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THE MARLBOROUGH - NELSON BAYS FLOODS OF 8-10 JULY 1983

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MARLBOROUGH - NELSON BAYS FLOODS OF JULY 1983

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Abstract

The meteorological situation giving rise to the floods of 8-10 July 1983 is described. An analysis of rainfalls over the northern part of the South Island is presented and discussed with reference to the rainfall climatology of the region, and to previous major floods in the area. The economic impacts of the event are also described.

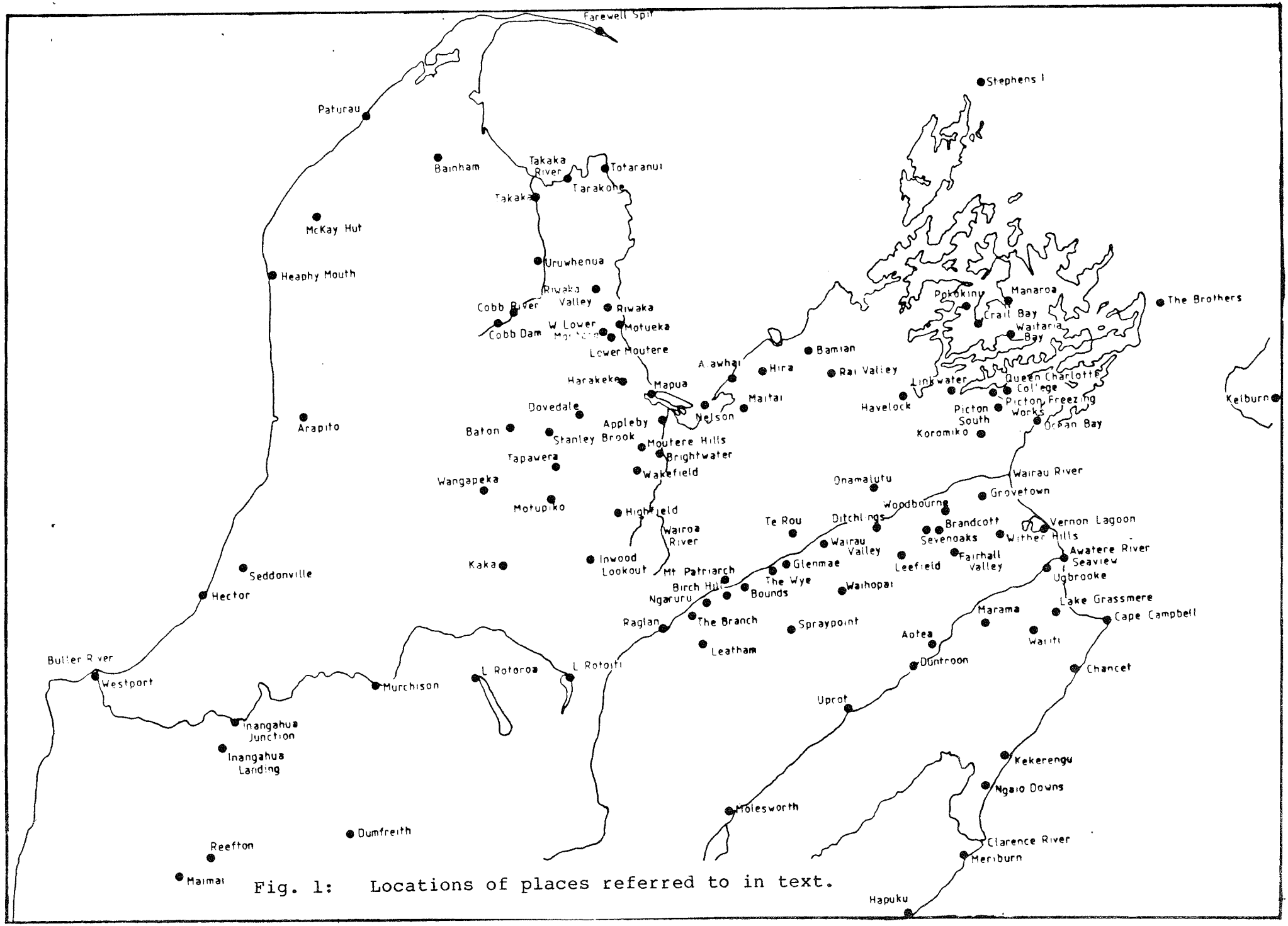

Fig. 1: Locations of places referred to in text.

MARLBOROUGH - NELSON BAYS FLOODS OF JULY 1983

1. Introduction

A moist northerly airstream brought prolonged heavy rain to northern areas of the South Island during the 8th and 9th of July 1983. The heavy rains resulted in extensive and severe flooding in parts of the Marlborough, Golden Bay and Nelson Districts.

Some 500 people were evacuated from residential areas at Tuamarina, Spring Creek and Renwick. Takaka residents were also evacuated from their homes as floodwaters rose in the town. The Takaka Hill road (SH60) was closed by slips, State Highway 1 was closed when the northern approaches to the Wairau bridge were washed out and State Highways 6 (Renwick to Okaramio) and 63 (Renwick to Rotoiti) were also closed due to damaged bridges.

Farmland areas were seriously affected, with more than 6500 stock being lost and horticultural crops damaged.

The places referred to in the following text are shown in Fig. 1.

2. The Synoptic Situation

During the night of Wednesday 6 July 1983 a small depression moved onto the Tasman Sea from the State of

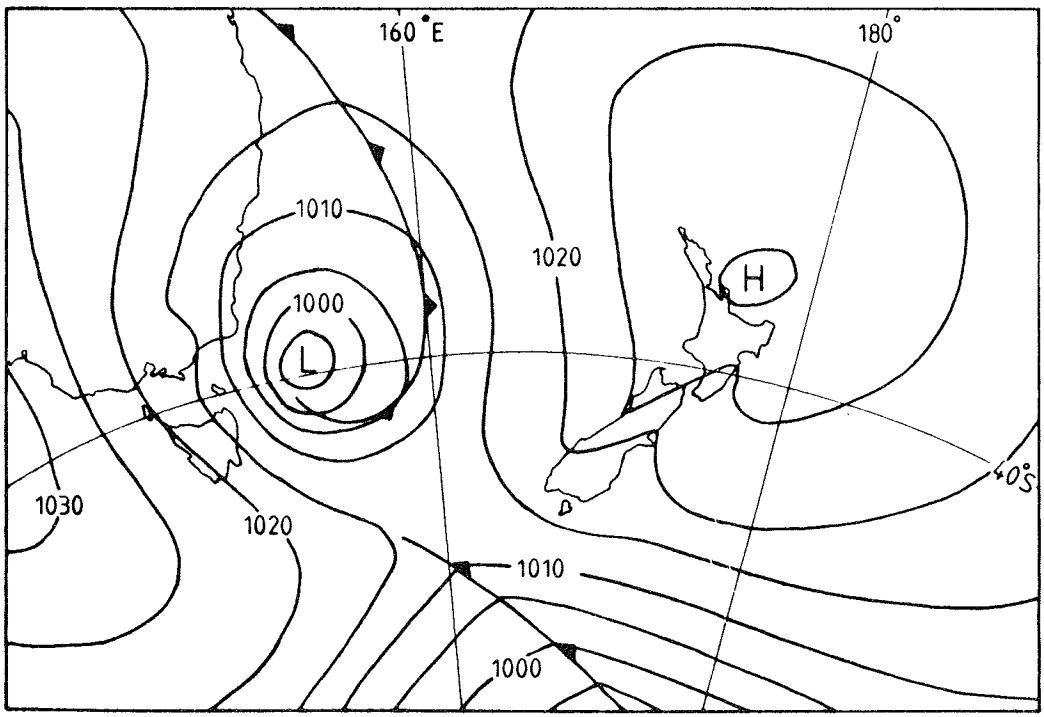

Fig. 2: Mean Sea Level Analysis for Midday (NZST) 7 July 1983.

Victoria, Australia. On the 7th the low moved steadily east and deepened rapidly (see Fig 2). During the same period an anticyclone moved eastwards across the North Island near Auckland and weakened slowly. An extensive area of cloud spread onto New Zealand as the ridge weakened.

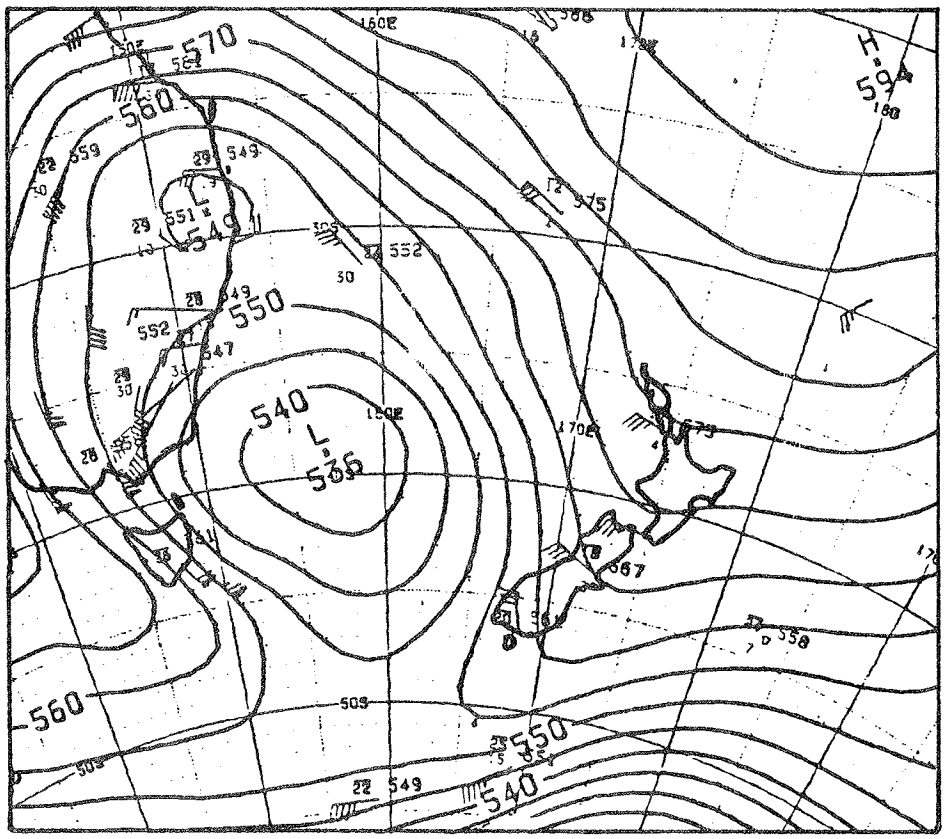

Fig. 3: 500hPa Analysis for Midday (NZST) 8 July 1983

On Friday July 8th the depression became slow-moving, under a large upper level low (Fig. 3) which covered much of the Tasman Sea. The low probably began to weaken, although pressure falls in the north increased the overall amplitude of the system. The anticyclone also became slow-moving, about 800km east of the North Island, and intensified with pressures rising in the Fiji/Tonga area and a strong ridge extending to the south. These developments resulted in a deep moist northerly airstream with a long fetch from tropical latitudes spreading over New Zealand. With the intense high effectively preventing any eastward movement of the low, a comparatively narrow band of moist tropical air continued to flow onto the country for some 48hrs during the 8th, 9th and 10th of July (Fig. 4).

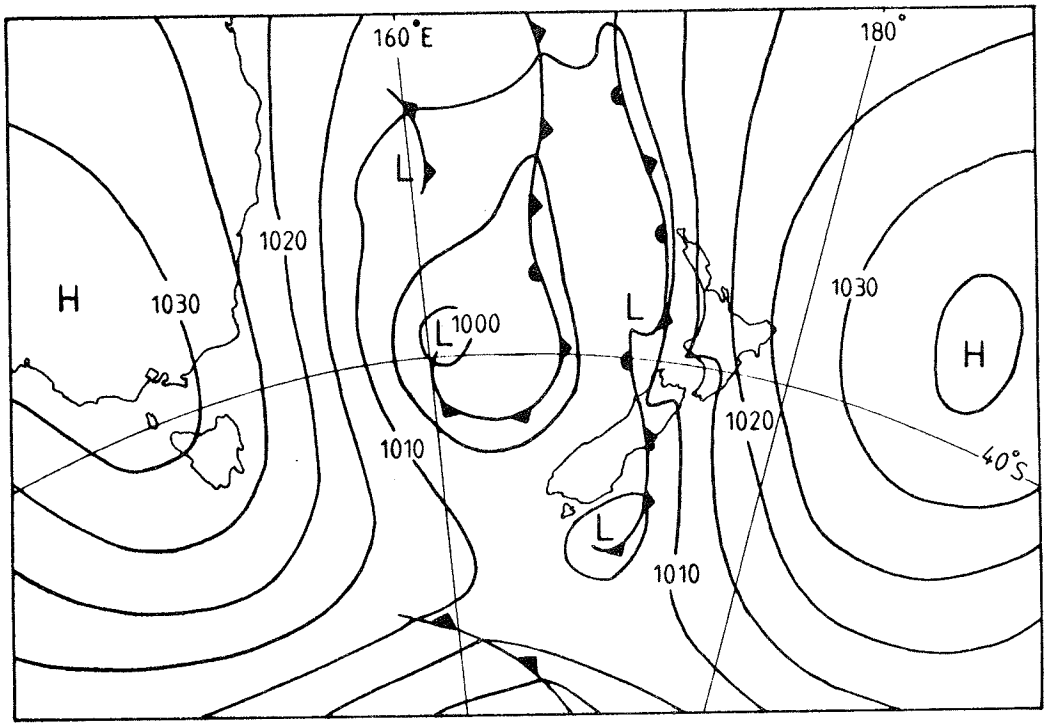

Fig. 4: Mean Sea Level Analysis for Midday (NZST) 9 July 1983

Precipitable water values, calculated from upper-air temperature and humidity soundings at Norfolk Island, Auckland and Christchurch are presented in Table 1 and illustrate this point.

Table 1:

Precipitable Water (mm) at 0000Z on July

	6th	7th	8th	9th	10th	(1983)
Norfolk Island	11.9	23.6	30.3	-	18.7	
Auckland	11.5	9.6	19.4	20.5	-	
Christchurch	8.2	5.6	22.8	23.4	22.0	

These figures show the increase in humidity at Norfolk Island between July 6th and 8th and corresponding increases at Auckland and Christchurch leading up to the heavy rain of the 9th.

The ascending motions inherent in the dynamics of this type of situation were enhanced over New Zealand as a result of orographic ascent over the high country, especially over the northern half of the South Island where extensive high country lay directly in the path of the wettest part of the northerly flow. The release of convective instability through lifting of the air over the mountains probably made a significant contribution to the rainfalls over the area. The broad cloud band over New Zealand can be clearly seen in satellite pictures taken during the period of heaviest rain. (See Fig. 5).

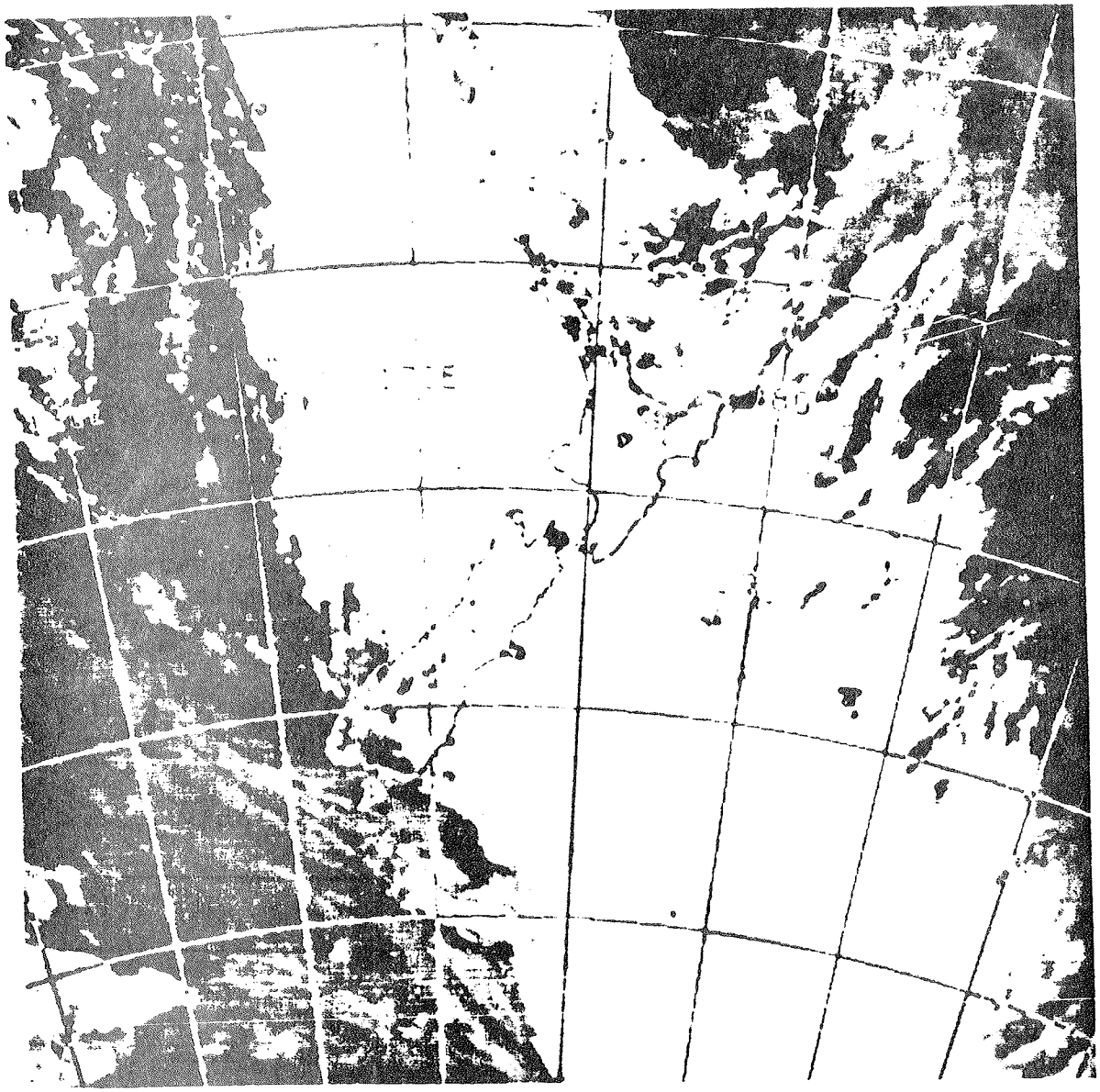

Fig. 5: Infrared Satellite Image from NOAA 7 at about 1600 hrs (NZST) 9 July 1983. The broad cloud band can be clearly seen lying North-South across central New Zealand.

As a result of the warm northerly flow spreading onto the country, temperatures in the lowest 3000 metres of the atmosphere rose, temporarily, on the 8th and 9th as the following figures (Table 2) from upper-air temperature soundings made at Auckland and Christchurch show.

Table 2:

Temperatures (°C) at Midday on July

	6th	7th	8th	9th	10th
Auckland					
3000 metres	-4	-4	0	+4	-2
1500 metres	+2	+2	+4	+5	+6
Christchurch					
3000 metres	-6	-7	-3	-2	-2
1500 metres	+3	+6	+2	+6	+5

The warming that took place on the 8th and 9th is reflected in reports from rainfall observers remarking on the depletion of snow cover on the high country during the period of heavy rain (see Section 3.4). The increase in temperature at 1500 metres above Christchurch between the 6th and the 7th was probably caused by the flow turning northwesterly over the South Island and the air warming as it descended in the lee of the Alps.

On Sunday 10th July the anticyclone began to move slowly east, allowing the complex low to move southeast across the South Island, and the moist northerly flow to move off to the east of the country.

3. Rainfall

3.1 Data Collection

The New Zealand Meteorological Service maintains a network of rainfall stations throughout the country. A large number of these gauges are read by voluntary observers who have made a very important contribution to our knowledge of New Zealand's rainfall patterns. The gauges are read daily at 9am, with the readings being credited to the previous day. In addition to these manual gauges there is a network of automatic gauges which record rainfall on either daily or

weekly charts. A number of "storage" rain-gauges have been installed in remote areas, by bodies such as Catchment Boards or the Ministry of Works and Development. Storage gauges are read at irregular and often infrequent intervals.

Daily rainfalls for July 8 and 9 (i.e. 24 hour rainfalls measured at 9am on July 9 and 10) are shown in Table 3. The locations of these stations are shown on Fig. 1.

Table 3:

24 hr Rainfalls (mm) Recorded at 9am on 9 and 10 July 1983

Station	Number	8th 9am 8th-9am 9th	9th 9am 9th-9am 10th	Previous 24hr Maximum (mm)	Return Period of 48hr Rainfall 9am 8th-9am 10th (Years)
Paturau	F02641	51.5	47.9	125	-
Heaphy Mouth	-	17*	30*	-	-
Bainham	F02751	144.8	162.7	494	2-5
Mckay Hut	F02821	238	286	-	-
Takaka	F02882	112	139	190	-
Tarakohe	F02891	77	49	169	-
Uruwhenua	F02981	162	300*x	229	>50
Farewell Spit	F03501	23.5	13.7	237	-
Totaranui	F03801	57.5	85	-	< 2
Hector	F11683	65.9	108.9	175	-
Westport	F11752	87.1	63.5	122	5-10
Inangahua	F11891	72	103	184	5-10
Inangahua Landing	F11991	63*	116*	148	-
Cobb River	F12071	88.6	178	199	10-20
Cobb Dam	F12162	75	133	439	2-5
Arapito	F12213	21.3	39.1		-
Wangapeka	F12462	40.2	69.7	122	<2
Seddonville	F12501	80.3	127.5x	124	-
Lake Rotoroa	F12752	34.3	50.4	-	-
Murchison	F12831	45.0	52.6	99	2-5
Lake Rotoiti	F12882	23.9	55.8	119	<2
Maimai	F21174	96	122	-	-
Reefton	F21181	65.8	148.1	205	>50
Dumfreith	F22021	60.1	98.2	127	-
Springs Junction	F22311	48.7	101.7	141	-
Stephens Island	G04601	7.4	18.9	76	<2
Riwaka Valley	G12091	95.7	187.7	230	5-10
Riwaka	G12191	68.2	165.2	199	10-20
Lower Moutere	G12193	60.9	135	154	-
Western Lower Moutere	G12191	60.2	122*	100	10-20
Baton	G12371	65.1	118	143	-
Stanley Brook	G12381	42.1	93.2	165	2-5
Tapawera	G12382	25.5	64.1	-	-
Dovedale	G12391	54	126x	96	20-50

Table 3 cont'd

Station	Number	8th 9am 8th-9am 9th	9th 9am 9th-9am 10th	Previous 24hr Maximum (mm)	Return Period of 48hr Rainfall 9am 8th-9am 10th (Years)
Motupiko Depot	G12481	21.5	61.3	125	-
Highfield	G12491	51.5	153.1x	130	20-50
Kaka	G12561	45.9	125.2	122	5-10
Inwood Lookout	-	23	66	-	-
Motueka	G13102	67.3	177.2x	161	>50
Bamian	G13154	47.2	121.5	199	-
Pokokini	G13193	39.3	82.7	228	<2
Crail Bay	G13195	34.3	76.4	-	-
Harakeke	G13201	65	142	220	20-50
Mapua	G13203	35.9	130.8x	86	>50
Appleby	G13211	39.1	120.9x	116	20-50
Nelson	G13222	29.1	83.2	137	5-10
Hira Forest	-	41	99	-	-
Maitai	G13232	66.6	154	241	5
Rai Valley	G13251	71	164	305	5-10
Havelock P.O.	G13271	54	198x	176	-
Linkwater	G13281	57	152.2	199	-
Moutere Hills	G13301	46.4	122.2x	107	20-50
Brightwater	G13312	40.8	93.9	166	-
Havelock	G13371	49.5	136.3	170	-
Koromiko	G13391	34.5	87.5	195	-
Wakefield	G13404	60.5	156.6	124	-
Onamalutu	G13461	74*	138*	157	-
Ditchling	-	43*	126*	-	-
Grovetown	G13491	16.5	67.6	85	2-5
Te Rou	-	85*	253*	-	-
Wairau Valley	G13552	58.6	166.8x	165	>50
Woodbourne	G13581	20.9	67.8	85	5-10
Sevenoaks	G13582	25.2	80.0	114	5-10
Fairhall Valley	G13583	19.5	59.9	75	-
Brancott Valley	G13584	19	65.1	-	-
Wither Hills	G13595	14.4	48	99	< 2
Patriach	-	85*	253*	-	-
The Branch	G1361A	75	170x	145	-
Raglan	-	79*	234*	-	-
Birch Hill	G13621	67.7	116.8*	150	-
Ngaruru	-	73*	217*	-	-
The Wye	G13633	50	155x	153	-
Glenmae	G13641	45.8	119.3x	106	-
Bounds	-	55	163	-	-
Leefield	-	34	99	-	-

Table 3 cont'd

Station	Number	8th 9am 8th-9am 9th	9th 9am 9th-9am 10th	Previous 24hr Maximum (mm)	Return Period of 48hr Rainfall 9am 8th-9am 10th (Years)
Waihopai	G13651	22.6	108.5x	93	20-50
Spray point	G13741	36	108x	100	-
Leatham	G13721	68.3	188.2	253	-
Aotea	G13782	17.3	79.3	87	-
The Haldons	G13791	13.7	64.5	120	-
Hillside, Marama	G13792	15.4	66.8	134	2
Duntroon	G13871	23*	93*	161	5-10
Upcot	G13951	21.6	99.5	117	20
Manaroa	G14101	24.3	55.2	193	< 2
Waitaria Bay	G14102	37.4	69.8	232	-
The Brothers	G14141	13.6	24.7	138	< 2
Picton Freezing Works	G14201	26	75.6	250	< 2
Queen Charlotte College	G14204	26.9	84	281	-
Picton South	G14303	27.9	88.1	299	-
Ocean Bay	G14311	30.5	67.7	164	<2
Vernon Lagoons	G14501	12.3	43.6	104	<2
Seaview	G14611	10	31	100	<2
Ugbrooke	G14613	13	42.5	99	-
Waiiti	G14702	11.2	45.7	107	<2
Grassmere	G14711	8.5	42.6	129	<2
Cape Campbell	G13721	8.2	25.1	203	<2
Chancet	G14811	11.7	34.2	222	<2
Hamner Forest	G22581	2.8	37.0	171	<2
Molesworth	G23021	10.3	67.8	78	2-5
Ngaio Downs	G23092	2.2	34.5	230	<2
Meriburn	G23183	1.2	29.4	-	-
Hapuku	G23361	0	36.3	345	<2

* - Estimated Rainfall
x - Exceeds previous 24 hr Maximum

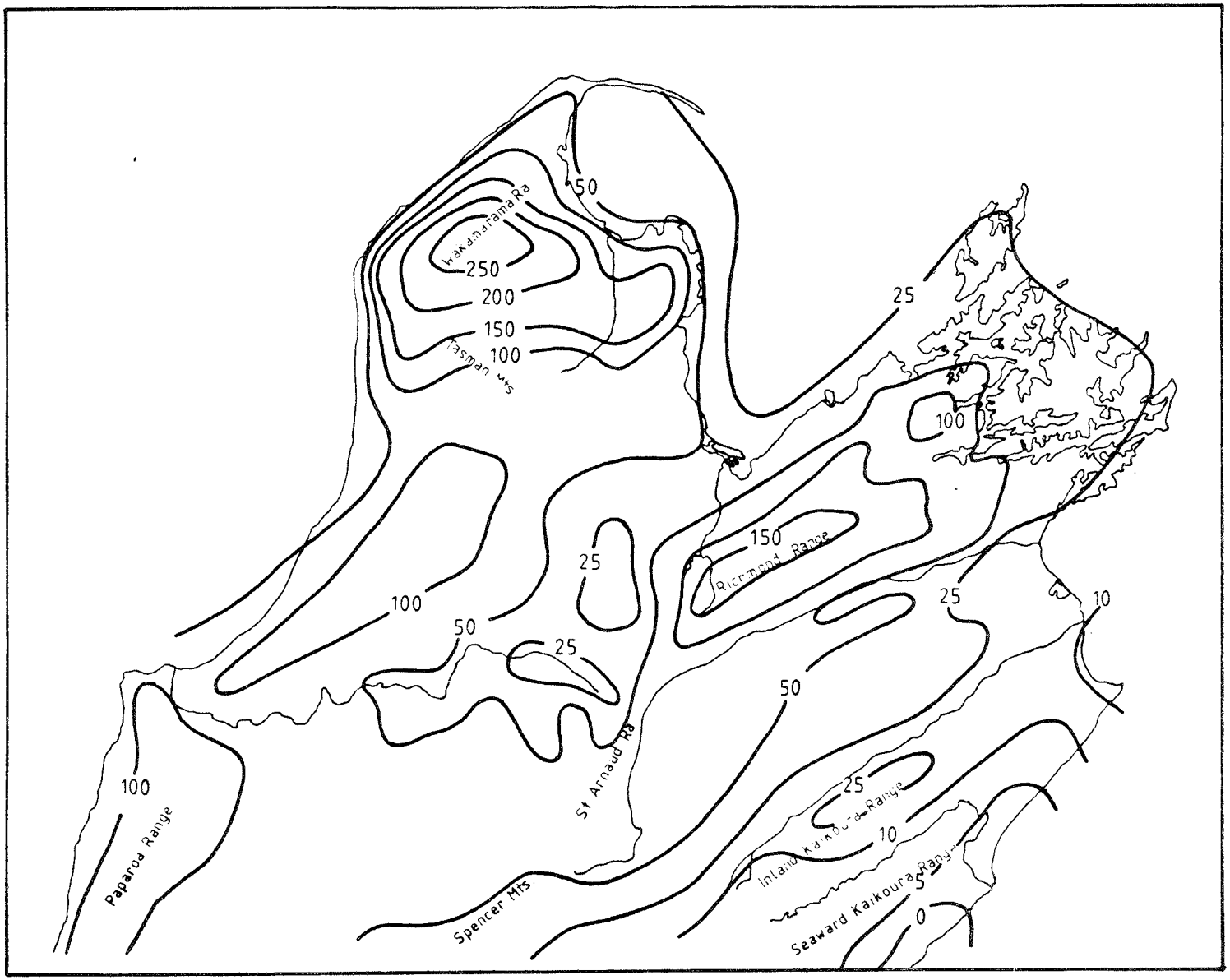

Fig. 6: Isohyets (mm) of 24 hour rainfall, 8 July 1983. (9am July 8th to 9am July 9th).

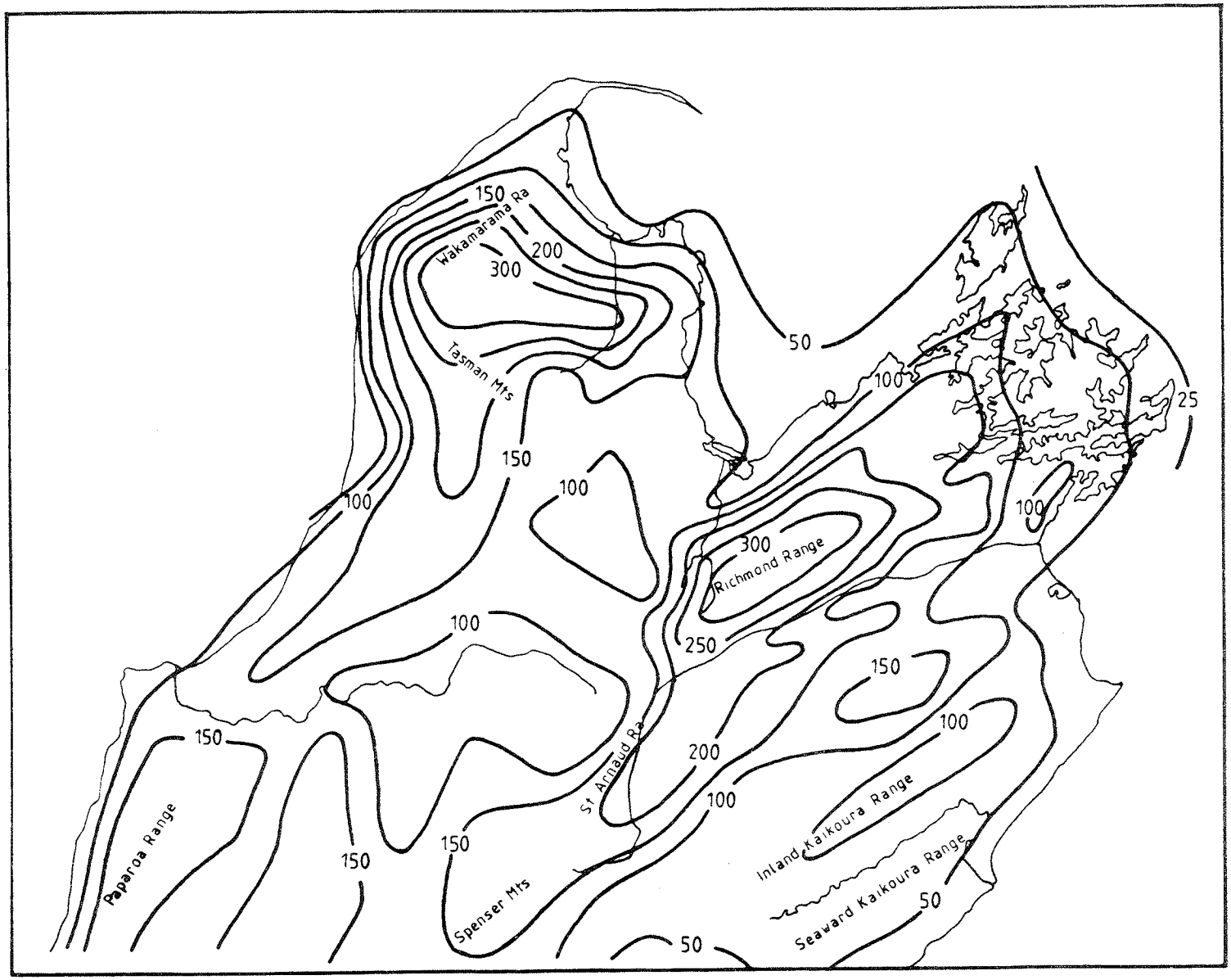

Fig. 7: Isohyets (mm) of 24 hour rainfall, 9 July 1983 (9am July 9th to 9am July 10th).

3.2 Estimated Rainfalls

In some cases an observer may be unable to read a gauge on a certain day. In such cases the gauge is normally read on the following day, with a note being made that this is a two day rainfall. It is possible to produce an estimate of the rainfalls on the individual days by calculating the percentage of rain that fell on each day and applying this percentage to the station with the missing reading.

This technique was also used to estimate the rainfall at Uruwherua on 9th July (when the gauge overflowed) and at Mckay Hut (where a 9 day rainfall total from a recording gauge was available).

Wherever a rainfall has been estimated in this manner it has been marked with an asterisk in Table 3.

3.3 Distribution of Rainfall

Figures 6 and 7 show the distribution of rainfall on July 8 and 9 and Fig. 8 shows the rainfall distribution of July 8 plus July 9 (i.e the 2 days of heaviest rain).

The heaviest falls occurred in high country areas exposed to the very moist northerly flow which prevailed during the 8th and 9th. The ranges of the Northwest Nelson Forest Park (source of the Aorere, Anatoki, Takaka and Riwaka Rivers) and the Richmond Range (source of the Pelorus River and tributaries of the Wairau River), experienced 24 hour rainfalls in excess of 300mm and 48 hour rainfalls in excess of 400mm. Areas sheltered by the high country, for example the large area southwest of Nelson, received substantially less rain. In spite of these variations in rainfall intensity heavy rain was widespread and prolonged, and therefore had a large impact on river levels.

3.4 Intensity of Rainfall

Cumulative rainfall graphs for a number of stations with recording gauges are shown in Figs 9 and 10. In most places continuous rain fell from the morning of the 8th until about midday on the 10th, with continuous heavy rain during the night of July 9-10.

The extremely high 24 and 48 hour rainfalls on the Richmond Range and on the high country southwest of Takaka, exceeded 50 year return period values (see Figs 11 and 12), and 10 year return period values were exceeded in most inland areas. However the most heavily populated areas and areas sheltered from the moist northerly flow, recorded rainfalls with short return periods.

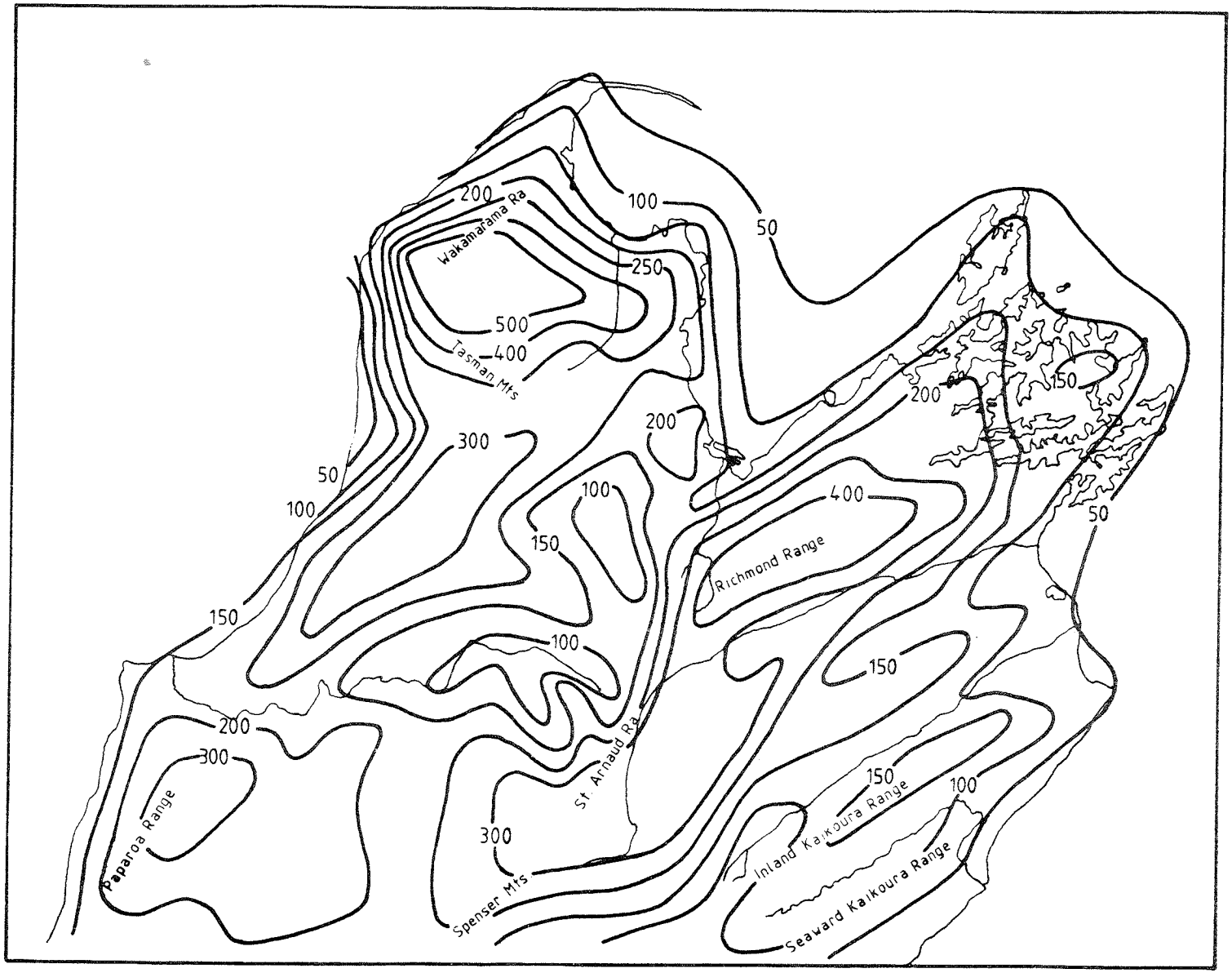

Fig. 8: Isohyets (mm) of 48hr rainfall, 8 July and 9 July 1983. (9am July 8th to 9am July 10th).

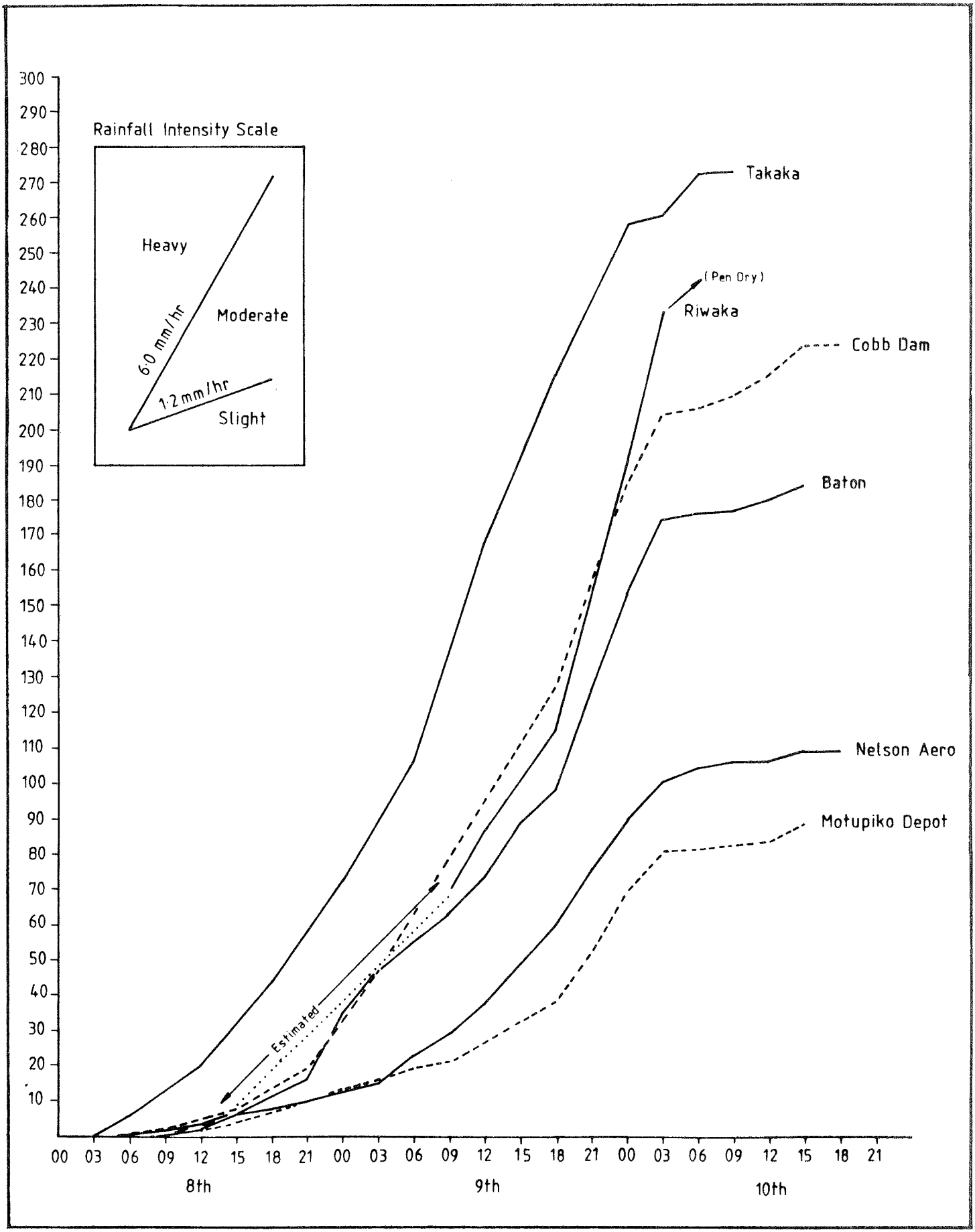

Fig. 9: Rainfall Accumulations (mm) at Takaka, Riwaka, Cobb Dam, Baton, Nelson Airport and Motupiko, 8-10 July 1983.

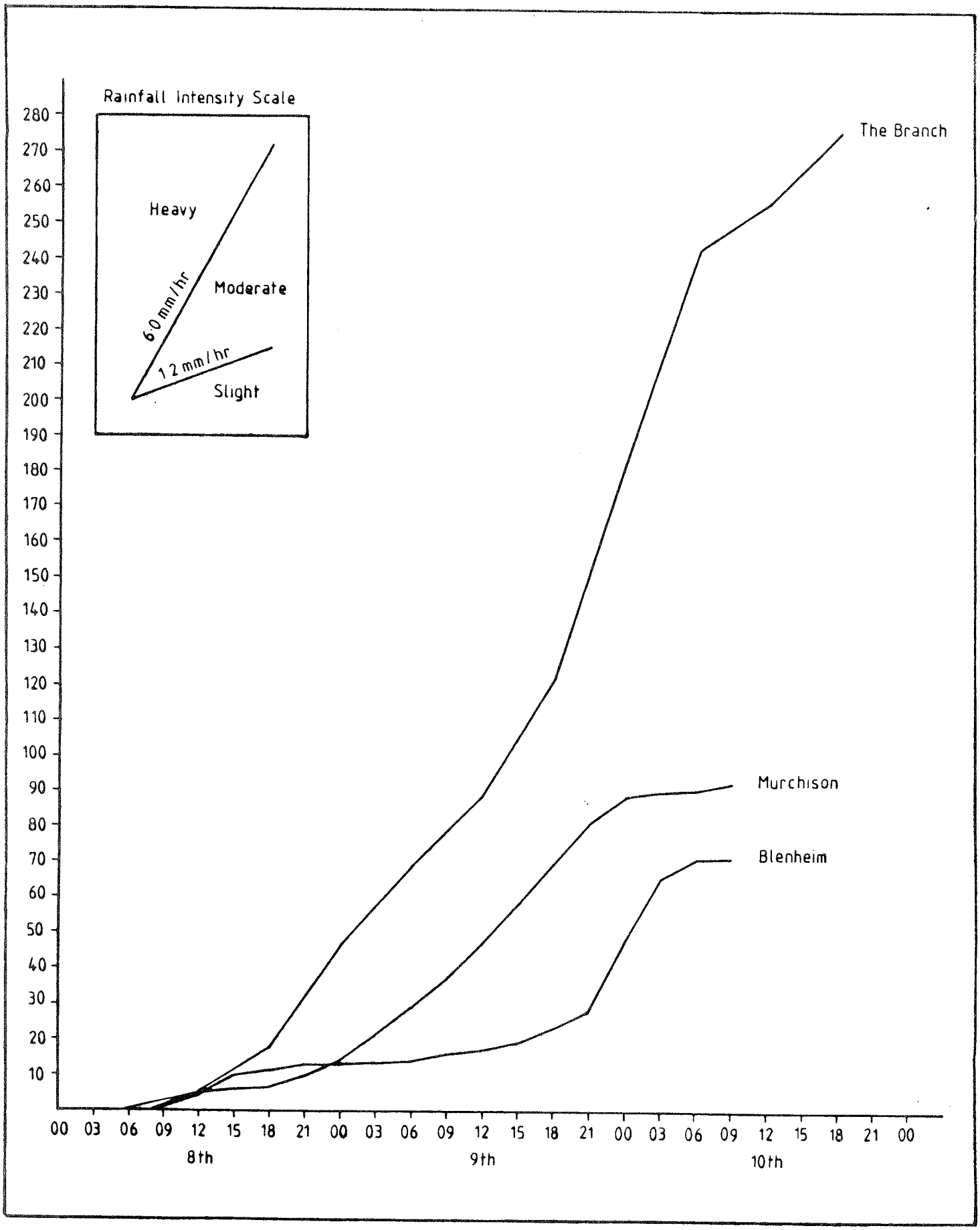

Fig. 10: Rainfall Accumulations (mm) at the Branch, Murchison and Blenheim, 8-10 July 1983.

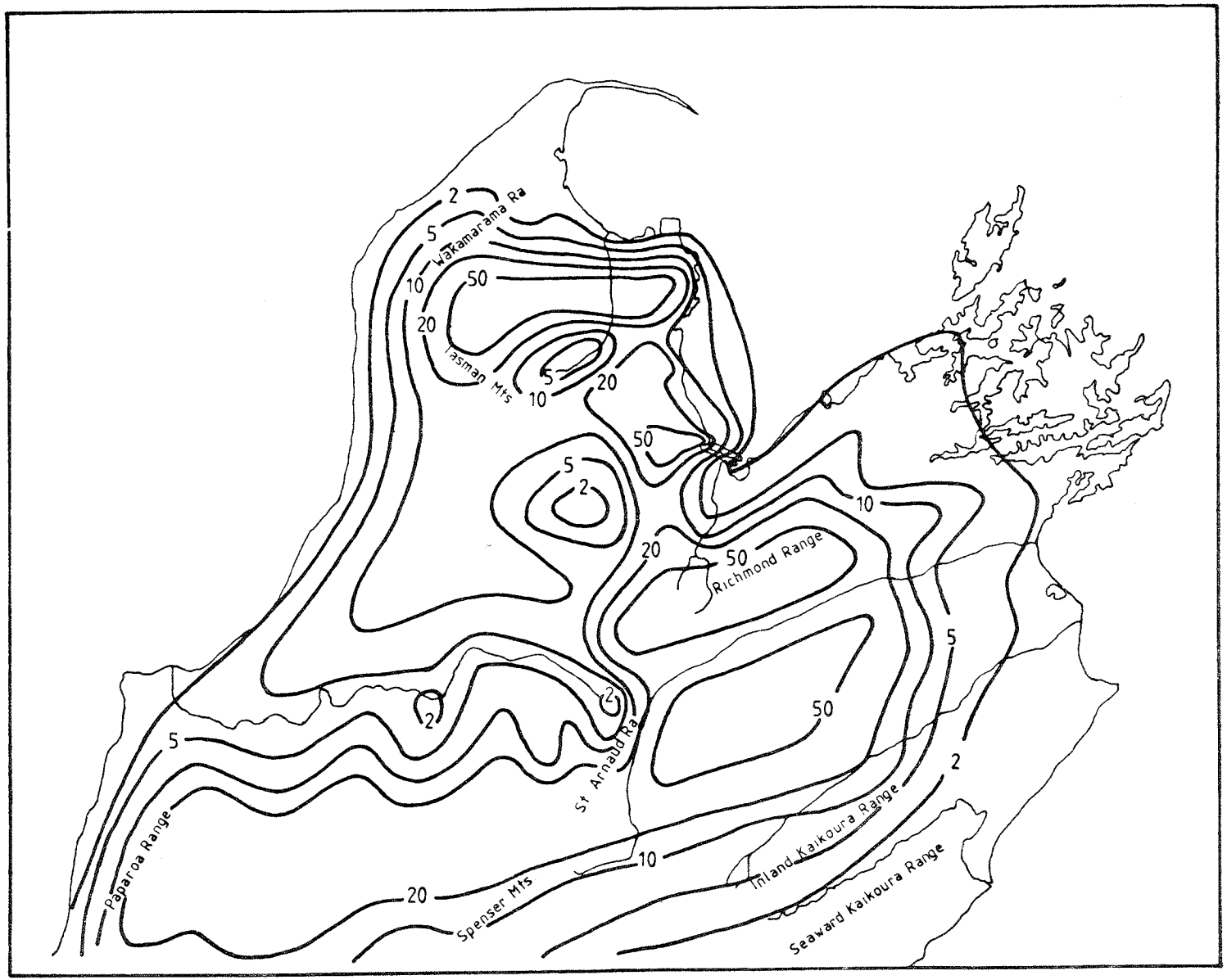

Fig. 11: Return period (years) of 24 hour rainfall, 9am July 8th to 9am July 9th 1983.

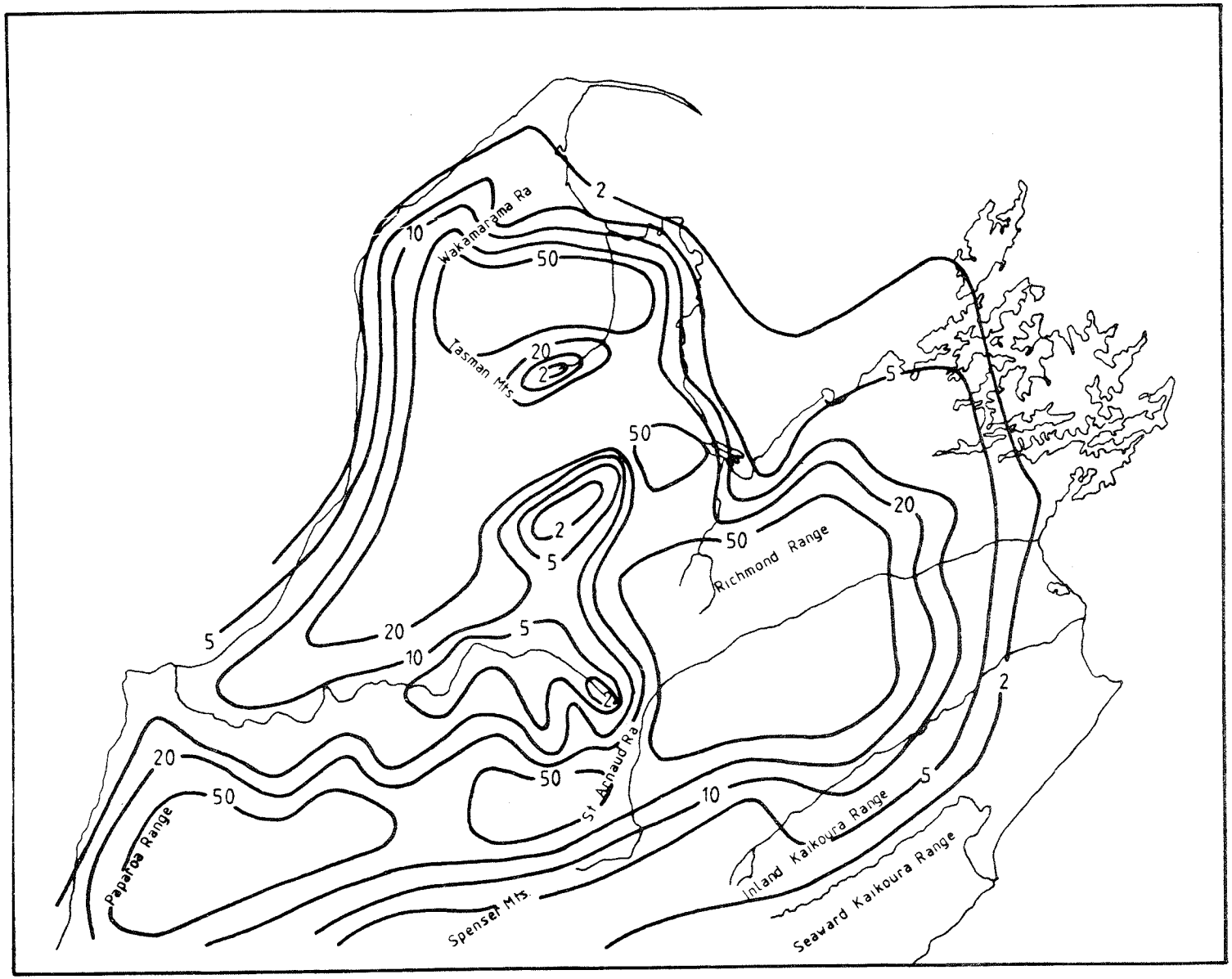

Fig. 12: Return Period (years) of 48 hour rainfall, 9am July 8th to 9am July 10th 1983.

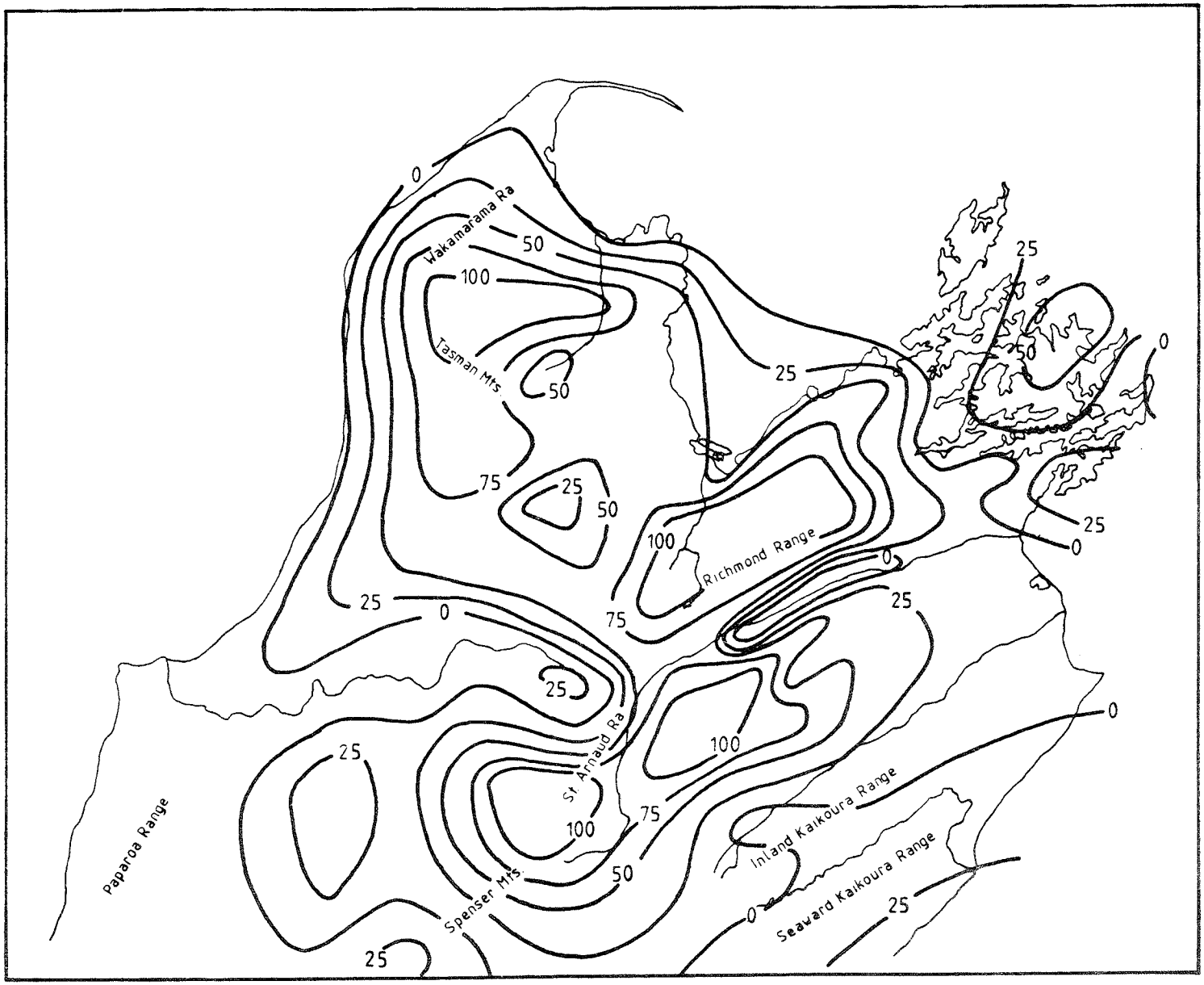

Fig. 13: 24 hour rainfalls of 9 July 1983 minus 24 hour rainfalls of 1 April 1975 (mm).

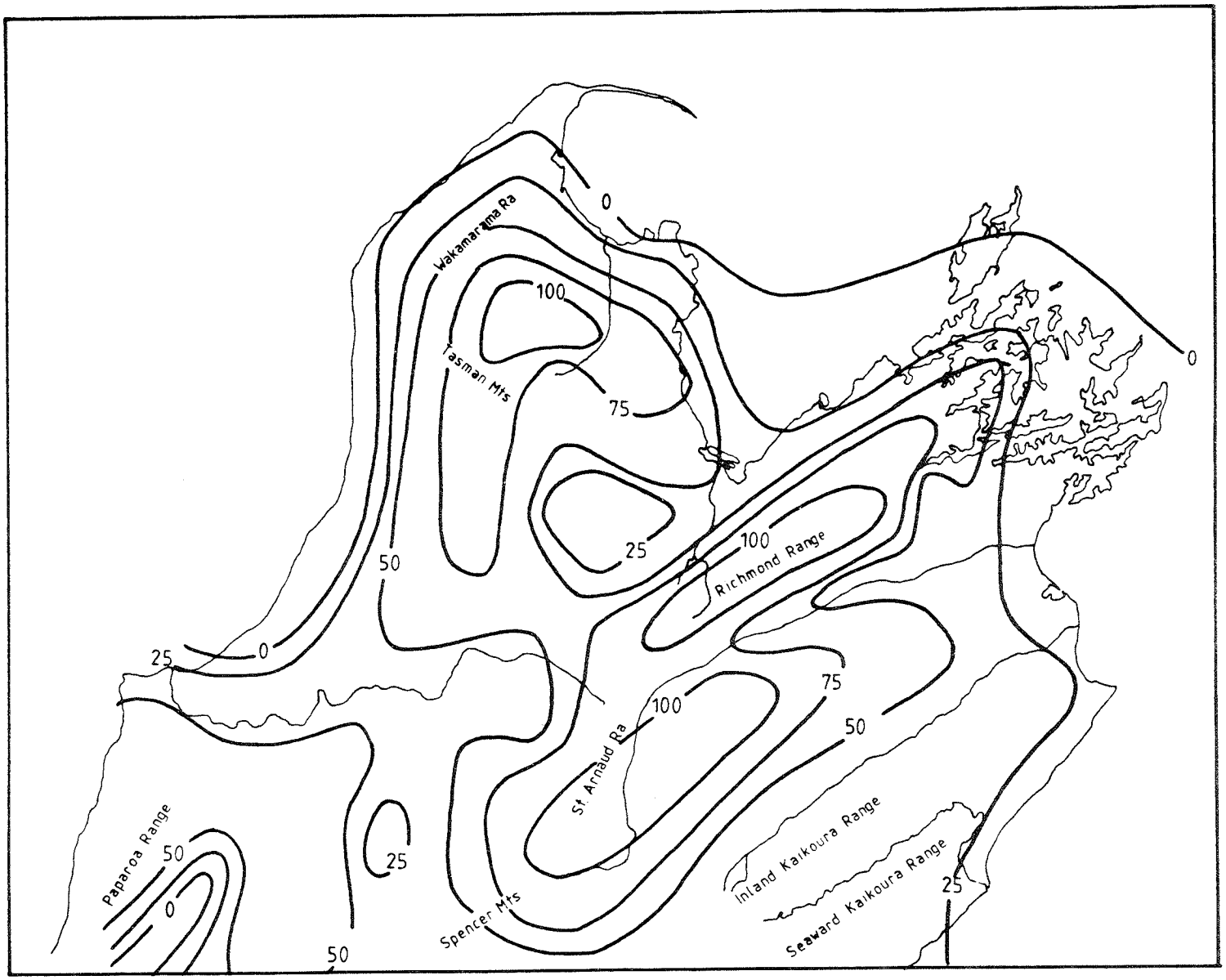

Fig. 14: 24 hour rainfalls of 9 July 1983 minus 24 hour rainfalls of 10 August 1967 (mm).

3.5 Snow Melt

Reports from several rainfall observers indicate that there was a rapid depletion of the extensive high country snow cover during the period of heavy rain. For example Molesworth Station reported on the 9th "much of the snow washed off hills and mountains, all gone off flats at station", and on the 10th "Much snow gone off hills".

Saturated ground, resulting from snow melt, would have permitted maximum runoff in high country areas and the melt water itself probably contributed significantly to the flooding.

3.6 Comparison with the Wairau River Flood of 1-2 April 1975

On April 1 1975 a flood with an estimated return period of 50 years occurred in the Wairau River. The Marlborough Catchment Board (Pascoe and Thompson, 1977) described this flood as ".... without doubt the greatest flow in the river since 1936, the earliest date from which continuous records of the river flows are available". The meteorological aspects of this flood have been described by Pascoe (1982).

A comparison of the 24-hour rainfalls, 9 July 1983 minus 1 April 1975, has been made (Fig. 13) in order to highlight differences in the distribution and intensity of rainfall between the two events. Rainfall differences along the Wairau Valley vary from area to area; the rainfall recorded at Wairau Valley on the 9th of July 1983 was 30mm greater than that on the 1st of April 1975, while those at Birch Hill and Onamalutu were 33mm and 19mm respectively lower than in the 1975 event. The surrounding high country on the other hand appears to have experienced some 100 mm more rain during the July 1983 floods.

3.7 Comparison with the Takaka Flood of 10 August 1967

Floodwaters at Takaka during July 9 and 10 1983 were reported to be 30cm deeper than in the area's previous worst flood, which occurred on August 10 1967. The 1967 flood was variously described at the time as "the worst and most damaging floods in (the region's) history" (1) and "the worst since the 1920s" (2).

Footnote

1. Nelson Evening Mail 11 August 1967

2. The Dominion 11 August 1967

Figure 14 shows the difference between rainfalls of 9 July 1983 and 10 August 1967. It is immediately apparent that the whole of the Takaka catchment received considerably more rain on 9 July 1983 than on August 10 1967, with totals at least 100mm greater being recorded in high country areas.

4. ECONOMIC IMPACTS OF THE FLOODS

The heavy rainfalls that occurred in the Nelson Bays/Marlborough area on the 8th and 9th of July, 1983, appear to have had little direct effect on economic activity, with most damage being due to the resultant flooding.

4.1 Direct costs of the heavy rainfalls

Despite the fact that both Nelson Bays and Marlborough are major horticultural areas, damage to crops from rain impact appears to have been minor. This can be attributed to the fact that these heavy rains fell in mid-winter when most plants are dormant.

As these heavy rains fell largely in the unfarmed high country, slope erosion was minimal on utilised land. The County Councils most effected by the heavy rains (Golden Bay, Waimea and Marlborough Counties) reported no major slipping on any of their roads, while neither the Ministry of Agriculture and Fisheries nor Catchment Boards report major slipping on farmland.

4.2 Indirect costs of heavy rainfalls

Flooding caused most of the damage and disruption resulting from these heavy rainfalls.

4.2.1 In-Channel flooding

Damage to dams, bridges, bridge approaches, river banks and stop-banks was extensive on all rivers in the Golden Bay, Waimea and Marlborough Counties. The Marlborough Electric Power Board reported extensive damage to the intake works on the Branch River power project, halting power generation temporarily. However, no damage to permanent works was reported.

Repairing bridges and bridge approaches constituted the main cost facing County Councils in the area (see Table 4). Flooding of smaller drainage channels resulted in damage to farm bridges and bank erosion. However, no dollar values are available for these items.

Table 4:

Costs to County Councils resulting from the floods of the 8th and 9th July, 1983, by general categories ($).

Golden Bay County Council		
Road, street and bidge repairs	150,000	
Civil Defence Emergency	12,000	
Total		162,000
Marlborough County Council		
Bridge and bridge approach repairs	246,000	
General road repairs	404,000	
Contingencies	56,000	
Total		706,000
Waimea County Council		
Bridge and bridge approach repairs	440,000	
Other	82,000	
		522,000
Total Cost to Councils		1,390,000

Damage to flood control systems in the two Catchment districts were assessed at:

Nelson Catchment Board District	2,173,282
Marlborough Catchment Board District	1,045,000
	3,218,282

The Nelson Catchment Board estimate that a further $1,123,000 of additional flood defence measures are necessary to remove weaknesses in their existing flood control systems.

4.2.2 Widespread flooding

The main costs to pastoral farmers were replacing stock, repairing fences and re-establishing pasture, while horticultural farmers faced high costs for replacing damaged crops and horticultural structures. Some horticultural farmers lost land (i.e. the land is no longer suitable for horticulture).

Total costs ($) to the farming sector of damage and stock losses (see also Table 5) are estimated at:

Nelson/Golden Bay	270,000
Marlborough	700,000
	970,000

Claims against the Earthquake and War Damage Commission (Table 6) will only recover the costs of damage to insured buildings and structures and thier contents.

The cost of relief activities during the Civil Defence emergencies was $15,000 while the Ministry of Agriculture and Fisheries spent an additional $9,000 on stock relief.

Table 5:

Stock losses during the floods of July 8th and 9th as reported to Ministry of Agriculture and Fisheries.

	Sheep	Cattle	Pigs	Goats	Deer	Horses	Total $ Value
Waimea/Golden Bay	1000	100	-	-	15	-	60,000
Marlborough	4400	100	1000	110	-	4	350,000
Total							410,000

Table 6:

The number and value of claims made against and processed by the Earthquake and War Damage Commission as at September 23, 1983.

	Total number of claims received	Average value ($) of claims paid out on as at 23.9.83	Estimate of total final payout ($)
Nelson	293	529	-
Marlborough	083	1,854	-
Total	476	-	600,000

4.3 Overall cost of the Floods

The total cost of the heavy rains of July 8th and 9th, 1983, is estimated at between 6 and 7 million dollars, as shown in Table 7. This, however, is only the measurable cost to the economy and does not include the opportunity costs involved in redirecting limited resources away from new projects to restoring existing activities.

Table 7:

Estimated total costs ($) of the heavy rains of July 8th and 9th 1983

Combined Catchment Board	3,218,000
Farming Sector (including stock losses)	970,000
Civil Defence Emergency	15,000
MAF stock relief	9,000
Combined County Council costings	1,390,000
Earthquake and War Damage Commission	600,000
Total estimated cost	6,202,000

5. Conclusion

Flooding in the Marlborough and Nelson - Golden Bay areas, as a result of the heavy rain of July 8 and 9 1983, was the most severe experienced by these regions in recent history. The total cost of the damage has been estimated at between six and seven million dollars.

Heavy rain occurred as a result of a very humid northerly flow being forced to ascend over the high country in Nelson Bays and Marlborough. The rain was prolonged and widespread, with rainfalls in high country areas exceeding the 50 year return period values, although return periods for rainfalls recorded in the more heavily populated areas were generally less than 10 years.

Melting snow on the high country during the weekend 9-10 July added significant quantities of water to the catchments and raised soil moisture levels, resulting in high runoff during the heavy rain.

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