

MARCH 2004

The Miramar rainfall event of 17 February 2004

Hydrology and meteorology

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1. Introduction

This report summarises the hydrology and meteorology of the rainfall event on 17 February 2004 that affected Wellington, in particular the suburb of Miramar. The report gives an overview of the synoptic weather patterns, quantifies the rainfall, and provides a frequency analysis of the event. This report does not describe the extent of flooding, any damage that occurred, or the emergency management response.

There were several storm events during February 2004 that resulted in flooding, slips and wind damage in many parts of the Wellington region. Although it is recognised that these storms and the effects were related, for simplicity this report focuses on the rainfall event on 17 February in Wellington city only (where the heaviest rain fell). For an analysis of the storm of 15 – 16 February 2004 the reader is referred Watts & Gordon (2004).

Please note that all times referred to in this report are given as New Zealand Standard Time.

2. Synoptic situation

On the morning on 17 February 2004 a low passed over Wellington from the north-west (Figure 1). A front embedded in this low gave steady light rain to the city from about 4 am until 6 am. Between 7:30 and 8 am a band of thundery rain within this system passed across Wellington, giving a burst of rain that was moderately heavy. However, as this rainfall was short in duration it was not significant – there was about 6 mm in Miramar during this period but less than 1 mm in Wellington city.

Soon after 9 am the low had moved to the east of Wellington, causing a southerly surface wind flow to establish over Wellington (Figure 2). The change in wind direction allowed a front on the southern side of the low to move onto Wellington. As southerly rainfall began over Wellington there was a burst of very heavy rainfall over Miramar and Seatoun from about 9:20 to 10 am. It is likely that this heavy rainfall was the result of a local convergence zone, from the cool moist southerly winds undercutting the moist unstable air and the north east wind flow that was still prevailing at height. These conditions lead to a rapid ascent of moist air causing heavy rain in a localised area.

The MetService issued severe weather watches on 16 February 2004 at about 8 pm, and again just after 8 am on 17 February, forecasting a brief period of heavy rain with a southerly change. The MetService advice relating to the event is contained in Appendix 1.

Figure 1: Weather map showing the situation that brought north-westerly rainfall to Wellington. Situation at 6 am on 17 February 2004.

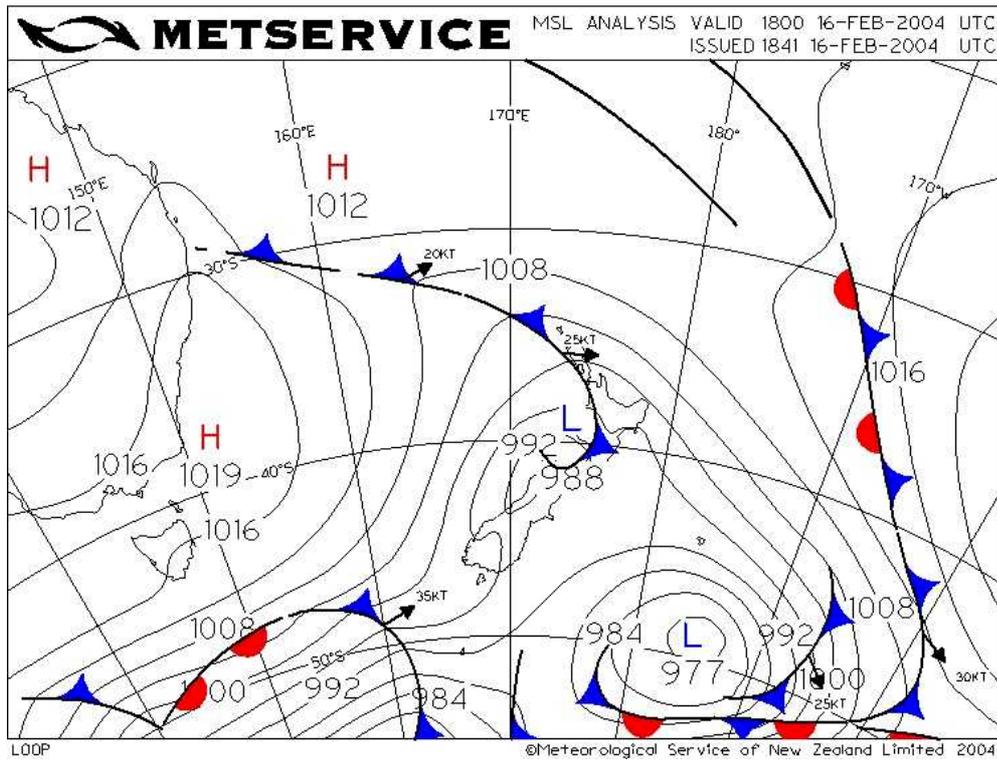
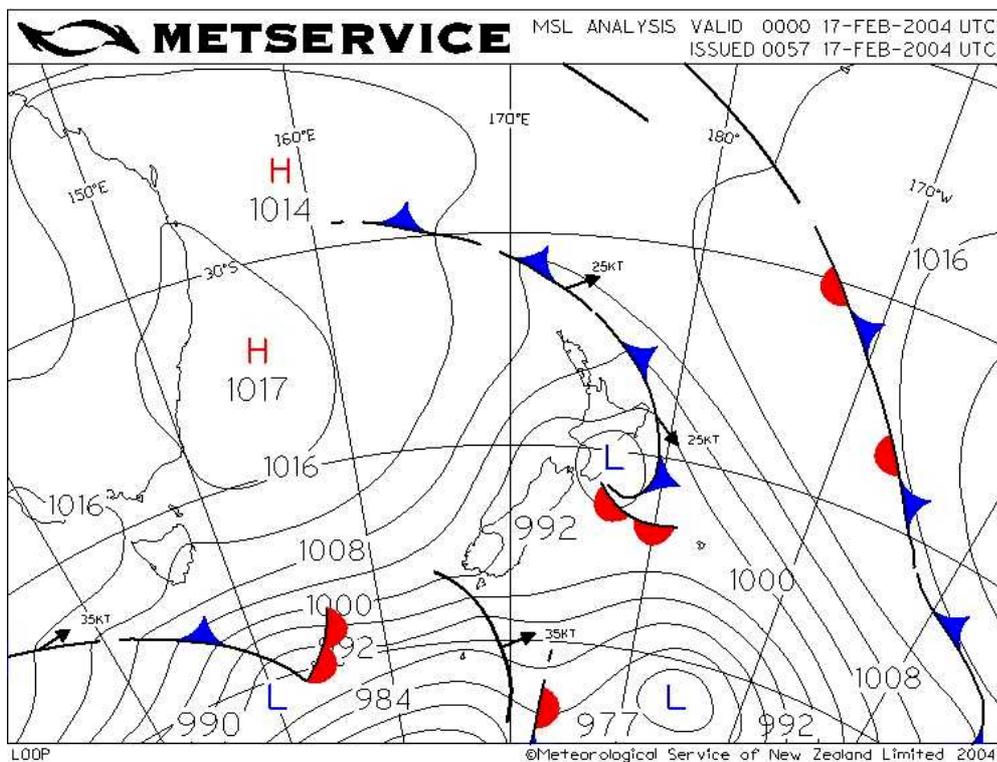


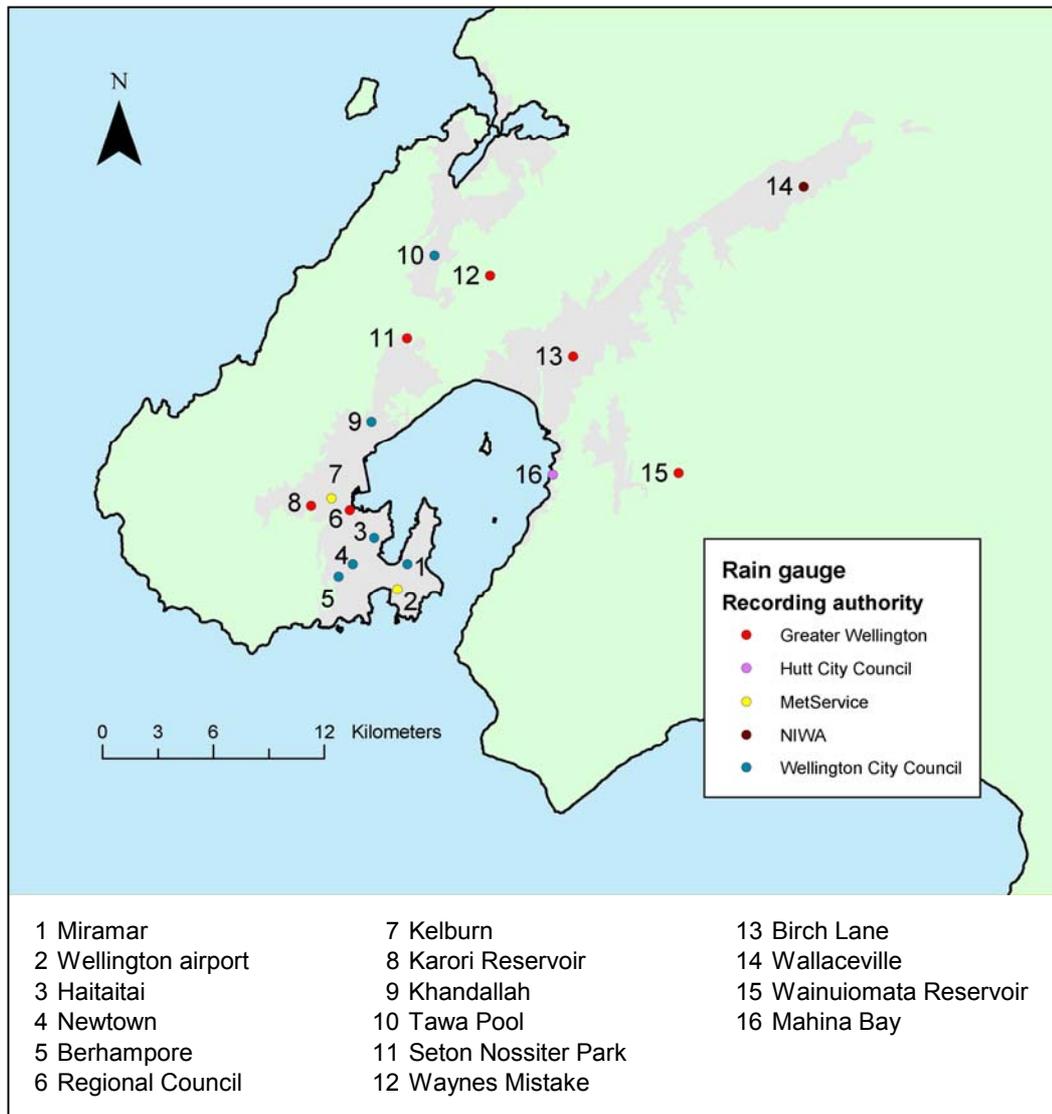
Figure 2: Weather map showing the situation that brought southerly rain to Wellington. Situation at 12 noon on 17 February 2004.



3. Rainfall analysis

Rainfall data for this event is available from a selection of rain gauges operated by Wellington City Council, Greater Wellington, MetService and NIWA (Figure 3). Hutt City Council rainfall data is useful for extrapolating rainfall isohyets for the event.

Figure 3: Location of rain gauges used in this report

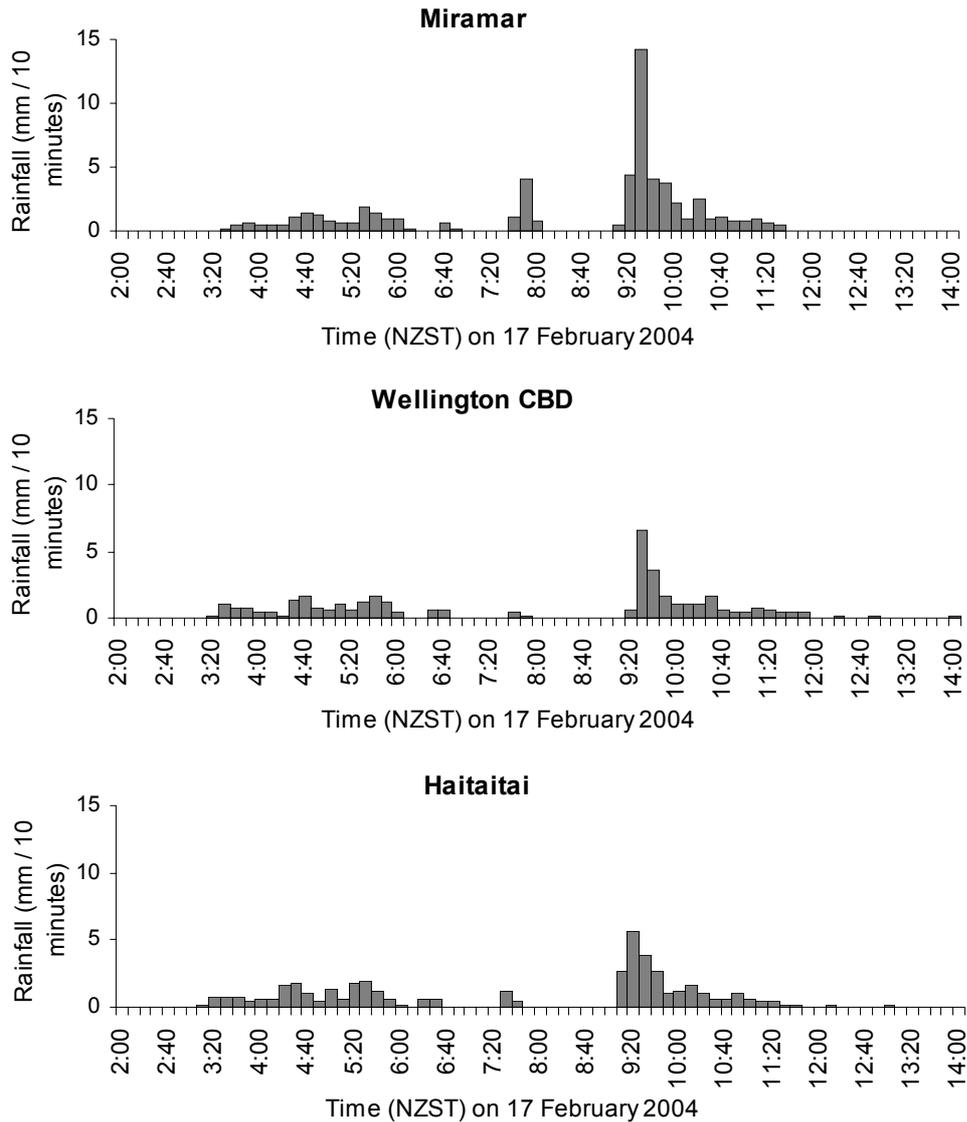


3.1 When did it rain?

Rainfall associated with the north-westerly front began soon after 3 am on 17 February in most parts of Wellington city. This rain was relatively light (maximum intensity of about 12 mm/hour) but continued steadily until about 6 am. At about 7:30 am there was a brief burst of rain in many parts of Wellington that was associated with thunderstorm activity. This rain only lasted between 20 and 30 minutes and was not particularly significant – there was about 6 mm in Miramar, 3.6 mm in Tawa, and 3.8 mm in Khandallah during this time.

After the low moved away from Wellington there was about an hour and a half without rain. At about 9:20 am rain commenced again, and was heavy at first. The heaviest rain at this time was around Miramar, associated with the local convergence zone. From 10 am until nearly 12 noon steady but light rainfall continued, caused by the southerly front as described in Section 2. As shown by Figure 4, the temporal distribution of rainfall was consistent across Wellington, although the rainfall intensities varied.

Figure 4: Timing of rainfall on 17 February 2004 in Wellington city



3.2 Where did it rain?

Figure 5 shows the spatial distribution of the total rainfall recorded on 17 February. The highest rainfall total for the day (60 mm) occurred at the Miramar rain gauge. With distance from Miramar the daily rainfall total decreased, with about 44 mm in Haitaitai and 35 to 40 mm in Newtown, Wellington CBD, Kelburn and Karori. The Hutt Valley, Porirua, and Wainuiomata received significantly less rainfall than Miramar (less than 30 mm).

Figure 5: Daily rainfall isohyets for Wellington, 17 February 2004

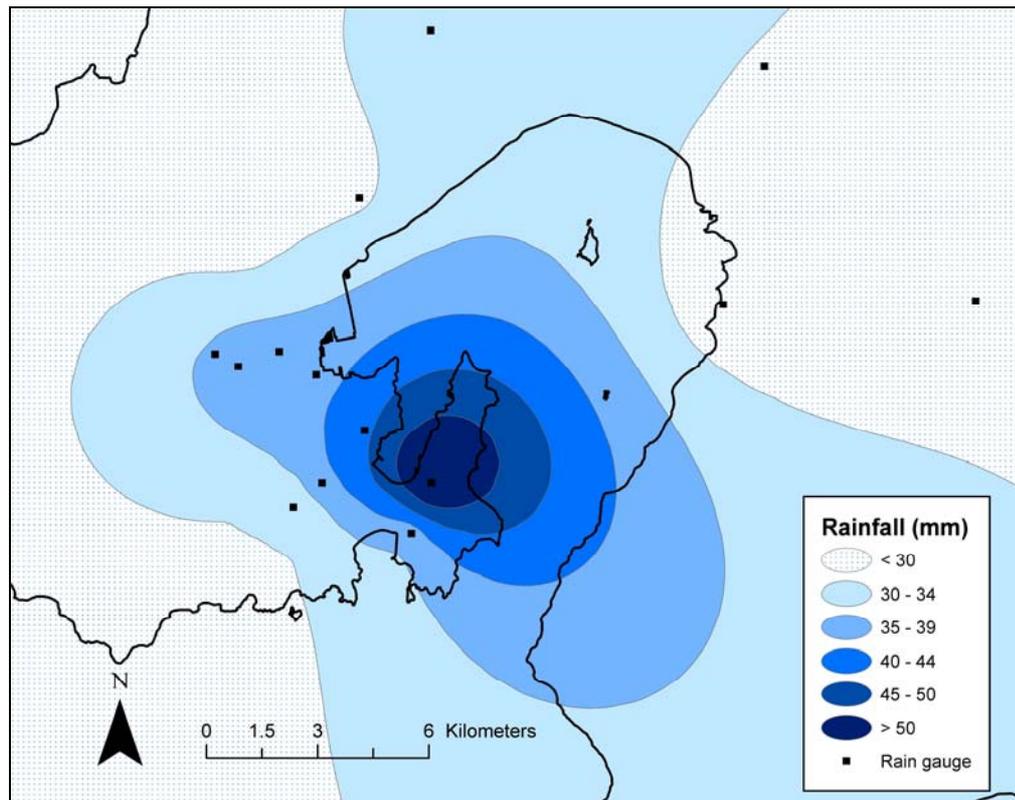
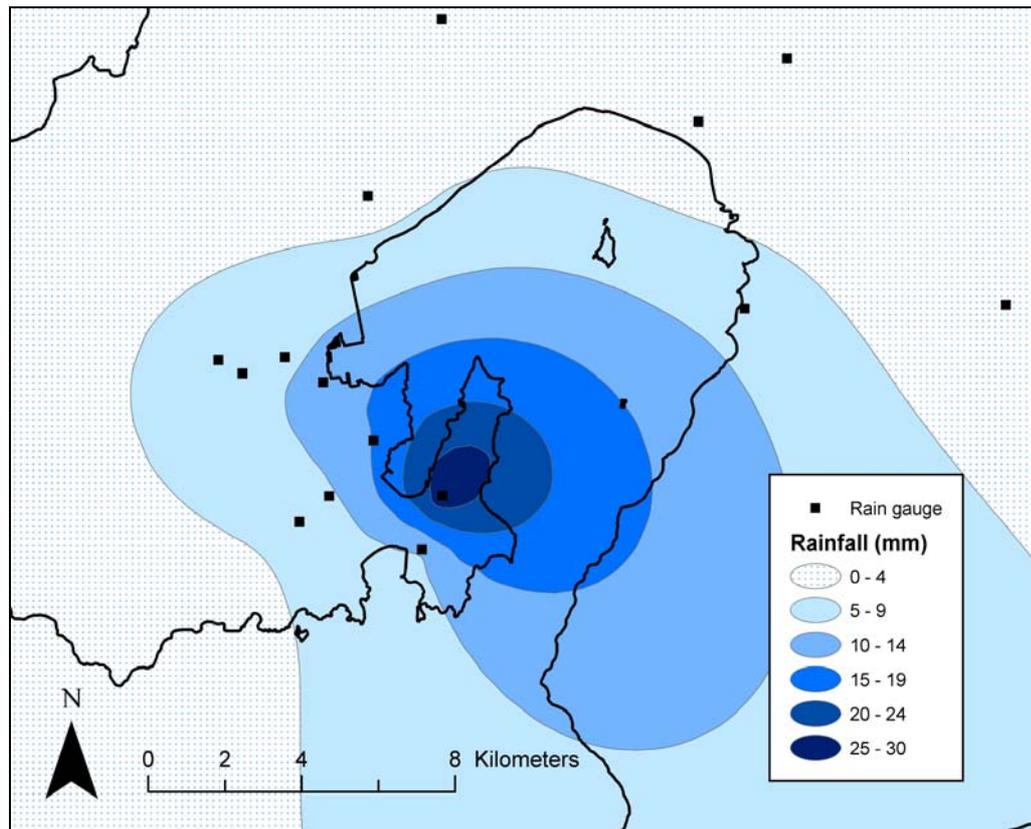


Figure 6 shows the rainfall distribution for the hour between 9 and 10 am on 17 February. The map shows a similar pattern to the rainfall distribution in Figure 5 – i.e. with the most rain occurring around the Miramar peninsula. During this time Miramar received about 29 mm – significantly more than nearby Haitaitai (15 mm), Newtown (9 mm) and Wellington CBD (13.4 mm). The map shows the heaviest rain was confined to a relatively localised area – to the extent that Wellington airport received only one-third (9.8 mm) of the rainfall that occurred in Miramar between 9 and 10 am.

Figure 6: Rainfall isohyets for Wellington, 9 – 10 am on February 2004

The hourly and daily rainfall totals used to produce these isohyetal maps are contained in Appendix 2.

3.3 Rainfall frequency analysis

Table 1 shows the maximum rainfall depths over various durations on 17 February 2004 at selected gauges across Wellington. The table highlights how the rainfall was considerably higher at Miramar compared to the other sites. For durations of 1 hour and less there was about three times as much rainfall in Miramar than in Newtown, Berhampore, Kelburn and Karori, and about twice as much rainfall as in Haitaitai.

The return period of the rainfall was generally not significant in places other than Miramar. At Kelburn and Karori the rain was less than a 2 year return period for all durations. At Haitaitai, the rainfall was probably about a 2 year return period for the 30 minute duration, but not significant for all other durations. Although the return period cannot be estimated for Newtown and Berhampore due to the short length of record, the rainfall on 17 February 2004 does not appear to be significant compared to other events on record¹.

¹ Records begin in 1996.

Table 1: Maximum rainfall depths for various durations, 17 February 2004

Gauge		10 mins	20 mins	30 mins	1 hour	2 hours	6 hours	12 hours	24 hours
Miramar	Depth (mm)	14.3	18.7	22.7	29.7	36.6	50.5	58.7	58.7
	Return period	See Table 2							
Hataitai	Depth (mm)	5.6	9.6	12.8	17.2	22.2	33.8	43.8	43.8
	Return period ²	< 2 years	< 2 years	2 years	< 2 years				
Newtown	Depth (mm)	3	5.4	7.6	12.6	18.2	26.2	37.2	38.4
	Return period	n/a – rainfall record for the site is too short							
Berhampore	Depth (mm)	2	3.4	4.2	7.4	12.2	20	30	30.2
	Return period	n/a - rainfall record for the site is too short							
Kelburn	Depth (mm)	3.3	4.9	6.5	9.6	14.9	24	37	39
	Return period	< 2 years for all durations							
Karori	Depth (mm)	3	4.5	5.5	9	14	23.5	38	38.5
	Return period	< 2 years for all durations							

It is difficult to estimate the return period of the rainfall in Miramar due to the short rainfall record (1996 – 2004). Table 2 shows estimates of the return periods derived through several methods. The first method is the High Intensity Rainfall Design System (HIRDS) (Thompson, 2002), a computer-based procedure for estimating design rainfalls at any point in New Zealand. The second method the use of the rainfall records at Wellington airport to estimate the return period of rainfall in Miramar. For durations of 1 hour and greater the record for Wellington airport from 1960 to 2004 was used. For durations less than 1 hour the estimates provided in Lew & Blackwood (1995) for Wellington airport were used, which are based on the data from 1961 – 1978³. The third method applies the frequency estimates from the Kelburn rainfall record (1955 – 2004) to Miramar.

² Return periods estimated from rainfall record at Wellington airport

³ The rainfall record for Wellington airport is hourly data only. The short duration design intensities were extrapolated from this data by Coulter & Hessel (1980) and re-published in Lew & Blackwood (1995).

Table 2: Estimated return periods for maximum rainfall depths at Miramar, 17 February 2004

Duration	10 mins	20 mins	30 mins	1 hour	2 hours	6 hours	12 hours	24 hours
Rainfall depth (mm)	14.3	18.7	22.7	29.7	36.6	50.5	58.7	58.7
Return period (years) (HIRDS)	65	50	45	40	20	2 - 10	2 - 10	< 2
Return period (years) (Airport)	20 – 50	50	50	50	20	6	3	< 2
Return period (years) (Kelburn)	50	20	20	20	8	4	2	< 2
Recommended return period (years)	50	20	20	20	8	4	2	< 2

The HIRDS and Wellington airport data give similar return period estimates for this event. HIRDS is useful when there are no long rainfall records in an area, but in this case it is probably more accurate to use at-site data.

The higher return periods assigned using the Wellington airport data compared to those derived when using the Kelburn data is probably because:

- The Wellington airport data is recorded on an hourly basis (on the hour) therefore it does not account for rainfall maximums which are spread across different hours; and
- The short-duration (less than 1 hour) return periods for Wellington airport were derived using data from 1961 – 1978, thus the analysis does not take into account several high intensity events that have occurred since then.

Although Kelburn is at slightly higher altitude and further away from Miramar, it is recommended that the Kelburn rainfall frequency analysis be used in preference to that from Wellington airport. This recommendation is made because the Kelburn analysis uses a longer data record, and because the gauge measures rainfall continuously rather than on the hour (therefore it is more accurate for short duration analyses).

The lower return periods assigned for the durations of 20 minutes to 2 hours using this method compared to other methods provides a more conservative approach. In addition, the lower return periods are probably more accurate considering that this event was not the largest on the record (which is only 8 years long). The 20 minute, 30 minute and 6 hour rainfall totals for this event were exceeded on 26 May 1998, and the 1 and 2 hour durations were exceeded on 26 May 1998 and 10 January 2002. The 1-hour rainfall depth in May 1998 was assigned a 50-year return period at Kelburn (Harkness, 1998), and that event produced nearly 4 mm (13%) more rain in Miramar than this event.

The return periods in Table 2 highlight that the event in Miramar on 17 February 2004 was most significant for short time periods. Short durations of heavy rainfall are critical for causing flooding in urban areas due to the short time of concentration of stormwater systems. For 1 hour and less the return period of the event is estimated to be 20 years. However, the critical duration on 17 February 2004 was 10 minutes, which was assigned a return period of 50 years. As the rainfall was not sustained for more than a few hours the return period for the 12 and 24 hour rainfall totals was not significant.

Note that the flooding that resulted in Miramar, and any landsliding around Wellington, was probably exacerbated by wet antecedent conditions in permeable parts of the catchment. Thus the rainfall that occurred on 17 February may have produced more runoff than it would have if there had not been rain in the days and hours leading up to this event.

4. Summary

On the morning of 17 February 2004 high intensity rainfall occurred for a short duration over Miramar, as a result of a localised convergence zone. At the same time moderate intensity rain associated with a southerly front occurred throughout Wellington.

The rainfall that occurred in Miramar had a significant return period. The estimated return period of the event is 50 years for the 13.4 mm of rainfall that occurred in 10 minutes, and 20 years for the rainfall that occurred over 20 minutes to 1 hour. The rainfall received in other parts of Wellington was not significant compared to other events on record.

References

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Acknowledgements

This report was funded by Wellington City Council.

Many thanks to Stuart Powell of Microclimate New Zealand for providing an analysis of the synoptic weather situation.

Thank you to MetService (John Crouch) for comments on the weather patterns and provision of weather maps and radar images.

Data for this report was provided by Wellington City Council, MetService, Hutt City Council and NIWA.

Appendix 1: MetService advice

**SEVERE WEATHER WATCH FOR WELLINGTON AND WAIRARAPA
ISSUED BY METSERVICE AT 2016hrs 16-Feb-2004**

MORE RAIN ON TUESDAY, WITH POSSIBLE HEAVY FALLS

MetService forecasters are monitoring the progress of a front moving over southern South Island this evening and expected to cross the North Island during Tuesday. It seems likely that a small low developing on the front will cross central New Zealand, probably just north of Cook Strait, around the middle of Tuesday, accompanied by a band of rain. From Taranaki to Manawatu the rain band should pass through fairly quickly but over Wellington and southern Wairarapa there is a possibility that a slow moving southerly change may trigger some localised heavy falls in a fairly narrow band during the period from about 9am to 3pm Tuesday. There remains considerable uncertainty in the amount and distribution of this rainfall, but after the high rainfalls of the past two days a close watch will be maintained on developments.

This Watch will be reviewed by 9am Tuesday 17 February 2004

Forecast prepared by: Bob Lake

For Further information after 9pm contact Duty Forecaster Geoff Sanders

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**SEVERE WEATHER WATCH FOR WELLINGTON WAIRARAPA
ISSUED BY METSERVICE AT 0814hrs 17-Feb-2004**

BRIEF HEAVY RAIN POSSIBLE

A southerly change is forecast to slowly spread north through Wellington and Wairarapa this morning, with an associated band of rain. Some of the rain may be heavy and thundery for a time, with 20 to 40mm possible in some areas up to mid-afternoon. This amount of rain does not ordinarily warrant a warning, however given the already water logged conditions it could cause further problems in these areas.

This Watch will be reviewed by 2pm Tuesday 17th

Forecast prepared by: Andy Downs

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**SEVERE WEATHER WATCH FOR WELLINGTON WAIRARAPA
ISSUED BY METSERVICE AT 1602hrs 17-Feb-2004**

HEAVY RAIN IS NOW MOVING OFF

The heavy thundery rain which moved across the Wellington and Wairarapa regions is now moving away to the east and the Watch is now lifted.

NO FURTHER SEVERE WEATHER WATCHES WILL BE ISSUED

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Appendix 2: Rainfall depths

Site	Rainfall total 9 – 10 am (mm)	Rainfall total for entire day (mm)
Miramar	29	59
Wellington airport	9.8	36.6
Hataitai	15	43.8
Newtown	9	38.4
Berhampore	6	30.2
Regional Council	13.4	38
Kelburn	8	37.5
Karori Reservoir	8	38.5
Khandallah	2.4	29.2
Tawa Pool	5	28.6
Seton Nossiter Park	3.4	33
Waynes Mistake	0.2	34.4
Birch Lane	0.5	29.5
Wallaceville	5	26.8
Wainuiomata Reservoir	0.5	29
Mahina Bay	8	26

Appendix 3: Media coverage

Extreme weather highlights shortage of civil defence

The recent Miramar flood has highlighted a lack of civil defence in the area.

There are not enough volunteers in about half-a-dozen communities around the city and the Wellington City Council is so concerned it is calling a meeting to discuss the situation.

Emergency Management Office manager Karen Stephens says although civil defence volunteers were out and ready for evacuations in Miramar, if a major earthquake struck Wellington each area would need its own organised response.

"Certainly there are a number of locations around the city where we don't have volunteers," she says.

A city-wide meeting has been called for March 25 to talk about, and raise awareness of, areas currently without community involvement.

Anybody who has a role to play in looking after communities in a major crisis is invited, Ms Stephens says.

The details of the meeting are yet to be released.

"The response by communities is absolutely essential in looking after themselves."

During Tuesday's floods in Miramar



SIMON SMITH

the civil defence ended up helping out with road closures.

"We were there just waiting for a green light that they were evacuating," Ms Stevens says.

Meanwhile, the city council is warning Wellingtonians to stay off city bush tracks on the Town Belt and reserves for at least a week until staff have been able to assess storm damage.

Park rangers are checking the most popular routes to identify any hazards, but the cleanup will take time, a council spokesperson says.

"People should use common sense and avoid these areas if possible.

"If they do use them they should be aware of the likely hazards and take particularly care - many areas will be muddy and slippery."

There are 200km of tracks in the city.

DAMAGE BILL \$100 MILLION AND RISING

No letup

- Dam fears – 1000 evacuated in Picton
- Chopper to rescue as house swept away

Pollution raises health worries

STAFF REPORTERS

THERE has been no respite for ravaged communities as more heavy rain and swollen rivers forced another 1100 people from their homes in what have become the most devastating floods on record.

Yesterday was the third day of widespread destruction across central New Zealand, with the damage bill now estimated at \$100 million and rising.

Storm clouds dumped up to 40 millimetres on already sodden areas in Wellington, Horowhenua, Wairarapa, Manawatu and Wanganui while a sudden deluge in Marlborough caused a flash flood.

Worst affected was Picton, where 1000 people were evacuated because of fears that a dam could burst, sending millions of tonnes of water into the town. Most were allowed to return home last night after engineers

River were forced to flee as the river burst stopbanks, and livestock were trapped.

The Horowhenua towns of Shannon, Whirokino, Foxton Beach, Foxton and Sanson were evacuated yesterday as floodwaters rose — adding to the destruction in Tangimoana, Feilding and Marton.

The floods have also cut water supplies to several towns and residents in other areas have been warned to boil drinking water. Water is being trucked in to some areas.

Road and rail travel was severely affected for the third day running as bridges and roads were washed out by floodwaters and slips. Several state highways, including State Highway 1, were closed in several places last night as were other major roads in Wanganui, Manawatu and Horowhenua. Police urged motorists to keep off the roads.

The main trunk line between Auckland and Wellington will be closed for at least three days because of track damage.

There was concern that sewage and dead stock washed down flooded rivers would pose a serious health

risk along with contaminated water supplies.

There had been breakdowns in the sewage systems in Ohakune, Taihape and Bulls. Most of the sewage was going into fast-moving swollen rivers.

THE BIG WET



checked the dam.

A civil defence emergency was declared in the town at 1.30pm. This followed several hours of torrential rain — in one 40-minute period 40mm fell — which swept away campervans, flooded houses and caused havoc for

emergency services. There were also civil defence emergencies in Rangitikei, Manawatu and south Taranaki.

A house near Feilding was swept away by floodwaters moments after its owners were plucked off the roof by a helicopter. Several neighbouring properties were left hanging precariously after a normally placid stream gouged away banks.

And in Wellington, a Karaka Bay resident had to scramble to safety down a rope ladder dangling from a balcony after a slip smashed into his \$650,000 house, filling it with tonnes of rock.

Police cordoned off part of Karaka Bay Rd, on the Miramar peninsula in Wellington, yesterday as a rock slide and driving rain threatened to smash Bob Bird's two-storey house to bits.

Farmers alongside the Manawatu

- Kapiti residents gets off lightly **A2**
- Farmers suffer severe losses **A3**
- Picture page **A5**
- Editorial **B4**



Broken home: Bob Bird outside his house in Karaka Bay after a rock slide smashed into the back of it. **Report A3.**

Picture: CRAIG SIMCOX

While power was restored to thousands of homes in Wellington, Hutt Valley, Horowhenua and Manawatu, fresh problems caused more outages elsewhere. About 2000 homes were still without power last night.

Miramar bore the brunt of rain in the capital yesterday, with the eastern suburb recording 30mm in an hour. This caused surface flooding and residents were put on standby to evacuate but the floodwaters receded and evacuation proved unnecessary.

Farmers have been asked to dump milk because road closures and gas supply cuts have stopped milk com-

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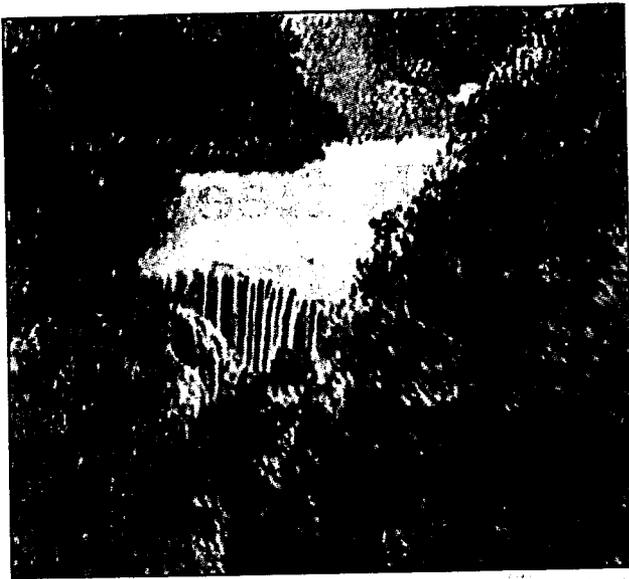
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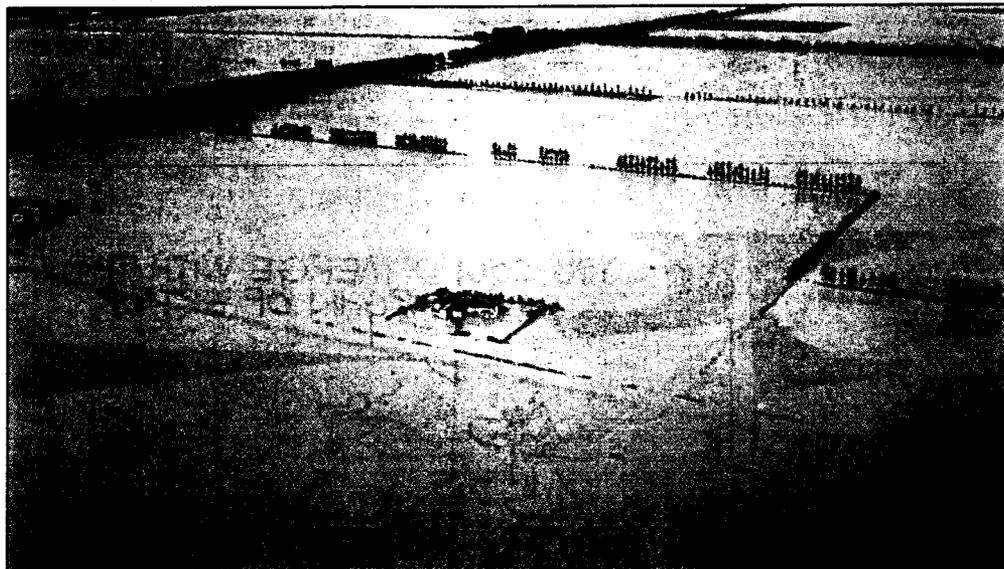


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The Dominion Post (2nd Edition)
18 February 2004
Wellington, NZ
Daily, AM
Circulation: 101,511

Dam threat: One thousand people had to leave their homes in Picton as fears grew that this dam above the town could burst.

pany Fonterra collecting milk. The company says up to 1650 farms in the lower half of the North Island have been affected.

Telecom said it had not restored full phone services in Manawatu,



No sign of land: A farm at Moutoa, near Shannon. In the worst-hit part of Manawatu, at least six homes have been inundated, 1000 cows are missing and three rotary cowsheds are under water.

Rangitikei and Horowhenua and about 5000 to 6000 phone lines remained affected.

Insurers have doubled their estimate of the damage caused by this week's storm to \$100 million but

farming leaders say it could be more. Insurance Council chief executive Chris Ryan said the destruction was greater than first thought.

The cost equals the Southland floods in 1984 and is double the bill

for Cyclone Bola in 1988. Earthquake Commission insurance manager Lance Dixon said 250 claims for landslip and flood damage had been received in the past 24 hours. He estimated the cost would be \$3 million.

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