MARLBOROUGH CATCHMENT BOARD

REPORT

on the

10th JULY 1983

FLOOD

Marlborough Express Photo

SEPTEMBER 1983

7th September, 1983

The Chairman,
MARLBOROUGH CATCHMENT BOARD

Dear Sir,

My report on the 10th July, 1983 floods and aspects of works and organisation procedures which have arisen from the flood are attached.

This report is in two parts -

PART A : 'Report on the 10th July 1983 Flood' which deals largely with the sequence of events and details of the flood. Unfortunately, it has not been possible to complete the collection and assessment of all hydrological data, at this stage, and this will be reported in its final form later. Also, it has not been practicable to include all details related to the flood, and no doubt there will be some omitted aspects that others may consider should have been included.

Part B : 'Works and Recommendations for Future Actions'- covers many of the works and organisational matters arising from the flood. Many of the sections do not conclude in a recommendation, but record matters for future consideration and decision.

There is a large amount of information recorded in this report, and it would not be practicable for the Board to consider all of this detail and subsequent action at one initial meeting. For that reason, I have restricted my recommendations to those matters which should be dealt with urgently. These are found in Part B as follows :-

Section 1 - Adoption of the flood damage repair estimate for submission to NWASCO for approval, and amendment to the Board's annual estimates.

Section 3 - To enable the early preparation of a comprehensive warning list these recommendations should be considered.

Section 4 - Before other proposals can be considered objectively, the standard of protection should be reviewed.

Section 5 - Improvement to the capacity of the Diversion should have a high priority and the recommendations should be considered to allow an early start to the preparation of development proposals.

Section 6 - Recommended proposals that will provide a quick increase to the standard of flood protection at Tuamarina should be considered to enable works to commence immediately in conjunction with flood damage repair.

Section 9 - The need to review the present overflow provisions at Upper Conders and to replace these with another 'safety valve' to provide greater protection to property should be given early consideration.

Other matters dealt with in Part B involve various issues and policies, some of which may require investigation and/or discussion with those involved before a decision can be made.

Yours faithfully,

P.A. THOMSON,
CHIEF ENGINEER

PART A

REPORT

on the

10th JULY 1983

FLOOD

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PART A - REPORT ON THE 10TH JULY 1983 FLOOD

PART A - REPORT ON THE 10TH JULY 1983 FLOOD

This report follows my interim report of the 11th July, and submissions made to the Minister of Works on the 26th July, and is intended to provide a total overall coverage of the situation. Even now, some hydrological aspects of the flood still need to be resolved, and will probably be reported on in detail at some future date.

1. GENERAL BACKGROUND INFORMATION

The Wairau River catchment has an area of 416 436 hectares. Historically the 26 600 hectare flood plain of the Wairau River and a number of smaller rivers on its southern side, has suffered severely from floods. It is the most intensively farmed area in Marlborough where horticulture is now becoming the major land use. About 24 000 people live on the flood plain, including 18 300 in the Borough of Blenheim. The area extends 25 km inland from the coast and is protected from flooding by 160 km of stopbank along rivers and the five major diversion channels built over the last 106 years.

Because of a series of geological and historical accidents, Blenheim is located where many natural flood overflows join together, including a second channel of the Wairau River, known as the Opawa. Early river works in the Provincial Council era were concentrated on protecting the town, and later, rival River Boards fought each other to protect their districts, until they were amalgamated in 1921 following a Royal Commission.

Until the formation of the Marlborough Catchment board late in 1955, the Wairau River Board maintained a precarious situation where overflows and breaches of the Wairau River stopbank system happened every few years.

From 1960 to 1975, financial assistance from government enabled the Catchment Board to build a major modern river control and drainage scheme This 'Wairau Valley Scheme' substantially improved the existing stopbank system, incorporating a major diversion to take some Wairau River floodwater and New Zealand's largest flood detention dam in the hills to the south of Blenheim. The drainage works provided 160 km of community drains in the lower flood plain with 37 flood and drainage pumps in 22 stations which provide drainage and remove stormwater during floods.

Since 1960, capital expenditure on river control works throughout the Wairau catchment has totalled $36 million, in present day value, and $2.8 million has been spent on drainage and pumping works. Total expenditure including maintenance and other associated costs is around $57 million, in present day value, of which 62% was contributed by Government.

1.1 The River Control System

There are two parts to the Wairau River Control System and their different functions are important in considering the effects of this flood :-

a) A Stopbanking System along the right bank from the Waihopai River confluence downstream, and on the left bank from just above Tuamarina. The areas protected by these stopbanks are rated for flood protection.

b) A Channel Training System consisting mainly of rock faced training banks whose purpose is to contain the active channel to protect the stopbanking system from attack by the river and to avoid erosion of adjacent land. Many of these training banks also provide some flood protection, but the adjacent land is only rated for erosion protection. This system extends further upstream than the stopbank system, and has enabled large areas to be developed for farming in recent years in the Wairau Valley, Hillersden and Northbank areas.

1.2 The Telemetry System

For over 20 years, the Board has operated a few flood warning telemeters which provide river information on request. For a number of years, only the telemeters at the Branch River and Wairau River at Tuamarina have been operating. This equipment is now outdated and has been difficult to keep going. In 1975, the Board submitted a proposal to government for a new comprehensive data telemetry system. This initiated nation wide consideration of such systems. At present, the situation has been reached where some electronic firms have developed this type of equipment, and the Catchment Authorities with the Ministry of Works and Development have had equipment developed to a specification which is about to be field tested. Some Boards, including ourselves, have been unhappy about the rate of progress with the 'official' telemetry development. Two Boards have already obtained other equipment. Last year we called tenders, but because of incomplete technical details were unable to accept any of the tenders. At present, with three North Island Boards we are considering new tenders for the equipment.

The new system will be a complete data collection system for river levels, rainfall and other measurements, with the information being automatically processed through the Board's computer. It will be able to remotely control the operation of pumps, control gates, etc.

Because of the Branch Hydro intake works which are partially completed, the Branch telemeter has not been fully operable as damage has occurred to the telephone lines at intervals during construction. Water levels at the recorder have also been affected by the Hydro works. When the intake is completed a new recorder will operate just upstream of the intake weir.

2. METEOROLOGICAL SITUATION AND RAINFALL 7TH-10TH JULY

2.1 Meteorological Situation

A deep complex depression and fronts which formed in the northern Tasman Sea moved south preceded by a warm moist northerly flow. A rainfall alert for persistent rain over 36-48 hours with 100 mm in the northern Marlborough high country was received verbally from the Forecaster at the Meteorological Service shortly before midday on Friday 8th July. This was advised to a number of authorities. Civil Defence was advised independently and the possible effect of the predicted rain was discussed briefly with the recipient.

The Forecaster's prediction of the length of the rain was fairly accurate, but rainfalls in the period were much larger than was predicted.

The existence of snow on the catchments and its melting in the warm conditions contributed to runoff during late Friday and Saturday and was a

particular feature of the gradual build up of river flows. This is a relatively unusual occurrence in the Wairau Catchment. However, on top of what became a substantial flood and highly saturated catchment conditions, it was the more intense rain on Saturday evening to early Sunday morning which caused the rapid increase in flood flow from what had been a relatively slow and drawn out rise of the flood.

2.2 Rainfall

Over most of the Marlborough-Nelson-West Coast areas, the rainfall over three days was not exceptional. At the Cobb and at the Waihopai, return periods were between 10-20 years, yet at Wairau Valley were about 50 years. In many places, including Blenheim and the Rai Valley, return periods for the three days were between 2 and 5 years. However, most rain in Marlborough fell over a 48 hour period. More importantly, there was a build up of intensity on Saturday evening culminating in some extreme rain for a short period early on Sunday morning. This is best illustrated by the following rainfall intensity chart which shows the rain at the Branch recorder and at the Beneagle in the Taylor Catchment.

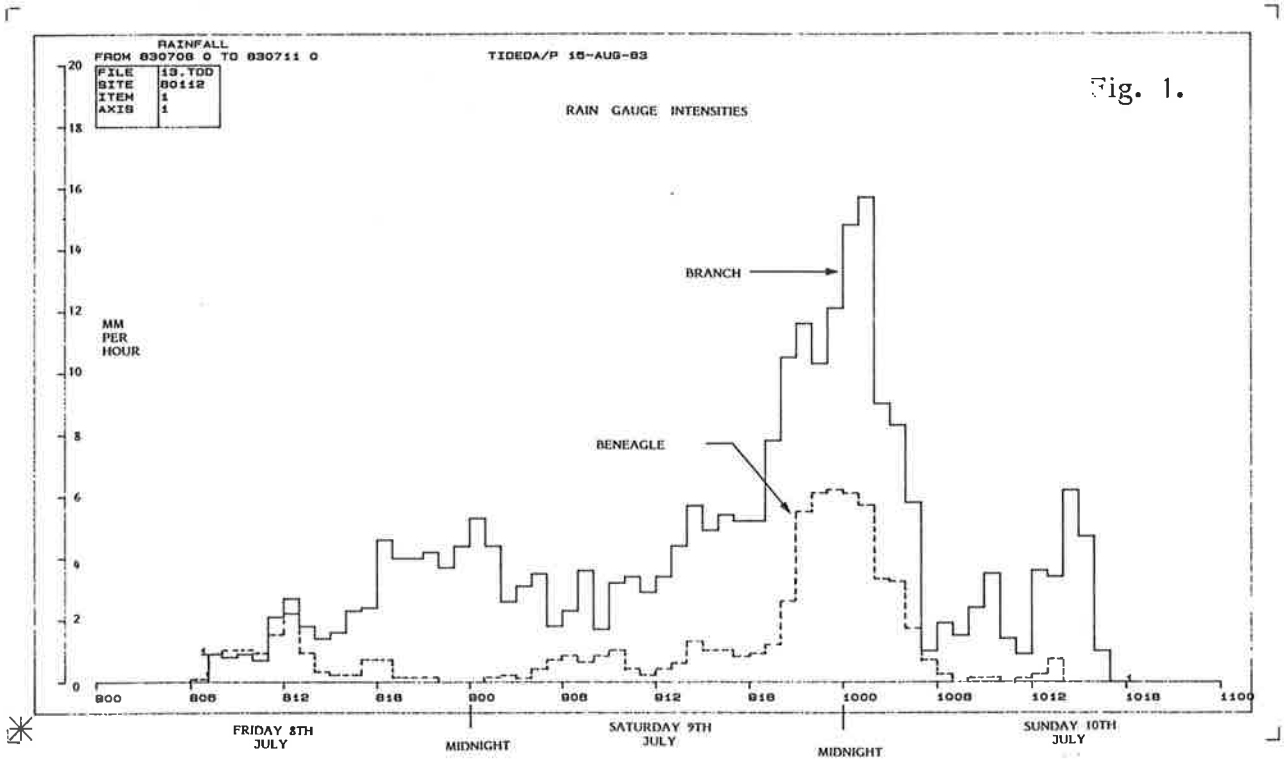


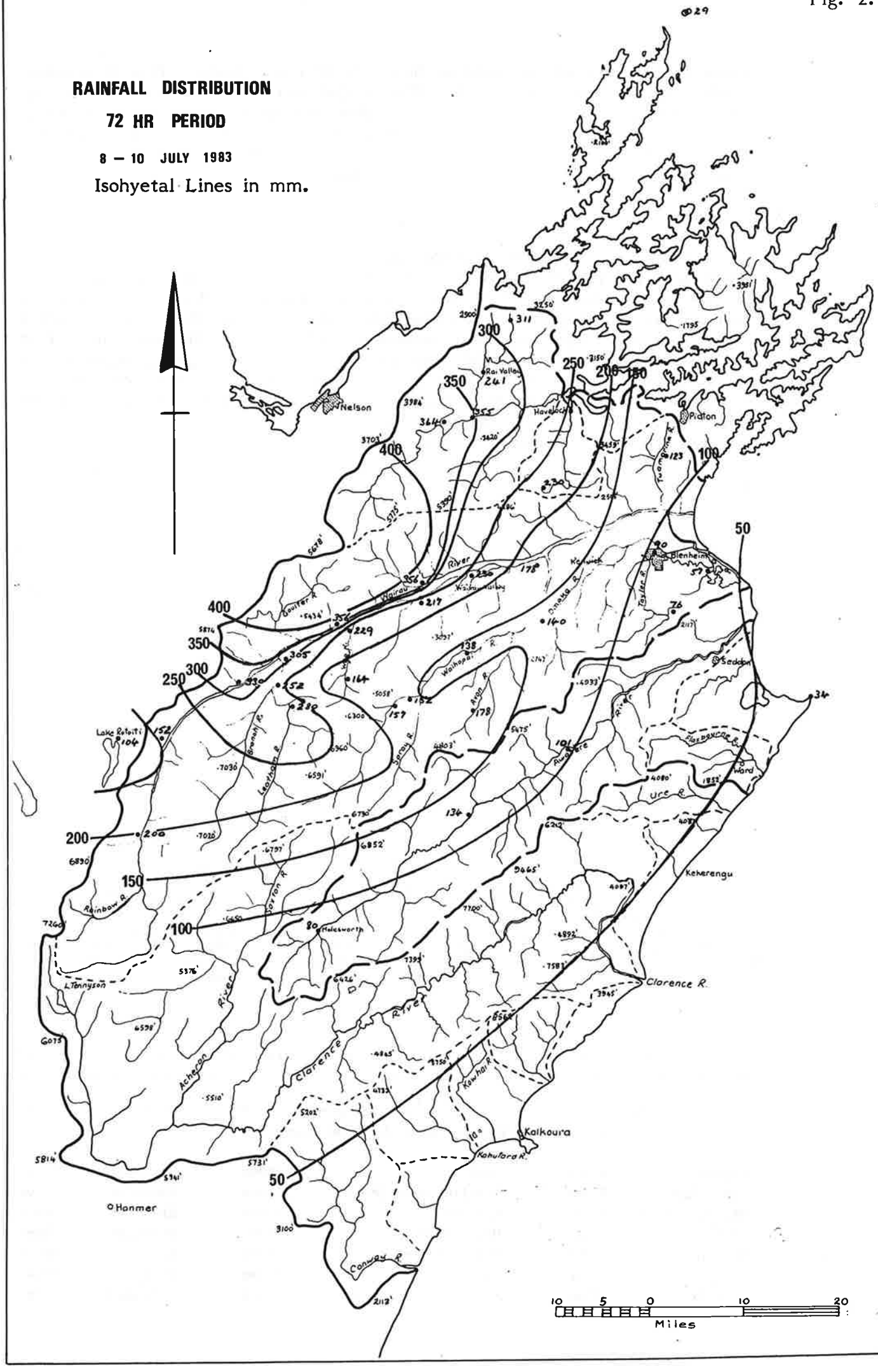
Fig. 1.

These higher intensities must have a relatively rare return period, but further study is needed to complete this part of the flood assessment.

Rainfall contours (isohyetals) are shown on figure 2 for the full rain period. The following are falls over the same period at selected places:

Pelorus	355mm	Leatham	280mm	Stronvar	157mm
Canvastown	255mm	Charlies Rest (Wye)	164mm	Koromiko	123mm
Mt. Patriarch	356mm	Ngaruru	305mm	Blenheim	90mm
Raglan	330mm	Hillersden	217mm	Beneagle	76mm
Branch	252mm	Wairau Valley	230mm	Awapiri	101mm
Dip Flat	200mm	Leefield	140mm	Upcott	134mm
Lake Rotoiti	104mm	Waihopai Power Station	138mm	Molesworth	80mm

Fig. 2.


RAINFALL DISTRIBUTION
72 HR PERIOD
8 – 10 JULY 1983
Isohyetal Lines in mm.
Nelson
Rai Valley
Havelock
Picton
Blenheim
Seddon
Ward
Kekerengu
Clarence R.
Kaikoura
Hanmer
Lake Rotoiti
L. Tennyson
Rainbow R.
Waiau
Clarence River
Conway R.
Kowhai R.
Kahutara R.
Miles
10 5 0 10 20

3. RISE OF RIVER AND FLOODWARNINGS

As it was known that the Branch River floodwarning telemeter was inoperative, initial alerts were issued to those affected by smaller river rises on Friday afternoon. On Saturday afternoon, largely on the basis of 'rough' information from the Branch hydro weir and on Northbank rainfall observations, a complete series of warnings was issued by 1700 hours. This included an alert for Civil Defence and the prediction was for a flood in excess of 5.8 m (19 ft) at Tuamarina. At 1400 hours, the Wairau was at the 4.3 m (14 ft) level.

At 1545 hours on Saturday, a request was received from the Marlborough Electric Power Board to provide rock for emergency protection at the Branch River hydro intake. This was made available from the Pukaka Quarry. The first trip by ten trucks (including two County and one Board truck) left by 1730 hours. Two subsequent trips were made, the last (not including the Board's truck) left at 1.04 a.m. on Sunday. These trips provided useful information on conditions, and with some rainfall data and the river rise at Tuamarina indicated that a major flood was likely, probably about the size of the April 1975 flood. The river had entered Morrins Hollow about 1930 hours and was rising relatively slowly at Tuamarina by 0.2 metres (0.67 ft) per hour, and reached 6.2 m (20.3 ft) by midnight. Heavy rain was obviously falling at that time. Just after 2.00 a.m. we received reports of overflows at Upper Conders. This confirmed our assessment of a flood greater than the 1975 flood which rose to 7.4 m (24.2 ft) at Tuamarina. Civil Defence Sector Wardens for the Lower Wairau and Renwick were advised, as was the Civil Defence Officer who then manned the Civil Defence Headquarters.

The river continued to rise at about the same rate at Tuamarina, and by 5.00 a.m. had reached 7.3 m (23.8 ft), and on this basis and the timing of the cessation of rainfall, a late morning peak of about 7.6 m (25 ft) was anticipated.

About this time reports of actual and potential stopbank overflows in the Rapaura area commenced. Board staff, Civil Defence personnel and landowners then became involved with sandbagging overflows. By 6.30 a.m. it was apparent that this was a very large flood. All these events were occurring in the dark, which made it difficult to accurately assess the situation. The peak level of 8.5 metres (28 ft) occurred at Tuamarina at 10.30 a.m. at which time there were already 2 major breaches. The maximum pre-Diversion peak at Tuamarina was 7.5 m (24.54 ft) in 1962.

Although these reports of overflows from Upper Conders were received at 2.00 a.m., this confirmed what was then expected. The very rapid rise in the river which started after that time was not anticipated. Although we were receiving information from people up river, it did not indicate the size of flow which eventuated. Only a much more sophisticated data telemetry system could have done that. The lack of the usual telemetry readings from the Branch River seriously affected our ability to understand the event.

Although all usual warnings were sent out in plenty of time for stock to be removed, and Civil Defence was activated, we were unable to do much more with the information that we had available. It is now apparent that information received from Civil Defence at Renwick at 3.40 a.m. indicated at least the initial overflow at Lower Conders, but was misinterpreted at the time. It was not until 9.10 a.m. that we became aware of the breach in that area.

The overflow of the Spring Creek stopbanks had been anticipated, and Civil Defence took this matter in hand. We did not expect the overtopping of the Tuamarina stopbanks, which was caused to a large extent by the failure of the upstream end of Barnetts Training bank. Had we been aware of that happening, then a warning might have been given, but at that stage, it was apparently not possible to reach Tuamarina. Neither were we receiving any information from

people in that area.

There has been some criticism because of the lack of warning prior to water overtopping the stopbanks in some areas. In some places the initial warnings by Civil Defence and others were not heeded, and unfortunately some warnings did not get to those involved. It is very apparent that a better system of warning and providing information is needed. In future, we should not rely on this being disseminated by the Police or Civil Defence. Some recommendations are made about this later in the report.

Although overflows occurred into the Opawa River, the only warnings issued were to Civil Defence and the A1 Motor Camp. This is an unfortunate gap in our warning system, although by daylight most of those in that area were probably aware of what was happening. There were some concerns about how large that flow would become, and water escaped upstream of Jacksons Road through a number of unauthorised holes put through the stopbank to lay irrigation pipes.

Valuable information was received during the initial stage of the flood from Brian Powell at Fabians Creek, Alex McIntyre at the Narrows and Allen Gifford at Conders. I would like this assistance to be recorded and that they be thanked.

4. FLOOD HYDROGRAPH AND PEAK DISCHARGES

4.1 General

Because we are in the midst of a change-over from chart recorders to punch tape digital recorders, and have yet to receive all the necessary equipment to quickly process the tapes, there are still some rainfall and river data that has not yet been processed. A detailed search has yet to be made to see if the metallic tapes can be found from the Goulter Recorder and the Narrows recorder on the Wairau which were destroyed. Further detailed study of the flood is still needed, and it will be some time before the final document on rainfall and river flows can be completed. At this stage, it is only possible to make a further interim assessment of the peak discharge, but even after further study it is likely that no better assessment is available.

4.2 Flood Hydrograph

The shape of the flood hydrograph is unusual for the Wairau River. After a study of rainfall and other flow records, it is apparent that three separate hydrographs were superimposed. These were due to :-

a) The long rainfall period of about 36 hours from before midday on Friday until 1900 hours on Saturday which included the effect of warm conditions and rain on snow.

b) The more intense rain during Saturday evening which continued in most areas until about 2 a.m.

c) A period of intense rain which fell from midnight to 2 a.m. over the middle of the catchment creating very large peak flows in the Northbank above Bartletts Creek and from the Wairau Valley-Hillersden-Branch foothill areas. The resulting hydrograph at Tuamarina shows a relatively slow rising flood until 6 a.m. on Sunday (See Fig. 3) when there was a short rapid rise, followed by an apparent peak. This was followed by a futher rapid rise from 9 a.m. to 10.30 a.m. when nearly a 30% increase in flow appears to have occurred at the Tuamarina bridge. At first sight, the false peak between 6 a.m. and 9.30 a.m. was thought to have been caused by upstream overflows. While these may be partly responsible it is more likely that this peak was caused by the intense two hour rain in the middle of the catchment early on Sunday morning. This is

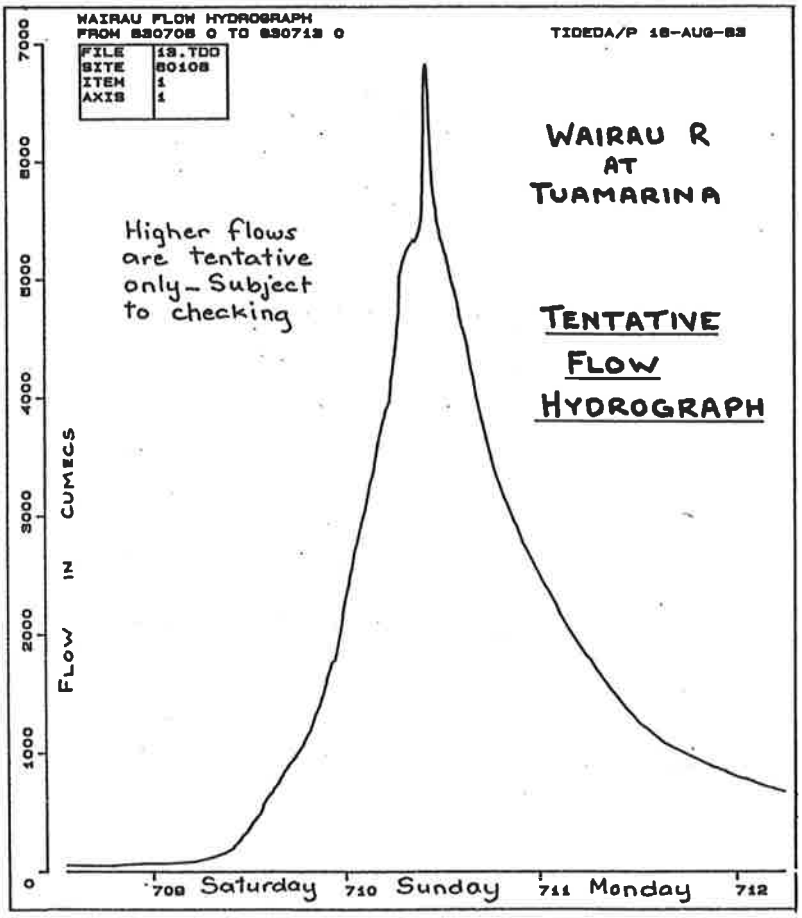
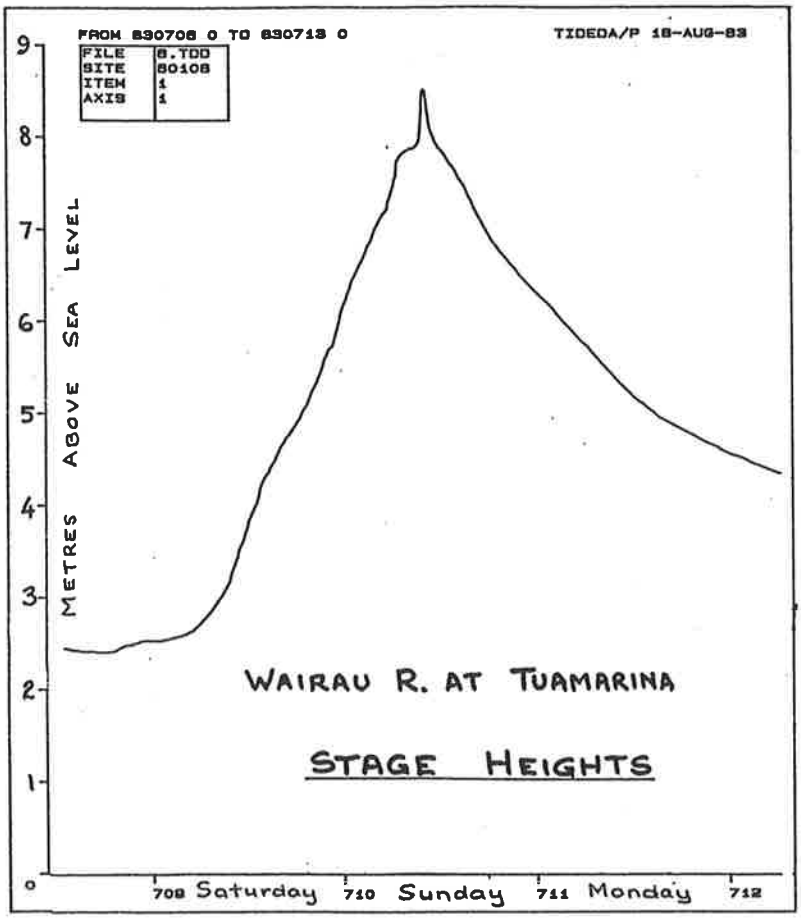

WAIRAU FLOW HYDROGRAPH
FROM 830708 0 TO 830713 0
TIDEDA/P 18-AUG-83
FILE 18.TDD
SITE 80108
ITEM 1
AXIS 1
WAIRAU R
AT
TUAMARINA
Higher flows are tentative only - Subject to checking
TENTATIVE
FLOW
HYDROGRAPH
FLOW IN CUMECS
0
1000
2000
3000
4000
5000
6000
7000
708 Saturday
710 Sunday
711 Monday
712

Fig. 3.


FROM 830708 0 TO 830713 0
TIDEDA/P 18-AUG-83
FILE 8.TDD
SITE 80108
ITEM 1
AXIS 1
METRES ABOVE SEA LEVEL
0
1
2
3
4
5
6
7
8
9
WAIRAU R. AT TUAMARINA
STAGE HEIGHTS
708 Saturday
710 Sunday
711 Monday
712

perhaps verified by a similar shape on the Wye Recorder chart, but does not show on the Waihopai river record. Unfortunately, there is no record of the peak at the Branch River, only a maximum flood level which is within the recorder house. Here the record is affected by the partly built Branch Hydro intake.

More study of the situation is needed before the interpretation of the data can be finalised.

4.3 Flood Peak

Any assessment of the flood peak must be based upon information from the Tuamarina recorder. However, with the very rapid rise to the final peak, levels are affected by the lack of a uniform flow down the lower river system. For a given level in these circumstances, a greater flow can be passed compared with a fully developed uniform flow situation that is usual during Wairau floods. This complicates the assessment of the size of this flood. The following information describes flood levels and assesses discharges, overflows, etc.

4.3.1 Flood Levels and Peak Discharge down the Wairau River Channel from the Tuamarina to the Wairau Bar

The peak flow during this flood was the greatest quantity of floodwater which has been carried to the sea in this length of channel. Flood levels were generally 150 mm to 200 mm above 1962 flood levels and averaged 500 mm above 1975 levels in the length of river from the Ferry Bridge to Jones Road. The 1962 flood was prior to the completion of the Wairau Diversion and considerable stopbank overtopping occurred in this reach. Because of this the Board, immediately following the flood, prepared proposals for stopbank improvements which were to provide a minimum standard of 600 mm freeboard for a discharge of 2975 cumecs. On the recommendation of the National Authority the standard was reduced to provide 300 mm of freeboard, increased to 600 mm adjacent to houses. Stopbanks were improved to this standard in 1962-63. (This accounts for the step in the stopbank downstream of Watsons Road).

The 1975 flood levels coincided almost exactly with calculated design profile for 2975 cumecs. Estimated flow through this reach in 1962 was 3250 cumecs. On this basis the probable peak flow through the reach in 1983 was in the order of 3500-3700 cumecs, based on flow profiles downstream of Morrins Hollow.

Overtopping of stopbanks occurred in many areas, notably at Morrins Hollow on the left bank and on the right bank, downstream of Watsons Road to below the Grovetown Pumping Station, and downstream of Roses Overflow.

4.3.2 Wairau Diversion Flood Levels and Peak Discharge

Survey of the Diversion has yet to be done, and only an approximate discharge can be estimated on the basis of the peak level at the Diversion bridge based on earlier records. The probable peak flow through the Diversion was 2000 cumecs (at least).

Flood levels were the highest ever, but because the downstream section of the channel did not deepen as it has paved itself with large stones, most of the flood level gradient was in the 800 m length from the coast, over which there was a fall of 4 metres. This compares to a total fall of 7.9 metres over the 5300 m length from the Tuamarina bridges to the mouth of the Diversion. The steep gradient is between 4 and 5 times the river gradient at upstream of the Tuamarina bridges.

4.3.3 Flood Levels and Peak Discharge above Tuamarina to the Waihopai Confluence

Surveys of flood levels are completed but recording on plans has not yet been done. However, it is known that over the full length of stopbanks on the right bank from Tuamarina to the Waihopai flood levels were generally very close to the top of the banks. Overflows of stopbanks occurred in many places with the two worst areas being opposite Mrs Dobson's house, at the end of Wratts Road and at Phillip Roses between Bishells groyne and Giffords road. Minor overflows occurred just upstream of spur banks or access ramps. Flood levels generally appear to have been approximately one metre higher than any previous measurement and 400 mm to 700 mm above the calculated flood profile for the 200 year design discharge of 5100 cumecs.

4.3.4 Estimates of Losses from Overflows, Breaches, etc.

The estimation of overflows, breaches, etc., which were occurring at the peak cannot be entirely accurate. The following estimations have been made at this stage :-

a) Downstream of the Tuamarina Recorder

Overflows in the Morrins Hollow area	300 cumecs
Flow absorbed into raised flood levels	200 "
Back flow into Spring Creek (At this stage Spring Creek was being fed by the breach at the State Highway)	NIL
TOTAL	500 cumecs

b) Upstream of the Tuamarina Recorder

Flow in Tuamarina River into the Para Swamp (It was substantially greater prior to the peak)	250 cumecs
Overbank flow at Tuamarina Village	380 "
Stopbank breach at the south end of the S.H. B Bridge	120 "
Overflows between Tuamarina and Conders	10 "
Breach in the Lower conders stopbank	405 "
Overland flow at Upper Conders	400 "
TOTAL	1565 "

4.3.5 Estimation of Peak Wairau River Discharge

At Tuamarina Recorder

Lower River Channel	3700	
Diversion	2000	
Losses	500	6200 cumecs

(Note: This is less than the 6800 cumecs calculated from the tentative stage - discharge relationship at the recorder).

Plus

Losses immediately Upstream of the Recorder

To the Para Swamp	250	
Overbank flow	380	
S.H. Breach	120	750 cumecs

Plus

Upstream Losses

Bank Overflows	10	
Lower Conders breach	405	
Overland flow & Upper Conders	400	815 cumecs

Estimated Total Peak Discharge	7765 cumecs

(This does not allow for any storage losses between the Waihopai confluence and Tuamarina)

4.3.6 Opawa River Flow

Flood water which escaped in the Conders area traversed an extensive area of flood plain before it was finally channelled into the Opawa river. Under these circumstances a considerable reduction in peak flow would occur because of the effect of storage on land and possibly some loss into the aquifer.

Flood levels in the Opawa River system have not been analysed as yet but it is probable that when this is done it will be shown that flood levels in that system will indicate a flow of some 400 cumecs down Roses Overflow based on calculated flood profiles for the channel.

This reduction in flow during the passage of the overflow water down this channel is not unreasonable. The peak overflows probably occurred in the conders area between 6.00 and 7.30 hours. The peak flow arrived at the Grove Road bridge about 12.30 hours.