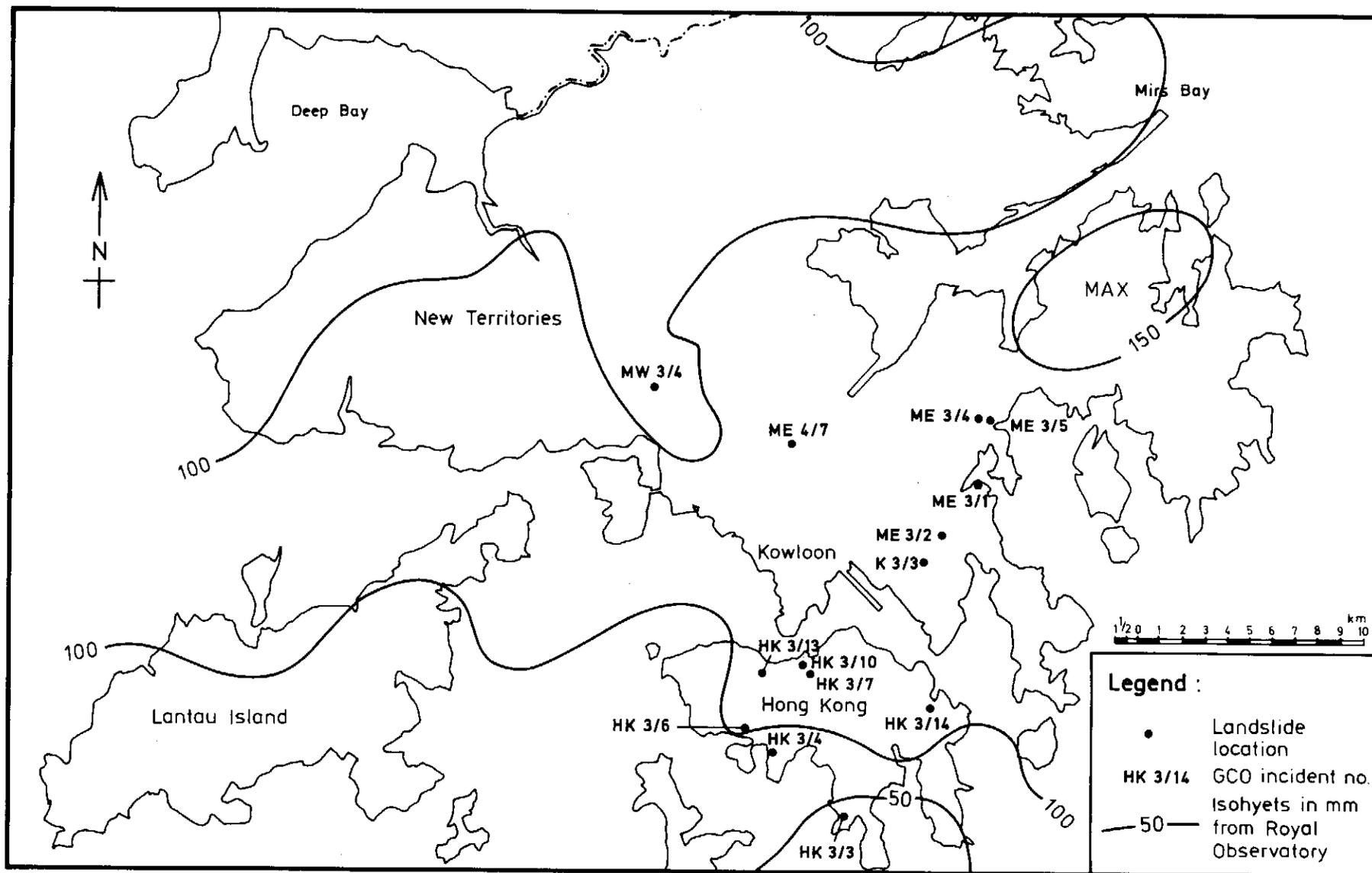


Figure 6 - 24-hour Rainfall Distribution Ending at 3 pm on 17th March 1987 and Location of GCO Incidents

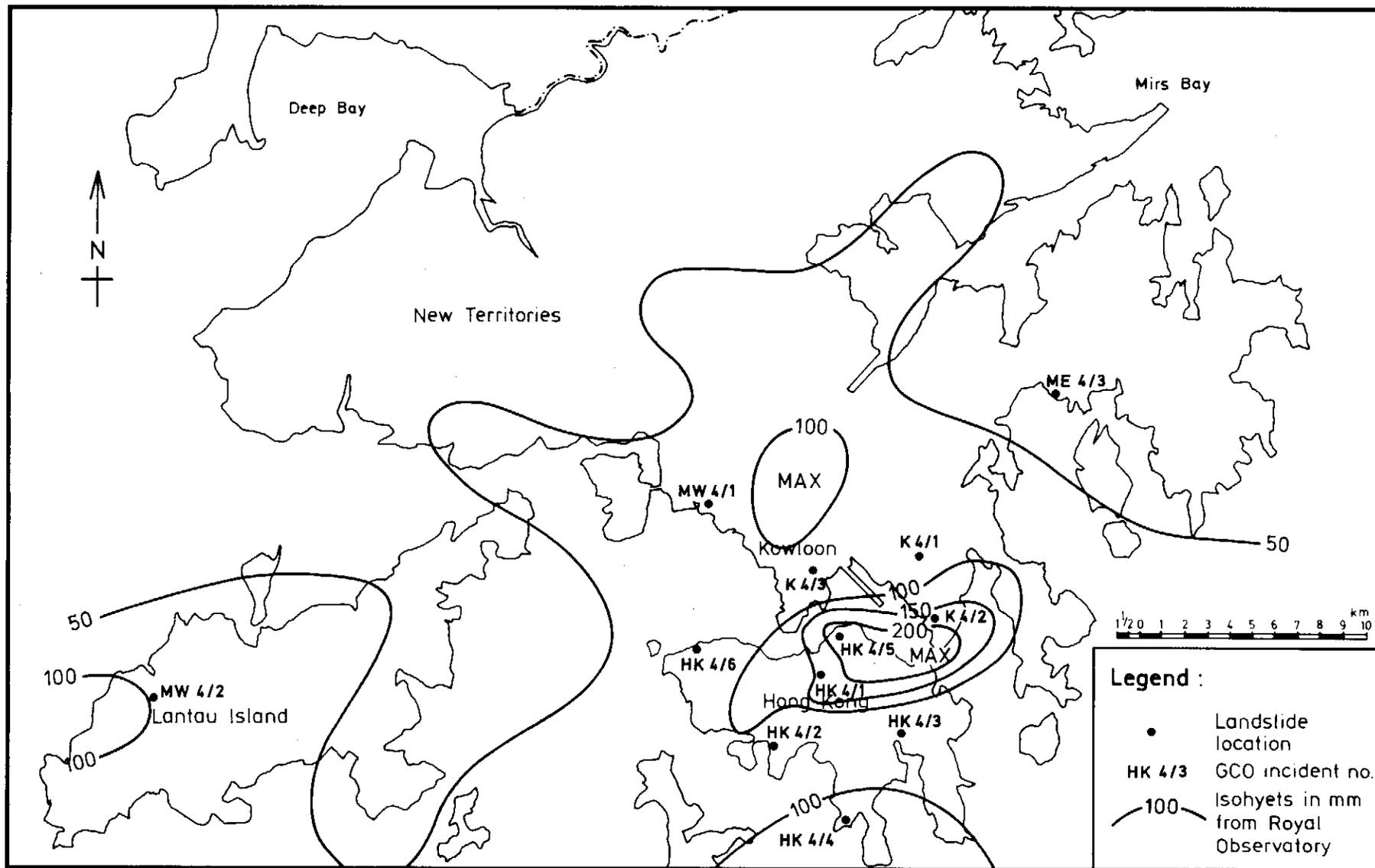


Figure 7 - 24-hour Rainfall Distribution Ending at 3 pm on 7th April 1987 and Location of GCO Incidents

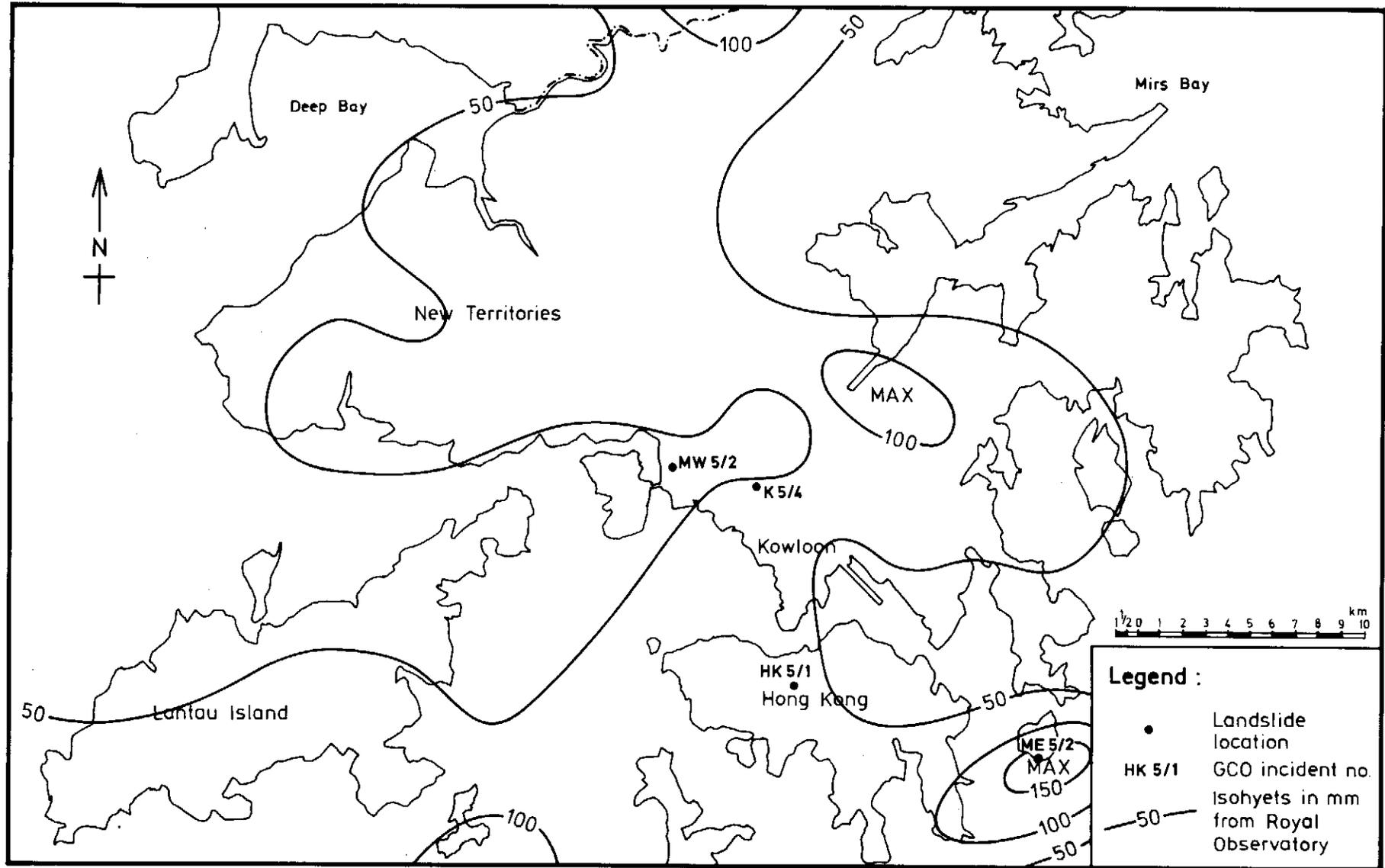


Figure 8 - 24-hour Rainfall Distribution Ending at 3 pm on 17th May 1987 and Location of GCO Incidents

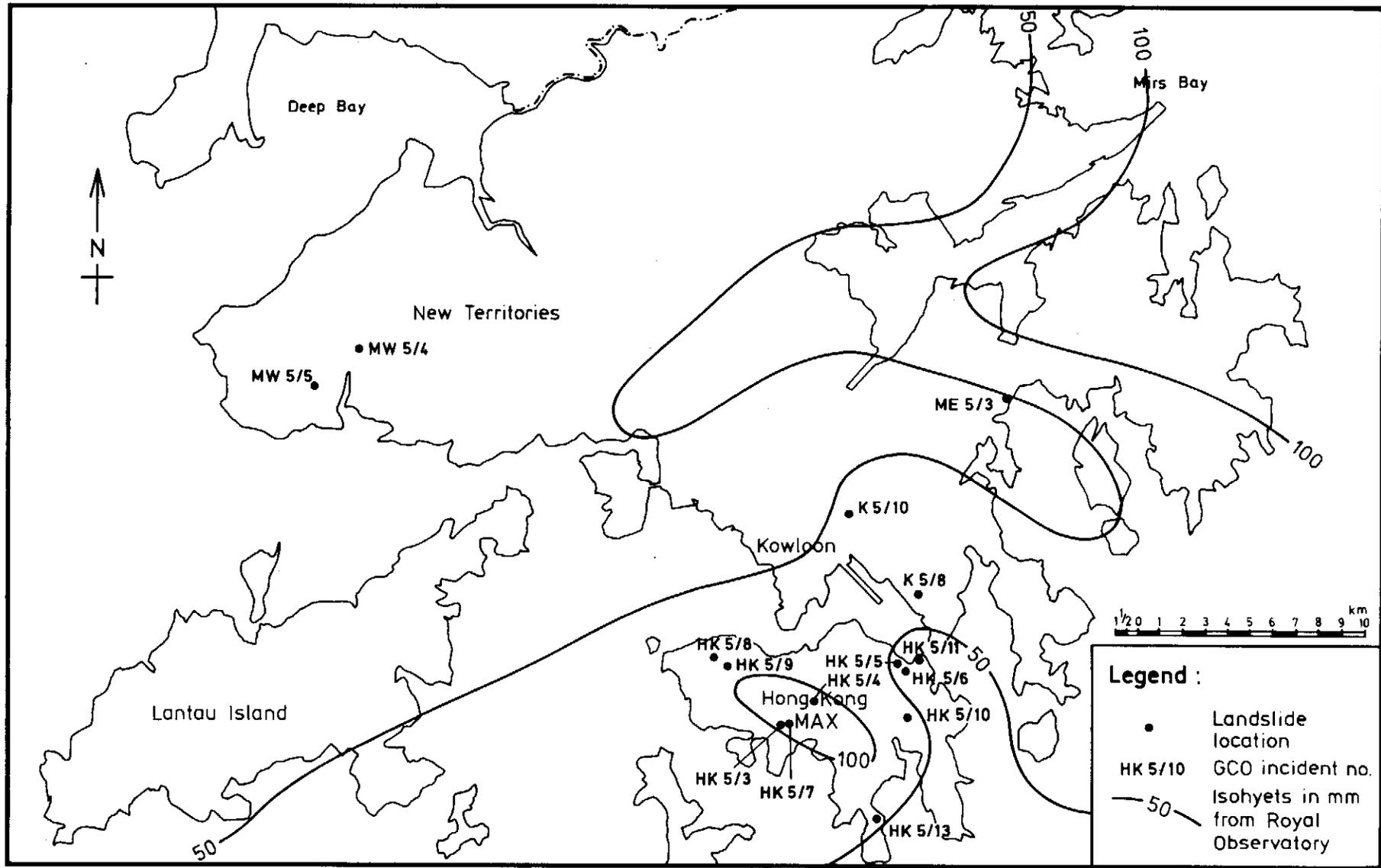


Figure 9 - 24-hour Rainfall Distribution Ending at 3 pm on 22nd May 1987 and Location of GCO Incidents

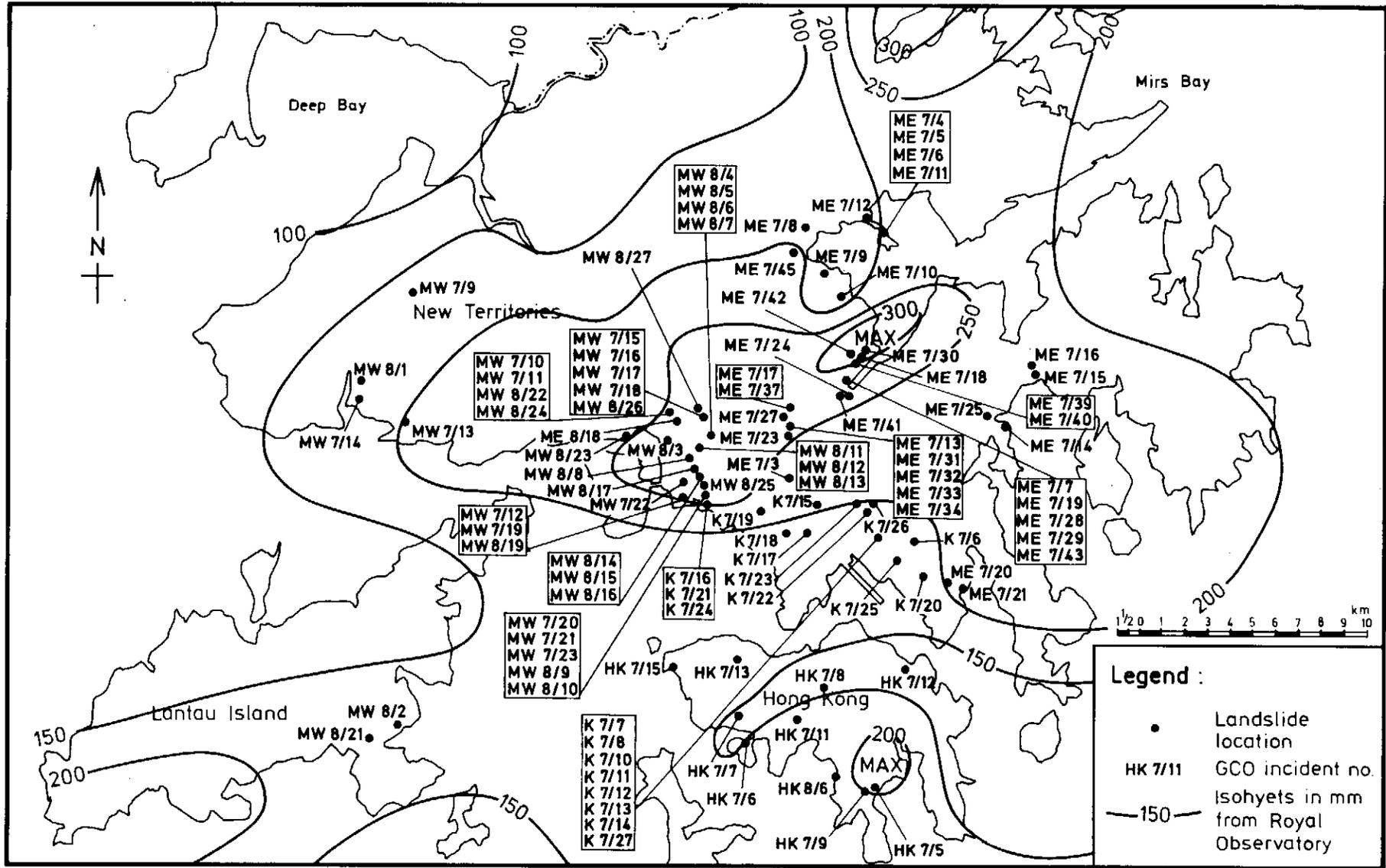


Figure 10 - 24-hour Rainfall Distribution Ending at 3 pm on 30th July 1987 and Location of GCO Incidents

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Plate: 1 Negative No.: IE8708717 Date: 18.3.87



Plate: 2 Negative No.: IE8708715 Date: 18.3.87

Description : Soil/rock cut slope failure affecting road,
footpath closed

Plates 1 & 2 - Shek Pai Wan Road, Aberdeen
(Incident No. HK 3/8)



Plate: 3 Negative No.: SP8706119 Date: 18.3.87

Description : Sheet-pile wall failure affecting road,
one lane closed

Plate 3 - Tai Po Road near Keng Hau Road, Sha Tin
(Incident No. ME 4/7)



Plate: 4 Negative No.: MW8711224 Date: 18.5.87



Plate: 5 Negative No.: MW8711216 Date: 18.5.87

Description : Soil cut slope failure affecting road,
footpath blocked

Plates 4 & 5 - Kwai Fuk Road, Tsuen Wan
(Incident No. MW 5/2)

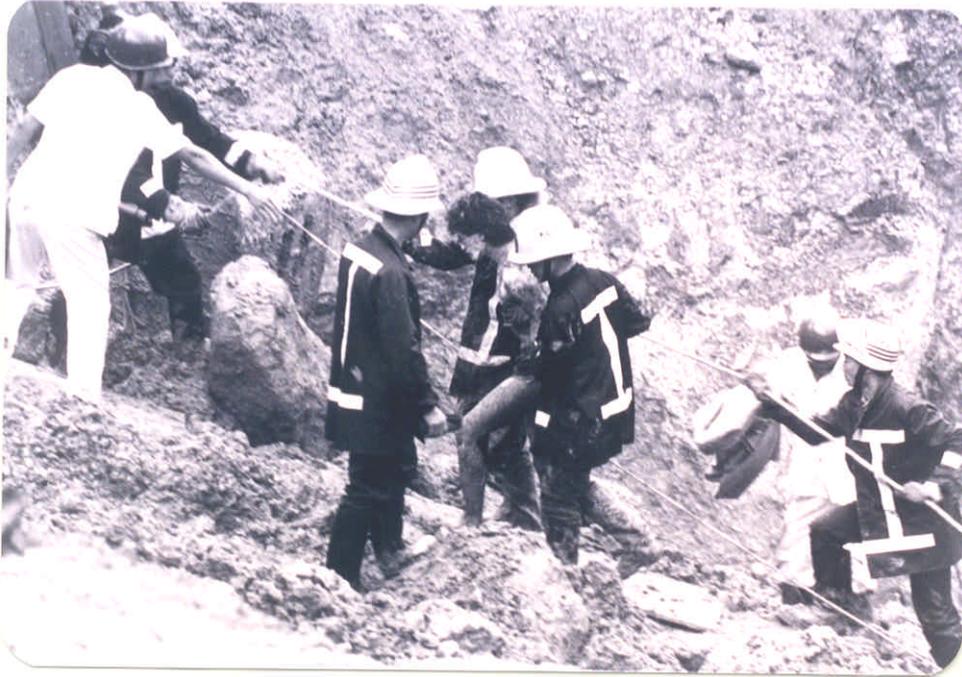


Plate: 6 Negative No.: SP8706121 Date: 27.7.87



Plate: 7 Negative No.: MW8715619 Date: 28.7.87

Description : Major failure in excavation in construction site,
three persons injured

Plates 6 & 7 - Wai Tsuen Road, Tsuen Wan
(Incident No. MW 7/7)



Plate: 8 Negative No.: MW8715711 Date: 30.7.87

Description : Retaining wall failure affecting squatters,
two persons injured, two huts destroyed

Plate 8 - 277 Tan Kwai Tsuen, Yuen Long
(Incident No. MW 7/9)



Plate: 9 Negative No.: HQ8702920 Date: 30.7.87



Plate: 10 Negative No.: HQ8702909 Date: 30.7.87

Description : Major failure of soil/rock cut slope (11NW-A/C140), affecting building and road, 24 flats temporarily evacuated, two lanes of road closed

Plates 9 & 10 - Cho Yiu Estate, Ha Kwai Chung, Tsuen Wan
(Incident No. MW 7/12)



Plate: 11
Negative No.: ME8723519
Date: 30.7.87



Plate: 12
Negative No.: ME8723624
Date: 30.7.87

Description : Major failure of a soil stockpile (11NE-C/C12),
affecting building, 20 flats temporarily evacuated

Plates 11 & 12 - Housing Block No 10, Jordan Valley Estate
(Incident No. K 7/25)



Plate: 13 Negative No.: ME8723406 Date: 30.7.87



Plate: 14 Negative No.: ME8723408 Date: 30.7.87

Description : Soil/rock cut slope failure affecting road,
one lane of road blocked

Plates 13 & 14 - Lion Rock Tunnel Road, Sha Tin
(Incident No. ME 7/3)



Plate: 15
Negative No.: ME8723810
Date: 30.7.87

Plate: 16
Negative No.: ME8723806
Date: 30.7.87



Description : Major failure of soil cut slope affecting road,
one lane blocked

Plates 15 & 16 - Sai Sha Road, Long Keng, Sai Kung
(Incident No. ME 7/15)



Plate: 17 Negative No.: ME8724107 Date: 31.7.87



Plate: 18 Negative No.: ME8724117 Date: 31.7.87

Description : Retaining wall failure affecting squatters,
one person injured, one hut destroyed

Plates 17 & 18 - 323, Ma Yau Tong Village, Sai Kung
(Incident No. ME 7/20)



Plate: 19 Negative No.: IW8710411 Date: 31.7.87



Plate: 20 Negative No.: IW8710412 Date: 31.7.87

Description : Major failure of soil cut slope (11SW-A/C286),
affecting road, one lane blocked

Plates 19 & 20 - Victoria Road near Kung Man Village
(Incident No. HK 7/18)



Plate: 21 Negative No.: MW8716601 Date: 3.8.87



Plate: 22 Negative No.: MW8716616 Date: 3.8.87

Description : Major failure of fill slope affecting squatters,
eleven huts destroyed and permanently evacuated

Plates 21 & 22 - Chi Kwu Wan, Kwai Shing, Tsuen Wan
(Incident No. MW 8/3)



Plate: 23
Negative No.: MW8718108
Date: 12.8.87



Plate: 24
Negative No.: MW8718106
Date: 12.8.87

Description : Rock fall (from slope 15NW-C/C13) affecting building,
store room damaged

Plates 23 & 24 - Sok Kwu Wan, Lamma
(Incident No. MW 8/20)

APPENDIX A
LIST OF INCIDENTS

APPENDIX A

LIST OF TABLES

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Table A1 - List of Incidents on Hong Kong Island Reported to GCO in 1987 (Sheet 1 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
HK 1/1	Squatter area above Shum Wan Road	21/1	HyD	NK	Hut collapse	Minor	Squatters		
HK 2/1	Holy Cross Path Village, Shankeiwan	11/2	HyD	NK	Soil cut slope	Minor	Squatters		
HK 2/2	Squatter area between Shek Pai Wan Road & Tin Wan Praya Road, Aberdeen	16/2	HyD	NK	Retaining wall	Minor	Squatters		
HK 3/1	Holy Cross Path Village, Shaukeiwan	4/3	HyD	4/3	Soil cut slope	Minor	Squatters	3 huts permanently evacuated	
HK 3/2	46, Aldrich Village, Shaukeiwan	9/3	HyD	NK	Soil cut slope	Minor	Private access		
HK 3/3	B3, Jade Beach Villa, 3-7 Horizon Drive, Chung Hom Kok	17/3	Public	16/3 (pm)	Soil cut slope	Minor	Building lot		
HK 3/4	Squatter area below Nam Long Shan Road	17/3	HyD	17/3 (11am)	Fill slope	Minor	Squatters	1 hut temporarily evacuated	
HK 3/5	Chor Sheung Tsuen, Nam Fung Road	17/3	HyD	12/3 (9am)	Soil cut slope	Minor	Footpath		
HK 3/6	A.I.L. 411, Yue Kwong Road, Aberdeen	17/3	BOO	17/3 (8am)	Wash-out	Minor	Construction site	1 lane of road blocked, footpath closed	
HK 3/7	6, Broadwood Road	17/3	HyD	17/3 (3pm)	Boulder	Minor	Squatters, construction site		
HK 3/8	Shek Pai Wan Road, Aberdeen	18/3	HyD	18/3 (8am)	Soil/rock cut slope	Minor	Road & footpath	1 lane of road blocked, footpath closed	
HK 3/9	Holy Cross Path Village, Shaukeiwan	19/3	Police	16/3 (11am)	Hut Collapse	Minor	Squatters		Not a geotechnical problem
HK 3/10	Wong Nei Chung Road behind No.155	17/3	HyD	17/3 (am)	Soil cut slope	Minor	Building lot & construction site		
HK 3/11	Cloud View Road, Ngar Choi Hang Village	11/3	HyD	NK	Boulder	Minor	Squatters		Complaint only no movement
HK 3/12	Cloud View Road, Ngar Choi Hang Village	17/3	HyD	16/3	Wash-out	Minor	Footpath	Footpath blocked	
HK 3/13	114-120, MacDonnell Road	18/3	BOO	17/3 (9am)	Retaining wall	Minor	Building lot	An area fenced off	

Table A1 - List of Incidents on Hong Kong Island Reported to GCO in 1987 (Sheet 2 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
HK 3/14	Yuen Dao Ngam Village	24/3	HyD	17/3	Retaining wall	Minor	Squatters	1 hut permanently evacuated	Complaint of potential failure
HK 4/1	Wesley Village No.15, Tai Hang	6/4	HyD	6/4 (1am)	Soil cut slope	Minor	Squatter	1 hut temporarily evacuated	
HK 4/2	Shum Wan Road squatter area	7/4	HyD	6/4 (6pm)	Fill slope	Minor	Squatter	1 hut temporarily evacuated	
HK 4/3	Tai Tam Road catchpit No.TT51	6/4	Police	6/4 (6pm)	Soil/rock cut slope	Minor	Road	1 lane of road closed	
HK 4/4	68-70, Chung Hom Kok Road	7/4	HyD	7/4 (9am)	Rock cut slope	Minor	Footpath		
HK 4/5	North Point Methodist Primary School, Cheung Hong Street	7/4	HyD	6/4	Soil cut slope	Minor	Playground		
HK 4/6	Belcher's Street Ambulance Depot	8/4	GCO	7/4 (am)	Boulder	Minor	Construction site		
HK 4/7	52, Aldrich Village, Shaukeiwan	14/4	HyD	NK	Soil cut slope	Minor	Squatters		
HK 4/8	Tai Tam Road	15/4	HyD	NK	Subsidence	Minor	Road		
HK 4/9	Victoria Road near Kung Man Village	14/4	Police	14/4 (am)	Boulder	Minor	Footpath	Footpath closed	
HK 5/1	Junction of Stubbs Road and Mt. Nicholson Road	16/5	HyD	16/5 (10pm)	Rock cut slope	Minor	Road	1 lane blocked	
HK 5/2	11, Guildford Road, German Swiss International School	14/5	Public	NK	Soil cut slope	Minor	Road	Footpath blocked	
HK 5/3	Wong Chuk Hang, Kau Wo Yuen	23/5	HyD	22/5 (4pm)	Soil cut slope	Minor	Squatters	2 huts permanently evacuated	
HK 5/4	8-10, Wong Nei Chung Gap Road	23/5	BOO	23/5 (8am)	Natural slope	Minor	Footpath	Footpath blocked	
HK 5/5	Tsin Tsui Ma Tau Village, Shaukeiwan	23/5	HyD	22/5 (5pm)	Natural slope	Minor	Squatters	3 huts permanently evacuated	

Table A1 - List of Incidents on Hong Kong Island Reported to GCO in 1987 (Sheet 3 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
HK 5/6	Hing Wan Terrace near Aldrich Village, Shaukeiwan	23/5	HyD	22/5 (6pm)	Retaining wall	Minor	Squatters	1 hut permanently evacuated	Soil wash-out only
HK 5/7	Nam Fung Road, Yau Sheung Chuen	23/5	HyD	23/5 (9am)	Retaining wall	Minor	Squatters	Footpath blocked	
HK 5/8	24, Po Shan Road, Mid-levels	23/5	HyD	23/5 (am)	Soil cut slope	Minor	Road	1 lane blocked	
HK 5/9	26, Lugard Road, The Peak	23/5	HyD	23/5 (am)	Fill slope	Minor	Road & building lot	1 lane of road blocked	
HK 5/10	Fei Tsui Road, Chai Wan	23/5	HyD	23/5 (am)	Rock cut slope	Major	Construction site	An area fenced off	
HK 5/11	1-3A, Shaukeiwan Main Street East	25/5	HyD	22/5 (9pm)	Soil/rock cut slope	Minor	Road		
HK 5/12	12, Fung Fai Terrace, Happy Valley	28/5	Public	NK	Soil cut slope	Minor	Building lot		
HK 5/13	Stanley Prison, Block E	29/5	Arch SD	22/5 (12pm)	Soil cut slope	Minor	Rear footpath	Footpath blocked	
HK 6/1	Yuen Dao Ngam Village, Chai Wan	2/6	HyD	2/6 (2pm)	Soil cut slope	Minor	Squatters	3 huts permanently evacuated	
HK 6/2	Junction of Tai Hang Road & Broadwood Road	5/6	HyD	5/6 (10am)	Boulder	Minor	Road	1 lane blocked	
HK 6/4	Wang Hang Village, Shaukeiwan	5/6	HyD	5/6 (1pm)	Retaining wall	Minor	Squatters	1 hut permanently evacuated	
HK 6/5	Ma Hang B Village, Stanley	5/6	HD	5/6 (8am)	Soil cut slope	Minor	Squatters	7 huts permanently evacuated	
HK 6/6	Ma Hang B Village, Stanley	5/6	DO	5/6 (5am)	Soil cut slope	Minor	Squatters	3 huts permanently evacuated	
HK 6/7	Tin Wan Praya Road Squatter area	6/6	DO	NK	Retaining wall	Minor	Squatters	1 hut permanently evacuated	
HK 6/8	Harlech Road, The Peak	4/6	HyD	NK	Rock cut slope	Minor	Road		
HK 6/9	Old Peak Road, below Peak Tower	12/6	HyD	8/6	Fill slope	Minor	Footpath	Footpath blocked	

Table A1 - List of Incidents on Hong Kong Island Reported to GCO in 1987 (Sheet 4 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
NK 7/1	Peel Rise, Aberdeen	25/7	HyD	25/7 (4am)	Soil cut slope	Minor	Squatters	3 huts permanently evacuated	
HK 7/2	Yuen Dao Ngam Village, Chai Wan	28/7	DO	28/7 (5am)	Retaining wall	Minor	Squatters	2 huts permanently evacuated	
HK 7/3	Illumination Terrace, Tai Hang	28/7	DO	28/7 (1am)	Soil cut slope	Minor	Squatters	2 huts permanently evacuated	
HK 7/4	Repulse Bay Road, Repulse Bay	28/7	Police	28/7 (10pm)	Soil/rock cut slope	Minor	Road	1 lane of road blocked	
HK 7/5	Stanley Gap Road	29/7	Police	29/7 (8pm)	Soil/rock cut slope	Minor	Road	1 lane of road blocked	
HK 7/6	6 & 8, Ho King Street, Ap Lei Chau	29/7	Police	29/7 (5pm)	Soil/rock cut slope	Minor	Squatters	2 huts temporarily evacuated	
HK 7/7	Peel Rise, Aberdeen	30/7	HyD	30/7 (9am)	Retaining wall	Minor	Squatters	8 huts permanently evacuated	
HK 7/8	Tai Hang Road near Maryknoll Sisters School	30/7	HyD	30/7 (6am)	Soil cut slope	Minor	Road	1 lane of road blocked	
HK 7/9	Stanley Gap Road	30/7	HyD	30/7 (9am)	Soil/rock cut slope	Minor	Road	1 lane of road blocked	
HK 7/11	Yau Sheung Chuen, Nam Fung Road	30/7	HyD	30/7 (1pm)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated, 6 huts temporarily evacuated	
HK 7/12	Aldrich Terrace, Shaukeiwan	30/7	BOO	30/7 (3pm)	Soil cut slope	Minor	Squatters	4 huts permanently evacuated	
HK 7/13	7, Seymour Road	30/7	BOO	29/7	Subsidence	Minor	Building lot		
HK 7/14	4, Repulse Bay Road below Black's Link Road	30/7	BOO	NK	Soil cut slope	Minor	Road	1 lane of road blocked	
HK 7/15	66, Mount Davis Road	31/7	HyD	30/7 (10am)	Soil cut slope	Minor	Footpath	Footpath blocked	
HK 7/16	Ngar Choi Hang Squatter Area, Kennedy Town	31/7	HyD	31/7 (am)	Soil cut slope	Minor	Squatters		

Table A1 - List of Incidents on Hong Kong Island Reported to GCO in 1987 (Sheet 5 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
HK 7/17	San Ha Street opposite Block 1	28/7	HyD	NK	Rock cut slope	Minor	Footpath	Footpath blocked	Rupture of water main closed
HK 7/18	Victoria Road near Kung Man Village (11SW-A/C286)	31/7	HyD	31/7 (11am)	Soil cut slope	Major	Road & footpath	1 lane and footpath closed	
HK 8/1	Ma Hang Gap Village, Stanley	1/8	HyD	31/7	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
HK 8/2	88 A-B, Pokfulam Road	3/8	HyD	31/7	Soil cut slope	Minor	Building lot	An area fenced off	
HK 8/3	Aldrich Village, Shaukeiwan	4/8	HyD	NK	Soil cut slope	Minor	Squatters	Complaint only no movement	
HK 8/4	South end of Hoi An Street	6/8	Public	NK	Soil/rock cut slope	Minor	Construction site		
HK 8/5	Tanner Road Police Quarters (11SE-A/C229)	8/8	Police	7/8 (1am)	Rock cut slope	Minor	Car-park	An area fenced off	
HK 8/6	12, South Bay Road	11/8	Public	30/7	Natural slope	Minor	Building lot		
HK 8/7	Victoria House, 17 Barker Road	10/8	Arch SD	NK	Soil/rock cut slope	Minor	Road	Cul-de-sac blocked	
HK 8/8	14, Shouson Hill Road	8/8	HyD	NK	Soil/rock cut slope	Minor	Road		
HK 8/9	44, St. Francis Street, Canossa School for the Deaf	20/8	Arch SD	15/8 (10pm)	Natural slope	Minor	Building lot	Nearby canopy damaged	
HK 8/10	65, Blue Pool Road	21/8	Public	21/8 (2pm)	Soil cut slope	Minor	Building lot		
HK 8/11	Bradury Junior School, Stubbs Road (11-SW/C4)	13/8	Public	NK	Soil cut slope	Minor	Playground		
HK 9/1	O Pui Lung Village, Shaukeiwan	1/9	HyD	NK	Soil cut slope	Minor	Squatters		
HK 9/2	Tin Wan Praya Road Squatter Area	5/9	HyD	5/9 (2am)	Hut collapse	Minor	Squatters	2 huts permanently evacuated	
HK 9/3	A Kung Ngam Village Road, Shaukeiwan	21/9	HyD	16/9	Rock fall	Minor	Squatters	2 huts permanently evacuated	

Table A1 - List of Incidents on Hong Kong Island Reported to GCO in 1987 (Sheet 6 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
HK 9/4	Bowen Road Tennis Court (11SW-B/C208)	24/9	USD	25/8 (am)	Natural slope	Minor	Tennis court		
HK 9/5	Squatter above Shum Wan Road	25/9	DO	NK	Hut Collapse	Minor	Squatters		Not a geotechnical problem
HK 10/1	Tai Hang Road	19/10	HyD	19/10 (5pm)	Boulder	Minor	Road	A car was slightly damaged	
HK 10/2	110-112 MacDonnell Road	28/10	HyD	28/10 (am)	Soil cut slope	Minor	Building lot		
HK 11/1	Kei Wan Primary School, Shaukeiwan	6/11	Public	6/11 (am)	Rock fall	Minor	School area	An area fenced off	
HK 11/2	Tai Hang Tung Village, Chai Wan near Fei Tsui Road	23/11	HyD	NK	Soil/rock cut slope	Minor	Access to squatters		Complaint of a deteriorating slope

Table A2 - List of Incidents in Kowloon Reported to GCO in 1987 (Sheet 1 of 5)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
K 1/1	Muk Kuk Village	5/1	HyD	5/1 (6am)	Soil cut slope	Minor	Squatters	2 huts permanently evacuated	
K 3/1	Heung Yeung Village	10/3	DO	NK	Boulder	Minor	Squatters		Complaint only no movement
K 3/2	Lion Rock Lower Village, Tsing On Temple	16/3	HyD	NK	Settlement	Minor	Building lot		
K 3/3	San On Village, Sau Mau Ping	17/3	HyD	17/3 (11am)	Fill slope	Minor	Squatters	2 huts permanently evacuated	
K 3/4	Lion Rock Upper Village	18/3	DO	18/3 (9am)	Boulder	Minor	Squatters		
K 3/5	Fei Ngo Shan Road	24/3	HyD	NK	Soil cut slope	Minor	Road and pedestrian pavement	Pedestrian pavement blocked	
K 3/6	Ling Nam Sun Tsuen	31/3	DO	31/3	Subsidence	Minor	Squatters		Not a geotechnical problem
K 4/1	Tai Shing Village, Sau Mau Ping	7/4	HyD	6/4 (4pm)	Fill slope	Minor	Squatters	4 huts permanently evacuated	
K 4/2	Junction of Lei Yue Mun Road & Kai Tin Road	7/4	HyD	6/4 (pm)	Wash-out	Minor	Road	1 lane of road blocked	Soil wash-out from slope blocked a large sand trap causing flooding
K 4/3	Sheung Foo Street, Ho Man Tin	7/4	HD	6/4 (4pm)	Soil cut slope	Minor	Footpath	Footpath blocked	
K 4/4	Tai Shing New Village, Sau Mau Ping	15/4	HyD	14/4 (5pm)	Fill slope	Minor	Squatters	1 hut permanently evacuated	Wash-out due to rupture of water main
K 4/5	Ngau Chi Wan East Village	19/4	BOO	19/4 (9am)	Soil cut slope	Minor	Squatters	1 hut temporarily evacuated	
K 4/6	54-72 La Salle Road	21/4	Arch SD	3/4 (pm)	Soil cut slope	Minor	Building lot	A fence damaged	
K 4/7	Chung Luen Chuen	27/4	HyD	26/4 (1pm)	Retaining wall	Minor	Squatters	2 huts permanently evacuated	

Table A2 - List of Incidents in Kowloon Reported to GCO in 1987 (Sheet 2 of 5)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
K 5/1	Cha Kwo Ling Village	29/4	DO	29/4	Retaining wall	Minor	Squatters		
K 5/2	Cha Kwo Ling Village	8/5	DO	8/5	Boulder	Minor	Squatters		
K 5/3	Tai Shing Village, Sau Mau Ping	15/5	HyD	14/5 (9pm)	Hut collapse	Minor	Squatters		Not a geotechnical problem
K 5/4	Chung Luen Chuen	18/5	HyD	16/5 (9pm)	Boulder	Minor	Squatters	1 hut temporarily evacuated	
K 5/5	Ngau Chi Wan East Village	19/5	HyD	18/5 (8pm)	Hut collapse	Minor	Squatters		
K 5/6	Ngau Chi Wan East Village	19/5	HyD	18/5 (9pm)	Hut collapse	Minor	Squatters		
K 5/7	Heung Yeung Village	19/5	HyD	18/5 (pm)	Settlement	Minor	Squatters		
K 5/8	HD Staff Quarters, Junk Bay Road	25/5	HD	23/5 (am)	Boulder	Minor	Car-park	An area fenced off	
K 5/9	Our Lady's Kindergarten, Sha Tin Pass Road	23/5	CEO	NK	Flooding	Minor	Playground		Flooding due to blockage of drains by soil debris
K 5/10	Man Kuk New Village	25/5	HyD	23/5 (am)	Retaining wall	Minor	Squatters		
K 5/11	New Clear Water Bay Road	29/5	HyD	NK	Boulder	Minor	Road		
K 6/1	Tai Shing Village, Sau Mau Ping	4/6	HyD	4/6 (10am)	Soil cut slope	Minor	Squatters	2 huts permanently evacuated	
K 6/2	Ngau Chi Wan West Village	5/6	HyD	4/6 (10pm)	Boulder	Minor	Squatters	1 hut permanently evacuated	
K 6/3	Gun Club Hill Barrack, Chatham Road	4/7	Arch SD	NK	Soil cut slope	Minor	Footpath		
K 7/1	Tai Shing Village	14/7	HyD	14/7 (am)	Rock fall	Minor	Squatters	2 huts permanently evacuated	
K 7/2	On Lok Village, Sau Mau Ping	16/7	HyD	15/7 (pm)	Soil cut slope	Minor	Squatters		

Table A2 - List of Incidents in Kowloon Reported to GCO in 1987 (Sheet 3 of 5)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
K 7/3	Diamond Hill New Village	23/7	HyD	22/7 (11pm)	Soil cut slope	Minor	Squatters	3 huts permanently evacuated	
K 7/4	Kam Shing Road near Baptist College	23/7	Public	22/7 (pm)	Soil cut slope	Minor	Footpath	An area fenced off	
K 7/5	Tai Shing Village	23/7	HyD	23/7	Soil cut slope	Minor	Squatters	2 huts temporarily evacuated	
K 7/6	Sau On Village, Sau Mau Ping	30/7	HyD	30/7 (2am)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated, footpath blocked	
K 7/7	Ngau Chi Wan West Village	30/7	HyD	29/7 (pm)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
K 7/8	Ngau Chi Wan West Village	30/7	HyD	29/7 (2am)	Soil cut slope	Minor	Squatters	2 huts temporarily evacuated	
K 7/9	Ngau Chi Wan East Village	30/7	HyD	NK	Hut collapse	Minor	Squatters	2 huts permanently evacuated	
K 7/10	Ngau Chi Wan East Village	30/7	HyD	29/7 (2am)	Subsidence	Minor	Squatters	1 hut permanently evacuated	
K 7/11	Ngau Chi Wan East Village	30/7	HyD	29/7 (pm)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
K 7/12	Ngau Chi Wan East Village	30/7	HyD	29/7 (pm)	Soil cut slope	Minor	Squatters	2 huts permanently evacuated	
K 7/13	Ngau Chi Wan East Village	30/7	HyD	29/7 (pm)	Soil cut slope	Minor	Squatters	1 hut temporarily evacuated	
K 7/14	Ngau Chi Wan East Village	30/7	HyD	29/7 (pm)	Soil cut slope	Minor	Squatters		
K 7/15	Lion Rock Lower Village	30/7	HyD	30/7	Soil cut slope	Minor	Squatters		
K 7/16	Lai Chi Kok Hospital (11NW-A/C25)	30/7	Hospital	30/7 (2am)	Soil cut slope	Minor	Road	Access road blocked	
K 7/17	Model Village	30/7	HyD	30/7 (2am)	Natural slope	Minor	Squatters	1 hut temporarily evacuated	

Table A2 - List of Incidents in Kowloon Reported to GCO in 1987 (Sheet 4 of 5)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
K 7/18	Tai Hang Lane, Shek Kip Mei	30/7	HyD	30/7 (am)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
K 7/19	Chung Luen Chuen	30/7	Police	30/7 (2am)	Fill slope	Minor	Squatters	2 huts permanently evacuated	
K 7/20	On Lok Village, Sau Mau Ping	31/7	HyD	30/7 (9pm)	Subsidence	Minor	Squatters		
K 7/21	Mei Lai Road	30/7	USD	30/7 (am)	Wash-out	Minor	Road		
K 7/22	Diamond Hill New Village	3/8	DO	30/7	Soil cut slope	Minor	Squatters		
K 7/23	Tai Kwu New Village	1/8	Police	30/7 (pm)	Soil cut slope	Minor	Squatters	1 hut temporarily evacuated	
K 7/24	Wai Man Tsuen, Lai Chi Kok (11SW-A/N3)	6/8	HD	30/7 (12pm)	Natural slope	Minor	Building	Store room damaged	
K 7/25	Housing Block No 10, Jordan Valley Estate (11NE-C/C12)	30/7	DO	30/7 (3am)	Soil cut slope	Major	Building	Two floors, 20 flats of estate block temporarily evacuated	Slope under reconstruction, temporary stockpile failed
K 7/26	Diamond Hill Crematorium near Nam Shan Mei Village	14/8	Arch SD	30/7	Soil cut slope	Minor	Footpath	Footpath blocked	
K 7/27	Ngau Chi Wan West Village	23/11	HyD	30/7	Soil cut slope	Minor	Squatters	4 huts permanently evacuated	
K 8/1	Heung Yeung Village, Tsz Wan Shan	24/8	HyD	22/8	Retaining wall	Minor	Squatters	2 huts permanently evacuated	
K 8/2	On Lok Tsuen, Sau Mau Ping	27/8	HyD	27/8 (11am)	Soil cut slope	Minor	Squatters	5 huts permanently evacuated, footpath blocked	
K 8/3	Cha Kwo Ling Tsuen	2/9	HyD	30/8 (12pm)	Hut collapse	Minor	Squatters		
K 9/1	On Lok Tsuen, Sau Mau Ping	5/9	Police	5/9 (11am)	Soil cut slope	Minor	Footpath	Footpath closed	

Table A2 - List of Incidents in Kowloon Reported to GCO in 1987 (Sheet 5 of 5)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
K 9/2	On Lok Tsuen, Sau Mau Ping	7/9	HD	NK	Subsidence	Minor	Squatters.		
K 9/3	Tai Kun New Village, Diamond Hill	14/9	HyD	12/9 (1am)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
K 9/4	Junction of Caldecott Road & Tai Po Road	17/9	Police	17/9 (11am)	Boulder	Minor	Road	1 person injured, 1 lane of road blocked	Boulder dislodged as a result of contractor's work on the slope (Stage II Tai Po Road Improvement)
K 9/5	Behind Block 9, Jordan Valley Estate	20/9	DO	20/9 (6pm)	Retaining wall	Minor	Squatters	2 huts permanently evacuated	
K 9/6	Kau Pui Lung Road Playground (11NW-D/C48)	24/9	Arch SD	NK	Soil cut slope	Minor	Playground		
K 11/1	Jockey Club Clinic, 200, Junction Road	2/12	HyD	25/11	Soil cut slope	Minor	Building lot		Fallen trees
K 12/1	Heung Yeung Village	17/12	HD	NK	Retaining wall	Minor	Squatters	7 huts permanently evacuated	

Table A3 - List of Incidents in Eastern New Territories Reported to GCO in 1987 (Sheet 1 of 5)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
ME 1/1	Pai Tau Village, Sha Tin	20/1	DLO	NK	Soil cut slope	Minor	Licensed house		
ME 2/1	134, Pak Tin Sixth Village, Sha Tin	12/2	Public	NK	Boulder	Minor	Squatters		
ME 3/1	59, Nam Wai, Sai Kung, DD214 Lot 366	17/1	DLO	17/3 (am)	Fill slope	Minor	Building lot		Wash-out from works in adjacent lot
ME 3/2	69A, Pak Shek Terrace, Sai Kung	17/3	Police	17/3 (8am)	Retaining wall	Minor	Private access	Access blocked	
ME 3/4	4, Kap Bin Long Village, Sai Kung	17/3	HyD	17/3 (9pm)	Retaining wall	Minor	Building lot		
ME 3/5	5, Sun King Terrace, Po Lo Che, Sai Kung	21/3	HD	17/3	Soil cut slope	Minor	Building lot		
ME 3/6	Che Kung Miu Road, Sha Tin, Lot 769 DD179	24/3	HyD	20/3	Soil cut slope	Minor	Access		
ME 3/7	Tseng Lan Shue, Sai Kung, DD225 Lot 1108	25/3	HyD	23/3	Flooding	Minor	Building lot		Soil wash-out blocked the drains
ME 3/8	60, Sun on Village, Sai Kung	26/3	DO	17/3	Soil cut slope	Minor	Building lot		
ME 4/1	33, Wo Mei Tsuen, Sai Kung	7/4	HyD	1/4 (12am)	Soil cut slope	Minor	Building lot		
ME 4/2	Sai Sha Road, Long Keng, Sai Kung	7/4	HyD	5/4	Soil cut slope	Minor	Road	1 lane of road blocked	
ME 4/3	Tai Mong Tsai Road, Sai Kung	8/4	HyD	7/4 (11am)	Soil cut slope	Minor	Footpath	Footpath blocked	
ME 4/4	Tai Mong Tsai Road, Tai Wan, Sai Kung	13/4	HyD	5/4	Soil cut slope	Minor	Private access	Footpath closed	
ME 4/5	Lion Rock Tunnel Road, Sha Tin (7SW-D/R46)	24/4	HyD	NK	Soil/rock cut slope	Minor	Road		
ME 4/6	31, New Fisherman's Village, Tap Mun (Grass Island), Tai Po	28/4	DO	NK	Soil cut slope	Minor	Building lot and access		
ME 4/7	Tai Po Road, near Keng Hau Road, Sha Tin	20/3	H & S consult	17/3	Retaining wall	Minor	Road	1 lane of road closed	Failure of sheet-pile wall under construction. (Tai Po Road Improvement) File no. GCMd 2/B2/43

Table A3 - List of Incidents in Eastern New Territories Reported to GCO in 1987 (Sheet 2 of 5)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
ME 5/1	16, Po Lo Che Village, Sai Kung (C.L.L. S11655)	12/5	DO	NK	Retaining wall	Minor	Building lot		
ME 5/2	Tung Lung Island, Access Leading to Light Tower	18/5	MarD	16/5 (4pm)	Rock cut slope	Minor	Access	Access blocked	
ME 5/3	Chuk Yeung Road, Sha Ha, Sai Kung	25/5	HyD	23/5 (12am)	Soil cut slope	Minor	Footpath	Footpath blocked	
ME 5/4	Tai Po Road, Tai Po Kau, near Villa Deux Ponts	28/5	HyD	28/5 (am)	Rock cut slope	Minor	Road	1 lane of road blocked	
ME 6/1	St. Paul School, Che Ting Tseun, Tui Min Hoi, Sai Kung	3/6	DO	21/5	Soil cut slope	Minor	Footpath		
ME 6/2	Clear Water Bay Road near Leung Fai Tin, Sai Kung	5/6	HyD	5/6	Soil cut slope	Minor	Road	1 lane of road blocked	
ME 6/3	Kam Shan Road, Tai Po	8/6	DLO	7/6 (9am)	Soil cut slope	Minor	Footpath	Footpath blocked	
ME 6/4	Ha Yeung Sun Tsuen, DD225 Lot 777, Clear Water Bay Road, Sai Kung	8/6	DLO	5/6 (am)	Soil cut slope	Minor	Building lot		
ME 6/6	Luk Hop Village, 6.5 MS, Tai Po Road	11/6	ND	NK	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
ME 6/7	96B, Shek Kwu Lung Village, Tai Po	25/6	DLO	22/6	Soil cut slope	Minor	Building lot		
ME 6/8	69B, Shek Kwu Lung Village, Tai Po	30/6	DLO	22/6	Boulder	Minor	Private access		
ME 7/1	Clear Water Bay Beach, Sai Kung	15/7	HyD	5/6	Subsidence	Minor	Footpath	Footpath destroyed	
ME 7/2	Clear Water Bay Beach, Sai Kung	15/7	HyD	16/6	Soil cut slope	Minor	Lavatory		
ME 7/3	Lion Rock Tunnel Road near the Tunnel Portal, Sha Tin	30/7	L & WB	30/7 (5am)	Soil/rock cut slope	Minor	Road	1 lane of road closed	
ME 7/4	38, Wo Liu Hang Village, Sha Tin	30/7	HyD	30/7 (1am)	Soil cut slope	Minor	Squatters		
ME 7/5	43, Wo Liu Hang Village, Sha Tin	30/7	Public	30/7	Retaining wall	Minor	Building lot	An area fenced off	
ME 7/6	68, Wo Liu Hang Village, Sha Tin	30/7	Public	30/7	Wash-out	Minor	Squatters	Footpath blocked	

Table A3 - List of Incidents in Eastern New Territories Reported to GCO in 1987 (Sheet 3 of 5)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
ME 7/7	26, To Fung Shan Road, Sha Tin	30/7	Public	30/7	Soil cut slope	Minor	Private access	Access blocked	
ME 7/8	Pine Hill Village, Tai Po	29/7	Public	29/7	Soil/rock cut slope	Minor	Building lot		
ME 7/9	Tsung Tsai Yuen, Tai Po	30/7	Police	30/7	Soil cut slope	Minor	Road	1 lane of road blocked	
ME 7/10	Tai Po Road opposite Ferry Hill House, Tai Po	30/7	Police	30/7	Soil cut slope	Minor	Road	1 lane of road blocked	
ME 7/11	1 & 2, Sam Mun Tsai New Village, Tai Po	30/7	DO	30/7	Soil cut slope	Minor	Building lot		
ME 7/12	Chan Uk, Shuen Wan, Tai Po	31/7	DO	30/7	Soil cut slope	Minor	Building lot		
ME 7/13	Tai Po Road near junction with Sha Tin Heights Road	30/7	Police	30/7	Soil cut slope	Minor	Road	1 lane of road blocked	
ME 7/14	55B, Tui Min Hoi Village, Sai Kung	30/7	DLO	30/7 (3am)	Subsidence	Minor	Squatters	1 hut permanently evacuated	
ME 7/15	Sai Sha Road, Long Keng, Sai Kung	30/7	HyD	30/7 (7am)	Soil cut slope	Major	Road	1 lane of road blocked	
ME 7/16	Sai Sha Road, Ma On Chan Country Park, Sai Kung	30/7	HyD	29/7 (10am)	Soil cut slope	Minor	Road	1 lane of road blocked	
ME 7/17	110A, Fuk Luk Village, Pak Tin, Sha Tin	31/7	HyD	30/7 (9am)	Soil cut slope	Minor	Building lot	1 building temporarily evacuated	
ME 7/18	5A4, Chut Shui Wan, Sha Tin	31/7	HD	30/7 (2am)	Natural slope	Minor	Squatters	1 hut permanently evacuated, 1 hut temporarily evacuated	
ME 7/19	300, Pai Tau Village, Sha Tin	30/7	DLO	30/7 (am)	Soil cut slope	Minor	Footpath	Footpath blocked	
ME 7/20	323, Ma Yau Tong Village, Sai Kung	30/7	DLO	30/7 (4am)	Retaining wall	Minor	Squatters	1 person injured, 1 hut permanently evacuated, 1 hut destroyed	
ME 7/21	48, 4th District, Rennie's Mill, Sai Kung	30/7	DLO	30/7 (8pm)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
ME 7/23	29, Keng Hau Road, Sha Tin	4/8	DO	30/7 (am)	Natural slope	Minor	Squatters	1 hut destroyed, 5 huts permanently evacuated	

Table A3 - List of Incidents in Eastern New Territories Reported to GCO in 1987 (Sheet 4 of 5)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
ME 7/24	10, Sha Tin Tau Village, Sha Tin	4/8	DO	30/7 (2am)	Soil cut slope	Minor	Building lot	1 building temporarily evacuated	
ME 7/25	74, Po Lo Che Village, P.N.T. S1713, Sai Kung	31/7	DO	30/7 (3am)	Soil cut slope	Minor	Building lot	1 building temporarily evacuated	
ME 7/26	41, Wo Liu Hang Village, Sha Tin	6/8	GCO	NK	Soil cut slope	Minor	Private access	1 lane of road blocked	
ME 7/27	37, Pak Tin Section 4, Sha Tin	31/7	HyD	29/7 (pm)	Soil cut slope	Minor	Squatters		
ME 7/28	110, Pai Tau Village, Sha Tin	6/8	DLO	30/7	Soil cut slope	Minor	Private access	Access blocked	
ME 7/29	110, Pai Tau Village, Sha Tin	6/8	DLO	30/7	Soil cut slope	Minor	Squatters		
ME 7/30	Tai Po Road, 11 MS, Sha Tin	6/8	HyD	30/7	Soil cut slope	Minor	Road	1 lane of road blocked	
ME 7/31	Sha Tin Heights Road below Happy View House	10/8	DO	30/7	Soil cut slope	Minor	Access road	1 lane of road blocked	
ME 7/32	Sha Tin Heights Road below Pink House	10/8	DO	30/7	Soil cut slope	Minor	Access road	1 lane of road blocked	
ME 7/33	2B, Sha Tin Heights Road	12/8	DLO	30/7	Natural slope	Minor	Squatters		
ME 7/34	Sha Tin Heights Road	10/8	DO	30/7	Soil cut slope	Minor	Access road	1 lane of road blocked	
ME 7/35	95, Tung Lo Wan Hill Road, Sha Tin	10/8	DO	31/7	Soil cut slope	Minor	Building lot		
ME 7/36	23, Yau Oi Tsuen, Sha Tin	10/8	DO	31/7	Soil cut slope	Minor	Squatters		
ME 7/37	103, Pak Tin, Section 2, Sha Tin	10/8	DO	30/7	Soil cut slope	Minor	Building		
ME 7/38	55, Third Street, Ko Lau Wan, Sai Kung	10/8	DO	30/7	Soil cut slope	Minor	Footpath		
ME 7/39	11E, Pat Tsz Wo Village, Sha Tin	7/8	DLO	30/7	Soil cut slope	Minor	Building lot	3 huts temporarily evacuated	
ME 7/40	105, Man Hang, Sha Tin	7/8	DLO	30/7	Soil cut slope	Minor	Private access	Access blocked	
ME 7/41	14, Sha Tin Tau Area 2, Sha Tin	4/8	DO	30/7 (am)	Soil cut slope	Minor	Squatters		
ME 7/42	DD 174, Yiu Dau Ping, Sha Tin	21/8	DLO	30/7	Soil cut slope	Minor	Squatters	1 hut temporarily evacuated	

Table A3 - List of Incidents in Eastern New Territories Reported to GCO in 1987 (Sheet 5 of 5)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
ME 7/43	29, To Fung Shan Road, Sha Tin	24/8	DLO	30/7	Natural slope	Minor	Footpath	Footpath blocked	
ME 7/44	Yiu Dau Ping, Sha Tin	21/8	DLO	30/7	Soil cut slope	Minor	Footpath	An area fenced off	
ME 7/45	Greenwich Garden, Kam Shan, Tai Po	17/8	HyD	30/7	Soil cut slope	Minor	Building lot		
ME 7/46	31A, Yau Oi Tsuen, Sha Tin	23/9	HyD	NK	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
ME 7/47	Kau Tam Tso, Fanling	11/9	HyD	NK	Soil cut slope	Minor	Footpath	Footpath blocked	
ME 7/48	Ping Ling School, Tai Wai, Sha Tin	14/10	GCO	NK	Soil cut slope	Minor	Building lot		
ME 8/1	123, Kam Shan Village, Tai Po	8/9	DLO	NK	Boulder	Minor	Private access		
ME 11/1	1, Yau Oi Tsuen, Sha Tin	4/12	Public	NK	Soil cut slope	Minor	Footpath		

Table A4 - List of Incidents in Western New Territories Reported to GCO in 1987 (Sheet 1 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
MW 1/1	Kwai Hau Street, Kwai Chung (7SW-C/C52)	25/11	DO	NK	Rock fall	Minor	Footpath	Footpath closed	
MW 1/2	Lai Chi Yuen Tsuen, Mui Wo, Lantau	5/1	DLO	NK	Soil/rock cut slope	Minor	Building lot		
MW 2/2	Tai Lam Chung Reservoir	5/2	WSD	NK	Soil cut slope	Minor	WSD tunnel portal		
MW 2/3	18A, Sheung Yat Village, Shing Mun Reservoir	12/2	HD	NK	Subsidence	Minor	Squatters		Cracks in structures, blasting operation nearby
MW 3/1	91A, Shek Tsai Po Street, Tai O (9SW-C/CR2)	6/3	GCO	NK	Soil cut slope	Minor	Building lot		
MW 3/2	Tai O, Lantau (9SW-C/CR4)	6/3	GCO	NK	Boulder	Minor	Building lot		
MW 3/3	Shing Mun Road, Tsuen Wan	13/3	GCO	NK	Natural slope	Minor	Footpath		
MW 3/4	Chuen Lung, Tsuen Wan	24/3	HyD	17/3 (10am)	Soil cut slope	Minor	Car-park		
MW 3/5	Lai Chi Ling Road near Lim Cho Street	23/3	HyD	NK	Soil/rock cut slope	Minor	Road		A minor abandoned tunnel was found on the slope
MW 4/1	Kau Wah Keng Sheung Tsuen, Tsuen Wan	7/4	HyD	6/4 (pm)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
MW 4/2	Luk Wu, Lantau	9/4	HyD	6/4 (11am)	Soil cut slope	Minor	Building lot		
MW 4/3	12, Ma Tong, Route Twisk, Tsuen Wan	14/4	HyD	4/4	Soil cut slope	Minor	Squatters		
MW 4/4	Shek Pai Street & Lei Pui Street, Tsuen Wan (7SW-C/C176 & C177)	9/4	DB Member	NK	Soil/rock cut slope	Minor	Footpath		
MW 4/5	Tuen Mun Area 2B	24/2	GCO	NK	Soil cut slope	Minor	Footpath		
MW 5/1	Road to Sha Lo Wan from Ngong Ping Road, Lantau	28/4	DO	NK	Soil cut slope	Minor	Road		

Table A4 - List of Incidents in Western New Territories Reported to GCO in 1987 (Sheet 2 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
MW 5/2	Kwai Fuk Road, Tsuen Wan	18/5	HyD	16/5 (12pm)	Soil cut slope	Minor	Footpath	Footpath blocked	Progressive erosion around 10-tonne boulder
MW 5/3	21A, Sai Wan Road, Sai Wan, Cheung Chau	20/5	DO	NK	Boulder	Minor	Footpath		
MW 5/4	Tseng Tau Chung Tsuen, Tuen Mun	23/5	HyD	23/5 (am)	Soil cut slope	Minor	Squatters	2 huts temporarily evacuated	
MW 5/5	Tsing Shan Tsuen, Fat Chi Tsing Monastery, Tuen Mun	25/5	DO	23/5 (am)	Soil cut slope	Minor	Squatters	2 huts permanently evacuated	
MW 5/6	Sam Dip Tam, Lo Wai, Tsuen Wan	29/5	HyD	NK	Retaining wall	Minor	Footpath		
MW 6/1	Wo Li Hang Village, Tsuen Wan	2/6	Police	31/5	Soil cut slope	Minor	Squatters	2 huts permanently evacuated	
MW 6/2	Sok Kwu Wan, Lamma	5/6	DLO	5/6 (am)	Soil cut slope	Minor	Footpath	Footpath blocked	
MW 6/3	45, Bo Wah Yuen, Yung Shue Wan, Lamma	6/6	BOO	NK	Soil cut slope	Minor	Building lot	An area fenced off	
MW 6/4	123, Kam Shan Village, Kwai Chung	11/6	Police	10/6 (12pm)	Retaining wall	Minor	Squatters	2 huts permanently evacuated	
MW 6/5	Lot 140 DD 111, Pat Heung, Yuen Long	16/6	FSD	5/6	Soil cut slope	Minor	Farmhouse		
MW 6/6	Pak She San Tsuen, Cheung Chau	11/6	HyD	5/6	Boulder	Minor	Building		
MW 7/1	Kwun Yam Wan Road, Cheung Chau	3/7	Public	NK	Soil cut slope	Minor	Footpath		
MW 7/2	Tin Hau Temple, Cheung Chau	30/6	DO	NK	Boulder	Minor	Building lot		
MW 7/3	16-21, Ying Sin Leung Village, Cheung Chau	9/7	DO	NK	Soil cut slope	Minor	Building lot		
MW 7/4	Sham Tseng San Tsuen, Tsuen Wan	9/7	HD	8/7 (3pm)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
MW 7/5	1, Kam Shan Village, Sheung Kwai Chung, Tsuen Wan	18/7	Police	18/7 (11am)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
MW 7/6	6.5 MS Castle Peak Road, Tsuen Wan	22/7	Police	22/7 (6pm)	Retaining wall	Minor	Squatters		

Table A4 - List of Incidents in Western New Territories Reported to GCO in 1987 (Sheet 3 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
MW 7/7	Wai Tsuen Road, Tsuen Wan	27/7	BOO	27/7 (5pm)	Excavation	Major	Construction site	3 persons injured, 1 lane of road closed	File No. GCMd 6/9092/86 Failure volume >1000cu m. Files Nos. GCMd 3/5/DH483/87K & GCSP 2/D9/14
MW 7/8	Sai Tso Wan Road, Tsing Yi	28/7	Public	28/7	Boulder	Minor	Construction site		
MW 7/9	277, Tan Kwai Tsuen, Yuen Long	30/7	HyD	29/7 (12pm)	Retaining wall	Minor	Squatters	2 persons injured, 2 huts destroyed	
MW 7/10	1, Tai Wo Tsuen, Fu Yung Shan, Tsuen Wan	30/7	HD	29/7 (11pm)	Retaining wall	Minor	Private access		
MW 7/11	Fu Yung Shan Road, Tsuen Wan	30/7	BOO	30/7 (1am)	Natural slope	Minor	Road	Road blocked	
MW 7/12	Cho Yiu Estate, Ha Kwai Chung, Tsuen Wan (11NW-A/C140)	30/7	FSD	30/7 (2am)	Soil/rock cut slope	Major	Road, building	24 flats temporarily evacuated, 2 lanes of road blocked	
MW 7/13	Siu Sau Tseun, 17.5 MS, Castle Peak Road, Tuen Mun	30/7	HyD	30/7 (5am)	Fill slope	Minor	Squatters	2 huts temporarily evacuated	
MW 7/14	Sam Shing Hui, Castle Peak Road, Tuen Mun	31/7	HyD	30/7	Boulder	Minor	Road	Road partly blocked	
MW 7/15	Shing Mun Ha Tsuen, Tsuen Wan	31/7	HD	29/7 (1am)	Soil cut slope	Minor	Squatters	5 huts permanently evacuated, 3 huts temporarily evacuated.	
MW 7/16	Shing Mun Ha Tsuen, Tsuen Wan	31/7	HD	29/7 (3am)	Soil cut slope	Minor	Squatters		
MW 7/17	Shing Mun Ha Tsuen, Tsuen Wan	31/7	HD	29/7 (3am)	Soil cut slope	Minor	Squatters		
MW 7/18	Shing Mun Ha Tsuen, Tsuen Wan	31/7	HD	29/7 (am)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
MW 7/19	Lim Cho Road, Ha Kwai Chung, Tsuen Wan (11NW-A/C161)	30/7	HyD	30/7 (am)	Rock cut slope	Minor	Road	1 lane of road blocked	
MW 7/20	Ching Cheung Road, Tsuen Wan	30/7	HyD	30/7 (am)	Soil cut slope	Minor	Road	1 lane of road blocked	

Table A4 - List of Incidents in Western New Territories Reported to GCO in 1987 (Sheet 4 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
MW 7/21	5 MS Castle Peak Road, Tsuen Wan	30/7	HyD	30/7 (am)	Soil cut slope	Minor	Road	1 lane of road blocked	
MW 7/22	6 MS Castle Peak Road, Tsuen Wan	30/7	HyD	30/7 (am)	Soil cut slope	Minor	Road	1 lane of road blocked	
MW 7/23	Castle Peak Road, near Kau Wa Keng, Tsuen Wan	30/7	HyD	30/7 (am)	Rock cut slope	Minor	Footpath	Footpath blocked	
MW 8/1	Tseng Tau Chung Tsuen, Tuen Mun	3/8	DO	30/7 (3am)	Soil cut slope	Minor	Squatters	3 huts permanently evacuated	
MW 8/2	7.5 MS South Lantau Road, Tong Fuk, Lantau	5/8	HyD	30/7 (am)	Soil cut slope	Major	Road	1 lane of road blocked	
MW 8/3	Chi Kwu Wan, Kwai Shing, Tsuen Wan	31/7	HD	30/7 (am)	Fill slope	Major	Squatters	11 huts destroyed and permanently evacuated	
MW 8/4	Shek Lei Hang Village, Tsuen Wan	31/7	HD	30/7 (am)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
MW 8/5	Shek Lei Hang Village, Tsuen Wan	31/7	HD	30/7 (am)	Soil cut slope	Minor	Squatters	4 huts permanently evacuated	
MW 8/6	Shek Lei Hang Village, Tsuen Wan	31/7	HD	30/7 (am)	Natural slope	Minor	Squatters		
MW 8/7	Shek Pai Street, Kwai Chung	3/8	HyD	30/7 (am)	Soil cut slope	Minor	Footpath	Footpath blocked	
MW 8/8	Tai Lin Pai Road, Kwai Chung (7SW-C/C230)	31/7	FF Consult	30/7 (am)	Soil cut slope	Major	Footpath	Footpath blocked	
MW 8/9	Kau Wa Keng Sheung Tsuen, Tsuen Wan	3/8	HD	30/7 (am)	Retaining wall	Minor	Squatters	5 huts permanently evacuated	
MW 8/10	Kau Wa Keng Sheung Tsuen, Tsuen Wan	3/8	HD	30/7 (am)	Soil cut slope	Minor	Squatters		
MW 8/11	6.5 MS, Castle Peak Road, Tsuen Wan	4/8	HD	30/7 (am)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
MW 8/12	6.5 MS, Castle Peak Road, Tsuen Wan	4/8	HD	30/7 (2am)	Soil cut slope	Minor	Squatters	3 huts permanently evacuated	

Table A4 - List of Incidents in Western New Territories Reported to GCO in 1987 (Sheet 5 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
MW 8/13	6.5 MS. Castle Peak Road, Tsuen Wan	4/8	HyD	30/7 (am)	Soil cut slope	Minor	Road		
MW 8/14	On Chit Street, Kwai Chung	5/8	HyD	30/7 (am)	Soil cut slope	Minor	Footpath	Footpath blocked, Fence damaged	
MW 8/15	Wu Li Hang Village, Kwai Chung	3/8	HD	30/7 (2am)	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	
MW 8/16	Wu Li Hang Village, Kwai Chung	3/8	HD	30/7 (am)	Soil cut slope	Minor	Squatters	2 huts permanently evacuated	
MW 8/17	Sheung Yat Tsuen, Tsuen Wan	5/8	DO	30/7 (am)	Fill slope	Minor	Footpath		
MW 8/18	Shing Mun Road, Tsuen Wan	7/8	HyD	30/7	Soil cut slope	Minor	Footpath	An area fenced off	
MW 8/19	Kwai Chung Road, Tsuen Wan	30/7	HyD	30/7 (am)	Soil cut slope	Minor	Road	1 lane of road blocked	
MW 8/20	Sok Kwu Wan, Lamma (15NW-C/C13)	11/8	DLO	8/8	Rock fall	Minor	Building	Building (store room) damaged	
MW 8/21	8.5 MS, South Lantau Road, Shui Hau, Lantau	6/8	HyD	30/7 (am)	Soil cut slope	Minor	Footpath	Footpath blocked	
MW 8/22	Tai Wo Tsuen, Fu Yung Shan, Tsuen Wan	17/8	HD	30/7 (am)	Soil cut slope	Minor	Squatters	An area fenced off	
MW 8/23	Castle Peak Road, Yau Kam Tau, Tsuen Wan (6SE-D/CR26)	14/8	WSD	30/7	Soil cut slope	Minor	Access Road		
MW 8/24	Tai Wo Tsuen, Fu Yung Shan, Tsuen Wan	17/8	HD	30/7 (am)	Soil cut slope	Minor	Private access	Access blocked	
MW 8/25	Cheung Hang Village, Tsuen Wan	3/8	HD	30/7 (am)	Soil cut slope	Minor	Building		
MW 8/26	Ha Lo Wai, Kwai Shing, Tsuen Wan	17/8	DO	30/7	Fill slope	Minor	Squatters	1 hut permanently evacuated	
MW 8/27	53, Wo Yi Hop Village, Tsuen Wan	21/8	HyD	30/7	Fill slope	Minor	Footpath	An area fenced off	
MW 8/28	Fu Yung Shan, Tsuen Wan	27/8	DO	NK	Soil cut slope	Minor	Squatters	1 hut permanently evacuated	

Table A4 - List of Incidents in Western New Territories Reported to GCO in 1987 (Sheet 6 of 6)

Incident No.	Location	Call Received		Failure			Area Affected	Consequence	Remarks
		Date	From	Date (Time)	Type	Scale			
MW 8/29	Fu Yung Shan, Tsuen Wan	27/8	DO	NK	Natural slope	Minor	Footpath	Footpath blocked	
MW 9/1	Shek Lei Estate, Phase III, Tsuen Wan	7/9	HyD	31/7	Natural slope	Minor	Footpath		
MW 12/1	Chi Ma Wan Closed Camp (14NW-A/C12)	10/12	Arch SD	26/10	Soil cut slope	Minor	Building lot		
MW 12/2	Pak She San Tseun, Cheung Chau	11/12	HyD	NK	Soil cut slope	Minor	Building lot		

APPENDIX B
RECORDS FROM GCO RAINGAUGES

APPENDIX B

LIST OF FIGURES

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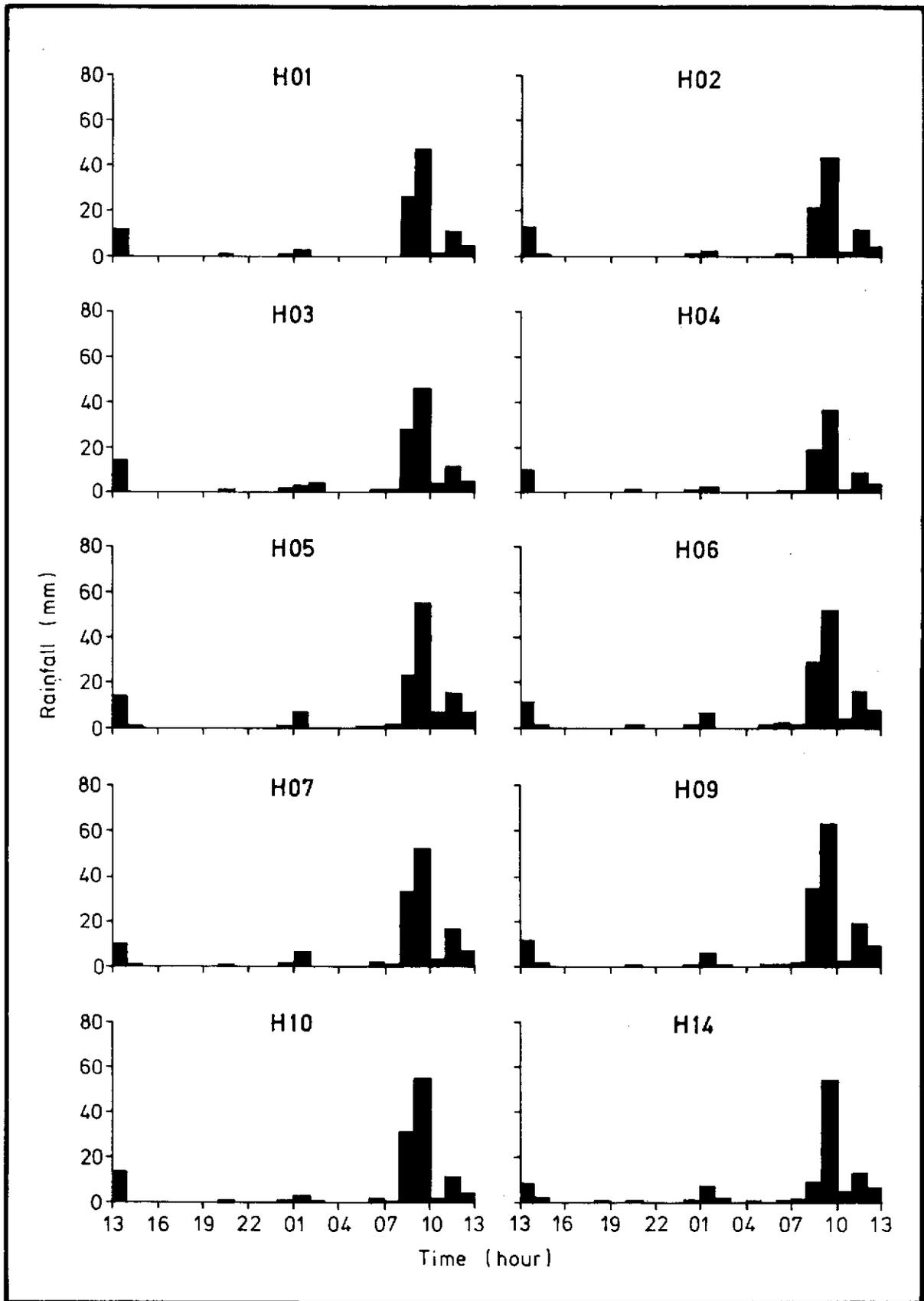


Figure B1 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 17th March 1987 (Sheet 1 of 4)

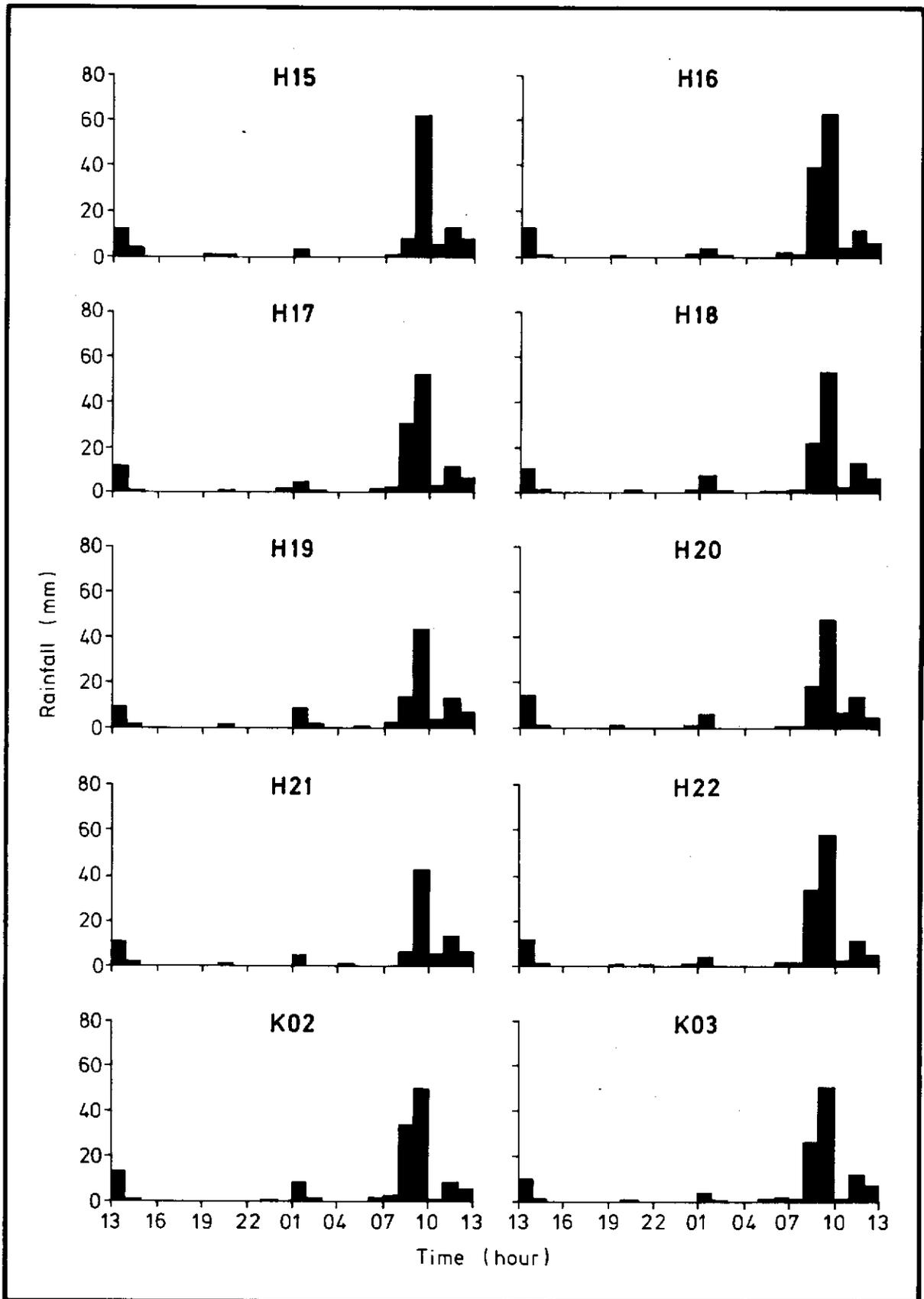


Figure B1 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 17th March 1987 (Sheet 2 of 4)

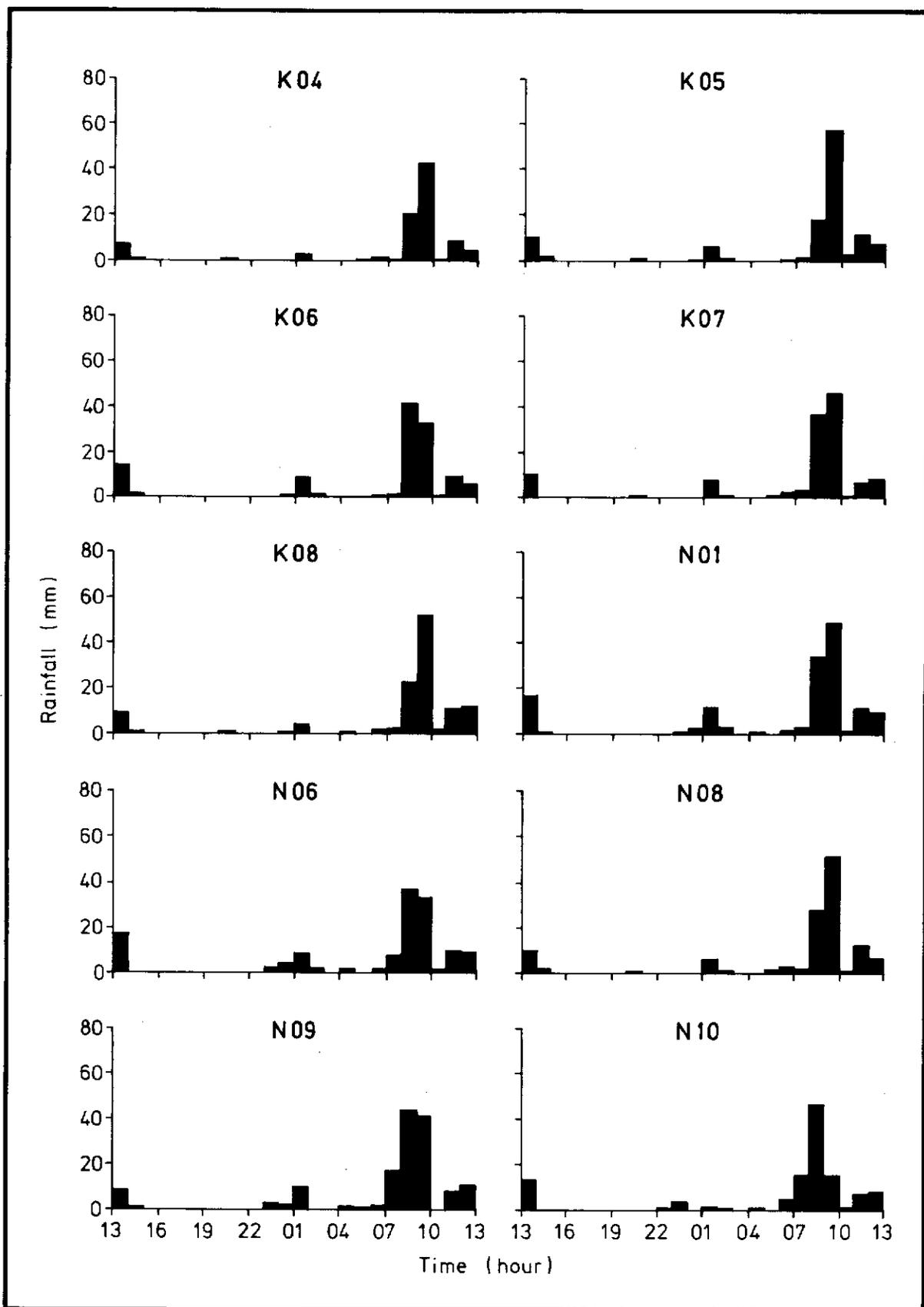


Figure B1 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 17th March 1987 (Sheet 3 of 4)

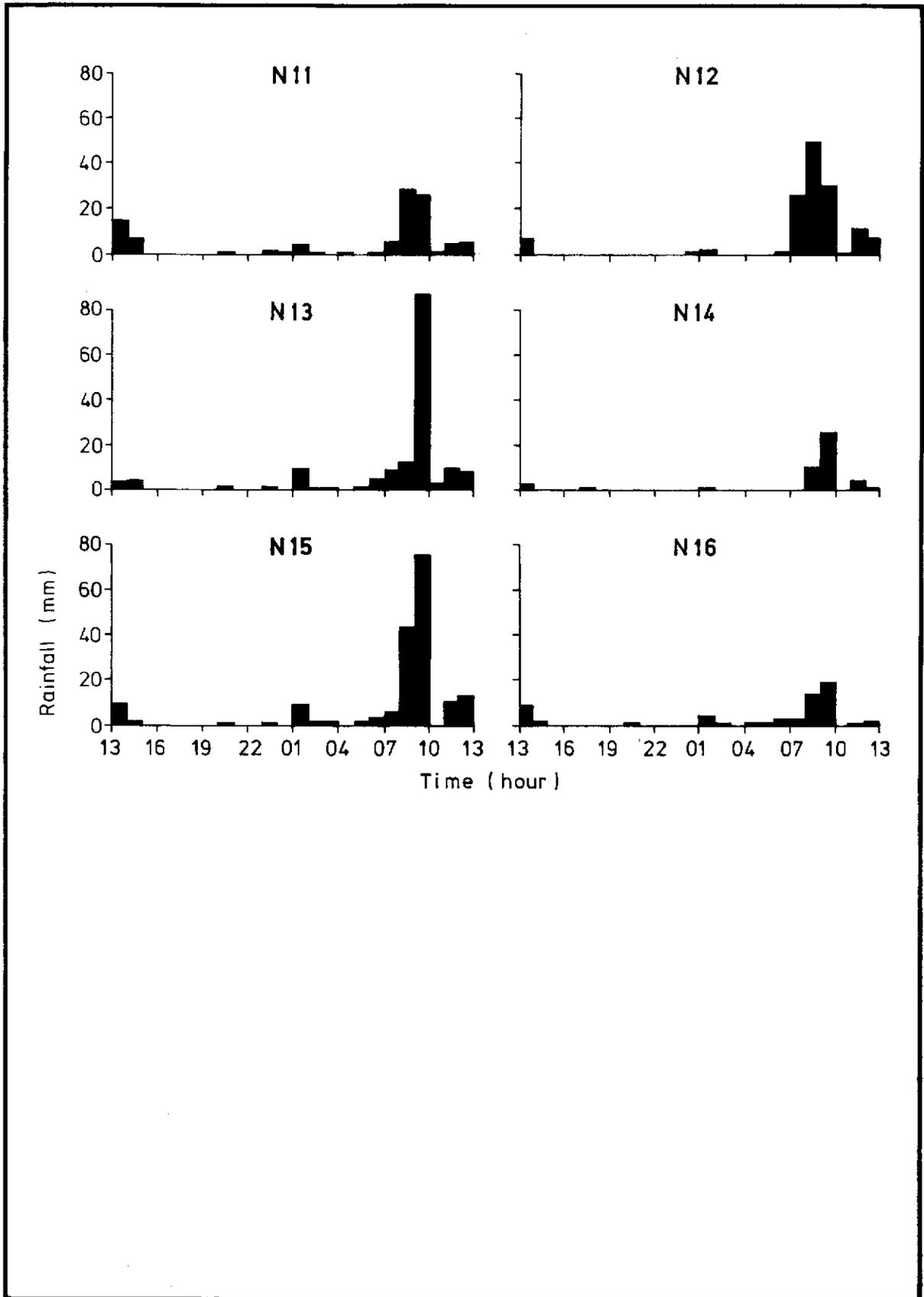


Figure B1 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 17th March 1987 (Sheet 4 of 4)

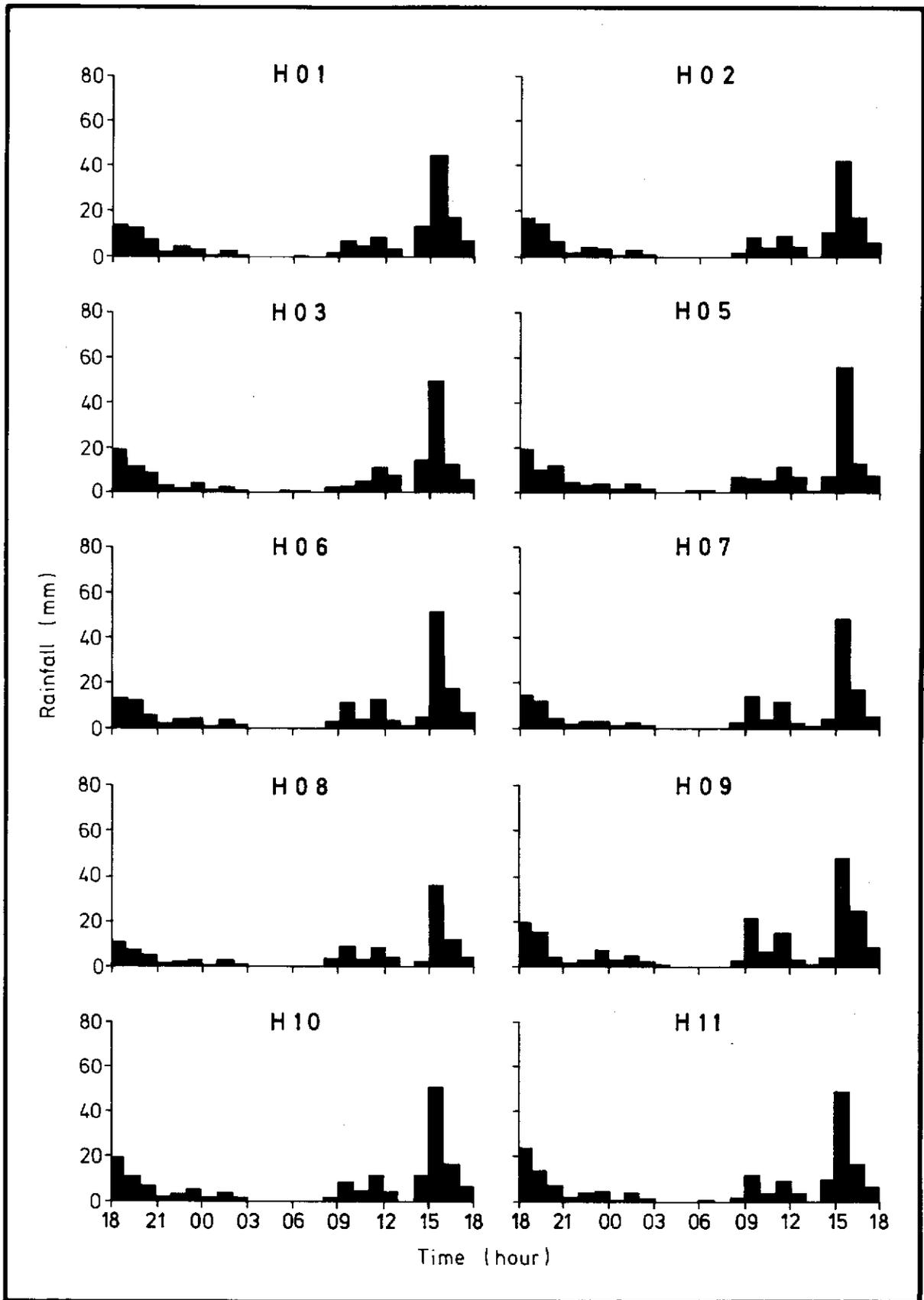


Figure B2 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 6th April 1987 (Sheet 1 of 4)

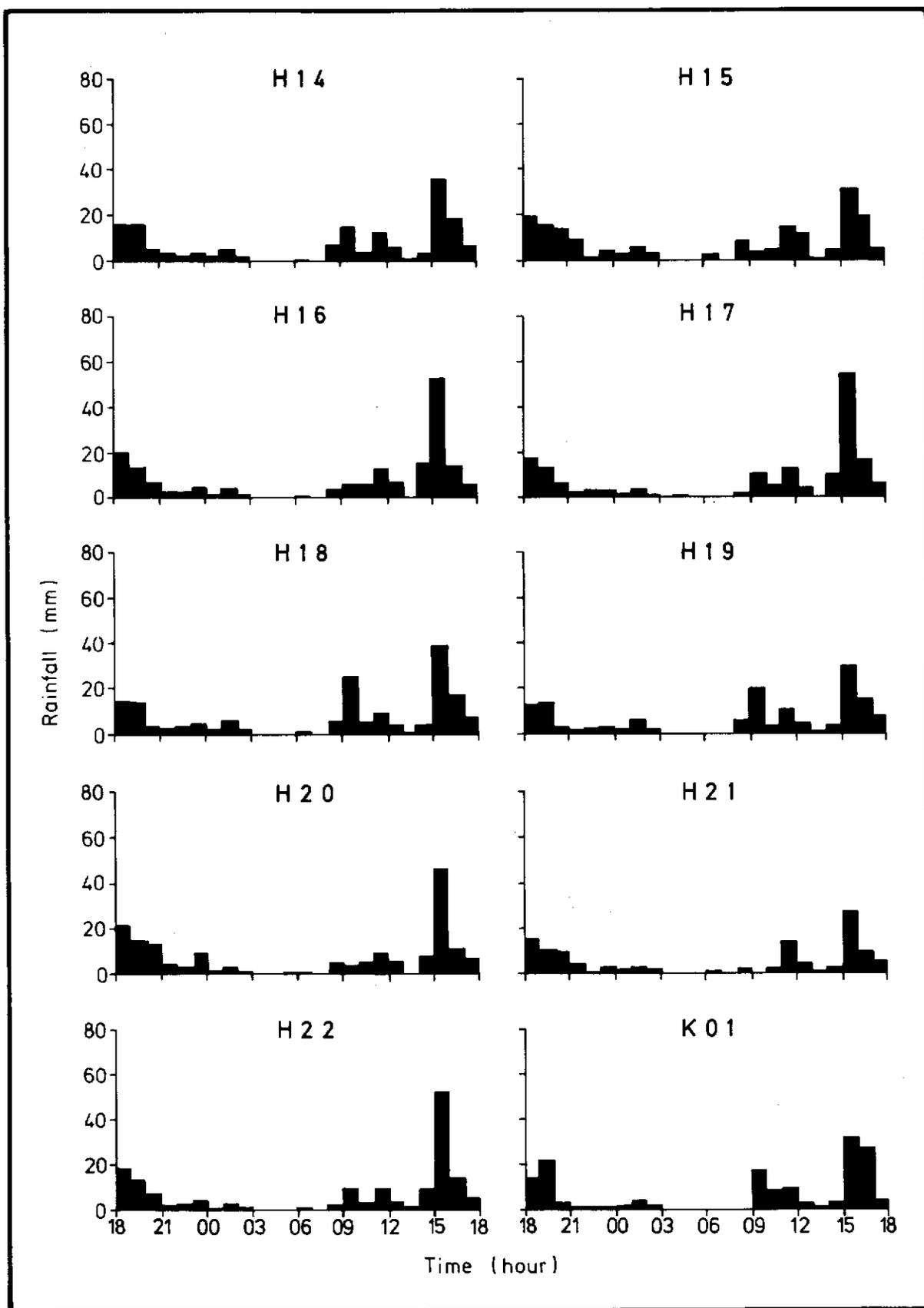


Figure B2 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 6th April 1987 (Sheet 2 of 4)

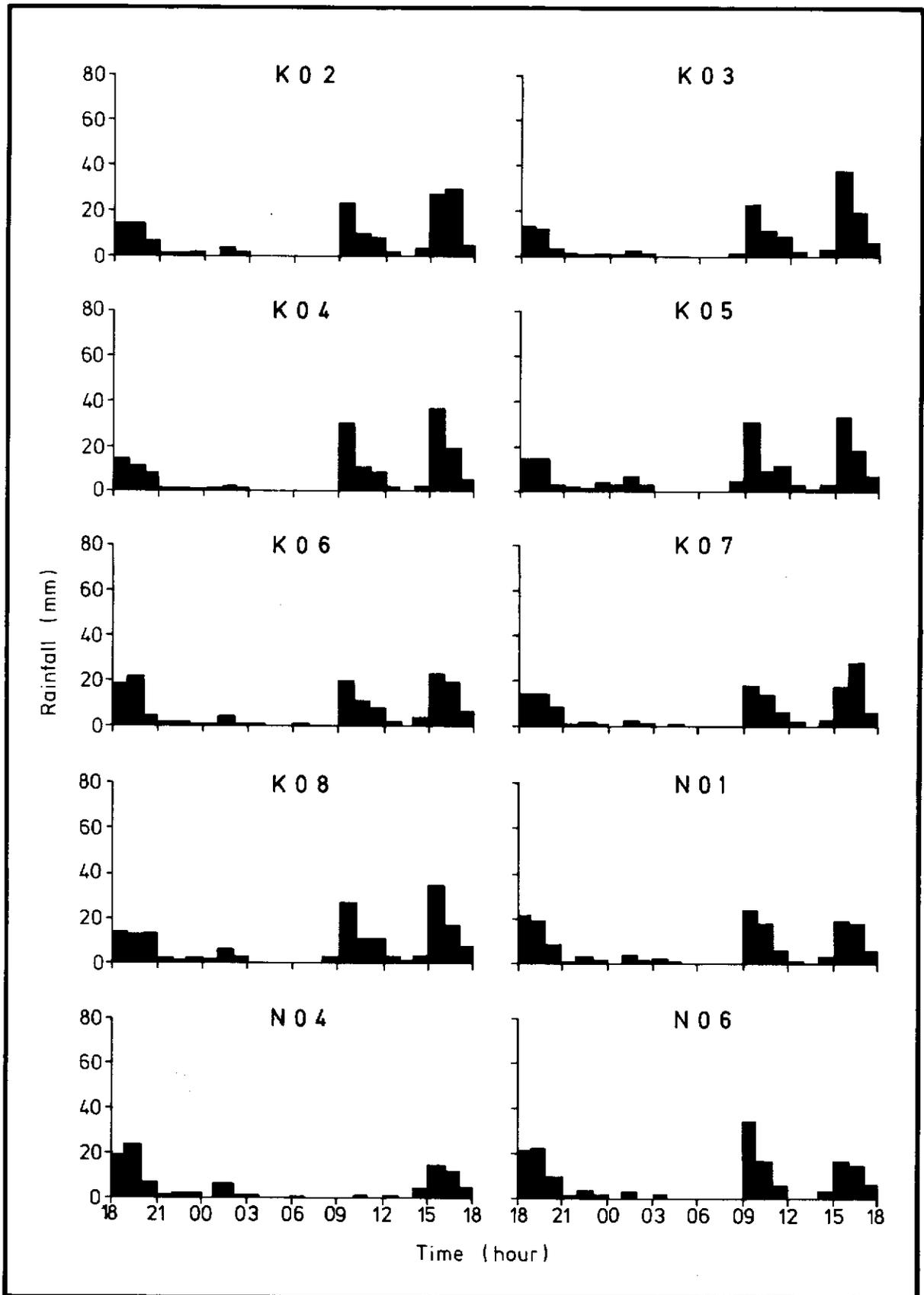


Figure B2 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 6th April 1987 (Sheet 3 of 4)

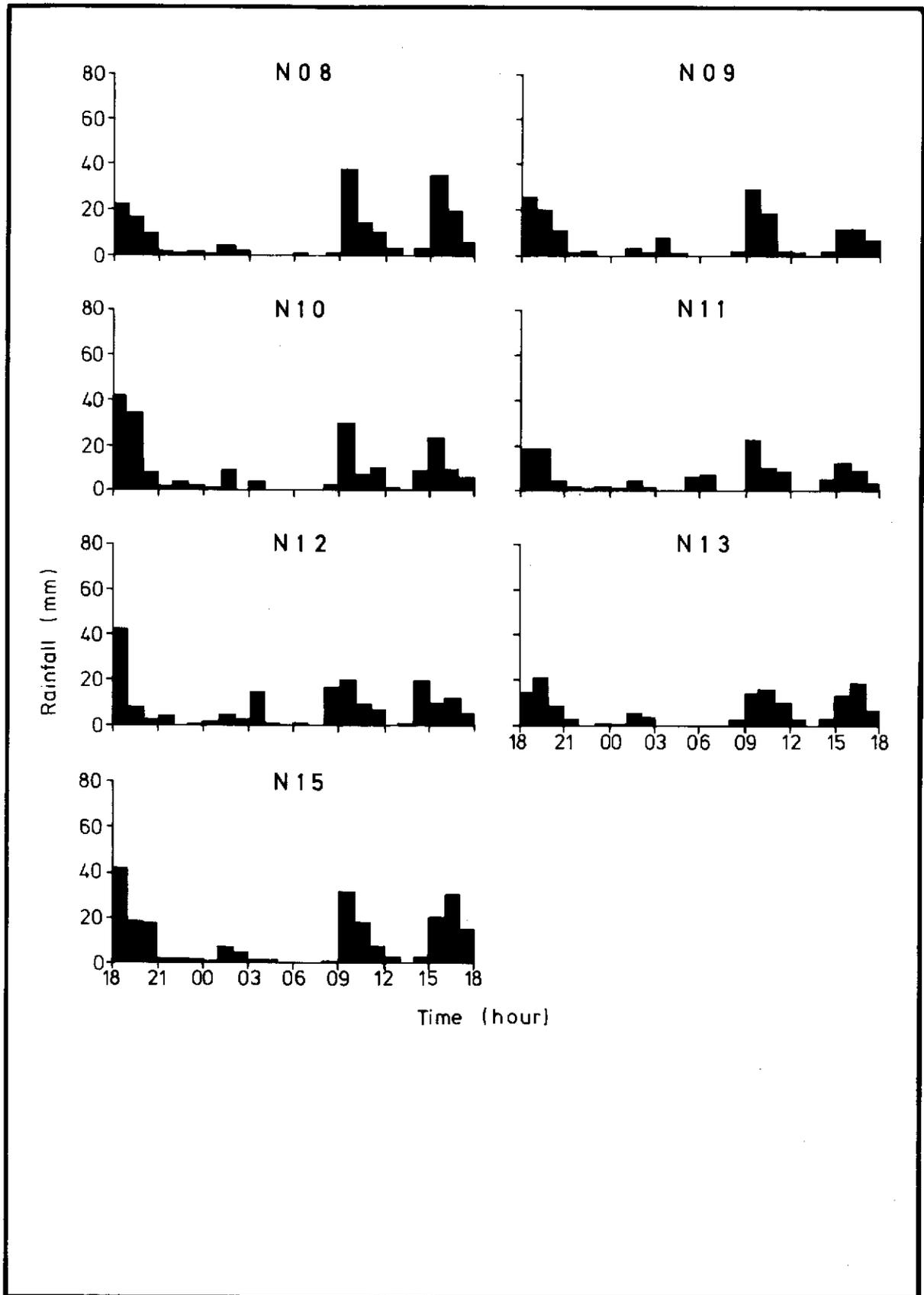


Figure B2 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 6th April 1987 (Sheet 4 of 4)

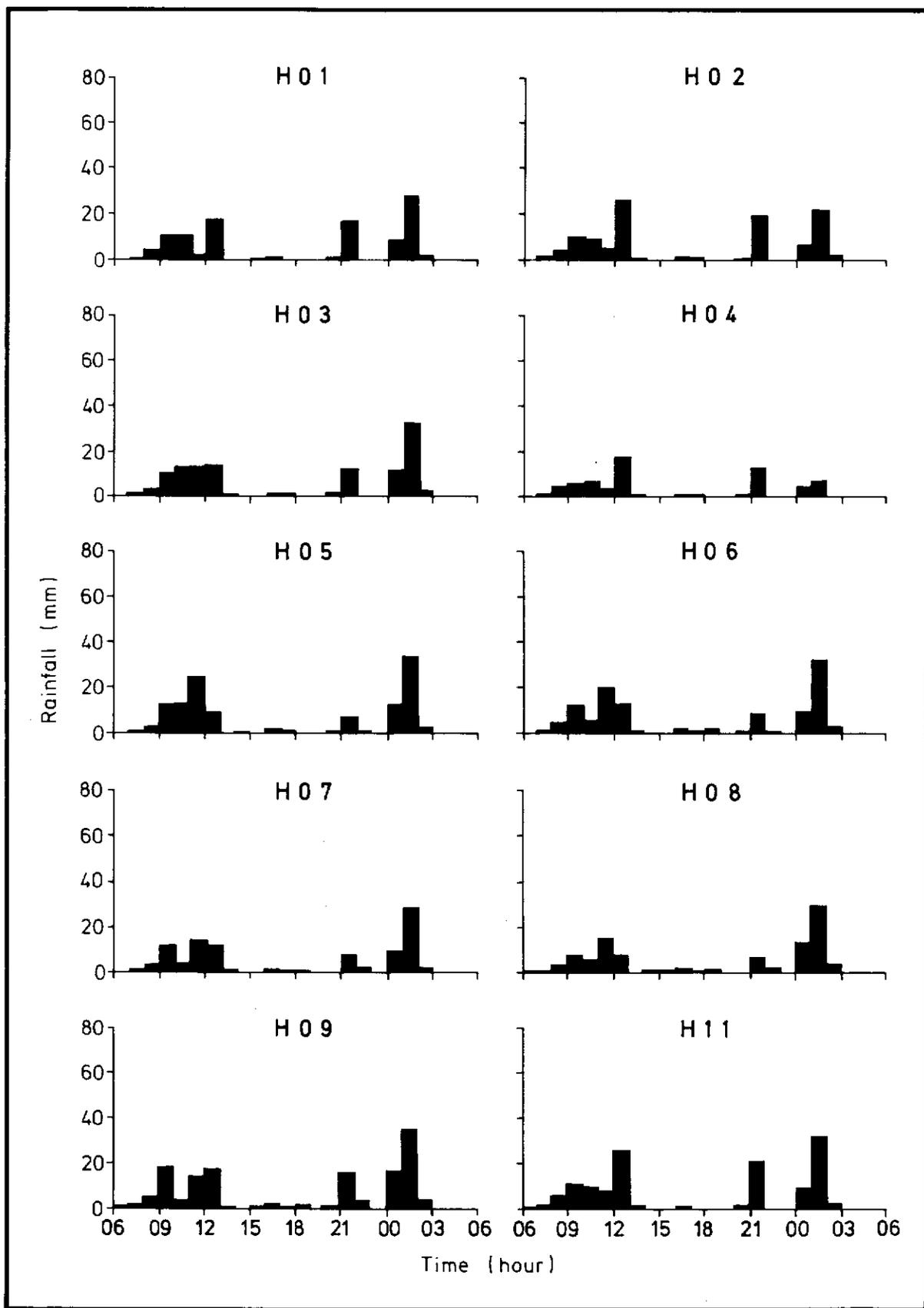


Figure B3 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 17th May 1987 (Sheet 1 of 4)

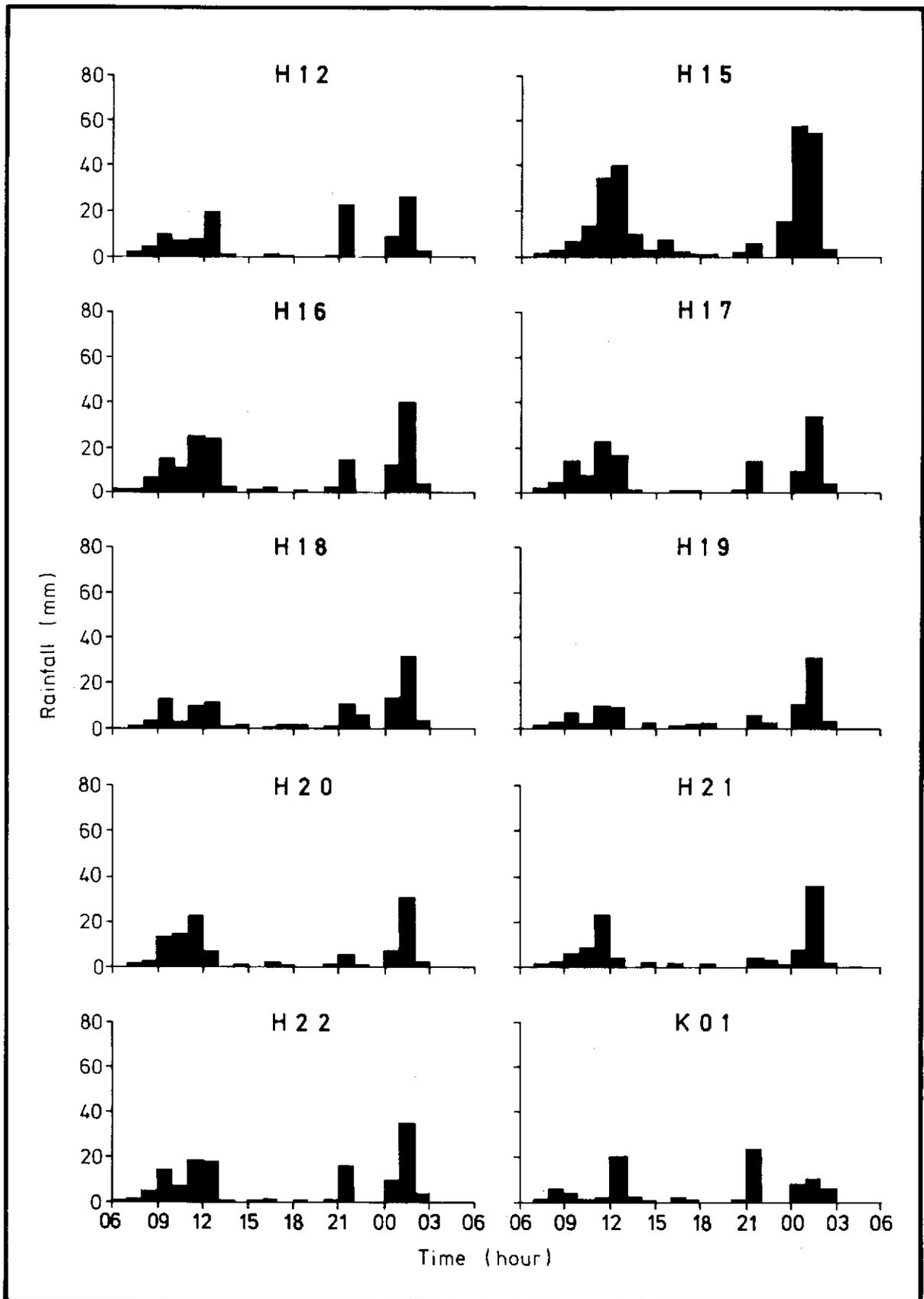


Figure B3 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 17th May 1987 (Sheet 2 of 4)

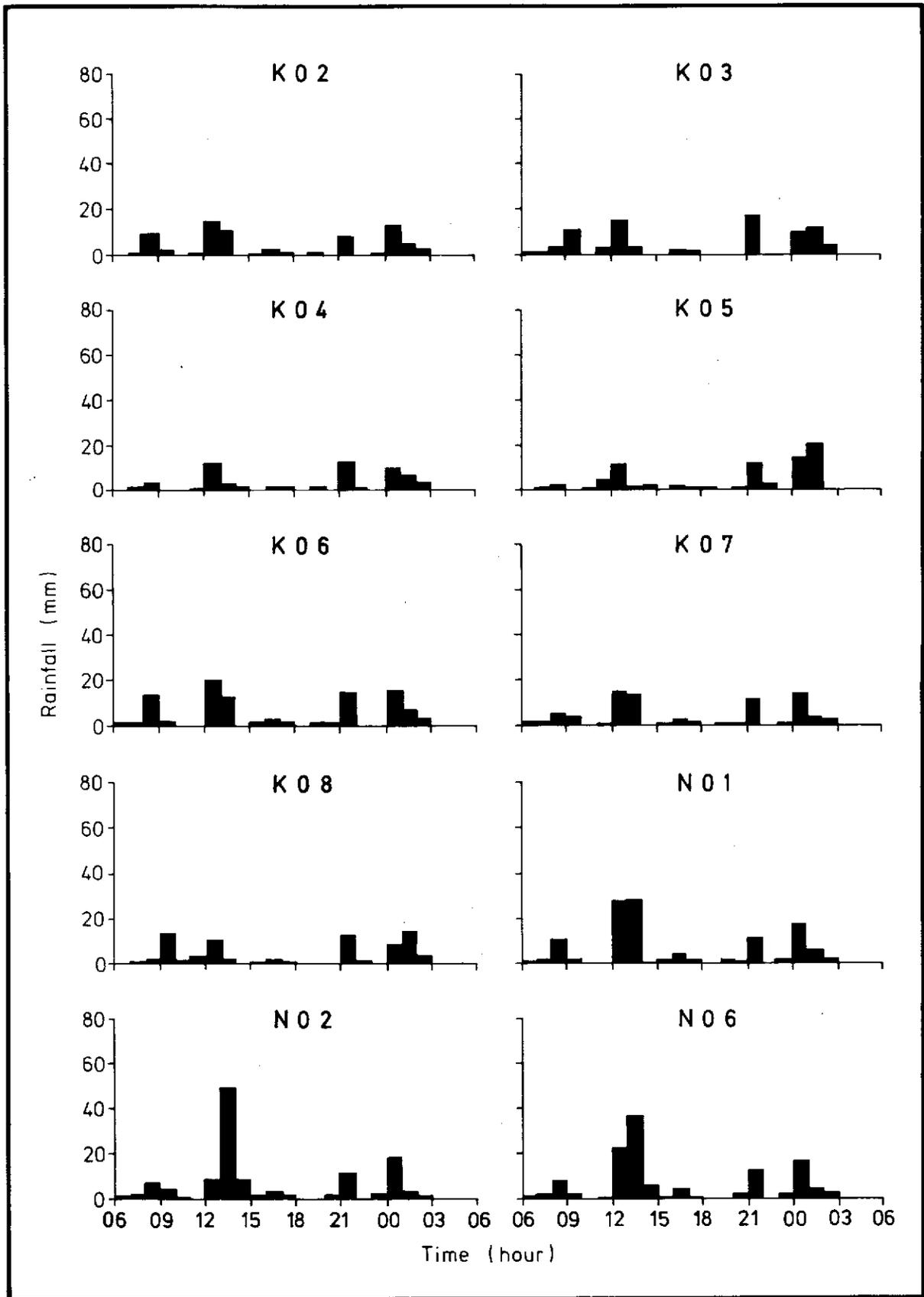


Figure B3 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 17th May 1987 (Sheet 3 of 4)

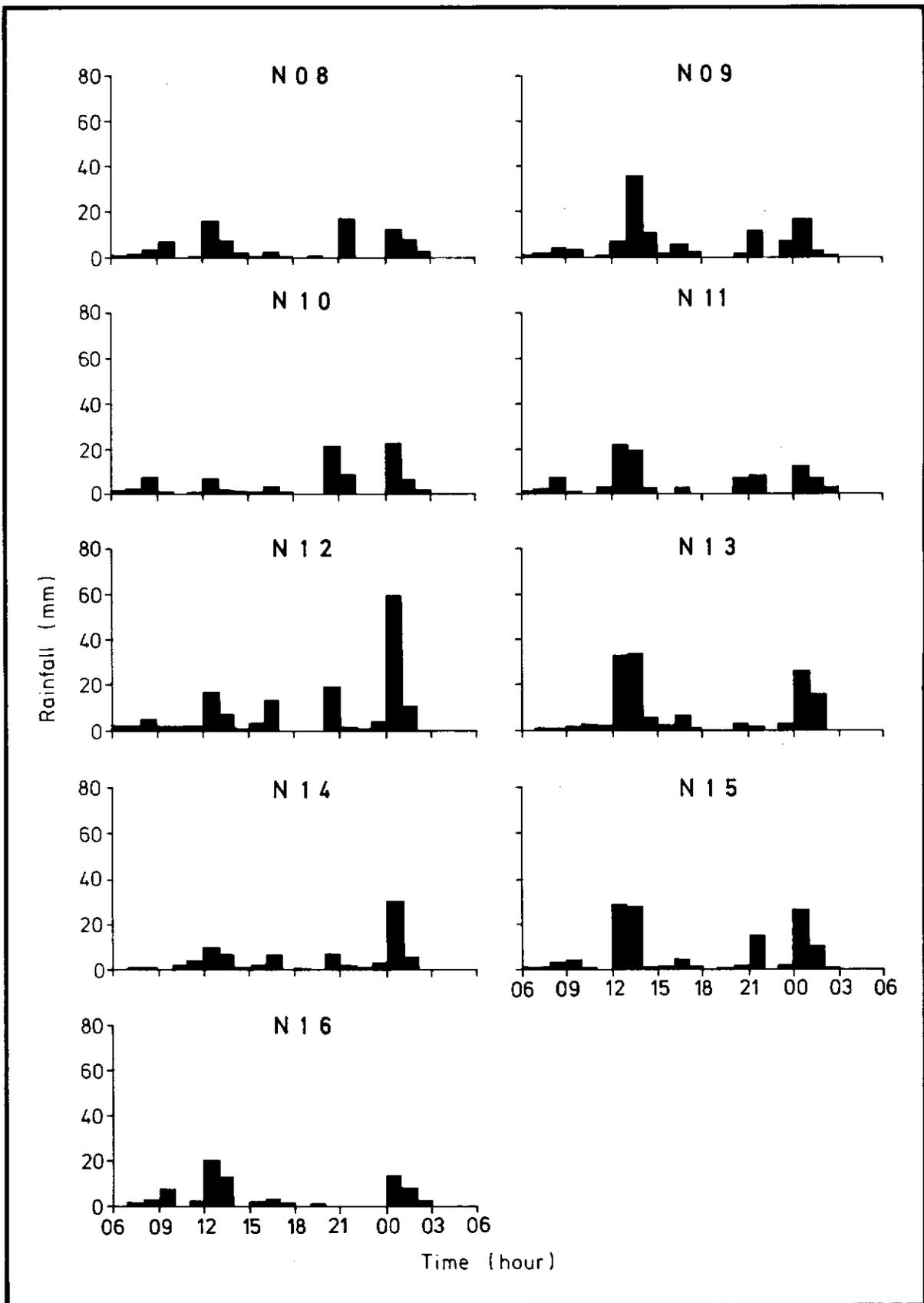


Figure B3 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 17th May 1987 (Sheet 4 of 4)

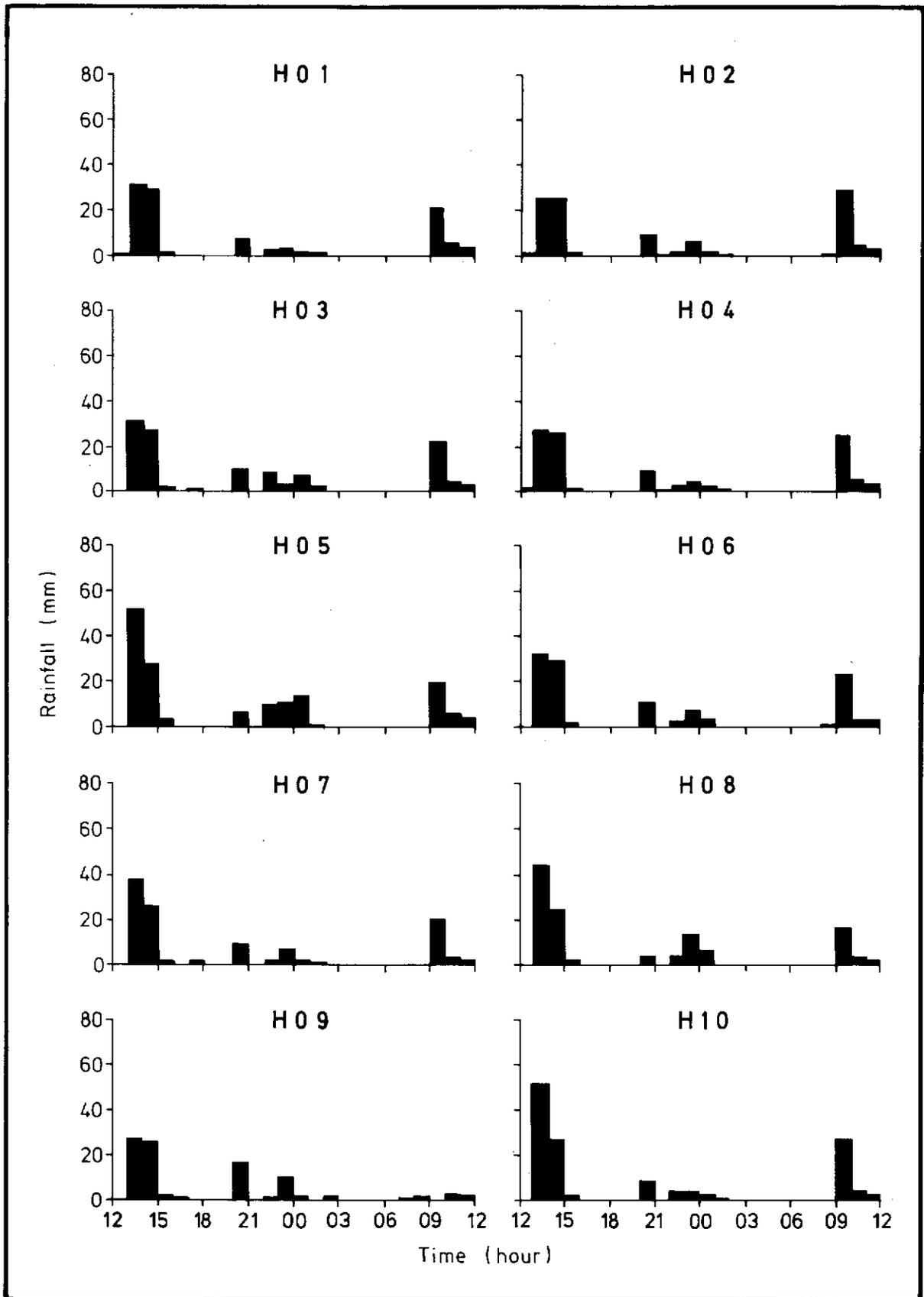


Figure B4 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 22nd May 1987 (Sheet 1 of 5)

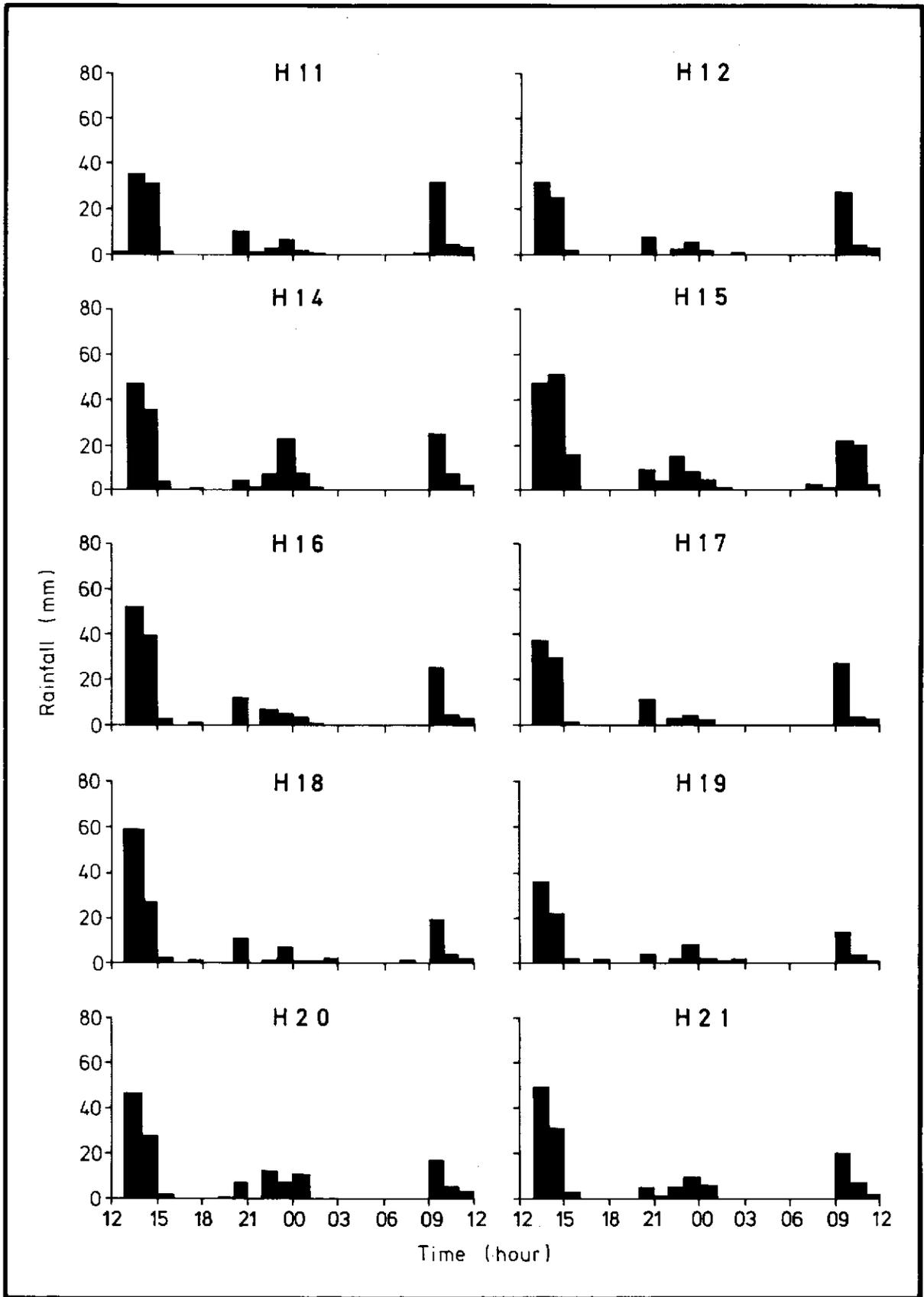


Figure B4 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 22nd May 1987 (Sheet 2 of 5)

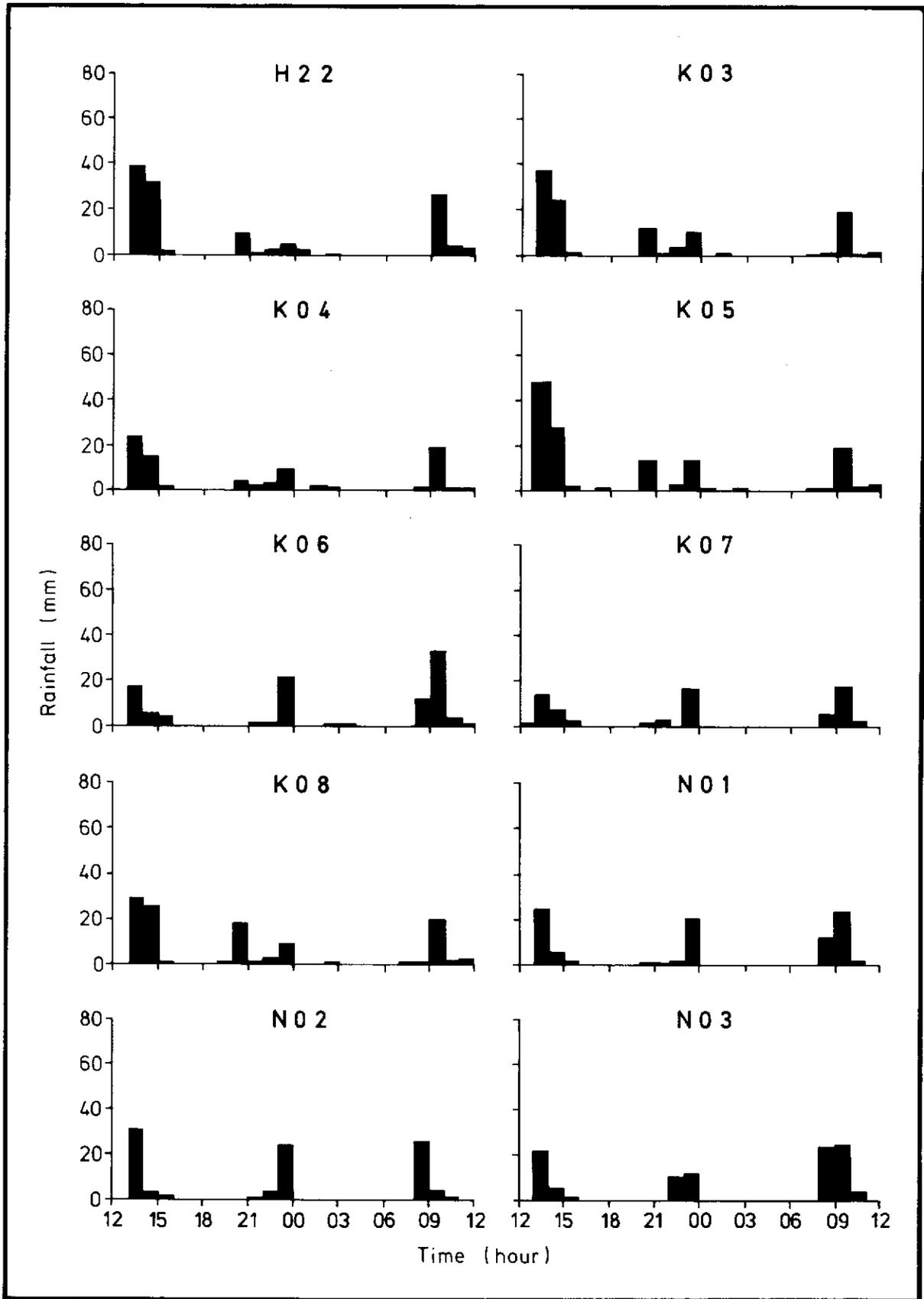


Figure B4 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 22nd May 1987 (Sheet 3 of 5)

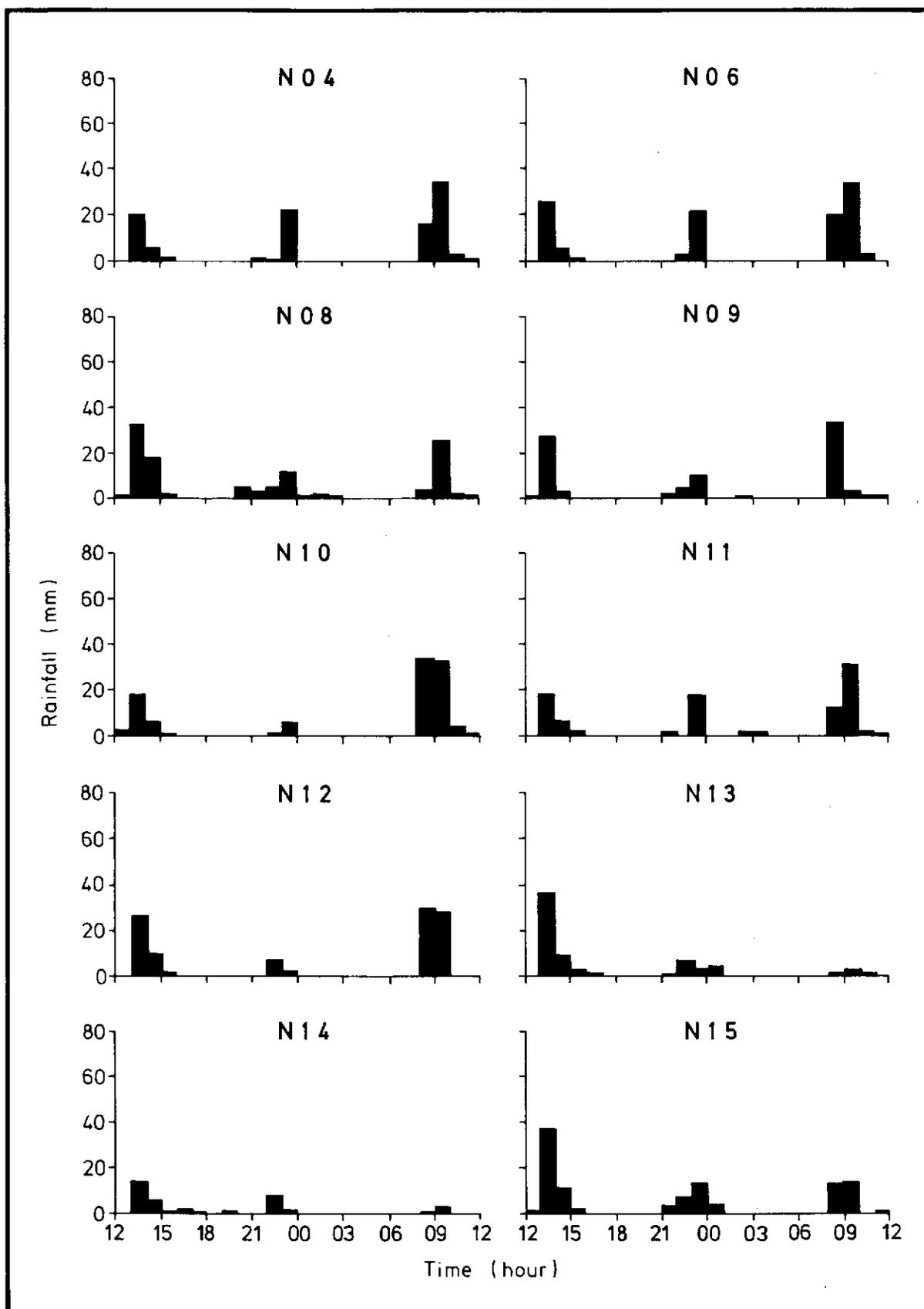


Figure B4 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 22nd May 1987 (Sheet 4 of 5)

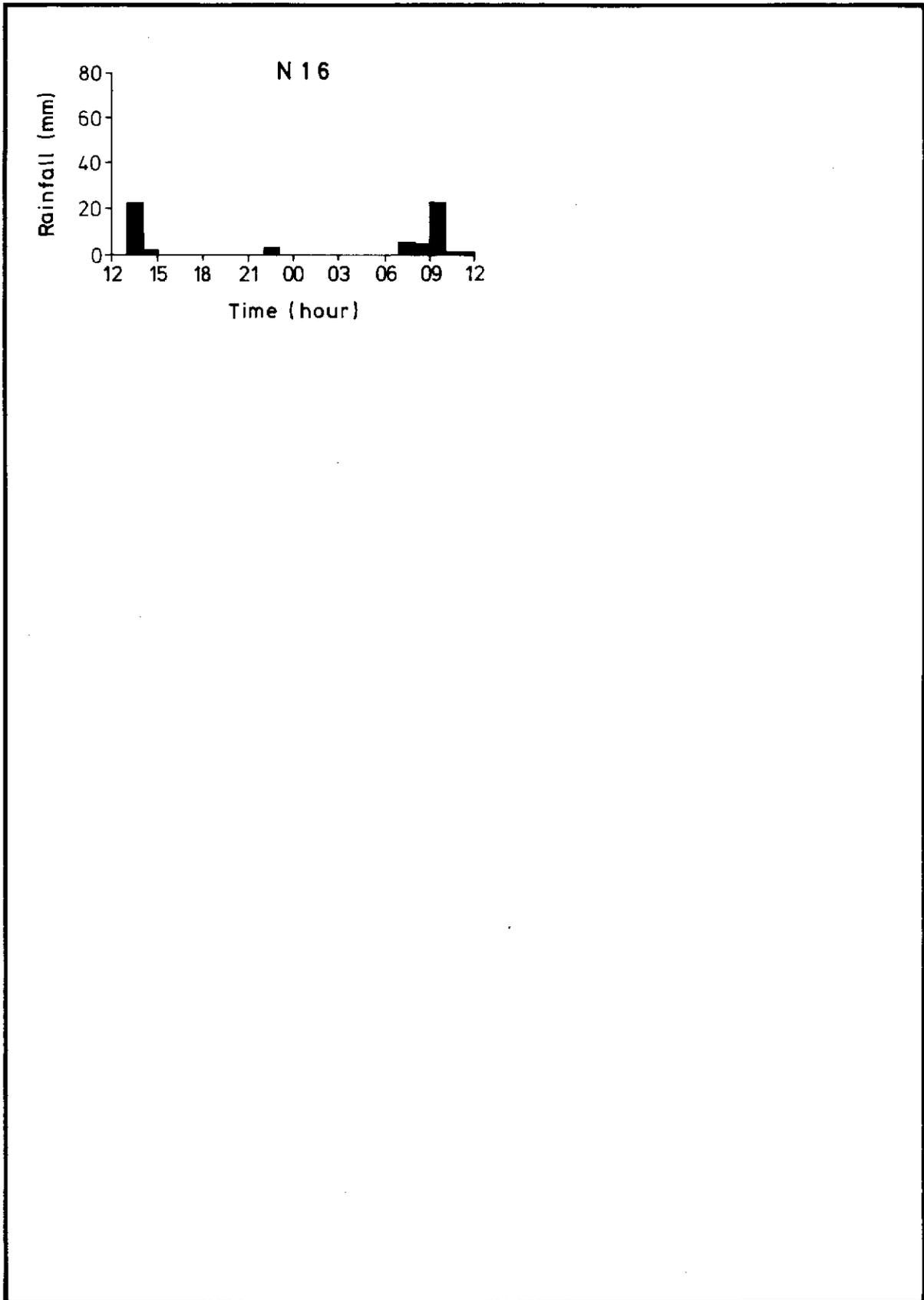


Figure B4 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 22nd May 1987 (Sheet 5 of 5)

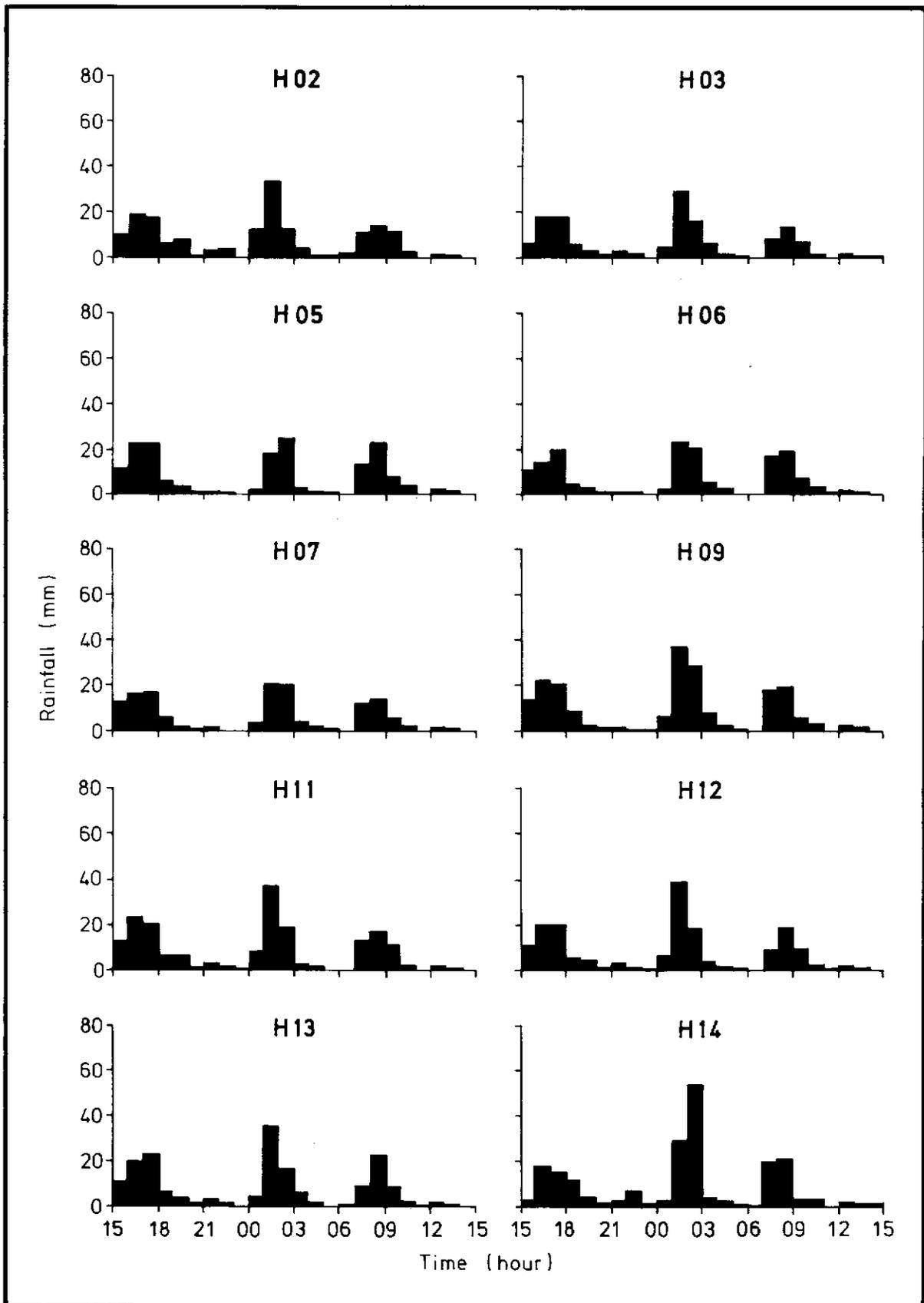


Figure B5 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 30th July 1987 (Sheet 1 of 4)

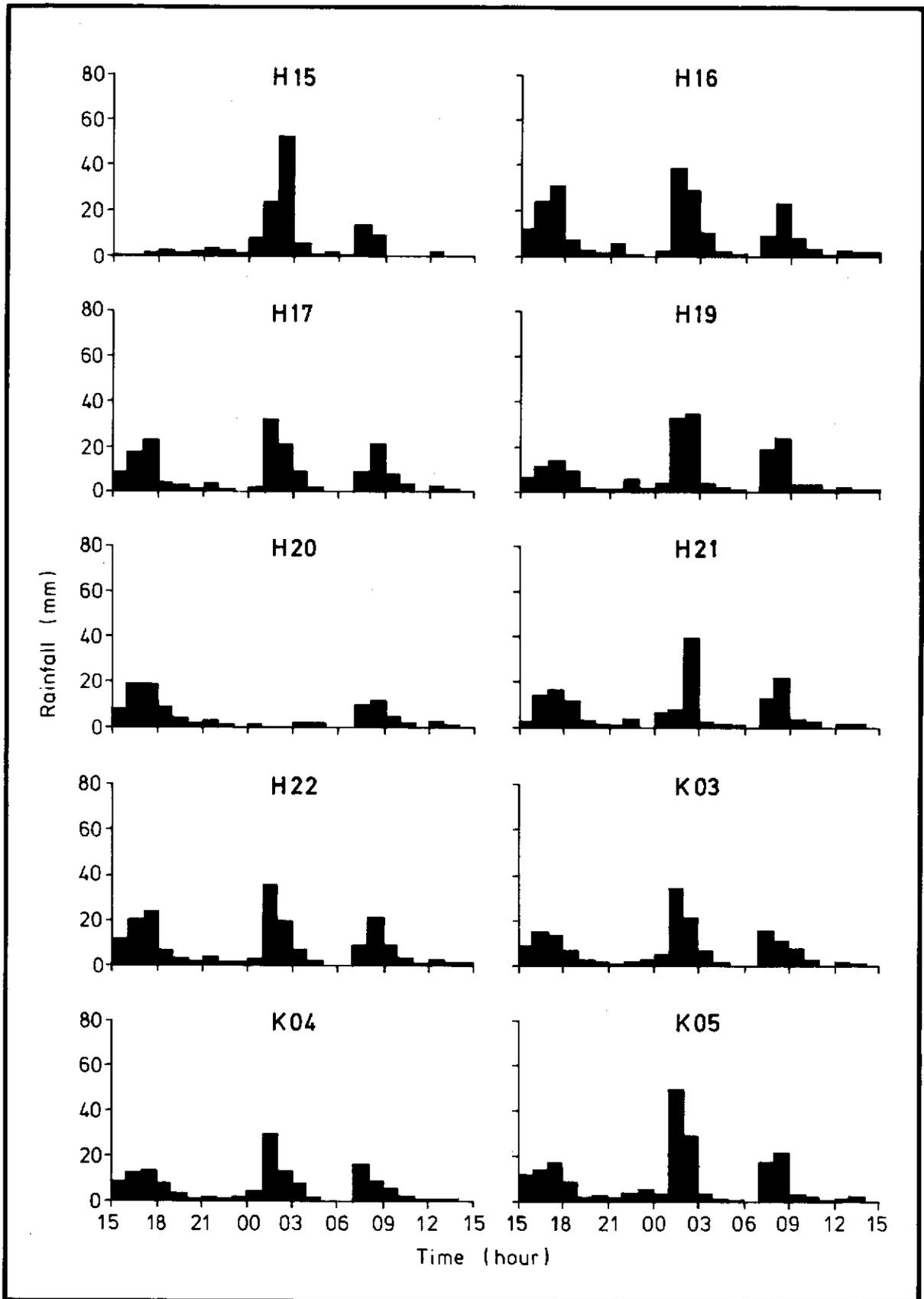


Figure B5 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 30th July 1987 (Sheet 2 of 4)

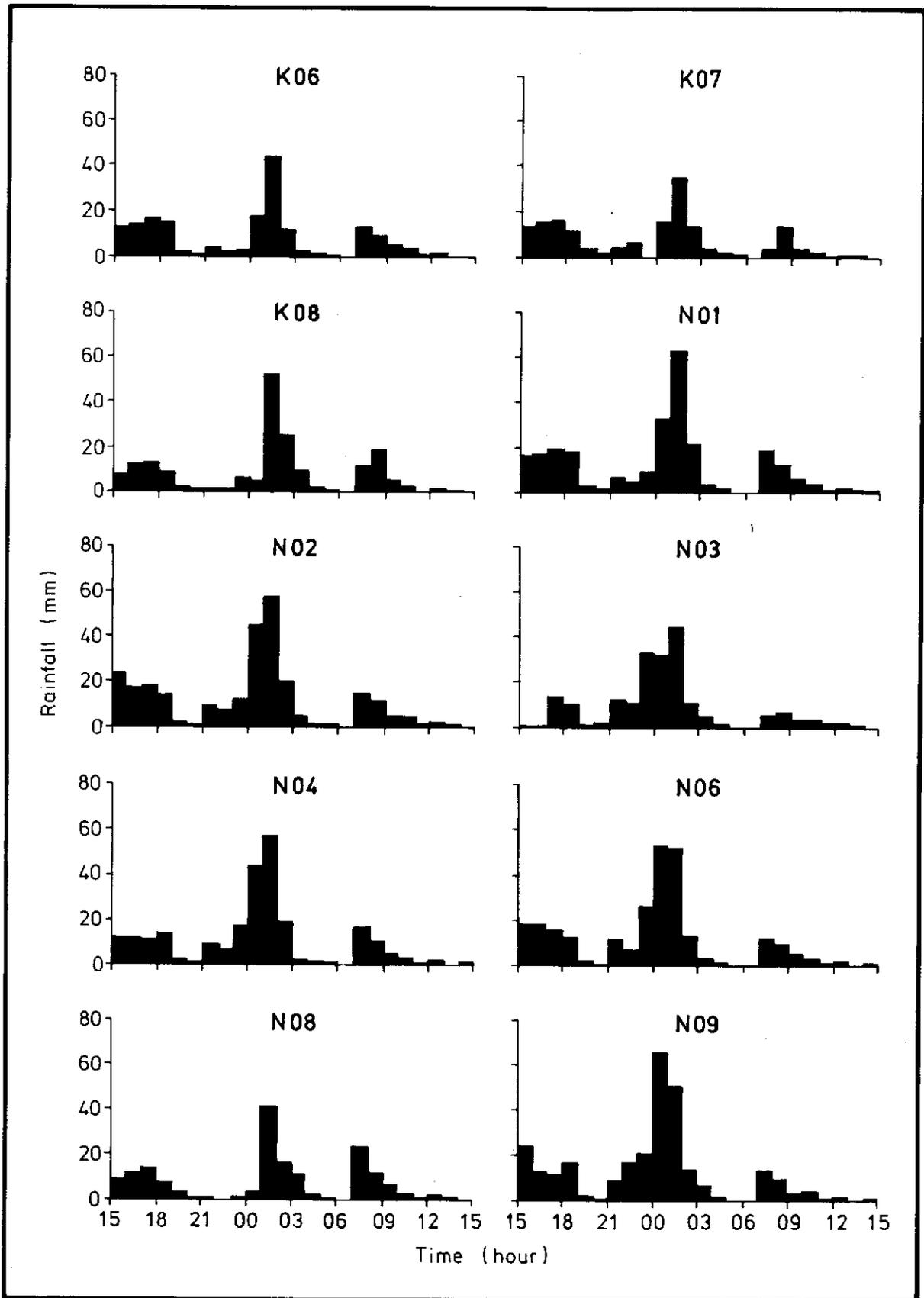


Figure B5 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 30th July 1987 (Sheet 3 of 4)

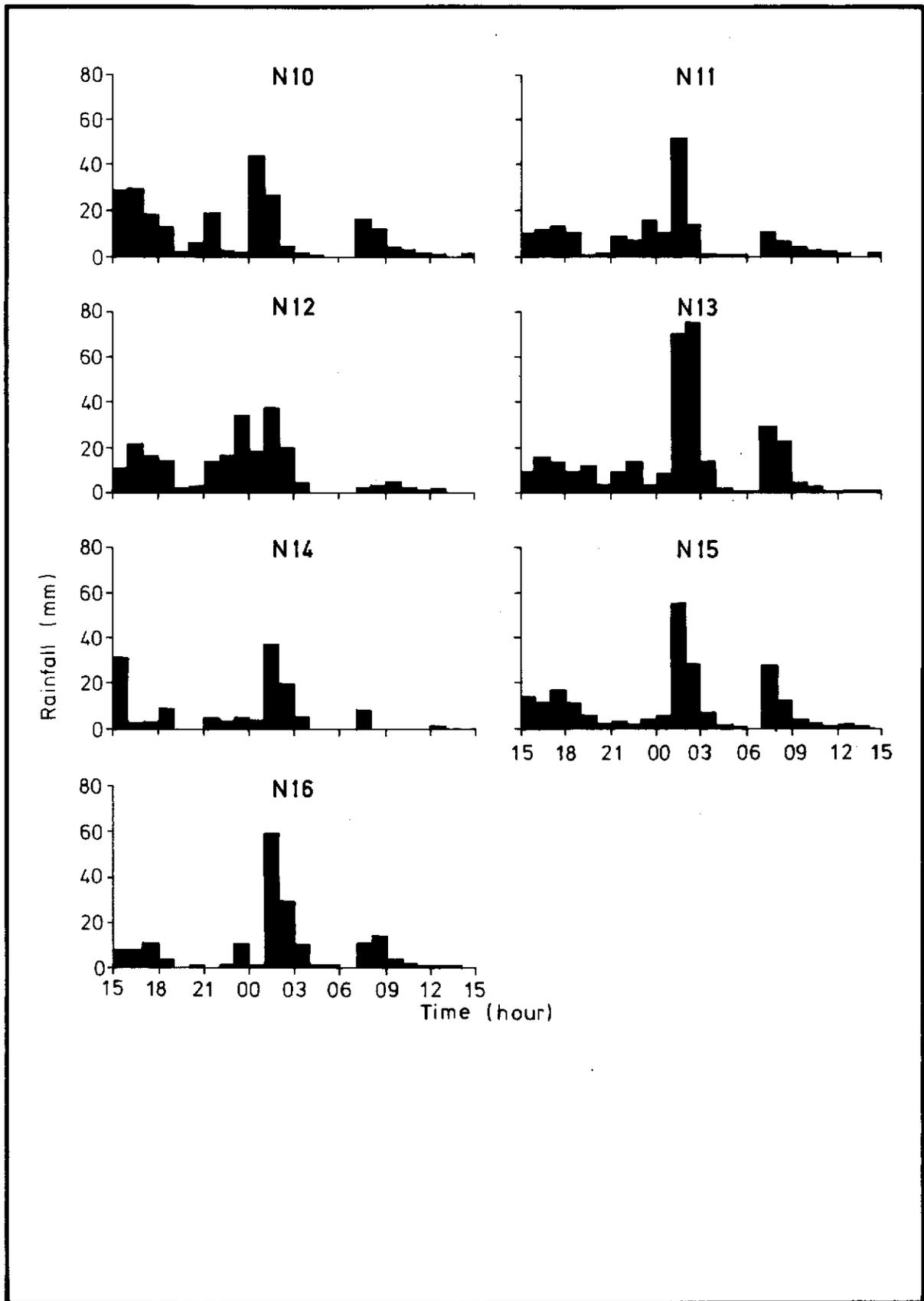


Figure B5 - Histograms of Hourly Rainfall Recorded by GCO Raingauges on 30th July 1987 (Sheet 4 of 4)

LIST OF DRAWING

Drawing
No.

GCSP 8/4 Location Map of Landslides and Related Incidents
in 1987