



Living with the River

Hutt River Floodplain Management Plan:
Phase One Summary Report

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The purpose of the report is to raise awareness of the risks of flooding in the Hutt Valley and the issues which must be addressed during subsequent stages of the floodplain management planning process.

Submissions on any or all of the issues will be welcomed and can be made at any time to;

The Manager
Rivers Department
The Wellington Regional Council
PO Box 11-646, Wellington
Ph 3845708, Fax 3856960

November 1996



*caring about you
& your environment*



As a long standing resident of the Hutt Valley I have lived with the Hutt River all my life. Along with thousands of others, I visit the river regularly to enjoy the beauty and tranquillity of this valuable regional resource. But I also

know of its enormous destructive potential. I saw first-hand the large flood of 1939 and I've seen the devastating economic effects of flooding in more recent times.

We are all members of a regional community that includes New Zealand's most densely populated floodplain. I use the term *floodplain* to refer to the present river corridor (the area within the current stopbanks) *and* the urban areas which have been built within the old floodways. Approximately 70,000 of us have built our homes or spend our working lives in these potentially flood-prone areas. The security of the floodplain must be important to us all, either as residents or as members of a wider community that depends on the Hutt Valley as a vital part of the regional economy.

Concern for the security of the floodplain is the rationale behind the Regional Council's preparation of a floodplain management plan. The Council is concerned that the level of security provided by flood defences designed almost 50 years ago is no longer appropriate for an ever-increasing and sophisticated urban population. Council is also aware that some current river management practices are of concern to residents.

To address these concerns, the Regional Council has commissioned reports on how the floodplain has been managed and how this could be improved. These reports make up Phase One of the Hutt River Floodplain Management Plan. They give us an invaluable and reliable source of information on which to build new management strategies that will take advantage of all the opportunities the floodplain offers. A wide range of options for

protecting life and property and for improving the environment can now be considered.

Some of the issues that have been addressed in Phase One include;

- The security of the existing flood defences and their chances of failing.
- The damages that will result from failure of the defences. Who will be affected? What warning can be given and how effective will this be in reducing damages?
- Reducing the chances of failure of the flood defences.
- The value placed on the river environment for uses other than flood mitigation. Can aesthetic, ecological and recreational values be improved while also improving flood security?
- Ensuring widespread support for the floodplain management plan.

The results are summarised in *Living with the River*. The detailed information is contained in thirteen technical volumes available from public libraries.

The importance of the plan cannot be underestimated. It will determine how well we provide for the security of our children and it will influence the future development of large areas of the Hutt Valley. Close co-operation between councils will be essential as the floodplain management plan will affect areas also covered by Upper Hutt City Council's and Hutt City Council's district plans.

I hope you find *Living with the River* both enjoyable and informative. Please take the time to consider the issues that are discussed in the report. We will need to work together closely to establish acceptable and secure ways of living with the Hutt River.

Stuart Macaskill
Chairperson
Wellington Regional Council

About *Living with the River*

In compiling *Living with the River* the Regional Council has tried to anticipate questions people may have on the nature of the Hutt River floodplain and the risks of flooding.

The report is in three parts:

The *Executive Summary* provides a useful overview of the report. We hope you will read this first, and that it will entice you into the body of the report.

Part One describes the nature of the floodplain and the risks of flooding by explaining the existing conditions and effectiveness of the flood defences. The resulting issues for future floodplain management are collected together at the end of each chapter. The results of a survey of the communities' perceptions of the risks and benefits of living within the floodplain environment complete Part One.

Part Two describes the development of floodplain management planning in the Hutt Valley. The process proposed by the Regional Council to complete the floodplain management plan is outlined. The issues from Part One are summarised and collated into three functional areas;

- policy issues
- technical and operational issues, and
- issues for local territorial authorities.

Between Part One and Part Two we have inserted a *Scrapbook* of clippings and articles which record some of the experiences of flooding in the Hutt Valley over the last 150 years.

How to obtain further information

Living with the River is based on information contained in technical reports prepared for the floodplain management plan. At the end of each chapter you will find references to the relevant technical reports.

There is a reference listing and summary of technical reports inside the back cover. Reference copies of the reports are available from the Regional Council library. Lending and reference copies are available from public libraries in the Hutt Valley and from Wellington Central public library.

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Terms Used to Describe Flooding

Flood size is measured as the quantity of water flowing past a point when a flood is at its peak. The unit of flow is cubic metres per second ($1 \text{ m}^3/\text{s} = 1000$ litres per second).

The *chances of a flood occurring* are described in the same way as the chances of any infrequent but predictable event are described. Chances of flooding can be predicted by counting how many floods of a certain size have occurred over a given period of time.

For example, floods measuring $1460\text{m}^3/\text{s}$ at their peak caused widespread flooding of the areas now occupied by the cities before the stopbanks were built. Floods of this size are large enough to test and damage the existing flood defences.

Over the last 155 years 8 floods of at least this size were observed in the Hutt River. They occurred in 1855, 1858, 1878, two in 1893, two in 1898, and the last in 1939.

As one occurred every 19.4 years on average, the chances of another flood of this size in any one year is said to be 1 in 20.

Predicting random events such as flooding is obviously an approximate science. These examples may help put risks of flooding of the Hutt River floodplain into context;

Burglary in any one year	1 in 16
<i>Serious damage to the flood defences in any one year</i>	<i>1 in 20</i>
Drawing the ace of spades in any one draw	1 in 52
<i>Failure of the flood defences in any one year</i>	<i>1 in 50</i>
Infant mortality	1 in 119
<i>Localised flooding of urban areas in any one year</i>	<i>1 in 100</i>
Contracting heart disease in any one year	1 in 1000
<i>Widespread flooding of the cities in any one year</i>	<i>1 in 1000</i>
Dying in a road accident in any one year	1 in 6000
<i>Widespread failure of the flood defences in any one year</i>	<i>1 in 5000</i>
Div. 1 lotto from a lucky dip in any one draw	1 in 400,000

Indexing Financial Sums

All financial dollar sums quoted in this report have been adjusted for inflation to represent the monetary value in June 1996 using the Construction Cost Index (C.C.I.) from 1946 and the Consumer Price Index (C.P.I.) prior to 1946. The C.C.I for June 1996 is 3700.

For example £1.0 million spent in 1939 is equivalent to spending \$88 million in June 1996. £1.0 million spent in 1954 is equivalent to spending \$10 million in June 1996.

Living with the River Executive Summary

marking the completion of Phase 1 of the Hutt River Floodplain Management Plan

The Hutt River Floodplain Management Plan is a Regional Council initiative to plan for the long-term development of the Hutt River. The plan will help improve the security and quality-of-life of present and future generations of Hutt Valley residents.

The floodplain management plan Phase One Summary Report *Living with the River* completes the first part of the plan.

The objectives of the first phase have been to gather information and to develop the analytical and decision-making processes required to consider river management options.

Living with the River summarises the findings of the Phase One investigations and defines the issues for the management plan.

Phase One Investigations

Technical investigations and social assessments have been completed covering:

- **Rainfall & Runoff:** identifying the rainfall and catchment conditions which will lead to flood-producing runoff, and predicting the size and nature of floods and the chances of these occurring.
- **River Engineering:** describing natural processes which take place in the river and how these have been affected by the construction of flood defences. This includes understanding how the river can erode and breach flood defences, and assessing the capacity of existing flood defences to safely contain floods.
- **Risk Assessment:** analysing the risks of flood defences breaching, and identifying urban areas which may then be flood-prone and the damages that may result.
- **Social Assessment:** recording current and historical community perceptions of the risks of flooding, values placed on the river environment, communities' abilities to carry acceptable risks, and their need for collective action to reduce unacceptable risks.

Decision-Making Tools for Floodplain Management

The Phase One investigations have developed decision-making tools to help evaluate options for improving floodplain management. The tools include;

- an hydraulic model to predict the nature of floods,
- a breach scenario model to simulate failure of flood defences,
- a flood damage assessment model to quantify flood damages resulting from breaches, and
- a risk assessment model to calculate the reduction in flood risk provided by possible options.

These tools allow comparison of the value of the various management options. The overall costs of each option can be compared to the corresponding reduction in risks and flood damages.

Policy Issues Raised by the Phase One Investigations

The Phase One investigations identified 15 key issues to be addressed by the floodplain management plan:

- 1) ***Risks of current occupation of the floodplain:*** The Hutt River has been greatly constrained and modified by the construction of flood defences. Parts of the urban areas of Upper Hutt and Lower Hutt are built within the river's natural floodplain. These areas were regularly flooded by the Hutt River prior to the construction of the flood defences. The flood defences will need ongoing maintenance and improvement to protect these areas.
- 2) ***Ongoing damage to the flood defences:*** In any one year, there is a 1 in 20 chance that a flood will cause damage to the flood defences which will cost between \$500,000 and \$1,000,000 to repair.
- 3) ***Breaching of the flood defences:*** In any one year, there is a 1 in 50 chance that damages to the flood defences will be serious enough to lead to breaches. Flooding of urban areas may then occur. The extent of flooding of these areas will depend on the size of the flood in the Hutt River and the size and number of breaches.
- 4) ***Flooding of urban areas:*** In any one year, there is a 1 in 100 chance that breaching of the flood defences will lead to significant flooding of urban areas.
- 5) ***Condition of the flood defences:*** The line of flood defences consists of sections in good condition linked to sections in poorer condition. The chances of flooding of urban areas is directly related to the condition of the weakest section of the flood defences.
- 6) ***Improvements to the flood defences:*** The costs of improving the weakest sections of the flood defences to provide consistent security throughout the Hutt Valley would exceed \$20 million. This would reduce the chances of flooding of all urban areas to approximately 1 in 300 in any one year.
- 7) ***Ultimate security of the flood defences:*** It is impractical to construct flood defences to provide ultimate security. There will always be a residual risk that sections of the flood defences may breach.
- 8) ***Flood-prone areas:*** Potentially flood-prone areas can be identified. Urban areas which have a 1 in 1000 chance of flooding in any one year contain approximately;
 - 14,500 homes,
 - 36 schools,
 - 9 medical facilities,
 - 175 community & recreation facilities, and
 - 1,330 commercial & utility facilities.Within the flood-prone areas there are approximately 71,000 people who are directly exposed to the risks of flooding.
- 9) ***Potential flood damages:*** Flood damages within flood-prone areas may be as high as;
 - \$190 million in Upper Hutt City, and
 - \$700 million in Lower Hutt City.There is a 1 in 1000 chance that damages of this order may occur in any one year.

Smaller, more likely floods, will cause less damage. If no further action was taken to improve the flood defences, flood damages may be equivalent to incurring approximately \$5 million worth of damages every year.

- 10) Risk Management:** Reducing this \$5 million “average annual damage” is the principal objective of the floodplain management plan. Risk management options must be compared in terms of their affordability and by how much they reduce the \$5 million figure. Money spent on non-structural projects (planning measures, preparedness and flood-proofing projects within the urban areas) may result in similar reductions in flood damages to money spent on structural projects to strengthen the flood defences. Non-structural projects typically involve smaller levels of expenditure and may be more effective and affordable. They will provide individuals with greater choice in the risks they are prepared to carry or the sums they are prepared to spend on risk reduction.
- 11) Intangible losses:** The damage figures do not include intangible losses; loss of life, personal possessions and the trauma of flooding. These are expected to be as large as tangible losses.
- 12) Flood Preparedness Measures:** For now, the risks of flood defences breaching in a major flood remain high. The risks will not reduce until the current conditions of the flood defences are improved. This may take many years. In the interim, there is a need

to manage flood risks. Effective risk management involving community and individual preparedness and floodproofing measures have been shown to reduce flood damages by up to 60%. Preparedness also reduces intangible losses, trauma, personal injury, and the risks of loss of life.

- 13) Raising general awareness:** Improved general awareness of flood risks will gradually lead to a reduction in flood damages. With increased knowledge business managers will make decisions to reduce business risks. Individuals can take steps to protect their own property.
- 14) Te Tūtobinga O Te Whakaaetanga (Charter of Understanding):** The charter is a consultative agreement between the Regional Council and iwi in the Wellington Region. Iwi have the opportunity to be involved in management planning and decision-making for the Hutt River floodplain, particularly for activities which could affect cultural values and waahi tapu (areas of significance). Tangata whenua of the floodplain are Te Atiawa.
- 15) Recreational Values:** The river corridor is increasingly valued for its recreational opportunities, receiving more than one million visitors each year. Improvements to flood defences must be through a participatory process which leads to the enhancement of environmental and recreational values.

Where to from here?

Living with the River is endorsed by the Wellington Regional Council. The release of the

document represents the start of the next stage of the floodplain management planning process which will include the following steps:

- Distribution of the report to affected stakeholders' representatives; iwi, city council politicians and management, affected government departments, special interest technical groups, special interest community groups, and significant asset owners within the floodplain. Stakeholders will be requested to review the report and declare their interest in taking part in the floodplain planning process.
- Press releases and support for the media to stimulate general public discussion. Presentations and meetings that focus on the issues will be arranged in response to the demand for further information.
- Meetings with stakeholders to obtain feedback on the policy framework and membership of the consultative groups proposed by the report.
- Agreement with the City Councils on the scope and programme for the next stage of planning and implementation.
- Regional Council endorsement for the next stage of the floodplain management plan.

It is expected that this process will take 6 to 8 months to complete.

Proposed Policy Framework

A decision-making framework has been proposed in *Living with the River* to consider the issues raised by the Phase One investigations. The framework includes the formation of the following special consultative groups;

- Technical and Community Advisory Groups to obtain community input, and
- A Hutt River Floodplain Management Committee to manage the next stage of the floodplain management plan.

The Landcare Committee, the standing committee of the Regional Council responsible for floodplain management planning, will approve the terms of reference for the consultative groups and will consider issues raised during the plan preparation. The Wellington Regional Council, the principal decision-making body, will endorse and approve the implementation of the next stage of the plan.

Your Involvement

You are encouraged to read *Living with the River* and to express your opinions on the issues that are raised. Comments, or requests for additional copies of *Living with the River*, should be addressed to;

Manager Rivers
Wellington Regional Council
P.O.Box 11-646, Wellington
Ph 3845708, Fax 3856960

Further Information

Further information can be obtained by reference to the Hutt River Floodplain Management Plan: Phase One Investigations Technical Reports, held by public libraries in the Hutt Valley, by the Wellington City Council Central Library, and by the Wellington Regional Council Library.

WRC October 1996



Part One


The Nature of the Hutt River Floodplain
and the Risks of Flooding

Cabbage Tree and Flax species belong to the diverse mix of vegetation found in the original forests and swamps of the Hutt Valley before it was cleared last century. Flax was an important resource for Maori.


The native Tree Weta has adapted well to the changes in its habitat from native forest to urban sprawl. Invertebrates are an important link in the food chain and play a significant part in post-flood recovery of an area by being the food source for returning animals.

Hutt River Catchment

 Urban areas


 Rural Use, regenerating bush and pasture

 Belmont Regional Park


 Akatarawa Forest and proposed protected catchment area


 Akatarawa water catchment area


 Hutt/Kaitoke water catchment area

 Kaitoke Regional Park and Forest Park

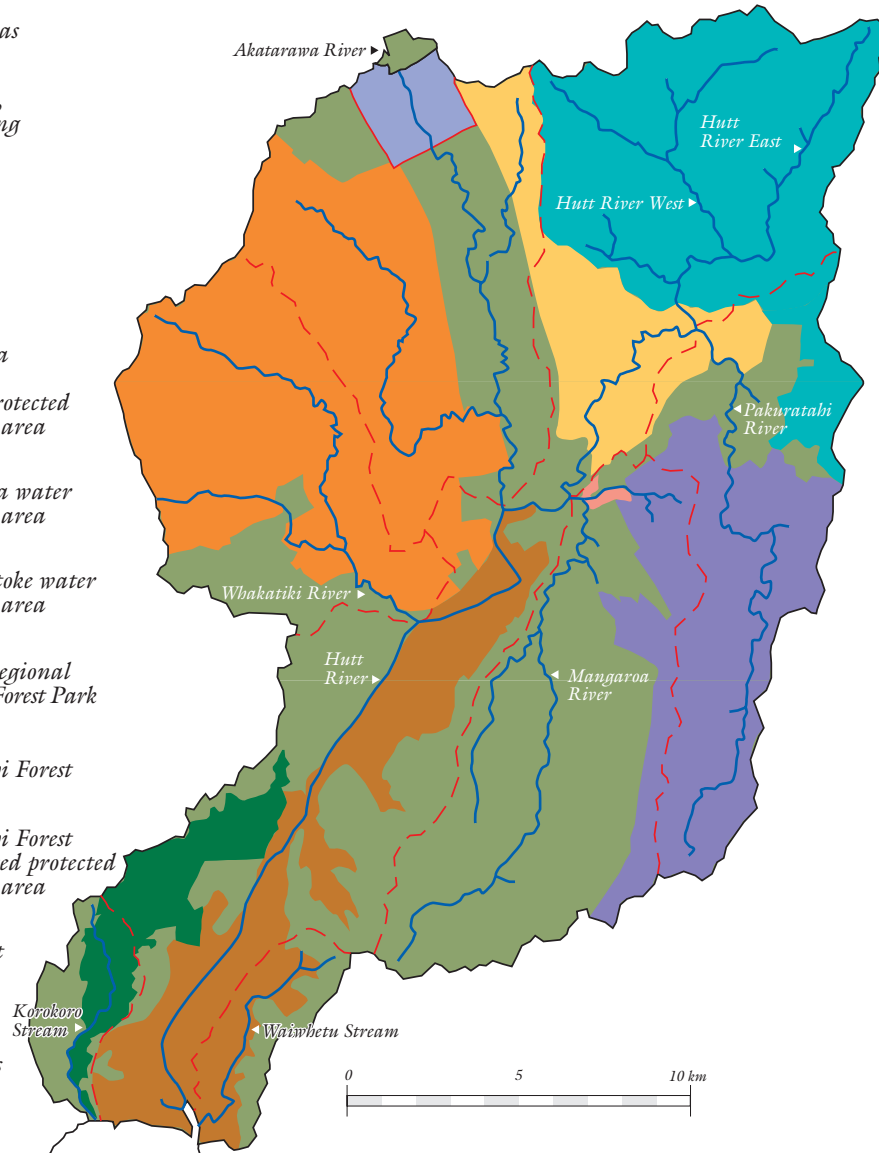
 Pakuratahi Forest

 Pakuratahi Forest and proposed protected catchment area

 Catchment boundary

 Sub-catchments

 Rivers



River/Catchment Information

Catchment Name	Area (km ²)	Length (km)
Hutt River	655	54.0
Hutt headwaters	88.6	15.6
Pakuratahi River	81.4	25.3
Mangaroa River	104.1	21.6
Akatarawa River	116.4	24.4
Whakatiki River	81.8	18.4
Waiwhetu Stream	18.1	8.1
Korokoro Stream	15.7	7.2



Hutt River Catchment

Development of the Hutt River Floodplain

The Hutt River is a steep alluvial river, draining small mountainous catchments of the southern Tararua Ranges. Nearly 130,000 people live within the catchment. Many live on the floodplain.

The map on page 2 shows current land uses. The floodplain is shown in more detail overleaf.

Today's Floodplain Environment

European settlement and subsequent urban development have created the floodplain environment we know today.

The Hutt Valley is now a key communications corridor for the southern North Island. A high level of personal, business and public investment exists in buildings, property and utilities. These have accumulated through time to constitute a major component of the Wellington regional economy.

Future floodplain management will need to focus on the needs of an ever-increasing and sophisticated urban population.

The floodplain is also an evolving physical environment. The geological and climatological processes which have shaped the river valley are all still active and will lead to ongoing changes.

This chapter describes the recent natural events and the stages of urban development which have influenced past floodplain management and will continue to influence future management. A chronology of historic events is shown in the exhibit on page 6.

Climatic & Geological Influences

Climatic changes have been dramatic, with a complete cycle of global warming and cooling occurring in geologically recent time.

The present river valley was formed through glacial erosion during the last ice age, 2 million years ago.

Less than 14,000 years ago, during the last period of global cooling, sea levels fell 135m below present levels. The river then flowed south to a mouth in Cook Strait. Gravels deposited during this period form the water-bearing layer of the Hutt Valley aquifer, now approximately 20m below the existing valley floor.

During the subsequent period of global warming, sea-levels rose 2m above current levels. Marine and river-borne silts and sands were deposited over the aquifer gravels. The impervious silty layer is called the aquiclude. It allows water pressure to develop within the aquifer which prevents polluted surface water entering the aquifer and contaminating the pure artesian water supply.

In the future, sea level changes will continue to affect the position of the river mouth. This, in turn, will affect the level of protection provided by the flood defences in the estuarine reaches of the river. The position of the river mouth will also influence processes of river erosion and deposition south of Melling Bridge.

Hutt Valley Floodplain



Current predictions for climatic changes are that sea levels may rise 200 to 400mm by 2050AD. Climatic changes may also increase rainfall intensities meaning that larger floods may occur more frequently. Long term planning to raise existing flood defences throughout the valley needs to be considered. All new works need to be designed to allow future raising.

Climatic changes may also increase the frequency and duration of droughts. Future river flows need to be managed to ensure that there is always sufficient water available to sustain the aquifer and recharge water extracted for drinking.

The Hutt Valley follows the Wellington Fault, one of New Zealand's active earthquake fault-lines. It is also affected by a number of other faults closely associated with the boundary of the Pacific Plate, popularly referred to as the *Pacific Rim of Fire*. The fault lines separate the region into large geological blocks of land. The blocks tilt, lift and subside in response to pressures from adjoining blocks. East-west tilting of the blocks beneath the floodplain has helped confine the river to the western side of the floodplain. Uplift has extended the river mouth from central Lower Hutt to its present position.

Recent fault movements led to large earthquakes in about 1060, 1460 and 1855. In 1855, movement of the Wairarapa Fault lifted parts of the Valley by over 1.5m and drained the estuarine swamps of Petone and Waiwhetu. Earthquakes on this scale are expected to

continue, causing further uplift, subsidence and horizontal fault movements within the floodplain.

Rupture of the Wellington Fault is likely to be the next large earth movement to affect the floodplain. There is a 1 in 2 to 1 in 6 chance of this occurring over the next 200 years. The rupture may lower the blocks to the east of the fault by about 300 to 500mm, particularly at the southern end of the floodplain. The accompanying earthquake may damage some of the older flood defences. Flood defences in the lower valley may need to be reconstructed or rebuilt to a higher level. If uplift occurs, river bed levels will need to be maintained a safe distance above the aquiclude to prevent scour of the aquiclude and to protect the integrity of the aquifer.

Ecological Influences

European settlement commenced in 1840. Between 1850 and 1880 the forests which had covered the entire floodplain were cleared. From the time of their establishment nearly 4000 years ago the forests had controlled both the river alignment, the processes of erosion and sediment transport, and the force of the river-in-flood. Their removal destabilised the natural balances within the river system, resulting in rapid changes in river alignment and life-threatening flooding of the floodplain.

Ongoing river management works have been required to maintain the river alignment, manage accumulations of gravel deposits and contain the erosive forces of the river-in-flood.

Years before present

4,000 Peak of global warming. Thick layers of silt deposited over the forests in Lower Hutt to form the impermeable cap for the Hutt artesian system (the aquiclude).

10,000 Global warming. Hutt Valley delta becomes densely vegetated with forest and swamp.

14,000 Most recent global cooling. Hutt River 22km longer than at present, sea level 100-135m below its present level, deposition of artesian gravels.

2,000,000 Ice Age. Formation of the present Hutt Valley depression and diversion of the river channels south.

3,000,000 Final shape of modern New Zealand formed. Many Hutt River tributaries flow westward to the Porirua-Pauatahanui Inlet.

10,000,000 Folding, raising and squeezing of base rock forms the central ranges of New Zealand which start to erode into the eastern & western plains.

150,000,000 Ancestral New Zealand appears from the Pacific basin. The country becomes an ever-changing archipelago.

Years AD

1200 Earliest signs of permanent Maori settlements in the Hutt Valley.

1460 The 'Hao-whenua' earthquake. 4-7 m rise in land levels around Port Nicholson.

1820s First significant Maori migration to the Wellington area.

1840 European settlement. Removal of the floodplain forest begins.

1855 The Wellington Earthquake. Floodplain rises 1.5m. River length extended and a new estuary and foreshore formed.

1858 Largest flood experienced by European settlers ending a decade of extreme flooding. 9 lives lost.

1871 First Hutt River cross section survey carried out from the mouth to Boulcott.

1880 Most of the forests south of Taita Gorge removed.

1875-1890 First attempts are made by the Provincial Council and Hutt River Board to control the new river regime which emerged following the 1855 uplift and removal of the floodplain forests.

1893 Flood inundates Petone and Lower Hutt Borough.

1894 Stopbank built to protect Petone. Promoted by Gear Meat Company.

1898 Largest flood in recorded history (approx. 2000 m³/s). Hutt River Board reconstituted to promote stopbanks to protect Lower Hutt Borough.

1900-1906 First stopbanks built on the east bank from the Estuary Bridge to Boulcott. The Petone stopbank replaced by a new stopbank from the Estuary Bridge to Melling.

1900-1930 In the Lower Valley, removal of the last remnants of the primeval forest from the river bed. In the Upper Valley, most of the floodplain forests had been cleared for pasture by 1900.

1916 Hutt River Board recognition that the newly constructed stopbanks would fail if the river alignment and gravel deposits could not be managed. Management philosophy adopted to straighten the river by dredging and to fund river management through the proceeds of gravel sales.

1924 Large scale exploitation of the gravel resource commences.

1939 Largest flood of the twentieth century (1600m³/s). Demonstrated that the flood defences and the management techniques based on dredging and straightening were effective, but that large areas of the Upper Valley were still flood-prone.

1944-72 Government & Hutt River Board reconstruct stopbanks and extend stopbanks from Boulcott to Maoribank. River straightening completed to current day alignment. Dredging of upper reaches accelerated.

1970 Gravel resources exhausted. Gravel industry scales down.

1972 Hutt River Board functions taken over by the Wellington Regional Water Board. Management techniques modified to take account of sustainability and environmental concerns. Greening of the river environment commences. Sustainable gravel extraction methods adopted.

1986 Investigations for the Floodplain Management Plan commence.

1996 Phase One of the Floodplain Management Plan completed.

Upper Hutt - Whakatiki. WRC photo.

From 1865 to 1965 mechanical methods and the construction of river engineering structures were used to manage the river. These methods included gravel extraction using heavy equipment, groyne construction, and ongoing reshaping and diversion of the river bed using large bulldozers, commonly referred to as cross-blading.

The mechanical methods led to the deterioration of the river environment. Since 1972, river management techniques have been changed to re-establish vegetative bank-edge protection works and a healthy riparian ecology. This has been achieved by managing gravel extraction more carefully and by planting rapidly growing exotic trees. All new river management works must be designed to minimise environmental effects, increase the use of native species within the river corridor and incorporate landscape improvements.

Social Influences

The dangers of flooding delayed widespread settlement of the floodplain until stopbanks were constructed. (Clippings and articles recording flooding before the construction of stopbanks are included in the Scrapbook section of *Living with the River*.)

The gradual northward progression of stopbanks between 1893 and 1972 has divided the natural floodplain into two parts under separate administrations. The river corridor,

now administered by the Regional Council, is where flood mitigation works and compatible recreational activities occur. The urban areas, where rural, urban, commercial and industrial uses now predominate, are administered by the City Councils. As the stopbanks are likely to remain indefinitely, this division of the floodplain can be considered permanent. The administrative and land-use divisions raise special issues for planners.

Future management of the river environment will need to meet the environmental and recreational demands of an increasing urban population while maintaining adequate flood security.

The urban areas will remain places of low flood risk only so long as the flood defences are maintained and improved. It will be unacceptable to achieve this at the expense of the quality of the river environment as has occurred in the past.

There must be a recognition that the stopbanks may fail and that steps can be taken to reduce flood damages. Planners will need to acknowledge flood-prone areas and apply appropriate planning measures.

The land-use patterns and the environment of the entire floodplain are now established. The aim of the floodplain management plan is to allow for improvements in the quality and security of this environment.

Issues for Floodplain Management Planning

Raising Flood Defences

Climatological, geological and hydrological studies indicate that;

1. climatic changes may lead to 200 to 400mm rises in sea level by 2050AD,
2. climatic changes may increase rainfall intensities with the consequence that larger floods may occur more frequently, and
3. movement on the Wellington Fault may lower the floodplain by 300 to 500mm, particularly at its southern end. The accompanying earthquakes may damage some of the older flood defences.

Within the next 100 years, the flood defences may need to be rebuilt and raised as a result of climatic and geological changes. Consideration needs to be given to;

- *provisions to raise all flood defences south of Melling Bridge to accommodate sea level changes and earthquake induced movement, and*
- *longer-term provisions to raise stopbanks to cope with increased frequency of flooding which may result from climatic changes.*

Management of the River Environment

The river corridor is used for a wide range of recreational pursuits. There remain large areas where the recreational and ecological qualities of the habitat can be developed.

Current river management practices will need to be improved or adapted to achieve;

- *acceptable environmental effects, enhancement of recreational areas and longer-term objectives to re-establish as much of the natural riparian environment as is practicable,*
- *the best use of open space in the Hutt Valley, and*
- *links between open space throughout the adjoining urban areas.*

Regional and District Planning : Headwater and Tributary Catchments

The land-use patterns for the headwater and tributary catchments have not changed for some time. The catchments are mostly in conservation reserves, sustainably managed production forestry and life-style farming activities. The current uses are mostly compatible with flood mitigation and are of acceptable environmental quality. However, there is no statutory guarantee that they will remain this way or that floodplain management issues will be considered in future planning of the Hutt River's headwater and tributary catchments.

Planning provisions need to be strengthened to protect and enhance the headwater and tributary catchments by formally linking catchment land-use planning to the floodplain management plan.

Development Adjacent to the River Corridor

The costs of improving flood defences and the associated environmental effects are related to the proximity of adjoining urban development.

For the recently completed Ewen Floodway Improvements over \$9.5 million, 63% of the total river works cost, was spent on purchasing and clearing private property which confined the river. In 1945 the Crown purchased and removed the dwellings from the Newton Street subdivision (now Poets' Park, Upper Hutt) for similar reasons.

There are areas where the current line of flood defences remain unreasonably constrained by development adjacent to and within the river corridor. These need to be identified so that the Regional and City Councils can consider options to acquire the properties or to encourage appropriate redevelopment.

The material in this chapter is drawn from the following technical references:

Ref 1: Volume 2 : Climatology - Volume 1: Summary, referring to Volumes 2-5.

Ref 11: Volume 11 : Environmental - Summaries & Maori Component.

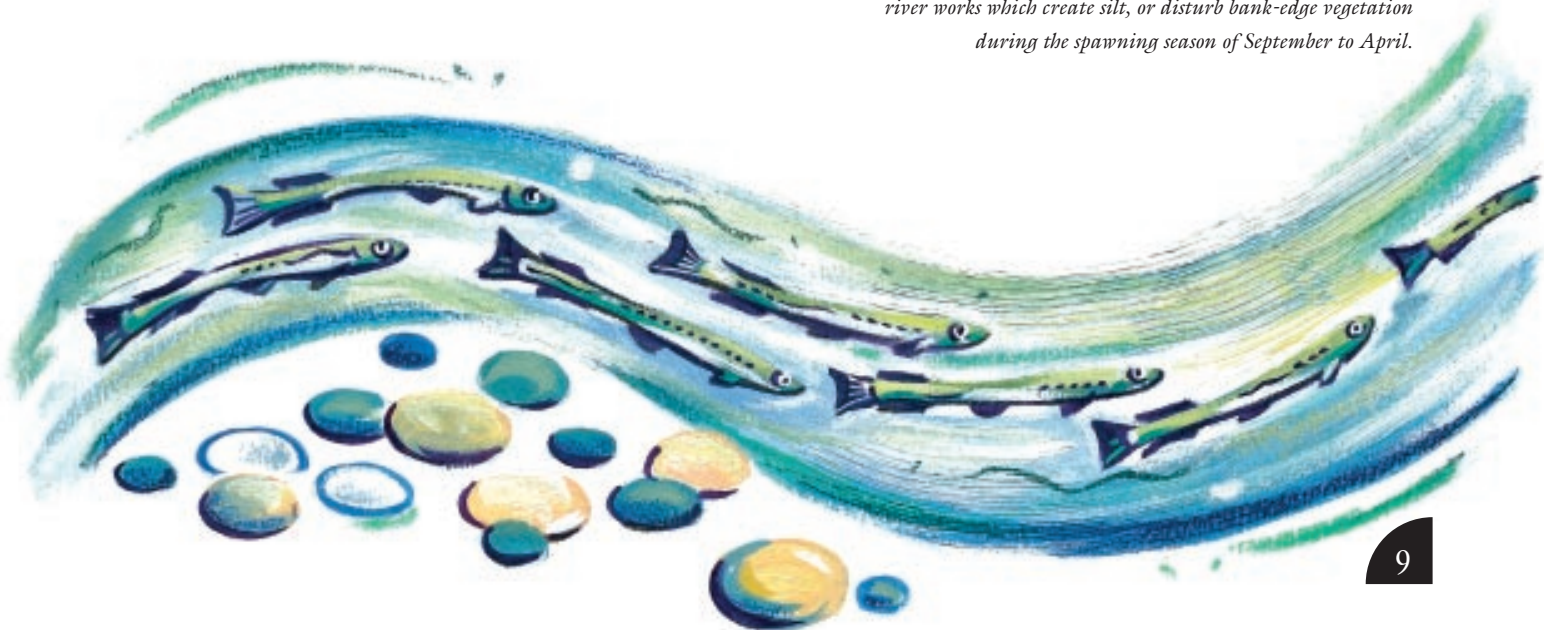
Ref 12: Volume 12 : History - Chapters One and Two.

Ref 14: Rugged Landscape - all, especially chapters 3, 8, 11 & 13.

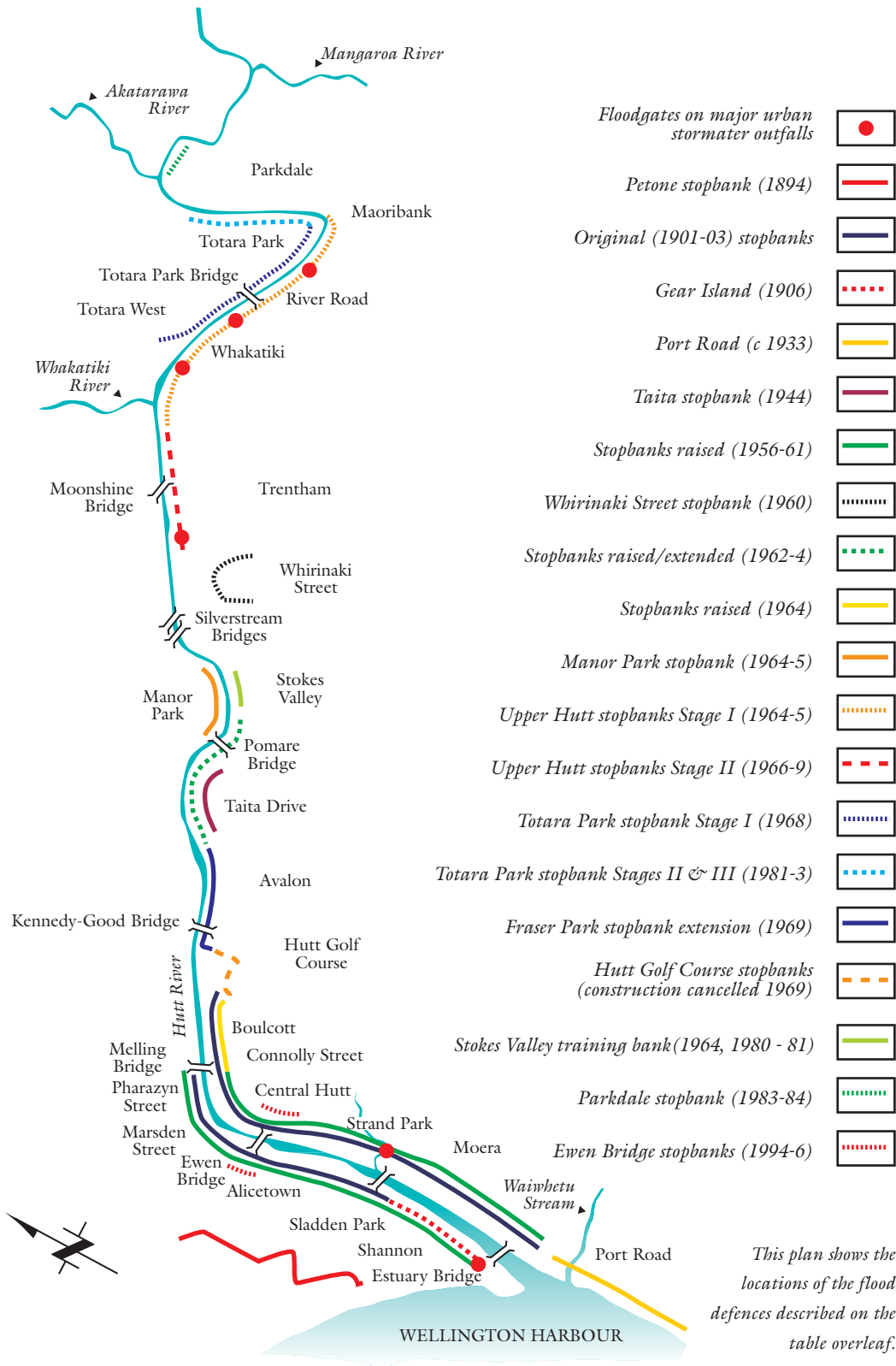
Ref 15: Hydrology Report - chapters 2 & 8-14.

Ref 23: Climate Change - Summary.

Whitebait are some of the original native inhabitants of the river. Small numbers exist in the river now, and to spawn successfully they need habitat stability. This poses issues for river works which create silt, or disturb bank-edge vegetation during the spawning season of September to April.



Plan of Flood Defences



This plan shows the locations of the flood defences described on the table overleaf.

The plan on page 10 shows the lines of flood defences which now define the 26 km long boundary between the river corridor and urban areas. The table on pages 12 & 13 evaluates the current condition and security of each stopbank referred to in the plan.

The First Flood Defences

Between 1901 and 1906 the Hutt River Board built the “Scheme to Conserve the Hutt River”. This included flood defences from the river mouth to Boulcott. The scheme replaced the stopbank built by Petone in 1894 which only protected Petone.

The flood defences were loosely compacted gravel stopbanks covered with a thin layer of topsoil. The shape, foundation preparation, and overall standards of construction were consistent with the prevailing standards for rural stopbanks protecting rural assets.

The high demand for agricultural land confined the defences close to the edge of the river channel. Over much of their length the stopbanks were built within 20m of the river edge.

Timber groynes were erected and bank-edges planted in willow to direct river alignment and to prevent erosion of stopbank foundations. The stopbanks and the areas between the stopbanks and the river (referred to as berms) were leased for grazing or were allowed to revert to a wilderness of scrub and wasteland.

Managing the River Channel

The new flood defences confined the energy of the river-in-flood to a narrow central channel (previously, floodwaters spread across the entire valley floor). During each flood huge volumes of gravel were eroded and re-deposited, changing the river alignment and threatening flood defences. In 1916, the stopbank at the Moera Wool Scourers almost breached. It was clear that the security provided by the flood defences would be reduced if the gravel deposits and the alignment of the central river channel could not be managed.

The Hutt River Board implemented a programme of gravel extraction and river straightening. By the 1930s this lowered the river south of Melling by about 4m and established its current incised bedform. Moderate flooding in 1931 and 1939 came close to overtopping and breaching the banks but was safely contained. At the time the management of flood risks by dredging and highly modifying the natural river channel was considered effective and appropriate. However, the legacies of dredging have been despoiled riparian ecology and high nearly vertical bank-edges which are difficult and costly to maintain.

Extending the Flood Defences

From 1940 the government developed housing areas in the east and northern parts of Lower Hutt Borough. To protect the new housing estates the flood defences were extended north to Taita Gorge, and subsequently through Upper Hutt to

Hutt River Flood Mitigation Scheme - Security of Flood Defences, Berms

Stopbank Name	Year Constructed and dates of upgrading	Capacity (m ³ /s)	Construction standard and materials used in construction
WEST BANK			
Estuary Bridge to Ava Railway Bridge			
Shandon (875m)	1906, 56-57	2100	Loose river gravels, overlaid with compacted weathered greywacke
Sladden Park (400m)	1906, 56-57	2100	Loose river gravels, overlaid with compacted weathered greywacke
Ava Railway Bridge to Ewen Bridge			
Alicetown (950m)	1901-03, 56-57	1800	Loose river gravels, overlaid with compacted weathered greywacke
Ewen Bridge to Melling Bridge			
Marsden St (600m)	1901-03, 60-61, 72	2300	Loose river gravels, overlaid with compacted weathered greywacke
Pharazyn St (760m)	1901-03, 60-61, 72	2300	Loose river gravels, overlaid with compacted weathered greywacke
Pomare Railway Bridge to Silverstream Bridges			
Manor Park (1330m)	1964-65	2200	Compacted clay or weathered greywacke
Moonshine Bridge to Totara Park Bridge			
Totara West (980m)	1968	2800	Unknown – probably compacted silts with sand, gravels, clay
Totara Park Bridge to Birchville			
Totara Park (1880m)	1968, 81, 83	2500	Compacted silts with sand, gravels, clay
EAST BANK			
Seaview Marina to Estuary Bridge			
Port Road (450m)	circa 1933	1600	Loose river gravels
Estuary Bridge to Ava Railway Bridge			
Moera (1250m)	1901-03, 33, 56-57	2100	Loose river gravels, overlaid with compacted weathered greywacke
Ava Railway Bridge to Ewen Bridge			
Strand Park (1070m)	01-03, 33, 56-57, 65-66	1800	Loose river gravels, overlaid with compacted weathered greywacke
Ewen Bridge to Melling Bridge			
Central Hutt (1250m)	1901-03, 60-61	2300	Loose river gravels, overlaid with compacted weathered greywacke
Melling Bridge to Kennedy-Good Bridge			
Connolly St (1110m)	1901-03, 64	2100	Loose river gravels overlaid with compacted gravels/silts
Boulcott (440m)	1901-03, 72	1900	Loose river gravels overlaid with compacted gravels/silts
Kennedy-Good Bridge to Fraser Park			
Avalon (2620m)	1969	3700	Compacted weathered greywacke and river gravels
Fraser Park to Pomare Railway Bridge			
Taita Drive (2350m)	1944, 62-64	3500	Loose river gravels and compacted weathered greywacke
Pomare Railway Bridge to Silverstream Bridges			
Stokes Valley (300m)	1980-81	1700	Weathered greywacke and river gravels
Silverstream Bridges to Trentham Memorial Park			
Whirinaki Street	circa 1960	1600	Unknown - probably subdivisional waste fill
Trentham Memorial Park to Moonshine Bridge			
Trentham (1630m)	1966-69	3500	Compacted river gravels and weathered greywacke
Moonshine Bridge to Totara Park Bridge			
Whakatiki (1200m)	1966-69	2900	Compacted river gravels and weathered greywacke
River Road (2420m)	1964-65	3100	Compacted river gravels overlaid with clay
Totara Park Bridge to Birchville			
Maoribank (1000m)	1964-65	3600	Compacted river gravels overlaid with clay
Akatarawa twin Bridges to Mangaroa Bridge			
Parkdale (320m)	1983-84	1400	Compacted weathered greywacke

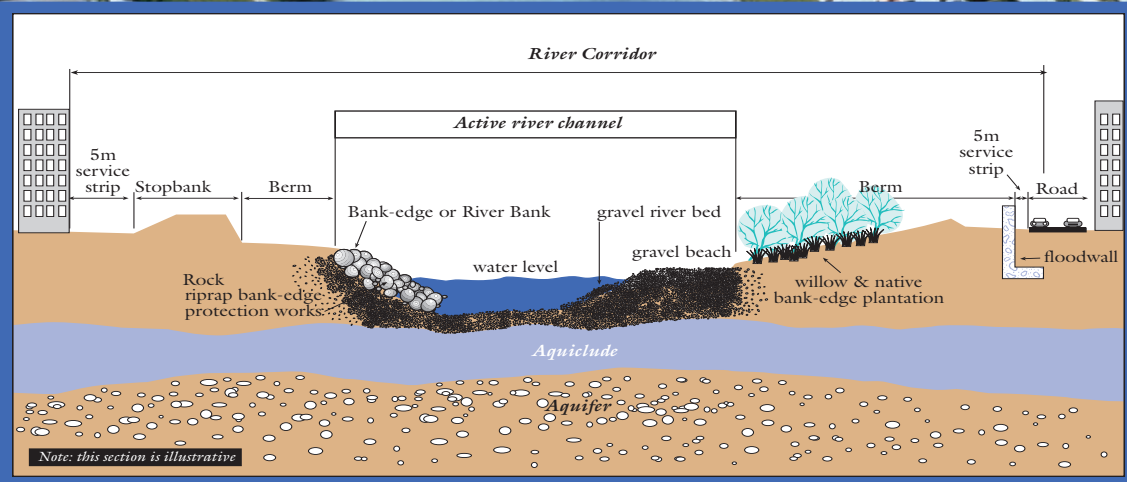
and Bank-edge Protection Works

	Structural Standard	Risk of Erosion of Berm/Foundation	Risk of Overtopping	Risk of erosion if overtopped	Overall Risk of Failure	Issues for Upgrading
WEST BANK						
Estuary Bridge to Ava Railway Bridge						
	Poor	Low	Medium	Medium	High	Structure, capacity, grass cover, vegetation.
	Average	Low	Medium	Medium	Medium	Structure, capacity, vegetation.
Ava Railway Bridge to Ewen Bridge						
	Poor	High	High	High	High	Structure, capacity, vegetation, erosion, services.
Ewen Bridge to Melling Bridge						
	Poor	Low	Medium	Medium	Medium	Structure, capacity, vegetation, services.
	Average	Low	Medium	Low	Low	Structure, capacity, vegetation, services.
Pomare Railway Bridge to Silverstream Bridges						
	Average	Low	Medium	Low	Low	Structure, capacity, vegetation, services.
Moonshine Bridge to Totara Park Bridge						
	Average	Low	Low	Low	Low	Structure.
Totara Park Bridge to Birchville						
	Average	High	Medium	Medium	High	Structure, capacity, vegetation, erosion.
EAST BANK						
Seaview Marina to Estuary Bridge						
	Poor	Medium	High	High	High	“Informal” stopbank: structure, erosion, services.
Estuary Bridge to Ava Railway Bridge						
	Average	High	Medium	High	High	Structure, capacity, vegetation, erosion, services.
Ava Railway Bridge to Ewen Bridge						
	Average	Low	High	High	High	Structure, capacity, vegetation, services.
Ewen Bridge to Melling Bridge						
	Poor	Medium	Medium	High	High	Structure, capacity, vegetation, erosion, services.
Melling Bridge to Kennedy-Good Bridge						
	Average	Low	Medium	Medium	Medium	Structure, capacity, services.
	Poor	Low	High	High	High	Structure, capacity, vegetation, services.
Kennedy-Good Bridge to Fraser Park						
	Good	Low	Low	Low	Low	Services
Fraser Park to Pomare Railway Bridge						
	Good	Medium	Low	Low	Low	Erosion, Services
Pomare Railway Bridge to Silverstream Bridges						
	Good	High	High	High	Medium	Indirect implications for Stokes Valley drainage.
Silverstream Bridges to Trentham Memorial Park						
	Average	Low	High	Low	Medium	Not maintained by WRC.
Trentham Memorial Park to Moonshine Bridge						
	Average	Low	Low	Low	Low	Structure, services.
Moonshine Bridge to Totara Park Bridge						
	Average	Low	Low	Low	Low	Structure, services, low capacity above Moonshine.
	Average	Low	Low	Low	Low	Structure, services.
Totara Park Bridge to Birchville						
	Average	Low	Low	Low	Low	Structure, services.
Akatarawa twin Bridges to Mangaroa Bridge						
	Average	High	Medium	Medium	High	Structure, capacity, erosion, services.

Colour key: Indicates overall risk of failure:



Components of the Flood Defences



Principal Components of the Floodway

Shingle Management. The bed of the river is made up of silts, sands and gravels eroded from the river banks and upper catchment and transported by the river to the sea. The processes of erosion and transportation form the ever-changing patterns of pools and rapids in the river bed. If the river had not been confined and the channel deepened, the river would meander over the floodplain, following its natural patterns of erosion and deposition. Now that it is confined, it must be managed so that it remains within the artificial constraints. If the beach deposits build up too high they must be lowered otherwise the river will divert into the opposite bank and erode berms and stopbank foundations. If the bed scours too low, banks become undermined. The way the shingle bed is managed has a fundamental influence on the design and management of the floodway.

River Alignment. Patterns of shingle erosion and deposition are influenced by the overall alignment of the river. Sudden changes in direction, channel width or grade will lead to erosion or deposition which can be almost impossible to control. The alignment of the river must be as regular as we can reasonably achieve within our current constraints.

Bank-edge Protection Works. River berms are made up of highly erodible sandy silts and gravel. If left unprotected, they will continue to erode, eventually exposing stopbank foundations (in 1981, the 20 m wide berms at Maoribank were completely eroded back to the stopbanks in a single flood with a 1 in 10 chance of occurring in any one year). The type of bank-edge protection required is dependent on the river alignment, the effectiveness of shingle management and how close the river banks are to the stopbanks.

The river banks were once protected from river erosion by forests which covered the floodplain. Subsequently, they were protected using timber and concrete block groynes. In recent years, the focus has been to re-establish bank-edge plantations and strengthen these with rock riprap in critical areas.

River Berms. River berms separate stopbanks from erosion processes taking place at the river banks and in the river channel. Where the berms are wide, the bank-edge protection works are not so critical. As the berm width reduces, the berm and stopbank must be protected against erosion in the same way as the bank-edges. Where there is very little room between the riverbank and the boundary of the river corridor, the bank-edges, berms and stopbanks can be replaced with massive floodwalls, as have been built in many European cities.

Stopbanks. The larger Hutt River floods typically span several days and during this time the river levels rapidly rise and fall as floodwaves move down the river. The stopbanks are built to a flood level that the river is expected to peak at, one or more times during the flood. This level is decided by reference to observed flood levels plus an allowance for larger floods, or by computational techniques which include an allowance for computational errors. Stopbanks are designed to contain water, to similar standards as small dams, and must be well built on competent foundations. In areas where the berms are narrow, the riverside stopbank faces must be resistant to erosion and should remain stable with the river flowing hard against the stopbank.

Weak Links in the Chain of Flood Defences

Improvement measures will be required sometime in the future to upgrade the flood defences to a consistent standard. The measures listed below will remove some of the weak links in the chain of flood defences. They are not listed in any order of priority. There is currently no commitment or funding to proceed with any of these works. A rough order-of-cost indicates the relative size of each work. The timing of works will be affected by how the works can be combined with other development opportunities. For example, the river realignment at Marsden Street (illustrated below) has been completed at a fraction of the anticipated cost by recycling waste fill in conjunction with a local earthworking contractor.

Elbow Park	Construct bank-edge protection works adjacent to Elbow Park, Upper Hutt, to overcome current erosion problems.	\$432,000
Ebdentown	Construct bank-edge protection works adjacent to Ebdentown St, Upper Hutt, to overcome current erosion problems and provide adequate security to the stopbank.	\$780,000
Marsden Street	Strengthen new bank-edge protection works and reconstruct stopbank.	\$2,000,000
Nash Street	Construct bank-edge protection to overcome erosion problems and protect stopbank.	\$900,000
Tama Street	Construct bank-edge protection to overcome erosion problems and reconstruct stopbank to new design specifications.	\$3,000,000
Daly Street	Reconstruct stopbank and realign river adjacent to Autopoint corner.	\$800,000
Woollenmills	Purchase land and realign bank-edge and reconstruct/realign stopbank to new design specifications.	\$700,000
Boulcott	Purchase land and reconstruct stopbank to new design specifications.	\$200,000
Pomare	Purchase land at Pomare rail bridge for river management purposes.	\$100,000



Marsden Bend Improvements 1995

Maoribank between 1956 and 1972. The new flood defences were built of compacted quarry fill and gravel to a standard then considered appropriate to protect urban areas.

The new stopbanks were designed to a higher standard than the original flood defences. There was concern that the original flood defences would then become the weakest link in the chain and the government would become liable for failure of the older stopbanks. This concern led to the strengthening and raising of the original flood defences while the new flood defences were being built.

Extending the Hutt River Board District

In 1959 the Hutt River Board District was extended to Maoribank to include the full length of the new flood defences. The Board repeated the same management practices developed in the downstream reaches throughout the new District. In the following years the meandering alignment from Melling to Maoribank was straightened and confined by extracting gravel and reshaping the bed. These practices continued until the gravel supply was depleted in the early 1970s.

Security of the Flood Defences

The components of the flood defences are described in the exhibit on pages 14 & 15. The table on pages 12 & 13 summarises the Regional Council's current assessment of the effectiveness of the individual components of the flood defences, and an assessment of the overall security provided by the flood defences. The overall security is a measure of the risks of flooding of the adjoining urban areas.

Since 1972, over \$20 million has been spent on rebuilding and extending isolated sections of the flood defences where they have been found to be deficient. Stopbank works have included;

- Parkdale stopbank,
- Totara Park stopbanks, and
- Ewen Floodway stopbanks.

River alignment and bank-edge protection works have included;

- Black Creek outlet, Lower Hutt,
- Croft Grove to Barber Grove rock-work,
- works associated with the Upper Hutt River Road,
- Pomare rock groynes,
- Ewen Floodway channel realignment,
- Marsden Bend improvements,
- Belmont Sewer Protection, and
- other bank-edge protection works from Ava to Te Marua.

There still remain a number of areas where improvement works are required to achieve a consistent standard of flood security throughout the Hutt Valley. Examples listed on page 16 illustrate the varied nature of the improvements which may be required. This is not a complete list nor is the list in any order of priority.

Channel management has changed to focus on re-establishing bank-edge vegetation and strengthening bank-edges. Gravel extraction and bed reshaping is now only undertaken to maintain an acceptable balance between the natural processes of erosion and deposition or to protect high value community assets.

Issues for Floodplain Management Planning

Reducing the Risks of the Flood Defences Breaching

The floodway is made up of a number of components which combine to form the flood defences. The condition and effectiveness of the components has been established and a process developed to assess the combined effectiveness and overall security of the flood defences.

To estimate the long-term costs of flood damage the Council has developed analytical techniques to combine the risks and effects of breaches with the knowledge of asset values within flood-prone areas.

These techniques can also predict the reductions in flood damages that can be expected from various options to improve the security of the flood defences.

This knowledge needs to be applied to reduce flood risks. Specifically;

- *the information base established by the floodplain management plan technical investigations provides the knowledge and evidence necessary to implement and prioritise planning measures to reduce the overall risks of flooding. Procedures will need to be developed to keep the information-base relevant and up to date,*
- *the flow of floodwaters into the urban areas can be estimated and measures specified to reduce flood risks,*
- *the long term costs of flood damages within urban areas can be calculated. The costs are currently estimated to be \$5 million every year for as long as the present level of occupation of the floodplain continues and the current level of risk management is maintained, and*
- *priorities for implementing flood risk reduction measures can be established in terms of reductions in tangible flood damages.*

Managing the Hutt River Flood Defences

Flood risks in the Hutt Valley are currently managed using traditional flood defences originally intended to contain all floods within the river corridor.

Recent hydraulic modelling has shown that when floods become deep enough to rise up the face of the stopbanks, erosion of the river bed and banks will become severe. Bed gravels may form large dunes, like sand-dunes on a wind-swept beach, which may move along the river bed forming scour holes up to 5m deep. It is impractical if not extremely costly to design flood defences which will not be damaged when there is movement of the bed on this scale. For these reasons, damage to flood defences is expected. The defences are considered to be effective when they prevent flooding of urban areas even though they may be severely damaged in the process. Upgrading flood defences will take a number of decades. In the meantime, there is a 1 in 100 chance in any year that urban areas will be flooded. Although this risk can be reduced, it can never be eliminated.

Management of the flood defences will need to;

- *continue to maintain and, as necessary, upgrade the existing flood defences to provide an acceptable level of flood risk reduction as determined by the **Flood Risk Acceptance Criteria** (refer to issue 1, page 84),*

- *integrate with City Council strategies to reduce flood risks within urban areas,*
- *establish priorities for upgrading all reaches of the river in terms of the overall level of risk reduction which can be reasonably achieved, as determined through the floodplain management planning process,*
- *integrate the functional design of individual components with the overall long-term upgrading objectives for the reach and for adjacent reaches,*
- *specify components of the flood defences which may progressively fail during a flood but will remain functional long enough to prevent total failure of the stopbanks, and*
- *take account of the life-cycle costs of flood defences, and not just the initial construction costs. Cost-effective flood defences should satisfy flood risk acceptance criteria and should achieve a balance between the initial capital cost of construction, the ongoing costs of repairs and upgrading, and the environmental effects of construction and subsequent repairs.*

Managing the River Environment

Some river management practices disturb the bed of the river and have detrimental effects on the environment. These will need to continue for the foreseeable future to maintain flood security. Re-evaluation of the life-cycle costs of bank-edge protection works compared to the economics of gravel management (extraction and cross-blading) to include environmental costs and benefits may lead to a preference and willingness to pay for more substantial bank-edge protection works.

Current management practices will need to be improved or adapted by;

- *considering more permanent bank-edge protection works which can cope with meandering within the channel, and the associated build-up of gravel deposits,*
- *enhancing the appearance of stopbanks, and*
- *continuing to extend and improve the diversity of river-side plantations by using native species.*

Urban Stormwater Outlets

There has been limited investigation of the links between Hutt River floods, which cause the floodgates on urban stormwater outfalls to close, and coincident flooding of urban stormwater systems.

The effectiveness of urban stormwater outfalls need to be assessed. Failure of local stormwater systems may reduce the benefits of improving the river's flood defences.

The material in this chapter is drawn from the following technical references;

Ref 4; Volume 4 : Channel Capacity - sections 2, 8 & 9.

Ref 6; Volume 6 : Channel Management - sections 2-5.

Ref 7; Volume 7 : T & T Qualitative Study

Ref 10; Volume 10 : Risk Assessment - sections 1-6.

Ref 12; Volume 12 : History - Part two : Project reports.

Ref 13; Volume 18 : Risk Process - sections 2.1.3, 3 & 5.

Ref 18; EFP : Floodway Channel Design - chapter 6.

Chronology of Flooding

In the past 150 years many large floods have swept through the Hutt Valley. The largest of these, and the effect they had on the people and their land, are described below.

Date	Description of flood effects
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1855	Heavy rain filled the river system, already choked with fallen trees and debris, sweeping away some 300 sheep and destroying large areas of crops. The river rose 600mm (2 ft) higher than had ever been seen before and completely destroyed the third Hutt Bridge, already severely damaged by the 1855 earthquake.
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1858	The most disastrous flood the European settlers had experienced ($\approx 2000 \text{ m}^3/\text{s}$). The river burst its banks and flowed across the floodplain into Black Creek and the Waiwhetu Stream. Nine lives were lost in Taita. The Hutt Valley road was gouged deeply, and the new Hutt Bridge damaged. Heavy livestock and crop losses were sustained and many acres of farmland reclaimed by the river in its fury. "The water was seen rushing along like an immense wave, crashing and roaring, carrying everything before it: huge trees, portions of buildings, timber, furniture, and debris of every description were borne away..."
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1878	Two large floods swept the valley, with widespread flow covering the entire floodplain. The river overflowed heavily at Boulcott into Black Creek. Few details are recorded, but the flooding led to the meeting of the first Hutt River Board in March 1879.
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1893	A large flood ($\approx 1500 \text{ m}^3/\text{s}$) inundated Petone properties, some to a depth of 1.2m (4ft). The floodwaters made travel to Wellington very difficult. Another flood ($\approx 1700 \text{ m}^3/\text{s}$) created a desolate scene in the valley with vast sheets of water covering paddock after paddock. As a result the Petone stopbank was built in 1894.
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1898	The largest flood on record ($\approx 2000 \text{ m}^3/\text{s}$) covered the valley from hill to hill. Floodwaters were knee deep in Lower Hutt township and came within 225 mm (9 in.) of the deck of the Hutt Bridge – the river rose 900 mm (3 ft) in half an hour, bursting its banks overnight and causing further heavy stock losses as it overflowed through Boulcott. A second flood ($\approx 1500 \text{ m}^3/\text{s}$), almost as heavy as the first, virtually filled the lower valley once again. Following these events, the second Hutt River Board was elected in 1899.
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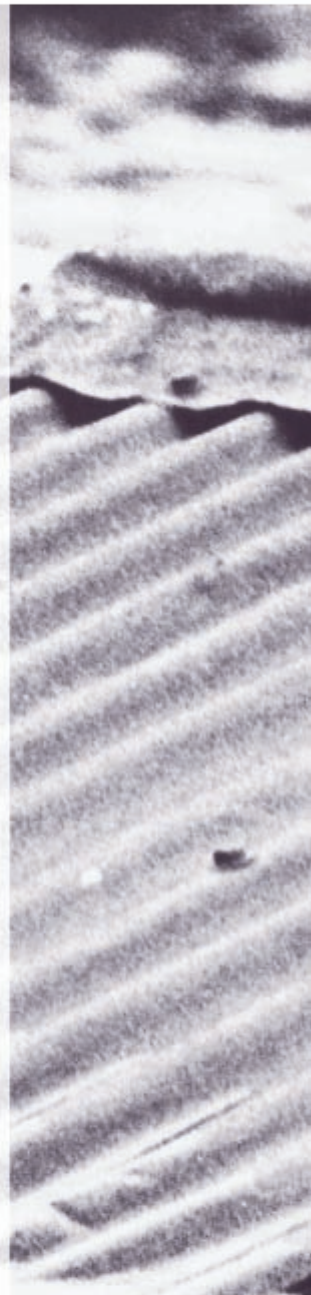
1931	The largest flood since inception of the Scheme works in 1901 ($\approx 1400 \text{ m}^3/\text{s}$). Vast quantities of gravel were brought down the river. The flood severely tested the Scheme works, and severe erosion occurred adjacent to the Daly Street stopbank, threatening Lower Hutt. The river rose 5.2 m (17 ft) at Lower Hutt, to within 600mm (2 ft) of the stopbank crest at Moera. At Silverstream it burst its banks and flooded a large area. The Manor Park Bridge and the Haywards Suspension Bridge were swept away. Extensive gravel deposits and berm erosion occurred at Manor Park, and part of the Taita Gorge road was washed out. There were calls to raise the lower valley stopbanks and extend the scheme to Maoribank.
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1939	Larger than the 1931 flood ($\approx 1660 \text{ m}^3/\text{s}$) the flood swept unprotected areas north of Boulcott, covering hundreds of acres, isolating houses, blocking roads, destroying and damaging bridges in the Mangaroa Valley and drowning large numbers of stock. At Silverstream the entire flat was one vast sheet of turbulent water. In the protected Lower Valley water came to within 150 mm (6 in) of the floodwall crest at Ewen Bridge, and to within 600 mm (2 ft) of the stopbank crest between Ewen and the mouth. There was no damage to stopbanks.
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1976	Heavy rainfall over the floodplain caused all the major small streams to flood. A small flood occurred in the Hutt River, closing the floodgates and blocking the outlets of the urban drainage systems. Widespread surface flooding occurred throughout the Hutt Valley high-lighting the need to improve the floodplain drainage systems and outlets to the Hutt River.
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Farmers Shed, Tuamarini, Marlborough, July 1983.

Photo courtesy The Marlborough Express.



The Hutt River floods a number of times each year. Floodwaters rise out of the central channel, flow across the river berms and occasionally flow against the stopbanks.

Many of the residents of the Hutt Valley are not concerned about these frequent floods. Their experience is that flooding of urban areas hasn't occurred, at least not as a result of the stopbanks breaching. Regional Council surveys indicate that residents have great faith in the system of flood defences. There is little understanding that the risks of catastrophic flooding of the cities are significant.

In sharp contrast to the residents' feelings of security, Regional and City Council staff will be on flood alert every time there is a heavy rainfall warning and the river rises out of its central channel (see chapter 5 for a discussion on flood preparedness). Regional Council staff responsible for managing the security of the flood defences are concerned about the risks that the flood defences may breach and lead to flooding of adjacent urban areas. City Council staff are concerned about damage to the roads, recreational facilities and car parks located within the river corridor. There is also concern that the outlets on urban stormwater systems may fail to operate efficiently to prevent the backflow of river water into urban areas, and subsequently to quickly discharge local urban stormwater ponding to the river.

Reconciling Perceptions of Flood Risk

There is a need to reconcile the different perceptions of security held by residents and

the councils' asset managers. Residents, City Councils and the Regional Council cannot be expected to develop a mutual understanding of acceptable risk if everyone's perceptions of the actual situations of risk are different.

The Regional Council's investigations indicate that the differences in perception are due to a lack of widespread knowledge of the chances of big floods within the river corridor and how these can lead to breaching of the flood defences and subsequent flooding of urban areas.

The risks of flooding of urban areas can be explained by considering;

- the causes of floods in the Hutt River, and
- the sorts of floods that may breach the flood defences.

What Causes a Really Big Flood in the Hutt River?

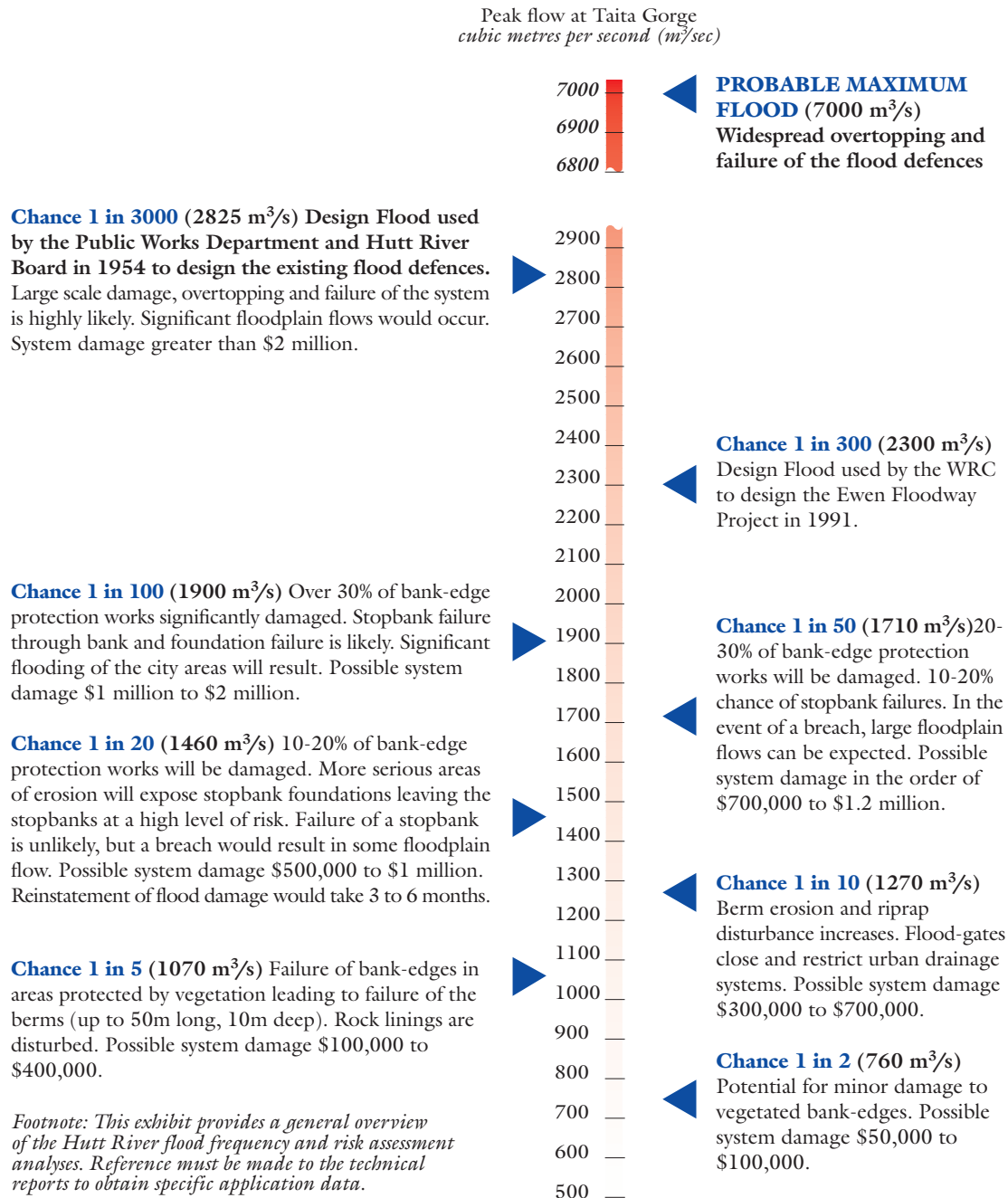
Most of the rainfall producing storms which pass over central New Zealand have the potential to cause big floods in the Hutt River if the storms pass directly over the Hutt Catchment.

The Hutt is a relatively small, short catchment with four steep tributary catchments located around the river's headwaters, much like a five leafed clover (see the map on page 2). A large storm must pass over the Hutt and most of the tributary catchments to produce a flood big enough to really threaten the flood defences and put urban areas at risk.

As the paths of storms are determined by complex global weather patterns it is not

Predicted Chances and Effects of Flooding

River management records now extend over 150 years. The following predictions of flood damage to the system of flood defences is based on this experience. Flood damage is equally dependent on how long a flood lasts as much as how high the flood waters rise.



possible to accurately predict their movements or their flood producing potential. The Regional Council tracks all storms that may produce intense rainfall as they pass through the region and regard all as potentially threatening until they have safely passed.

Even when a rainstorm is apparently well positioned to cause a flood, one may not occur. With some storms the river rises rapidly in flood while in others it does not respond at all. In some storms which last over a week or so, flood levels rise and subside a number of times. These differences in flood response are related to the condition of the catchments immediately prior to the period of heavy sustained rainfall.

A large proportion of the tributary catchments are covered in vegetation. When it first starts raining the vegetation intercepts and stores the rainfall. As the rain continues less and less can be intercepted until the catchments are saturated. Once saturated any further intense rainfall flows straight into the streams. The Hutt River will then rise quickly in flood. The flood peak will occur 5 to 7 hours after the onset of the period of intense rainfall.

Most storms last for several days. Rainfall occurring in the early part of the storm starts to saturate the catchments. If intense rainfall occurs during this early stage a big flood probably won't occur. However, if the same intensity of rainfall happens at a later stage, after the catchments are fully saturated, a large flood may result. When storms continue for a week or so (not uncommon in Wellington) several sudden flood peaks can be experienced within the same storm. The history of the Hutt

River is that big flood peaks often occur in clusters within the same storm or during unsettled climatic periods that maintain the catchments in highly saturated states.

So to recap, the prerequisites for big floods in the river are;

- a storm must cover most of the tributary catchments long enough for the catchments to become saturated, and must be followed by
- a period of high intensity rainfall.

The Sorts of Floods that may Breach the Flood Defences

Not all big floods have the potential to breach the flood defences or lead to flooding of urban areas. Only the larger floods which are either high enough to overtop the stopbanks or last long enough to erode through the flood defences will result in flooding of urban areas.

Once erosion of the bank-edge protection works starts the berms are rapidly eaten away exposing stopbank foundations. If flooding continues the stopbanks may fail. Except in a few areas direct erosion of the stopbank faces is not a major concern.

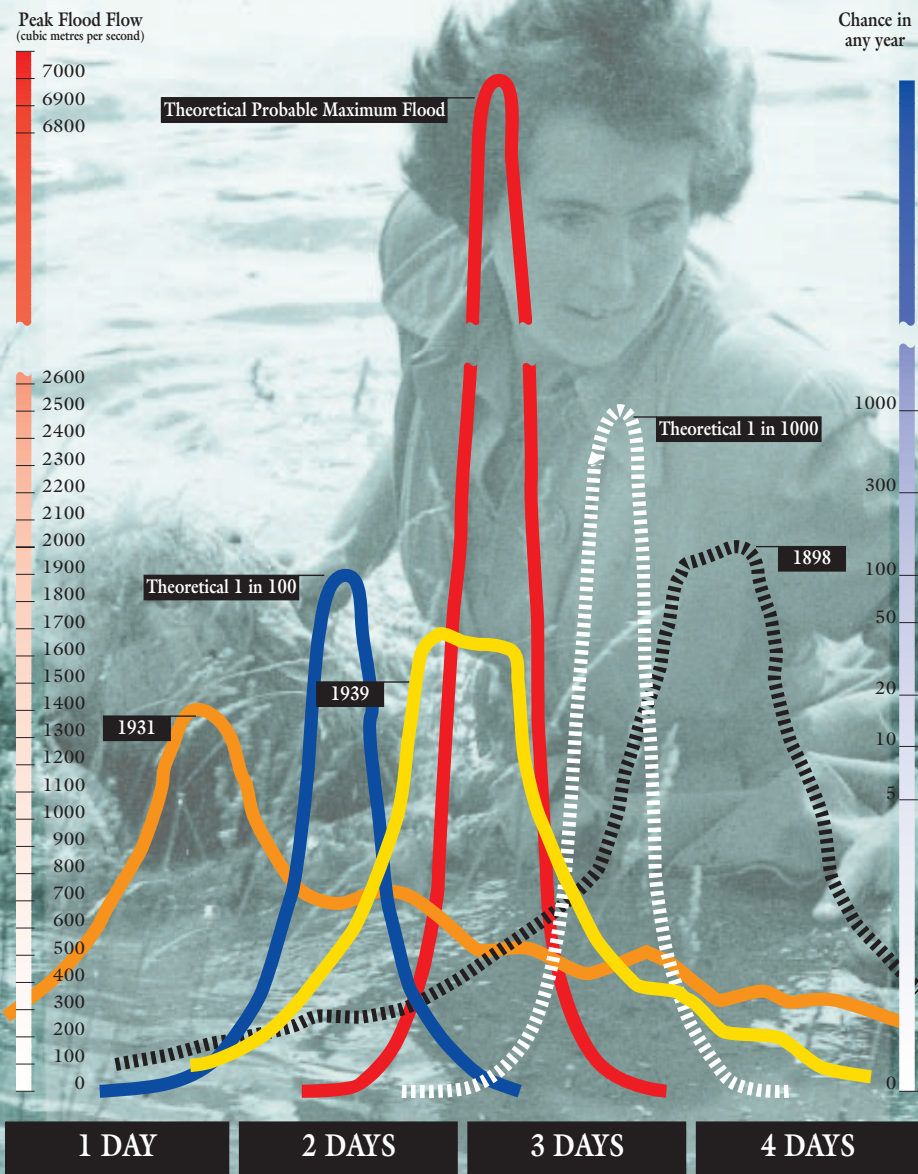
Is it Possible to Predict When and How Often Big Floods will Occur?

It is not possible to predict *when* a big flood will occur but it is possible to predict the *chances* of a flood of at least a certain size in any one year (refer to page iv in the introduction for an explanation of the chances of floods occurring).

Big floods occur in the river as randomly as do the storms which cause them. However, the chances of floods of different sizes can be

Hydrographs - Showing the Rise & Fall of Floodwaters

The hydrographs illustrate three of the largest recorded floods; 1898, 1931 and 1939, and theoretical floods: 1 in 100, 1 in 1000 and Probable Maximum Flood.



1955 Flood in the Hutt River: Courtesy of the Evening Post.

assessed by assuming that the random pattern of storms which affect central New Zealand will continue to cause similar floods to those experienced in the past. This assumption is conditional on the effects of future changes to the climate. For central New Zealand changes in climate are expected to increase the frequency of tropical storms. This will lead to increased risks of flooding. For example, a flood which historically has had a 1 in 100 chance of occurring is expected to occur more frequently in the future.

Account must also be taken of future changes in land-use. The vegetative cover of the Hutt Catchment is likely to be maintained or improved. Steps need to be taken to ensure this is the case. Reductions in the forest cover of the tributary catchments would increase the risks of flooding.

The Regional Council's predictions of flood risks are listed in the exhibit on page 22. A high degree of confidence can be placed on the predictions as they are based on 150 years of records and extensive hydrological analysis. The probable maximum flood is also predicted. This provides an understanding of the upper limit of flood risk and illustrates the proportion of risk that is managed by current risk reduction measures.

The exhibit shows that all floods with a 1 in 20 chance of occurring each year start to put the flood defences at serious risk of erosion. Even if the floods don't lead to failure of the flood defences, flood damage will reduce the security of the system until such time as the damages are repaired.

Floods with a 1 in 50 chance of occurring each year are likely to lead to stopbank breaches, although the flood may not last for long enough, at high levels, to lead to widespread flooding of urban areas.

Floods with a 1 in 100 chance of occurring each year are likely to breach the flood defences and lead to widespread flooding of urban areas. In the following chapter the effects of such flooding are discussed.

Smaller more frequent floods can also lead to indirect flooding. Floods with a 1 in 10 chance of occurring will start to close the flood gates on urban stormwater outfalls. If rainfall has not fallen in the urban areas this will not be a problem. The stormwater systems have adequate capacity to store stormwater by local ponding until the flood gates reopen. However, if the rainfall which caused the flood in the river also falls within urban areas, ponding will spread from the stormwater systems to low-lying areas. This can lead to widespread flood damage even though the flood defences and stormwater outlets have functioned as they were intended.

Objectives for Reducing Flood Risks

To prevent flooding of urban areas, it will not be sufficient to have high stopbanks. The flood defences must be designed so that they can withstand the tremendous erosive forces of the river-in-flood. They must also be designed so that they can be rapidly repaired (as discussed, history shows that repeat floods can be expected within a short time). The disposal of stormwater trapped behind the stopbanks must also be considered.

Risk Management – the Selection of Design Floods

The existing Hutt River Flood mitigation scheme has evolved over the last 100 years. The works have been extended or improved to manage perceived flood risks, as described below.

Date	Works	Risk Management Objectives
1894	Petone Stopbank	Designed to prevent a repeat of the flooding which occurred in 1893. Presumably designed to observed flood levels plus safety margin.
1901	Mouth to Boulcott Stopbanks	Designed to prevent a repeat of the 1898 flood. Stopbanks were constructed with a freeboard of between 1.2 – 2.1 m above the levels of the 1898 flood. Previous floods had not been constricted by stopbanks and were free to spread over the floodplain. Basic analytical tools were used to predict flood levels.
1906	Gear Island Stopbank	The stopbank replaced the Petone stopbank and was built to the same standards as the 1901 stopbanks.
1933	Moera Stopbank Raising	The 1931 flood came close to overtopping the stopbanks. Stopbank crest levels were revised to provide a generous freeboard of 1.2 m. above the 1931 flood levels, making a conscious allowance for larger events. The stopbank was raised as Depression relief work. In 1939 a larger flood occurred but was passed with adequate freeboard. The river managers believed the freeboard could have contained the “largest likely flood”. The increase in capacity of the scheme since the 1931 flood was attributed to dredging and gravel extraction.
1948	Stopbank Upgrading and extension. Estuary Bridge to Maoribank	A review of the Hutt River protection works was instigated by the Public Works Department as part of the Government’s development of the Taita housing area. The stopbanks were designed to the predicted level of a 2825 m ³ /s flood plus 600mm freeboard (100,000 cubic feet per second flood plus 2 ft freeboard). It was agreed by the Public Works Department, Hutt River Board and Meteorological Office that, with the freeboard safety margin, the works should contain a flood twice the size of the 1939 flood. These were the first works designed to levels derived from computational techniques. There was no intention to limit the works to a specified level of risk but rather to design for the maximum likely flood. The consequences of stopbank failure were considered to be unacceptable in view of the lives and assets at risk.
1976 to 1990	Computer Analysis of Scheme Design Standards	Computer analysis of the hydraulics of the river channel confirmed that only some reaches could contain a flood of 2825 m ³ /s. A hydrological analysis of flood records in 1976 set the 100 year flood as 2124 m ³ /s, revised in 1990 to 1900 m ³ /s. Stopbank improvements from 1976 to 1986 were designed on the basis of computer predictions of the 100 year flood levels plus a 1m freeboard. A flood of 2825 m ³ /s is now considered to have a frequency of occurrence greater than 1000 years, confirming the intention of designers to build for a “maximum” flood.
1995	Ewen Floodway Project	The Ewen floodway was designed to the prevailing capacity of the surrounding channel, approximately 2300 m ³ .



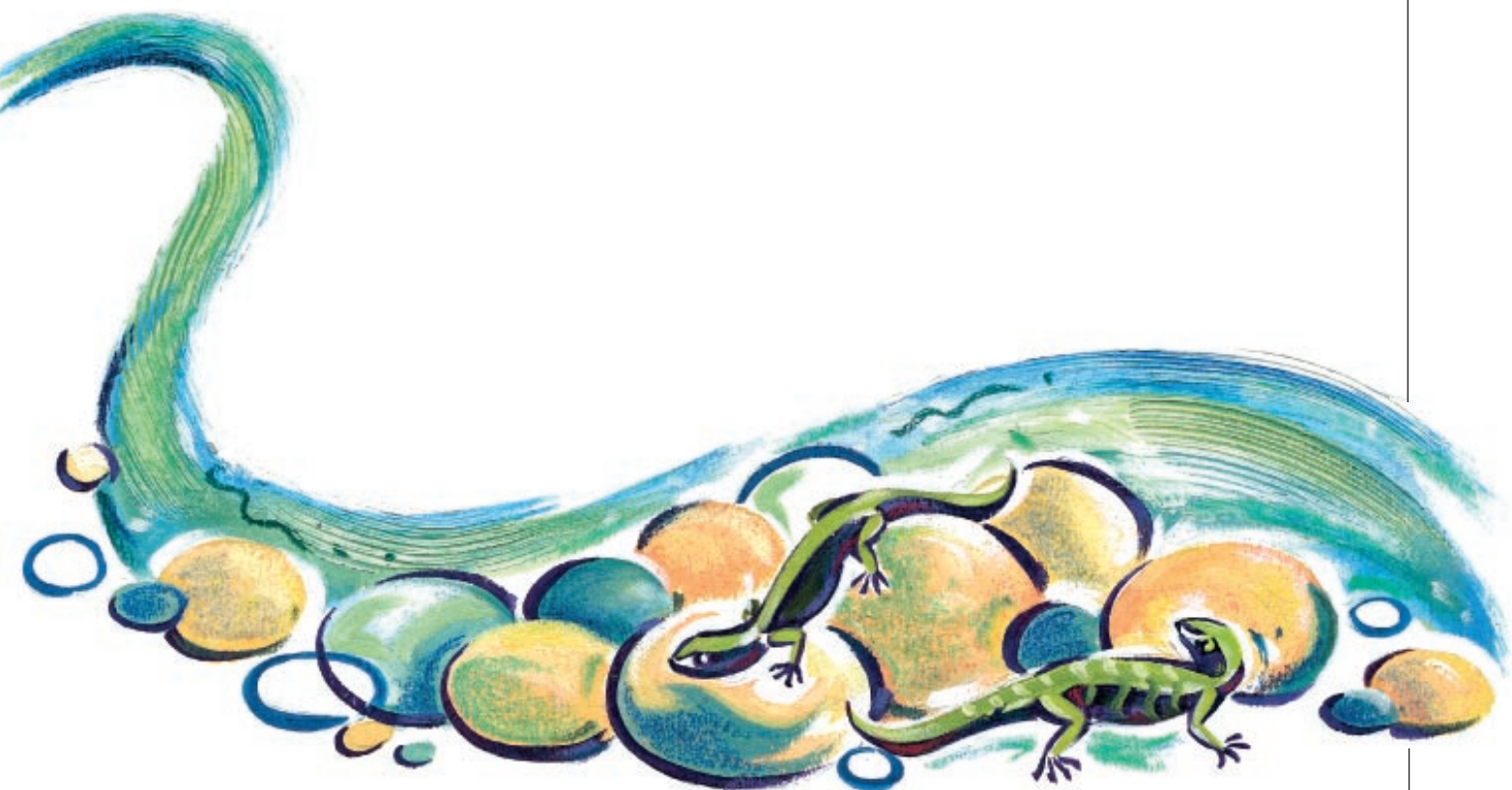
Wairoa Bridge collapse, Wairoa. March 1988.

The exhibit on page 26 lists the objectives which have been used in the past to manage the floodplain and the construction of flood defences.

These have all aimed to build stopbanks to contain floods to an agreed level. It was assumed that the river managers would then set appropriate rates to fund ongoing river management and maintenance necessary to protect the stopbanks from erosion.

Until the mid 1960s gravel extraction and associated river straightening were considered appropriate methods of management. Gravel

extraction produced revenue and avoided the need to raise rates. However, by the mid 1980s environmental and river management concerns had made it impractical to continue extraction as the principal method of management. Dwindling gravel revenue and rating constraints generally limited maintenance to repairing flood damages at critical locations. River management and maintenance was not undertaken at adequate levels for at least 20 years. It is only in the last 10 years that the Regional Council has begun to address the backlog of deferred maintenance.



Skink. As original members of the forest and river ecosystem, it is important that native lizard, skink and gecko species be protected. Little is known about these animals. Their presence may be a useful indicator of the re-establishment of a healthy riparian ecosystem.

Issues for Floodplain Management Planning

Understanding the Risks of Flooding

Technical investigations have been completed which predict with a high degree of confidence the chances of floods occurring in the Hutt River.

There is adequate knowledge of the hydrological and climatological processes which cause flooding of the Hutt River to define future flood risks and complete the floodplain management plan:

- *There is a 3 in 4 chance that floods large enough to breach the existing flood defences will occur within the lifetimes of current generations. There is a 1 in 4 chance that this will lead to widespread flooding of urban areas.*
- *In any one year, there is a 1 in 20 chance that a flood will cause damage to the flood defences. Repairs to the flood defences will cost in excess of \$500,000.*
- *In any one year, there is a 1 in 50 chance that damages to the flood defences will be serious enough to lead to breaches. Flooding of urban areas may then occur. The extent of flooding of urban areas will depend on the size of the flood in the Hutt River, and the size and number of breaches.*
- *In any one year, there is a 1 in 100 chance that breaching of the flood defences will lead to widespread flooding of urban areas.*
- *These chances of flooding may increase if climatic changes increase the frequency of extreme rainfall events over the Hutt catchments.*

Links between Floods in the Hutt River and Breaching of the Flood Defences

The links between the chances of floods in the Hutt River and the consequent risks of failure of the flood defences are defined by the security of the various components of the flood defences (bank-edge protection, berms, stopbanks).

The chances of failure of the flood defences can be analysed in a reliable and consistent way.

Quantitative data can be produced to assess risk and locate the most likely breach points.

The material in this chapter is drawn from the following technical references;

Ref 1; Volume 2 : Climatology - Volume 1.

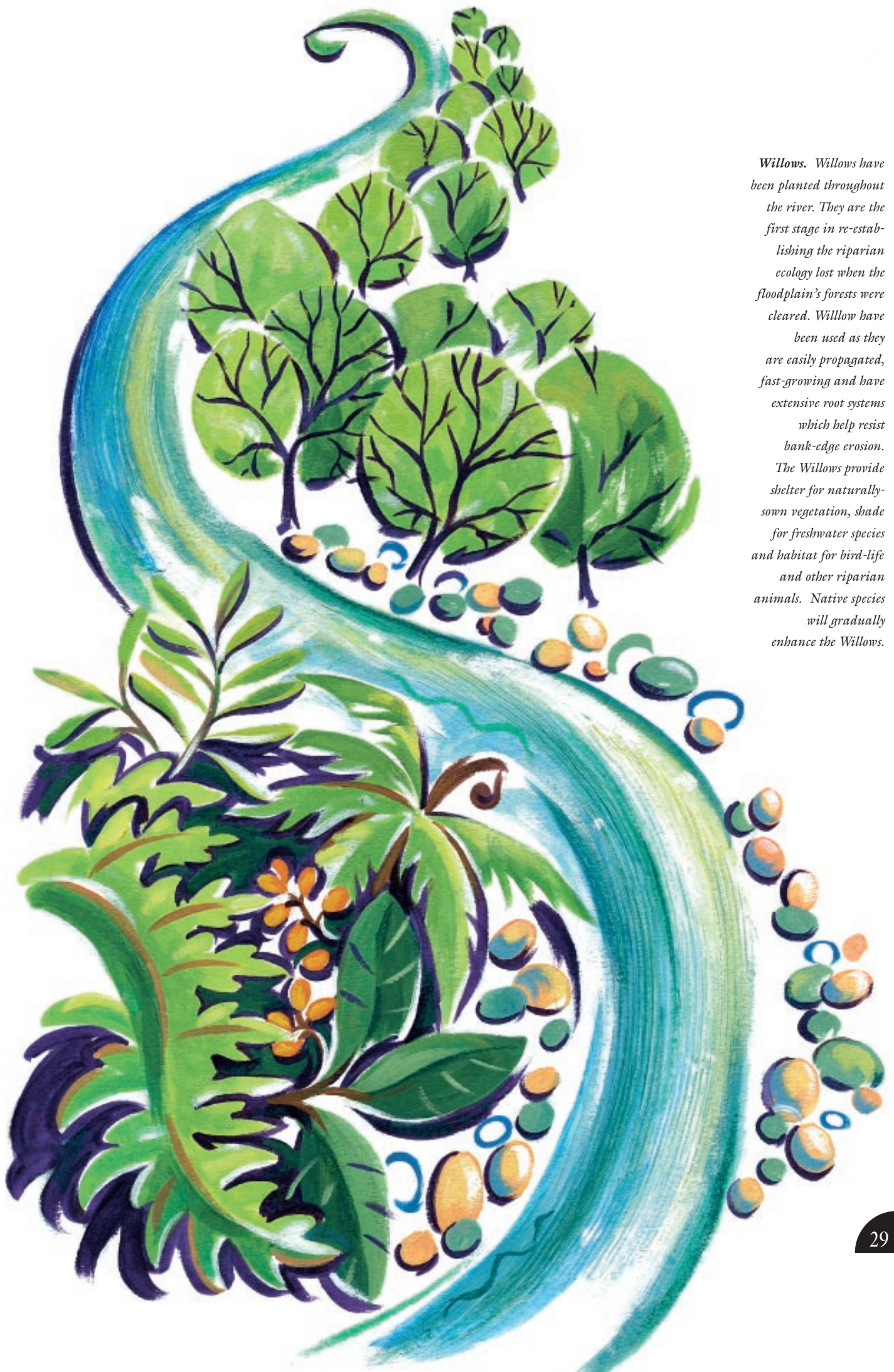
Ref 2; Volume 2 : Historical Floods - sections 5 & 6.

Ref 4; Volume 4 : Channel Capacity - Summary.

Ref 10; Volume 10 : Risk Assessment - all sections.

Ref 12; Volume 12 : History - chapters 2, 5 and 8.

Ref 13; Volume 18 : Risk Process - sections 3 & 5.



Willows. Willows have been planted throughout the river. They are the first stage in re-establishing the riparian ecology lost when the floodplain's forests were cleared. Willow have been used as they are easily propagated, fast-growing and have extensive root systems which help resist bank-edge erosion. The Willows provide shelter for naturally-sown vegetation, shade for freshwater species and habitat for bird-life and other riparian animals. Native species will gradually enhance the Willows.

Predicting Flood-Prone Areas: Assumed Breach Points

A stopbank will fail if it is too low and is overtopped, it is structurally unsound and collapses, or it is bodily eroded away during a flood. The floodplain management plan technical investigations have identified the sections of stopbank which are most likely to fail for one or more of these reasons. Refer to the exhibits in Chapter 2.

Derivation of Flood Maps

The stopbanks have been classified into reaches which protect distinct areas of the floodplain. The risks of failures occurring within each reach have been assessed. The breach locations have been selected to represent stopbank breaching within each reach.

Reach	Bank	Theoretical Breach Location
Mouth to Ava rail bridge	East	Woollen Mills point, Moera.
Mouth to Ava rail bridge	West	Shandon Golf Course.
Ava bridge to Melling bridge	East	Upstream of Ewen Bridge.
Ava bridge to Melling bridge	West	Upstream of Ewen bridge.
Melling to Pomare bridge	East	Just upstream of Pomare bridge
Manor Park	West	Northern end of Manor Park
Silverstream to Whakatiki Street	East	Upstream of Moonshine bridge
Whakatiki Street to Maoribank	East	Downstream of Maoribank bend
Totara Park	West	Ngati Tama Park, Totara Park.

Assessments have been made of the way the stopbanks may fail. The size and shape of a breach determines the likely flood flow onto the floodplain. Various physical factors are considered, including bank stability, height, width, erosion potential and seepage potential. To simulate the progressive development of an opening in a stopbank during a flood the theoretical openings are increased with time. Emergency efforts to contain a breach of the Waihopai River stopbank, Invercargill, January 1984 are illustrated below. Photo courtesy Ministry of Civil Defence.



The theoretical assessment of breaches that may result from stopbank failures is somewhat arbitrary, but appropriate in view of the other assumptions and uncertainties in the analysis of the risks of flooding. The analysis provides a comparative model for assisting with the selection of options for upgrading the flood defences or for implementing planning provisions in the potentially flood-prone areas.

Technical investigations undertaken by the Regional Council have established that there is a significant chance sections of the Hutt River flood defences will fail during the lifetimes of current generations (during the next 100 years). There is a 3 in 4 chance (almost a certainty) that a flood will occur in this period with the potential to breach the flood defences. There is a 1 in 4 chance that widespread flooding of the urban areas will result.

The flood maps on pages 32 to 35 show the areas in the Hutt Valley that are potentially flood-prone as a result of stopbank breaches. To show the full extent of potentially flood-prone areas, the maps have been prepared by simulating breaches at *all* the locations listed in the exhibit on page 28 (the breach points are also shown as arrows on the flood maps). *In any one flood event* it is unlikely that all these breaches would occur or that the *overall* extent of flooding would be as great as shown on the maps, as discussed further below.

How will Breaches Occur?

Breaches may occur as a result of;

- leakages where services and culverts pass through the stopbanks,
- floodwaters finding a path through porous gravels beneath the stopbanks, leading to erosion and failure of the stopbank foundations,
- stopbanks being bodily eroded by floodwaters flowing against the river-side stopbank face,
- stopbank foundations being eroded following failure of bank-edge protection works and adjoining berm areas, and

- stopbanks failing through faulty construction or where there are poor construction joints.

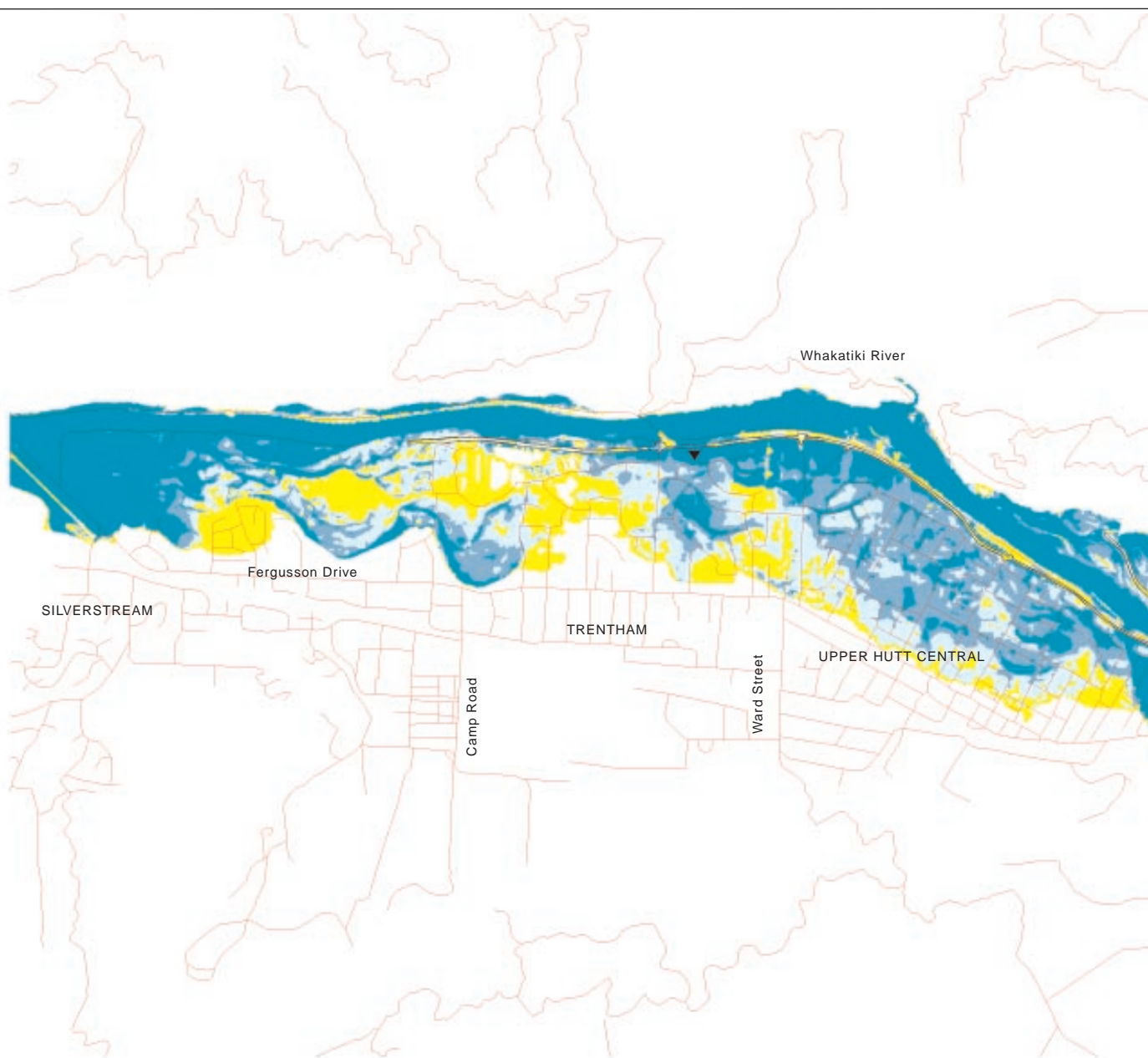
The term breaching includes overtopping of stopbanks where they are relatively lower than adjoining stopbanks. Overtopping typically results in erosion and failure of stopbanks, but in some instances they may remain intact.

In all cases the breaches will start as a small flow over or through the stopbank, which will rapidly increase as the leakage erodes away the body of the stopbank.









The size of the breach will depend on the type of fill material the stopbank is made from. The older stopbanks made of loosely compacted silty sands and gravels will develop into a wider breach much more quickly than will a stopbank made of well compacted quarry rock-fill.

Stopbank breaches develop quickly. Within an hour a small leakage may develop into a flow sufficient to erode a 20 to 100m length of stopbank. The extent to which the breach develops will depend on *when* the breach occurs. If it occurs while the river is rising in flood, the breach will become far larger than if the breach begins in the last hours of a flood. Timing can be critically important in determining the overall flood damages that will result. By delaying the time a breach starts, emergency efforts to prevent a breach may reduce flood damages, even though the efforts are unsuccessful in preventing the breach.

Technical investigations have shown that the volume of water which could flow through



LEGEND

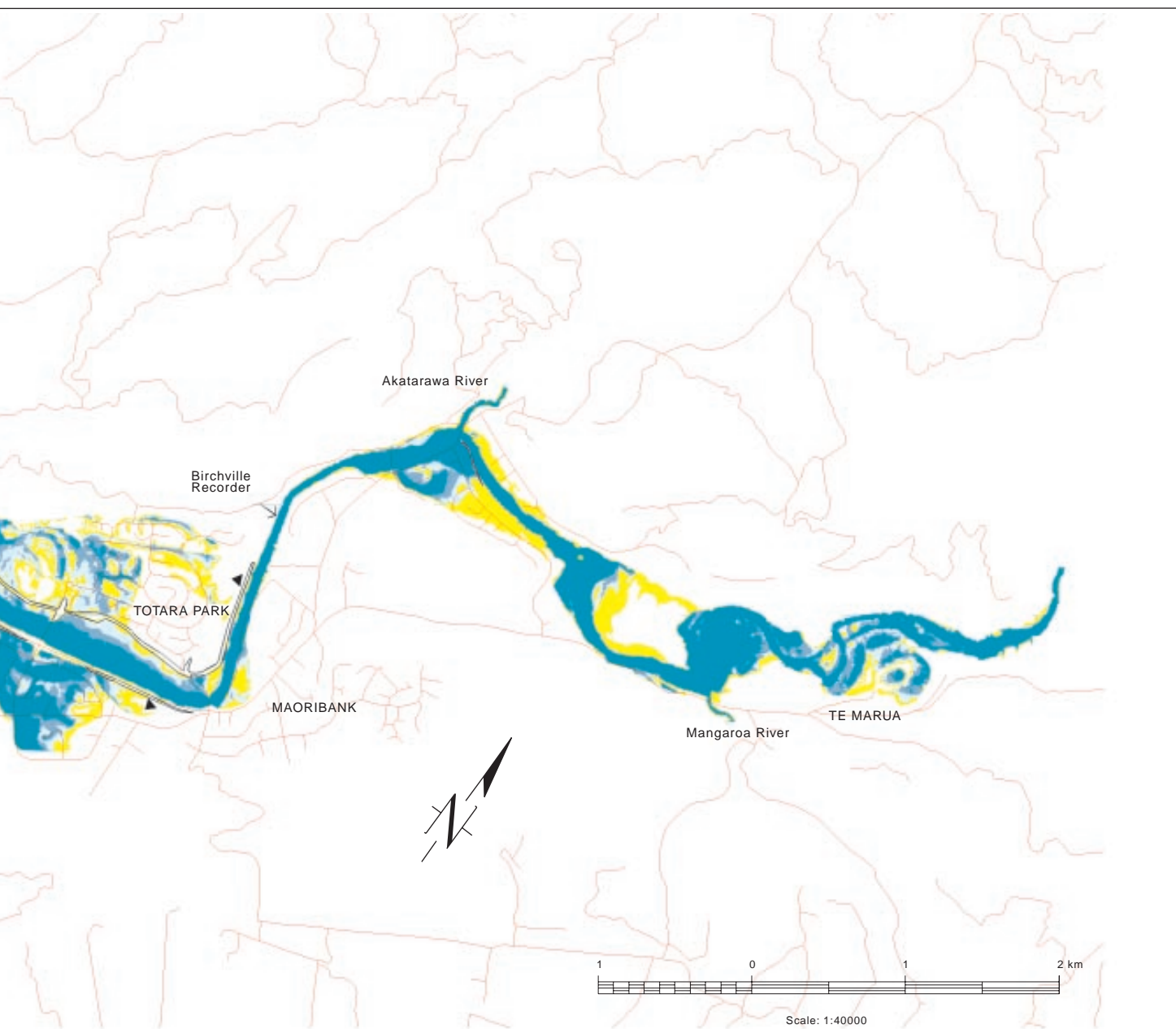
	< 0.5m depth of flooding		Road network
	0.5m - 1m depth of flooding		Stopbanks
	> 1m depth of flooding		Coastline
	Flood fringe		Breach locations

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**LANDCARE
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HUTT RIVER FLOODPLAIN
HUTT RIVER FLOODING
Scenario : 2500 cumecs (0.1% AEP)



This map shows areas that are potentially flood-prone should the flood defences fail or be overtopped. Within the potentially flood-prone areas of Upper Hutt City there are;

2500 Standard homes	25 Recreational Facilities	This includes;
2000 Larger Homes	5 Bulk Storage Facilities	8 Schools
180 Commercial Properties	15 Utility Services	2 Medical facilities
150 Industrial Buildings	30 Transport Facilities	
45 Community Services		

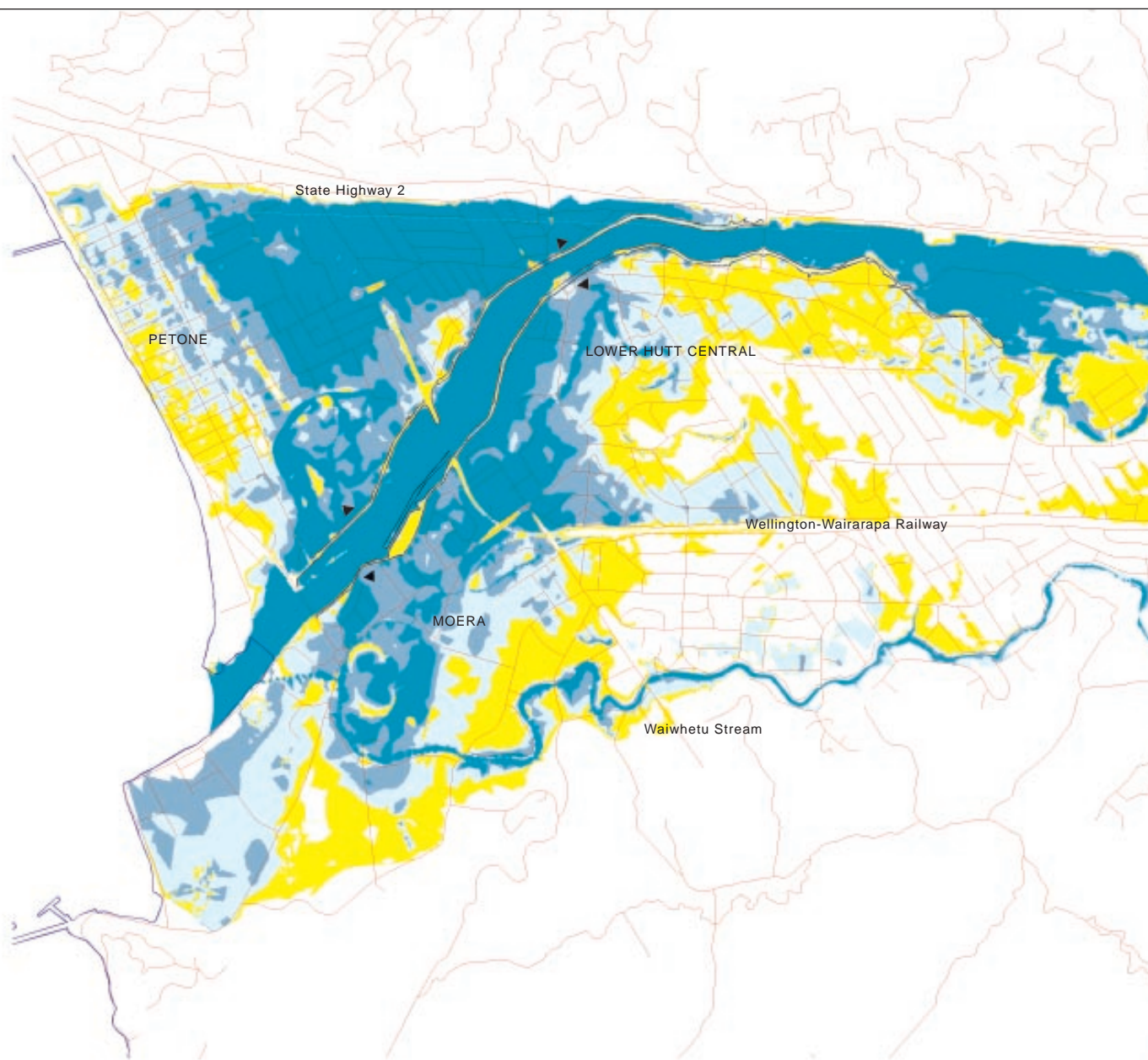
DISCLAIMER: This map was produced to give an indication of flood extent and depths for the stated scenario. It should only be used for the purposes intended in this report.

MANAGEMENT PLAN : PHASE 1
 - Upper Valley
 with 3 simulated stopbank breaches









SCALE
 1:40000

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LEGEND

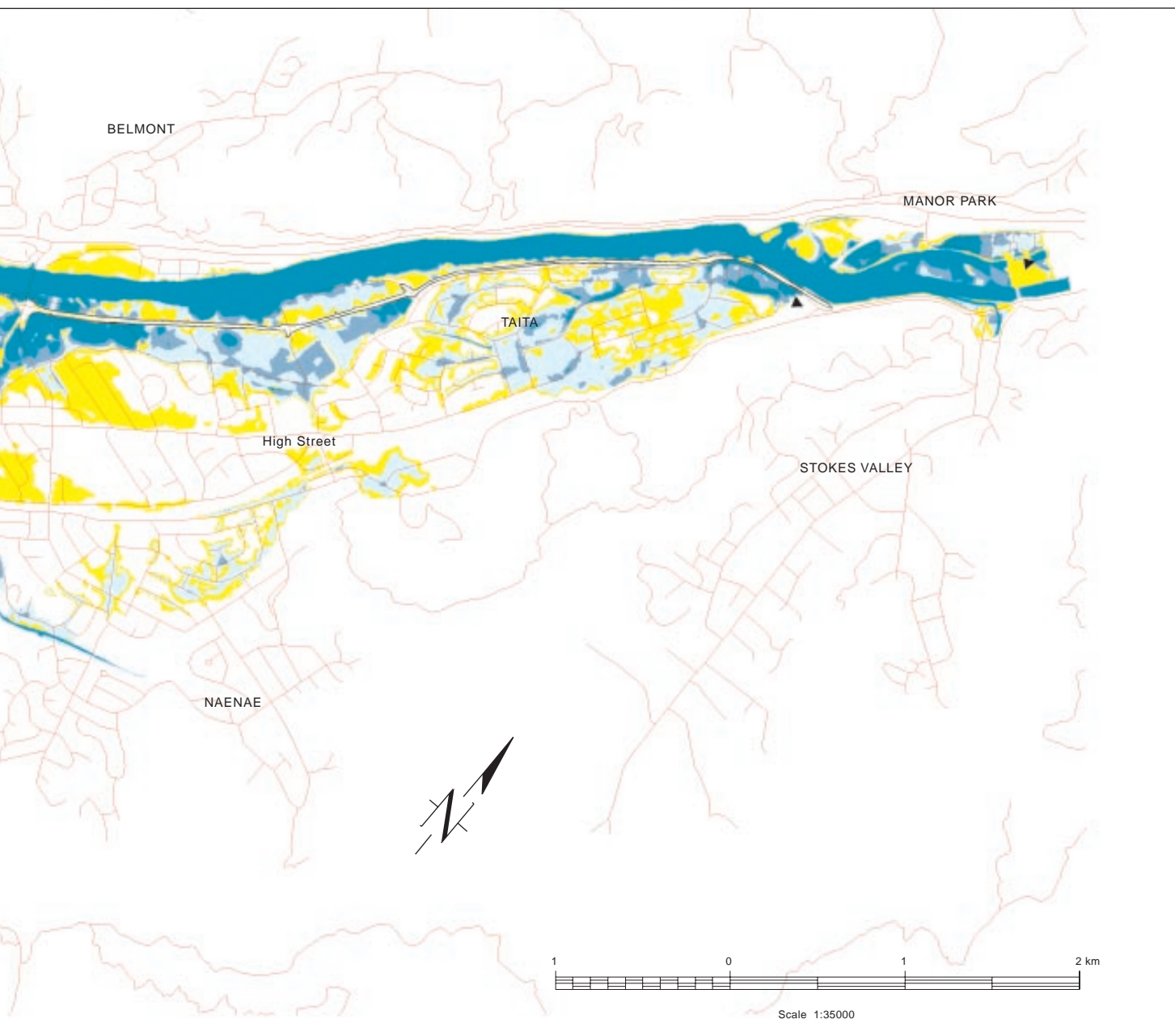
	< 0.5m depth of flooding		Road network
	0.5m - 1m depth of flooding		Stopbanks
	> 1m depth of flooding		Coastline
	Flood fringe		Breach locations

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LANDCARE
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Rivers
Department

HUTT RIVER FLOODPLAIN
HUTT RIVER FLOODING
Scenario : 2500 cumecs (0.1% AEP)



This map shows areas that are potentially flood-prone should the flood defences fail or be overtopped at known weak points. Within the potentially flood-prone areas of Lower Hutt City there are;

6000 Standard homes	50 Recreational Facilities	This includes;
4000 Larger Homes	20 Bulk Storage Facilities	28 Schools
350 Commercial Properties	40 Utility Services	5 Water supply stations
500 Industrial Buildings	50 Transport Facilities	1 Telephone exchange
100 Community Services		9 Power substations
		7 Medical facilities

DISCLAIMER: This map was produced to give an indication of flood extent and depths for the stated scenario. It should only be used for the purposes intended in this report.

MANAGEMENT PLAN : PHASE 1
 - Lower Valley
 with 6 simulated stopbank breaches

SCALE
 1:35000

DATE 29 AUGUST 1995	FILE NUMBER N/3/13/23
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a single breach will be as large as the peak flood-flow in one of the Hutt's smaller tributary rivers. Flows of this volume leaving the river corridor will effectively reduce the size of the flood in the river corridor downstream of the breach points. This may reduce the chances of breaches occurring downstream. The complex relationship between the timing and location of breaches makes it virtually impossible to predict how many breaches will occur during any given flood.

The table on pages 12 & 13 records the construction standard of the existing flood defences and identifies the risks of breaching through structural, overtopping and erosion failure. Although the sections of the flood defences at higher risk can be identified, it is not possible to predict with any degree of certainty which section may breach first, or the likely sequence of breaches.

Flood Scenarios

It is only possible to predict the areas which will be *flood-prone* if a breach occurs at one or more of the known weaker points.

Because the nature of a real flood will always be uncertain, the Regional Council has had to use flood scenarios to predict the extent of flood-prone areas.

The flood scenario which was used to define the flood-prone areas in the accompanying flood maps has been designed to include characteristics of the most likely flood events. Breaches have been assumed to occur at 9 locations; an unlikely outcome of a single event but useful to illustrate the extent of flood-prone areas. The scenario is based on a flood occurring within the river corridor with a

peak flow that has a 1 in 1000 chance of occurring in any one year. This flood is *smaller than the flood scenarios used in 1954 to design the existing flood defences*.

The hydrograph for the scenario is shown as the 1 in 1000 chance flood in the exhibit on page 24. The flood in the river has been assumed to peak at 2500 m³/s. The whole flood has been assumed to last little more than a day. The breaches listed on page 28 have been assumed to occur one hour before the flood peak. The scenario contains some approximations in order to simplify the analysis but overall fairly represents the types of flood events which have been recorded in the past (refer to articles in the *Scrapbook* section). The sensitivity of the scenario assumptions has been tested and the resulting predictions of flood-prone areas are not extreme.

The flood maps show the maximum depths of flooding likely at representative sections on the floodplain. However, the number of representative sections is not sufficient to depict the flow paths within and between flood-prone areas. During an actual flood, flooding will be more extreme than shown on the flood maps in the areas immediately adjacent to the breach points and in the path of flood flows. As options to reduce flood damages are considered, the flood maps will be regenerated to locate and analyse these critical areas.

Flood maps can be derived for any given flooding scenario, although costly computing and analytical resources are required for each scenario analysis. The flood maps shown can be used to provide an indication of flood-prone areas for other scenarios. In smaller floods, say with a 1 in 100 chance of occurring in any one

year, only one or two breaches may occur and the extent of flooding may not be so widespread. The flood fringe and areas flooded to minor depths are those areas which will be affected to a greater or lesser extent in different flood scenarios.

How will Flooding of Urban Areas Develop?

As breaches develop, floodwaters will pour from the river corridor into urban areas. They will follow the contours of the land, flooding low-lying areas first. Ponding will occur behind the stopbanks downstream of the breaches.

The contours of urban areas still follow many of the old river terraces and overflow floodways formed by the river prior to urban development of the floodplain. In many places these are now intercepted by road and railway formations. In some areas, floodwaters will be trapped and will pond to greater depths than would have previously occurred on the undeveloped floodplain.

Eventually floodwaters will flow south through the urban areas. As river levels fall, the water will return to the river through the stormwater systems. This may take 12 to 48 hours.

Properties immediately adjacent to breaches, and in the lower-lying areas, will be most severely affected. The number of flooded properties will depend on the size and number of the breaches and the size of the flood that caused the breaches. If the flood in the river rises and falls quickly, damage may be limited.

Damage within the urban areas can be expected to be widespread if the river levels remain above the level of urban areas after the breaches have developed, or if a second flood wave passes down the river corridor before the breaches can be closed.

Flood Damages

The exhibit on page 34 lists Valuation New Zealand's data for the value of personal and civic assets on the floodplain.

The Regional Council has developed methods for calculating flood damages for any particular flood scenario, based on this data.

The flood damage figures for Upper Hutt and Lower Hutt have been calculated by assessing the damage to assets within the flood-prone areas when flooding occurs to the depth shown on the flood maps (note: this excludes the flood fringe areas). The totals do not include intangible losses such as loss of earnings, ill-health or loss of possessions of sentimental value, and may be regarded as conservatively low estimates of potential flood damages.

Can Flood Damages be Reduced?

- Flood damages may be reduced by;
- increasing the level of flood awareness, education and preparedness to protect people and property in the low-lying areas and in areas near to likely breach points,
 - implementing measures to reduce the effects of floodwaters once they enter urban areas. This may involve lowering or putting openings through road and rail embankments, improving stormwater outlets, raising assets above known flood levels, floodproofing vulnerable buildings, (discussed more in chapter 7), and
 - increasing the security of the components of the flood defences (discussed in chapter 2).

The benefits that can be obtained from early flood warning and increased flood preparedness are discussed in chapter 5.

Personal and Civic Assets at Risk on the Floodplain

There are over 130,000 people living in the Hutt Valley. About 110,000 people live on the floodplain, the remainder in the hillside suburbs. The value of their personal assets, business assets and the assets of urban infrastructure *on the floodplain* is estimated to be:

Primary Use	Description	No.	\$
Residential	Private dwellings.	24,226	2,484,000,000
Commercial	Retail, wholesale, offices, services.	907	486,000,000
Industrial	Manufacturing, processing, production.	885	475,000,000
Community	Educational, medical, religious, defence.	297	410,000,000
Utility Services	Communications, energy, water, waste.	100	67,000,000
Recreational	Sporting, cultural, holiday.	161	63,000,000
Storage	Warehouse, fuels and materials.	47	60,000,000
Transport	Road, rail, parking, pipelines.	126	36,000,000
Rural	Agriculture, gardens, forestry, mining.	86	24,000,000
Miscellaneous	All other land-uses.	48	9,000,000

The values are derived from Valuation New Zealand data and include the value of the fixed assets - buildings and permanent fittings. They exclude the value of the land and moveable assets such as vehicles.

Flood Damages within the Theoretically Derived Flood-prone Areas Illustrated by the Flood Maps

About 70,000 people can be affected by flooding of the urban areas. Potential flood damages to property in areas that are likely to be flood-prone when the stopbanks fail or are overtopped are estimated to be:

Manor Park	Petone	Lower Hutt	Upper Hutt
\$935,000	\$437 million	\$263 million	\$190 million

These theoretically derived flood damage estimates are for a 2500 m³/s flood, with a 1 in 1000 chance of occurring in any one year. They represent a reasonable upper level of damages, although certainly not a maximum. Note that the flood defences were originally intended to protect the Hutt Valley from larger floods of 2825 m³/s.

Flood damages will occur at infrequent intervals, but their effects are statistically equivalent to suffering approximately \$5,000,000 flood damages, somewhere on the floodplain, every year. In addition, there will be intangible losses associated with;

- *personal loss, tragedy and possible loss of life*
- *family stress, tension, trauma, especially for the high proportion of aged, disabled and lower socio-economic groups who occupy the flood-prone areas.*
- *loss of income and loss of accommodation*
- *longer term psychological effects and domestic tension*
- *cost and time involved in the major cleanup required after large flood events*
- *monetary costs resulting from working days lost to businesses and employees*
- *loss of productivity, and loss of general business through delays*

*Main Picton-Blenheim Road at Tuamarina,
July 1983. Photo Marlborough Express.*

Issues for Floodplain Management Planning

District Planning : Flood-Prone Areas

City planning assumes that areas zoned for development will not be flooded by the Hutt River. Planning decisions do not consider ways to reduce flood risks once Hutt River floodwaters have entered urban areas.

District planning of urban areas needs to be reviewed:

- *Some of the areas of Upper Hutt City and Lower Hutt City currently zoned for urban development are potentially flood-prone. The Regional Council needs to provide city planners with specific information on flood-prone areas, the risks of flooding and measures to reduce risks.*
- *The value of potential flood damages within the flood-prone urban areas are estimated to be approximately \$890 million : \$190 million in Upper Hutt City and \$700 million in Lower Hutt City.*
- *Intangible flood losses - personal losses and the effects of trauma - are expected to be as large as tangible losses. A method to integrate intangible losses into the decision-making process needs to be agreed between the Regional and City Councils.*
- *When the sale or redevelopment of private property is proposed in flood-prone areas;*
 1. *subsequent purchasers need to be made aware of the potential flood risks, and*
 2. *options to reduce flood damages need to be considered.*

The material in this chapter is drawn from the following technical references;

Ref 8; Volume 8 : Hydraulics - sections 1, 2 & 8.

Ref 9; Volume 9 : Flood Damage - sections 3-5.

Ref 13; Volume 18 : Risk Process - all sections.

See also;

Regional Policy Statement.

Hutt City Council District Plan.

Upper Hutt City Council District Plan.

Building Act.

Resource Management Act.

RIVER STATIONS (▼)

- 29606 Wainuiomata @ Manuka Track
- 29808 Hutt @ Kaitoke
- 29809 Hutt @ Taita Gorge
- 29818 Hutt @ Birchville
- 29830 Mangaroa @ Te Marua
- 29838 Estuary Bridge
- 29844 Akatarawa @ Cemetery
- 29853 Hutt @ Te Marua
- 30516 Mill Creek @ Papanui
- 30701 Porirua
- 30707 Belmont Gully
- 30802 Pauatahanui @ Gorge
- 31504 Waikanae @ Water Treatment Plant
- 31807 Otaki @ Pukehinau
- 31907 Waitohu



RAINFALL STATIONS (●)

- 57302 Oriwa (East Waitewaewae)
- 58004 Water Treatment Plant (Waikanae)
- 58103 Transmission Lines (Mangaone)
- 58201 Taungata (Waitatapia)
- 59007 Warwicks (Akatarawa)
- 59104 Kapakapanui (Southern Waiotauru)
- 59201 McIntosh (Penn Creek)
- 141813 Wayne's Mistake (Porirua)
- 142811 Seton Nossiter Park
- 150010 Blue Gum Spur (Whakatiki)
- 150108 Cemetery (Akatarawa)
- 150109 Te Marua (Hutt)
- 150210 Phillips (Hutt)
- 151202 Centre Ridge (Pakuratahi)
- 152001 Skull Gully (Wainuiomata)
- 152004 TVL (Mangaroa)
- 152010 Orongo Swamp (Orongorongo)



LEGEND

Topographic:

- Coastline
- Catchment boundary
- Sub
- Major road
- Main river

Telemetered Sites:

- Rainfall stations
- ▼ River stations

NOTE:

Locations of telemetered recorders and catchment boundaries supplied from WRC Resource Investigations Department records. Topographical information derived from DOSLI. CROWN COPYRIGHT RESERVED. Map produced from WREGGIS. April 1996

WESTERN WELLINGTON REGION
Telemetered Rainfall and River Sites



The Meteorological Service of New Zealand tracks all major storms as they approach the country. The Service estimates the path a storm is likely to follow, how quickly it is moving and the intensity and volume of rainfall that it is likely to produce. Special weather bulletins are issued to the Regional and local Councils in the areas likely to be affected by major storms.

When the Wellington Regional Council receives special weather bulletins, Council staff respond in accordance with well practised floodwarning procedures. A duty flood manager takes control. When river or rainfall alarms are received, the floodwarning base at the Regional Council's headquarters is staffed.

Hydrological experts begin interrogation of the rainfall and river level recording stations located throughout the region (see the map opposite for those monitored directly from Wellington). Most of these automatically record rainfall and river levels at least every 15 minutes. By analysing recent records, the degree of saturation of the catchments can be assessed and predictions made as to how the rivers are likely to respond to the storm. On the basis of this assessment, the flood manager will issue flood information to those responsible for managing the various flood-prone areas.

The Regional Council's floodwarning base will remain staffed 24 hours a day, if necessary, as the storm approaches and passes across the region. During this time, the intensities and depths of rainfall will be monitored. River levels

will also be monitored as they rise in response to rainfall. Predictions of the likely maximum size and timing of floods are updated. As the storm progresses, further warnings or advice to stand down are issued on the basis of the flood manager's predictions.

Emergency Management

The Hutt City Council's operational flood procedures are copied on pages 38 and 39 to illustrate how closely the various Councils work together to manage flood risks. Upper Hutt City Council has similar procedures in place.

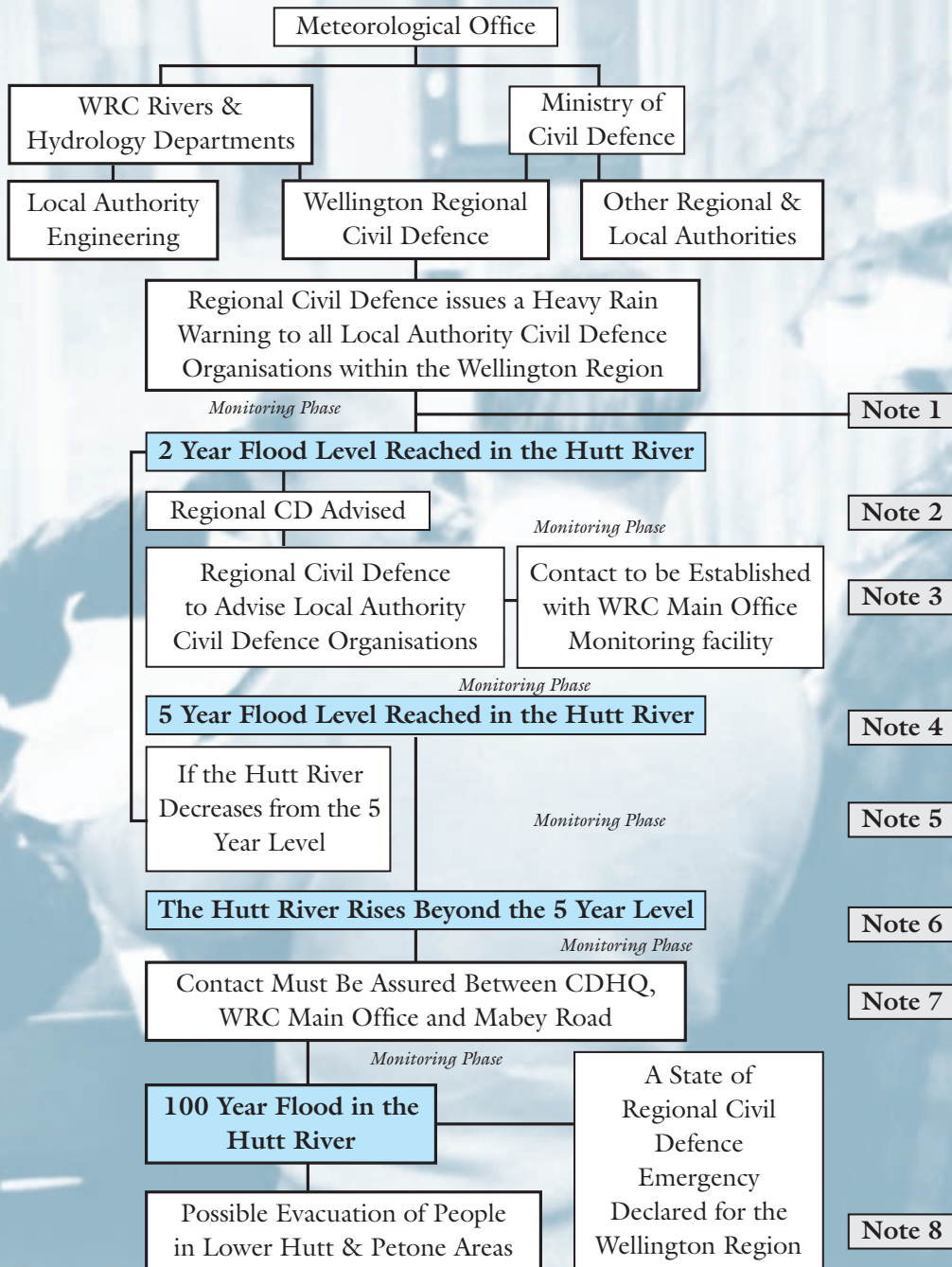
The Hutt City Council's flood procedures are part of their comprehensive *Emergency Response Plan* which defines responsibilities for managing the City's response during and immediately following major emergencies. People who have had their cars cleared from Hutt City's riverside carparks will have first hand experience of implementation of the flood management procedures. Residents will also have heard hazard warning sirens which are tested annually by Emergency Management on Hazard Awareness Day.

State of Preparedness

The state of preparedness of the Regional Council, the City Councils and individuals will determine the potential to reduce flood losses.

The best efforts of flood managers can provide only 5 to 7 hours warning of the arrival of the flood peak. There may be little that can be done to strengthen flood defences in the few hours before the peak arrives as a wave of water surging down the river channel.

Hutt City Council's Emergency Management Flood Procedures



County Council's Office, Invercargill.
January 1984. Photo J. Robertson.

Notes on the Flood Procedures

Regional Council

Note 1 Monitoring phases are carried out by the Rivers & Hydrology Departments of the Wellington Regional Council. Departments remain on alert when the heavy rain warning is issued. The time taken to reach a 2 Year flood state in the Hutt River depends on the existing state of the catchment area and river flood.

Note 2 Rivers Department to advise Regional CD of situation.

The following CD staff to report to the Regional CDHQ:

- Controller
- Operations Manager
- Regional Welfare Officer
- Regional CDO.

Note 3 Regional CD to advise Local Authority organisations of the following:

- The decision to activate the Regional CDHQ on a limited basis.
- Regional CD to open HQ, test radios, advise MOCD, advise balance of Regional HQ Staff, advise Emergency Services Committee plus contact with MOT, AA and duty weather forecaster.

Note 4 Rivers Department commences field effort, ie inspect critical areas.

Note 5 If Hutt River decreases from the 5 Year Flood Level, Rivers Department will continue to liaise with Regional CD until the 2 Year Flood Level in river is reached and indications are that the possible flood will not occur. Regional CD to advise Local Authority CD organisations and Emergency Services Committee of the situation. At the point where Hutt River has decreased to the 2 Year Flood Level Regional CDHQ is to stand down. Local Authorities continue to act on their own procedures.

Note 6 The following action is immediate:

- A helicopter survey to be conducted where warranted and possible and video record taken, Regional CD to arrange this on behalf of Rivers Department.
- A Rivers Flood Manager is to go to Regional CDHQ when requested.
- Media to be updated by Rivers Department until a State of Regional CD Emergency has been declared. Then all statements to the media will be through Regional CD Controller
- Regional CDHQ to be placed on full activation.
- Other WRC staff to be deployed by Rivers Department as appropriate.

Note 7 Rivers Department continue to provide estimated water levels in the Hutt River together with information on other possible areas of flooding in the Hutt Valley and Petone.

Note 8 A Declaration of a State of Regional Civil Defence Emergency will depend on the information from Local Authorities on surface flooding and from the Rivers Department on the state of the Hutt River.

Lower Hutt Civil Defence

- CDO or Personnel on 'Warning List' notified by Regional CD
- CDO alerts CD Upper Hutt
- CDO alerts City Engineer Lower
- CDO alerts CD Petone
- CDO alerts CD Eastbourne

- Monitoring Phase by CD
- Notify Emergency Services
- CE Department to clear car park as and when required and notify Public.

- CDO liaise with Regional CD
- Check weather forecast
- CDO warns key CD personnel.

If River Still Rising -

- Liaise with CE Dept
- Activate key personnel to CDHQ
- Activate HQ radio and warn other staff.

Stand down staff but monitor situation until 2 Year Flood level reached and crises averted.

CE Dept activated and reconnaissance reports received and relayed to CD. Regional CD to be informed. Activate all CD Staff.

- Identify Hazards
- Notify Public
- Log reports received
- Notify all necessary Liaison Organisations
- Activate key Warden Posts
- Prepare Plans.

- Warn Public
- Consider the need to make a local Declaration of a CD Emergency
- Consult with Emergency Services, City Engineers, Damage Control, Regional CD.

Declaration and possible evacuation of people at risk in district

Rapauru, Marlborough. 2.30am, July 1983.

Photo Paul Watson.

Over recent years the City Councils' emergency management groups have been working hard to spread messages about the risks of flooding and the advantages of being prepared. They hold regular hazard awareness seminars for Councillors, Council managers, businesses, community groups and schools, and have prepared information kits which explain how individuals can reduce their risks of exposure. Despite these efforts many urban dwellers are still unprepared for flooding. This may be because City Councils' preparedness has not yet extended to identifying flood-prone areas within the cities. The formal statutory planning and approval processes still place total reliance on the flood defences, assuming that the urban areas are flood-free.

Because of the lack of specific planning and building requirements only a small proportion of personal, commercial, and civic assets are being managed with the flood risks in mind. Some of the valley's communication centres, hospitals and key lifelines will be isolated or disabled by floodwaters. Many businesses store stock and produce on pallets less than 200 mm above road level. The most popular form of modern house construction is based on a concrete floor slab, set close to outside ground levels. Many old peoples' homes, kindergartens and schools are located in the areas where floodwaters could pond over 1.5m deep.

How can Flood Preparedness be Improved?

People need to practise how to remain alert, how to listen for instructions and how to

co-operate with authorities. There will not be time to learn how to respond when real breaches occur in the flood defences.

The initial focus of response needs to be on how to prevent loss of life, not loss of possessions:

- How can everyone ensure that all those who live around them are aware that the floodwaters are approaching? For example, people with English as a second language may not have heard or understood the flood warnings.
- Where is it safe for people to stay put?
- How can people get themselves above rising water levels? Particularly children, the elderly and infirm.
- Where will water pond the deepest? Who lives in these areas and is there a need to evacuate them or send in volunteer support to prevent drowning?
- Which streets will become the principal flow paths with water moving too swiftly to drive or walk through?
- Where are breaches most likely to occur? People must be evacuated from areas immediately adjacent to breaches.

The Regional and City Councils may need to consider testing the existing states of preparedness by simulating breaching of the flood defences on a community-wide scale.

Reducing Flood Damages

Individual and community action can reduce personal and social flood losses that

can't be insured against, and the personal trauma of flooding. Being physically and mentally prepared for floods has been shown to reduce the personal losses that destroy so many families following a major flood. Support may need to be given to schools to run education programmes designed specifically to provide children with the knowledge and skills to cope with flooding. They must be encouraged to carry these messages home to their parents.

There is also a need to implement measures to reduce flood damages to personal possessions, such as homes, cars and business assets. If possible, these should be adequately insured. Floodproofing is an alternative (water proofing buildings and storing possessions above flood levels). This may be impractical for buildings which have not been designed with the flood risks in mind, or for vehicles and other heavy objects which cannot be relocated within a few hours. However, studies have shown that possibly 60% of the value of damage to buildings and contents can be avoided if there is 4 to 8 hours flood warning and a high state of preparedness.

Increasing flood awareness and preparedness can be most effective in areas of

new development. Councils can then implement planning measures to ensure that new assets are located above likely flood levels or in areas safe from flooding.

The Benefits of Preparedness and Floodwarning.

Helping individuals and communities respond appropriately to floodwarning, and cope with the effects of flooding, will be emphasised in the coming stages of floodplain management planning.

Flood preparedness can save lives and reduce the trauma of flooding. If sufficient floodwarning is given it may save damages to household possessions, vehicles and equipment located in flood-prone areas. However, preparedness can only reduce a proportion of the potential losses to existing buildings and contents. Improvements to flood defences must also be considered to reduce flood damages beyond the levels achievable through preparedness measures.

Options to reduce flood risks, and the processes proposed to manage their consideration and implementation, are discussed in chapter 7.

Issues for Floodplain Management Planning

Emergency Management and Emergency Preparedness Planning

The Regional Council, Upper Hutt City Council and The Hutt City Council's flood warning procedures are tested regularly and are reliable. They can provide 5 to 7 hours warning of when a flood will reach its peak. The procedures have the potential to reduce property damage, trauma and loss of life if the community is well prepared and understands and acts on the warnings. However, the earliest possible flood warning is unlikely to be effective without a high level of community preparedness. This can only be achieved through regularly testing community response.

The Cities' emergency management plans need to be integrated with the floodplain management plan so that;

- *emergency response can be more closely targeted at the areas of highest risk,*
- *flood preparedness can be measured through regular testing of council procedures and community response,*
- *well publicised education and community planning programmes can be implemented to reduce risks to public and community assets, and*
- *emergency response plans can be linked to a strategy to reduce risks to life and assist individuals in reducing flood risks to their own belongings.*

Links between Emergency Management and Statutory Planning

Of those individuals and organisations who are aware of the general risks of flooding some have taken steps to reduce their flood risks (recent examples are flood-proofing undertaken by INL, TAB, IBM, Countdown and NZ Post, all major developments in flood-prone areas). Some do not feel bound to take individual steps to reduce their risks if they are not in a formally recognised flood-prone area. Others are not aware of the specific risks of their location. As a result many residents, businesses, utility operators and civic amenity operators are not prepared for flooding.

Councils' emergency management flood preparedness messages to residents and businesses are not supported by formally defined flood-prone areas on the Cities' District Plans.

City Councils need to adopt measures to ensure preparedness planning and floodwarning are effective in reducing flood losses, trauma and intangible losses and avoid new assets being located in flood-prone areas. Specifically;

- *City Councils need to take a precautionary approach to development in low-lying areas of the floodplain,*

- *the Regional Council needs to provide definitive information on flood-prone areas, and*
- *City Councils' promotions of planning and preparedness strategies do not need to wait for the completion of the floodplain management plan. They are likely to involve modest public expenditure, compared to the costs of upgrading flood defences, and will lead to similar reductions in flood damages.*

The material in this chapter is drawn from the following technical references:

Ref 9; Volume 9 : Flood Damages - sections 4 - 6.

Ref 15; Hydrology Report - section 4.

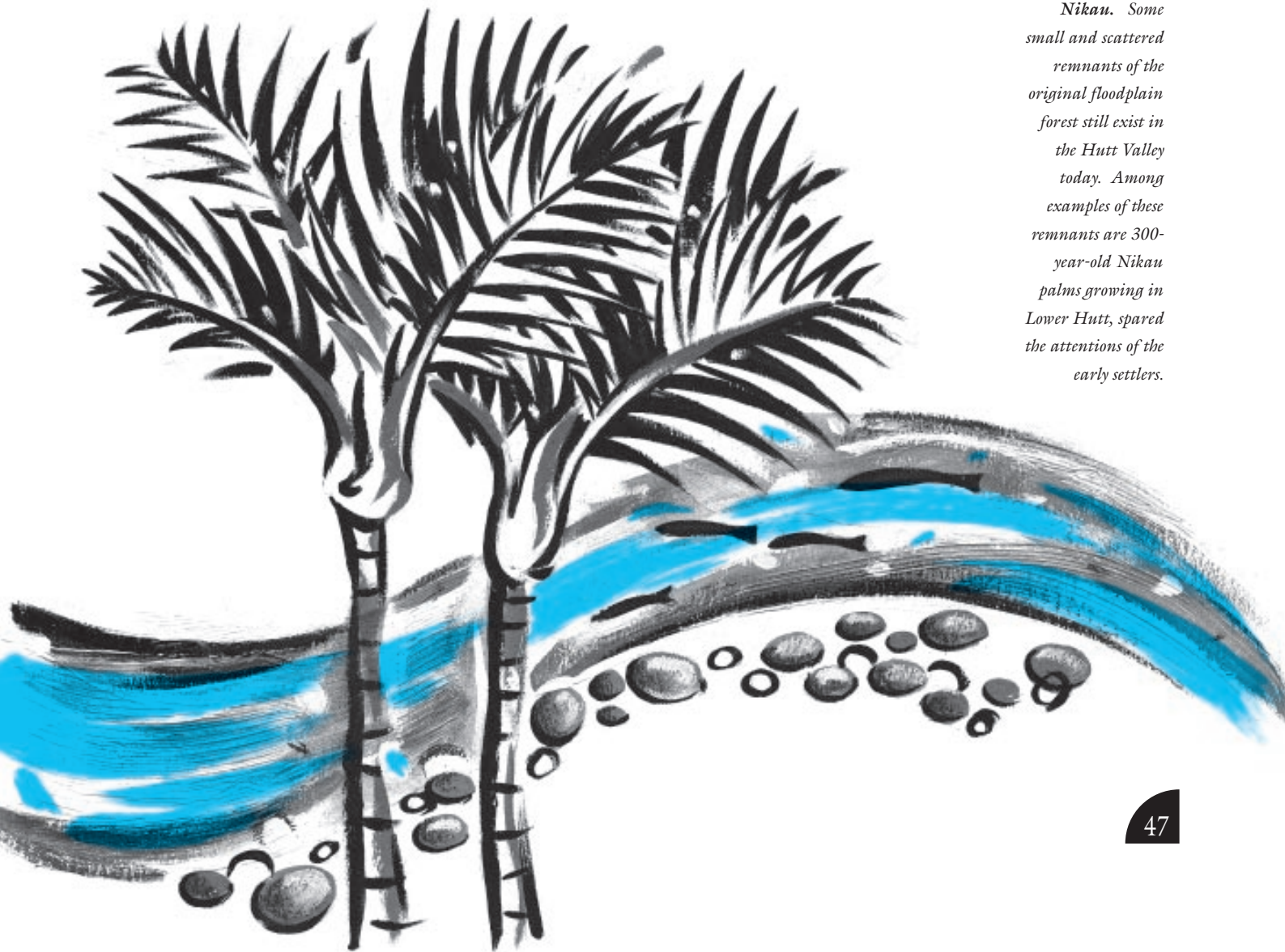
See also:

Hutt City Council Civil Defence Plan & Infrastructure Services Emergency Response Plan.

Upper Hutt City Floodwarning Procedures (Draft).

WRC Flood Warning Procedures.

Nikau. Some small and scattered remnants of the original floodplain forest still exist in the Hutt Valley today. Among examples of these remnants are 300-year-old Nikau palms growing in Lower Hutt, spared the attentions of the early settlers.



Surveying the Views and Concerns of the Public

In order to identify the key issues that concern the residents of the floodplain, and to decide on the direction for future public consultation, surveys of residents, businesses and institutions were carried out in 1990.

Household Survey

To gather sufficient data for a representative survey of residents' opinions, a random sampling of a large number of households was necessary. A wide range of questions also needed to be asked, which meant that using the face-to-face interview technique would have taken too long. A postal survey was considered to be the best option.

A total of 3,000 questionnaires were sent out to a randomly selected sample of addresses, representing approximately a 12.5% sample of the properties in the flood-prone areas.

Questionnaires were sent out on 6 August, with a reminder posted on 24 August 1990. The return deadline was 31 August 1990. Response was encouraged by offering a prize draw.

Questions Asked

The questionnaire contained 40 questions covering a wide variety of issues:

- details of current residence
- previous experience of flooding
- awareness of the flooding risk
- preparedness for a flood event
- perceptions of the river area
- personal details of the residents

Results

A total of 1,055 questionnaires were returned, representing approximately 4.3% of houses in the flood-prone areas. The results are analysed in the Public Involvement Technical Report (Ref 3) Volumes 2, 3 & 4.

Other Interviews

A total of 80 interviews were carried out among representative industrial, commercial and institutional organisations. These groups were asked a similar range of questions. This relatively small number of interviews meant that the completed questionnaires represent 'case-studies' rather than scientific data.

Public consultation is an important process in any project undertaken by a local or regional authority. The views and concerns of ratepayers must be identified and incorporated into the decision-making process.

The programme of public consultation may not accurately represent community preferences unless it is designed to address issues of common concern.

Consultation was undertaken during the first stage of the floodplain management plan to enable the Council to identify key issues and concerns. Future stages of consultation will be designed to take into account the issues discussed in this chapter.

Household and Business Surveys

A postal survey was considered to be the most efficient way of collecting a large amount of information from a wide range of households during the first phase of consultation. The survey, along with discussions with other businesses and institutions, was used to identify key issues. The exhibit on page 48 details the survey processes used.

Regular press releases at the time of the survey served to raise awareness of flood risks, the survey and the Floodplain Management Plan.

The survey and interviews identified the following key issues to be addressed by the floodplain management planning process.

Maori Issues

The history of Maori occupation of the floodplain is long and somewhat complicated in that it involves tribes from many areas.

As a general overview, Ngai Tara and Rangitane tribes, whose chiefs were the brothers Tara and Tautoki, were the first permanent occupiers of the area. Ngati Mamoe from the East Coast also settled in the valley during this time. Ngati Ira, also from the East Coast, moved down and intermarried, staying here for 8 or 9 generations. Te Atiawa, along with other northern and Taranaki tribes, including Nga Puhi, Ngati Whatua and Ngati Toa, drove Ngati Ira out after a raid in 1819.

Te Atiawa have maintained the tangata whenua role since 1832 when the major migration of the iwi occurred. As kaitiaki (caretakers) of Te Awa Kairangi (the Hutt River also known as Heretaunga) Maori have a responsibility to look after the resource for future generations. The river itself is tapu because it is a place where there were settlements, gardens, waahi tapu, urupa (burial grounds) and other significant cultural sites. It is important that these sites are identified before any major modifications to the river take place.

Little of the Maori heritage is now visible, and what remains is extremely valuable. Care needs to be taken to ensure that historic settlements, gardens, old urupa and battle sites are managed as archaeological sites and are not

threatened by river management activities.

Some ancient pa sites exist in name only, and there are urupa and marae currently in use. A number of places of importance to fishing, gathering watercress, flax and paru (mud for dyeing) have been identified. Waka were used extensively for travel up and down the river, and a number of tauranga waka (landing sites) have been identified, though the changing course of the river means that many of them are no longer visible. The tangata whenua consider that re-establishing swamp areas and native flora and fauna are priorities, as well as allowing clear access for the current use of waka.

Discharge of any contaminant into the river is an activity which iwi do not support. The Regional Freshwater Plan covers iwi values regarding fresh water in some detail.

Te Atiawa hold mana whenua over the river and should be consulted before all modification work. Consultation with iwi should be conducted by Council staff and not consultants, as this shows respect for the mana of both parties.

The Council and Te Tangata Whenua o Te Upoko o te Ika (tangata whenua of Wellington) have established *Te Tūtōhinga O Te Whakaaetanga* (*Charter of Understanding*), a protocol for implementing the provisions of the Treaty of Waitangi and the Resource Management Act, 1991.

The Resource Management Act requires that the Council gives particular regard to kaitiakitanga, or guardianship of the land, by Maori.

The Treaty of Waitangi provides for the exercise of kawanatanga by the Crown, while protecting te tino rangatiratanga, or full authority of iwi in respect of natural resources. A process of shared decision making, as set out in the charter, must be established in the ongoing process of floodplain management.

Potentially Disadvantaged Groups

It will be necessary to plan consultation so that it will not disadvantage certain groups. Special consultation processes will be required to involve groups such as immigrants, those with English as a second language, the disabled, the elderly, and other groups who may not have ready access to the decision-making process. These groups make up a significant proportion of the population in the flood-prone areas.

Public Perception of Scheme Management

Generally there is a lack of understanding of the different roles and responsibilities of the agencies involved in managing river issues, and concern about how well they are co-ordinating their management.

There is a perception that too much money is being spent on protection against high risk, but infrequent floods. Residents are interested in minimising the environmental effects of the smaller more frequent floods, enhancing the recreational opportunities of the river environment, and improving the ecological, botanical and landscape qualities of the river environment.

There is concern about whether the various agencies will plan land-use and building

development in a careful and wise manner. Residents are unsure of the powers of the agencies to limit private rights in the public interest in order to minimise flood losses.

Environmental Management

The river channel and riverbanks are greatly valued by residents as a tranquil haven in contrast to their urban surroundings. The river corridor is visited over 1 million times each year for recreational reasons.

Two differing views of the environmental quality of the river corridor have been expressed.

One view is that access to the banks and the river, the tranquillity of the surroundings, and the trees and bird life are enjoyed and highly valued.

The other view, expressed by a relatively small number of people, is that pollution, poor access to some parts of the river, litter control, and some management practices reduce enjoyment of the surroundings. Management practices that were considered to detract from recreational opportunities included;

- re-grading the river bed (cross-blading),
- gravel extraction,
- destruction of the wildlife habitat,
- planting of non-native vegetation,
- storing construction material on berms,
- placing rip-rap on river banks,
- destruction of swimming holes,
- lack of access to the river because of willow planting, and

- damage caused by vandals that is not repaired.

Opportunities to improve the river corridor suggested by survey respondents included;

- improving the appearance of stopbanks by adding landscape fill to break the monotony of the embankment shape,
- building additional facilities to enhance recreational activities,
- improving water quality,
- improving access to the water,
- planting native trees,
- generally reducing interference with the natural environment, and
- improving wildlife and wetland qualities.

Knowledge of Flood Hazards

Awareness of the potential for flooding in the Valley is not particularly high, although responses to the survey indicate that this awareness has grown in recent years. When asked if residents felt there was a chance of their home flooding when they first moved into it, 83% said 'no chance', and 17% said 'yes'. When asked if they now thought there was a risk, the number agreeing increased to 26%. The number saying 'no' dropped to 55%, and 19% said 'don't know'. This was regardless of the number of years they had lived in their current homes.

Awareness of flood risk is higher in some areas than in others. It is highest in Petone and Alicetown, but very low in areas such as

Ebdentown, Wallaceville and Elderslea. The level of awareness may not always mirror the actual risks. Those who are most aware of the risks, seem to think of flooding as something that may occur at some stage in the future, rather than as a risk they face on a daily basis.

In terms of security, distance from and height above the river combine to create the greatest sense of security. Stopbanks are seen to be the most effective mechanism to reduce flood risks.

Generally, those surveyed had not planned for flooding of the urban areas, nor had they taken precautionary measures. This was despite the fact that 10% of respondents had experienced flooding of some sort in the past, although not necessarily in the Hutt Valley. However, people did indicate a wish to know more about the risks and what to do in an emergency. Some people have made changes to their properties to deal with stormwater flooding, but not with that resulting from breaching of the flood defences.

People would like to know more about the floodplain management planning process; about various technical aspects of flood prediction and risk reduction, emergency actions and procedures, and the results of surveys and consultation activities.

Lessons to be Learned for the Consultative Framework

The respondents to the household survey expressed a strong desire to remain involved in the ongoing processes of consultation.

The value of public consultation comes from exploring issues, not in requiring people to suggest solutions. It is clear that the first stage of the consultation process could have presented more issues or technical information in a way that would have extended the understanding of flood risks for the public to debate. *Living with the River* is intended to address both these needs. It will be the focus for workshops and public meetings in future stages of consultation.

The survey identified that local media play an important part in getting information out to people, and alerting them to local issues. Media support will continue to be a valuable component of future stages of consultation.

The key objective for ongoing consultation must be to involve and inform the public so that the community regards the floodplain management plan as theirs, rather than something imposed from outside.

The principal contact for queries regarding ongoing consultation is the Manager, Rivers Department, Wellington Regional Council, phone 3845708.

Issues for Floodplain Management Planning

Partnership with Iwi

Te Tūtohinga O Te Whakaaetanga (Charter of Understanding) is a consultative agreement between the Regional Council and iwi in the Wellington Region. Iwi have the opportunity to be involved in management planning and decision-making, particularly for activities which could impact on waahi tapu (areas of significance) or lead to changes in the current uses of the river. Tangata whenua of the floodplain is Te Atiawa.

The Regional Council will implement the provisions of Te Tūtohinga O Te Whakaaetanga to ensure effective consultation with iwi during the completion of the floodplain management plan. Maori form a significant proportion of the floodplain community and must also be represented as directly affected residents.

Raising Public Awareness

Floodplain residents are generally unaware of the risks of flooding resulting from breaches of the Hutt River flood defences and are unprepared for that eventuality. Residents question the amount of money spent on river management works, compared to environmental enhancements, as there is great faith in the stopbank system. There is not a clear understanding of the role of the Regional Council and other agencies in flood risk management. The public suspects that there is a lack of co-operation between agencies.

The Regional Council must establish a programme to raise the profile of the work being done to manage the floodplain. Living with the River will be widely distributed as the first step of this strategy.

Participation of Stakeholders

Residents want to be involved in the floodplain management planning decision-making process, and kept informed of developments.

There is a need for a comprehensive strategy for stakeholders' participation, supported by an information strategy to ensure all stakeholders are kept up to date without being overwhelmed with unnecessary information. An 'open door' policy needs to be adopted so that stakeholders have access to the information they require to;

- *assess the extent of damages that will constitute a major risk, and their preferences for risk-taking,*
- *consider an acceptable balance of expenditure on asset protection and environmental enhancement,*
and
- *establish their level of support for a comprehensive programme of risk management.*

Management of the River Environment

The river corridor is used for a wide range of recreational pursuits. Residents would prefer to see the river in a more natural state rather than in a highly modified condition. They would like to see some action taken towards restoring its original environmental qualities. The recent improvements have been appreciated although some river management practices are still seen to be detrimental to the environment.

A strategy is required to achieve an acceptable balance between effective floodplain security, enhancement of recreational areas, and the longer-term objectives of re-establishing the natural riparian environment. Current management practices will need to be improved or adapted to address this balance.

The material in this chapter is drawn from the following technical references:

Ref 3; Volume 3 : Public Involvement - Volumes 1-4.

Ref 11; Volume 11 : Environmental: Maori Component - sections 3 and 4, Sociological Component - all sections, Ecological Component - Part B.



Scrapbook

Flood on 17th January 1858, from N.Z. Spectator Jan. 1858

THE FLOOD OF 1858

"The later rains have caused a very heavy flood at the Hutt which, we are sorry to learn, has occasioned very serious damage and loss to persons living in the district. It commenced raining on Sunday evening, and continued without intermission until the following evening. The river rose to a greater height than has been known before, the water entering many houses that have been above the level of previous floods. Immense trees were brought down by the flood and left in different parts of the road, which is broken up in several places, and has become quite impassable. Butler's house is entirely washed away, and the river has broken through still further in that direction. Corbett's—the Aglionby Arms—is rendered uninhabitable, the river having swept away half the house and made a fresh course for itself, so as to leave the remainder of the building standing as an island in the middle of the stream. Mr Corbett had incurred an expense of £100 the week previous driving pile sand forming a breastwork to protect the house against future freshes. With great difficulty he contrived to save the furniture from the upper rooms. The river had broken the bank away on both sides, which is now impassable; when the flood was at its height it was level with the floor of the bridge, many of the iron fastenings and cross sleepers of which had been carried away. Heavy losses have been incurred in the valley by the destruction of fences and other property, and the loss of sheep and other valuable animals which have been drowned by the flood. The damage to the road at Butler's and the parts adjacent caused by the previous flood has been further increased by that of Monday; very much of this, it is said, might have been prevented if timely precautions had been taken by the Provincial Government who never interfere in these matters until after the mischief is done.

To the above account of losses and destruction of property caused by the flood, we are concerned to add that news has this morning been brought of lamentable loss of life, the bodies of seven persons have been recovered, several other persons are reported to be missing. The unfortunate sufferers are, it is said, mostly newcomers who have recently settled in the district.

In our last we gave such details of the disastrous flood which had occurred in the Hutt as had reached us. We now furnish the following particulars which we believe may be relied on as being substantially correct. The number of bodies actually recovered at present is nine, namely, Mrs Hagan and infant, and Mrs Price; the other persons known to be missing are the husband of Mrs Stanway, and three more of his children, who were all seen to be washed away together. The particular locality where this awful loss of life occurred was nearby the 'Barley Mow Inn,' at the Upper Valley of the Hutt.

When the flood was at its height (about 1 a.m. Tuesday) the force of the water at this point is described by an eye-witness as being terrific. The water was seen rushing along like an immense wave, crashing and roaring, carrying everything before it: huge trees, portions of buildings, timber, furniture, and debris of every description, were borne away by the force of the current. To witness the havoc and destruction which the flood had caused is most painful and baffles all description. Many acres of land which only a few hours before to all appearances promised a plentiful crop, are now covered with sand and shingle, and not a particle of vegetation remains. The quantities of drift timber, in many instances large solid trees, which have been deposited by the flood, is perfectly incredible, and will take many months to remove. The unfortunate persons who have lost their lives by this sad calamity are mostly late arrivals in the country. Mrs Hagan (a

daughter of Mr Dew, an old settler at the Hutt) was living in a small wooden building near the first gorge; Mrs Price and a man named Charles Hartley were also residing in the house. Upon seeing the waters rising so rapidly some fear was entertained for the safety of the building, and the survivor Hartley proposed to go for a rope to secure the house; when he left the water was up to the window, and the house was actually shaking. He almost lost his footing, and was swimming with the current for nearly half a mile, until he succeeded in getting up a tree, where he remained for 14 hours, until rescued by some passers-by on the following day. From the position which he occupied he could see everything around him; he states that he soon saw the house borne away with the current: the inmates Mrs Hagan (who was only confined that morning) and the nurse Mrs Price, were climbing on to the roof of the house; they passed close to where he was in the tree, and he describes the shrieks of the women as fearful; a minute after the house turned over, and nothing more was seen of them. The bodies were recovered about a mile from the spot on Wednesday morning; the infant was found firmly locked in the dying grasp of its poor mother, the nurse was found close to her, the body was very much mangled. The bodies were removed to the house of Mr Dew, and an inquest held on them, when a verdict of accidentally drowned was returned. The husband of Mrs Hagan is absent in the country and, of course, is ignorant of the desolation of his home. Mrs Price, who was much respected, and who arrived here by the *Ann Wilson*, leaves a family of young children behind her: her husband was absent from home at the time. The other family, Mr Stanway, wife and family were all seen together on the roof of their house; the water rose rapidly and submerged the whole of them, and they were seen to sink one after the other. The blacksmith Sollers with his wife and infant perished in a similar manner; they imagined themselves secure, but the house was borne away with the current, and he was heard by persons on the hills to say 'good-bye'. The bodies were found mostly together, one completely buried in the sand. A man and his wife living near to Mr Dew were saved after remaining on top of a building for many hours whilst nearly all around them was borne away. To give anything like a detailed account of the losses sustained by residents at the Hutt would be impossible; we may, however, state a few of the most important particulars of individual loss of which we have been informed:—Mr D. Riddiford has lost about 120 sheep; Mr Barton has also lost a large number of sheep; Mr Thomas Mason a number of cattle; Mr Arnott cattle and sheep; Mr John Leverton has lost entirely 50 acres of crops, and a large number of cattle; Mr C. Mabey lost a number of sheep, and also a large quantity of fenced and cropped land; Mr Buckridge, of the Albion Hotel, has had his crops destroyed and the river has taken a course completely through his property; at William Tandy's the river now runs through his ground and has destroyed a large amount of property; Mrs Speedy's land is completely cut up in all directions by the different channels the rain has made, in many cases large fissures 12 feet deep have been formed; Mr Still has lost a number of sheep, etc.; Mr John Russell 10 head of cattle; Mr Dew, an old settler, estimates his loss at not less than £500; a property which was worth many hundreds of pounds is now comparatively worthless, five acres of grassland have been completely swept away. A large number of men had volunteered to assist in removing a shingle bed which had been thrown up, and which prevents the river from taking its old channel, and nearly all the residents of the Hutt were endeavouring to contribute either in labour or otherwise to this object. The destruction of the roads between Poad's public house and the Taita is almost incredible, scarcely a vestige remains at some places of the original road: at one place (a bridge near M'Donald's creek) the river runs right through the

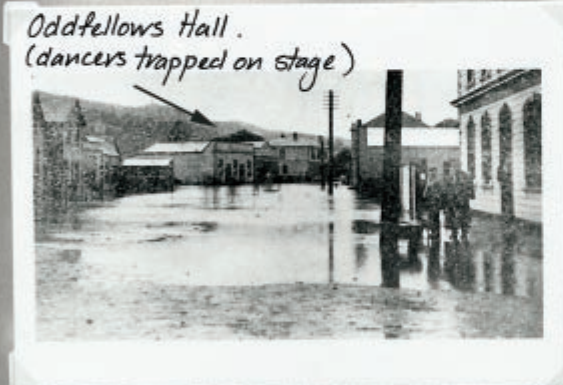
road making it very dangerous for passengers at night; the banks descend abruptly to the depth of 15 feet; other dangerous places occur along the whole line of the road. The Waiwhetu and Second River Bridge have both been carried away. It is to be hoped that the Provincial authorities will lose no time in removing the large quantities of drift timber now lying on the roads, and in making it again passable.

A public meeting, called by notice posted in the most public places within the district, was held at the Hutt Mechanics' Institute last night (26 January 1858), to consider the best steps to be taken under the circumstances. About 200 people were present at one time during the evening. Mr Braithwaite was in the chair. Great regret was expressed at the non-attendance of any person to represent the Provincial Government. Mr Ludlam, as one of those who had signed the notice calling the meeting, opened the proceedings by explaining his objects in so doing. The following resolutions were unanimously carried, after considerable discussion, in which, besides the movers and seconders, Messrs Lynch, M'Hardie, M'Dowell, Corbett, W. Milne, Jillett, Renall, Bruce, and D. Hughey took part. The meeting ended at about eleven o'clock. Moved by Mr Ludlam, seconded by Mr Hart—That this meeting is of opinion that immediate and energetic action is required in order to repair the serious public damage done by the recent inundation of this valley, and in order to guard against the recurrence of the attendant calamities as far as human means can avail. Moved by Mr Wakefield, seconded by Mr Jillett:—That the following gentlemen be requested to form a committee for the purpose of communicating with the Government on the subject, and of obtaining accurate information as to the causes of the damage and means of remedy and of collecting subscriptions towards the necessary expenses, viz, Messrs Ludlam, Hart, Corbett, Phillips, Wilcock, David Hughey, Lynch, Mason and Wakefield.

Moved by Mr Hart, seconded by Mr Riddiford:—That the Committee be requested to open a separate subscription list for the purpose of relieving serious cases of private distress among the sufferers by the recent inundation.

An inquest was duly held upon the bodies of the deceased and a verdict of accidentally drowned was returned in respect of each person."

High Street, Lower Hutt, 1904
(new stopbanks not yet completed)



Alexander Turnbull Library,
Wellington, New Zealand.

Notes - Before the stopbanks

In 1840, boatloads of settlers arrived in Wellington harbour ready to build 'Brittania' at the mouth of a great river. They had been sold the dream of an idyllic new existence on the lush and bountiful banks of the Heretaunga River.

After a very short time, most of the would-be residents packed up again and headed for Thorndon. The reason – flooding.

Some brave and hardy souls, willing to keep a small boat tied to their back doors, remained, and small communities grew slowly over the next 60 years. Significant growth, such as that seen in Wellington over those years, was hampered by the river which flooded frequently and dangerously.

During the first 60 years of settlement, at least 21 floods were recorded. Histories of the river are littered with tragic tales of drownings, and of homes and livelihoods swept away.

Bridges were repeatedly wiped out, stock was lost, gravel and silt were dumped onto good pasture, paddocks next to the river were eaten away overnight.

Despite the low population, settlement of the valley had a devastating effect on the natural life of the river, and worsened the flooding problem.

Continuous felling of the mighty trees on the valley floor and on the hillsides caused massive soil erosion and worsened the flood risk. Some of the trees were disposed of in the river where they were swept as far as the nearest bridge. Here they stopped and formed dams which effectively clogged up the river channel.

Settlers, an independent breed, would often set up their own flood defences with little regard for the flow-on effect downstream.

The catalogue of destruction continued on through the century. In 1871, a large flood finally put paid to the Aglionby Arms. This pub had valiantly tried to remain on the banks of the river, but had been washed out three times. In 1890 a flood swept away a child, and in 1898 two tremendous floods caused enough damage to finally force the issue of flood protection.

Over the years River Boards had been appointed to consider the problems of flooding, but with no vision for a co-ordinated scheme they proved to be ineffectual.

Politics, money and stubbornness had also played their part in preventing the establishment of an effective flood protection scheme. However, strong public opinion after the 1898 floods finally forced the election of a new River Board that proclaimed, "...a scheme of river conservation, unselfishly pursued would make the Hutt Valley the garden of New Zealand".

THE HUTT RIVER AND THE LATE FLOOD.

The large hall of the Hutt Mechanics' Institute was filled on Friday evening in response to an advertisement convening a meeting for the purpose of considering means to be taken for the purpose of mitigating of the effects of floods. Dr. Purdy was voted to the chair and said it was a pleasure to him to realise that his action in convening the meeting had met with so enthusiastic a response. The time had arrived when the question of river protection had to be faced, as the present condition of things would prove a menace to the best interests of the district. He knew that a section of the community deprecated any money being spent for fear that it would be wasted, but he could not sympathise with this cause of action. He must decline to believe that good work could not be done. Years ago the Hutt County Council had to face the question of protecting the road at Silverstream, and by steady persistence they had succeeded, but not without repeated failure. What had been done there might be done elsewhere. Mr. Riddiford had also at another portion of the river done very effective work saving the part of the Hutt in the vicinity of his property. Then again much of the western side of the river had been saved. With so much done by private enterprise the eastern portion of the river bank had been neglected. He had bought a house in the Hutt well above the normal flood line, yet the recent flood had invaded it, and although he was not foolish enough to believe floods could be altogether stopped, he was of the opinion that with proper protective measures taken that of the seventeen floods of recent years not more than one of them would have caused trouble. There was a matter which should come under the notice of the local Council, that was the condition of the creeks feeding the river, these waterways being blocked, frequently impeded the flow of water and in their present condition would prove a menace to public health. It was out of the question at the present time considering, however, a comprehensive scheme of drainage that would be too costly an undertaking. Still, he was satisfied that the troubles from floods could be prevented, and he invited an expression of opinion from the gentlemen present.

Mr. C. Cauley thought that one of the most fruitful evils causing floods was the accumulation of shingle on the south side of the bridge.

Mr. Strand advocated the formation of a River Board.

Mr. E. P. Bunny explained the legal position of affairs as they appeared to him, and suggested a motion, that a committee be appointed to wait on the Lower Hutt Borough Council for the purpose of urging that steps be taken to have a River Board constituted, or as an alternative that the Council frame a measure for consideration of Parliament, giving the Council the powers of a River Board.

The motion was seconded.

Mr. Scales considered that immediate steps should be taken in the direction indicated by the Chairman and Mr. Bunny, except that it would be far better to have a River Board, as against the Borough Council having the necessary powers. In 1885 a River Board was constituted by special legislation, having control over a River Board district which comprised, besides what was now the Hutt Borough, both the Petone Borough and the Taita. This Board, for all practical purposes, had ceased to exist; in fact, only two of the five members elected were no alive, and it was obvious, in the face of the recent expenditure in the direction of protective works by the Petone Council, that the burgesses of Petone would not care to be included in any district which might be rated for the purposes in question. The residents at Taita would probably take the same view. So that before any fresh

River Board could be constituted it would be necessary that both the old district and the old Board should be abolished.

Mr. Jones suggested the adjournment of the present meeting for the purpose of convening a meeting of ratepayers.

Mr. Fitzherbert stated that the Council was prevented from spending money on the river, their revenue being devoted to strictly defined purposes. He had on other occasions interested himself in the adoption of means of protection against floods, and although considerable interest had been taken at the time no definite line of action followed. It would be necessary to abolish the old Board and for this purpose two-thirds of ratepayers would require to sign a petition. The last River Board elected were Messrs. Brown, Bruce, Johnson, Reston and Speedy.

Mr. C.W. Brown one of the two survivors of the Board agreed with Mr. Scale's remarks, and considered a new district and a new Board should at once be constituted.

At this stage Mr. Scales submitted a motion which was agreed to Mr. E.P. Bunny consenting to withdraw his.

"That steps be taken to protect the Hutt Borough from floods, and that a Committee of five to consist of Messrs. Scales, W.G. Foster, E.P. Bunny, Moorhouse and Dr. Purdy be appointed to investigate and report on the proper 'modus operandi' of having a new River Board and river district constituted. The Committee to request the Mayor to convene a meeting of ratepayers at which such report shall be presented."

The meeting then terminated with a vote of thanks to the Chairman and convener of the meeting, Dr. Purdy.

The Chairman announced that it had been the intention of Mr. E.J. Riddiford to be present. He had, however, been hastily summoned to Fielding.

SUBSEQUENT PROCEEDINGS.

The Committee afterwards met and appointed a sub-committee, consisting of Messrs. Bunny, Foster, and Scales, to wait on the Colonial Secretary, with the view of ascertaining what steps should be taken to give effect to the resolution, and the same Committee to arrange with the Mayor for a date upon which the ratepayers should be called together.

The sub-committee, as a deputation, with Mr. Field, M.H.R. waited upon the Hon. J. Carroll, Colonial Secretary, on Saturday and explained to him the difficulty of the position at the Hutt. The Minister promised that the matter should be at once looked into, and he would inform the deputation on Monday the result of his enquiries.

The deputation then waited upon the Mayor of Petone, and arranged that his Council should grant it an interview on Monday evening.

LAST NIGHT'S MEETING.

There was a numerous attendance at the meeting last evening at the Oddfellows' Hall, Lower Hutt, convened by the

QUIET SERVICE

HUTT RIVER BOARD

The history of the Hutt River Board since its foundation in 1899, following a severe flood, was briefly sketched by the retiring secretary of the board, Mr. A. J. Gearing, in an interview. Another board was in existence prior to 1898, but as no records had been located, little of its activities was known. The severe flood which had resulted in the constitution of the present board, said Mr. Gearing, had covered the area at present traversed by High Street with three feet of water, and other sections of the district were flooded. Among the board's possessions was a photograph of the flood, showing almost the entire width of the valley from the Western Hutt Road to the Waiwhetu foothills under water.

Local agitation after the flood had resulted in the formation of the board, Mr. Gearing continued, the chief movers in its constitution being the late Mr. E. P. Bunny and the late Dr. J. R. Purdy. The efforts of the board at that time centred mainly in keeping flood waters away from the area now forming the business portion of the city. The first of the stop-banks constructed to protect the residential area was commenced in 1901, and protective works had continued until a capital expenditure of well over £250,000 was now represented by them. A further expenditure of £212,000 was contemplated in the near future.

Instead of the rates rising in the same ratio as the capital expenditure they had actually fallen considerably, Mr. Gearing said. A class 1 property, valued at £1000, carried an annual river rate of £1 7s in 1926; but in 1941 a similar property paid only 8s 10d. This was mainly due to the large increase in the number of ratepayers sharing the burden of river rates. In 1926 the board's rates came from only 2627 owners; now they were paid by 16,000.

"There can be no question that, but for the operations of the Hutt River Board, there would be no City of Lower Hutt today," Mr. Gearing said. The board worked largely in the background, and the majority of the public had no idea of its unspectacular, but continuous, operations.

*Evening Post
14 December 1945*



River in flood November 1898

*November 1898
original held by Hutt City Council Memorial Library.*



*NO THROUGHFARE
HUTT RIVER IN FLOOD, MELLING A 2036
PROTECTED BY S. B. ALBRIGHT*

*Melling Suspension Bridge 1913
Hutt City Memorial Library*

THE HUTT IN FLOOD

TRAFFIC BLOCKED

MOTORISTS IN DANGER

A NIGHT IN THE TREES

Human lives were endangered by the flooding of the Hutt river yesterday. The river rose with remarkable rapidity, and spread over a great expanse of flat land, flooding houses and making the main road impassable at the point where it crosses under the railway bridge at Silverstream. Many motor-cars met trouble, and two motorists had to spend the night in trees, perched above the flood waters. A good deal of stock was lost, and considerable damage was done to houses and farm property.

Flood waters between four and five feet deep swirled across the main road yesterday afternoon in the vicinity of the railway bridge at Silverstream, where there is a dip for two or three hundred yards. From shortly after noon onwards all traffic was blocked, and those motorists who attempted the passage without exception came to grief.

RAILWAY BUS STRANDED.

A railway bus which essayed to get through under its own power shared the fate of the smaller vehicles, and for ever an hour the passengers had to watch the waters rising steadily until they reached the floor boards. Finally the services of a break-down car, which had been busily engaged in towing cars out of trouble, were requisitioned, and the bus was towed into comparatively shallow water. Then the passengers were carried out before attention was directed towards getting the big machine to a repair shop. Another bus had meanwhile arrived on the scene, and with considerable difficulty the stranded bus was taken in tow and ragged backwards through the narrow gorge.

A smart roadster with two occupants came from the direction of Lower Hutt shortly after the bus had been brought out, and it tried to get through, but stuck in the middle of the flood. The breakdown car went to its assistance, and actually took it in tow, but it was a case of the pitcher which went too often to the well. The rescuers were themselves involved, the waters having continued to rise, and they had no option but to anchor their van with the roadster in tow to the fence, and make their way out by clinging to the fencing wires and literally pulling themselves to safety. The occupants of the roadster for some reason or other did not follow suit, and darkness fell without their having made any attempt to get out.

SEA OF YELLOW WATER.

The tea-rooms at the approach to the bridge and the caretaker's residence had to be vacated early in the morning. The Manor Park golf house had about five feet of water in the late afternoon, and the course was a sea of yellow water. At the commencement of the Taita Gorge the flood waters had spread across the whole valley from the main road to the railway line, a distance of over half a mile, and the sight was an awe-inspiring one.

The western end of Mabey road ends at a terrace down which the road descends steeply, giving access to a wide area of river flat. This area, which it is impossible to protect without the expenditure of a very large sum, the Hutt County Council some time ago granted the owner permission to subdivide, despite a strong protest by the Hutt River Board. During the November flood and on the present occasion the whole area was feet deep in water, and a large quantity of plant used by a contractor for road-making was submerged. The clearings which have been made for the roads were channels of rushing water. The terrace itself was eaten into in many places, and yesterday afternoon a tree with several hundred-weights of soil clinging to its roots was carried away. Mr. P. S. Hower, chairman of the board, pointed out the justification for the protest.

The road was covered to the extent of about two feet near the spot where the big slip came down in the Taita Gorge, but cars were able to negotiate this stretch without much trouble, a patrol officer of the Wellington Automobile Club doing valuable work in pointing out the safest part of the road. Several slips appeared imminent, and fairly big rocks came down at intervals, necessitating caution on the part of motorists.

Houses at the river end of Mabey and Camp roads were flooded, but, having been given ample warning by Mr. A. Searle, foreman of the board, the occupants were not endangered. Mr. W. Kilminster lost about thirty sheep which were grazing at the end of Camp road, and other losses of stock were reported yesterday afternoon, although in most cases they were not extensive.

FLOODING AT MELLING.

Melling did not suffer to anything like the same extent as in the 1915 flood, but the new sub-station had water very close to it, and several houses were actually invaded by the flood. The river was rushing between the Western Hutt road, and the suspension bridge, and it was impossible to get past the western approach to the bridge.

But for the protection works carried out by the Hutt River Board the damage would have been much more extensive. The board's policy of encouraging companies to remove shingle from the river bed also proved beneficial in enabling the flood waters to escape more quickly from the lower reaches.

MAORI BANK RECORD

BITUMEN CROSSED

BY MAIN RIVER WATERS

(By an Upper Hutt Week-End.)

A double crossing (crossing and re-crossing) of the main highway bitumen by main river waters (not merely tributary streams) immediately below Maori Bank is an event that has not occurred before in the history of the Hutt River upper valley. It is not unusual for motor-vehicles to be stopped by flood waters on the bitumen near Silverstream railway bridge. But for this to occur between Upper Hutt and Maori Bank is unprecedented. It marks a super-flood, probably a record flood, for none of the old identities of the upper valley seems to remember encroachment of main river waters on the main road at or near that point.

CARS AT THE FORD.

A dwelling between river and road, a little bit above the incursion of the waters, was sufficiently beset by the flood to be temporarily vacated. The rising stream then found an old channel which involved a detour from the existing channel. This old channel has been crossed by the bitumen road in two places, but the waters over-leaped both hurdles. Two fords were thus imposed upon the main highway traffic, and for a time one of them was impassable, but most of the time it was possible to get through by plugging ahead in low gear; the many cars that stopped half-way always found some other vehicle to drag them out—for which purpose all the automobile experts (professional and amateur) of Upper Hutt seemed to have fore-gathered. In fact, yesterday afternoon was a motor experts' holiday.

RIPARIAN PROTECTION.

The crossing and the re-crossing fords were comparatively close together (the length of the flow on the east side of the main road being not more than about one hundred yards), but nevertheless this encroachment on the left bank of the Hutt River below Maori Bank should be seriously regarded by both road authorities and property owners. The event is one more new proof (additional to the repeated warnings opposite to the Whakatiki's mouth and at Moonshine bridge) that riparian protection in the Upper Valley must be earnestly considered, and that the restriction of organised protective work to the lower valley (the Hutt River Board's boundary is Silverstream railway bridge) is inviting bigger and bigger trouble as the years roll on.

IN THE HUTT VALLEY

RIVER BOARD'S GOOD WORK

EROSION AT SILVERSTREAM

The Hutt River Board's protective work stood up remarkably well. "There was a fair margin of safety as far as the stopbanks were concerned," said Dr. B. J. Dudley, chairman of the board today. "At no time was the town of Lower Hutt in real danger. It says a great deal for the cleaning up of the lower reaches of the river that late yesterday morning the river was back in its bed. A clean run has been provided in the deep channel towards the mouth of the river and the water quickly ran away. The surface water in most places drained away fairly easily. The ratepayers may congratulate themselves on the work of the outside staff and the engineer, Mr. H. Sladden."

A drive from Petone via the Western Hutt Road today revealed that the surface water is subsiding rapidly and that there is perhaps less in the way of damage than was at first suspected.

Water still lies on Hutt Park, but Randwick Road, yesterday partly under water, is quite clear, though the footpaths are well covered with silt. Low-lying ground all along the route shows traces of flood water and debris.

At Melling part of the foundation of the shingle plant to the north of the bridge has been carried away. Minor slips along the Western Hutt Road are being cleared, but in no case are they a hindrance to traffic.

DAMAGE AT MANOR PARK.

The Manor Park golf links, and the surrounding low country, present a bedraggled appearance. In some places the ground has been scoured out and logs and pieces of timber litter the course. The boxes and other gear have been removed bodily, as have several sheds on property to the east of the course. At its height the river touched the planking of the Manor Park footbridge, as is evidenced by grass and small sticks wedged in the decking. This bridge is three feet higher than the larger bridge which was swept away by the 1931 flood. When the water subsided smaller debris was left against the walls of the pavilion, which was isolated throughout the flood.

Just south of where the new concrete bridge crosses the river at Silverstream, the river seems to have taken a more easterly sweep. The main road is closed from the Silverstream bridge to the small bridge at the mouth of Stokes Valley. Most of this stretch was under water at the height of the flood.

About 150 yards south of the new traffic bridge the river has taken two deep bites out of the main road, cutting it away for half its width in one place. Other subsidences are visible further south in the Taita Gorge.

This morning there was one fair-

HURRICANE AND FLOOD

DAMAGE IN WELLINGTON DISTRICT

MANOR PARK BRIDGE DESTROYED

FATALITY AT OTAKI

A storm of almost unprecedented violence swept over parts of the Dominion yesterday. The wind at times reached hurricane force, and in some districts very heavy and continuous rain caused serious flooding. The areas most affected seem to have been Wellington, Otaki, the Wairarapa, the West Coast district of the South Island. Otaki has been practically under water, and a woman fell from a bridge and was drowned. A washout on the railway at Otaki caused considerable delay in the railway traffic, some of which was diverted through the Wairarapa. The Hutt River rose to a level higher than has been recorded for the last quarter of a century, and serious flooding occurred. In Westland swollen rivers and slips followed a deluge of rain, and a Public Works employee was killed by a slip that carried away a camp in the Karamea Gorge. In some of the flooded districts motorists found themselves held up by the flood waters and had narrow escapes, and the occupants of a number of houses were forced to seek refuge on higher ground. Yesterday evening the Manor Park suspension bridge, which had been severely buffeted by the hurricane and pressure of water on the pylons, collapsed and was swept down river. One pylon remained standing.

HURRICANE WIND

SWEEPS WELLINGTON

RAIN AND FLOODS

MINOR DAMAGE DONE

Good Friday will go down in history as the stormiest ever experienced in Wellington. A northerly wind, which at times reached the unprecedented velocity of over 80 miles an hour—officially a hurricane—was accompanied by heavy and driving rain. The storm started on Thursday evening, continued through the night, and lasted for the greater part of yesterday. The wind yesterday afternoon gradually died down, but a steady rain continued to fall.

Flooding was confined to the Hutt Valley, where the position at one time was alarming. In the city itself the wind did considerable damage, although most of the havoc wrought was not of a very serious description. Considering the force of the wind, it would not have been surprising if more serious and extensive damage had resulted.

The aerial of the 2YA transmitting station on Mount Victoria was badly twisted, and the illuminated sign was blown down. Power surges caused damage to the transmitter, too, but temporary repairs have enabled broadcasting to continue, although it was interrupted yesterday.

A number of iron roofing sheets were blown off the Kilbirnie Cinema just as Thursday evening's programme had begun. The noise caused momentary alarm. To keep the rain out, tarpaulins were later stretched across the gaps. Repairs have been effected and the theatre is open as usual. Quite a number of shop verandahs in the suburbs came to grief, and some windows were blown in. A store at the corner of Tinakori road and St. Mary street suffered in this way, and in Moxham avenue and in Hataitai similar damage was done.

Several fences went "west," including one at the corner of Molesworth and Little Pipitea streets. Sheds had their tops removed in a number of instances, and gardens generally were a sorry spectacle, with ruined chrysanthemums and other plants, shrubs, and trees battered by the wind.

Telephone and electric power lines were damaged in a few cases. On Thursday evening, just before 6 o'clock, Wellington was in darkness for a few minutes. The cause was the breakage of an earth-wire in the high-tension system near Newlands, this falling across the high voltage cables. The alternative circuit, however, was brought into operation almost at once. The Hutt Valley service was affected similarly, but the spell of darkness was not of long duration. Flickering lights yesterday evening indicated that the gale had made a further mess of things somewhere in the system.

A number of slips of a minor nature are reported from various districts, but cars are able to negotiate roads radiating from Wellington, although the flooding in the Hutt Valley, as reported

HUTT HIGHEST AFTER DARK.

At the Upper Hutt the river assumed dangerous proportions about 7 a.m., and rose steadily until it was ten inches above the level of the last big flood, which was generally accepted as a record. All day the flood rose and sank at intervals, remaining higher in the late afternoon than at midday. It was after dark, however, that residents near the river bank commenced to feel anxious. The flood had lasted longer than usual, the rain still fell in torrents, and there was still the accumulated water from the hills, which takes five or six hours to reach the lower country, to come down. At about 6.30 the river began to rise swiftly, and rose the better part of a foot, remaining at a very high level until 9.30, when it swiftly fell eight inches. It stopped at that level until 3 a.m., but thereafter fell so rapidly that at daybreak there was only a small volume of water going down the river, and the flats were mostly drained.

Anxiety was felt regarding people spending the holidays near Moonshine bridge. Just above the bridge the channel is narrowed down by rocky bluffs on the western side, and never carries the full flood waters, which spread out over the flats toward the main Hutt road. On this occasion the water had spread out until it was only 150 yards from the Trentham school, and less than 300 yards from the main bitumen road. The unbroken sheet of water from the school to the river, some three-quarters of a mile, made it look as though anyone near the river bank must be in difficulties, especially as the flood had taken to old channels, and had cut across the road, completely blocking all traffic some 200 yards from the Moonshine bridge. Fully two-thirds of the total flood water was flowing between this and the school, and though a small crowd had waded down until stopped by the torrent across the road, it could get no further. The Upper Hutt Fire Brigade turned out in full uniform, with a boat, to see if residents needed succour, but the only man who got across, after a good deal of difficulty, ascertained that nobody was in need of immediate assistance. The family in the store at the corner had piled all their belongings high up out of reach of the water, and other week-enders in shacks had waded through several feet of water to refuge in the house of a riverbank resident who had had the forethought to build well off the ground. There, with electric light and cooking, a good fire, and dry floors, they were quite a merry party, though marooned until daylight this morning. The force of the swift current at Moonshine bridge needed to be seen to be realised. Waves eight feet high were caused, and the knocking of big boulders along the river-bed provided a continual rumbling. All the river flats this morning were covered by driftwood, some of the logs of enormous size.

Coming to town in the train, it was seen that the suspension bridge at Haywards had given way in the night, only the pillars on either bank remaining intact, the bridge having broken in the middle. Manor Park golf course, with the water drained off, was covered at one place from one side to the other with a strip of shingle a foot deep in places. Here the river had evidently cut across it in a strong current. In other places the turf had been stripped, and there were lagoons everywhere.

RISE OF 15 FEET

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*Melling Suspension Bridge
L. Calvert Collection
Alexander Turnbull Library, Wellington, N.Z*

Notes - 1931

On Good Friday, 1931, the worst flood for 16 years swept through the Hutt Valley. The road at Taita Gorge was washed out as well as the bridge between Manor park and Stokes Valley. The stopbank at 'The Convent', where Autopoint House is now located on Daly Road, almost breached. To prevent the breach, the whole of the River Board staff, plus extra men, battled in the storm to build a willow and wire mattress along the threatened bank. Concern ran so high as to consider ringing the town bell, the signal for a general evacuation.

It was a close call, and a letter from a concerned farmer living near the river said that "unless some further work is carried out before the next big flood, I think grave danger will occur."

Although the river engineer recommended raising the stopbanks after this scare, the Board was still reluctant to spend money in this area, preferring to put its faith in gravel extraction. In any case, it would have been impossible to collect more money from rates to finance this, as it was the time of the Great Depression. In a half-hearted attempt to support the Government's request to provide employment relief, the Board established a work scheme building stopbanks by hand, but by 1933 only a quarter of the recommended works had been completed.

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BRIDGE DAMAGE

UPPER HUTT VALLEY

PIER SWEEP AWAY BY FLOOD

TRAFFIC STOPPED

The worst particular damage done by the storm on Monday was the weakening of bridges in the upper length of the Hutt Valley. The first of the Akatarawa bridges has been so badly weakened that it will have to be destroyed and replaced; the Maymorn Estate bridge, built of heavy totara beams, has disappeared as a bridge, and the Te Marua bridge, over the Mangaroa, above Upper Hutt, has been weakened, but may be repairable.

The Akatarawa bridge was built in 1915 in lightly reinforced concrete—lightly, that is, in comparison with present standards of bridge construction—near the fork of the Akatarawa and Hutt Rivers, which were earlier crossed by two wooden bridges, one over each stream. These bridges were built many years ago and for the last fifteen or more years have been closed to traffic, and one of them has lost most of its decking. They were probably the most photographed bridges in the North Island (not excepting the Hohaka) for they gained in the picturesque as they aged; now they look like coming back into temporary use for light traffic, for the concrete bridge is dangerous and cannot be replaced within many weeks.

Why the bridge failed cannot be established until expert examination is made when the flood goes down. Heavy scouring took place at the foot of the pier in the middle of the main current; residents thereabout suggest that repeated pounding by logs and beams brought down from above were the last straw, and about one o'clock on Monday the pier crashed and disappeared; how far it has gone is not known, for the river is still high. A photograph on the illustrations page shows where the pier used to be, but cannot, of course, show the signs of failure in the upper structure in cracks developing at a score of points.

Yesterday afternoon Public Works official made a preliminary examination of the bridge and ruled that it should be closed to all traffic, foot or wheel, as the two 45-foot spans, transformed into a 90-foot span, might go at any time. Not long before that a dairy farmer higher in the valley had crossed with a milk lorry and got back, and a second lorry had crossed once; he was right annoyed when he was denied his return trip.

The likelihood of collapse now seems less, and explosives may be used to drop the double span. The old bridges are being looked over today and if they are good enough will be redecked and opened for light motor traffic.

BLACK BRIDGE REOPENED.

Much the same thing happened at the Te Marua bridge, but the single pier in the middle of the Mangaroa did not fall entirely. Scouring let the footing down by the best part of a foot, and the two short spans are badly strained and the junction crushed. Examinations will be made as soon as the stream flow falls, and unless the footing is more affected than is thought likely the bridge will be jacked up and the pier made good.

Just beyond the concrete bridge, which was built in 1926, the old Black Bridge is standing, and this has been opened for careful traffic, but it has no margin of safety and the Public Works Department is insisting upon day driving only, from 7 a.m. to 7 p.m. only, and speeds and loads must be kept low.

Near the Te Marua bridge is a light suspension bridge from the main road to a farm over the stream. This was damaged by drift timber and the wreck of the wooden bridge from Maymorn, but came through lightly, and repairs will be quickly carried out.

TAITA GORGE CLOSED.

The Taita Gorge damage has occurred further north than usual, not far from the junction of the Western Hutt and the Main Roads, between the junction and Silverstream railway overbridge. The river has bitten into the bank and has taken out half the road width over a length of a chain or more. The eating-back continued yesterday afternoon, and is likely to go further, for there is a good deal of overhang of the present edge of the roadway. Protective work will be a fairly big job.

The new faces of the Ngahauranga Gorge Road stood up very well, for there were no slips of any consequence at all. The coastal highway was not affected, nor was the new Hutt Road, the better provision made for surface drainage on the banked curves taking the water away rapidly.

AFTER THE STORM

FLOODS SUBSIDING.

MUCH SILT AND DEBRIS ABOUT

CONDITION OF ROADS

Although the storm may be over and the sun shining again, evidence of the phenomenal rainfall of the last few days is still at hand on every side. Large areas in the Hutt Valley were still under water this morning, and where the flood waters have receded there is much left in the way of silt and debris, and the same applies to those areas in the suburbs which were flooded yesterday.

The rain eased off very considerably yesterday, and after 9 a.m. only a further 11 points were recorded at Kelburn. This brought the total for the spell up to 7.88 inches, only just short of eight inches. That the rain was heavier in the hills than in the city is shown by the fact that the gauge at the Wainui reservoir at 9 a.m. yesterday registered a fall of 10.19 inches, as against one of 6 inches at Kelburn. The Orongorongo fall during the same period was 6.45 inches, while that at the Karori reservoir was 6.5 inches.

With the cessation of the heavy rain, the Hutt River fell fairly quickly yesterday. By last night it had gone down some eight feet, and was lower still this morning, although a turbulent flood was still carrying much debris out to sea and discolouring the harbour waters over a very wide area.

The work of clearing slips, of removing silt from the floors of flooded houses, and of restoring washed-out gardens once again to productive plots, is proceeding in many parts of the city and suburbs, but it will be some time before all traces of the "Centennial flood" of December, 1939, will have been removed.

Train from Upper Hutt passing close to the Hutt River between Melling and Belmont.



*Maoribank Suspension Bridge
Alexander Turnbull Library*



Evening Post 13/12/39

Evening Post 13/12/39

ROADS CLOSED

WAIRARAPA LINE

REOPENING SOON

The bright weather this morning enabled the Railway Department and county councils to make an early start on the clearing of slips, repairing bridges, and restoring washouts, and it is expected that most of the storm damage will be remedied within a few days. The reopening of the Wairarapa railway line is expected by tomorrow, but several roads will be impassable for several days.

This morning the first four trains between Upper Hutt and Wellington were delayed, but normal services were running early in the forenoon.

The Rimutaka line was cleared to Kaitoke late last night, and the Railway Department reported today that it would be clear to Cross Creek by 5 p.m. and that normal traffic would be resumed tonight.

The roads in the Hutt County Council did not suffer further damage after the rain ceased. A full inspection of the Whiteman's Valley road is being made today, but it is unlikely that the damage done to bridges on the road can be repaired within a few days.

The Johnsonville-Makara road has been closed until further notice because of an unsafe bridge. The South Makara road is again passable for traffic.

TRAINS DELAYED

EROSION AT BELMONT

LINE BEING SHIFTED

Erosion by the Hutt River, at a point just south of Belmont, this morning endangered the permanent way, and the railway line, which at this point is a single track, is being shifted about 8 feet further away from the bank.

The trouble started after the flood had passed its height. At about 4 a.m. today, the bank of the river began to crumble at a point several chains south of the old danger spot. At 6 a.m. another 6 feet of bank broke away and the river proceeded to take out a huge bite measuring about 20 yards across.

Up till then, it had looked as if trains could get through, but as it was, with the track barely three feet from the lip of the straight drop into the river, it was thought advisable to stop traffic. Passengers on the first train at about 7 a.m. were transferred, and the shifting of the line was begun. By 11 a.m. the line had been moved three feet, and had about four or five feet to go. Trains were passing, but at a pace somewhat slower than a walk.

The protective work, consisting of groynes of piles and rails, carried out at the previous danger spot, has proved very effective. This time, however, the river swung in from the east at a wider angle.

It was suggested that the violence of the flood in the upper part of the valley may be traceable to the Pakuratai Stream, which runs from the summit to the head of the valley. It is reported that this stream was in full flood long after the waters lower down had commenced to drop.

Notes - 1939

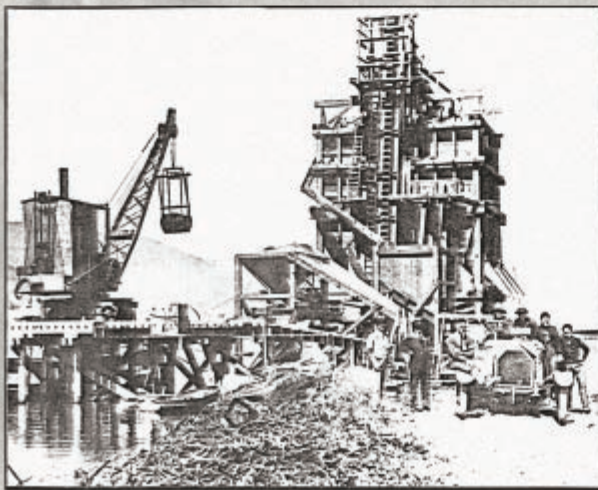
Improved river alignment, gravel extraction and dredging at the estuary had increased the level of protection enjoyed by Hutt Valley residents over the years. However, in 1939, another large flood saw the system nearly fail, with water lapping to within 600mm of the top of the bank, and only 150mm from the top of the wall by the Ewen Bridge.

Although there was no material damage in the stopbanked areas, flooding was severe in some areas that had no protection. Damage to land in Belmont and Upper Hutt was severe, and upheld criticism that the Board needed to expand its outlook.

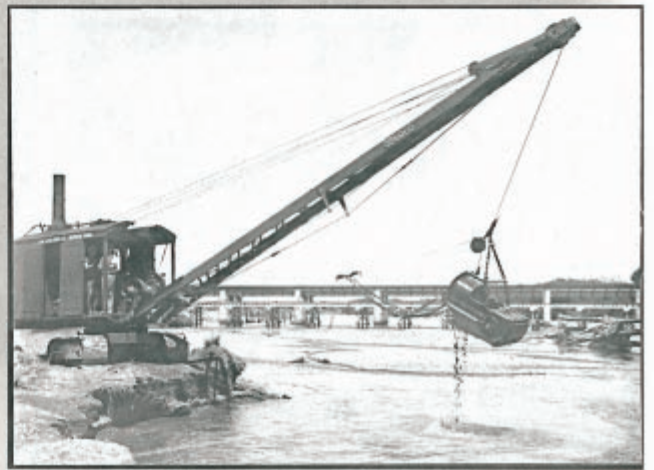
The rapid development of urban housing under government schemes put pressure on the Board, and the government, to lessen the flood risk, leading to a review and extension of a more comprehensive scheme which is under-going refinement to this day, and will continue on into the future.

Notes - Working with the river - Gravel extraction

This Hutt River Board established a gravel extraction operation that dragged gravel from the river bed using huge buckets slung from wire cables. "Draglines", as these were known, were successful in managing the river alignment, but they led to the destruction of the river environment. Their use was abandoned in the late 1960s.



*MacArthur Bros Plant, River Mouth 1926
Alexander Turnbull Library*



*Extraction for Ava Rail Bridge (by dragline) c. 1925
Alexander Turnbull Library*

It is my contention that with the absorption of the Epuni Riding of the Hutt County into Lower Hutt City the river is now the focal, or central point of the entire city. It is the dominant natural feature of the valley floor and plays many roles. It is a barrier to access, a visual delight (if it were not discoloured so often), a natural drain for the whole area, and in my view, it should be a place where the city populace could enjoy a wide range of activities including swimming, fishing, picnicking, horse riding, canoeing etc. There should be lawns, trees, walkways, trails for horse riding etc. In some parts where industry has been removed from the banks such development has already taken place.

Very few photographs. Includes two 1 set.

**OBJECTIONS TO THE APPLICATIONS BY SHINGLE COMPANIES AND QUARRIES
TO TAKE WATER FROM THE HUTT RIVER AND RETURN IT IN A
POLLUTED CONDITION (applicants No. 57, 60, 62, 68 & 72)**

By Wellington Acclimatisation Society (Southern Branch)
presented by W.B. DURNLEY

This objection to the pollution of the Hutt River by discharges from Shingle Companies and Quarries, is made by ordinary citizens of the Hutt Valley and Wellington who are concerned at the destruction of the River as a recreational and aesthetic resource.

We are not scientists, with scientific resources, nor are we lawyers, skilled in debate, but we trust these submissions will be considered with these facts in mind.

As evidence of the very serious pollution, we offer the following photographs, taken by myself on 12th June 1973, between 11 a.m. and noon.

- RIVER SHINGLE & SAND*
- Photograph 1. shows the outflow from ~~the~~ Quarries
Photograph 2. shows this effluent flowing into the river
Photograph 3. shows the same effluent ONE mile downstream from the outfall
Photograph 4. shows the same effluent TWO miles downstream from the outfall
Photograph 5. shows one of the outfalls from River Shingle and Sand Company. (PLANT)
Photograph 6. shows the pollution 100 yds. downstream from River Shingle and Sand Company outfalls.

These are not the only cases of pollution; all the companies, to a greater or lesser extent pollute the river in the same way. - The photographs are an example of the pollution.

The pollution not only discolours the water, as conclusively shown in the photographs, it also covers the bottom of the river with a layer of slime, which kills or drives away the aquatic insects that normally live in the river and form the food of trout and other fish.

Without a food supply almost all of the trout have died in the river in the region of the Shingle plants and Quarries (of Stokes Valley).

The slime which covers the bottom of the river also makes it unpleasant even on Sundays, when the water runs clear.



Bagnuda, Adams and Blyth crusher erected upstream of Ewen Bridge 1930, photo 1958 Alexander Turnbull Library

- 2 -

As evidence of this slime I have collected samples of stones from the river:

- Sample 1. taken from near Silverstream bridge, above the outfalls from the applicants
Sample 2. taken from near Melling bridge, below the outfalls from some of the applicants.

These stones were taken from similar types and depths of water on 21-7-73 by myself.

We contend the River belongs to everybody, and no-one, nor any organisation has the right to use it to the detriment of other river users.

We would like all commercial exploitation of the river to cease, but some compromise is needed, and we therefore have no objection to the applicants taking, using and returning water to the river, provided it is returned in the same condition as that in which it was taken, or at least meeting the requirements of the classification of the river at the site of discharge. (Water and Soil Conservation Act, Amendment No. 2 1971)

At the moment some applicants are "ponding" or holding back their pollution during the day and discharging it at night. This is equally as harmful as discharging during the day, and is only an attempt by these firms to mislead the public into thinking they are reducing their pollution.

Only some six years ago there was still good trout fishing in the river in the Belmont area, and during summer many fishermen, swimmers and other river users were to be seen.

During the last year or two the river has become so polluted that almost all the trout have gone, and the river is unfit for swimming. Very few fishermen or swimmers are now seen in the lower reaches of the river. - This is almost entirely due to the discharges from the Shingle Companies and Quarries. -

A priceless recreational asset destroyed.

Hutt Residents Urged To Quit Capital As Further Rain Threatens Road Links

HUTT VALLEY residents were urgently advised early this afternoon to head for home from Wellington as quickly as possible.

The appeal came from the Lower Hutt City Council and Ministry of Transport officials as the weather this morning further deteriorated and the Weather Office warned that another 50mm (2ins) of rain was expected in the Valley before 4pm.

This rain was expected to aggravate the position on the Hutt motorway. A water main burst this morning closing the northbound lane and washing further slips down and creating more flooding.

Buses

Buses were still leaving the railway station regularly and the railways still planned a limited service on all lines except Melling tonight although a

meeting to consider the situation was to be held early this afternoon.

Slips have occurred on the Western Hutt Road and it was feared there could be slips north of Taita along the Eastern Hutt Road and through the Taita Gorge.

Flood waters were also appearing in the Petone area, specially near the overbridge and the Korokoro turnoff and the possibility of many people being marooned in Wellington again tonight was looming as a real possibility as rains continued to fall in the Hutt Valley.

spokesman said: "We're not at all optimistic about the weather for the rest of the day." "There's another depression sitting over central New Zealand and there's

widespread rain in the Wellington district."

Worst

The worst period was expected to be at the middle of this afternoon.

Tomorrows forecast was for cold southerlies and showers. The heavy rain was expected to break tonight.

Damage at Wellington Hospital Board's bulk store at Petone has been reassessed and the estimated loss is now put at \$500,000.

A board spokesman said the store held about \$1,200,000 worth of medical supplies and hospital linen and nearly half its contents had been damaged and was unsalvageable.

It was earlier estimated that damage would be about \$250,000.

At 12.30 today 25 volunteers from the crew of the United States Coastguard icebreaker Burton Island were preparing to leave the ship for the Hutt Valley in a New Zealand Army truck to dig mud and otherwise help clear up houses in Harbour View.

After the warnings issued by the Ministry of Transport, staff in Government department were being given the option of going home if they live in the Hutt or Tawa-Porirua areas.

A communications office had been set up at the Wellington Town Hall for emergency calls, and an officer had been appointed to get information to radio and emergency services.

"There seems to be information coming from all sorts of areas. I've had a dozen and one people calling me about different broadcasts, and I'm very concerned about this," said Town Clerk, Mr Ian McCutcheon. He said there had been one particular broadcast advising people to tell everyone living north of Tawa to go home, and it seemed that this had come from the Ministry of Transport which did not have the authority to give the broadcast.

Railways officials had a meeting this morning and reported that, subject to the weather, a limited rail service was expected to operate this evening on all lines except the Melling line which would not have a bus service either.

The Ministry of Transport also reported late this morning that the only roads closed were the Ngaio Gorge Road and the Makara Road.

On the urban motorway there were long delays this morning to northbound traffic. Churchill Drive was still the best road out of the city and there were few problems there.



Cornish Street
/ Hutt Road Intersection
Flooding caused by
the Korokoro Stream
Petone 1976

Notes - 1976

The 1976 floods were caused by the urban storm-water systems, unable to cope with the high rainfall. The flooding problem was not caused by the river itself.

But if the same amount of rain had fallen ten kilometres further north, the river probably would have flooded, the stopbanks could well have been overtopped, and the results would have been much, much worse. Imagine a large part of the valley floor lying under half a metre of water.

In 1976, Stokes Valley and Pinhaven residents were over-whelmed by the help given to them.

But if the half of the valley was under water, how would the help agencies cope?

The fabric of normal everyday life would disintegrate with perhaps a couple of hours' warning.

Following a disaster, the enormity of material losses can be counted, and demonstrated in money terms. But what of the costs that can't be counted? Numbers can't be attached to the grief families feel when most of their lifetimes' possessions are destroyed.

blockage was cleared Good.

Stokes Valley Rallies To Help Victims

FLOOD-HIT Stokes Valley residents have been overwhelmed with local help and sympathy for their plight.

And they also agree in decrying cut-and-fill-type subdivisions and in calling for greater capacity for sewer and storm water in the area.

The kindness of friends will mean a happy Christmas after all for Josephine and Jo Van der Hoorn and their five children. Joanna, Tony, Simon, Mark and Peter.

Rescued

When water flooded their home at the lower end of Stokes Valley's main road to the window sills most of the Christmas presents were rescued. But the new carpet in the bedroom and the rest of the floor coverings are a sudden write-off today and the condition of the electrical appliances still has to be ascertained. The water reached the bedding and soaked it all.

The Van de Hoorns have lived in Stokes Valley for 15 years and have never experienced such flooding before. They had to wade in waist-deep water, carrying the children, to reach the safety of their friends, the Zwarts, on the Eastern Hill road.

Mr Van der Hoorn says they like the area in which they live, but he is not going to go through another flood like this and is planning to raise his house on larger foundations.

He feels there will be more flooding again because the storm water drain behind his property cannot cope with the extra water which comes from the hills due to increased housing subdivisions.

They described help from

neighbours and other agencies as "splendid."

This year Mr Alec Morris thought he had his garden looking its best. Now it is hidden beneath a layer of silt inches deep. Even the lemons will have to be washed of clay before they are used.

The water in their main road home was up to 20cms inside the living room and their garden, which was their pride and joy, will need re-planting from scratch.

For Greta and Les George, further up Stokes Valley Road, it is the second time they have lost their floor coverings. They have lived in the area for 25 years and 20 years ago flood water entered the skirting boards. This time it was up past the lower cupboards and submerged the stove.

The kitchen had just been remodelled and all their new wallpaper was ruined. "It came so high the almonds were floating on the top of the Christmas cake and some of the plastic ware in the lower cupboards has floated out of the house and has been lost for ever," Mrs George said. Their brand-new lounge suite is also ruined—it became too heavy with water to be lifted out.

The Georges were due to shift to Masterton last Friday.

However, the shift was cancelled until January 14 and so the furniture was still in the house.

Bad Luck

And for bookshop-owner Ken Chapman at Scott Court it has been a chapter of bad luck. Not only did he have 15 centimetres of water in the shop, ruining the flooring and lower shelves of books, stationery and toys, but he has also been burgled twice.

On Monday he put a trakkor bike worth \$92 and packed it in a cardboard carton in the back toilet to salvage it and other items from the flooding. Someone removed the toilet window louvres and took the carton.

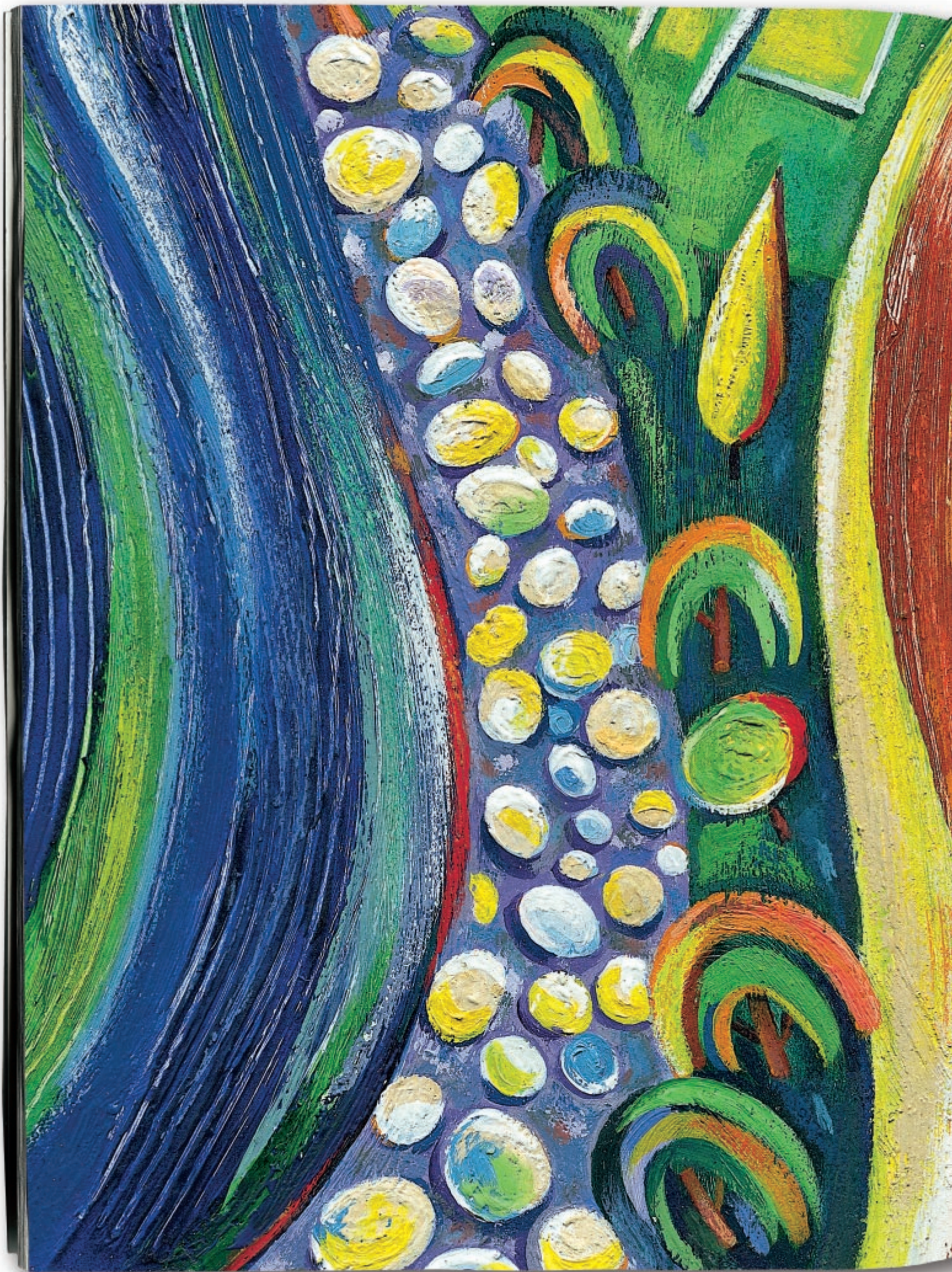
Then at 2am today watches worth between \$500 and \$600 were stolen together with \$150 worth of lighters. They got in by smashing a side door.

The Stokes Valley Motor Lodge, itself 45cm under water on Monday with the loss of about an acre of carpet, offered accommodation to anyone wanting it, but had no takers. They had one inquiry but because their telephone is out of order feel there may have been others who could not get through.

**'Post' and Radio Windy
appeal off to flying
start — Page 6,**

20/12/76 Stokes Valley Road, cnr George St and Holborn Cres.
Ray Wiblin.





Part Two

Issues for the Future Management
of the Hutt River Floodplain

Tui. Early settler Charles Heaphy noted in 1839 that “the forest was teeming with birds”. They had mostly gone by 1879. Birds such as the Tui feed on the nectar and fruit of native trees which are now limited on the floodplain. Tui are still seen over much of the area, although not in large numbers. They are more noticeable in September and October when the Kowhai trees are in flower.



Chronology of Floodplain Management in the Hutt Valley

- 1879 First Hutt River Board formed to manage river bank erosion
- 1887 Board goes into permanent recess due to lack of support
- 1893 Flooding - “the lower valley a desolate scene”
- 1894 Petone Borough builds a stopbank to protect the urban & commercial areas of Petone
- 1898 Two large floods sweep through Lower Hutt Borough
- 1899 Second Hutt River Board (HRB) formed
- 1901-06 Flood defences built from the Estuary to Boulcott
- 1910 HRB district extended to include Normandale, Taita and part of Belmont
- 1915 HRB district extended to include Epuni
- 1921 Rating for the HRB changed from area of benefit to a uniform rate over the district
- 1924 Gravel extraction industry established
- 1931 Flooding comes near to overtopping stopbanks
- 1933 Stopbanks raised in Moera
- 1935 The extraction industry has lowered the bed of the river by 4m south of Melling
- 1939 Flooding - largest since 1898 - shows that the flood carrying capacity of the channel has been increased by gravel dredging. The stopbank almost breaches at Daly Street due to foundation erosion.
- 1938> Government sponsored housing development in Waterloo, Epuni, Waddington, Naenae and Taita
- 1944 First Scheme Review started
- 1947 HRB district extended to include Petone
- 1953 Proposals to upgrade and extend the flood defences approved by Cabinet
- 1955 Severe flooding in Upper Hutt Borough
- 1956-72 Construction of works to upgrade and extend the flood defences
- 1959 HRB district extended to include Upper Hutt Borough
- 1973 HRB amalgamated into the new Wellington Regional Water Board.
- 1973> Regional rating and agreement with District Councils to fund capital works.
- 1977-83 The National Water and Soil Conservation Authority (NWASCA) requires a comprehensive review of the Hutt River Flood Control Scheme for the government to continue to subsidise maintenance and capital works.
- 1980 Formation of the Wellington Regional Council
- 1986-87 NWASCA promotes integrated risk-based floodplain management planning, including appropriate use of flood-prone areas and flood-proofing of assets, to reduce ongoing reliance and capital expenditure on stopbanks and other structural works.
- 1987-88 The scope of the Hutt River Flood Control Scheme Review is extended to provide for the preparation of a comprehensive floodplain management plan.
- 1988 Government phases out grants for river management. Costs fall on Regional and District ratepayers.
- 1988-96 The Ewen Floodway Project becomes a pilot for the consultative and floodplain management decision-making processes that will need to be applied to the wider floodplain.
- 1996 Publication of the floodplain management plan phase one summary report *Living with the River*.



Hutt River. Photo WRC.

The First Flood Defences

The first Hutt River stopbanks were built at the turn of the century to prevent regular and widespread flooding of Petone and Lower Hutt Boroughs. Petone was then an industrial town with a population of 2200. Lower Hutt Borough had a scattered rural population of 1300. Their assets were meagre by today's standards.

As the boroughs have grown into today's cities, the stopbanks have been raised, strengthened and extended to include Lower Hutt north of Boulcott, and Upper Hutt City. The flood defences now include 26 kilometres of stopbanks and associated river management works.

The flood defences were originally built and maintained by the Hutt River Board, an authority closely aligned with the needs of Lower Hutt Borough. As settlement of the Hutt Valley expanded north from Lower Hutt, the Board also agreed to represent the interests of the Crown and Upper Hutt City. The Crown developed the Taita and Naenae housing estates from 1944 and subsidised all new works and maintenance from 1956 to 1986. Upper Hutt City was included in the Hutt River Board District in 1959.

The principal function of the Hutt River Board, as defined by local authority politicians, local ratepayers and the Crown, was the maintenance of the river corridor as an efficient floodway. Little regard was given to environmental issues. The broader concepts of

floodplain management did not begin to emerge until after 1972 when the functions of the Hutt River Board were taken over by the Wellington Regional Water Board, and subsequently the Wellington Regional Council (see the chronology on page 52).

Extensions and Upgrading

The Hutt River Board worked hard to achieve objectives set by local interests but was also required to meet standards and guidelines set by Cabinet, Treasury, the Public Works Department, and the National Water and Soil Conservation Authority. The Board's objectives changed as the Hutt Valley's population grew, and as national philosophies for river management and conservation developed.

The management objectives for the Hutt River were comprehensively reviewed in 1954. The policy directives resulting from that review were:

- Any flooding of the urban areas would be unacceptable.
- Stopbanks would be the primary form of flood defence.
- Ongoing maintenance and improvement of river alignment and erosion management works would be required for the stopbanks to be effective.

In 1956, the Hutt River Board and the government embarked on an \$11.5 million scheme to build new flood defences from Boulcott to Taita Gorge and upgrade the existing flood defences south of Boulcott. In 1958, a further \$18.5 million was approved to

extend the flood defences to Maoribank. The extensions and upgrading works were completed in 1972.

Ongoing Improvements

The Regional Water Board and the Regional Council have since spent a further \$20 million on flood damage repairs, works to strengthen the flood defences, and on the purchase of private land required to undertake improvements. This expenditure has been necessary to ensure the flood defences do not expose the community to unreasonable risks while the Regional Council is working through the process of developing a long-term floodplain management plan.

The most recent investigations show that the flood defences still contain defects that may lead to failure in moderate floods. Furthermore, it now appears that the community may not be able to afford to upgrade the flood defences to a standard that could guarantee a high level of security. The 1954 objective to reduce potential flood-damages has not been achieved.

Increasing Potential Flood Damages

Potential flood damages have in fact increased. In 1954, the Public Works Department and the Hutt River Board estimated that the total value of property improvements in flood-prone areas was \$1.6 billion. The current value of improvements in these areas is now approximately \$4.1 billion (Note: All figures quoted in *Living with the*

River have been adjusted for inflation - see page iv). Over the same period, the population of the valley has increased from 69,000 to 130,000.

Current investigations estimate that approximately 70,000 people will be affected if the flood defences fail. Flood damage may be as high as \$890 million (see chapter 4). Potential flood damages will continue to increase if development within flood-prone areas does not take account of flooding.

New Concepts in Floodplain Management Planning

Statistics collated by researchers, both within and outside New Zealand, confirm that flood damages on protected floodplains are typically *not reduced* by spending increasing sums on extending or upgrading flood defences. Total reliance on engineering structures to transform marginal floodable land into prime real estate will not lead to sustainable reductions in flood damages.

A new philosophy for floodplain management planning and for mitigating flood losses has begun to evolve. Wherever possible, the principal goal is to avoid the need for costly flood defences. Development is discouraged in flood-prone areas. These areas are reserved for recreational or other purposes which are not adversely affected by flooding. Where there is existing development within flood-prone areas, the principal objective is to encourage a wide range of measures that will reduce flood losses to an acceptable level and reduce the trauma of

flooding. The long-term aim is to achieve floodplain management practices which are sustainable and do not impose unacceptable constraints on current or future generations.

This philosophy sounds like good old fashioned common sense. However, as the evidence of increasing potential flood damages illustrate, it is a philosophy that is difficult to apply. Fundamental to the philosophy is widespread community understanding and acceptance of the risks of flooding and the options available to manage flood risks. In the past, access to this knowledge has been limited. The result has been unsustainable development.

Measures for Risk Reduction

There are many options for reducing the risks of flooding, as summarised in the exhibit on page 56.

The Regional Council uses two categories to group risk reduction measures. The first category includes traditional flood defences. These are termed *structural measures* because they involve constructing engineering works designed to contain floods.

Until 1986, structural flood defences were the only measures taken in the Hutt Valley to reduce flood risks. The result is approximately \$0.9 billion worth of investments now directly at risk on the “protected” floodplain. This requires the Regional Council to continue maintaining the stopbanks as the first line of defence. (Chapter 2 discusses the condition of the existing flood defences, the security provided by them, and the opportunities for their improvement.)

The second category of risk reduction measures are called *non-structural measures*. These are generally long-term planning provisions and steps that individuals can take. They aim to keep people, possessions, and development out of floodwater - or better still, away from flood-prone areas. Non-structural measures are most effective when they are implemented *before* a floodplain is developed. After development has occurred, particularly after extensive flood defences have been built, they are effective as a second line of defence. They help to reduce flood damages to assets located in flood-prone areas. By helping communities prepare for flooding they can help reduce traumatic social effects. This can be particularly important if the community cannot afford measures to reduce flood risks. In the long-term, non-structural measures lead to the gradual redevelopment of flood-prone areas for more appropriate uses.

Events like the Mississippi floods of 1993 vividly demonstrate that total reliance cannot be placed on structural flood defences to reduce flood losses. When they fail, flood damages are dependent on how well people are prepared to help themselves. Their readiness will depend on their prior knowledge of the risks they are exposed to, and the assistance given to them to manage their own exposure.

The next phase of the Hutt River Floodplain Management Plan will consider the range of options for reducing flood risk in an affordable and integrated way.

Options for Managing Flood Risk

Options for managing flood risk fall into two categories. *Structural options* are intended to prevent floodwaters leaving the river corridor. *Non-structural options* are intended to reduce the effects of floodwaters which do leave the river corridor.

The Hutt River flood defences, described in chapter 2, are *structural options* which were built to contain the largest flood that could be expected in the Hutt River. This expectation has led to the false assumption that urban areas are flood-free. The failure of the flood defences has not been acknowledged as a possibility, or when acknowledged, has been discounted as a remote risk. As a result, discussion of *non-structural options* to manage potential flooding of areas has been limited.

Non-structural options can reduce flood risks to existing development in urban areas, and can ensure that future development in flood-prone areas is appropriate. *Non structural options* include;

Land Use Options

These can promote the wise and rational use of flood-prone land. The costs of hazard zoning urban land can be compared to the costs of constructing and maintaining flood defences. The flood-prone city areas can be divided into hazard categories which separate the varying hazard across the area. Appropriate land-use restrictions could be applied. District and regional plans provide the best long-term means of regulating land-use to reduce flood risks (using appropriate policies, methods and rules).

Management Options

These are already used to some extent and include; policies to locate services where they won't initiate a failure of the flood defences or be damaged during floods, Council purchase of land offered for sale in flood-prone areas to prevent redevelopment, increased recreational use of the river environment, and regional funding of risk reduction initiatives which recognises the effect of localised flood events on the regional economy.

Community Preparedness Options

Community preparedness options give communities the ability to cope with flooding by reducing social disruption and flood damage. They can include measures to prepare for a flood, e.g. encouraging flood awareness, disaster response planning and flood warning systems, and measures to reduce the flood loss burden, e.g. insurance, disaster relief and recovery plans.

House Raising and Flood-proofing Options

Protecting individual houses from floodwaters can be an option where there are isolated properties at risk, where such methods are cheaper or more acceptable than constructing flood defences, or where the construction of flood defences is not practical.

Catchment Management Options

Catchment management options reduce land instability and decrease the rate of run-off in tributary catchments. Appropriately managed catchments reduce peak flood flows by intercepting rainfall and releasing it slowly. Examples of catchment management options include afforestation, revegetation and animal control.



Crossblading at Totara Park, 1993. Photo WRC.

The Regional Council Floodplain Management Planning Model

The exhibit on page 78 illustrates the model adopted by the Regional Council to ensure an appropriate, economically acceptable, and balanced set of measures will be adopted to manage risks on the Hutt floodplain.

As discussed, potential risks of flooding can be reduced with a variety and combination of measures. Some of these are common sense and do not require a great deal of capital expenditure, but they do require a high degree of co-ordination and education. Other measures transfer the costs and responsibilities of reducing potential losses to the developer or individual. Measures requiring higher capital expenditure are often paid for by the community.

A multi-phased planning model is essential to ensure that planning *does not* focus on particular measures at the initial stages, as this may compromise the outcomes of the planning process.

Phase One of the model illustrated in the exhibit has now been completed with Council's endorsement of the Phase One Summary Report, *Living with the River*.

Floodplain Management Planning Policy Framework

Floodplain management planning requires a formal structure to achieve a widespread understanding of flood risks. The framework provides the political process to obtain consensus on acceptable risk management options and agreement on the management

plan for implementing approved options.

The following issues will need to be addressed when preparing the floodplain management plan:

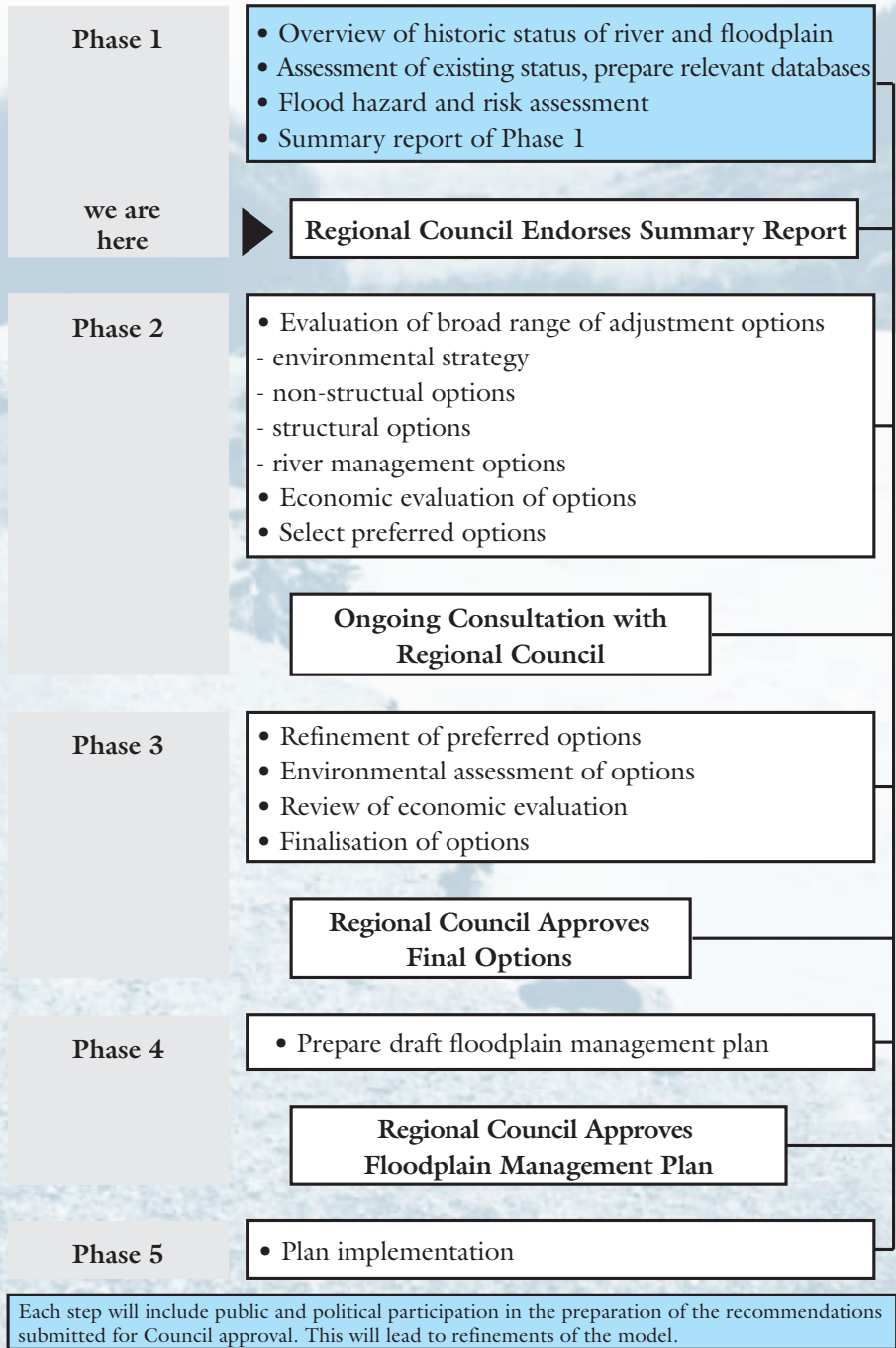
- Is it affordable to upgrade existing flood defences to provide an acceptable level of risk?
- If not, what levels of security are affordable?
- In the meantime, are the existing levels of flood risk tolerable?
- Over what period of time can improvements be implemented?
- How can public input and participation into the options evaluation and decision-making processes be assured?
- How can the river's ecology be protected from river management activities?
- How is the value of the river corridor recognised as an environmental asset?
- How can improvements to the river environment enhance adjoining urban environments? What opportunities are there to link the two?

Proposed Policy Framework

Planning investigations undertaken during phase one of the floodplain management plan have proposed the policy framework shown in the exhibit on page 80. The framework aims to define roles and responsibilities for preparing, evaluating and deciding on measures to reduce flood risks.

At the top of the proposed framework is the elected Wellington Regional Council, the

Regional Council Floodplain Management Planning



principal decision-making body. It comprises 14 representatives elected from the 7 constituent territorial authorities. The Council undertakes its work by delegating policy development to standing committees.

The Landcare Division of Council is responsible for River Management and Floodplain Management Planning for the western part of the Wellington Region. The Rivers Department reports to the Council's Landcare Committee.

Hutt Floodplain Management Committee

An outcome of the phase one investigations is a recommendation to convene a Special Committee of Council to consider and endorse recommendations to the Landcare Committee. The recommended composition of the proposed committee is;

- an independent chairperson,
- 3 WRC Councillors,
- 2 Upper Hutt City councillors,
- 2 Hutt City councillors,
- 2 representatives of Iwi,
- 2 representatives elected by a community advisory group, and
- 2 representatives from a technical liaison group nominated by the WRC.

The idea of a committee of 14 is to provide a balance of elected and non-elected representatives, technical experts and community groups. The terms of reference for the committee would need to be formally endorsed by the Regional Council prior to its formation.

Project Management Group

The Hutt Floodplain Management Committee would be supported by Regional Council staff. To do this the Council would need to form a *Project Management Group* or project team. This would include a team leader and two to four team members or other specialist advisors, as required.

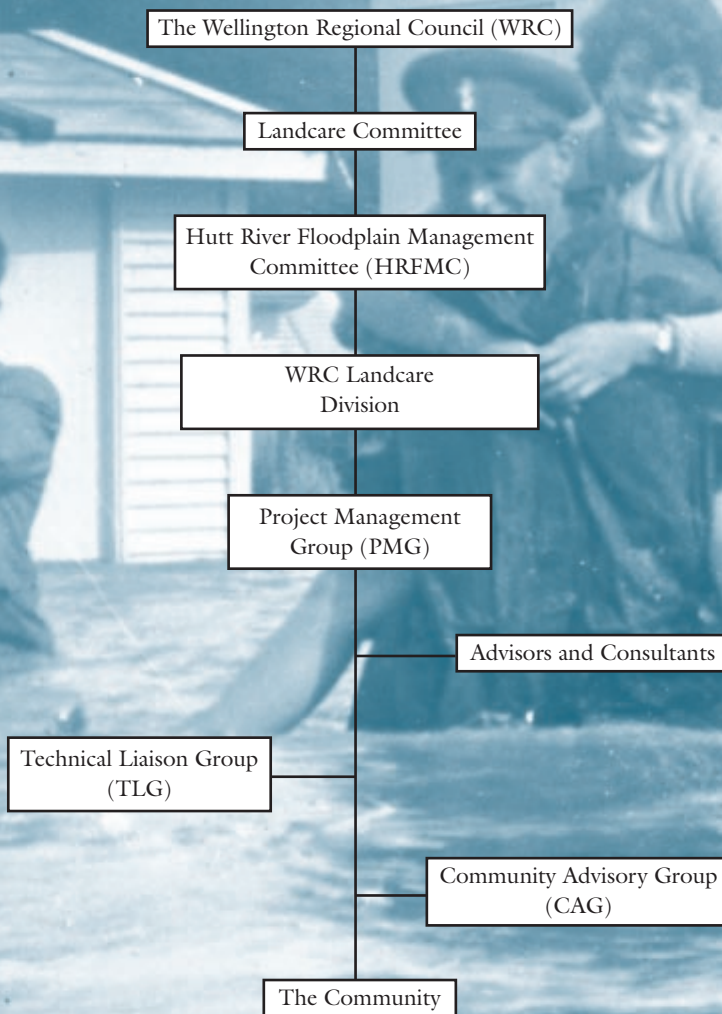
Consultation would be a key responsibility of the project team. It is proposed that two special consultative groups be formed; a *Technical Liaison Group* and a *Community Advisory Group*.

Technical Liaison Group

A technical liaison group was brought together during Phase One of the floodplain management plan. It ensured a two way flow of information between the Regional Council and other technical groups employed by government, local government and special interest organisations with statutory responsibility for related aspects of planning and resource management.

A re-convened technical liaison group would incorporate several working groups focusing on different technical aspects and special stakeholder interests. For example, a group would be required to consider the special needs of utility operators. The groups would include representatives from Hutt City Council, Upper Hutt City Council, Department of Conservation, Ministry for the Environment, and the Fish and Game Council. The groups might also include representatives from other Regional Council divisions.

*Proposed Decision-Making and Consultative Framework for
The Hutt River Floodplain Management Plan*



*Photo: 1955 flood in Upper Hutt.
Courtesy Evening Post.*

Community Advisory Group

A community advisory group would provide community input to the preparation, evaluation and choice of measures for reducing flood risks. The Council's experience is that this input is best provided by a small representative group who can be fully informed of the issues.

The group would include;

- representatives of Iwi,
- representatives of community and cultural (resident) organisations,
- representatives of recreational groups, and
- representatives of business groups.

A community advisory group would be the key to successful public involvement. Input from the wider community would be obtained through dissemination of relevant information and direct feedback.

Clearly option preparation, evaluation and decision-making may take time and will require careful deliberation.

Auditing the Floodplain Management Planning Process

In 1992, Ian Robertson (Royds Consultants) and Alex Sutherland (University of Canterbury), both recognised experts in floodplain management, were asked to review the Council's floodplain management planning processes in terms of current best practices.

Their key findings were;

With respect to the work undertaken up to the time of the review (April 1992):

- The decisions to undertake a review of the

flood mitigation scheme, and to extend the review to the preparation of a floodplain management plan, were timely and well founded.

- The objectives and scope of the data collection were appropriate for floodplain management planning.
- The decision to disrupt the planning process to concentrate effort on the Ewen Floodway Project was justified by the benefits that accrued. (Note: The review was undertaken just after the Regional Council had committed resources to the Ewen Floodway Project. This project improved the security of the flood defences in central Lower Hutt, the highest priority security issue raised by the Phase One investigations. The project was completed in February 1996.)
- In future stages, there should be greatly increased involvement of councillors and the public.

With respect to the overall planning process:

- The time taken to complete the first phase had been excessive.
- An equally long time for the completion of the plan would compromise the public and other inputs, and the quality of the management plan.
- A strategy should be developed for the floodplain management plan to be completed as rapidly as resources and procedures permit.

- The strategy should define resources required, a programme for completion, and provisions for monitoring and audit.
- The roles and responsibilities of existing and future committees and consultative groups should be established.

WRC Action on the Audit Findings

The findings generally endorse the Council’s planning process but show concern

for the resources that have been applied, and the need for a formal project structure.

The proposed policy framework, outlined above, has been prepared to address both these issues. The Regional Council must determine the priority to be given to the completion of the plan.

The process proposed to establish these priorities is discussed in chapter 9.

The material in this chapter is drawn from the following technical references:

Ref 9: Volume 9 : Flood Damages - sections 5.3-5.6.

Ref 16: Flood Mitigation Options - section 6.

Ref 17: Non-structural Options - Part B.

Ref 19: Business Plan.

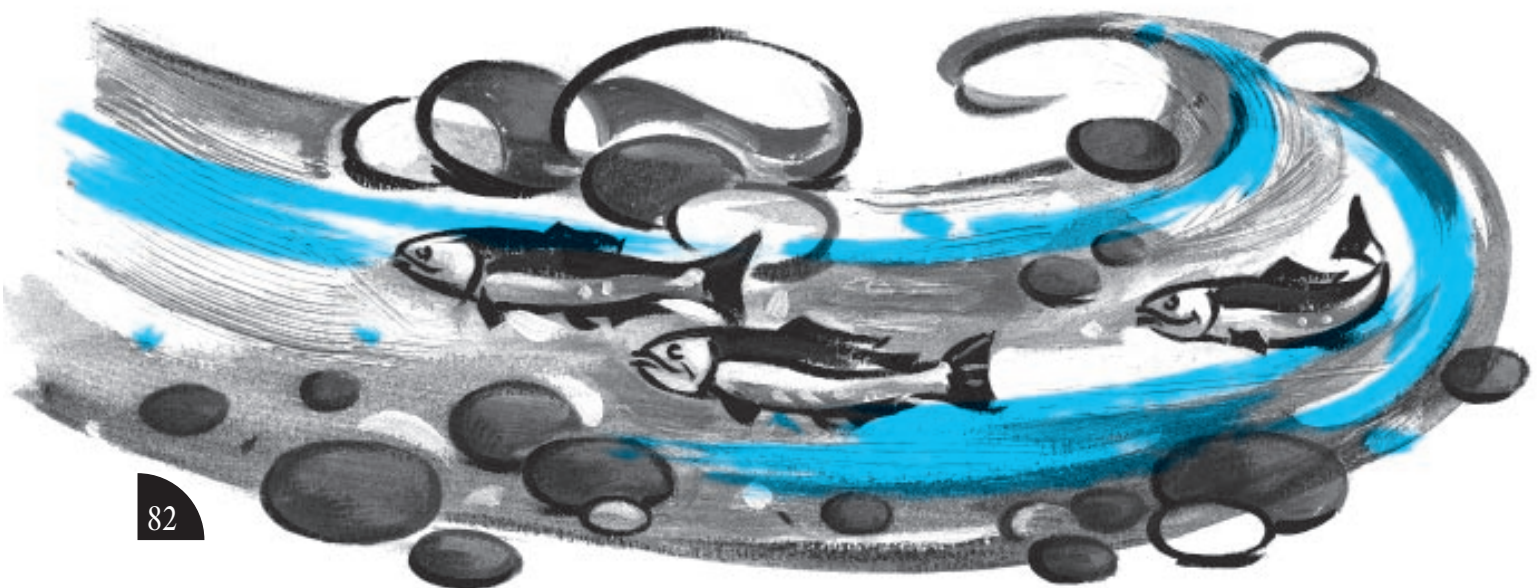
Ref 20: HRFCSR Report

Ref 21: HRFCSR Presentation

Ref 22: HRFMP Review

Brown Trout

The Hutt River is now one of the most intensely used fishing rivers in New Zealand (20,000 angler days per year) and has a strong self-sustaining Brown Trout population. The Fish and Game Council regularly monitors the population to ensure that it doesn’t become ‘fished out’. The recent recovery of the Brown Trout population records the Regional Council’s success in caring for the quality of the river environment through improved management techniques.



Part One of *Living with the River* describes the nature of the Hutt River floodplain and the risks of flooding. This establishes the existing conditions and effectiveness of the flood defences. From the analysis of the existing status, issues for future floodplain management have been derived. These include issues which were raised during the Phase One household and business survey to determine the community's perceptions of the risks and benefits of living within the floodplain environment.

Resolving these issues will require careful management as they cut across distinct areas of functional and statutory responsibility. The Regional Council will need to work closely with Upper Hutt City Council and Hutt City Council. For some issues, the Regional Council may manage the process of resolution. Other issues are clearly the responsibility of the City Councils, where the Regional Council may only play a facilitation role.

Bringing the Issues Together

The issues raised in *Living with the River* have been grouped into three functional areas of responsibility.

1. Policy Issues

These include matters relating to the Regional Council's statutory role as manager of the Hutt River:

- Regional Council priority to be given to the management of the Hutt River.
- Allocation of Regional Council resources.
- Consultative and management frameworks.

- Determining the appropriate planning horizons.
- Providing for future generations - determining the priority to be placed on issues that will principally benefit future generations at the cost of today's ratepayers.
- Agreements with the City Councils on the split of responsibilities for floodplain management.

2. Technical and Operational Issues

These include technical issues related to the management and improvement of the flood defences and issues for the improvement of the physical and ecological environment within the river corridor.

3. Local Territorial Authority Issues

These include issues for reducing flood risks within the urban areas.

Priority and Completeness

The issues listed on the following pages are intended to stimulate discussion. They do not include all issues which will be raised during the floodplain management planning process. Nor are they presented in any order of priority. The floodplain management plan will evolve as these and other issues they invoke are resolved. It is hoped that public discussion of these issues will be the catalyst required to complete the Hutt River Floodplain Management Plan.

Against each issue you will find references to the previous chapters of *Living with the River* which contain the discussions leading to the issue statements.

Policy Issues

1) Policy Framework, Resources and Funding

refer to chapter 7

Hutt River floodplain management planning will involve evaluating a complex mix of structural and non-structural risk management measures in terms of the needs and objectives of a range of stakeholders. The evaluation will take place within the context of acceptable flood risks.

Flood Risk Acceptance Criteria will measure.

- Risk Holding Preferences - the preferences of residents and the community for risk taking.
- Costs of Insurance - the opportunities to insure against or spread the consequences of flooding.
- Overall Hazard Exposure - the proportion of hazard exposure attributable to the risks of flooding.
- Residents' Commitment - the ability and willingness of residents to pay for risk reduction.
- Community Commitment - the availability of community funding and levels of wider regional funding for risk reduction measures.
- Available Resources - competing demands on residents', community and regional funds.

The Regional Council will;

- *establish a Hutt Floodplain Management Committee reporting to the Landcare Committee, responsible for completing the floodplain management plan,*
- *obtain endorsement of Flood Risk Acceptance Criteria,*
- *establish a Project Management Group to provide technical support for the Committee,*
- *establish within the Council's wider strategic planning framework the funds and resources necessary to consider the issues raised in Living with the River, and*
- *reach agreement with constituent local authorities on the balance of community and regional funding and risk holding.*

2) Setting the Objectives for Flood Risk Reduction

refer to chapter 7

The benefits of floodplain management planning accrue over long periods of time and include intangible benefits which are difficult to value in economic terms. Comparing programmes for flood risk reduction with other programmes of public expenditure cannot be based solely on economic criteria. The comparison requires political assessment of the value of intangible benefits, and the value to be given to benefits which accrue to future generations. These concepts will be embodied in the *Flood Risk Acceptance Criteria* (refer to Issue 1).

Current floodplain communities benefit from flood defences built by the Hutt River Board and the Crown between 1901 and 1972. The works were built to achieve long-term risk management objectives. Between 1945 and 1972 Crown agencies took the lead in designing and funding the construction of flood defences.

The Regional Council is now responsible for setting the objectives for the Hutt River floodplain management plan and for long-term community funding of flood risk management.

The Hutt Floodplain Management Committee will establish the political processes to;

- *establish the balance of short-term and long-term risk management objectives, and*
- *establish the priority for Hutt River floodplain management within the Council's flood protection programme and within the Council's public debt management strategy.*

3) Participation of Stakeholders

refer to chapters 6 & 7

Surveys show that residents want to be involved in the floodplain planning decision-making processes, and kept informed of developments.

*The Regional Council will implement a **public participation strategy** for residents' involvement, supported by an efficient and effective **communications strategy** to ensure all are kept up to date without being overwhelmed with unnecessary information. An 'open door' policy will be adopted so that residents have access to information they require, including access to the Council's Project Management Group. A **Community Advisory Group** will be formed to help implement the strategies.*

With the assistance of the Community Advisory Group, the Regional Council will ensure that residents have the information and the opportunity to contribute to Council's assessment of;

- *the extent of damages that will constitute a major risk, and residents' risk-taking preferences,*
- *an acceptable balance of expenditure between asset protection and environmental enhancement, and*
- *residents' level of support for a comprehensive programme of risk management.*

4) Raising Public Awareness

refer to chapter 6

Surveys to assess the views and concerns of the floodplain communities show that;

- floodplain residents are generally unaware of the risks of flooding resulting from breaches of the Hutt River flood defences, and are unprepared for that eventuality,
- some residents question the amount of money spent on river management works, compared to environmental enhancements, as they have great faith in the stopbank system,
- there is not a clear understanding of the role of the Regional Council and other agencies in flood risk management, and
- residents suspect that there is a lack of co-operation between agencies responsible for floodplain management.

*The Regional Council will implement a **flood risk awareness strategy** to raise the profile of the work being done to manage the floodplain. **Living with the River** will be widely distributed as the first step in this strategy.*

5) Partnership with Iwi

refer to chapter 6

Te Tūtohunga O Te Whakaaetanga (Charter of Understanding) is a consultative agreement between the Regional Council and iwi in the Wellington Region. Iwi have the opportunity to be involved in management planning and decision-making, particularly for activities which could impact on waahi tapu (areas of significance). Tangata whenua of the floodplain is Te Atiawa.

The Regional Council will implement the provisions of Te Tūtohunga O Te Whakaaetanga to ensure effective consultation with iwi during the completion of the floodplain management plan. Maori form a significant proportion of the floodplain community and must also be represented as directly affected stakeholders.

Technical and Operational Issues

6) Applying Knowledge from the Phase One Investigations

refer to chapters 2 & 3

The Regional Council can now predict with a high degree of confidence the risks of floods in the Hutt River and the consequent risks to the urban populations of Upper Hutt City and Lower Hutt City. Specifically:

- There is adequate knowledge of the hydrological and climatological processes to define flood risks.
- There is a very high chance that a flood large enough to severely test or breach the existing flood defences will occur within the lifetimes of current generations (over the next 100 years the chances are 3 in 4).
- The floodway is made up of a number of components, which combine to form the flood defences. The condition and effectiveness of each of these has been established and a methodology developed to assess the combined effectiveness and overall security of the flood defences.
- To estimate the long-term costs of flood damage, analytical techniques have been developed to combine the risks and effects of breaches with the knowledge of asset values within flood-prone areas.
- The analytical techniques developed to assess flood risks can calculate reductions in tangible flood damages resulting from proposed improvements in the security of the flood defences, or from flood-proofing measures taken within the urban areas of the floodplain.
- The information base established by the floodplain management plan technical investigations provides the knowledge and evidence necessary to implement and prioritise statutory planning measures to reduce the overall risks of flooding.

The Regional Council needs Upper Hutt City Council and Hutt City Council support to implement a knowledge transfer strategy to transfer information on the risks of flooding to planning and development agencies. The strategy will;

- *establish procedures to keep the agencies' knowledge of the risks of flooding relevant and up to date,*
- *provide estimates of flood flows into urban areas and specify measures to reduce flood risks,*
- *provide estimates of the potential costs of tangible flood damages within the urban areas. Costs are currently estimated to be equivalent to \$5 million every year (this sum is termed the "average annual damage" and is the sum of the present values of all future flood damages). Costs will remain at this level for as long as the present occupation of the floodplain continues and flood defences remain in their current state, and*
- *establish priorities for implementing measures to reduce flood risks in terms of reducing tangible flood damages.*

7) Managing the Hutt River Flood Defences

refer to chapter 2

Flood risks in the Hutt Valley are currently managed using structural flood defences which were originally intended to contain all floods within the river corridor.

Recent hydraulic modelling has shown that during high floods erosion of the river bed and banks will be severe. Bed gravels will form large dunes, like sand-dunes on a wind-swept beach, which will move along the river bed creating scour holes in the bed up to 5m deep. It is impractical if not extremely costly to design flood defences which will not be damaged when there is movement of the bed on this scale. For these reasons, damage to flood defences is expected. The defences are considered to be effective when they prevent flooding of urban areas *even though they may be severely damaged in the process.*

Upgrading flood defences will take a number of decades. In the meantime, there is a 1 in 100 chance in any year that urban areas will be flooded. Although this risk can be reduced, it can never be eliminated.

The Regional Council needs Upper Hutt City Council and Hutt City Council support to implement a flood defences management strategy. The strategy will;

- *continue to maintain and as necessary upgrade the existing flood defences to provide an acceptable level of flood risk reduction as determined by the risk acceptance criteria (refer to issue 1, page 84),*
- *integrate with City Council strategies to reduce flood risks within urban areas,*
- *establish priorities for upgrading all reaches of the river in terms of the overall level of risk reduction which can be reasonably achieved, as determined through the floodplain management planning process,*
- *integrate the functional design of individual components with the overall long-term upgrading objectives for each reach and for adjacent reaches,*
- *specify components of the flood defences which may progressively fail during a flood but will remain functional long enough to prevent total failure of the stopbanks, and*

- *take account of the life-cycle costs of flood defences, not just the initial construction costs. Cost-effective flood defences should satisfy **Flood Risk Acceptance Criteria** and should achieve a balance between the initial capital cost of construction, the ongoing costs of repairs and upgrading, and the environmental effects of construction and subsequent repairs.*

8) Raising Flood Defences

refer to chapter 1

Climatological, geological and hydrological studies indicate that;

- climatic changes may lead to 200 to 400mm rises in sea level by 2050AD,
- climatic changes may increase rainfall intensities with the consequence that larger floods would occur more frequently, and
- movement on the Wellington Fault may lower the floodplain by 300 to 500mm, particularly at its southern end. The accompanying earthquakes may damage some of the older flood defences.

*Within the next 100 years, the flood defences may need to be rebuilt and raised as a result of climatic and geological changes. The **flood defences management strategy** will;*

- *make provisions to raise all flood defences south of Boulcott to accommodate possible sea level changes and earthquake induced movement, and*
- *make long-term provisions to raise stopbanks to cope with possible increased frequency of flooding which may result from climatic changes.*

9) Managing the River Environment

refer to chapters 1 & 2

The river corridor is used for a wide range of recreational pursuits. There remain large areas where the recreational and ecological qualities of the habitat can be enhanced or developed further.

Surveys show that residents would prefer to see the river in a more natural state rather than in a highly modified condition. They would like to see some action taken towards restoring its original environmental qualities. The recent improvements in the quality of the river environment have been appreciated.

River management practices which disturb the bed of the river are seen as detrimental, although these may need to continue for the foreseeable future to maintain flood security. Including environmental costs and benefits in the evaluation of the life-cycle costs of bank-edge protection works, compared to the economics of gravel management (extraction and cross-blading), may lead to a preference and willingness to pay for more substantial bank-edge protection works.

*The **flood defences management strategy** aims to achieve an acceptable balance between effective floodplain security, enhancement of recreational areas, and longer-term objectives to establish a more natural riparian environment. Current management practices will need to be improved or adapted to;*

- *enhance the appearance of stopbanks,*

- *enhance recreational areas and establish a more natural riparian environment,*
- *continue to extend and improve the diversity of river-side plantations by using native species,*
- *consider more permanent bank-edge protection works which can cope with meandering and the associated build-up of gravel deposits,*
- *ensure all river management works have acceptable environmental effects, and*
- *make the best use of open space in the Hutt Valley by creating links with open space throughout the adjoining urban areas.*

10) Development Adjacent to the River Corridor

refer to chapter 1

The costs of improving flood defences and the associated environmental effects are related to the proximity of adjoining urban development.

For the recently completed Ewen Floodway Improvements, over \$9.5 million, 63% of the total river works cost, was spent on purchasing and clearing private property which had confined the river. In 1945, the Crown purchased and removed the dwellings from the Newton Street subdivision (now Poets' Park, Upper Hutt) for similar reasons.

The flood defences management strategy will define the areas where the current line of flood defences remain unreasonably constrained by development adjacent to and within the river corridor. The strategy will consider options to acquire the properties or to encourage appropriate redevelopment.

Issues for Local Territorial Authorities

11) Headwater and Tributary Catchments

refer to chapter 1

The land-use patterns for the headwater and tributary catchments have not changed for some time. The catchments consist of conservation reserves, sustainably managed production forestry, and life-style farming activities. The current uses are compatible with flood mitigation and are mostly of high environmental quality. However, there is no statutory guarantee that they will remain this way, or that floodplain management issues will be considered in future planning of the Hutt River's headwater and tributary catchments.

Planning provisions need to be strengthened to protect and enhance the headwater and tributary catchments by formally linking catchment land-use planning to the floodplain management plan.

12) District Planning : Flood-Prone Areas

refer to chapter 4

Within the lifetimes of current generations there is a 3 in 4 chance that a flood large enough to severely test or breach the existing flood defences will occur. There is a 1 in 4 chance that breaching of the flood defences at one or more locations will lead to wide-spread flooding of some urban areas.

City planning assumes that areas zoned for development will not be flooded by the Hutt River. Planning decisions do not consider ways to reduce flood risks once Hutt River floodwaters have entered urban areas.

District planning of urban areas needs to be reviewed:

- *Some of the areas of Upper Hutt City and Lower Hutt City currently zoned for urban development are potentially flood-prone. The Regional Council needs to provide city planners with specific information on flood-prone areas, the risk of flooding and measures for managing risk.*
- *The value of potential flood damages within the flood-prone urban areas have been estimated to be approximately \$890 million : \$190 million in Upper Hutt City and \$700 million in Lower Hutt City.*
- *Intangible flood losses, personal losses, and the effects of trauma are expected to be as large as tangible losses. A method to integrate intangible losses into the decision-making process needs to be agreed between the Regional and City Councils.*
- *When the sale or redevelopment of private property is proposed in flood-prone areas;*
 - 1. subsequent purchasers need to be made aware of the potential flood risks, and*
 - 2. options to reduce flood damages need to be considered.*

13) Emergency Management and Emergency Preparedness Planning

refer to chapter 5

The Regional Council, Upper Hutt City Council and The Hutt City Council's flood warning procedures are tested regularly and are reliable. They can provide 5 to 7 hours warning of when a flood will reach its peak. The procedures have the potential to reduce property damage, trauma and loss of life if the community is well prepared and understands and acts on the warnings. However, the earliest possible flood warning is unlikely to be effective without a high level of community preparedness. This can only be achieved through regularly testing community response.

The Cities' emergency management plans need to be integrated with the floodplain management plan so that;

- *emergency response can be more closely targeted to the areas of highest risk,*
- *flood preparedness can be measured through regular testing of council procedures and community response,*
- *well publicised education and community planning programmes can be implemented to reduce risks to public and community assets, and*
- *emergency response plans can be linked to a strategy to reduce risks to life and assist individuals in reducing flood risks to their own belongings.*

14) Links between Emergency Management and Statutory Planning

refer to chapter 5

Of those individuals and organisations who are aware of the general risks of flooding some have taken steps to reduce their flood risks (recent examples are flood-proofing undertaken by INL, TAB, IBM, Countdown and NZ Post, all major developments in flood-prone areas). Some do not feel bound to take individual steps to reduce their risks if they are not in a formally recognised flood-prone area.

Others are not aware of the specific risks of their location. As a result many residents, businesses, utility operators and civic amenity operators are not prepared for flooding.

Emergency Management's flood preparedness messages to residents and businesses are not supported by formally defined flood-prone areas on the Cities' District Plans.

City Councils need to adopt measures to ensure preparedness planning and floodwarning are effective in reducing flood losses, trauma and intangible losses and avoid new assets being located in flood-prone areas. Specifically;

- *City Councils need to take a precautionary approach to development in low-lying areas of the floodplain, and*
- *the Regional Council needs to provide definitive information on flood-prone areas through its knowledge transfer strategy.*

City Councils' promotions of planning and preparedness strategies do not need to wait for the completion of the floodplain management plan. They are likely to involve modest public expenditure, compared to the costs of upgrading flood defences, and will lead to similar reductions in flood damages.

15) Management of Urban Stormwater Outlets

refer to chapter 2

The correlation between floods in the Hutt River, which cause the floodgates on the urban stormwater outfalls to close, and coincident flooding of the urban stormwater systems is not well understood.

The Regional Council, Upper Hutt City Council and Hutt City Council need to undertake a co-ordinated programme of stormwater outlet investigations to assess the effectiveness of urban stormwater outfalls. Failure of local stormwater systems will reduce the benefits of improving the river's flood defences.

Flood Risk Reduction Measures

Taken by The Regional Council, Hutt City Council and Upper Hutt City Council from 1977 to 1996

Date	Council	Risk Reduction Measure
1977	HCC	OpahuStream Outlet protection works
1978	HCC	Maungaraki Detention Dams
1980-81	WRC	Stokes Valley Stream outlet stopbank reconstruction
1981	WRC	Te Marua SH1 protection works
1981	WRC	Maoribank groynes, debris fences and willow planting
1981	WRC	Berm widening to protect Alicetown stopbank
1981-84	UHCC	Drainage Channel work beside stopbanks
1981-86	WRC/UHCC	Upper Hutt Bypass Riverworks – rock lines and realignment
1983	WRC/UHCC	Totara Park Stopbank completion
1983-84	WRC/UHCC	Parkdale stopbank construction and bank stabilisation
1984	WRC	Woollen Mills (Moera) stopbank toe repair
1984-87	WRC	Trentham Memorial Park debris fences
1984-88	WRC	Totara Park bank protection and stabilisation – groynes, rip-rap, debris fences, willow planting
1984-89	WRC/HCC	Opahu Stream outlet stopbank strengthening and culvert replacement
1985	UHCC	Pinehaven Stream and Hulls Creek upgrading
1985, 89	WRC	Ewen bridge bank stabilisation to protect flood walls and car park
1985-87	WRC/HCC	Bank stabilisation at Harcourt and Haukaretu Parks
1985-88	WRC	Croft Grove bank protection work
1987	UHCC	Mangaroa Hill Road stormwater deviation
1987	UHCC	Trentham Detention Dam
1987-89	WRC	Belmont concrete block groynes and planting
1989	WRC	Melling tree removal and stopbank reinstatement
1990	WRC	Pomare rock groynes
1990	WRC	Lower Belmont rock protection works
1990	UHCC	Whiteman Road culvert duplication
1992	WRC	Norbert Street footbridge and protection works - gabions
1993-96	WRC	Ewen Floodway Project
1994	WRC	Totara Park Bank Stabilisation
1995	WRC	Trentham Memorial Park bank protection works
1995-96	WRC	Marsden Bend Improvements
1996	WRC	Upper Belmont sewer and bank protection
1996	WRC	Ava tree removal and stopbank reinstatement



Ewen Floodway Project. Photo WRC.

What have the Councils been Doing?

Over the past 20 years, the Regional Council (and its predecessor, the Wellington Regional Water Board), the Hutt City Council and Upper Hutt City Council have reduced the risks of flooding within the urban areas of the Hutt Valley. The exhibit on page 92 lists the measures that have been taken. The broad scope and extent of these measures, built during a period of intense pressure on public funds, reflects the priority that has been given to increasing the security of the flood defences and improving the quality of the floodplain environment.

Planning of most of these measures have been loosely co-ordinated. While there have been good levels of communication between the officers and politicians of the three Councils, so that all are generally aware of the initiatives the others are planning, the implementation of measures has only been informally linked to common goals.

In most instances the Councils have been reacting to events. Measures have been implemented in the “windows of opportunity” which exist immediately *after* flood damage has occurred, or when the measures could be justified as essential components of other public works. Examples are the upgrading of urban stormwater systems after the 1976 floods, or the reconstruction of the Ewen Floodway after plans to re-develop southern High Street led to the replacement of Ewen Bridge.

Need for a Floodplain Management Plan

Floodplain management planning has been by default. This has created difficulties for all Councils in raising funds and managing their other public works programmes.

The need for a longer-term management plan for the whole Hutt Valley, indeed for the whole catchment, was recognised as early as 1976. Work finally started on the plan in the mid 1980s. This was in order to maintain government grants for river management works. However, not long after, restructuring of central government put an end to government technical and financial involvement in floodplain management. The Councils were faced with the tasks of establishing management and funding agreements for assets of which they had little historical or technical knowledge.

Living with the River marks a turning point. The Regional Council now has the information to promote a co-ordinated action plan to manage flood risks within the Hutt Valley.

The exhibits on pages 94 & 95 are extracts from the Regional Council’s 10 year plan and 1996/97 Annual Plan. The targets in the 10 year plan are being achieved. These demonstrate the Council’s commitment to floodplain management planning throughout the region.

Extracts from "Facing the Future" - WRC Ten Year Plan

Flood protection is a concern for many residents, businesses and landowners in the Region. In fact, the history and development of some communities is tied up with living in the vagaries of rivers and the effects of flooding and erosion. The dilemma facing these communities has always been how to achieve the level of flood protection required with the limited community resources available.

In the past, a number of separate authorities were responsible for flood protection and river management. Today the Regional Council assumes that role.

Flood protection is primarily about ensuring the safety of life and property. A spin-off can be the enhancement of the local environment. However, floodplain management planning and flood protection works are expensive. Therefore, the Council's major consideration is to provide a cost effective service to the community.

The Council's approach to its guardianship role has been to work closely with communities through territorial authorities, residents and ratepayer groups, special interest groups and individual landowners. An informed community is in the best position to decide on the level of flood protection required and what its corresponding financial contribution should be.

Ultimately, deciding on what work should be done is a question of balancing the immediate benefits to those directly affected with those that accrue to the regional community as a whole. This is reflected in the Council's funding policy for flood protection and river works and environmental enhancement.

Floodplain management planning

Floodplain management planning is the key to identifying significant flood hazards in the Region. It informs local communities about flood hazards and involves them in decision making on planning issues, mitigation and flood protection.

To ensure success, the Council will work closely with local communities to:

- identify flood risk and ensure that communities are fully informed.
- Gain community consensus to sustainable, cost effective solutions.
- Ensure that systems work within designed standards and provide for environmental enhancement.
- Respond quickly and appropriately to flood emergencies.

Maintaining assets

The Council will ensure that existing flood protection assets and river environments are maintained to acceptable standards. To this end, asset management plans are being developed.

River corridors

Recognising the environmental and recreational values of riverside environments, the Council will continue to enhance and improve access to river corridors.

The Ten Year programme of Actions

Investigations and Planning

Preparing Floodplain Management Plans for:

- Hutt River by 2001
- Otaki River by 1997
- Waikanae River by 1997

capital expenditure \$3,520,000

SPECIFIC ACTIVITIES FOR 1996/97

PLANNING FOR FLOOD PROTECTION

- Complete Waikanae River Floodplain Management Plan. (\$46,000)
- Complete a draft Otaki Floodplain Management Plan. (\$178,000)
- Investigate management options for the Hutt River Floodplain Management Plan. (\$259,000)
- Investigate Hutt River Nash Street protection works options. (\$25,000)
- Complete a Stream Management Plan for the Waiwhetu Stream. (\$27,000)
- Complete Phase 2 of the Waiohine River management study. (\$53,000)
- Supply input into regional and district planning processes relating to flood and erosion hazards. (\$126,000)
- Complete Phase 2 of the Upper Ruamahanga River Floodplain Management Study with publication of the Options Report. (\$46,000)
- Complete Phases 1 and 2 of the Waipoua River Floodplain Management Study, with publication of Issues and Options reports. (\$66,000)
- Complete design of the Saywells stopbank and the Apple Barrel Floodway improvements for the Waiohine River management study. (\$46,000)
- Complete the Hutt River Ewen Floodway Project. (\$140,000)
- Purchase of land necessary for construction of Kauri/Puriri Stopbank and El Rancho river realignment. (\$96,000)
- Begin the Waikanae River Kauri/Puriri stopbank and El Rancho channel improvements. (\$732,000)
- Complete maintenance operations on western area rivers. (\$1,633,000)
- Complete operations and maintenance programme for the Lower Wairarapa Valley development scheme and the Waiohine, Upper Ruamahanga, Waipoua, Lower Taueru, Lower Whangaehu and Upper Mangatarere River Management Schemes. (\$917,000)
- Replace control weir on the Waipoua River. (\$80,000)
- Continue gravel extraction, and monitoring of riverbed levels. (\$44,000)
- Complete contracting and consulting work for other Council departments. (\$47,000)
- Provide an effective warning system in event of serious flooding within accepted timeframes. (\$110,000)
- Continuing investigation for Otaki River Upper Rahui river improvements. (\$20,000)

Where to from Here?

The release of *Living with the River* represents the real start of the floodplain management planning process within the Hutt Valley. The steps which follow include:

- Distribution of *Living with the River* to affected stakeholders' representatives;
 - city council politicians and management,
 - iwi,
 - affected government departments,
 - special interest technical groups,
 - special interest community groups,
 - significant asset owners within the floodplain.
- Requests to stakeholders to review the report and declare their interest in taking part in the floodplain planning process.
- Support for the media to stimulate general public discussion.
- Meetings to discuss the issues (in response to the demand for further information).
- Meetings to obtain feedback on the policy framework and on the membership of the consultative groups discussed in chapter 7.
- Discussions with the City Councils on the scope and programme for the next stage of planning and implementation.
- Upper Hutt City Council, Hutt City Council and Regional Council endorsement for the next stage of the floodplain management plan.

It is expected this process will take 6 to 8 months to complete.

Proposed Policy Framework

The decision-making framework discussed in chapter 7 will be established. The framework will include the formation of the management committee and the special consultative groups;

- the Hutt River Floodplain Management Committee to manage the next stage of the floodplain management plan, and
- the Technical and Community Advisory Groups to obtain specialist and community input.

Your Involvement

You are encouraged to express your opinions on the issues that have been raised. Comments, or requests for additional copies of *Living with the River*, should be addressed to:

*The Manager
Rivers Department
The Wellington Regional Council.
PO Box 11-646, Wellington
Ph 3845708, Fax 3856960*

Further Information

Further information can be obtained by reference to the Hutt River Floodplain Management Plan: Phase One Investigations Technical Reports, held by public libraries in the Hutt Valley, by the Wellington City Council Central Library, and by the Wellington Regional Council Library.

Living with the River

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Living with the River

Submission Form

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Manager Rivers
Wellington Regional Council
P O Box 11 646
WELLINGTON

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Bibliography

The list includes the Technical Reports produced as part of the first phase of the Hutt River Floodplain Management Plan. Other directly relevant reports and publications referred to in “Living with the River” are also listed. Each publication has been given a reference number and a short title. These are used to cross-reference to the reports at the end of each chapter.

1. **Volume 2 : Climatology**, *Hutt River Flood Control Scheme Review - Topic No.2: Climatology and Hydrology, Volumes 1-5*, National Institute of Water and Atmospheric Research (NIWAR), 1990.
2. **Volume 2 : Historical Floods**, *Hutt River Flood Control Scheme Review - Topic No.2: Climatology and Hydrology, Historical Flood Re-estimation by Channel Modelling*, Catchment Engineering NZ Ltd and Rivers Dept, Wellington Regional Council, Nov 1989.
3. **Volume 3 : Public Involvement**, *Hutt River Flood Control Scheme Review - Topic No.3: Public Involvement Procedures, Volumes 1-4*, Royds Garden Ltd, Environmental and Planning Associates, James Barnes Associates, November 1990.
4. **Volume 4 : Channel Capacity**, *Hutt River Flood Control Scheme Review - Topic No.4: River Channel Capacity*, Christina Robb, Rivers Dept, Wellington Regional Council, August 1992.
5. **Volume 5 : Sedimentation**, *Hutt River Flood Control Scheme Review - Topic No.5: Sedimentation and River Characteristics*, G & E Williams Consultants Ltd, August 1994.
6. **Volume 6 : Channel Management**, *Hutt River Flood Control Scheme Review - Topic No.6 : Channel Management and Protection Works (main report and reference volume of plans)*, G & E Williams Consultants Ltd, August 1994.
7. **Volume 7 : T & T Qualitative**, *Hutt River Flood Control Scheme Review - Topic No.7 : Structural and Geotechnical Assessments : Qualitative (stopbanks and structures)*, Tonkin & Taylor Ltd, draft 1991 (to be finalised).
8. **Volume 8 : Hydraulics**, *Hutt River Flood Control Scheme Review - Topic No.8 : Floodplain Hydraulic Modelling*, Barnett Consultants, June 1993.
9. **Volume 9 : Flood Damages**, *Hutt River Flood Control Scheme Review - Topic No.9 : Flood Damage Assessment*, Agricultural Engineering Institute (AEI), December 1992.
10. **Volume 10 : Risk Assessment**, *Hutt River Flood Control Scheme Review - Topic No.10 : Risk Assessment*, Philip Wallace, Rivers Dept, Wellington Regional Council, March 1993.
11. **Volume 11 : Environmental**, *Hutt River Flood Control Scheme Review - Topic No.11 : Environmental Investigations, Component volumes 1-7*, Boffa Miskell Ltd, June 1993.
12. **Volume 12 : History**, *Hutt River Flood Control Scheme Review - Topic No.12 : The Hutt River (Te-Awa-Kai-Rangi) A Modern History 1840-1990*, John Easter, Catchment Engineering of NZ Ltd, 1991.
13. **Volume 18 : Risk Assessment Process**, *Hutt River Flood Control Scheme Review - Topic No.18 : Risk Assessment Process : Method and Results*, Philip Wallace and Christina Robb, Rivers Dept, Wellington Regional Council, December 1993.
14. **Rugged Landscape**, *Rugged Landscape: The Geology of Central New Zealand*, Graeme R. Stevens, A H and A W Reed Ltd, 1974, reprinted by DSIR publishing, 1990.
15. **Hydrology Report**, *Hydrology of the Hutt Catchment, Volume I : Surface Water Hydrology*, Darryl Lew, Hydrological Services Group, Wellington Regional Council, May 1995.
16. **Flood Mitigation Options**, *Otaki River Floodplain Management Plan - Phase II Investigations : Development and Evaluation of Flood Mitigation Options*, P L Blackwood, Rivers Dept, Wellington Regional Council, November 1993.
17. **Non-structural Options**, *Otaki River Floodplain Management Plan - Phase II Investigations : Non-structural Options*, T L Berghan, Wellington Regional Council, August 1994.
18. **EFP : Floodway Channel Design**, *Ewen Floodway Project Stage II Investigations : Floodway Channel Design*, C A Robb & B D Paul, Rivers Dept, Wellington Regional Council, August 1991.
19. **Business Plan**, *Rivers Department Business Plan 1995-2005*, Wellington Regional Council, May 1995.
20. **HRFCSR Report**, *Report to the Operations Committee, Hutt River Flood Control Scheme Review*, by Brendan Paul, Rivers Dept, Wellington Regional Council, September 1988.
21. **HRFCSR Presentation**, *Presentation to the Operations Committee, Floodplain Management Planning*, by Brendan Paul, Rivers Dept, Wellington Regional Council, April 1990.
22. **HRFMP Review**, *Review of Hutt River Floodplain Management Process*, I. Robertson, & A. Sutherland, for Wellington Regional Council, April 1992.
23. **Climate Change**, *The Potential Effects of Climate Change on River Protection: Case Study on the Hutt River*, D.C.K. Leong, R.S. Jordan, R.R. Ibbitt, National Institute of Water and Atmospheric Research, 1990.

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