



Wellington Regional Council

**Hydrology and
Meteorology of the
26 May 1998 Storm Event
for Wellington City**

**Resource Investigations Department
Technical Report**



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Meteorology of the
26 May 1998 Storm Event
for Wellington City**

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1. Introduction

This report summarises the hydrology and meteorology of the 26 May 1998 rainfall event in Wellington City. It gives an overview of the synoptic weather patterns leading up to the event, quantifies rainfall in terms of total rainfall, depth duration frequencies and isohyetal analysis, river flow that followed, and information on the tides at the time.

Together with previously recorded data, analyses have been carried out to give estimates of return periods for rainfall and river levels for the event.

Appendix 1 contains newspaper articles pertaining to the event from all newspapers around the region.

All times are given in New Zealand Standard Time

2. Synoptic Situation

Appendix 2 contains the synoptic weather maps for 25-26 May 1998 supplied by the New Zealand Meteorological Service. The following is a description of the maps:

Synopsis of Heavy Rain Event in Wellington, 25-26 May 1998

During 25 May a large complex low pressure system occupied the eastern Tasman. On its eastern side a mild humid north to northwest flow affected the North Island. A front in this flow had crossed the Wellington area by early morning of the 25th but was rather weak and was followed by a weaker northwest flow, still fairly humid and unstable though.

Meanwhile a new centre of the complex low formed southeast of Cook Strait during the early morning and the surface flow on the east coast of the South Island turned from easterly to southerly. The cool surface southerlies then encroached into Cook Strait and onto the Wellington area at about 6am.

The combination of cool moist southerlies near the surface pushing under the humid unstable northwesterlies created conditions for strong convection forcing, leading to development of embedded cumulonimbus cloud in a narrow slow moving band over Wellington. This gave rise to locally heavy rain about the Wellington City area from 6am to about 10am.

After that the southerly picked up in strength and the band of heavy rain cells weakened in activity and moved farther north. During the 4 hours of heavy rain, over 50mm fell at Kelburn and about 40 mm at Wellington Airport.

3. Rainfall

A period of rain occurred on Monday, 25 May 1998, between 2.00 pm and midnight. It was not heavy rain and had ceased over Wellington by midnight.

Rain started to fall over Wellington again on Tuesday morning, 26 May 1998, between 5.00 and 6.00 am. Heavy falls began at 5.00 am in Miramar, 5.10 am in Wellington City, and 5.30 am in Berhampore, Newtown, Hataitai and Karori. The heaviest falls in Tawa occurred between 7.00 and 7.40 am, although these were considerably less than those experienced elsewhere in Wellington.

Figure 1 shows the location of all automatic rainfall monitoring stations operated by the Wellington Regional Council (WRC) on behalf of the Wellington City Council (WCC) within Wellington City plus two operated by the National Institute of Water and Atmospheric Research (NIWA) at Kelburn and Wellington. Table 1 lists the station details.

Table 1: Rainfall Monitoring Stations

Catchment	Site	Site No.	Map Reference	Start of Record	Recording Interval (mm)	Recording Authority
Porirua	Wayne's Mistake	141813	R27:665020	28/03/84	15	WRC
Porirua	Tawa Pool	141816	R27:635021	29/08/96	5	WRC
Karori	Karori Reservoir	142701	R27:567892	1879	5	WRC
Kelburn	Kelburn	142702	R27:580899	14/04/55	0	NIWA
City	Regional Council Centre, Wakefield Street	142720	R27:589892	26/07/96	5	WRC
Khandallah	Library	142721	R27:601939	29/08/96	5	WRC
Karori	Duthie Street	142722	R27:562898	08/10/90	5	WRC
Porirua	Seton Nossiter Park	142811	R27:623981	07/07/92	5	WRC
Berhampore	Berhampore Nursery	143706	R27:583856	29/07/96	5	WRC
Newtown	Mansfield Street	143707	R27:591862	11/09/96	5	WRC
Hataitai	Old Post Office	143708	R27:602877	25/02/97	5	WRC
Rongotai	Airport	143807	R27:614852	01/04/60	60	NIWA
Miramar	Library	143813	R27:620862	17/09/96	5	WRC

All WCC rain gauges operated by the WRC record data at five minute intervals. These gauges are all 2 mm tipping bucket types, meaning they record rainfall in 2 mm blocks. The Wayne's Mistake rain gauge is a 5 mm tipping bucket and records at 15 minute intervals.

The Kelburn data is digitised from continuously recording charts. The data is referred to as a *break point* data as it does not have a threshold, e.g., 2 mm for WCC/WRC rain gauges, before rainfall is registered.

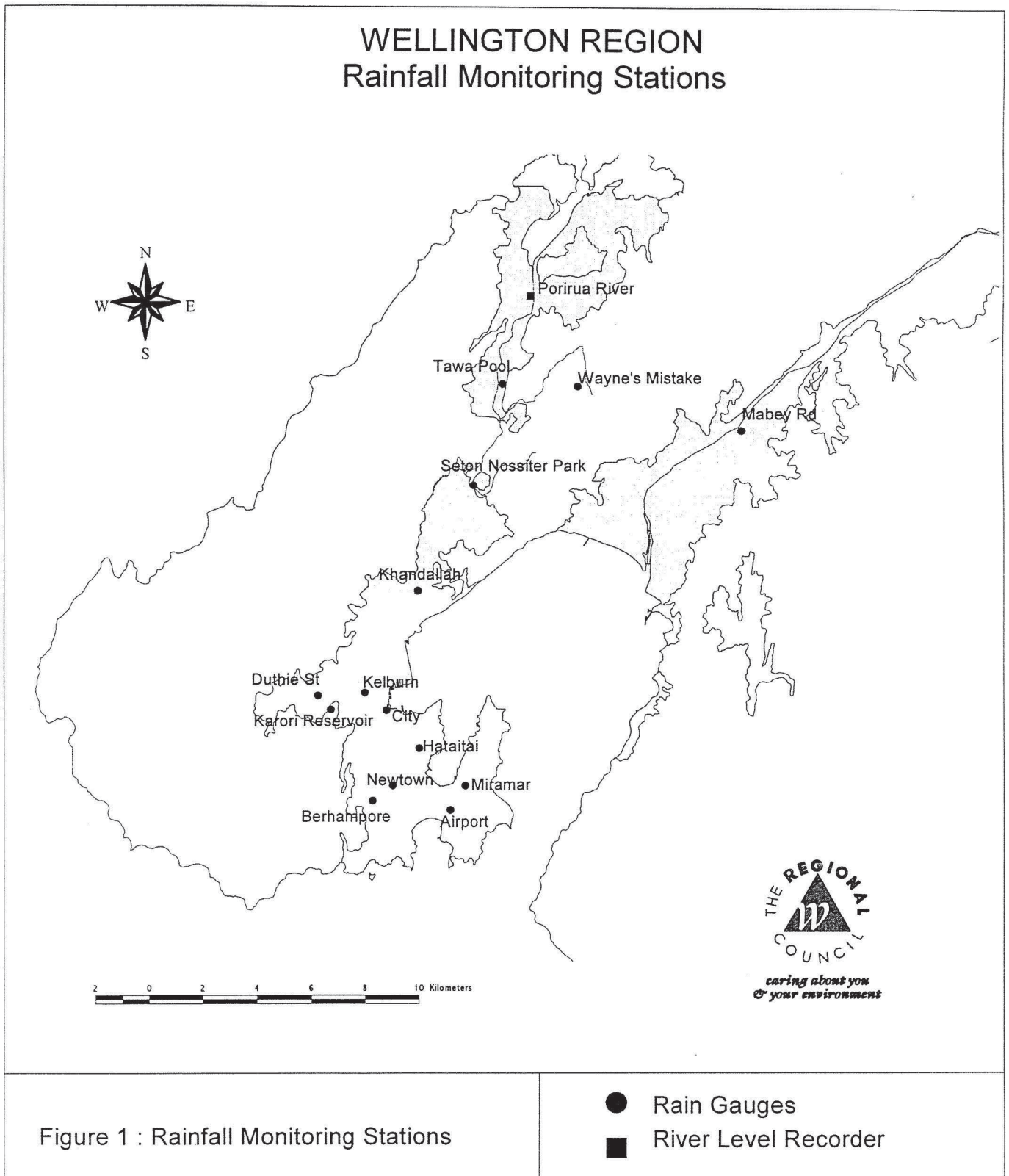


Figure 1 : Rainfall Monitoring Stations

- Rain Gauges
- River Level Recorder

3.1 Daily Rainfall

Daily rainfall depths were derived for each rainfall station for 25 to 26 May 1998 (Table 2).

Table 2: Daily Rainfall Depths (mm)

Station	25/05/98	26/05/98
Tawa Pool	11.4	15.6
Seton Nossiter Park	10	16.8
Wayne's Mistake, Porirua	N/A	N/A
Khandallah Library	N/A	N/A
Duthie Street, Karori	8.4	61.6
Karori Reservoir	8.	54.6
Kelburn	8.2	73.9
Mansfield Street, Newtown	7.4	49.4
Berhampore Nursery	8.2	46.6
Hataitai Old Post Office	6.8	80.8
Miramar Library	5.6	74.0
Regional Council Centre, Wakefield Street, City	5.6	70.0
Wellington Airport	7.8	53.0
Avalon, Mabey Road	4.9	14.1
Wainuiomata, Skull Gully	5	25.5
Waikanae	7.5	27

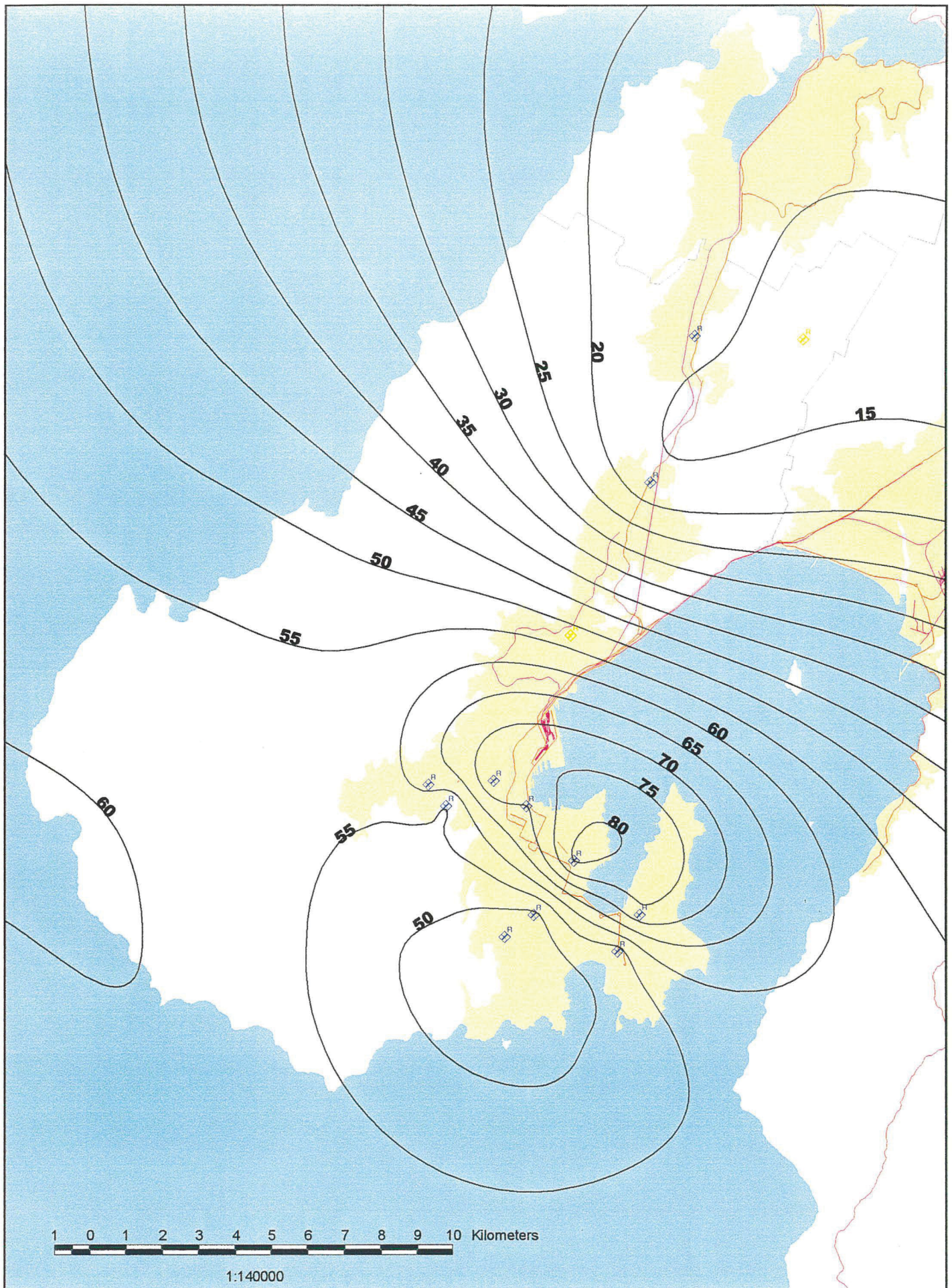
Table 2 clearly shows the amount of rainfall that fell on Tuesday, 26 May, over Wellington City.

The Seton Nossiter Park (Paparangi) and Tawa Pool rain gauges recorded relatively low daily totals of 16.8 mm and 15.6 mm respectively. All Wellington City rain gauges south of these recorded high daily totals. The Khandallah and Wayne's Mistake rain gauges were out of operation at the time of the event and consequently no data was recorded.

The highest daily rainfall was 80.8 mm recorder at the Hataitai gauge. The Miramar Library gauge collected 74 mm, whilst between the two, at Wellington Airport, 53 mm was recorded.

73.9 mm was recorded at the Kelburn rain gauge.

Figure 2 shows the rainfall isohyets at 5 mm intervals for the 24 hour total on 26 May 1998 over Wellington City. From the isohyets it is evident that the major rainfall concentration was over the Hataitai and Roseneath areas spreading out to Miramar to the east and Kelburn to the west. A very steep gradient from high to low intensities occurred from the city rain gauges out towards Seton Nossiter Park and Tawa Pool.



- Railway lines
- Main roads
- Urban areas
- TA boundary
- 5mm rainfall contour (26/05/98)
- Rainfall gauge site



Figure 2. Daily Rainfall Isohyets for 26 May 1998

In comparison to the 4-5 October 1997 storm event the rainfalls recorded were higher for Wellington City. However, the October 1997 event produced heavy rainfall over a far larger area than this event which was concentrated around the central Wellington City area.

Table 2 also lists rainfall totals at Avalon, Wainuiomata and Waikanae as a comparison.

3.2 Hourly Rainfall

Table 3 breaks the daily totals for the 26 May 1998 event into hourly figures. The critical hours in terms of rainfall intensity were between 5.00 am and 7.00 am. The Hataitai gauge recorded 30.6 mm in the hour between 5.00 am and 6.00 am, and 27.6 mm in the hour from 6.00 am to 7.00 am.

Also of note are the totals of 29.6 mm and 28.2 mm for Miramar and the City gauges respectively between 5.00 am and 6.00 am.

All the WCC rain gauges maintained by the WRC record rainfall totals at five minute intervals. The maximum rainfall over five minutes was 7.6 mm at the Hataitai gauge in the five minutes to 6.50 am.

In the 20 minutes to 6.05 am at the Miramar gauge 20.6 mm of rain fell. For the same 20 minute period of intense rainfall 19.4 mm was recorded at the Hataitai gauge.

Appendix 3 contains the rainfall plots at five minutes intervals for all rain gauges.

Table 3: Hourly Rainfall Totals, 26 May 1998

Station	5.00- 6.00 am	6.00- 7.00 am	7.00- 8.00 am	8.00- 9.00 am	9.00- 10.00 am	10.00- 11.00 am	11.00- 12.00 pm	12.00- 1.00 pm	1.00- 2.00 pm	2.00- 3.00 pm	3.00- 4.00 pm	Daily Total
Tawa	1.0	2.0	4.8	1.4	0.4	0	1.6	1.8	0.4	0.6	0.2	15.6
Seton Nossiter Park	0.4	4.8	2.4	2.6	0.6	0.6	1.8	1.6	0.8	0.2	0	16.8
Karori Reservoir	14.0	18.8	3.2	2.6	3.8	1.6	4.8	2.0	1.8	0.8	0	54.6
Duthie Street	24.6	15.2	2.4	2.8	3.6	2.6	5.2	2.4	1.8	0.6	0	61.6
Kelburn	23.4	28.2	4.6	3.1	2.7	1.6	4.2	1.8	1.4	0.8	0.1	73.9
Newtown	9.8	18.2	4.4	2.8	4.4	2.4	3.8	1.4	1.0	0.6	0.2	49.4
Berhampore	5.4	19.6	4.4	2.8	4.4	2.6	3.2	1.4	1.2	0.6	0	46.6
Hataitai	30.6	27.6	3.0	3.4	4.0	1.6	4.2	1.2	1.0	0.4	0.2	80.0
Miramar	29.6	16.4	8.2	3.0	3.4	2.4	3.6	0.8	0.8	0.4	0.2	74.0
City	28.2	20.2	3.4	4.2	2.6	1.4	4.8	1.2	1.4	0.4	0	70.0
Airport	9.6	19.6	7.2	2.8	3.6	2.6	3.8	1.4	1.2	0.8	0	53.0

3.3 Rainfall Depth Duration Frequency

Rainfall depth duration frequency analyses were carried out for all stations with sufficient length of record. One, two, six, twelve, and 24 hour moving durations were analysed using the EV1 distribution and the L moments method of fitting (Table 4). The EV1 distribution has been shown as statistically correct for the modelling of high intensity rainfalls in New Zealand. The L moments method of fitting is superior to other estimation techniques and is regarded as the most accurate method used at present.

A moving average technique is used to find the maximum rainfall for a given duration. For example, rather than taking the daily total of 54.6 mm starting and ending at midnight for Karori Reservoir, the maximum moving depth for 24 hours is 62 mm.

The stations at Tawa Pool, Duthie Street, Mansfield Street, Berhampore, Hataitai and Miramar have insufficient data to estimate frequencies.

Karori Reservoir data from 1984 is used for the frequency analysis to derive return periods. Seton Nossiter Park has record from 1992, Kelburn from 1955 and Wellington Airport from 1960.

When compared to previous literature, particularly a report by Coulter and Hessell (1980) titled *The Frequency of High Intensity Rainfalls in New Zealand*, the results obtained by the L moments method using current data is considered superior. Often the results calculated are comparable to Coulter and Hessell estimates although some differences are found at the high return periods.

Some limitations of the Coulter and Hessell estimates are given in the 1995 WRC report titled *Rainfall Intensities and Run-off Estimates for Culvert Design in Wellington City* prepared for the WCC.

Some discrepancies may exist between return period tables in this report and those reported in the news media. Figures given in news reports are often provisional as no data checking will have taken place at the time. The figures are usually quoted by the Met Service reading from estimate similar to those of Coulter and Hessell. The estimates given here by WRC are obtained by the current accepted method by staff trained in the hydrological sciences.

Rainfall totals given here are included in the frequency analysis and if large enough have the effect of reducing the return period. This will yield a lower result than when the total is applied to a return period that has not taken account of this.

Table 4: Maximum Moving Duration/Depths Return Periods (years)

Duration	1 hr	2 hr	3 hr	6 hr	12 hr	24 hr
Tawa Pool Total (mm)	5	7	8.8	10.8	18	26.6
Seton Nossiter Park Total (mm)	4.8	7.4	9.8	13	16	25.8
Return Period (years)	<1	<1	<1	<1	<1	<1
Karori Reservoir Total (mm)	27.4	34.2	36.8	46.0	53.6	62
Return Period (years)	8	5	4	4	3	<2
Karori, Duthie Street Total (mm)	31.2	40.8	42.6	52.4	61.4	69
Kelburn Total (mm)	37.0	52.4	56.3	64.1	72.1	79.8
Return Period (years)	51	89	55	14	5	2
Berhampore Nursery Total (mm)	19.6	27.2	30.6	40.4	45.6	53.6
Newtown, Mansfield Street Total (mm)	19.8	29.6	32.8	42.8	49.0	56.2
Hataitai Total (mm)	35.0	59.0	64.4	73.2	80.6	87.2
Miramar Total (mm)	33.6	49.2	58.6	67.2	73.8	79.2
Wellington Airport Total (mm)	19.6	29.2	36.4	45.4	52.6	59.0
Return Period (years)	4	4	5	3	2	<2
City, Regional Council Centre, Wakefield Street Total (mm)	32.4	48.4	52.4	60.4	68.8	74.4

From the sites with enough data record for frequency analysis to be completed it can be seen that the Kelburn station recorded a significant event. A rainfall event with a return period of 51 years was experienced for the 1 hour duration, an 89 year return period over the two hour duration, a 55 year return period over the 3 hour duration, and return periods of 14, 5 and two years for the longer durations of 6, 12, and 24 hours respectively.

This is a significant amount of rainfall at the Kelburn gauge which has data record beginning in 1955. The two hour duration total is especially significant and is the highest since records began. The rainfall totals for the 1, 2 and 3 hour durations were very similar to the 8 November 1994 event with less than 1 mm separating the totals for the respective events.

The Karori Reservoir station received rainfall amounts equating to return periods of 8, 5, 4, 4, 3 and 2 years for the 1, 2, 3, 6, 12 and 24 hour durations respectively.

The Wellington Airport station received rainfalls of 4, 4, 5, 3, 2 and 2 year return periods for the 1, 2, 3, 6, 12 and 24 hour durations respectively.

Seton Nossiter Park experienced less than an annual event, emphasising the fact that the rainfall event was most severe over the southern half of Wellington City.

At the time of writing this report (July 1998), the totals recorded at the Hataitai and Miramar sites for this event for all durations are the highest since records began. For the City rain gauge the totals over all durations are only the second highest recorded. They were exceeded by the 26 June 1998 event. The Newtown and Berhampore totals for the 1, 2 and 3 hour durations are the largest on record but the 6 hour duration totals fall behind the 26 June 1998 event, and for the longer durations rank only fourth largest.

Given the return periods experienced at Kelburn, Karori and the Airport, and the totals recorded at others gauges around the city, the rainfall event of 26 May 1998 was a significant one at the short durations.

4. River Flow

Peak flow, time and return period are given in Table 5 for the Porirua at Town Centre flow station. Location of the flow station is shown in Figure 1.

Table 5: River Stations and Peak Flows Recorded on 26 May 1998

River	Station	Time of Peak	Peak Stage (m)	Peak Flow (m ³ /s)	Est. Return Period (yrs)
Porirua	Town Centre	083000	0.582	5.04	<1

The peak flow recorded at the Porirua flow station of 5.04 m³/s was not a significant flow, being less than an annual event, and is evidence of the small amount of rain that fell in the Porirua catchment as shown in the Tawa Pool and Seton Nossiter Park rain gauge record.

Figure 3 shows the flow hydrograph for the Porirua Stream for 26 May 1998 and the rainfall recorded at the top of the catchment at the Seton Nossiter Park rain gauge.

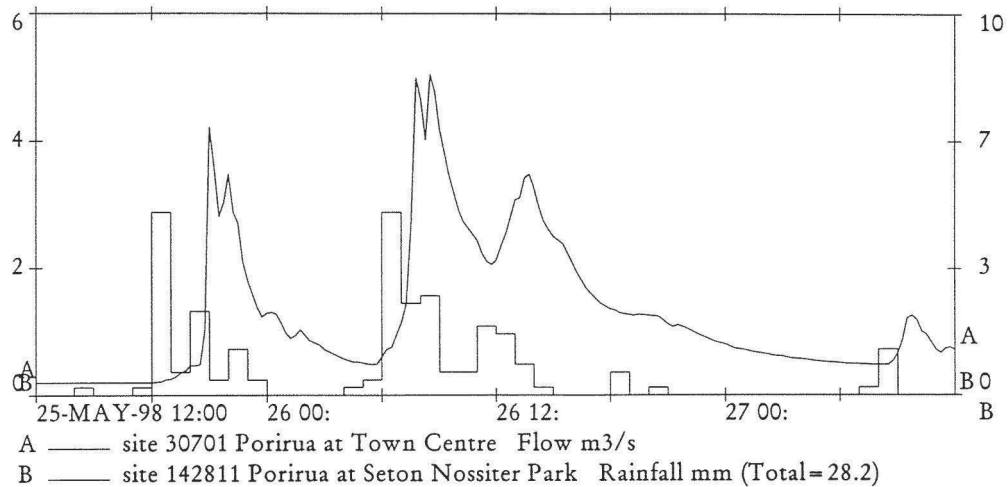


Figure 3: Flow Hydrograph for Porirua Stream at Town Centre

5. Tide Levels

Figure 4 shows the tidal cycle as recorded at the WRC Queen's Wharf tide level monitoring station. Rainfall at Kelburn is overplotted on the tide plot to illustrate when the rainfall occurred in relation to the tide level.

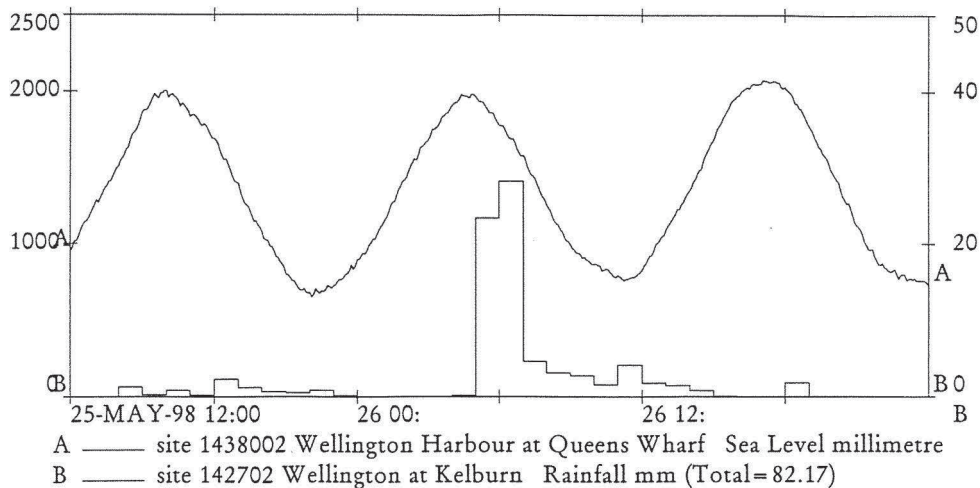


Figure 4: Tide at Queen's Wharf and Rainfall at Kelburn

The plot begins on 25 May 12.00 pm. The X axis is marked in six hour intervals.

The two high tides on 26 May 1998 were at 4.50 am and 5.05 pm. The high tide of 5.05 pm was the highest tide recorded for the year so far reaching a maximum of 2.074 m in terms of Admiralty Chart Datum.

The heaviest falls of rain occurred after the morning high tide at 4.50 am.

**Appendix 1:
Newspaper Articles**

Information Services Newspaper Clippings

Source: Evening Post

Date: 27 May 1998

Page: 3

File No:

Floods aid might suffer – firefighter

By NEIL REID and REBECCA WALSH

Firefighters would find it a struggle to help flood victims if proposed restructuring of the Fire Service was introduced, says a senior Wellington firefighter.

Fire crews from as far away as Porirua were sent to central Wellington and the eastern suburbs after a deluge of rain caused flash floods throughout the Capital yesterday.

Worst hit was Ira St in Miramar, where several houses were flooded and one family had to evacuate.

Kilbirnie senior firefighter Jason Brinck said had the crews operated with the proposed crew size of three officers – instead of the current four – they would have struggled to control the flood and help residents.

"If we had been cut to three people we wouldn't have been able to help everyone as we did," Mr Brinck said.

But Arapawa Fire Region commander Rod Nightingale said the proposed "modernisation" of the Fire Service would allow local fire chiefs more flexibility to change crew sizes to match the seriousness of incidents.

"If that necessitates sending additional resources then that will occur," Mr Nightingale said.

Ira St resident Gertruda Knap today recalled how she looked on in horror as flood waters seeped into her uninsured Miramar house for the second time in four years yesterday.

Mrs Knap and her two sons were evacuated from their house after firefighters feared residents could be electrocuted in ankle-deep water.

"I thought, 'Oh no, lots of work again'," Mrs Knap said.

"We don't have insurance for contents, our carpet has been damaged. We're not sure if the dishwasher or the washing machine work either."

Yesterday's flooding prompted a string of claims to insurance companies.

State Insurance communications manager Jackie Curtis said a number of claims had been filed for damage to carpets and four for flooded cars.

Other insurance companies reported between half a dozen and a dozen claims for flooding and water damage to Miramar and Strathmore houses.

Miramar South School principal Jeanette De La Mare said it would cost thousands of dollars to repair flood damage at the school, closed yesterday after the administration area and staff room were flooded by about 60mm of water.

Wellington City Council spokesman Richard MacLean said yesterday's rain would enable the council to complete a study on water flows through stormwater drains in the Miramar-Strathmore area.

The council had installed water-flow monitoring devices six months ago after the area was identified as a risk area. The figures would be used to assess whether the current system was adequate.

Meanwhile, Wairarapa drought coordinator Vic Rosenbrook said although about 30mm of rain had fallen it was not enough to end the drought.

Information Services Newspaper Clippings

Source: The Kapiti Mail

Date: 28 May 1998

Page: 3

File No:

Flooding follows heavy rain storm

by Lindsay Rabbitt

Tuesday's heavy rain had KCDC staff rushing to different locations around Paraparaumu in an attempt to minimise flood damage to properties.

Even Mayor Brett Enbler donned his yellow KCDC-issue raincoat and raced round in the mayoral car to keep a paternal eye on things.

Repco Auto Parts showroom on Kapiti Road was in danger of being flooded after a blocked pipe caused the parking area to be flooded.

Four houses sustained water damage,

with three being minor, but water went right through a house in Nathan Avenue.

KCDC stormwater engineer Blair Murray said the house is on a low-lying property and has had problems in the past and that the carpark in Kapiti Road was owned by local property developers Ballinger Ltd.

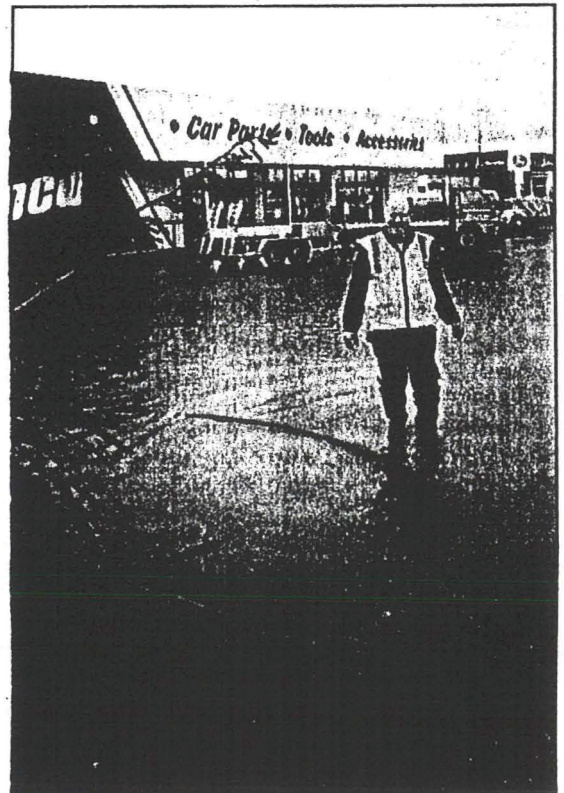
Mr Murray Ballinger, of Ballinger Ltd, said the drain is not coping with the recent heavy downpours and they would have to do something about it long term.

Mr Murray said that the nature of the rainfalls in the region are changing, with the high dura-

tion of the rains causing problems.

He said at the rainfall's peak (10-11am) 8mm fell in four minutes.

He said there are five pumps in the Paraparaumu floodwater system and that most problems occurred in the gravity-fed system. The system was updated in 1989 to cope with a one-in-ten flood scenario. Problems are also compounded if heavy rain coincides with high tide, when stormwater is pushed back up the pipes.



A KCDC worker pumping water from a blocked drain in the carpark outside Repco in Kapiti Road during the heavy rains on Tuesday.

Information Services Newspaper Clippings

Source: Cook Strait News

Date: 1 June 1998

Page: 1

File No:

Tears over flooded drain

By KATHRYN O'SULLIVAN

Strathmore resident John Lyons is fed up with drain water overflowing onto his property.

For the past ten years Mr Lyons has taken time off work, a couple of days every year, to clean up his property after heavy rain.

On Monday water flooded up to his back step and rubbish from the Wellington City Council drain was deposited on his section.

"I was in tears this morning when I had to take another day off to clean up," says Mr Lyons.

The drains fill up with rubbish and when it rains they overflow down his driveway, flooding the property.

When rain began to brew on Monday night, Mr Lyons went out to the street drains and picked up paper, cans and plastic containers - enough to nearly full a recycling bin.

"Council workers have assessed the drain and have told me it is too small. This has been happening for ten years, however, nothing has been done."

Mr Lyons says that over the years, he has been promised everything from the council, he is now "fed up to the neck" of city council water on his property.

He is now desperate for the council to fix the problem.

City Council drainage maintenance contract manager Kevin Armstrong says Mr Lyons needs to write a letter to the council to say the drain is an on-going problem.

"If there is a problem we are happy to look into it," he says.

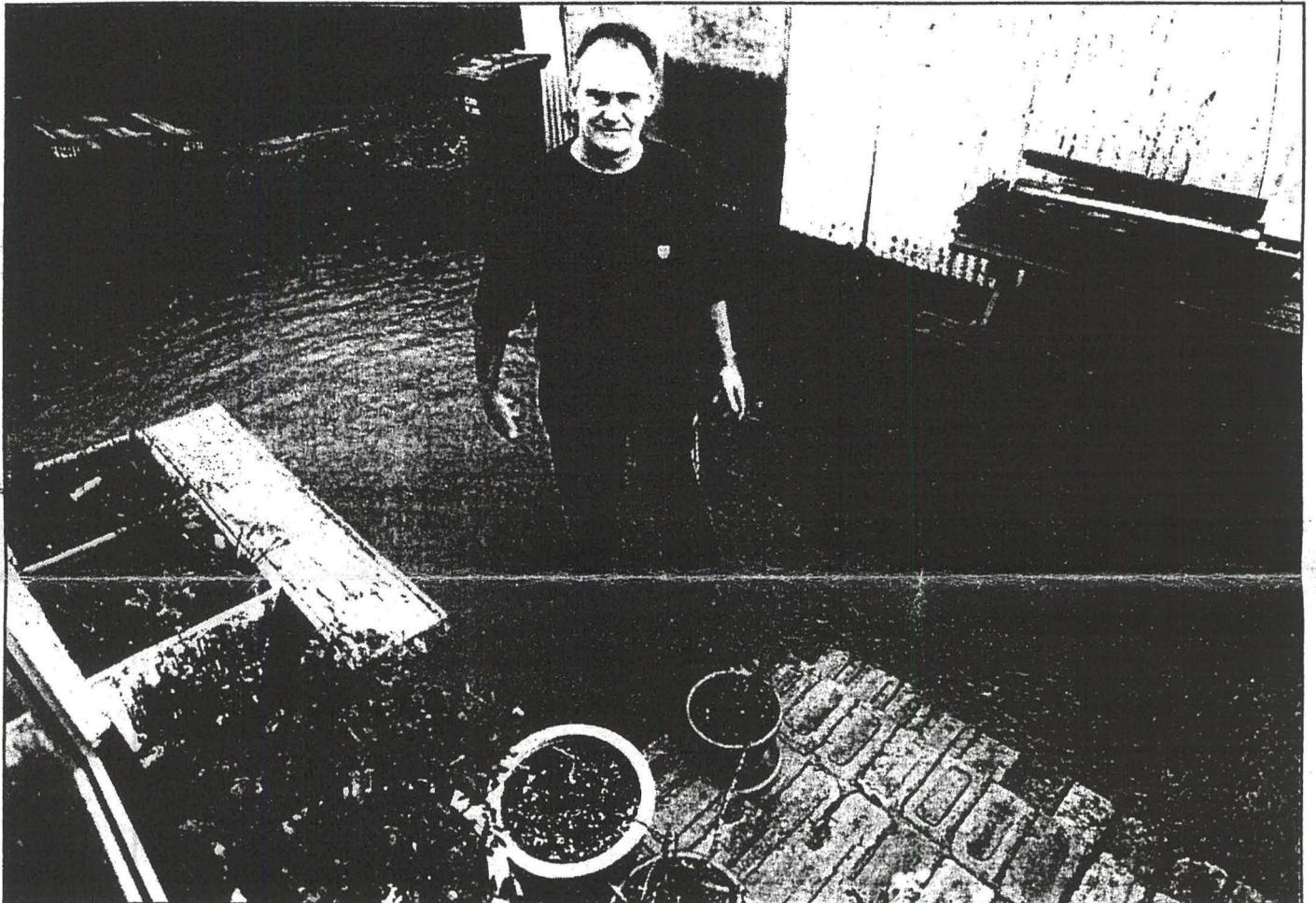
Mr Armstrong says it is hard to determine if the sump or the drain is a problem until he sees it.

Eastern Ward councillor Ruth Gotlieb says people in her ward are not able to get past the council's reception to lodge their complaints. She says there is a lack of monitoring to see if complaints are followed up.

"It is very sad to see things at the council are not working at the moment."

Mrs Gotlieb says she has spoken to Mr Armstrong and he has now seen the drain.

He will now find out what the problem is and will come back to her in two weeks, says Mrs Gotlieb.



A WET TIME OF IT - Drain water has reached Mr Lyons doorstep and he is now desperate for the council to fix the problem.

Information Services Newspaper Clippings

Source: Evening Post

Date: 8 June 1998

Page: 2

File No:



FED UP – Strathmore resident John Lyons is fed up with bailing water off his property.

Picture: PHIL REID

Ten years of floods anger ratepayer

By REBECCA WALSH
Civic reporter

A Strathmore man whose property was flooded during recent heavy rainfall says he has been trying to get Wellington City Council to improve the area's drainage for the past 10 years.

John Lyons is fed up with bailing water out of his property and fed up with the council, which he says acknowledges there's a problem but hasn't done anything about it.

The situation has caused Eastern ward councillor Ruth Gottlieb to question whether the council employs enough staff to monitor complaints.

But council spokesman Richard MacLean said the council was investigating the problem. It believed it had good emergency and complaint monitoring systems in place and was keen to hear about cases that were "falling through the cracks".

For the past decade Mr Lyons' property has flooded at least once a year during heavy rain. Each time he has taken time off work to clean up the mess, and complained to the council, which has promised to do something about it, but nothing has happened.

"... it goes right through my property, my veggie garden, my lawns. It's absolutely disheartening."

Mr Lyons didn't want compensation. "I want it fixed so it doesn't happen next year."

After the recent downpour, which flooded properties in Miramar, Mr Lyons received a letter from the council saying it would investigate the cause of the flooding and possible improvements. It was the first time he had received a letter acknowledging the situation.

Mr Lyons believed drains were too small to cope with the amount of rain during a heavy downpour and they were often blocked with rubbish.

Council drainage maintenance contract manager Kevin Armstrong said the problem was being investigated.

"It's urgent. If it's been

flooded more than once, or once in fact, it's something we need to be concerned about."

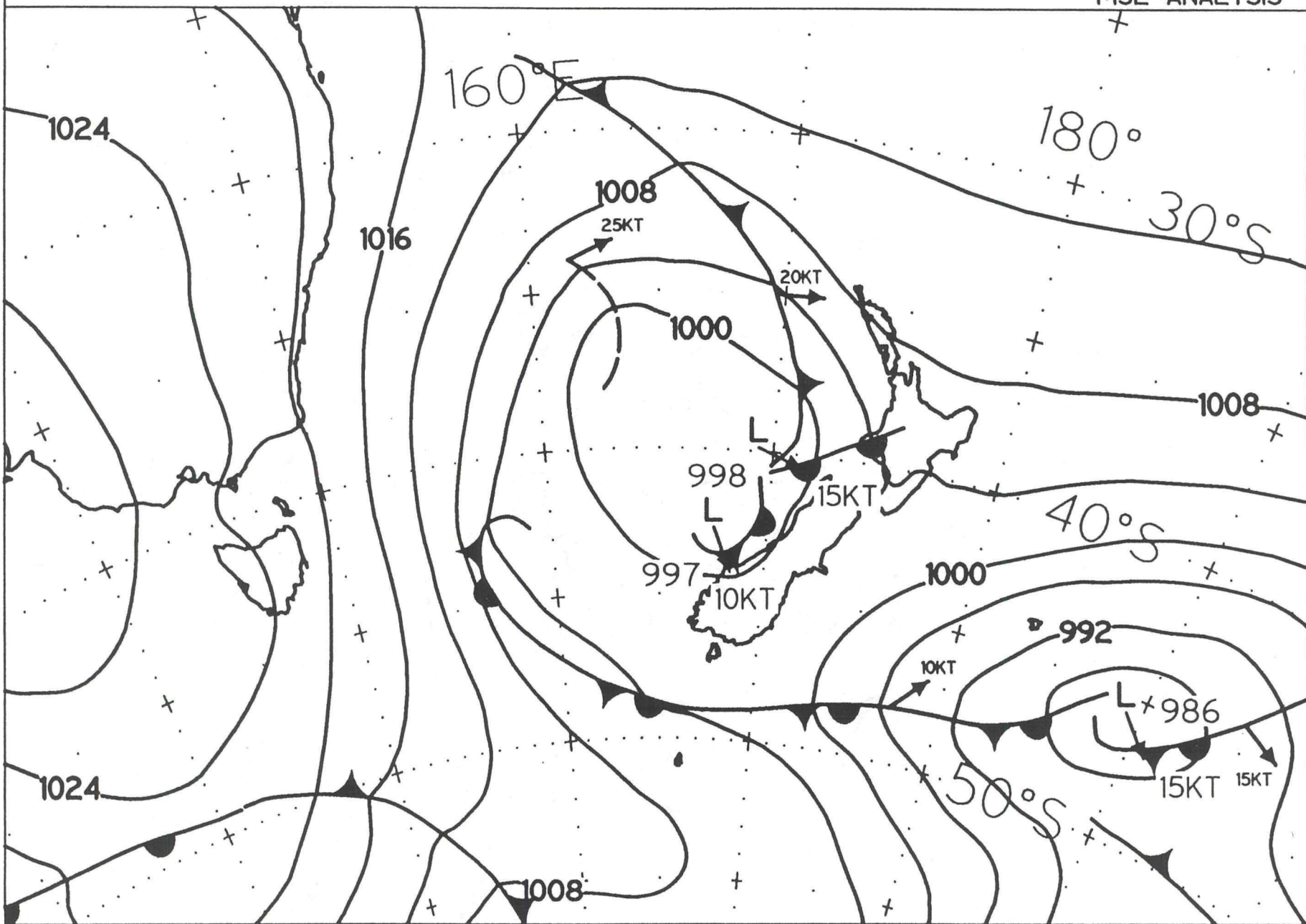
Asked whether the council response was good enough, Mr MacLean agreed 10 years was a long time for the problem to go on but said the council was looking into stormwater flows in the area.

During the recent downpour the council received 148 calls about blocked drains, flooding and slips. The time between the council logging the calls and the problem being resolved ranged from nine minutes to two hours and 22 minutes.

Mr MacLean said work had to be prioritised and the council was pleased with the response times.

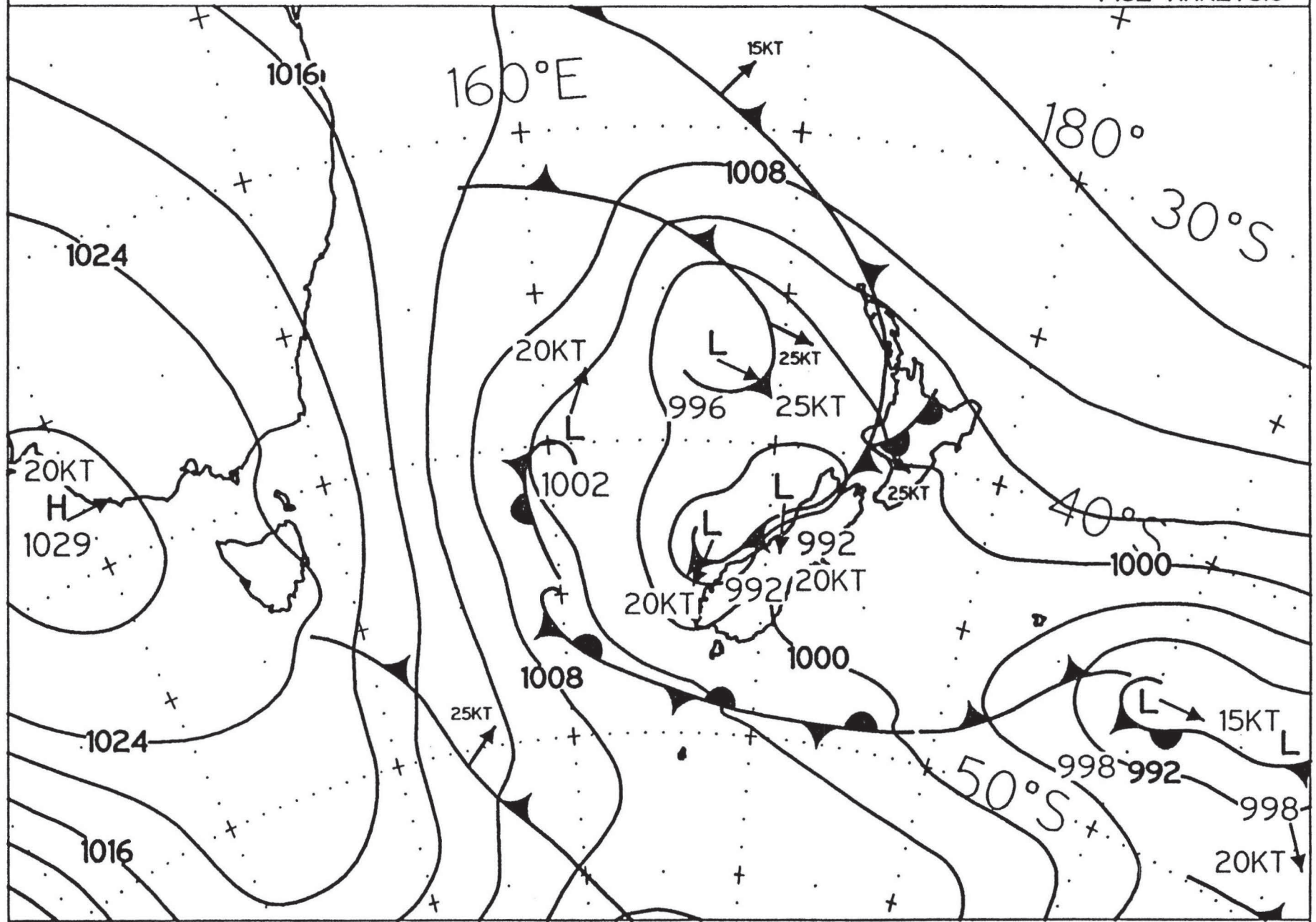
**Appendix 2:
26 May 1998 Synoptic Weather Maps**

Times are given in GMT. Add 12 hours for NZST



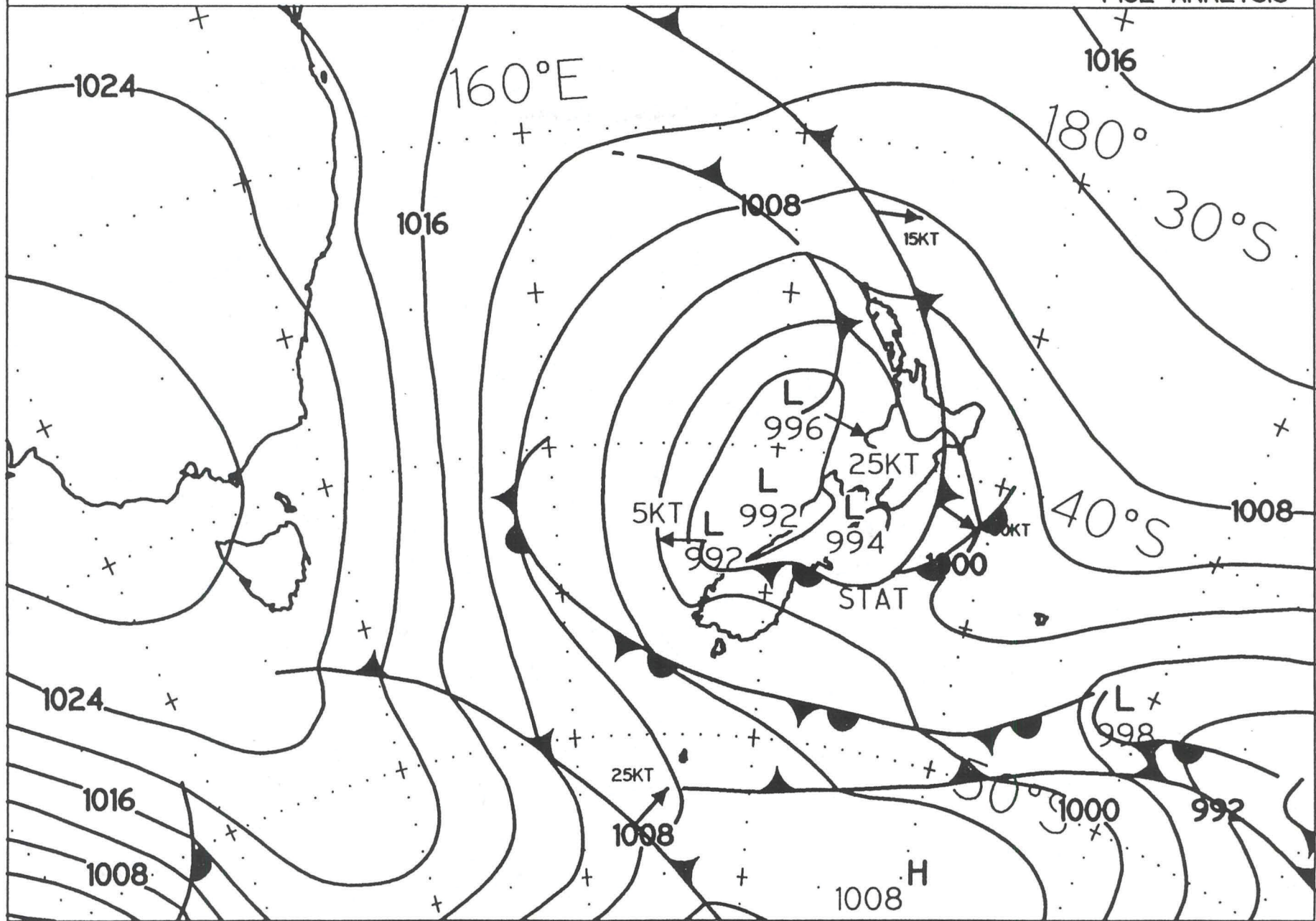
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ISSUED 0213 25-MAY-1998 UTC



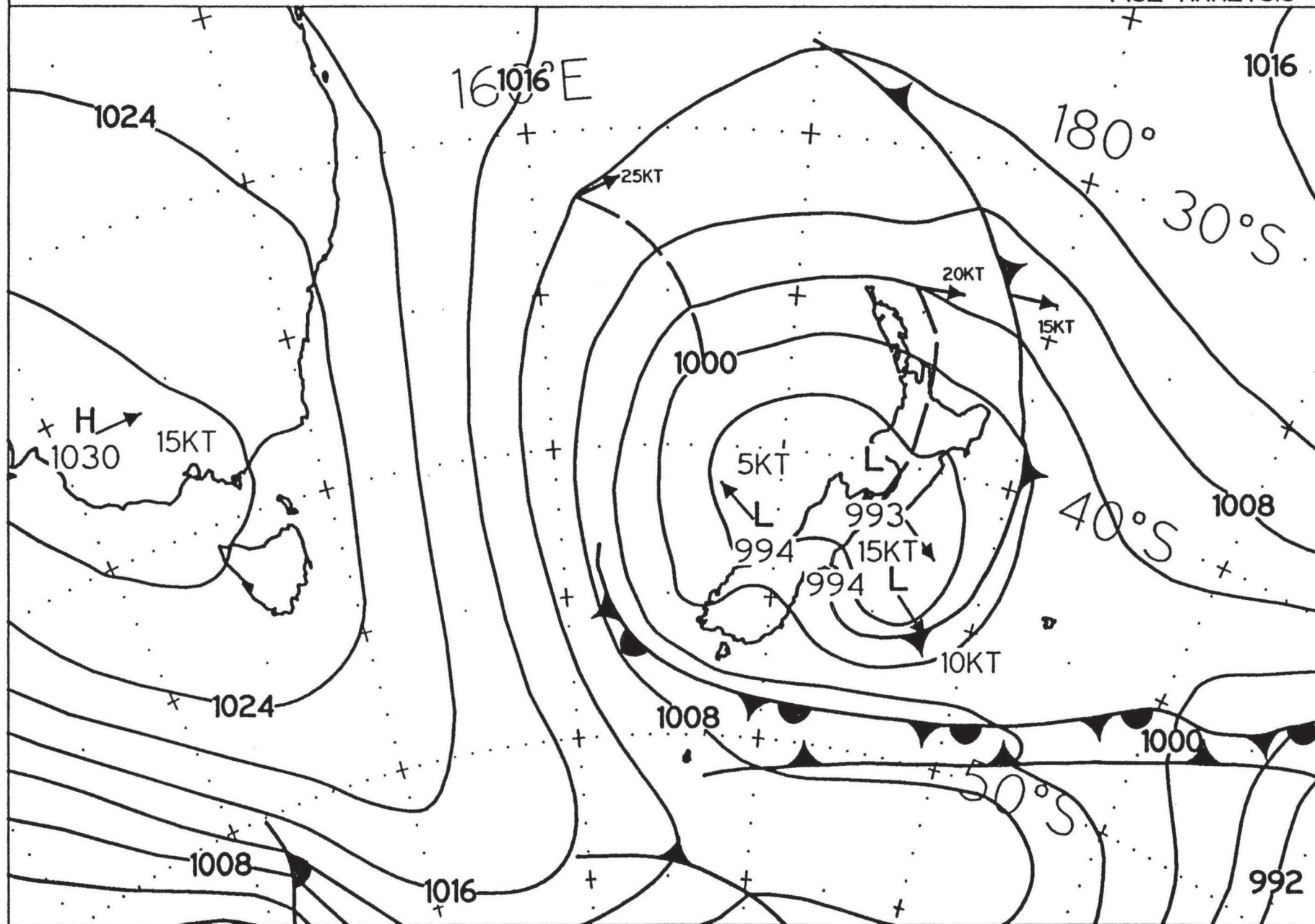
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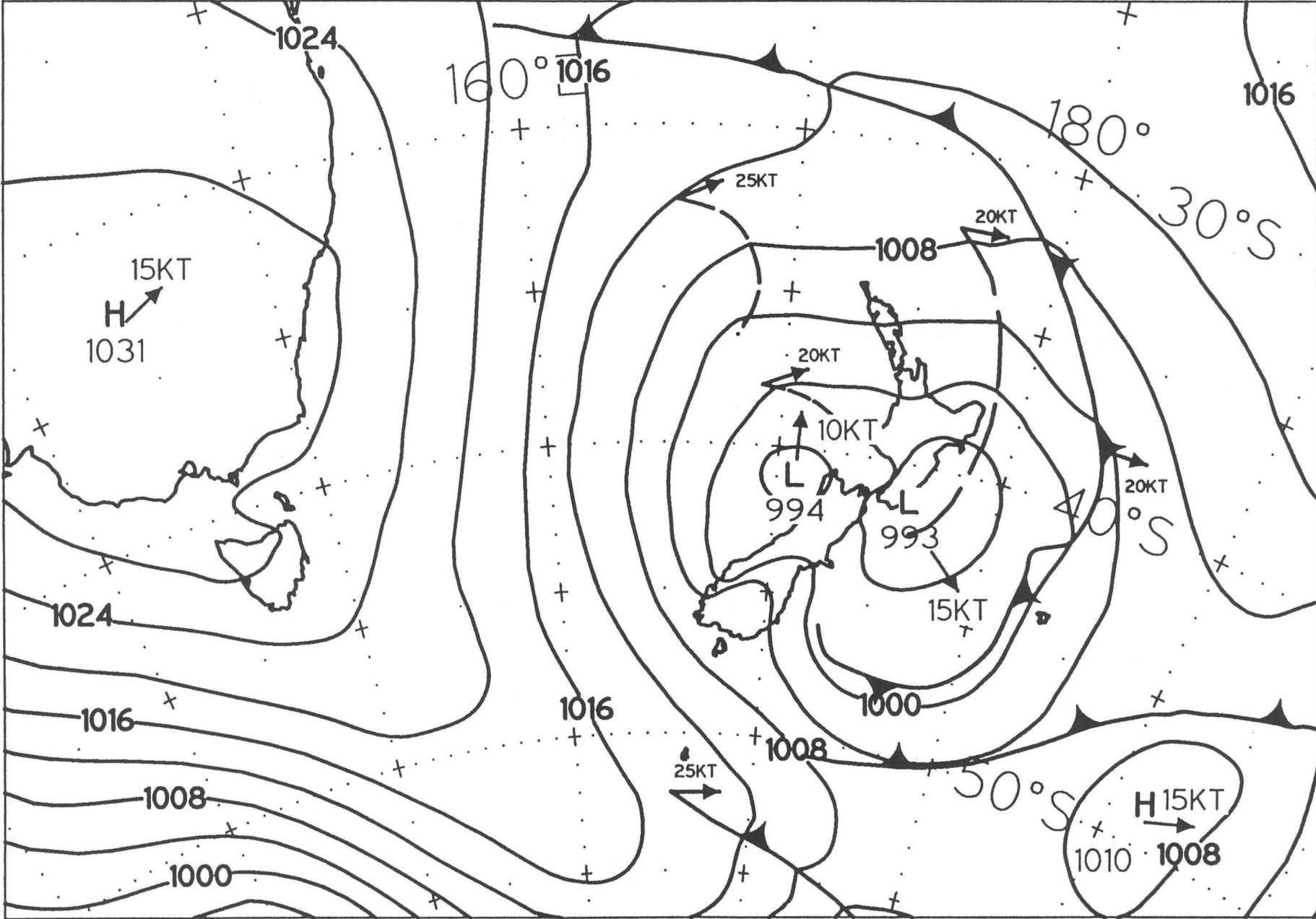
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ISSUED 1348 25-MAY-1998 UTC



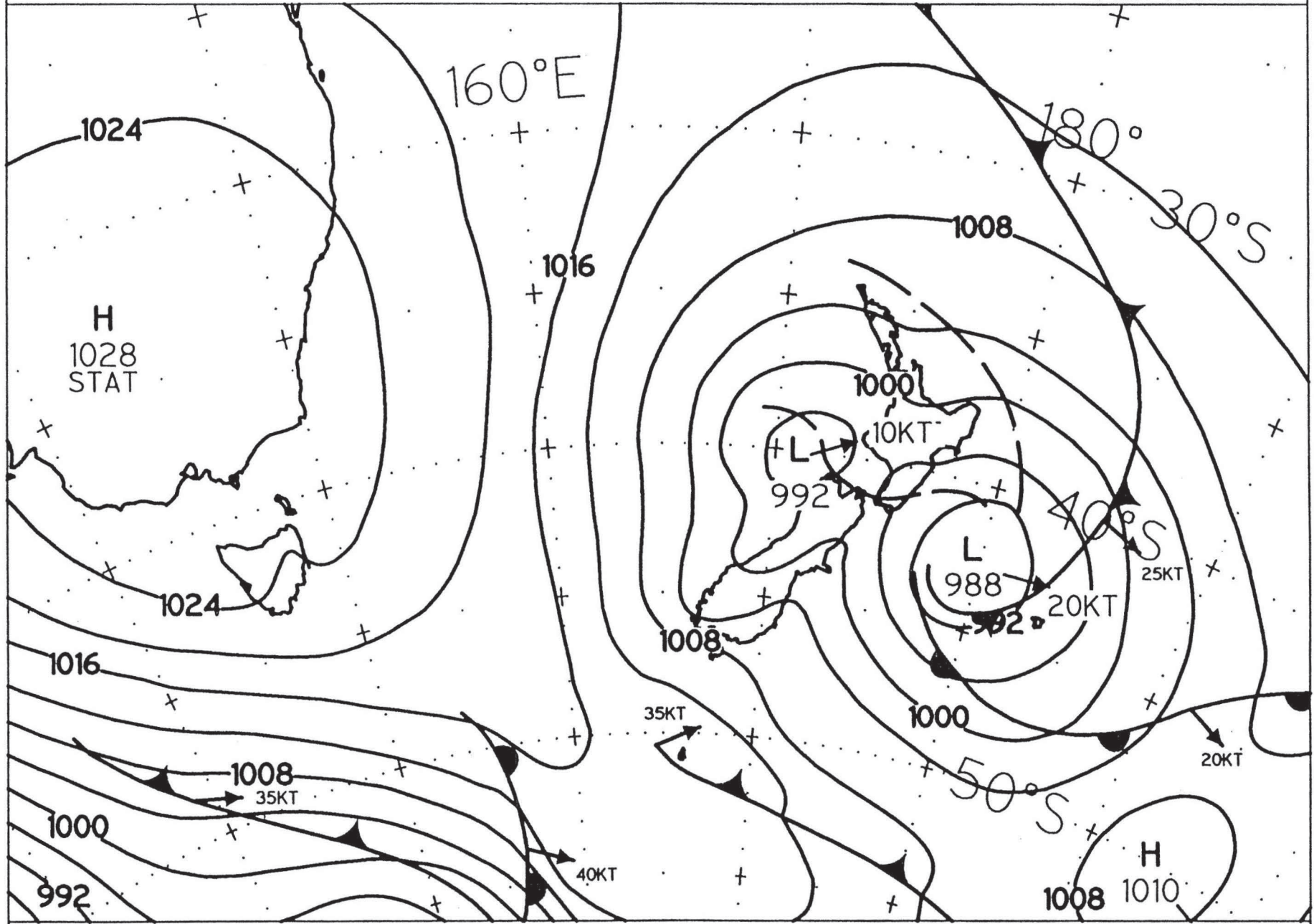
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ISSUED 1951 25-MAY-1998 UTC



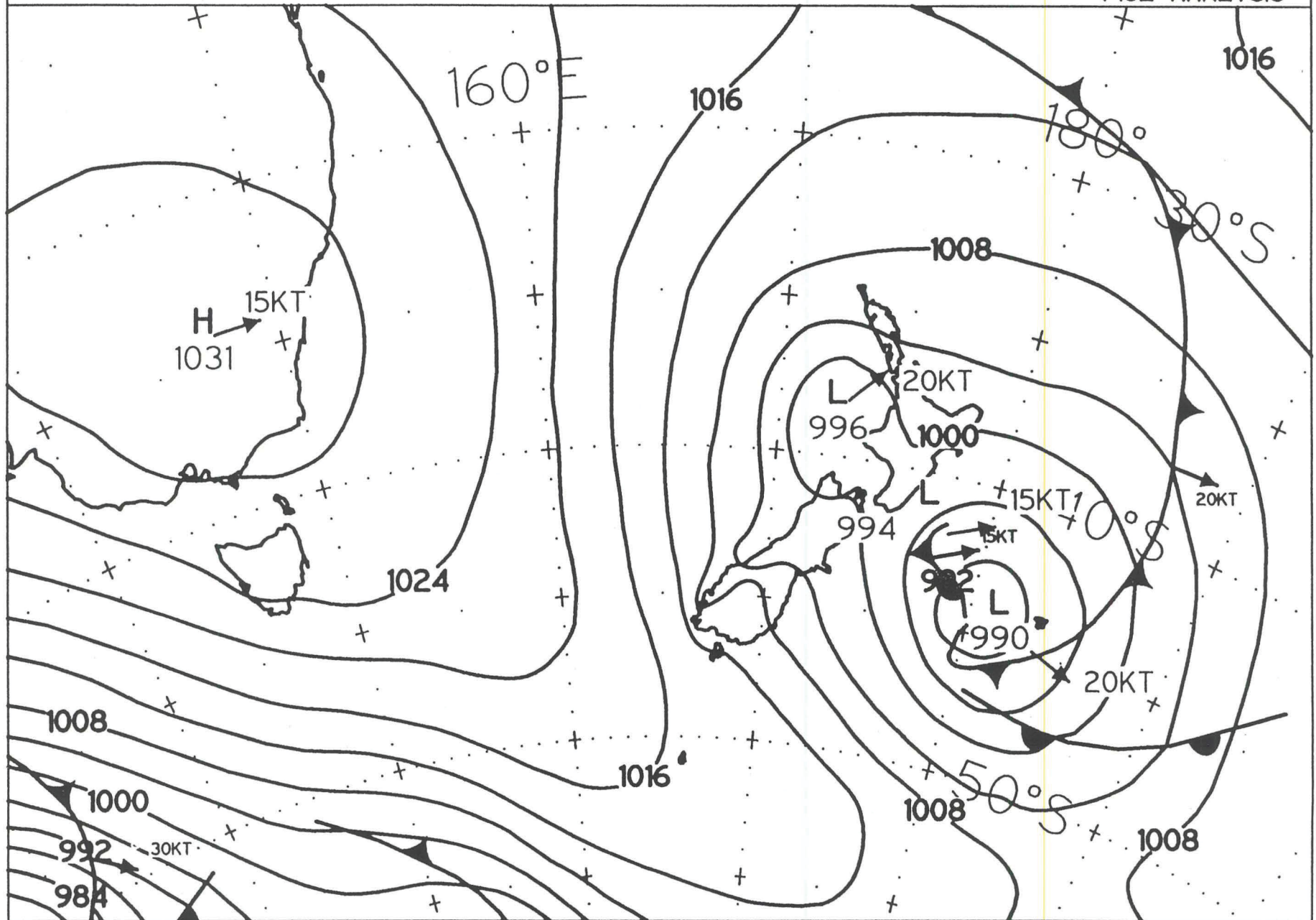
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ISSUED 0214 26-MAY-1998 UTC



VALID 0600 26-MAY-1998 UTC

ISSUED 0920 26-MAY-1998 UTC

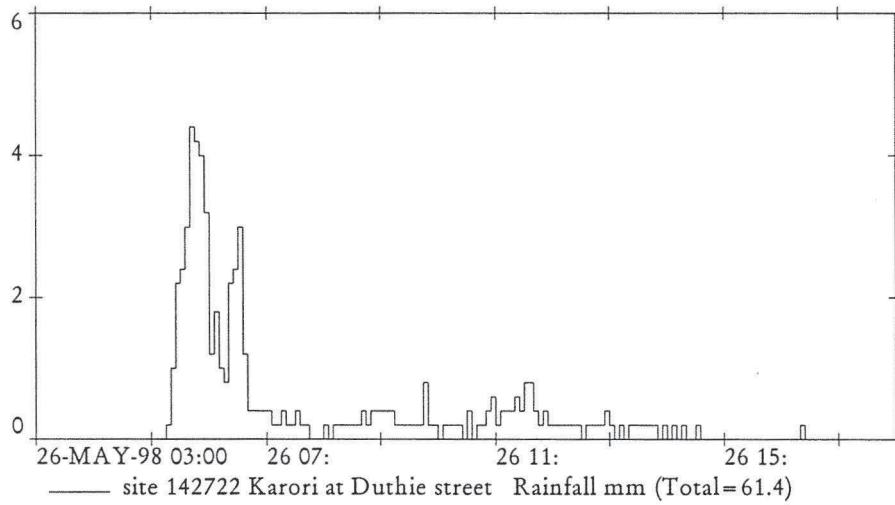
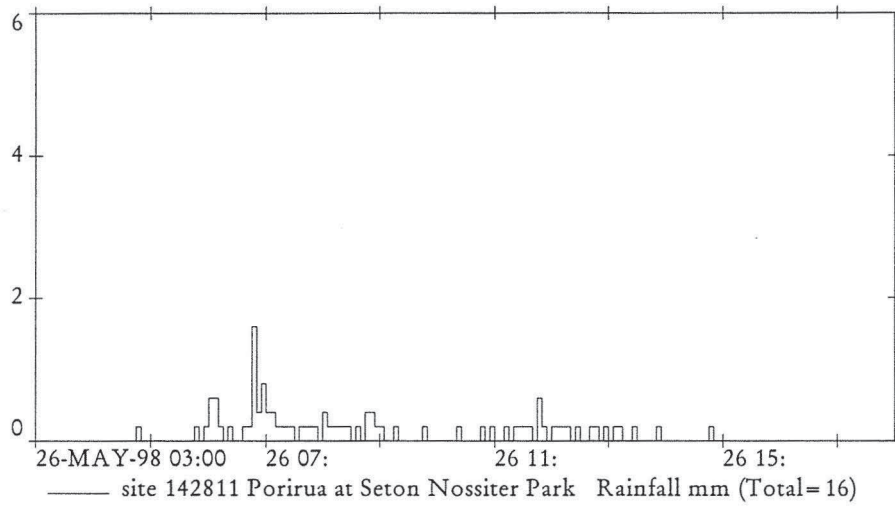
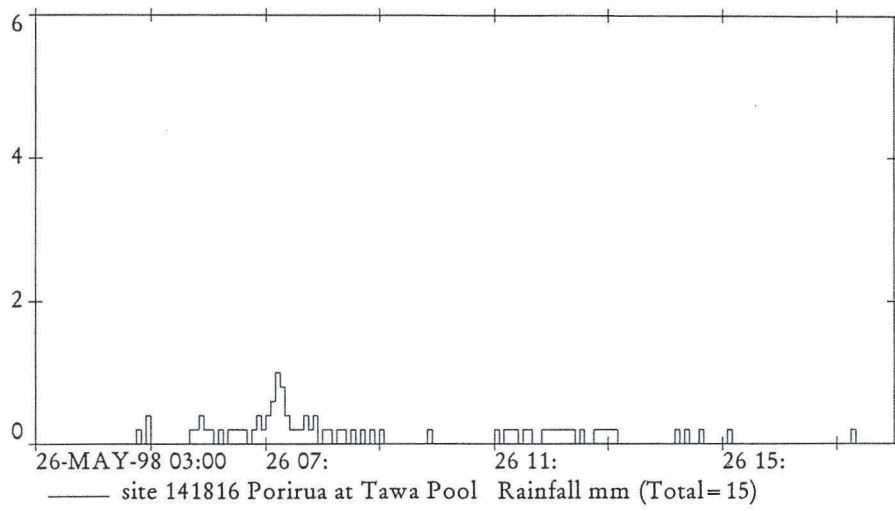


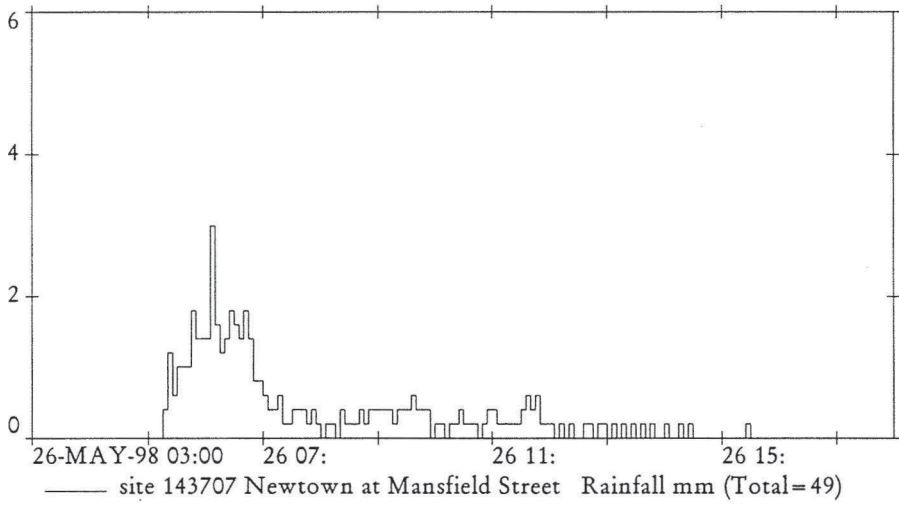
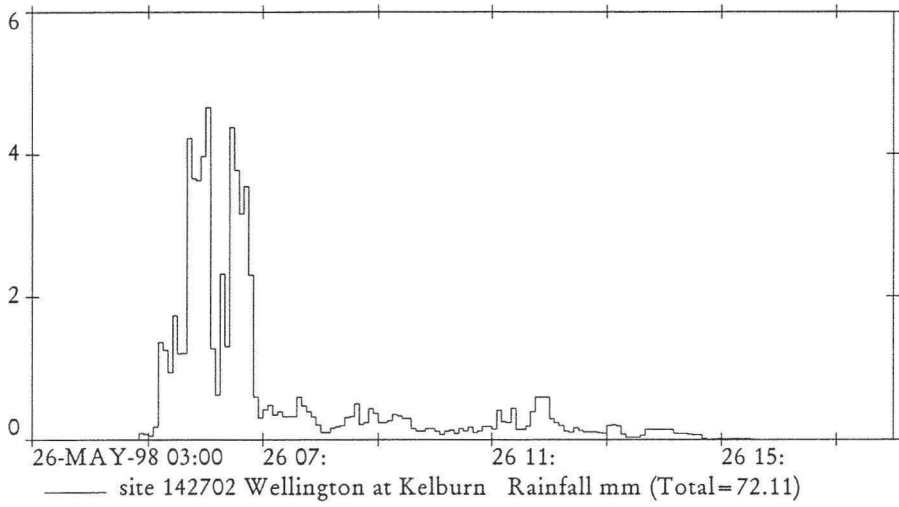
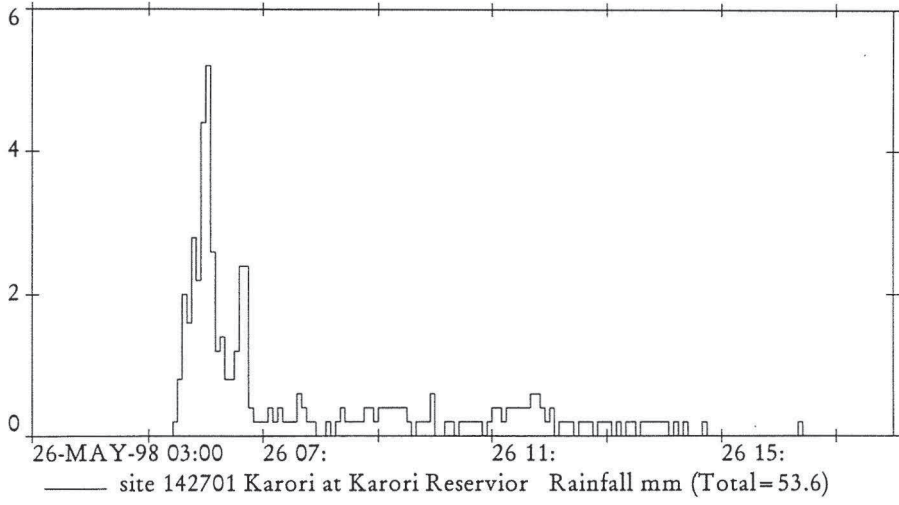
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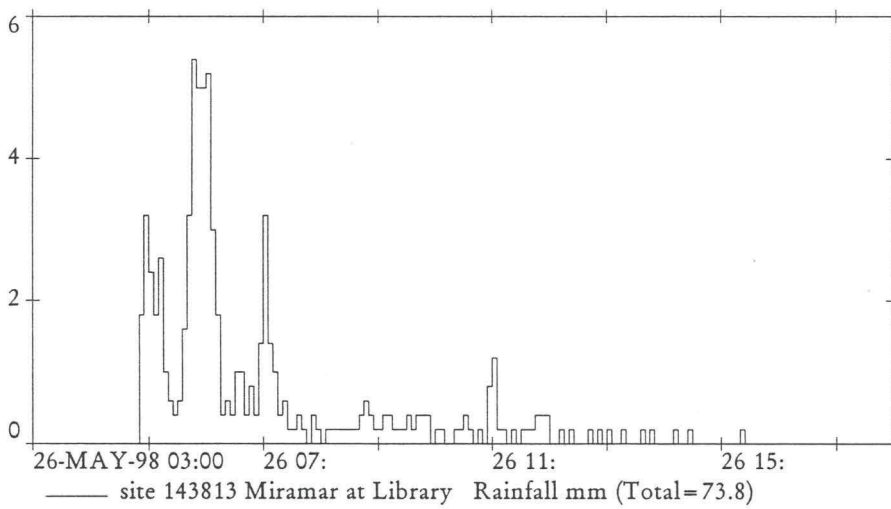
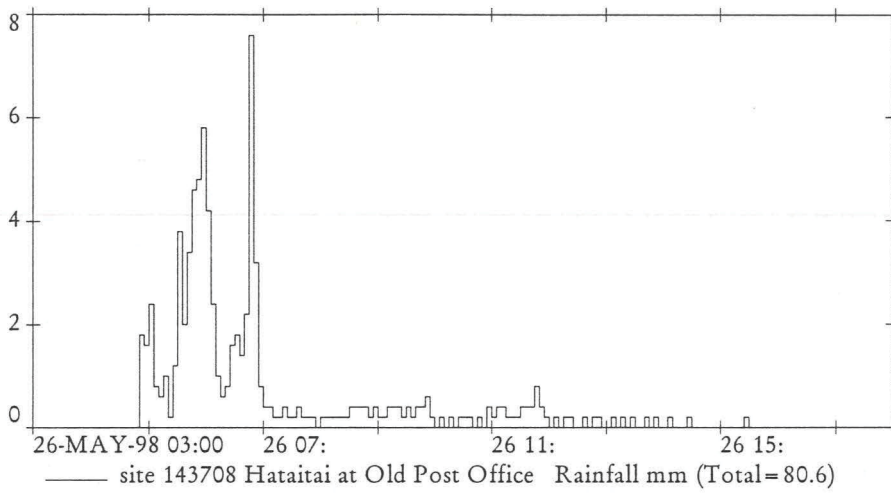
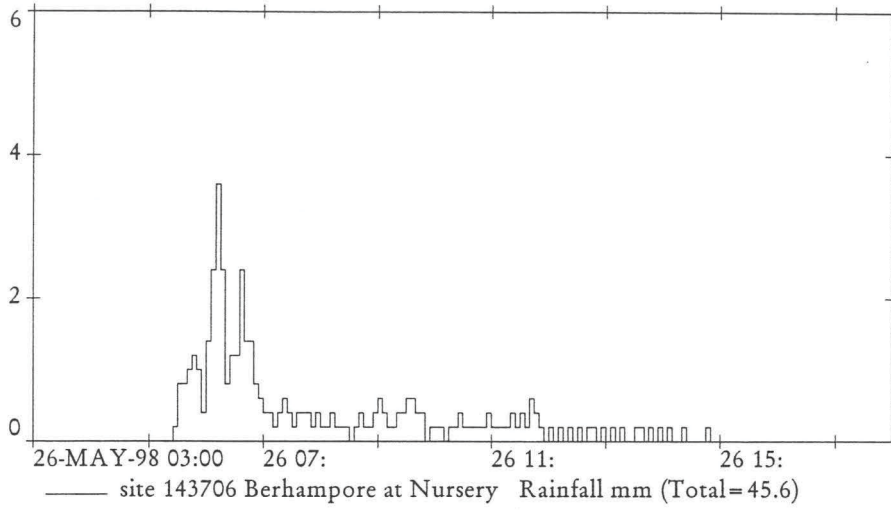
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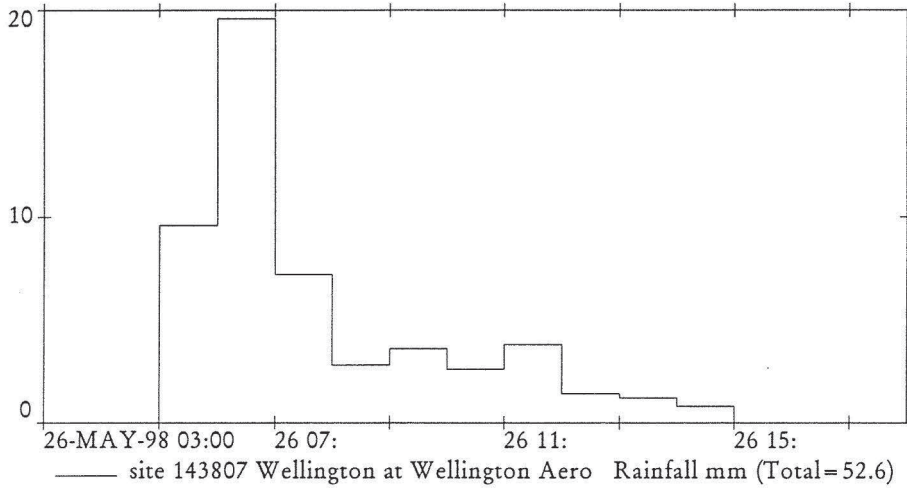
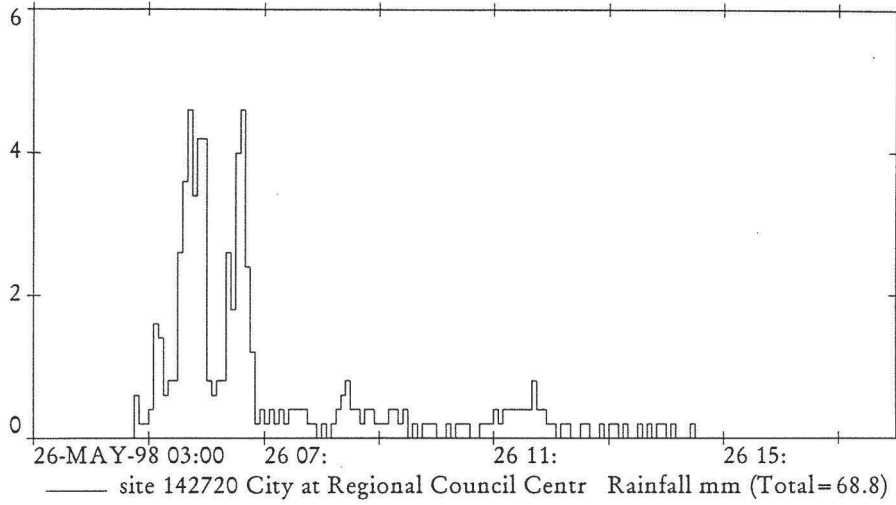
**Appendix 3:
26 May 1998 Rainfall Plots**

Plotted at five minute intervals.
Wellington Airport (143807) plotted at hourly intervals.











caring about you & your environment

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