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

INDEX

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.

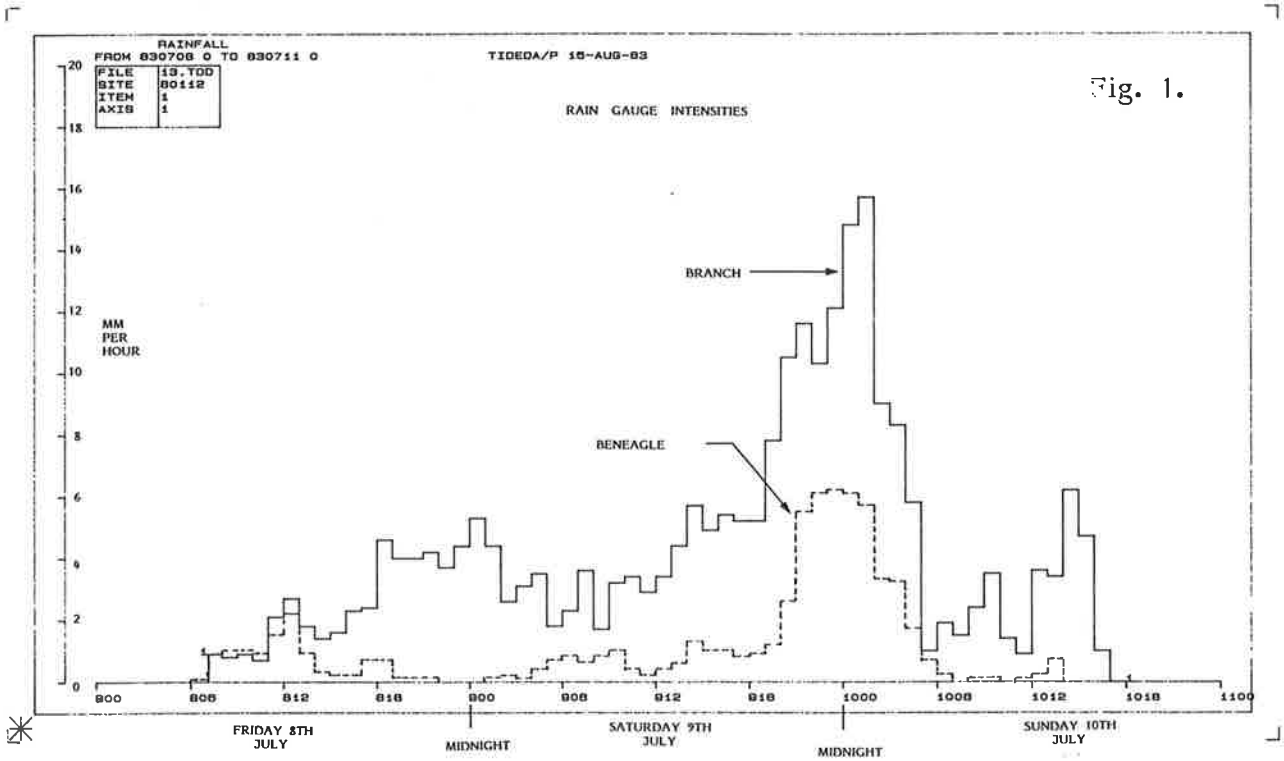


Fig. 1.

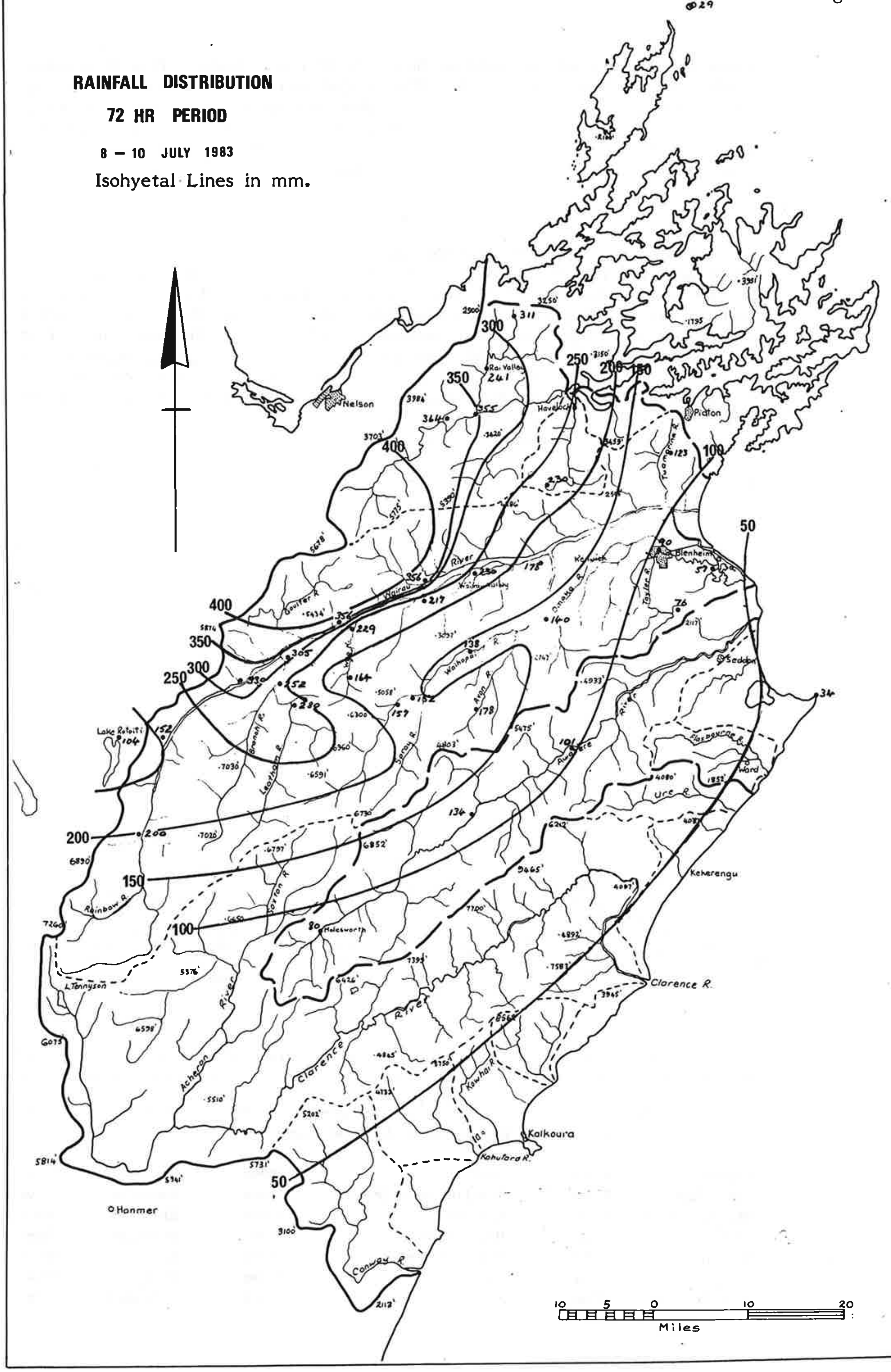
These higher intensities must have a relatively rare return period, but further study is needed to complete this part of the flood assessment.

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.



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

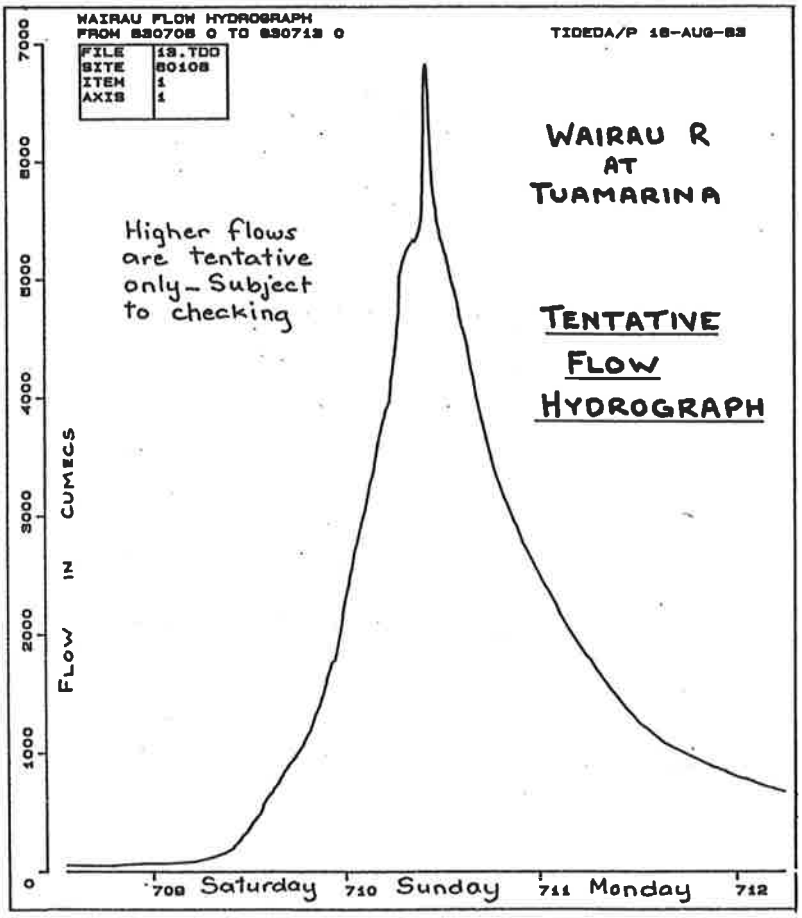
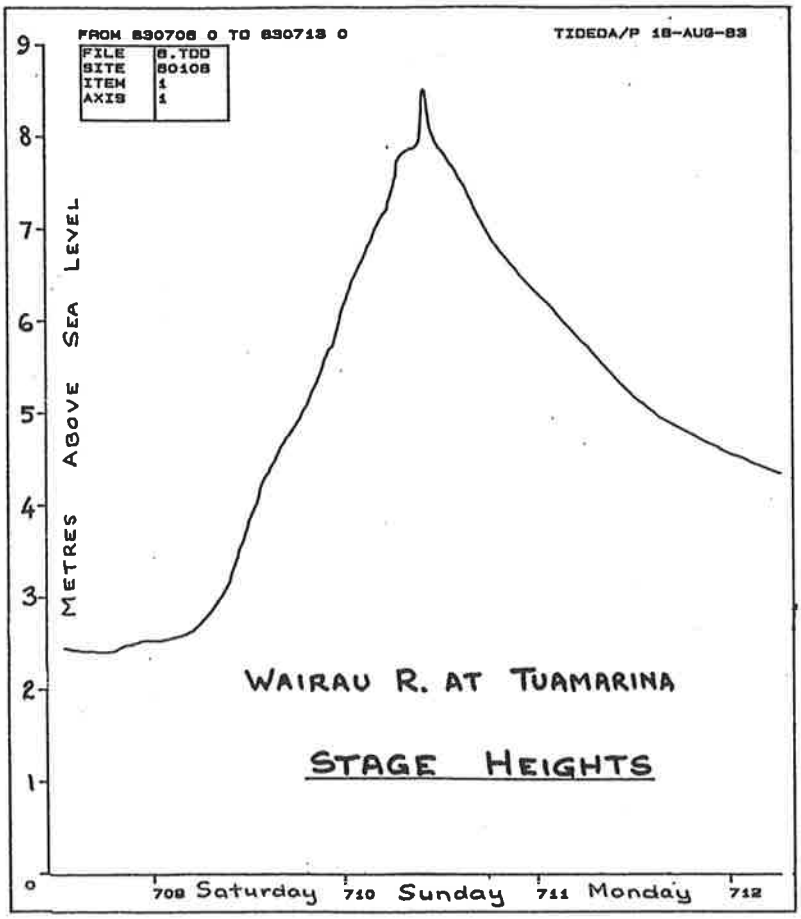

WAIRAU FLOW HYDROGRAPH
FROM 830708 0 TO 830713 0
TIDEDA/P 18-AUG-83
FILE 18.TDD
SITE 80108
ITEM 1
AXIS 1
WAIRAU R
AT
TUAMARINA
Higher flows are tentative only - Subject to checking
TENTATIVE
FLOW
HYDROGRAPH
FLOW IN CUMECS
0
1000
2000
3000
4000
5000
6000
7000
708 Saturday
710 Sunday
711 Monday
712

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.

4.3.7 Tributary Peak Discharges

Peak discharges of the main tributaries are still being assessed, using 'slope area' measurements.

4.3.8 Conclusion on Size of the Peak Discharge

The present estimate of 7765 cumecs (274 000 cusecs) for the peak discharge into the stopbanked flood control system is still approximate. The flow is so large and is 52% greater than the design flow, that its occurrence is not easy to comprehend. We have deliberately used conservative judgements to determine this figure.

It will be some time before detailed analysis can be done to confirm a final assessment. The fact that even at this stage it is not possible to assess the flood emphasises the problems in forecasting the final size of the event during the hectic few hours of Sunday morning.

5. FREQUENCY OF THE FLOOD EVENT

5.1 Return Period of the July 83 Flood

It is important to be able to predict within what time span a flood of this magnitude will occur again. Reaction from those affected tends to relate to the return of the event and not the likelihood of it happening again. The probability of natural events can be predicted statistically, but these predictions are more accurate when there is a longer record.

Detailed flood records for the Wairau River have been kept for nearly 50 years, and there is a reasonable historic record of major flood events for over 100 years. Only the 1868 flood defies reasonable estimation of its size. By New Zealand standards, this is a good length of record. These records have been rigorously examined and have been compared with estimations from the Regional Flood Frequency Procedures (NWASCO publication No. 57). The Wairau Catchment lies partly in both the South Island West Coast and East Coast regions. The frequency curves are shown on Fig.4.

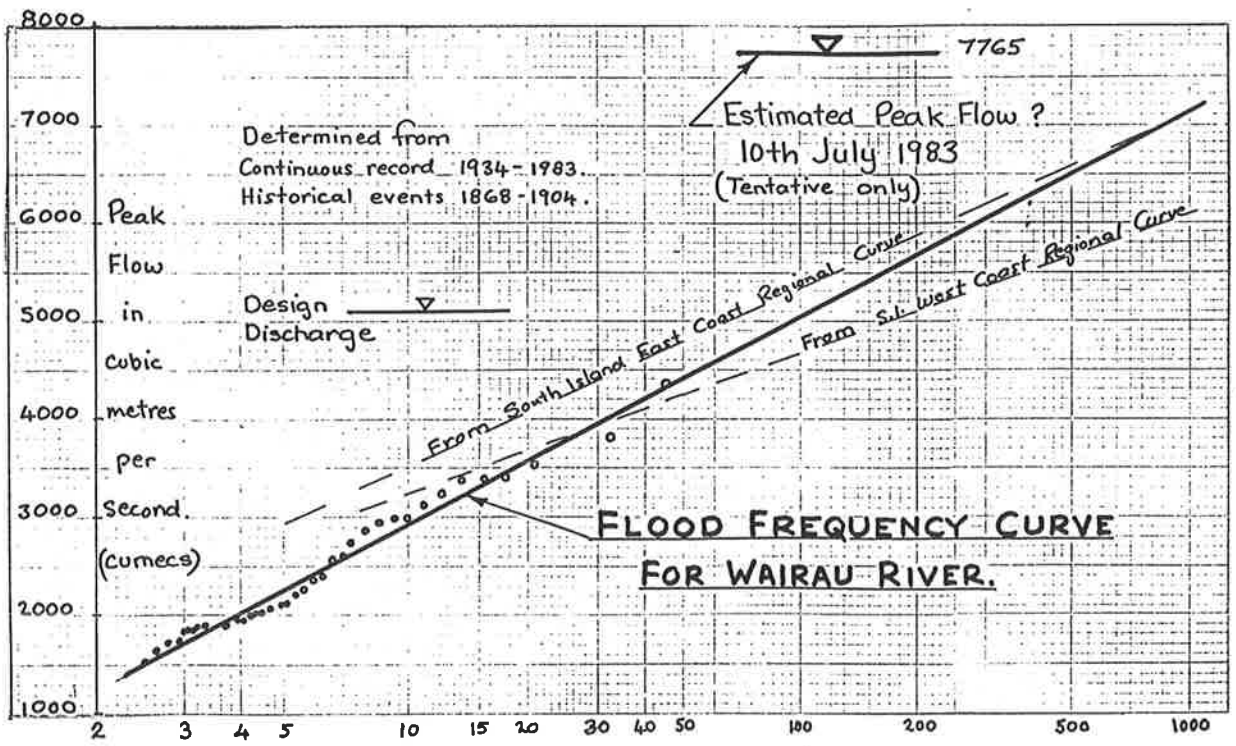


Fig. 4.

The 10th July 83 flood peak was so large relative to other floods in the record, that it plots as an outlier and cannot be directly compared in the record. It appears to have a return period of at least a 1000 years, but this assessment can be verified only after some hundreds more years of records are obtained. However, it can only be said that this was a very extreme event, which is unlikely to be repeated for a very long time.

5.2 Return Period of the Design Flood

Of greater significance is the change in probability values since the original 1959 analysis for the design flood. The usual standard for flood control schemes is a 100 year flood with freeboard. Because the Wairau Diversion and lower river system would ultimately achieve at least a 5100 cumec capacity, which it was estimated would not be exceeded more than once every 200 years, this was adopted as the design figure for Wairau River flood control works. The present probability analysis gives the design flood a frequency of just over 100 years. This is because of the affect of the 1962-1975 series of large floods which were significantly more numerous than those during any other period in the 100 years of record. Again, the correctness of this assessment will be affected by future flood events.

This means that the design flood may be exceeded more often than was first expected, but only once every 100 years instead of once every 200 years.

Now that it has been exceeded, the chances of another flood greater than the design flood is not very likely for many years.

6. OVERFLOWS AND BREACHES

Overflows and breaches have already been mentioned in Section 4 during estimation of the flood discharge.

6.1 Upper Conders

The first overflow occurred through the pine plantation at Upper Conders where a section of stopbank has not yet been built pending the full development of the Diversion. This has been left as a safety valve where some of the peak flow can be skimmed off. (See 4.3.6)

6.2 Lower Conders Breach

The next overflow and subsequent breach occurred at Lower Conders. Water from here passed through the Conders plantation down the old Opawa River bed where it caused damage to the Zoological Park.

Fig. 5.

The stopbank breach at lower Conders upstream of State Highway 6 about 7 hours after the peak which overtopped the stopbank. (Sunday)

6.3 Right Bank Overflows from Waihopai to Tuamarina Bridges

Stopbanks were virtually topped from Lower Conders downstream, to Tuamarina on the right bank. A serious overflow occurred below Giffords Road. Had it not been sandbagged in the dark, this would have created a major and very serious breach. Virtually the whole of the back face of the bank was destroyed. Other overflows at Wratts Road, Dobsons and in a few other places were relatively minor. Recently a new stopbank on a different alignment has been built over part of the section between Selmes and Cravens Road. The old stopbank would probably not have contained the flood without serious overflows.

6.4 State Highway Breach (Right Bank)

At both ends of the highway bridge the peak flood level was on the deck of the bridge and overflows occurred down the road approaches. Although the stopbank adjacent to the south end of the bridge was not overtopped, both the highway and the access road to the block factory and river bed were lower, but within the freeboard allowance, and overflows resulted in the scouring of a large breach early on Sunday morning.

Water from this breach overflowed the Spring Creek stopbanks and most probably went over the far stopbank into Spring Creek and the Grovetown-Lower Wairau area. This breach may not have significantly altered the situation at Spring Creek. It possibly only replaced the flow which was flowing up the Spring Creek from the Wairau River.

Fig. 6. Typical overflow in the Lower Wairau River. Some overflows were 0.3m deep.

6.5 Tuamarina Overflows and Breach

At Tuamarina, serious overflows to a general depth of about 0.3 m occurred right into the village. These commenced about 6.30 a.m. and ceased after midday. Water from here caused considerable damage and flowed to the east to eventually pond in the Pembers Road-Hunters Road area.

Fig. 7. Stopbanks overflowing at Tuamarina. The Wairau River and road and rail bridges in the background.

These overflows were made worse by the failure of the upper end of Barnetts Training bank. This failure occurred quickly with what seems to have been a relatively shallow overflow. The bank had previously been fairly heavily grazed, and the lack of a good grass cover may have accelerated the failure. In other overflows, the value of a good grass cover to reduce scouring has been very apparent.

Sandbag dam

Fig. 8. The Stopbank Breach at Tuamarina on Tuesday

When overflows ceased at Tuamarina, the pondage levels were below those of the 1962 flood. However, about 8.15 a.m. a breach occurred in the stopbank at Tuamarina on a road reserve near the 'Incident' site. Initially the breach was not significant, but it widened to cause a second wave of floodwater which flowed until about 11.30a.m. on Monday when the remaining small flow was sandbagged. Unfortunately, during the events at Tuamarina information about the breach did not reach Civil Defence, the Board, or residents in the Pembers Road-Thomas Road area until the afternoon, at which time it was too late to remove stock.

Later in this report I make recommendations for the improvement of safety standards at Tuamarina.

6.6 Northbank of the Wairau River

There is no formal stopbanking system on the left bank of the Wairau River, although many training banks provide significant flood protection.

A major training bank failure caused a large overflow from downstream of the Rock Ferry bank towards the State Highway and Gibsons town. At Williams there was also a failure of the training bank. These were both caused initially by overtopping.

6.7 Spring Creek Overflows

The Spring Creek stopbanks were not raised as part of the Wairau Valley Scheme works, so overflows of these banks were expected after the Wairau River flow rose beyond 4300 cumecs. Some sections were sandbagged, but there were substantial overflows along most of these banks. However, there were no breaches and relatively little damage was caused to the stopbanks. Some water from these overflows passed through the eastern end of the township and railway yard storage sheds. The rest either flowed down the State Highway to Drain 'O' or entered Drain 'O' by overflowing from the Junction to the Rapaura Road bridge. Water eventually ponded in the Watsons Road, and Grovetown-Lower Wairau areas. Gravity drainage was available at the Ferry bridge early Monday morning. Sandbagging at the Ferry bridge approach was apparently started too late and bags could not be held. A very substantial flow came through here, and could have caused failure. Filling around a Post Office cable duct was all washed out, but luckily the trench did not scour.

6.8 Left Bank Overflows Downstream of Tuamarina

The secondary stopbank from the Railway Bridge to Bothams Bend was overtopped to a minor extent, and the water ponded between this bank and the main stopbank. However, the ponded level probably resulted more from the flooding at Blind Creek than from this overflow.

Fig. 9. Floodwater from the overflow of Spring Creek stopbanks passing through the township of Spring Creek. (Sunday)

There were no overflows of the Diversion stopbank, but downstream of the Diversion overflows occurred at the access road to Bothams Bend Island at Aberharts and at the downstream end of Morrins Hollow where there was substantial overflow. A few minor overflows occurred downstream and some stock tracks were sandbagged. This water ponded in the Wairau Pa area to a level which was similar to 1962 when virtually the whole length of stopbank overflowed and was breached in two places. This indicates the severity of the overflows around Morrins Hollow during this flood.

6.9 Right Bank Overflows Downstream of the Ferry Bridge

Overflows occurred at a number of places to downstream of Steam Wharf Road at Grovetown. Many of these were sandbagged. There was also an overflow downstream of the Bluegums pumping station into the Dillons Point area, and over the Lower Riverlands stopbank south of Hardings Road.

Fig. 10. Marlborough Express Photo

7. PASSAGE OF FLOOD WATER OVERFLOWS AND PONDAGE

During Sunday escaping floodwater passed over 4350 hectares of farmed and urban land, and on Monday was ponded on 1650 hectares. Maximum depth of 2.7 m was at Pembers Road. Breaches in stopbanks were made to commence removing the bulk of the ponded water. On Monday, two breaches were made in the Pukaka stopbank, one by the board and one by residents and a breach was made in the Spring Creek stopbanks west of the State Highway. On Tuesday the Roses Overflow stopbank was breached to remove ponded floodwater from the Lower Wairau area. The rest was removed through gravity outfalls and by pumping. By the end of the first week only small pockets of water remained on farmland.

The extent of these is best shown on the adjacent map. A full sequence of aerial photographs showing pondage was taken at intervals during the next ten days.

7.1 Removal of Water at Pembers Road-Thomas Road Area

There has been public criticism of the Board's actions over the removal of ponded water from this area. On Sunday there was no known access to the area, and both the Board and Civil Defence staff were fully committed with saving potentially dangerous situations. It was known that stock were in danger of being drowned and that the breach at Tuamarina was putting more water into the area. There was no way to stop the rise in water level. Only two residents in the area maintained any contact with the board.

At 20.55 hours, Mrs Freeth rang and at our request obtained some information about water levels at Pembers Road. At that stage, the Pukaka Stream was higher than the level of the ponded floodwater.

My first priority on Monday was to assess this situation and to commence the earliest possible removal of the floodwater. My own knowledge of this area is considerable, including the measures required to remove water after the 1962 flood.

The operation was discussed with the Sector Warden at Spring Creek Civil Defence Headquarters before daylight and arrangements were made with the Rarangi Post Warden to assemble a group of volunteers to open a breach by hand, should that be necessary.

At daylight, while I inspected the breach at Tuamarina and requested urgent sandbagging to stop the remaining flow, one of the Board's staff managed to reach the Pukaka area via the stopbanks from the Tuamarina bridges.

At that time, the levels of the Pukaka, the ponded floodwater, and the Diversion were equalising and outflows were commencing. There was still an overflow into the formal pondage area to the east of the Pukaka which continued into the afternoon. A small dozer from Chaytors was eventually used to make a breach at 9.45 a.m. south of the Pembers Road pumping station. This was not the most effective means of making the breach and throughout Monday we endeavoured to improve the cut. The Mustang Excavator was tried but could not safely negotiate the narrow stopbank. Improvements were made with a larger dozer, and the Board's Smalley excavator was brought in after dark and improved the cut at daylight on Tuesday. Despite comments being made by some people, this operation was arranged by the Board and was being done at the direction of Board staff with the assistance of the Rarangi Post Warden.

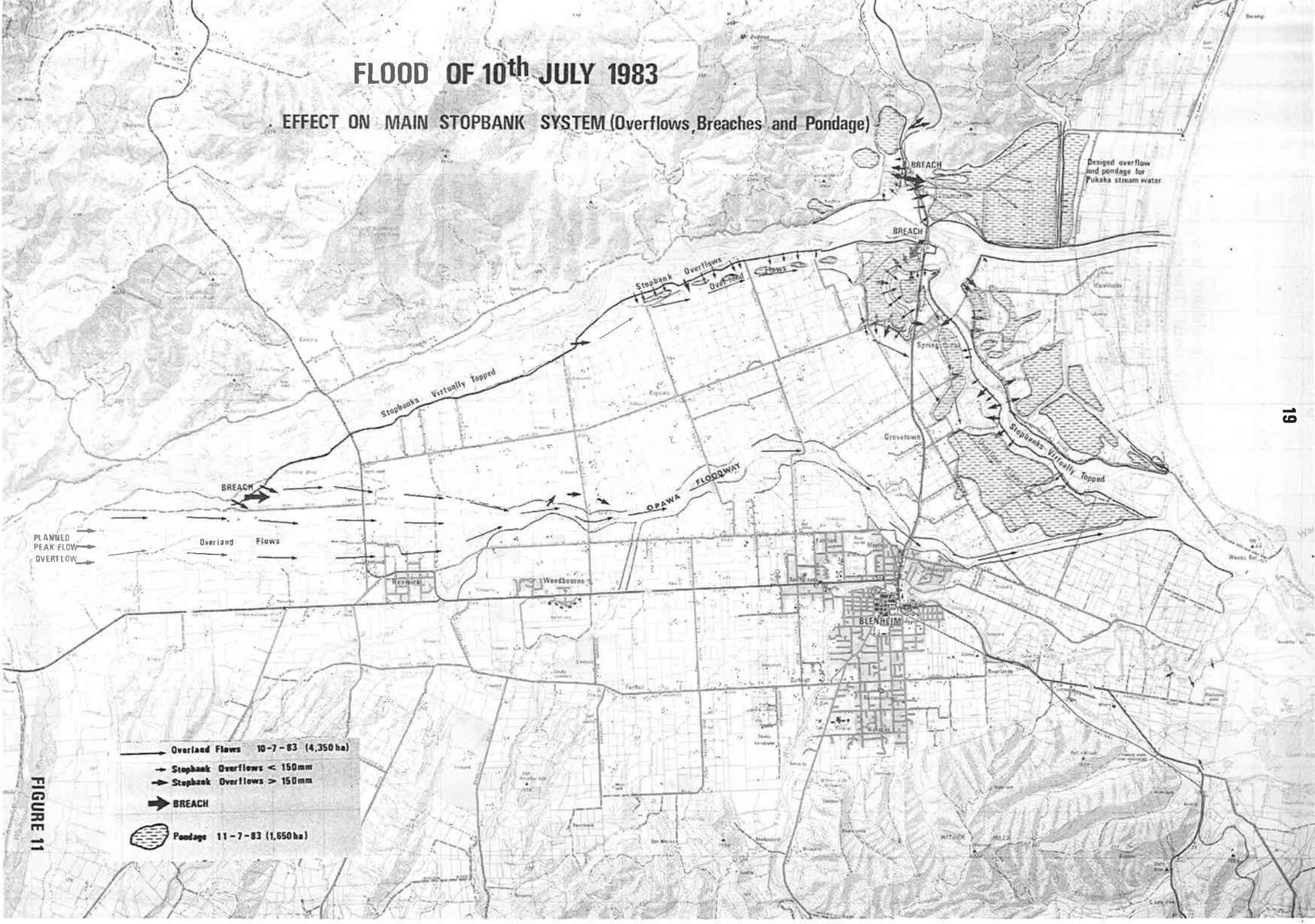

FLOOD OF 10th JULY 1983
EFFECT ON MAIN STOPBANK SYSTEM (Overflows, Breaches and Pondage)
BREACH
Designed overflow and pondage for Pukaka stream water
BREACH
Stopbank Overflows
Overland Flows
Stopbanks Virtually Topped
Spring Creek
Grovetown
Stopbanks Virtually Topped
BREACH
OPAWA FLOODWAY
PLANNED PEAK FLOW OVERFLOW
Overland Flows
Redwoods
Woodbourne
BLENHEIM
Overland Flows 10-7-83 (4,350 ha)
Stopbank Overflows < 150mm
Stopbank Overflows > 150mm
BREACH
Pondage 11-7-83 (1,650 ha)

FIGURE 11

There were obviously some communication problems with some residents in the area that did not become apparent until Tuesday. Lack of direct contact with the Board and our reliance of apparent contacts through the Civil Defence organisation appears to be the problem. I have suggested to the Civil Defence organisation they they ensure that direct contact is made between people with specific requests and the agency with statutory responsibilities.

Late on Monday morning, residents opened up a small breach in the Pukaka stopbank near Thomas Road, which was enlarged by the Board on Tuesday. The removal of water was not solely through the two breaches and a large proportion of water was removed through culverts at Pembers Road, Bothams Bend, at the Thomas Road pumping station and into the Pukaka at Thomas Road, and also to a small extent by pumping. Both pumping stations were kept working but their contribution was ineffectual until only surface water remained. It was politically expedient to keep them operating, and at one stage, it would not have been easy to switch off the Thomas Road station. However, the continued running of these pumps while their thrust bearings were underwater has caused bearing damage.

A close watch was kept on the progress of water removal, and improvements were made to the breach at Pembers Road on a number of occasions. Despite the larger volume of water, the area was cleared of water much faster than it was in 1962.

Later in the report, the possibilities of further improving the removal of water are discussed.

8. STOPBANK EROSION AT WRATTS ROAD

This section of stopbank had been overtopped without damage before daylight. Later in the morning the failure of two wing banks that had been severely overtopped caused raw scars on the side of the stopbank in two places. These areas commenced to erode, and about 10 a.m. the stopbank was being quickly eroded and evacuation of residents commenced. The lower erosion was being partially held back with gates and sand bags. At that time it was not thought possible to avoid a breach at the other point, a short distance downstream of Wratts Road, where erosion had nearly reached the back batter. However, by using gates and sand bags the erosion through the bank was reduced. By 10.25 hours there was some hope and by 11.00 hours it was apparent that the bank might be held, but with substantial effort. When erosion was stopped at one place it progressed downstream, so eventually a substantial length of stopbank was held using a combination of wired gates and sand bags.

On occasions the stopbank was nearly lost, and the potential for failure continued until Tuesday. This work strained local and Board resources and was continued using volunteers in shifts throughout Sunday night. At 13.45 hours on Sunday these volunteers were called for by the Police and Civil Defence over Radio 2ZE, and the response was overwhelming. In all, over 300 people worked until 4 a.m. on Monday morning and Board staff and others continued through until Tuesday.

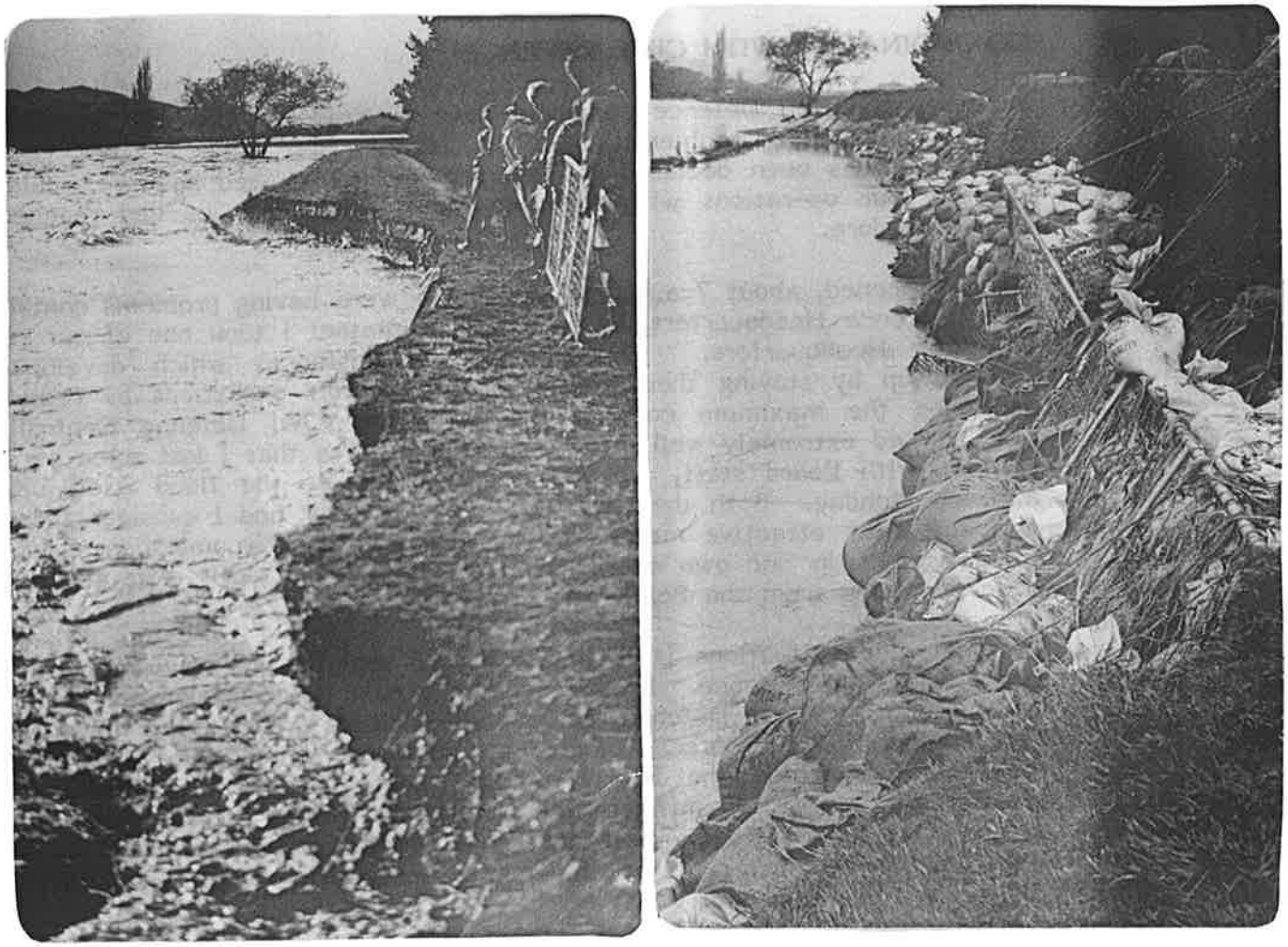


Fig. 12. 10.25 a.m. Sunday erosion starts Wratts Road Later

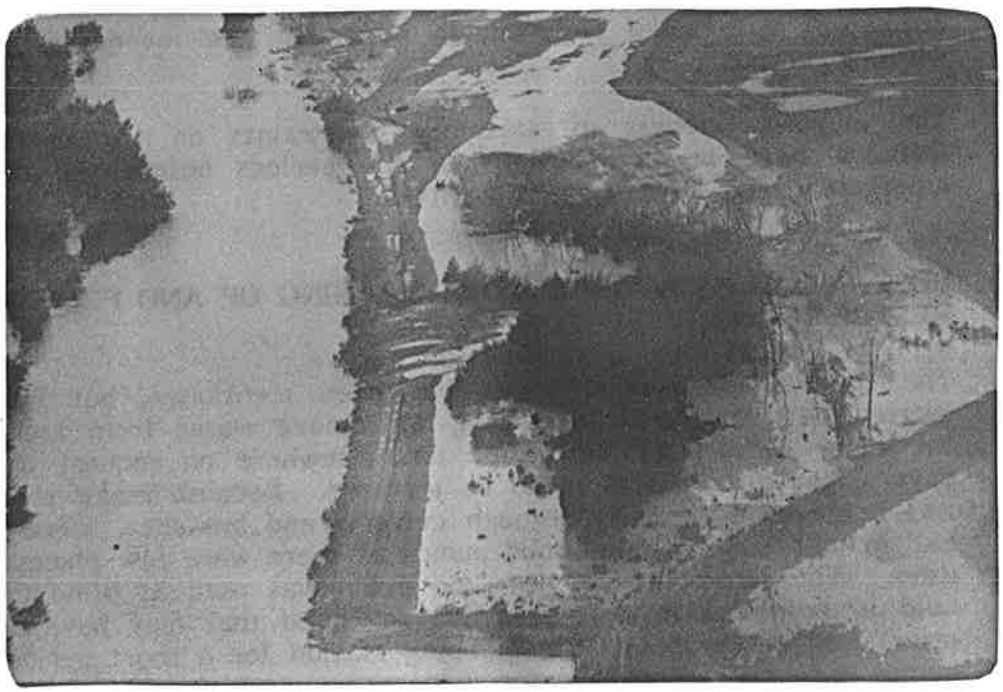


Fig. 13. Failure of a river training bank with the flood control stopbank to the right. (Monday).

9. CO-ORDINATION WITH CIVIL DEFENCE

In the past, Civil Defence personnel have assisted the Board unofficially to deal with flooding problems, but this is the first time a Civil Defence emergency has been declared. I had previously discussed how we would co-ordinate our operations with the late Mr Hegglun, but we had reached no firm procedure.

As it happened, about 7 a.m. on Sunday we were having problems contacting Civil Defence Headquarters, so to establish contact I took one of our radios to their Headquarters. Through the circumstances which developed, I finished up by staying there, directing the Board's operations by radio and achieving the maximum co-ordination with the Civil Defence Controller. This worked extremely well. My only concern was that I lost some personal contact with Board staff, and did not actually see the flood itself until 5 a.m. on Monday. Both the Civil Defence controller and I consider that this was the most effective method of operation in the circumstances, although some aspects in our own operations may have been more effective, had I been operating from the Board office.

In local flood situations it is impossible to separate the operations of the Board and Civil Defence. In this event the past co-ordination and unofficial exercises with Civil Defence during other flood events were invaluable. Their manpower resources, including personnel from the RNZAF Base Woodbourne, enabled the Board to cope adequately with serious overflow situations, and later to mitigate the potentially serious erosion threat to the stopbank at Wratts Road. Both the Civil Defence organisation and ourselves were unable to muster all our manpower because of people being out of the district for the weekend.

Following the flood I have attended de-briefing sessions with Civil Defence, and certain improvements in a number of aspects are being considered. Useful lessons have been learnt by both our organisations. Recommendations are made in Part B Sections 2 and 3 of this report that involve aspects of co-ordination with Civil Defence, in particular the means of giving adequate warning.

The inappropriateness of statutory constraints on the operation of Civil Defence have become obvious in the periods before the declaring of an emergency, and later when it is lifted.

10. POST FLOOD ASSISTANCE WITH CLEANING UP AND PROPERTY RESTORATION

The removal of ponded water has been mentioned, but Board staff also carried out considerable pumping to remove water from around homes and the dairy factory at Tuamarina and elsewhere on request over five or so days. Not all requests could be serviced. Because major removal of water was achieved by gravity through culverts and breaches, there was not much call on our large mobile flood pumps as there were few places they could be used. The large 18" mobile flood pump was used at Blind Creek, and was held in readiness in that area for any need that may have arisen. It was later used at Pembers Road pumping station for a short period to assist the pumps once the breach became inoperative.

The Mustang Excavator was made available for urgent drain repairs at Tuamarina, but was not really needed. A valuable co-ordination with the relief operations was achieved by having one of our staff act as our repre-

sentative through whom all requests for help were made. Some assistance was given with ensuring that water supplies were tested before re-use.

Restoration work was done in the vicinity of the Tuamarina breach, and this was obviously appreciated. Initially we avoided restoring stopbanks while people got their own properties in order and to allow the stopbanks to dry out. Assistance was given with problems regarding the reinstatement of drainage in this and other areas of Tuamarina.

The Ministry of Agriculture and Fisheries was assisted in the disposal of carcasses, with advice about suitable dumping sites to avoid water contamination, and then to do some of the digging of pits.

The weather outlook was of considerable importance during restoration work, and we obtained direct information from the forecaster whenever there was any doubt about the weather.

11. PUMPING STATIONS

Water reached the underside of the motors at the Pembers Road and Thomas Road pumping stations, and these pumps continued to operate. The policy of placing electrical equipment at a high level paid off, although these pumps will have to be removed to replace the top thrust bearings which were under water. Only the Parkes Pumping Station motor was submerged. It was taken out once it could be got at and dried and replaced the next day. However, further problems have occurred. This station was done 'on the cheap', using an inclined pump instead of a vertical one. Consideration should be given towards improving this station.

All other pumps operated without major problems.

Concern was expressed from Spring Creek on Saturday evening about ponding of stormwater near the Ferry Bridge. Had the Watsons Road pumping station been built, this would not have occurred.

12. DAMAGE TO PROPERTY AND LOSS OF STOCK

The assessment of damage to property and loss of stock is to be done by the Ministry of Works and Development. However, some comments should be made to complete the total picture.

Damage to homes occurred at Renwick, Spring Creek and at Tuamarina where two homes were totally destroyed. Little publicity has been given to the situation at Renwick, but damage to properties, and loss of stock was also considerable in the path of the Conders overflows.

Stock losses being claimed exceeds 5 000, of which over 80% are sheep. Unfortunately many of the losses could have been avoided. Some farmers failed to take adequate precautions to secure their stock on Saturday and got caught with the rapid rise of water early on Sunday morning. A significant reduction in stock losses would have been achieved if better warning of overflows and breaches could have been given.

In view of the damage and the relatively few areas affected, it must be stressed that the areas affected should not be considered as being potentially more flood prone than other parts of the Wairau Plains. Another event may not happen in quite the same way. Also, the lessons learnt and information

gained will be used to ensure that improvements are made, where necessary, to provide a greater safety for these areas.

It is also pertinent that it is 21 years since this type of event has happened and we had expected a much longer respite from stopbank overflows. In the previous 23 years before the Wairau Diversion and major stopbanking, this type of event happened five times.

13. NEWS MEDIA

During the flood event, Radio 2ZE did a magnificent job in difficult circumstances. As Civil Defence were operating, we passed all information through them, and did not have any direct contact with the station. This may not have been the best arrangement, and I have a recommendation on this matter in Part B. On Sunday afternoon and Monday, I did make statements regarding the flood.

Later , we had more contact with the radio, and in subsequent 'panics' in the days after the flood over pending rain events, they greatly helped to cool down the situation.

The paper media was less able to help during the event, but later I ensured that they received as much information as possible, particularly to counter any incorrect or biased reports. They were generally quite co-operative and helpful.

There was virtually no contact with TV news, who on Sunday did not seem inclined to obtain any Catchment Board information - although it was given. Since the event we have endeavoured to obtain copies of their video film, and while some has been obtained, with difficulty, we do not have it all.

An interesting fact about the news media coverage of the flood was the speed and extent that it went internationally. It apparently received front page coverage in San Francisco, with a photo. It appeared in papers in Singapore and Hong Kong. Mr. C.C. Davidson, the Board's first Chief Engineer, learnt about the flood in London, and the news went through Australia virtually as it happened. By world standards, the event and its resulting damage, with no loss of life, seemed too small to rate a mention. Yet it received such wide coverage.

14. VOLUNTEER ASSISTANCE

Throughout the event many people came forward with offers of help and equipment, to both ourselves and Civil Defence. in fact, we had more assistance offered to us than we could use.

Despite a gap of 21 years, it brought back memories of the way the community used to react to similar situations in the past. In those days such problems were more frequent. It was very heartening to obtain that similar public support. In particular on behalf of our staff and our volunteer helpers I would like to publicly thank all those people, organisations and firms who provided food and drink. Offers of help continued for many days, and included the loan of equipment.

15. CONCLUDING REMARKS ON THE FLOOD

The Wairau River flood control works have been designed to a high standard by world standards. The 10th July 1983 flood peak appears to have exceeded the design flood by 50%. That this size of flood with a return period in excess of 1000 years should occur within a relatively few years after works were completed is a salutary reminder that we only achieve a precarious balance with nature in our attempts to protect the land upon which we live and produce our livelihood.

Although the district was shocked and dismayed at the damage caused by this event, it is with some satisfaction that works were in place which effectively prevented much greater damage and loss of life. The extent to which that might have happened is illustrated by the comparison between the flood's estimated peak discharge of 7765 cumecs at the Waihopai confluence, and the bankful capacity of 3000 cumecs twenty one years ago. At the peak, an estimated 80% of the flow (6200 cumecs), was kept within the floodway system.

Many lessons have been learnt from this event, by the Board and its staff, the Civil Defence organisation and the community both as a whole and in local groups. There was a lack of adequate river information at that critical time when after a fairly slow rise the volume of flow unexpectedly increased by 30% in less than two hours. This highlights the need for better observation of floods and improvements to the warning system so that people at risk can be warned swiftly.

There is an obvious need for better communications amongst local people and between them and the Board if information and requests are to be accurately conveyed so that misunderstandings are avoided.

The cost of repairing damage to the Board's works is relatively low at $1 045 000 considering the size of the flood. However, this is only part of the cost to the district, which has unfortunately been borne disproportionately. The flood control works were built to provide a uniform standard of protection, with two exceptions initially, and they still do. Because of its size the flood has emphasised those few areas where there is less effective freeboard over the design flood level. Statistically, the recurrence of a flood of this size is extremely remote and the event has not provided any compelling reason for changing the present standard of flood protection. However, the valuable information gained from this flood must be used to 'fine tune' the system to achieve a uniform margin of safety over the design flood. Those who suffered the effects of this flood should, if possible, be given renewed confidence in the effectiveness of the flood protection works. Part B of this report includes information and discussion about aspects of the whole river control system and highlights these places and organisational procedures where improvements can be made.

P.A. THOMSON,
CHIEF ENGINEER

PART B

WORKS

and

RECOMMENDATIONS

for

FUTURE ACTION

INDEX

PART B - REPORT ON WORKS AND RECOMMENDATIONS FOR FUTURE ACTION

PART B

ACTION TAKEN BY THE BOARD AT ITS MEETING ON THE 12TH SEPTEMBER 1983 IN REGARD TO EACH SECTION IN PART B

SECTION 1 — FLOOD DAMAGE REPAIR WORKS - adopted

SECTION 2 — FUTURE FLOOD OPERATIONS - received

SECTION 3 — FUTURE FLOOD WARNING SYSTEM - adopted
With emphasis on the words 'consider adopting' and 'remove stock to safety' in recommendation (c) of Clause 3.2

SECTION 4 — REVIEW OF DESIGN DISCHARGE - adopted

SECTION 5 — WAIRAU DIVERSION DEVELOPMENT - adopted

SECTION 6 — TUAMARINA FLOOD PROTECTION - adopted
subject to the outcome of a meeting with the Residents Association on the 14th September, following which some modification to the proposals were made.

SECTION 7 — SPRING CREEK FLOOD PROTECTION - received and referred to the Chief Engineer for further investigation and report for consideration of the Works Committee at a future date.

SECTION 8 — BOTHAMS BEND ISLAND FLOOD PROTECTION - received

SECTION 9 — RENWICK-CONDERS BEND FLOOD PROTECTION - adopted

SECTION 10 — REMOVAL OF PONDED WATER FROM THE PEMBERS-THOMAS ROAD AREA - received and referred to a future meeting of the Works Committee for inspection and further consideration.

SECTION 11 — MISCELLANEOUS MATTERS - received for further consideration and reports as appropriate, and -

a) That action be taken as soon as possible to return bags that were lent by farmers and others (Section 11.7)

b) That the Chief Engineer investigate the matter of suitable lighting being available when emergency work needs to be done during the hours of darkness.

PART B - REPORT ON WORKS AND RECOMMENDATIONS FOR FUTURE WORKS

The following sections are about specific aspects arising from the flood related to works and organisational matters.

1. FLOOD DAMAGE REPAIR OF RIVER WORKS

1.1 Wairau River - Tuamarina to the Sea

Where stopbanks were overtopped there has been extensive damage to the back batter of the bank, particularly at Morrins Hollow. Reconstruction of stopbanks will be required in many areas.

Rock protection has been destroyed at Sadds on the right bank and rock placed in 1982 has slumped near Watsons Road but is still intact. At Lukes and McDonalds on the left bank, rock and willow protection requires replacement.

1.2 Wairau Diversion

This is the first time that rock protection, placed when the Diversion was built, has been damaged. Damage was confined to a 400 m length upstream of the coast on the right bank and to 160 m on the left bank at Pipitea Creek some 800 m from the coast. Without doubt this was caused by extremely high velocities in this length. Flood levels over the 800 m length of channel from the coast indicate a water slope of .005 approximately, which is 4 to 5 times the gradient at Tuamarina. (See Section 5)

1.3 Wairau River - Tuamarina to Waihopai

Repair work includes the reinstatement of the three breaches, and replacement of sections of training banks at Barnetts, Pigous, Williams, Jeffries Road and Lower Conders.

Some repair to rock is required in a number of places. Two of the worst losses of rock protection occurred at Lower Conders and in the middle of Rock Ferry, probably because there was no training bank on the rock line and failure was caused by scouring of the berm behind the rock.

Two other major losses of rock occurred at the downstream end of training banks at lower Rock Ferry and McLauchlans, where extreme pressure is created by a flood of this size which tends to flow straight down the floodway.

1.4 Wairau River - Waihopai to Wye

No actual levelling of flood marks has been done above the Waihopai but it is apparent that flood levels were very close to the formation level of all training banks between the Waihopai and Wye and overflows of the banks occurred in many places. There is no stopbanking system as such in this area although river training banks, in normal circumstances, do provide flood protection. On this occasion most training banks were outflanked and extensive flooding occurred on land adjacent to the river. Breaches of training banks notably at R. Adams and Mapps also contributd to the area flooded.

Destruction of sections of training banks was apparently due to overtopping or extreme pressure on the downstream lengths of bank. There appears to be little damage, other than the loss of rock protection just upstream of Timms Creek, which cannot be attributed to these two factors.

Aerial inspection and aerial photographs indicate no significant loss of land by lateral erosion other than a relatively small area above Timms Creek. Several hectares have been covered by gravel where training banks broke at R. Adams and Dwans. Much of this will be removed when banks are rebuilt.

1.5 Wairau River and Tributaries above the Wye

Generally no ground inspection has been made in these areas and estimates of damage are based on aerial inspection and photographs. Major losses of rock protection have occurred on the Wairau River just below the Branch confluence and at the high terrace on the Branch River in Holmes. Apart from this and some damage at Andersons (Mt. Patriarch), protection works in the Upper Wairau and Branch seem to have survived. The work done for the Marlborough Electric Power Board's Hydro Scheme at The Traverse worked very successfully.

1.6 Southbank Tributaries - Waihopai to Wye

All south bank tributaries in the Hillersden-Wairau Valley areas carried major floods and considerable channel damage has occurred. Ground inspections have not been made yet but it is expected that there will be a considerable amount of new work in this area. Floodwater from these catchments covered large areas of flats, and on the lower river terrace aggravated the effects of overflows from the Wairau River.

Some damage has occurred to Waihopai River works, but generally these works held very well.

1.7 Northbank Tributaries

While both the Goulter River and Top Valley Stream had record floods, peak flows in the lower tributaries were not exceptional. Damage to works is not significant.

1.8 Estimate of Flood Damage Repair Costs

1. FLOOD EMERGENCY WORK DURING AND IMMEDIATELY AFTER FLOOD — $ 30 000

2. WAIRAU RIVER - BELOW TUAMARINA

   a) Wairau Diversion
   Restore 700 m of rock protection
   5000 cu.m @ $10 — $ 50 000

   b) Lower Wairau Rock Protection

Badmans	60m
Lukes	50m
McDonalds	100m
Sadds	120m

   2200 cu.m of rock @ $14 — $ 30 800

c) Repair Stopbanks

Morrins Hollow	300m		
Grovetown	1400m		
	1700m @ $10		$17 000
			$97 800

3. WAIRAU RIVER - TUAMARINA TO WAIHOPAI

a) Tuamarina Stopbanks

Repair Breach	$12 000	
Restore Scoured Batters	$ 3 000	$15 000

b) Wairau Bridge - Tuamarina

Rebuild breached stopbank		$ 5 000

c) Barnetts

Rebuild breached training bank	$30 000	
Replace Willow protection with rock 500 cu.m @ $10	$ 5 000	$35 000

d) Cravens

Repair rock protection 200 cu.m @ $13		$ 2 600

e) Pigous

Repair training bank	$ 7 000	
Repair rock protection 200 cu.m @ $15	$ 9 000	$16 000

f) Stedmans

Rebuild berm	$ 5 000	
Repair rock protection 1000 cu.m @ $12	$12 000	$17 000

g) Dobsons/ McLauchlans

Repair stopbanks, wingbank and berms	$15 000	
Rebuild training bank	$20 000	
Replace rock protection 2000 cu.m @ $12	$24 000	$59 000

h) Roses

Repair stopbanks		$ 7 000

i) Williams

Repair training bank	$12 000	
Restore rock protection 2500 cu.m @ $10	$25 000	$37 000

j) Jeffries Road

Restore training bank	$ 8 000	
Repair scoured berms	$ 5 000	$13 000

k)	Orchards		
	Restore rock protection 1500 cu.m @ $10		$15 000
l)	Norths		
	Restore rock protection 500 cu.m @ $8		$ 4 000
m)	Lower conders		
	Restore alignment	$30 000	
	Restore rock protection 2600 cu.m @ $9	$23 400	
	Repair breached stopbank	$ 5 000	$58 400
n)	Rock Ferry		
	Rebuild training banks	$40 000	
	restore rock protection 4000 cu.m @ $9	$36 000	$76 000
o)	Giffords		
	Restore rock protection 500 cu.m @ $11		$ 5 500
p)	A. Adams		
	Repair training bank		$ 2 000
			$367 500

4. WAIRAU RIVER - WAIHOPAI TO WYE

a)	Kerrs		
	Restore training bank	$ 3 000	
	Repair rock protection 1000 cu.m @ $15	$15 000	$18 000
b)	M. Adams		
	Rebuild training bank	$12 000	
	Replace rock protection 1800 cu.m @ $10	$18 000	$30 000
c)	McIntyres		
	Rock - 800 cu.m @ $15		$12 000
d)	R. Adams		
	Rebuild training bank	$20- 000	
	Replace rock protection 2800 cu.m @ $10	$28 000	$48 000
e)	Dwans		
	Restore training bank	$ 3 000	
	Repair rock protection 800 cu.m @ $10	$ 8 000	$11 000

f)	Mapps			
	Rebuild training bank	$ 8 000		
	Repair rock protection 1600 cu.m @ $11	$17 600	$25 600	
g)	Roughans			
	Replace rock protection 2200 cu.m @ $11		$24 200	
h)	Andersons			
	Repair rock protection 800 cu.m @ $8		$ 6 400	
i)	Powells			
	Rebuild training bank	$ 8 000		
	Replace rock protection 2500 cu.m @ $8	$20 000	$28 000	
j)	Dilrews			
	Rebuild training bank	$ 5 000		
	Replace rock protection 1500 cu.m @ $10	$15 000	$20 000	
k)	Top Valley			
	Rebuild training bank	$ 5 000		
	Restore rock protection 3000 cu.m @ $7	$21 000	$26 000	
l)	Conlans			
	Repair training banks	$ 2 000		
	Replace rock protection 1500 cu.m @ $12	$18 000	$20 000	
m)	Townleys			
	Rebuild training bank	$15 000		
	Replace rock protection 2500 cu.m @ $14	$35 000	$40 000	
				$309 200
5.	WAIRAU RIVER ABOVE WYE			
	Allow Lump sum			$ 20 000
6.	WAIRAU RIVER TRIBUTARIES			
a)	Branch River	$10 000		
b)	Waihopai	$40 000		
c)	South bank Streams	$20 000		
d)	North bank Streams	$10 000	$80 000	
7.	CONTINGENCIES 5%		$45 500	
8.	SERVICE CHARGE at 10%		$95 000	
		TOTAL		$1 045 000

1.9 Services Charge

It should be noted that a special services charge of 10% has been used. Because the servicing of flood damage works costs relatively less than for new proposals, the normal percentage is inappropriate. However, the costs of supervision, preparing records and assessing the hydrological aspects, damage, etc., are not inconsiderable for this size of historical event. Also, other planned works will not go ahead until flood damage repairs are finished, so service charges from those jobs will not be received this year, although some costs will have been expended. Effectively, the Service Charge aims at ensuring that the costs during the year are covered by the total Service Charges.

1.10 Financing of Flood Damage Repairs

1.10.1 Government Grant

An initial $200 000 at a 70% grant rate has already been received on the day following the flood, with approval to proceed with repairs. This prompt action by NWASCO was much appreciated. Inspections of damage have already been done and an approximate total damage figure has been advised verbally through the Ministry of Works and Development District Office. We have been told that approval of flood damage repairs will be at the 70% grant rate. This means that the government grant for repairs will be $731 500 with a local share of $ 312 500.

It is anticipated that only 79% of the repair work will be done in the 1983/84 financial year. Savings of $ 166 700 in government grant will result from other works not proceeding this year. (See 1.10.2 below). This means that a nett $ 410 800 additional government grant will be required this year.

1.10.2 Local finance

At first sight, the local share requirement of the repair work appears formidable. However, some works will not now be able to be done until plant and equipment complete flood damage work. Also there will be a substantially reduced expenditure on river maintenance which releases a significant amount of local share due to the difference in grant rates. The following is a schedule of expected reductions in budgeted expenditure for 1983/84 :-

	Reduced Expenditure	Reduced Local Share	Reduced Govt. Grant
Wairau Valley Scheme follow-up	78 000	31 200	46 800
Riverlands Floodway	45 000	22 500	22 500
Miscellaneous River works	100 000	57 000	43 000
Mapps Waterway Improvements	38 000	19 000	19 000
River Maintenance	118 000	82 600	35 400
Total Reductions	$379 000	$ 212 300	$166 700

The expected 79% completion of flood damage repair this financial year is dictated by our ability to carry out rock work.

During the 1983/84 year, changes in total works costs, local shares and government grant are as follows :-

	Expenditure 1983/84	Local Finance	Govt. Grant
Flood Damage Repairs	825 000	247 500	577 500
Pumping Station power	10 000	10 000	-
	835 000	257 500	577 500
Reductions are :-	379 000	212 300	166 700
Nett Additions are :-	$ 456 000	$ 45 200	$410 800

Compared to budget, flood damage repairs will require an additional $45 200 this year from Rating District funds, and next year $66 000 will be required. This is a total of $111 200. The Rating District has a Flood Damage Reserve fund of $115 000. This means that flood damage repairs can be fully funded from savings this year and the flood damage reserve. However, the budgeted deficit of $84 099 in the rating district account at the end of this year remains, and may be increased because of reduced revenue from reserves.

Next year new works arising from the flood may need to be included. Next year's programme and finances should be considered at an early stage. Because 16% of this year's works rate was used to reduce the opening debit balance, the impact on next year's rates may not be as severe as might be imagined. But it will also be necessary to rebuild the flood damage reserve.

2. FUTURE FLOOD OPERATIONS

2.1 General

A major factor during the July flood was the relative inexperience that most Board staff had with floods. In time this factor will become more serious as longer serving staff retire. It is a coincidence that shortly before the flood I had discussed with Mr Pascoe the preparation of flood instructions for staff. I am sure that had there been a reference document detailing aspects to be actioned, that we would have been able to avoid the few inadequacies which did occur.

While my presence at Civil Defence Headquarters was of advantage to both our organisations, I am not completely satisfied that this did not create some gaps in our understanding of the event during Sunday. Staff with previous experience in such flood situations were all in the field, and perusal of the flood log indicates that at times, some information received was not effectively used and some advice given may not have been as good as it could have been. Lack of firm river information was the most serious handicap.

2.2 Recording of Messages, etc.

The volume of information coming in and out is quite considerable and when being handled by two or three people is difficult to record coherently. The use of tape records on the Board's radio system and possibly telephone conversations could be of considerable advantage, to provide an overall record, but particulary to verify any point in a conversation after the caller has hung up.

2.3 Communications

As a consequence of office improvements, better arrangements for staff using telephones and radio are already being considered. Problems occurred because other people waited around and talked in the area. Some telephone calls were lost because of the set up of the exchange set and other telephones. Poor radio communication from the Tuamarina area was a problem during the following week.

Better methods of contacting Civil Defence Headquarters and Sector Headquarters also needs to be obtained on a 'hot line' or dedicated radio basis to avoid unnecessary delays in passing information and requests.

2.4 Aerial Surveillance

The availability of helicopters was difficult during the July event. These were fully employed by Civil Defence, but the availability of a reconnaiscance flight by an experienced staff member during Sunday morning may have produced a better understanding of the situation, particularly at Tuamarina. Although one of our junior staff was put up in a plane to take general photographs, he was concerned with that task, and was not an effective observer.

2.5 Volunteer Manpower

The availability of manpower through Civil Defence and from volunteers was of major assistance. Without these people we could not have coped, particularly on the Sunday evening. However, better arrangements for the recruitment and assemblage of volunteers are needed, and I have referred this aspect to Civil Defence. The large numbers of people around the Board's depot interfered with staff movements and the obtaining of equipment, etc.

It is also apparent that volunteers need to be organised into gangs, preferably with someone in charge who has some knowledge of sand bagging and the dangers of working alongside rivers in flood situations.

2.6 Road Access

Because of sightseers, at times road access became a problem with only the Picton highway as access to any part of the river from Blenheim. At times staff had to resort to illegal and dangerous driving to ensure that sand bags etc. were delivered promptly. One reason was the method of screening vehicles at Civil Defence road blocks. The need for quick separation of official vehicles is apparent. At one stage, the Wratts Road situation was nearly lost because of this sort of delay. I have already asked Civil Defence to examine this matter.

2.7 Conclusions on Flood Operations

To ensure that the lessons of this flood event are adequately learnt and applied, some changes in flood operations will be made, and a 'Flood Plan' prepared to ensure that future staff will have a record of past experiences and a sequence of operation to refer to.

In general, the Board's organisation operated very well during the July flood and all staff gave of their best. Improvements to the organisation of any future operation are largely in the communications and information areas, and relate also to the co-ordination with other agencies.

3. FUTURE FLOOD WARNING SYSTEM

3.1 Public Safety

The July flood was the first major Wairau flood since the completion of the Wairau Valley Scheme flood control works and the establishment of Civil Defence where there was a danger to life and property.

Prior to the introduction of the Civil Defence system, the Board's flood warning system was designed to effectively warn each area of possible overflows so that stock rescue and securing of property could occur. As overflows were a fairly frequent happening, every seven or so years, there were a number of loosely organised but effective groups of people, transport firms and the like who sprang into action once the warnings were given.

Since the advent of Civil Defence, the Board has only warned persons farming the floodways, or for some other specific reason. Warnings are given to Civil Defence personnel with whom a close understanding and co-operation has been established. The local Warden Posts have taken over the saving of stock and property in the event of stopbank overflows. With a gap of over 20 years since the last serious event, and hopefully a much longer period until the next, it is not easy to retain a practical and effective operations plan. This was a problem this time, and there were some less effective performances. In particular, the rapidity at which the July flood developed from a major but seemingly fully controllable flood event to one where human life and property were at risk. Even though Civil Defence were already activated, and the Police were informed, knowledge of the situation did not get to those who were under threat as quickly as it should.

The present flood warning system has caused the Board to lose contact with communities alongside the river, and has reduced the amount of information 'feed back' that it used to receive. The Board's staff is unable to patrol all the stopbanks, and in the past relied considerably upon local initiative, based on the flood warning system. There has been some talk of this being done by Civil Defence, but this has not been arranged.

There is no doubt that the improvements to flood control works has possibly created a false sense of security, but has also meant that people rely more upon the Board to advise them of the situation in their own 'backyard'. Only the people in the Rapaura-Renwick areas have continued to patrol stopbanks and to advise the Board of the situations as they occur. Valuable information is also received from some farmers in the Wairau Valley area.

Although we alerted the Civil Defence organisation, in July 1983, as in April 1975, they operated at sector level, the organisation does not function fully with authority until a Civil Defence emergency is declared. To do this there must be a danger to human life. In the intermediate stage, the Police can operate with authority, but they are not an organisation who can readily advise the appropriate groups of people who may be potentially at risk.

The present situation must be confusing to many people, and this was obvious in July. Through discussions with people, it is apparent that information and requests meant for the Board did not reach us or were delayed, or if it did, a wrong emphasis created a wrong impression. It seems imperative that the Board should have a system of local contact people to ensure that we are immediately informed of situations as they develop in each part of the river system.

During the build up of a flood event, there should be more dialogue with a selected number of contact people. Because flood events that can cause risks or concerns are now less frequent, such a system must be carefully used to avoid unnecessary involvement, yet be operated frequently enough to ensure that it works efficiently when required. Such an arrangement should be made in conjunction with the Civil Defence organisation, who would eventually take over if an emergency developed. In the initial phase the involvement of and co-operation with the Police and other agencies, such as the Ministry of Works, should be strengthened, to ensure that all are adequately informed of developments, and that information comes to the Board.

Comments have been made that in July earlier use should have been made of the local radio. In the confusion that was caused after the July event on one occasion when rain was predicted, their help was invaluable in reducing pending panic. However, when a flood develops overnight, the radio has limited value, and direct contact with people via telephone is the best method. Once the district is aware of the situation, then the radio is a useful means of giving information. However, there can be no guarantee that all those affected have received the information.

I therefore recommend :-

a) That the Board's flood warning list can be expanded to provide for local contacts to assist with stopbank surveillance; the giving of river information to people in their locality; and to report flood information to the Board's staff.

b) That the organisation of these additional local contacts be co-ordinate with both the Civil Defence organisation and the Police.

c) That specific arrangements be made with the local radio station for the broadcasting of flood information.

3.2 Warnings to Farmers Using Floodways

The present system provides for warnings to be given to those using floodways from the Narrows downstream. In most cases only one warning is given. Warnings are given in batches in relation to the expected level of the river. In this way, we avoid warning too frequently when there may not be any real need. In recent years, we have issued alerts, sometimes based on rainfall warnings from the meteorological service and at other times when some flood appears inevitable. These are usually issued before dark to enable removal of stock in the daylight. These types of warnings were issued on the Friday and Saturday 8/9 July, 1983.

Once these warnings are issued, responsibility for the safety of stock and property rests with the owner. However, some people are given more than one level of warning, and there has been a growing tendency by others to move stock so far, and to then rely on further advice from the Board. This is most prevalent where the owner has no safe land easily available for stock and is a particular problem at Morrins Hollow and Bothams Bend Island, which are all Board Reserves.

On occasions these demands can mean that the person issuing warnings has to remain on duty during the night when this is not necessary, and then be available for work the next day.

If the additional floodwarnings are to be issued as recommended in the previous section then it will be necessary to simplify the existing flood warning list, which contains 83 entries and most have an alternative contact. Usually, and particularly on Saturdays, well over 100 calls have to be made

to issue warnings of a large flood event. There are seven levels of warning, the last being for a flood of over 5.79 m (19 ft) at Tuamarina. In July, that level was exceeded by over 2.7 m (9 ft).

In some areas, arrangements have been made for warnings to be given to a group of farmers and the first one contacted warns the others. This also has the advantage of encouraging local joint action to cover for anyone away, and for ensuring that a contact is always available. However, there are some situations where individual warnings must be given.

I therefore recommend :-

a) That the flood warning system for those occupying floodway areas be reviewed with the objective of :-

   i) providing for an early alert system to enable stock to be removed during daylight before a flood actually occurs.

   ii) the issuing of flood warnings and alerts in three stages.

   iii) the introduction (where appropriate) of further group warnings and the integration of these with the previous recommendations.

b) That alerts or warnings be issued only on the basis that the responsibility for ensuring the safety of stock or property then rests with the owner, and that further individual additional warnings will not usually be given.

c) That the Board consider adopting a leasing policy for grazing leases on floodway land that requires applicants to demonstrate an ability to remove stock to safety, and that if that ability is later lost for any reason, the lease can be resumed.

3.3 Conclusion on Future Flood Warning

The recommendations made in this section are not solely the result of the July flood as some were being considered before then. In July, adequate warnings were issued to those using floodways, and any losses of stock were the result of owners not removing their stock to a safe place.

The recommendations made will change the emphasis of the flood warning system from a mainly individual basis to the basis of most warnings and information being given to small local community groupings. In this way newcomers will be able to be assisted by their neighbours to appreciate flood situations and neighbours will be encouraged to give mutual assistance to each other. It will also improve our ability to quickly advise of any major changes to the situation, and in some events to remove unnecessary concerns.

In particular, the recommendations should result in better surveillance of the stopbank system, and the obtaining of situation reports from each area. Although in the near future while memories of the July event are still fresh, these objectives will be easily achieved, later, with no major events, the relevance of the system could be lost. However, this difficulty should be largely avoided through the integration of the major emergency warning system with the more frequently used warning system for those using floodways.

4. REVIEW OF DESIGN DISCHARGE

It is appropriate to review the standard of protection after a flood event that exceeds the design capacity of protection works. This flood substantially exceeded the design flow, yet was largely contained within the designed system. On the existing flood record the probability of the event could be considered to be extreme. Yet there must always be that doubt about the accuracy of historical records. That the present design flood now appears unlikely to be exceeded more than once every 100 years compared with an expected 200 years originally, must be given some attention. Most modern schemes are built for 100 year floods, the greater apparent standard of the Wairau Scheme is an exception, for reasons already mentioned.

It is believed that the number of large floods and the frequency of these since 1962 exceeds that of any other period over the last 100 years, and comprise nearly half the length of detailed river records. because in assessing some 100 years of records this period is effectively added to the record twice, the resulting 100 year return period for the design flood is conservatively obtained.

While design standards must be reviewed as the record extends and estimates of return periods become more sure, at this stage it would not seem to be appropriate to alter the present design discharge, which should remain at 5100 cumecs.

When repairs are completed, attention can be given to those areas where stopbank levels appear to be less than adequate. This will fine tune the system. The effects of the flood have also given impetus to encouraging the development of the Wairau Diversion, and to considering other aspects of the flood control system. The result will provide significant improvement to the standards of safety in those areas which suffered most during the July flood, to improve the uniformity of protection throughout the plains.

I recommend that the design flood remain at 5100 cumecs.

5. WAIRAU DIVERSION DEVELOPMENT

5.1 General

As yet it has not been possible to survey the extent of the development of the Diversion caused by the July 1983 flood. Based on visual observation only, the development has been disappointing. Further widening out to the trenched rock has occurred up to about 1500 m from the mouth and some minor widening has occurred in embayments in other areas. However, channel depth in the critical reach from Pipitea Creek (800 m) to the Pukaka (2600 m) has not significantly altered. Failure to deepen in this area is caused by deposits of 100 mm to 150 mm stones which have been left as a residue from in-situ beach gravels as the finer materials have been washed away. These stones have had the effect of armouring the bed of the channel and preventing any further deepening. While this section of channel remains in an armoured condition any significant development of the Diversion is unlikely and there will be no increase in the proportion of total flood carried by the Diversion.

During the July flood, 52% of the total fall from the Tuamarina bridges down the Diversion occurred in the lower 15% of the distance. These stones operate rather like an extended control weir and are the major factor controlling the amount of flow in the Diversion. While some encouragement at the top end may cause a small increase in the amount of water carried by the Diversion, works here will be largely ineffective until the lower section is more developed by deepening.

5.2 Encouragement of Development

The original diversion proposal recognised the problem of paving, and made some estimates of it, which have been evident previously and are proven by the resistance of the channel to scour in an event the size of the July flood.

Development of the Diversion will increase flood safety margins at Tuamarina and Spring Creek, and will reduce the possibilities of overflows and ponding from Pembers Road to the Wairau Pa, and from Spring Creek to the Lower Wairau. It will also enable completion of flood protection above Renwick. For these reasons, works to encourage the development of the Diversion should now be given a high priority.

The removal of this layer of 'paving stones' will not be accomplished easily or cheaply. In most areas the layer is now buried under smaller gravels which will need to be removed first. A large area and volume of material is involved. It will be necessary to determine a mechnical removal technique that will avoid further paving of excavated areas during floods that occur before the work is completed.

The cost of this work will be considerable, and a request to Government for grant finance is likely. For this reason it will be necessary to have discussions with appropriate NWASCO staff during the preparation of the proposals.

I recommend -

a) that the encouragement of the development of the downstream section of the Diversion be given a high priority.

b) that site investigations to establish the depth and extent of the deposits of large stone be made immediately to determine the practicability of their mechanical removal.

c) that following the site investigations, proposals be prepared for works to encourage the development of the Diversion, including works to encourage the effective entry of water at the top end following the effective development of the lower Diversion channel.

6. TUAMARINA FLOOD PROTECTION

6.1 General

Although stopbank overflows and breaches have occurred in the Tuamarina area in 1954, 1962 and 1983, flooding of this area should not be considered as being inevitable. The first two events were prior to the opening of the Diversion and the recent event seems to be an extremely rare happening. While there can be no certainty about future floods, the statistical chances of further stopbank overflows are not great.

However, the configuration of the Wairau and Tuamarina Rivers, the historical stopbank alignments, and adjacent hills all create particular flood control problems. The Tuamarina Village stopbank is at right angles across the line of Wairau berm overflows and causes a build up of flood water. In earlier years some protection was given by the screening effect of willows on the berm, and in more recent years Barnetts training bank was built to avoid flows down this old river berm area. The original Tuamarina Pocket Stopbank was raised on its original alignment in 1958, and is still retained as the main stopbank.

6.2 Constraints to Raising Stopbanks

The Tuamarina River stopbanks opposite Nolans Crossing are structurally the highest in the Wairau Plains. The raising of these banks is therefore undesirable. These stopbanks have been designed to take flows both into and out of the Para Swamp. During most Wairau flood events, the flow is into the Swamp, but there is always the possibility of a significant flood in the Tuamarina River during a Wairau River flood event. For this reason the widening floodway downstream of the Tuamarina Track bridge is important for the control of upstream flood levels if this happens.

Physical conditions make it impracticable to build the stopbanks for a situation when major Tuamarina and Wairau River floods occur together. Because unusual weather conditions would be required, this combination may even be more rare than the probability of extreme Wairau River flood events, such as in July. However, there is always the possibility of a combined event which might overflow the Tuamarina stopbank system. For this reason, flood protection in this area cannot be solely related to the design of stopbanks to provide protection against Wairau River floods, although the lack of records for combined events suggests their relative unimportance.

6.3 Flood Levels and Overflows

During the 10 July flood the failure of Barnetts training bank was a contributing factor to the major stopbank overflows at Tuamarina. The highest flood levels were at O'Sullivan's house and those were 0.3 m (1 ft) above the flood level upstream of the State Highway bridge. Flood water gradients fell in both directions from this point and overflows of the stopbank were generally 0.3 m deep as the floodwater profile was similar to that of the stopbank. It is significant that flood levels against the Tuamarina Pocket stopbank some distance to the west, and therefore upstream in terms of the Wairau River, were not greatly different. Thus, there is a large ponded area adjacent to the Tuamarina stopbank that can be fed from upstream breaches or overflows of the training bank. The maximum levels against the Tuamarina stopbank are also affected by the ease by which this water enters the Para Swamp and/or returns to the Wairau River. While the rebuilding of the upper end of Barnetts training bank to a high level may

satisfy some, it is well upstream, and a failure further downstream could cause similar problems. Also the lower end of the training bank may in some circumstances constrain the return of floodwater to the Wairau River.

6.4 Local Opinions on the Means of Achieving Better Flood Protection

Local opinion seems divided on what should be done to give greater protection to Tuamarina. Some favour raising stopbanks, others do not. Those in the Tuamarina Pocket do not want higher stopbanks at the Tuamarina Village, as this could force water their way. Possibly because of this dilemma, others see the two bridges across the Wairau River at Tuamarina as being the cause of their flood problems, and consider that they should be lengthened.

6.5 Effect of Tuamarina Road and Rail Bridges

Because of the appearance of flows around bridge piers, there is a tendency for observers to exaggerate the effect of head losses at bridges. Under a bridge, water levels are depressed, and the bow wave against the pier is only a local effect. The real head loss is the increase in the upstream flood level which is greater for bridges with shorter spans and many piers compared to bridges with fewer piers. Bridge length is also another factor, but is usually of more significance to the bridge owner than it is to a flood control scheme. In an uncontrolled river system the bridge owner must balance the long term cost of protecting the abutments against attack by the river, against the cost of more spans. Usually this results in an adequate bridge opening for flood control. Although the Tuamarina bridges are shorter than is desirable for an uncontrolled river, they are adequate for the present controlled situation. On the same basis the Highway bridge near Renwick is now excessively long. Compared to the Tuamarina bridges it imposes less constraint on the selection of river control alignments, but the total waterway is unnecessary.

Before Barnetts training bank and the secondary stopbank to Bothams Bend were built, the active floodways upstream and downstream of the bridges were overwide. Because of this the bridges appeared to create an excessive constriction. A floodway which substantially varies in width is less controllable, so the Board's policy has been to develop a more consistent floodway width between Tuamarina and the Waihopai confluence. For this reason, the bridges do not now cause a significant reduction in floodway width.

When the Diversion is fully developed, the bridges will be at the point where the floodway converges from a channel and flood berm type of floodway into virtually two channels with no effective berm flow. Additional spans would only add some berm flow, and would have an insignificant effect on head loss. In any case, at that stage flood levels at the bridges will be lower so the present problems would not exist to the same extent. Therefore, it would be more practicable to aid development of the diversion rather than lengthen the bridges.

During the 10th July flood the measured head loss caused by the bridges was 0.57 m (1.9 ft) which compares closely to the calculated head loss for the design flood. If there had been no flow directed towards the Tuamarina stopbank from upstream, overflows would still have occurred, but would have been much less, and the breach probably would not have occurred.

Had the bridges been longer the head loss would have been marginally less, so stopbank levels would have been built at slightly lower levels for this lower head loss. In those circumstances, the depths of overflow would not have been less than they were, as the overflow and breaching of Barnetts training bank was not influenced by the bridges. It is therefore not correct to blame the bridges for what happened at Tuamarina in July.

6.6 Stopbank Levels

Stopbanks have been constructed to contain the design flood. A freebord has been built into the stopbank system to accommodate minor variations in flood levels. As the July 1983 flood upstream of Tuamarina probably exceeded the design flood by nearly 30%, freeboards were virtually used up and were insufficient in some areas. Although the actual flood levels from this size of flood are valuable to 'fine tune' the stopbank system, the system is still built to only contain the design flood without danger of overflows. The stopbanks as they now stand are still sufficient for that purpose, but obviously the amounts of effective freeboard do vary. The record of peak flood levels in July 1983 show the variations in levels caused by river and stopbank alignments, berm flow and the partial protection given to the main Tuamarina Pocket stopbank by Barnetts training bank, even though it had been breached substantially at the top end.

More direct comparisons can be made immediately upstream of the bridges, and as was so painfully apparent during the July flood, the effective freeboard at Tuamarina is less than it is along the south stopbank.

Because of the need to provide greater safety for the Tuamarina Village and to reduce the possibility of ultimate flood water ponding against the Diversion stopbank in the Pembers-Thomas Road area, some improvements must be made to increase the effective freeboards in this area. However, if a similar event was to recur, such works may adversely affect other areas.

Prior to being breached, Barnetts training bank was of sufficient height to have contained the design flood without overflow. Therefore, any works to improve the freeboard at Tuamarina are unlikely to influence flood levels up to the design event.

Any improvement works to the stopbanking system will be only to increase the safety margin over the design flood.

6.7 Proposed Flood Control Improvements

To improve present safety margins and to regain public confidence in the flood control system, I recommend that :-

a) the low cross bank from the Tuamarina Pocket stopbank be rebuilt to provide a freeboard of 0.9 m above the design flood to its junction with Barnetts training bank and that the lower end of the training bank be extended to the Tuamarina River with a freeboard of 0.6 m above the design flood level.

b) the present Tuamarina Pocket stopbank be raised upstream of the crossbank and that the extra height be gradually reduced over a distance of 640 m.

c) that Tuamarina Pocket stopbanks north of the cross bank along the Tuamarina River floodway be left as they are, except for the raising of a low area north of the Tuamarina Track bridge.

d) the Tuamarina Village stopbanks be brought to a uniform safety standard relative to design flood level upstream of the State Highway bridge and to the existing level of the Tuamarina Pocket stopbanks at the upstream end by achieving a uniform level of 8.7 m above mean sea level. (This includes extension of the stopbank to the highway bridge abutment).

e) That the upper 800 m of Barnetts training bank be rebuilt to the same levels as the south stopbank. Figure 1 shows the recommended works.

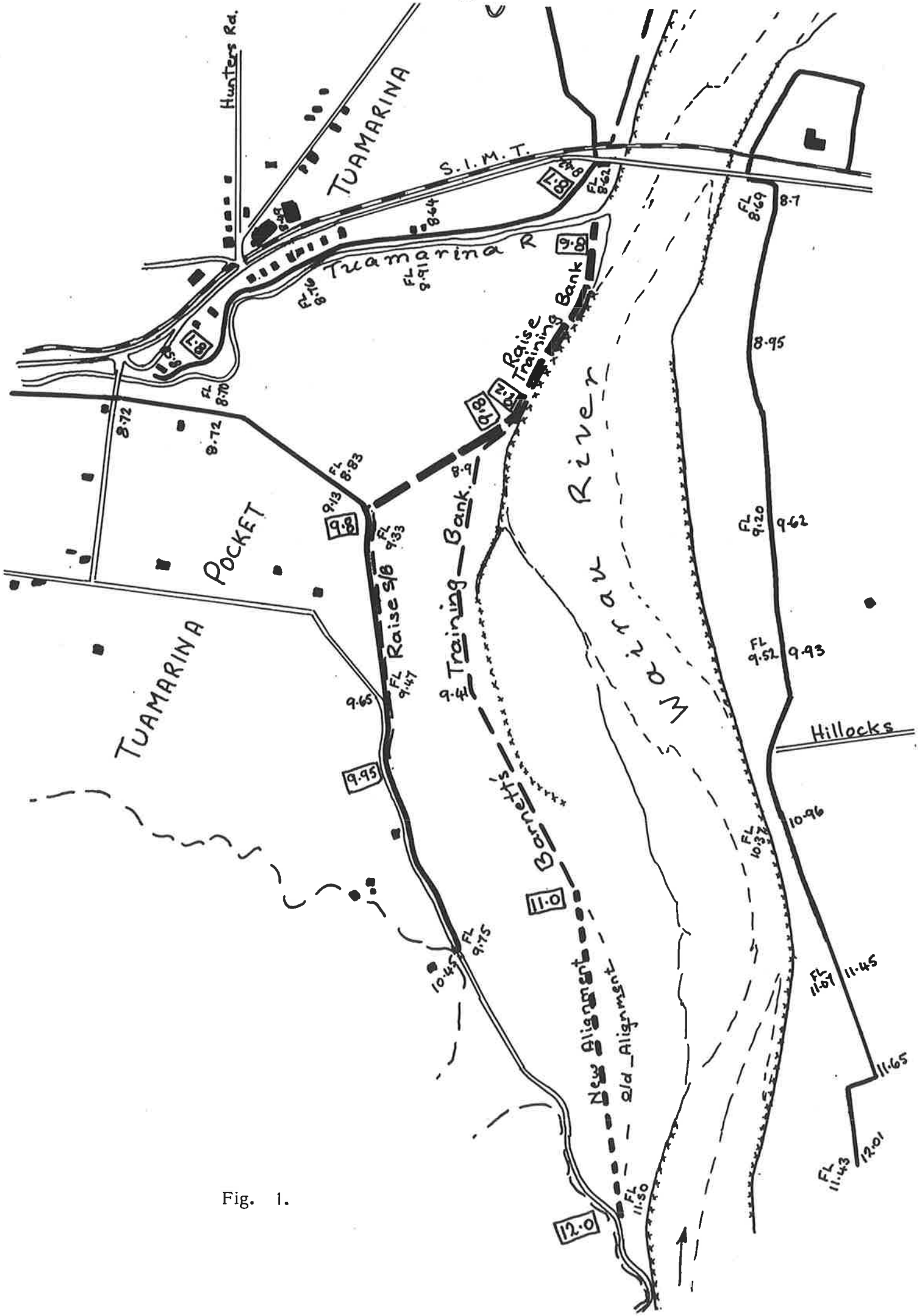

Hunters Rd.
TUAMARINA
S.I.M.T.
Tuamarina R
Raise Training Bank
Training Bank
Barnetts
New Alignment
Old Alignment
Raise s/b
POCKET
TUAMARINA
Hillocks
River
9.0
9.5
10.0
10.5
11.0
11.5
12.0

Fig. 1.

6.8 Effects of Recommended Works

These proposals would appear to meet all the various requirements of residents in the area, as well as the need to preserve the effectiveness of the Tuamarina River floodway. These works will :-

a) Provide a major flood control bank with increased freeboard upstream of the present Tuamarina stopbanks to avoid the possibility of a situation such as occurred in July 1983.

b) Provide a second line of defence against the effect of a failure of Barnetts training bank.

c) Create a better transition of flood water into the narrower floodway at the road and rail bridges during extreme flood events.

d) Place the effective outlet of the Tuamarina River floodway during all flood events in the area upstream of the Tuamarina bridges, thus effectively lowering flood levels along the Tuamarina Village stopbank. However, the width of the outlet must not be too narrow as to adversely effect the outflow of Tuamarina River floods.

e) Reduce the amount of back flow up the Tuamarina River floodway into the Para Swamp during major flood events.

f) The Tuamarina Village stopbank will need to be raised by less than 0.15 m (6") except for some low spots and from O'Sullivans to the highway bridge where up to 0.3 m additional height may be needed.

Had these works been in place during the July 1983 event, overflow of the Tuamarina stopbanks would have been avoided. In contrast, a further two or three spans on the end of the two bridges would not have prevented the overflows, nor would the severity of the overflows have been affected to any noticeable extent.

6.9 Costs of the Proposals and Other Factors

The cost of items (a) and (b) of these works is estimated at $50 000,, after allowing for the cost of replacing damage to existing banks. This part of the proposals can be approved by the Board and be proceeded with immediately. The cost of improving the safety margin on the Tuamarina Village stopbanks will not be great, but at this stage the cost of this part of the work has not been estimated in detail.

It is in the interests of the well-being of Tuamarina that this be done, and that confidence in the area be restored. Already there are suggestions of excesses on insurance policies, reduced property values, and difficulties over capital financing. That the recent flood event should highlight this area is unfortunate, as the degree of protection given to this community should be no less than that given to other areas.

6.10 Future of the Road and Rail Bridges at Tuamarina

This report would be incomplete without some further reference to what should be aimed for regarding these two bridges. Because of the 'hog' in the deck of the highway bridge an extension is not practicable unless the whole bridge is to be rebuilt. Any approach to lengthen both bridges could not yield immediate results, compared to the recommended stopbanking proposals. Also, the benefits of lengthened bridges could not be justified economically when bridge head losses can be accommodated easily and cheaply in stopbank works.

The replacement of the highway bridge is conceivable at some future date. If so there will probably be some change in highway alignment. There may be some advantage in then obtaining a separate bridge opening to extend the Tuamarina River outlet to downstream of the highway bridge. However, if the effects of Diversion development are then significant, the increased costs may not be justified.

6.11 Conclusions on Tuamarina Flood Protection

I hope that the recommended proposals will be seen as providing sufficient safety margin to restore confidence in the Board's flood control scheme and in the safety of the Tuamarina area. That these works can be done soon is significant.

It must also be appreciated that these proposals improve the present margins of safety. As the Diversion develops these safety margins will be increased. Although works may be done to encourage the development of the Diversion there is no certainty about how long this will take.

It is preferable that the work proceed in conjunction with the repair of Barnetts training bank, which is already underway. As it is the Board's wish to first consult the residents in the area, this should be done as soon as possible.

7. SPRING CREEK FLOOD PROTECTION

7.1 General

At the commencement of the Wairau Valley Scheme in the early 1960's, a decision was made to not raise the Spring Creek stopbanks. It was considered that as the Diversion developed and flood levels were lowered down river of the Diversion, these stopbanks would become adequate. In the 1966/67 estimates, finance was provided to stopbank off the Spring Creek and to place culverts and floodgates to prevent a back flow of Wairau River floodwater. In present day terms the cost of that work was $210 000. Later the situation was reviewed, and the proposal was not proceeded with as the development of the Diversion had become more rapid.

The last time that a major overflow of the Spring Creek stopbanks occurred was in 1962, and the flooding in Spring Creek was similar to the July 1983 event. However, since then there has been substantial industrial and residential development on the areas subject to flooding from overflows of the Spring Creek stopbanks. This water eventually finds its way into the Grovetown-Lower Wairau areas where substantial development has also occurred. Small overflows in 1975 did not cause any demand for better protection and the possibility of continuing with the original proposal has not been considered. Because of the recent events, the Board must decide whether it should improve the protection for Spring Creek.

7.2 Effect of Diversion Development

If works are to be done to encourage the development of the Diversion, and these successfully accelerate the improvement to flood levels affecting the Spring Creek, then specific works to improve the standard of flood control along the Spring Creek may not be justified. However, no guarantee can be given on the rate of Diversion development, but even a small improvement will be effective. Unlike Tuamarina where the present stopbank system provides flood protection to above the design flood size, this is not so at the Spring Creek where stopbanks will overflow when flood flows exceed 83% of the design flood. Even so, overflows under present circumstances should not occur more than once every 40 years. Now that an overflow has occurred, presuming that development of the Diversion will be more rapid given encouragement, the probability of future overflows may be insufficient to justify specific improvement works to increase safety margins at Spring Creek.

While the present situation continues, the stopbanking system has not been completed above Renwick, so that overflows can occur during floods above about 4000 cumecs, which reduces the chances of overflows at Spring Creek. Therefore, an improvement to the Spring Creek situation will also enable greater protection to be given to properties at Renwick which also suffered flooding in July 1983.

7.3 Possible Proposals to Improve the Flood Protection Standards of the Spring Creek Stopbank System

There are three alternative possibilities :-

a) To raise the existing stopbanks around Spring Creek to at least the expected flood level of the design flood for the present stage of Diversion development.

Only a small increase in height would be necessary, but over some 8 km of stopbank. The amount of preparation and restoration work would be considerable and with the proximity of buildings would make this alternative less attractive. There are also some complications at the road and rail bridges.

b) To stopbank off the Spring Creek floodway from the Wairau River by building a 480 m long stopbank between the Peninsular stopbank and the stopbank around the Block Factory and Gills Gravel Plant. Two 1830 mm (6 ft) diameter floodgated culverts would be needed to exclude Wairau floodwater, and there is adequate storage to hold normal Spring Creek flows in the stopbanked area upstream of the culvert. Because of the culvert and floodgates the cost of this proposal is estimated at $150 000. (See Figure 2).

c) To provide a stopbank as for (b), but instead of the culverts to build a constriction in the channel with rock. During an event where the stopbanks are being overtopped, this device would effectively limit the amount of overflow by throttling the inflow of Wairau River floodwater. This work could possible be done for $60 000. Both proposals (b) and (c) constrict the Spring Creek outfall, and if a Wairau River stopbank fails upstream of the Tuamarina bridges, then overflows of the Spring Creek stopbanks are a possibility, even though downstream river levels may not be at danger level. However, in this situation the stopbank could be breached, depending upon access conditions at the time.

7.4 Conclusion on Spring Creek Flood Protection

The cost of works to improve the flood protection standards around the Spring Creek are considerable. Statistically, there is less chance of further overflows before the Diversion develops sufficiently to cause the present stopbanks to be effective. Whether works should proceed may depend upon how well the Diversion can be developed through encouragement works, and at what cost? Therefore, a decision on this matter cannot be made quickly and will require further study, and other alternatives may be considered.

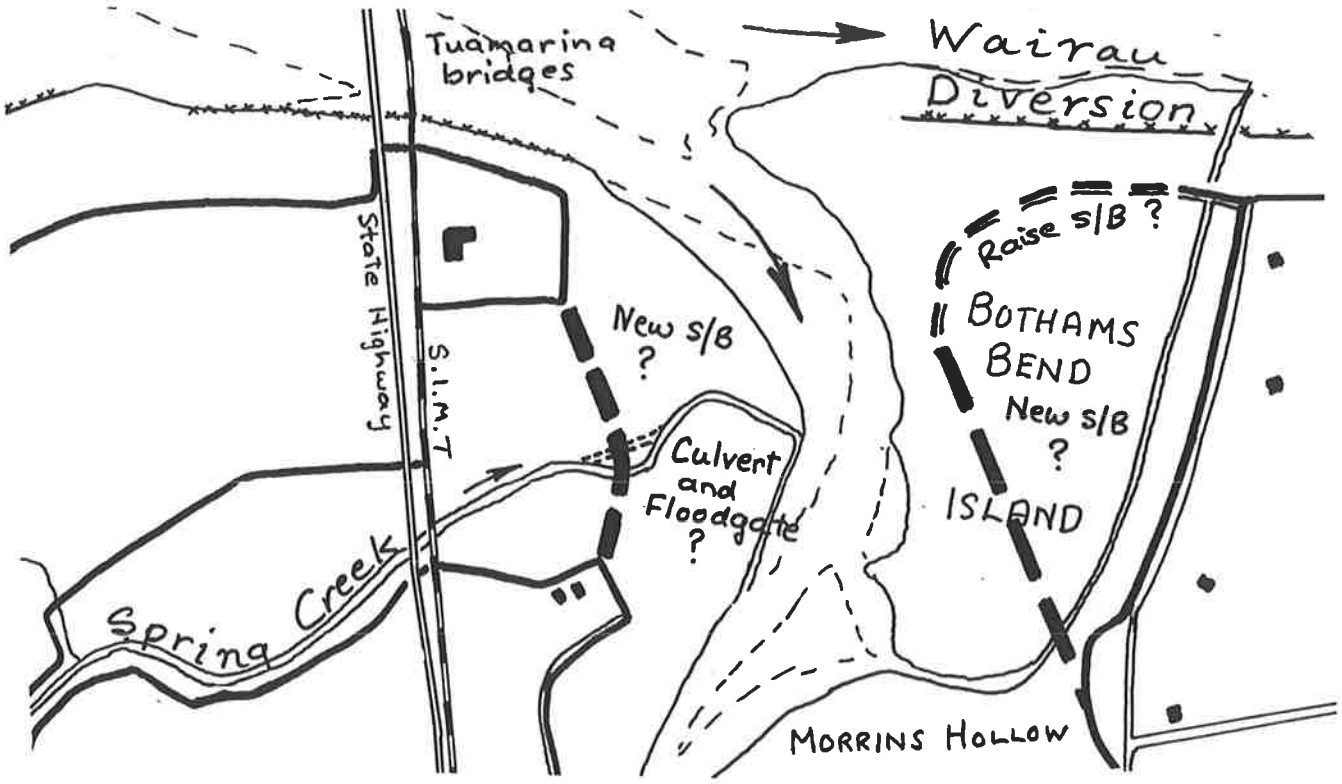


Fig. 2.

8. BOTHAMS BEND ISLAND FLOOD PROTECTION

Much of the Bothams Bend Island is no longer effective as a floodway, and will become less so as the Diversion develops. During the July flood the flow over the eastern side was in a northerly direction towards the Diversion, the reverse of the adjacent river flow.

At this stage, it seems appropriate to consider the stopbanking off of part of the Island by raising and extending the existing low stopbank on the south of the Diversion across the old channel to join up with the main stopbank at the top of Morrins Hollow at Aberharts. Before this is done, some study is required to ensure that there would be no detrimental effects. See Fig. 2.

This would be a relatively low cost job, which could enable better utilisation and management of the adjacent reserves. Ulimately, with full Diversion development the whole of Bothams Bend Island and Morrins Hollow can be made flood free.

9. RENWICK-CONDERS BEND FLOOD PROTECTION

Since the decision was made to leave a 'safety valve' at Upper conders there has been considerable development at Renwick on the Lower flood plain, and horticultural and other associated developments are becoming quite intense in this area. Not much publicity has been given to the damage to property in this area While the event here was not as spectacular as it was at Tuamarina, there was substantial damage, and there could alsc have been loss of life.

Consideration must be given to avoiding future overflows at Upper Conders by completing the stopbanking system in that area. This work is complimentary to the protection of Spring Creek township and the encouragement of Wairau Diversion development.

During this event the Opawa River floodway coped adequately with the escaping floodwater. It can also be commented that this was because there were no substantial flows from the Omaka and Fairhall Rivers. Again, we must realistically consider the exceptional probabilities of two events happening together. It is therefore reasonable to consider the old Opawa channel as an acceptable overflow area, particularly as the Board owns most of the land from Conders to the Opawa Floodway at the Omaka River confluence. It is therefore appropriate to consider replacing the present overflow 'safety valve' at Upper conders with an overflow system at Lower Conders.

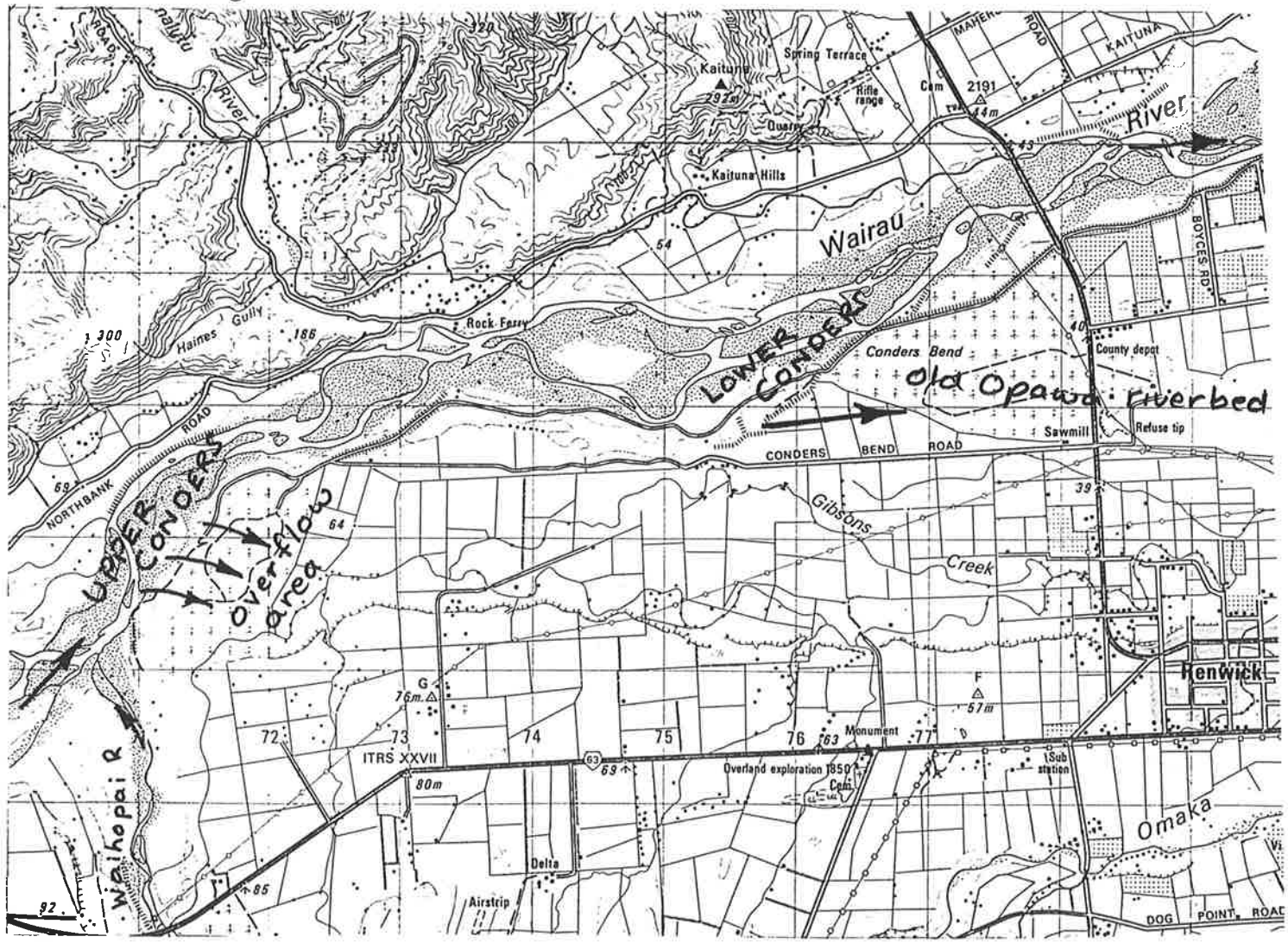
The mechanism for skimming off excess flows will need to be considered, but it could be a simple 'fuse plug' stopbank that failed through overtopping

This is effectively identical to the failure mode which occurred at the Lower Conders Breach. Some minor works may be necessary to ensure that such overflows are contained in the old Opawa channel, and undesirable developments must be avoided in the path of these potential overflows. This could mean a reconsiderabion of the permanent siting of cages at the Zoological Park.

The Board has some obligation to improve the flood protection at Renwick as in other areas.

I therefore recommend that the protection from flooding of the lower terrace at Renwick from both the Wairau River and Gibsons Creek be investigated.

Fig. 3.



10. REMOVAL OF PONDED WATER FROM THE PEMBERS-THOMAS ROAD AREA

10.1 General

Historically, this area is no more prone to flooding from stopbank overflows and failures than are the Wairau Pa, Spring Creek, Grovetown and Lower Wairau areas. However, because of the Wairau Diversion stopbanks, ponding levels can now be higher than in earlier years. Ponding of Wairau River flood water has happened here in recent times during the 1939, 1945, 1954, 1955, 1962 and 1983 floods.

The lower lying Pembers Road area at present relies almost entirely upon pumping to retain low drain levels, and is prone to more frequent ponding from heavy or prolonged rain. The Pembers Road pumping station was built in 1957 and previous to this a 'lake' formed here during most winters for long periods. Later in 1971, when the pumping system was upgraded and the Thomas Road pumping station was built to provide 3 times the pumping capacity. As the Diversion develops and lower water levels occur consistently, gravity drainage may be possible for this area.

On the 10th July 1983, the Wairau River flow under the Tuamarina Bridges was more than twice the earlier bankful capacity of the lower Wairau River floodway. This was possible because the Wairau Diversion was opened in 1963, and other stopbanks were upgraded after the 1962 flood. The July flood is recognised as being an extreme event, so, with the exception of stopbank failures, overflows of the Wairau stopbanks are still not likely to affect this area more frequently than once every 200 years.

10.2 10th July 1983 Flood

On the 11th July, 1983 the ponded level reached 4.15 m (13.6 ft) above mean sea level which was 0.9 m higher than in 1962, and was above any of the earlier recorded floods when floodwaters were able to flow to the Wairau Pa area. Maximum flood depth was about 2.7 m (8.7 ft) at Pembers Road. Like previous events, the water came from stopbank overflows and a breach. Had there been no breach in the stopbank the levels would have been lower and there would have been less damage to property and stock.

Although the removal of ponded floodwater was faster than in 1962, the Board's actions have been questioned, and improved means of removing water during a future event are being requested.

10.3 Flood Control Objectives

The Board's first objective must be to avoid any stopbank overflows which could cause pondage of floodwater in the area. Without any improvement to the existing stopbank system, overtopping of the Wairau stopbanks is still unlikely to occur more than once in 200 years. Although stopbank failures are usually associated with overflows, this is not necessarily so, and the failure of a stopbank during any flood event is a possibility, but not an inevitability.

Outlets through stopbanks are potential sources of leakage, and stopbank failure. In the Thomas Road-Bothams Bend area the underlying sand is a factor that has caused failures in the past. In recent times a potential stopbank failure at the Thomas Road gravity outlet was averted when the original pipes were replaced by one pipe. This action reduced the Board's ability to remove water during the July event.

Because of the recent event, people in the area see future flooding as being inevitable, and believe that the provision of additional means of removing ponded water is the first objective. This view can be questioned, but it is a natural reaction from those who have been recently flooded. The Board must therefore make a decision in what is a somewhat unreal and biased political climate.

There is no question that the greater public interest will be met by improving the stopbanking system upstream of Tuamarina and by positive works to encourage the development of the Wairau Diversion. If those proposals are proceeded with, they will reduce the possibility of overflows and flooding of this area. The Board must therefore decide whether the provision of additional means to remove floodwater is justified, and if so, to what extent should this be provided.

Quite complex consideration may be needed, particularly as some aspects of the situation are not clearly understood by people in the area. This report does not provide any firm recommendations, but endeavours to clarify and explain the situation so that Board members and people in the area can appreciate the implications involved.

10.4 Existing Outlets and Possibilities for Improvement

In a Wairau River flood overflow situation the removal of ponded water is at present controlled by the level of water in the Diversion. Under both present and future conditions, it will not be possible to remove the water as it flows in, even if a major new Pukaka channel was provided direct to the sea. No significant reduction in peak pondage levels can be achieved economically because of the practicable difficulties of providing an alternative outfall away from the river system.

However, improvements can be made to speed the removal of ponded water, but this may also be uneconomical as the reduction in damage would be slight.

10.4.1 Pukaka Stream Outlet System

While 'normal' drainage from the Pembers Road area is into the Pukaka Stream via the pumping station, there are also 760 mm and 915 mm diameter floodgated culvert pipes at the station which operate when water levels in the Pembers Road area are above those in the Pukaka Stream floodway. There is also a 600 mm diameter culvert at Thomas Road to remove any local stormwater or Diversion seepage from the 'sandhills' area. The lowest area is at Pembers Road where the likelihood of pondage is greater. Because of the sandhills, the Thomas Road culvert outfall could only operate effectively to remove ponded water during a large and hopefully rare pondage event.

The Pukaka Stream system was not specifically designed to remove ponded floodwater from the Pembers Road-Thomas Road area, but to protect that area from flooding by the Pukaka Stream. Because of stability problems and cost, it was not prudent to build stopbanks to a height that would have permitted an open ended floodway to the Diversion. When the floodgates at the Diversion outlet close, water in the Pukaka Stream floodway builds up until it overflows a weir into the formal pondage area on the eastern side. When the Diversion develops and maximum flood levels are below the level of the Pukaka stopbanks, removal of the culverts and floodgates can be considered. However, there are other factors related to the Diversion outfall that are not generally understood.

a) Pukaka Outlet to the Diversion

The outlet comprises twin 3.7 m high x 1.8 m wide box culverts with large side hung steel floodgates. The size of these culverts has been the subject to considerable argument over the years. Although these culverts and the Thomas road bridge have been blamed for constricting flows, the simple fact is that the capacity of the Pukaka channel and floodway is the real constraint in the system. If there was a larger opening, the frequency and size of overflows at the weir into the pondage area would not be changed to any significant extent, and water levels in the floodway upstream of the weir would not be altered. The present culverts are adequate for the capacity of both the floodway and channel. This was the reason for the Board's decision in 1977 to do nothing to the outlet.

The alleged 'constriction' caused by the culvert is only apparent when the Diversion water levels are significantly lower than those in the Pukaka floodway or channel. It is a hydraulic effect similar to the flow over a spillway where the water drops from one level to another and the speed of its flow increases considerably. With the present floodway and larger culverts, the drop in water level would move upstream away from the outlet culverts. The location of the drops would vary depending upon the relative size of Pukaka Stream flows and the Diversion level. Because the Pukaka channel and floodway in the lower end are built through old beach 'pea' gravels, that situation would cause indiscriminate scouring. The deposition of material downstream would periodically block the effectiveness of the outlet for low flows. (This has occurred to some extent downstream of the culvert within the Diversion where the channel has had to be paved with rock). To ensure that the speeding up of flows happened at a point where the channel bed and floodway would not scour, a section of the Pukaka Stream floodway and channel would need to be armoured. No doubt, this would then be seen as constricting the flow! The present culvert effectively provides both the armouring function and a structure upon which to hang floodgates to prevent back flows from the Diversion.

I hope that the explanation will help Board members and others to understand the actual situation. Unfortunately, some who have publicly criticised these culverts are apparently not prepared to consider any explanation, and have resorted to personal attacks to emphasise their views. This type of attitude is difficult to counter, but should not go unanswered.

Improvement to the Pukaka system cannot be done solely by the enlargement of the outlet culvert, but requires the complete reconstruction of the system. This could require the massive widening of the low level channel, or the separation of flood flows and drainage flows with alternative outlet works which would be costly and be disruptive to other properties and to public services. It is unlikely that such works could be justified if the Board decides to go ahead with improvements to the stopbank system near Tuamarina and works to encourage the more rapid development of the Diversion. The need for improvement to remove ponded floodwater via the Pukaka system then becomes less significant.

b) Soakage Disposal via the Pukaka into Pea Gravels

It has been suggested that the Board should have breached both Pukaka stopbanks in July to allow the water to soak into the pea gravels towards Rarangi. From previous experience with the Pukaka Pondage Area, no noticeable soakage occurs, at least with levels less than 3.25 m above mean sea level. From observations of soakage from the Diversion, and knowledge of increased groundwater pressures during floods, these gravels would not absorb sufficient water for this to be a viable proposition. The level of the gravel beaches are above that of the ponded water by about one metre, so water could not go very far.

The additional pondage volume obtained by breaching both stopbanks is not large relative to the flooded area, so ponded flood levels would only have been reduced by about 120 mm. This would not have significantly reduced property damage and would have involved other property and would have closed Pembers Road near the quarry, which would not have been desirable. Also, the removal of floodwater would have been no faster. The question of whether this could be done or not, did not arise on the day of the event. With the likelihood of further rain that could have affected the Pukaka Stream, the breaching of stopbanks could not have been seriously considered, as this could have aggravated the flooding situation. It must be accepted that judgements must be made by Board's staff based on their background of knowledge. In the recent circumstances, my subsequent enquiries show that the decision to wait until Monday to deal with the pondage situation was the correct one. During Monday a small amount of ponded water went over the weir into the Pondage Area.

c) Deliberate Breaching of Stopbanks

The breaching of the Pukaka stopbanks to create an effective outlet is not easy unless suitable plant can be used. At the Pembers Road end a breach must be virtually dug, while from Hunters Road to the Diversion a breach in sandy material could enlarge dramatically and cause other problems. Ultimately, the bulk of the ponded water must be removed from the Pembers Road area where safe access along these stopbanks to open a breach is a major difficulty.

d) Possibilities for Improving Removal of Ponded Water via the Pukaka Stream System

Possibilities appear to be :-

i) Major reconstruction of the Pukaka Stream system which would be very costly and therefore likely to be uneconomic.

ii) The provision of larger floodgated culverts, with or without (i), at the lowest Pembers Road area. These would avoid the need to breach the stopbanks, and like the present culverts would operate immediately there was an outfall head. These culverts would be more effective if the Pukaka channel was reconstructed. Additional floodgates add to the risk from leakage.

iii) The replacement of the present floodgated outlet into the Pukaka adjacent to Thomas Road with a larger culvert or culverts. These would only be effective during major pondage events when initially they would reduce the effectiveness of outflow culverts (or a breach) at Pembers Road. In the present circumstances this possibility may be more politically acceptable,but would increase the risk of floodgate leakage during floods.

10.4.2 Direct Outlets to the Wairau Diversion

When the Diversion was built, two 1220 mm (48") diameter floodgated culverts were put under the stopbank adjacent to where the Thomas Road pumping station now is. These pipes were in sand which caused problems so they were removed and replaced by one 1200 mm culvert. Because of previous leakage and blockage problems with the 1220 mm floodgates, a 914 mm (36") floodgate was put on the end of this culvert. That decision reduced the capacity of this outlet in July 1983, which although a large volume of water went through this outlet, its effectiveness was reduced because of siltation of the outlet channel across the Diversion berm.

This is the lowest area adjacent to the Diversion stopbanks from which the Thomas Road drain runs to Pembers Road. If this outlet was enlarged, it could be the best site for any new major outfall for ponded water. If sand problems along Thomas Road drain can be overcome, it would also be more effective for the removal of minor pondage around Pembers Road.

Some years ago the old Thomas Road outfall culverts at Bothams Bend were modified to provide a means of taking a controlled flow from Blind Creek to the Thomas Road pumping station. In the early stages of Diversion development these had become less effective as a drainage outlet. The new twin 48" pipes at Thomas Road were expected to eventually be the replacement drainage outlet. However, during the July 1983 event, water flowed out this way to the Diversion via the 914 mm diameter culvert under the 'outside' secondary stopbank at the Blind Creek outlet.

10.4.2.1 Breaching of Diversion stopbanks

Because of their height and the relatively high Diversion berm levels, the achieving of an effective outfall would be difficult and slow. It is therefore impracticable to breach the Diversion stopbanks to remove ponded water. The repair of a breach would be a major job and the risk of further flooding would be considerable. This situation is appreciated by people in the area, but has been mentioned because it highlights the value of being able to quickly breach the Pukaka stopbanks with much less risk of further flooding.

a) Possibilities for improving removal of ponded water direct to the Wairau Diversion

Possibilities appear to be :-

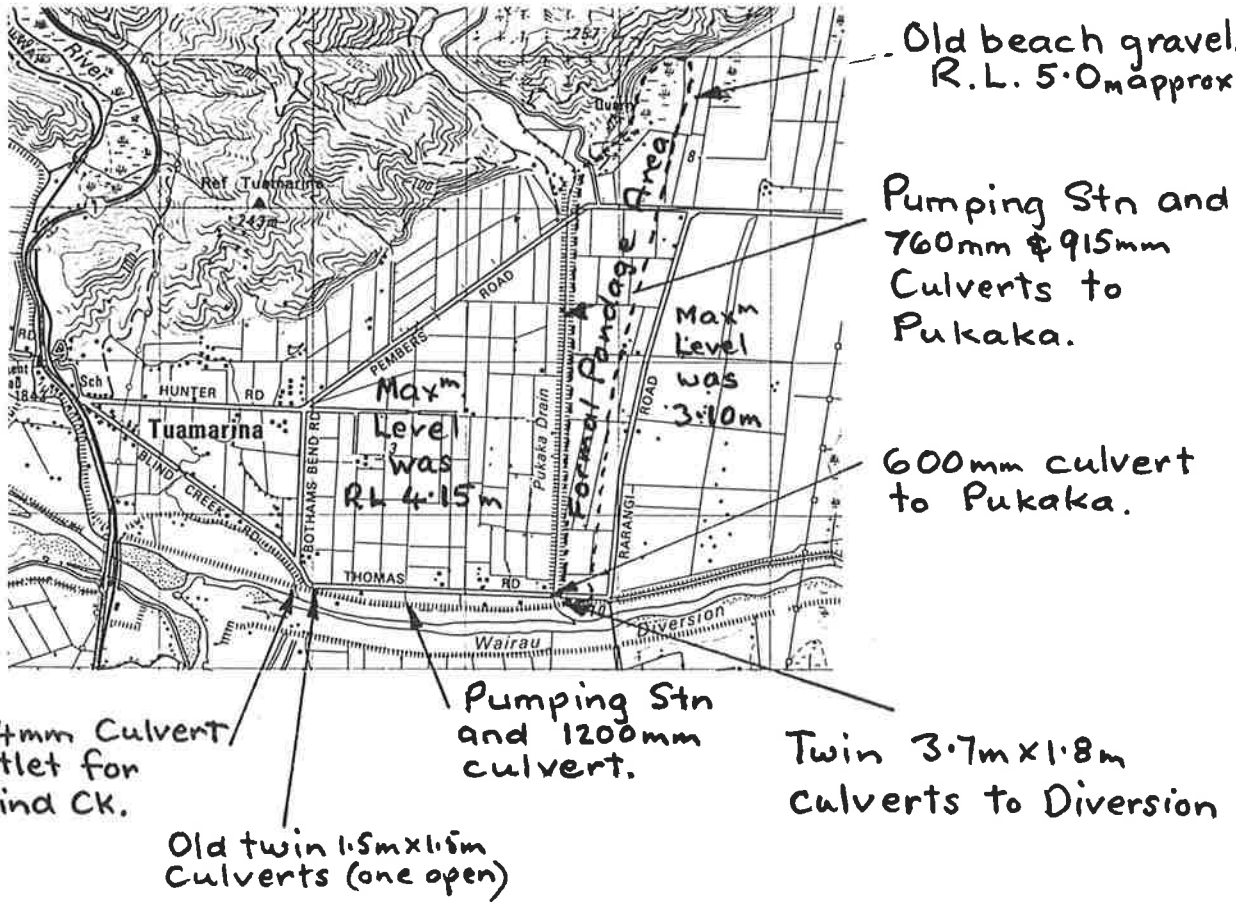
i) To provide a major outlet adjacent to the existing culvert and pumping station at Thomas Road with major reconstruction of the Thomas Road drain and the structures at Thomas and Hunters Roads. A major construction and cost factor would be caused because of sand in this area, and the problems of floodgate leakage would be increased.

ii) To re-open the existing twin 1.5 m x 1.5 m culverts alongside Thomas Road at Bothams Bend with floodgate control, and to place additional floodgated culverts through the 'outside' secondary stopbank to the Diversion. This could be done as an alternative to or as an addition to (a). The existing Blind Creek flow control to the Thomas Road pumping station would need to be removed, and the situation reconsidered. The larger outlet would also be of some small advantage for the removal of water from Blind Creek.

10.5 Conclusions on Removal of Ponded Water from the Pembers Road-Thomas Road Area

While possibilities for improving outfalls from the Pembers Road-Thomas Road area have been suggested, there are none that will significantly change the ponded level of flood overflows. The only practical means of doing this is to make improvements to the stopbanking system. Proposals to do this have been recommended, and can be done very quickly. This lessens the threat of ponding from Wairau overflows which even now is statistically a rare event. Some improvements can be made to the outfall system which as the Diversion develops will become of greater advantage for the normal drainage of the area during major rainstorms. Obviously, closer study and discussion is needed before the Board will be able to make a decision about whether to improve the outfalls, and if so, to what extent.

Fig. 4.



11. MISCELLANEOUS MATTERS

The following matters for further consideration have arisen from observations during the July flood. They are listd here for the record, and policies on some aspects should be considered soon.

11.1 Roads, Access Tracks and Stock Routes over Stopbanks

Past policy has been to allow roads over stopbanks to be built at a level of at least the design flood level, within the freeboard allowance. The failure and potential failure at these points, and particularly the lifting of road seal under such conditions, suggests that consideration should be given to revising this practice.

11.2 Spur (Wing) Banks and Access Ramps

The possible danger to stopbank failure caused by spur (wing) banks and access ramps is highlighted by the events at Wratts Road. Elsewhere the development of similar failures has been obvious. Current practices need revision.

11.3 Grazing of Stopbanks and Berms

The value of a good grass cover on stopbanks was obvious in many areas but particularly on the Board's reserves. Suggestions that gravel covered stopbanks erode faster than silt banks is not confirmed by observation. The existence of a good grass cover would appear to have more effect.

Because of last year's dry summer there was a tendency to overgraze in some areas. Where this has occurred the failure of training banks, and scouring along stopbanks and on berms is evident.

In critical areas better management of banks and berms is needed to ensure the safety of river control works. This could require changes in leasing policy, administration and management, and the fencing off of some areas.

11.4 Pipes Through Stopbanks

The dramatic re-excavation of buried Post Office cable ducts at the Ferry Bridge approach highlights the danger of pipes through stopbanks. With the advent of horticulture and irrigation there is a growing demand to put pipes through stopbanks. The actions of people doing this without authority are becoming alarming, and the situation upstream of Jacksons Road on the Opawa where ten breaches were made and left open shows the need for a positive policy.

Any pipe through a stopbank is a potential failure site. More particularly, if the pipe operates under a high pressure or suction which causes it to move about in the bank. In some stopbanks, depending upon the size of the installation, there may be no problems. However, a consistent policy would appear to treat everyone uniformly and would avoid pressure being placed on staff to approve an installation.

For this reason a policy to avoid all irrigation pipes and water supply pipes in stopbanks would appear to be desirable.

11.5 Fence Posts on Stopbanks

While fences over stopbanks cannot often be avoided, the danger of scours developing from these in an overflow situation is now very apparent. The

erection of such fences is covered by the Board's bylaw, and requires approval. However, this is rarely requested, and there has been no attempt to police these.

11.6 Buildings and Structures Adjacent to Stopbanks

Some concerns have been expressed about the proximity of buildings to the stopbanks at Tuamarina. Buildings close to stopbanks during an overtopping can cause swerls at the toe of stopbanks from which scours can migrate up the stopbank. There was some suggestion of this at Tuamarina, but it is rather inconclusive. However, it may be appropriate to require extra height on stopbanks where buildings are close to the toe to reduce the amount of overflow at these points.

11.7 Sandbag Recovery

Some 6000 sandbags have been recovered using PEP labour and have been roughly cleaned and dried. Of these, 5155 have been paid for, and obviously many were 'donated' during the flood by farmers and others. Jute bags do not last in storage and it would be desirable to reduce the numbers of these being held. Action is to be taken to return bags to farmers and others. Some polypropylene bags will be retained in storage. The possibility of storing bags at pumping stations or other locations for easy access has been considered in view of the problems experienced in getting bags quickly to the danger spots.

11.8 Control of Gravel Removal

Because very little bank erosion occurred, changes in gravel deposits have not been significant. In a few areas, there have been some deposits, and generally the river bed has been well stirred up. (The effect on groundwater recharge this summer will be interesting). It does not appear that there have been any significant general changes in river bed levels. A Ministry of Works and Development survey at the Tuamarina bridge suggests a lowering of the bed there.

It is apparent that close control over gravel removal will be needed in the immediate future to remove excess deposits and to avoid aggravating undesirable changes caused by the flood. Contractors have been advised that all previous approvals to remove gravels are cancelled, and that new arrangements are required. Greater care will be taken to ensure that large stones from screenings are put where we direct.

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