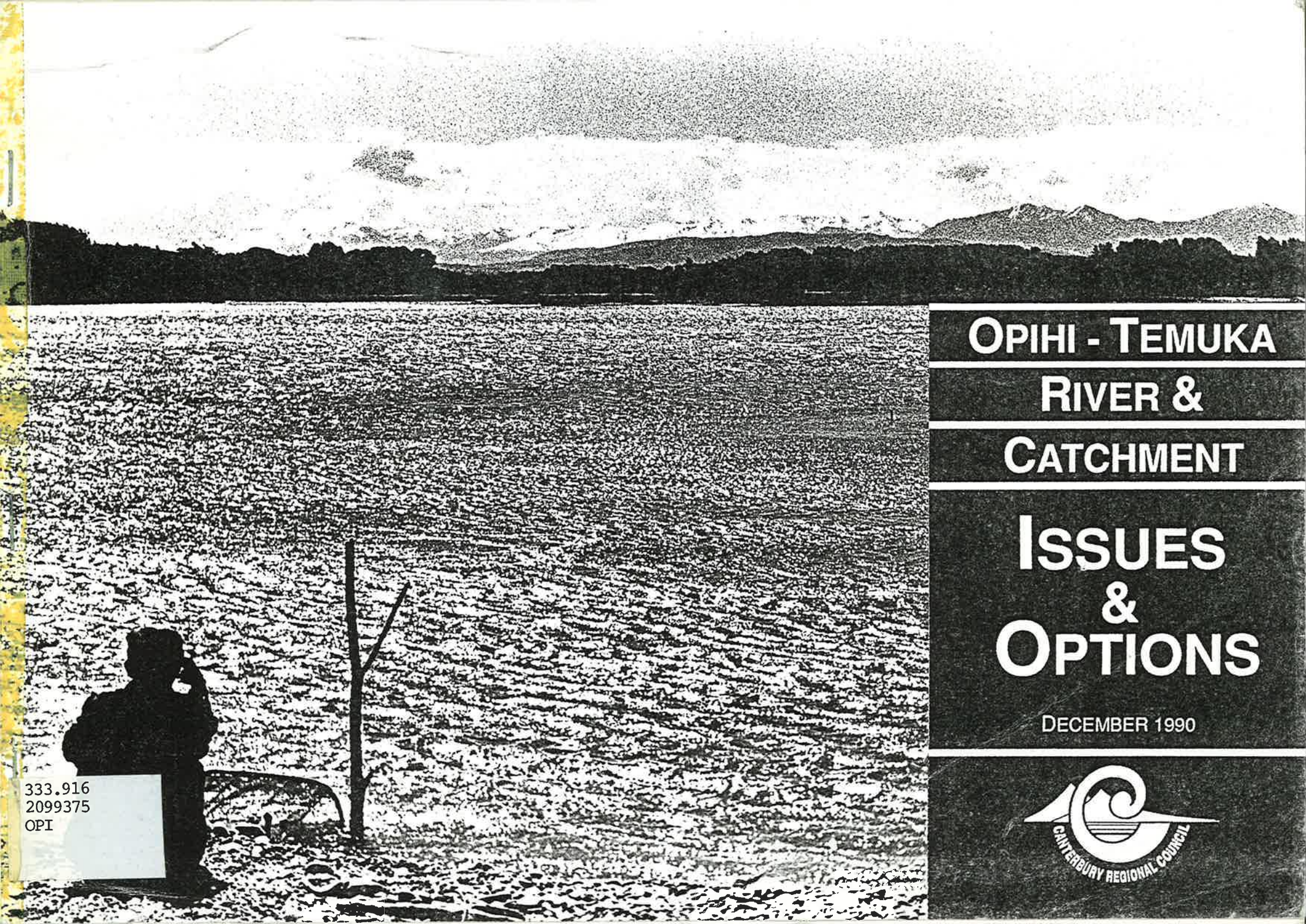

OPIHI - TEMUKA RIVER & CATCHMENT

ISSUES & OPTIONS

DECEMBER 1990

CANTERBURY REGIONAL COUNCIL

OPIHI - TEMUKA RIVER & CATCHMENT

ISSUES & OPTIONS

DECEMBER 1990

A Canterbury Regional Council document to facilitate public participation in the preparation of the Opihi-Temuka Catchment Management Plan.

This document has been prepared by the following contributors:

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Mahia nga mahi kaua e korero

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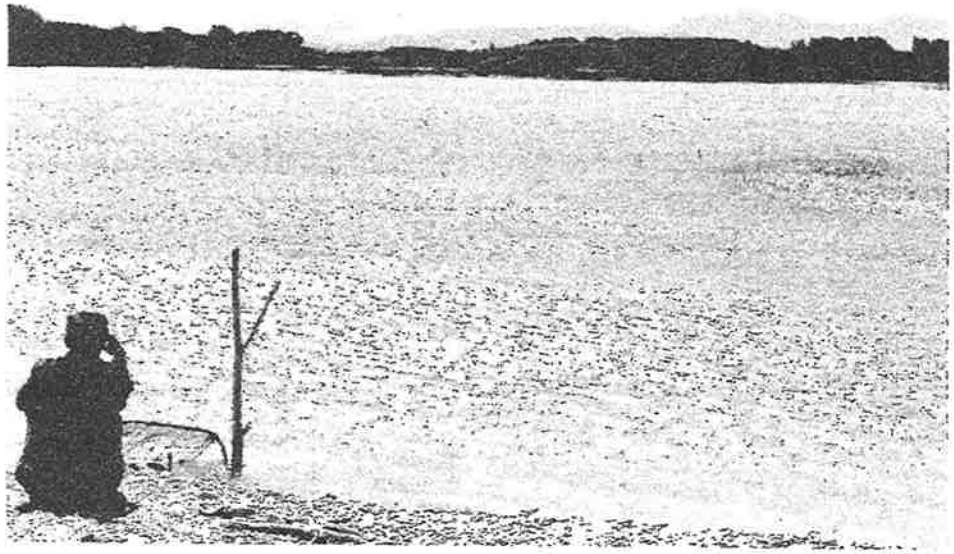


CONTENTS

1. Introduction

1.1 Purpose of this Document

The Opihi and Temuka river systems are short of water in most summers. Some parts of the Temuka River have poor water quality. The Opihi River Lagoon suffers poor water quality with the river mouth closing often in summer. Groundwater is a limited resource, wetlands have diminished and the catchments are prone to flooding. Land within the catchment is subject to erosion, with sediment moving into the river system.

For these reasons and others the Canterbury Regional Council needs to determine and promote the best ways of using the land and water resource for everyone's benefit. The Canterbury Regional Council and formerly the South Canterbury Catchment Board has managed the uses of the catchment by, for example, requiring water rights for using water, applying restrictions on water use during summer, physically opening the river mouth and instituting flood and erosion control schemes. The South Canterbury Catchment Board prepared a water management plan for the Opihi catchment (excluding the Temuka) in 1984 but this plan expires this year. A draft plan for the Temuka was released in September 1989 and submissions were received. It is now appropriate to review the problems in the whole catchment, determine people's aspirations for using the land and water and prepare a plan for the future use of the Opihi and Temuka rivers and catchment. The publication of this Issues and Options report and the invitation for anyone to comment on it is the first step in preparing a plan.

An important proposal affecting the Opihi River is the proposal to augment Opihi River flows either by transferring water from Lake Tekapo or by building storage dams in the Opihi catchment itself. This proposal could add up to 6 m^3/s of flow to the river during summer. Added flows would provide many benefits including more water for irrigation, improved low flow water quality in the Opihi River, guaranteed minimum flows and opportunities for development of water dependent industries. At present the Opihi Augmentation Society has not yet determined the specific proposal that it wants to pursue. The proposal could however affect many of the objectives and options in this report. Apart from section 2.8 the objectives and options in this report have been written assuming no augmentation of river flows.

The Canterbury Regional Council was formed in November 1989 and is responsible for regional planning and management of the land, water and coast. It is the stated objective of the Council to involve the community in the preparation of plans. The Council is seeking to achieve community confidence in its resource management decisions, by informing and involving the community. The community is then able to effectively monitor the Council's objectives and make a contribution to its performance.

Purposes of this document:

(1) To identify the land and water management issues to be resolved through the Opihi-Temuka Catchment Management Plan.

(2) To provide and make available information to the public.

(3) To facilitate and encourage participation in the drafting of the Opihi-Temuka Catchment Management Plan.

(4) To identify the opportunities and constraints of resources and their uses.

(5) To establish and make available to all, the objectives, of the Canterbury Regional Council, in order that interested parties can seek to influence them.

Submissions are invited, either in writing or orally, and should be delivered to:

The Project Leader
Tony Dons
Canterbury Regional Council
P O Box 550
Timaru

75 Church Street
Phone (03) 688 9069
Fax (03) 688-9067

by

11 February 1991

Following the consideration of submissions the Draft Opihi-Temuka Catchment Management Plan will be prepared. Public submissions will again be invited on the Draft Management Plan. The timetable for preparing the Management Plan appears later in this section.

1.2 The Catchment

The catchment area is depicted in Figures 1 and 2. The waters of the Opihi River flowing into the river lagoon come from the following sub catchments:

Sub Catchment		Area (ha)	%Total Catchment
Opihi	]	62,857	26
Tengawai	]	64,192	26
Opuha	]	48,811	20
Levels Plains & Seadown	]	8,702	3
	Opihi	184,562	
Waihi	]		
Te Moana	] Temuka	61,101	25
(including Kakahu)	]		
	Total Area	245,663	100

There are five areas within the catchment, with distinctive topography, climate, geology, soils, vegetation, drainage and erosion characteristics. These areas are the Coast, Rivers, Plains, Downlands, Hill and High Country.

Coast

The coast is characterised by the alluvium beach and swamp deposits which are low lying and subject to coastal erosion. Rainfall is 550mm per year.

Rivers

The River system is braided with a relatively steep grade. Supplies of gravel from upper catchment encourages meanderings of the river, with deposition and bank erosion reworking the sediment as it moves to the sea. The Opihi has become dry during severe droughts, while the Temuka flows are maintained from groundwater springs.

Plains

The plains are characterised by intensive land use on variable, versatile soils, with limitations of stoniness, droughtness and low moisture retention. Major centres of population are Temuka (3910), Geraldine (2110), Pleasant Point (1100) and Fairlie (770), total estimated population of 15,000. The plains are subject to flooding, erosion, including river scour and sedimentation. The coastal area is low lying and formerly a wetland. Rainfall ranges from 550-800mm per year.

Downlands

The downlands are characterised by intensive pastoral land use, loessial soils on rolling downs, and are seasonally dry. The downlands are dissected by numerous streams and watercourses. The steeper slopes are subject to slipping. Cultivated areas are subject to rill erosion following heavy rains. Rainfall ranges from 650-900mm per year.

Hill and High Country

Half of the catchment is above 500 metres and rises to 2200 metres above sea level and is described as being moderately steep to very steep tussock country. There is moderate to severe gully and slip erosion in localised areas plus extensive areal erosion. The tussock grasslands have been modified historically by fire, over grazing and rabbits. More recent development has seen subdivision, tracking, oversowing and topdressing of tussock blocks. Rainfall ranges from 850-1400mm per year.

1.3 Purpose of the Catchment Management Plan

The purposes of the Opihi-Temuka Catchment Management Plan are to (in addition to those common with the Issues and Options Document):

(6) Provide the framework for sound and consistent decision making.

(7) Enable a sound and quick response to changing circumstances.

(8) Provide the reasons for public expenditure.

(9) Provide a supporting framework for statutory consents and enforcement measures.

(10) Establish the means for ongoing evaluation of the effectiveness of objectives, policies, procedures and expenditure of monies.

Statutory Basis for the Management Plan

The Canterbury Regional Council has the delegated authority to administer the following resource management acts:

- Soil Conservation and Rivers Control Act 1941
  This Act makes provision for the conservation of the soil resources, and prevention of damage by erosion and floods.

- Water and Soil Conservation Act 1967
  The Title of the Act reads as follows:
  "An Act to promote a national policy in respect of natural water, and to make better provision for the conservation, allocation, use and quality of natural water, and for promoting soil conservation and preventing damage by flood and erosion, and for promoting and controlling multiple uses of natural water and the drainage of land, and for ensuring that adequate account is taken of the needs of primary and secondary industry, water supplies of local authorities, fisheries, wildlife habitats, and all recreational uses of natural water".
  Town and Country Planning Act 1977
  This Act makes provision for the preparation, implementation and administration of regional, district and maritime planning schemes. The Regional provisions of the Act are administered by Regional Councils.

The Regional Policies and Objectives drawn on for drafting the Management Plan are from:

- Canterbury Regional Planning Scheme, Section 1 (Aorangi) December 1989 (previously the Aorangi United Council Scheme)
- Canterbury Regional Council Corporate Plan 1990-1993
- Canterbury Regional Council Annual Plan 1990-1991

Resource Management Objectives

This document and the catchment management plan are guided by the following objectives from the Aorangi scheme:

- The conservation protection and enhancement of natural and physical resources in a way which recognises the cultural, ecological and economic values of the community.

- The integrated management of the land, air and water resources to achieve balanced, beneficial and sustainable use.

- The recognition of and provision for the relationship of the Takata Whenua (people of the land) and their culture and traditions with their ancestral lands.

Goals of the Opihi-Temuka Catchment Management Plan

Seventeen goals have been identified for the Plan. These goals guide the drafting of the objectives presented in Section 2, (Issues and Options).

Soil and Water Conservation

(1) Maintain versatility of the land.

(2) Maintain soil productivity.

(3) Enhance land productivity.

(4) Maintenance and enhancement of the quality of the natural waters.

(5) Achievement of the best uses of the natural water, and multiple uses.

Rivers and Wetlands

(6) The conservation, protection and enhancement of the natural character and visual appearance of river and lagoon margins and wetland areas.

(7) The maintenance of rivers and the lagoon in a condition that allows for the widest range of existing and future uses.

Coast

(8) The conservation of the coastal zone which takes into account natural values and the dynamic and fragile nature of the system.

Mahika Kai

(9) The recognition of the Takata Whenua as guardians of the Mahika Kai (traditional gathering areas).

Wildlife Habitats and Fisheries

(10) The maintenance of wildlife habitats and fisheries of the catchment.

Sites of Cultural, Historic and Scientific Importance.

(11) The identification of sites of regional significance and support of protection of sites, of cultural, historic and scientific interest.

Advocacy

(12) The advocacy of wise and sustainable management of the natural resources of the catchment.

Minimising Resource Conflict

(13) The minimisation of conflicts over the use and management of natural resources of the catchment and facilitation of resolutions.

Hazard Prone Areas

(14) Limited asset development in areas recognised to be subject to naturally occurring hazards so as to minimise economic losses and social hardships.

Recreation

(15) Access to recreation areas, activities and facilities, to meet the recreation needs of the regional community.

(16) The conservation and protection of the natural environment to retain a diverse range of recreational experiences.

Community Involvement

(17) The involvement of the community in the Council's discharge of its statutory responsibilities.

1.4 Explanation of Format

There are many issues relating to the use of natural resources in the Opihi Catchment. Ten major issues have been identified and presented in this document. Each issue is defined in terms of natural processes, uses of the natural resource and problems arising from uses. Objectives are presented with options as to how they can be achieved. The advantages and disadvantages of each option are presented. **The Council is not constrained to the issues identified or the objectives and options presented. The order in which they occur or are listed does not indicate any preference or priority.**

The objectives must be taken together, ranked and weighted to apply to a particular issue or area of the catchment. There may be a balancing process, which will involve monitoring to ensure that multiple objectives are met. The integration of objectives requires that the Council consult, liaise, re-assess and redefine along with continuing investigations, as the management plan is drafted, and during the life of the management plan.

The **goals** relate to basic statement of principle which remain constant over time. These goals have evolved over many years and may be considered as the goals generally accepted by the community, and reinforced by legislation.

The **objectives** in Section 2 indicate the Council's interpretation of its statutory responsibilities in the catchment including achieving the goals.

Policies are guides to decision making in the catchment by the Council and its staff. The Council's policies, objectives and outcomes have been published in the Corporate and Annual Plans. Policies reflect philosophy. The underlying philosophy of the Council is to encourage multiple and sustainable land and water management in the catchment. Policies and objectives must be ranked in any management, resource development or protection programme in the catchment..

The **options** presented in this document are ways that these objectives could be achieved, as part of the management plan.

The changes that have taken placed over the past two years need to be recognised and the Canterbury Regional Council Annual and Corporate Plans should be referred to. Understanding of the changes will assist in the selection of options.

The Canterbury Regional Council is not the Catchment Board. It is a new organisation, with resources drawn from what was the North Canterbury, South Canterbury and Waitaki Catchment Boards, Canterbury and Aorangi United Councils, Pest Destruction Boards, Noxious Plants Sections, Nasella Tussock Board, Regional Transport Sections, and Civil Defence.

The major change to Catchment Planning is the integration within one organisation of the allocation, control and promotion of the sustainable use of natural resources.

The Canterbury Regional Council is more accountable to the community The Regional Council has published its Corporate and Annual Plan which provide the means for the community to assess the Councils policies and objectives and performance in achieving them.

The Range of Objectives and Options is now wider than before. There is opportunity now to reconsider the previous Catchment Board way of doing things and select the most cost effective means of implementing a wider range of objectives and options in consultation with the community.

The Canterbury Regional Council is outcome orientated. The purpose of plans is to define **what** is to be achieved, **how** it is to be done, at what **cost** and **timetable**, with **monitoring**. The achievement of environmental outcomes (eg clearer water and maintenance of habitat), requires an integrated, holistic approach.

Farmers are land managers and have within their control those changes in land use or land use practices necessary to achieve some of the objectives set out in this document. Financial incentives, previously funded by Government, have in the past been a way of achieving change. Any changes now need to be by consultation and participation, recognising and serving community interests, within tight financial constraints. Hence the need to consider the best of a range of options including regulations, incentives, education, advisory and information services.

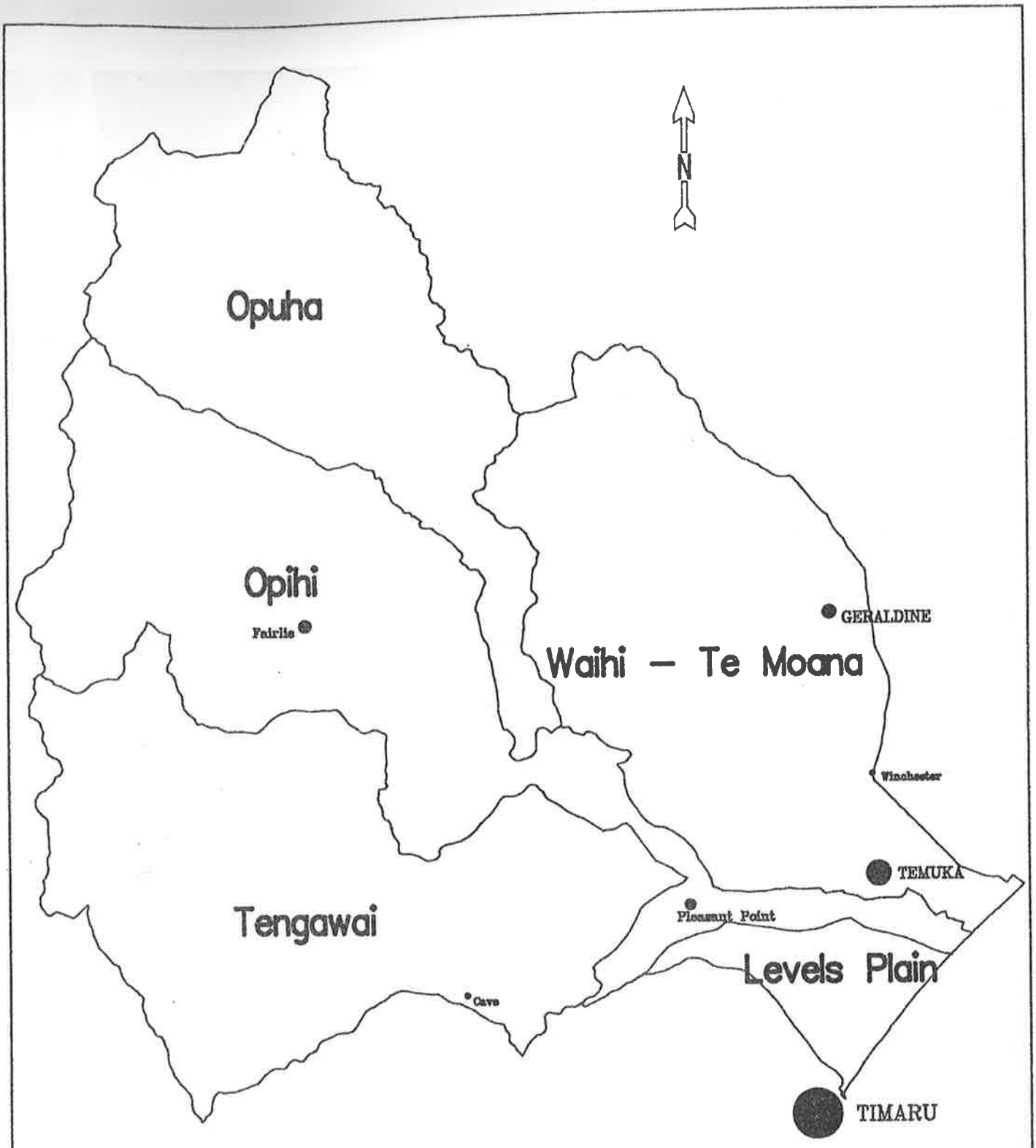
The Takata Whenua are the people of the land (indigenous people). The land gives the people their identity. The Takata Whenua are the guardians of the land. Town and country planning legislation requires provision for spiritual matters and for traditional and cultural uses. Water is highly regarded both for its spiritual qualities (its mauri or life-force, and its potential to give life, to purify and sanctify), for its benevolence and everyday usefulness, and as a source of food. Concepts of water are not alien to many of the policies and methods of good water management, however tolerance of pollution of water resources is very low compared with the standards of many Europeans. Refer to glossary of Maori terms and concepts.

Section 3 contains options for monitoring the catchment objectives and a summary of conflicts.

Section 4 contains acknowledgements, references, contact names and addresses and a glossary of terms used in this report.

1.5 Timetable

1.	Public Consultation - Issues and Options Report		1990
	(a)	Southern Area Committee releases Report	Dec 19
	(b)	Circulate report to Government Departments, Local Authorities, South Canterbury Constituency Committee etc for submission	Dec 19
			1991
	(c)	Community Liaison Group (CLG) Meeting	Jan 29
	(d)	Submissions received.	Feb 11
	(e)	Public meeting to hear submissions	Feb 19
2.	Prepare Draft Catchment Management Plan		
	(a)	Completion of first draft	March 1
	(b)	Circulation to project team and review first staff draft	March 29
	(c)	Staff and Councillor (SA Committee and Subcommittee) workshop	March 29
	(d)	Revise draft plan	April 15
	(e)	Consultation with CLG and SC Constituency Committee	April 16
3.	Draft Catchment Plan presented to Canterbury Regional Council		
	(a)	Subcommittee	April 30
	(b)	SA Committee	May 15
	(c)	Planning and Resources Committee	May 17
	(d)	Canterbury Regional Council	June 7
	(e)	Public notification of draft plan	June 15
4.	Public consultation using Draft Management Plan (including calling for submissions)		
5.	Presentation of Management Plan to Council (including its Committees)		
6.	Public notification of Management Plan including minimum flows.		
7.	Appeals on minimum flows if required.		



CATCHMENT NAME	AREA (ha)	% of TOTAL CATCHMENT
Opihi	62857	26
Tengawai	64192	26
Opuha	48811	20
Levels Plain	8702	3
Waihi – Te Moana	61101	25
TOTAL	245663	100

SCALE
0 km 5 km 10 km 15 km

Opihi – Temuka Catchment Management Plan

JEC 14/11/90

Figure 1 OPIHI TRIBUTARY CATCHMENTS

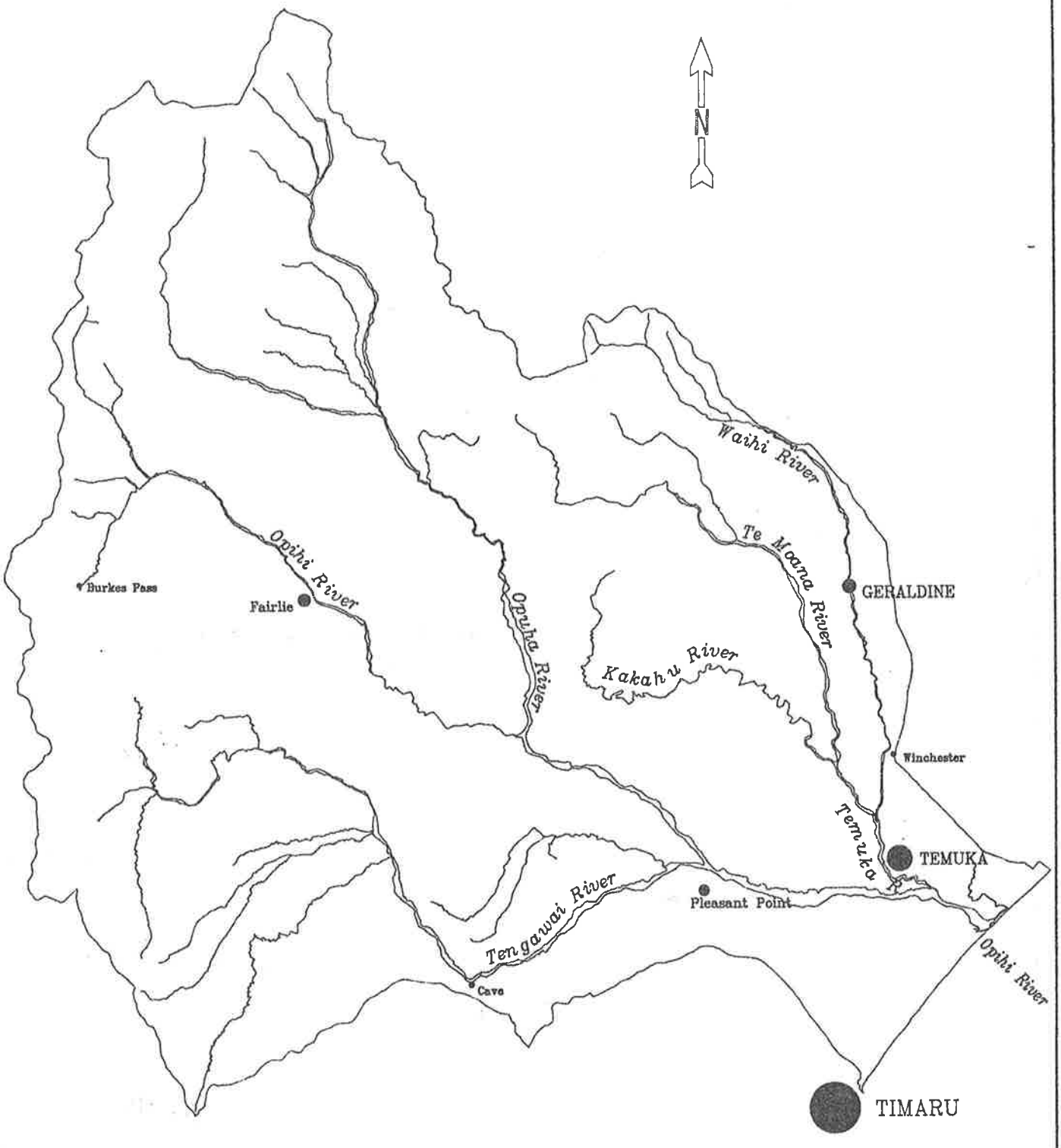


Figure 2 OPIHI CATCHMENT BOUNDARY, TRIBUTARIES AND TOWNS

2.1 Opihi River Lagoon

2.1 Opihi River Lagoon

Background

The Opihi River lagoon is characterised by the absence of tidal backflow and delta. One of the unique features of lagoons of the Canterbury Bight rivers is the strong drift northward along the mixed sand-gravel coast preventing any northward delta formation. The closure of the mouth is a natural feature. In the past closure occurred infrequently, during periods of natural low river flows and southerly sea conditions. Currently, the following problems have been identified:

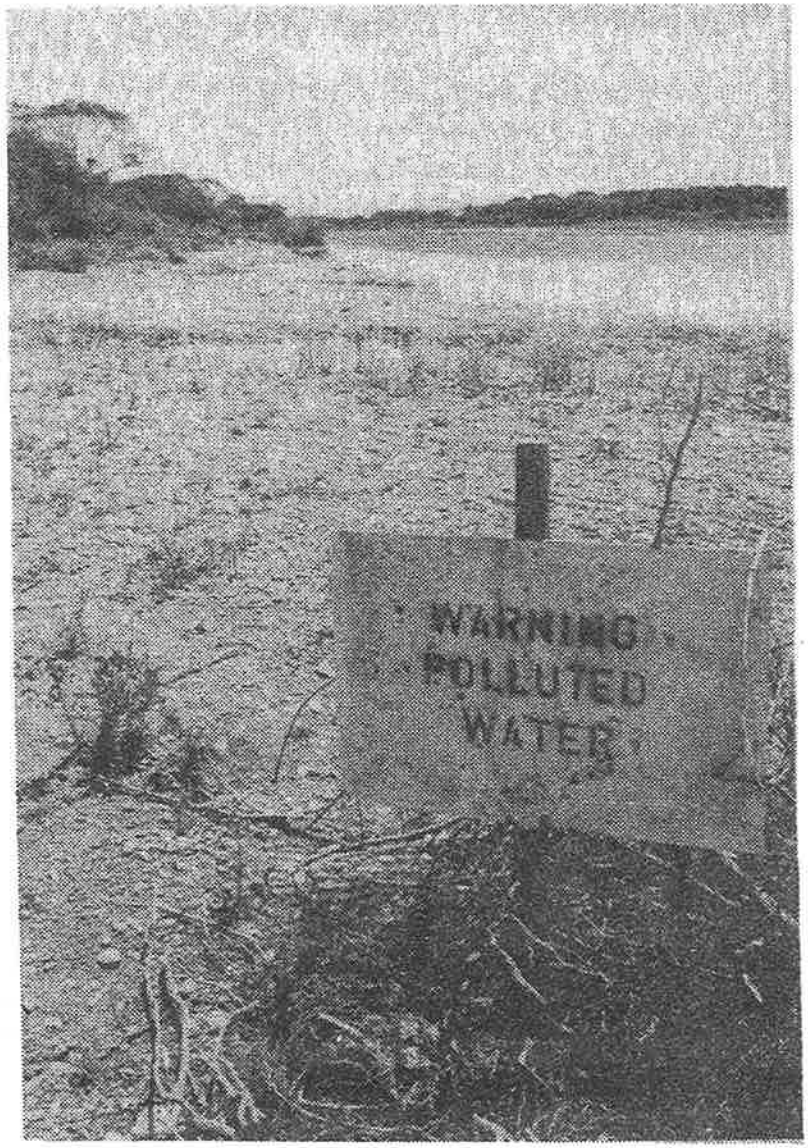
- increased frequency and duration of closure of river mouth
- interruption of passage of migratory fish, following mouth closure
- declining water quality following mouth closure, due to low flows and waste discharges (treated sewage, industrial waste, nutrient runoff from farms)
- decreasing area of the lagoon due to coastal erosion
- increasing pressure on the fisheries due to increasing numbers of people fishing and whitebaiting
- decreasing river flows into the lagoon due to abstraction for irrigation and water supply
- decreasing area of marsh vegetation and wetlands due to drainage and vegetation clearance, roading, housing, sedimentation and stopbanks
- reduced river channel width and braid numbers resulting from flood and erosion protection works, including stopbanks and plantings.

As a result of the identified problems, the number and condition of the niches and habitats that make up the Opihi River Lagoon environment has declined, resulting in declining natural populations and diversity of species. This includes wildlife species that are an important part of the recreational fisheries, and mahika kai (a place where the Takata Whenua sought food).

Over the past 120 years, the area available for ponding has decreased from 120 to 60 hectares due to coastal erosion. The lagoon beach has retreated 116 metres since 1865 (erosion rate of about one metre per annum). A 50m retreat in beach position at the Opihi River Lagoon would reduce the lagoon area by approximately 6 hectares (10% of present area) and any future retreat would result in the loss of the lagoon ponding area north of Harakeketautoro Island.

Eighteen fish species (Table 1) are known from the Opihi River system (Palmer and Sagar 1990). It is probable that some species have been lost since development of the land for production.

Prior to 1840 the Opihi River was a significant Maori fishery for tuna (eel), patiki (flounder), inanga (whitebait), kanakana (lamprey). Eels were still abundant up until recent times. The Opihi has been renowned in more recent times for the salmon and trout fisheries. Whitebaiting remains a popular pursuit. Most of the fish listed in Table



Warning sign erected by the Salmon Anglers Assn at the Opihi River Lagoon December 1988

Opihi River Lagoon looking north east towards the sea January 1989. The mouth was blocked resulting in declining water quality and an algal bloom.

1 are migratory. It is vital to the conservation of these species that the river mouth be open to facilitate migrations in all seasons and that loss and degradation of habitats in and around the lagoon ceases. Maintenance and enhancement of the habitats can be achieved by actions which resolve conflicts of use. (Refer to Table 2). A plan for the conservation of the river lagoon, to facilitate sustainable management of habitats, could be drawn up to resolve the conflicts of use.

The Canterbury Regional Council currently opens the Opihi River mouth about ten times each year, using a hydraulic digger at a cost averaging about $500 per opening. The criteria for opening the mouth are deteriorating water quality (temperature greater than 24°C, pH greater than 9.0) and water height (water at Milford huts). Increasing the number of openings to ensure passage (and survival) of migratory fish will result in increased costs. Alternatives to the status quo need to be looked at and discussed by all groups and people interested in the sustained management of the habitats of the Opihi River lagoon.

The proposal to augment Opihi River flows could benefit the Opihi River lagoon. If flows at Saleyards Bridge were mainted at 3.2 m^3/s the mouth could remain open and water quality maintained for longer periods. Section 2.8 expands on the augmentation proposals.

Objectives

The following objectives arise from acceptance of the concept of sustainability by the community. Put simply, we pass onto the next generation our natural resources (in this case the Opihi River Lagoon) in the same or better condition than it is now.

Objective 1 *The Canterbury Regional Council in consultation with all interested organisations, groups and people, draw up a conservation plan for the Opihi River Lagoon by June 1992.*

Objective 2 *The provision of,whenever possible, sufficient water to maintain a large enough flow in the Lower Opihi and Temuka Rivers to keep the mouth open.*

Objective 3 *The maintenance of water quality in the Opihi River Lagoon suitable for fish life.*

Objective 4 *The passage of migratory fish by opening the river mouth following closure.*

Objective 5 *To define the best and most cost effective option for mouth opening.*

Objective 1. One of the reasons why this conservation plan needs to be drafted in consultation with the community is to minimise conflicts over the use and management of the natural resource and facilitate resolution. Conflicts can be minimised by, for example, allocating areas and/or times to various users, that are compatible with sustainable habitat management. Planning involves landowners (including the Department of Conservation, Canterbury Regional Council, Timaru District Council and the Takata Whenua) in the detailed use and zoning of land, and the question of access.

Objective 2. This is an objective of the current Opihi River Water Management Plan. River flows at times of closure vary, according to the strength of beach gravel drift and position of the mouth channel. Offset channels close if flows recede below 6 m^3/s. Short straight channels can remain open at flows as low as 3 m^3/s **if there is minimal beach gravel drift.** Flows required to naturally breach the barrier following closure are in the range of 12.5 - 17.0 cubic metres per second.

Objective 3 is an objective of the current plan. The quality of water in the lagoon deteriorates following mouth closure. Water flowing into the lagoon receives discharge from sewage, industry and nutrient runoff from farmland. Currently the Opihi River mouth is opened if water temperature exceeds 24.0°C or if pH exceeds 9.0 or gauge height at Milford Huts exceeds 1.7 metres (2.8 metres above mean sea level (MSL))

Action can be initiated by the Canterbury Regional Council in advance of the above critical threshold conditions, through consultation with the Chairman of the Arowhenua Runanga, the Field Centre Manager, Department of Conservation and the South Canterbury Fish and Game Council.

Objective 4 is proposed to run concurrently with Objectives 2 and 3. Procedure for opening the mouth also includes common sense. That is, it is a waste of time opening the mouth during low flow conditions while southerly seas are running. Essentially the opening of the mouth based on these objectives (2,3, and 4) is part of management by the Council to decrease the conflicts in resource use. One of the disadvantages of taking water for irrigation, and dischargeing waste is increased artificial mouth openings.

Objective 5. Achieving Objectives 2, 3 and 4 will result in higher costs. Therefore all options need to be considered, within the context of a management plan. These options involve time (eg life of structures) and hence the use of appropriate discount rates when comparing the solutions within an economic framework. The benefits from the use of water for irrigation and water supplies can be defined along with the cost of maintaining an open mouth. The net benefit of resource use can be defined within an economic framework. Who benefits? Who pays? Water right holders? All water users? Ratepayers?

OPTIONS

Options for the maintenance of sustained low flows and water quality are detailed in sections 2.2 and 2.3.

The following options are proposed to artificially open the lagoon mouth. Figure 3 shows the location of structural options.

Option 1 Continue artificial openings of mouth as required, linked to temperature and pH, and lagoon water level. This is the status quo.

Advantages

- Avoidance of fish kills in lagoon. Reduced flooding at Milford Huts.

Disadvantages

- Insufficient openings to maintain passage for fish.
- Rough order of cost $5000 p.a. for 10 openings.

Option 2 As for Option 1 but with increased frequency to maintain an open passage for migratory fish throughout the year (linked to river flow and sea conditions.

This option could include an operation rule during critical migration periods, which sees the mouth opened within a period of five consecutive days following closure.

Advantages

- Maintenance of the fisheries.
- Avoidance of flooding at Milford Huts.

Disadvantage

- Rough order of cost $15,000 p.a. for 30 openings.

Option 3 Continue stopbanking on both sides of the river across the lagoon to the beach ridge (refer to Figure 3).

Advantages

- reduced duration of closure by quicker build up of water head in lagoon to initiate breach event because of reduced ponding area
- reduced flooding of Milford Huts area

Disadvantages

- Will require protection work on end of northern bank as point of maximum scour attack.
- Artificial opening will still be required at times.
- Mouth may outflank coastal work with coastal recession (erosion)
- Effect on habitats outside the stopbank river channels, with use of one way pipeoutlets not known. This will require investigation.
- Rough order of cost $80,000 (equivalent to 160 openings, $500 per opening).

Option 4 Continue the stopbanking down to the beach ridge on the northern side of the river only.

Advantages

- reduced duration of closure by quicker build up of water head in lagoon to initiate breach because of reduced ponding area. Approximately 70% of the water ponds north of the lagoon.

Disadvantages

- still requires protection work, plus similar fate as in option 3), with coastal recession
- may still require artificial mouth openings if closures occur when the mouth channel is in a southerly direction
- use of one way pipe outlets and need for ecological investigations as in option 3).
- Rough order of cost $35,000 (equivalent to 70 openings).

Option 5 Place heavy rock at end of stopbanking to contain mouth (similar to the Orari situation). Stopbanking as given in option 3 .

Advantages

- reduced number of closures by limiting ability of northward displacement of mouth channel

Disadvantages

- Continued maintenance required after major storms. Mouth may outflank rock work with coastal recession.
- Rough order of cost $200,000

Option 6 A type of boxed structure through the beach ridge.

Advantages

- reduced frequency and direction of closures in some circumstances (by creating a weak point for breaching)

Disadvantages

- still have requirement for artificial openings
- regular maintenance to box structure required due to storm damage and landward lengthening due to coastal recession.
- Rough order of cost $200,000.

Whitebaiting

November 1990

northerly river mouth.

. Mechanical opening of the Opihi River mouth may still be necessary from time to time, depending on sea and flow conditions. This photo shows the mouth being opened by SCCB during the 1982 drought, when water temperature and pH reached levels critical for fish survival.

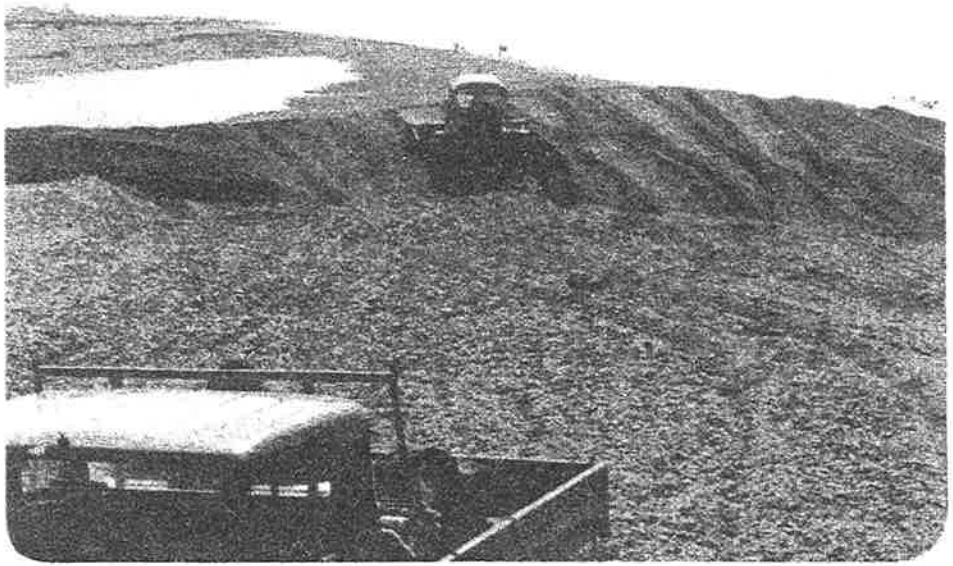


Figure 3 Location of Options to Maintain an Open River Mouth

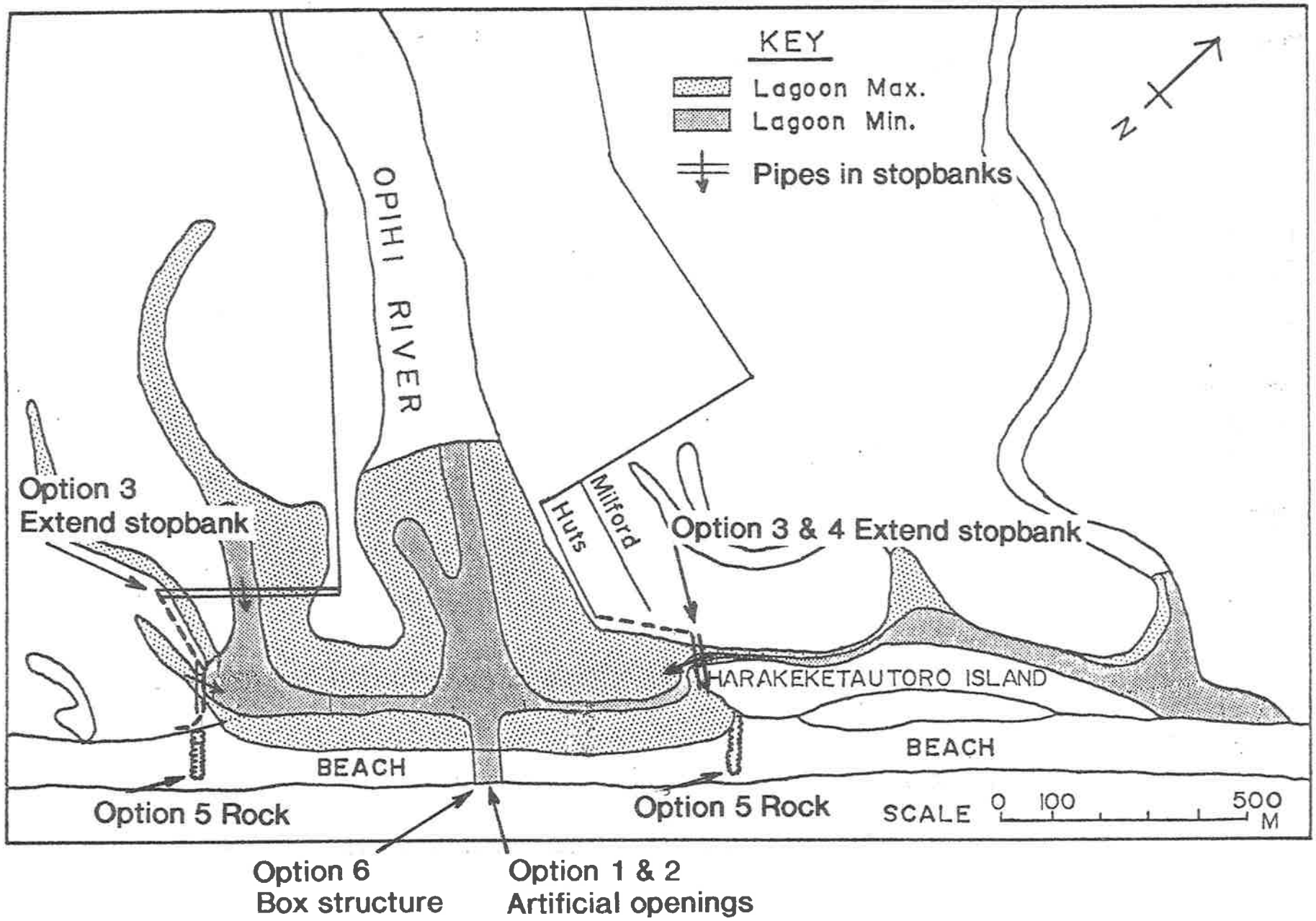


Table 1

MIGRATION AND SPAWNING OF FISH IN THE OPIHI RIVER SYSTEM

USERS	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
(Salmonid Fishing)	———	———	———	———						———	———	———
(Irrigation)	———	———	———							———	———	———
(Whitebait Fishing)								———	———	———		
Resident Brown Trout				Sp	spSP	SPsp						
Sea Run Brown Trout	←	←sp	←	sp	sp	sp				←	←	←
Quinnat Salmon	←	←	←	←	spSP	SPsp					→	
Rainbow Trout								sp	sp			
Inanga	sp	sp	SP	SP	sp			←	←	←	←	←
Alpine Galaxias								sp	spSP	sp		
Common River Galaxias							sp		sp	sp		
Common Bully	↔	↔							sp	sp	sp↔	sp↔
Upland Bully	sp	sp							sp	sp	sp	sp
Bluegilled Bully							sp	sp↔	sp↔	sp↔		
Koaro				sp	sp	sp	→	→	←	←		
Torrent Fish	sp	sp	sp	sp					←	←	←	
Lamprey								←	←	←		
Yelloweyed Mullet	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Kahawai	↔	↔	↔								↔	↔
Common Smelt	sp	sp								sp	sp	sp
Black Flounder							→					
Longfinned Eels	←	←	→	→	→		←	←	←	→	→	→
Shortfinned Eels	←	←	→	→	→		←	←	←	→	→	→

Key:
- sp — spawning
- SP — peak spawning
- ← — enter mouth, upstream migration
- → — downstream migration, exit mouth
- ↔ — both above

(After Palmer and Sagar 1990)

Table 2

IDENTIFICATION OF EXISTING CONFLICTS - OPIHI RIVER LAGOON

USES	Sustainable Habitat Management		
	River Mouth and Coast	**River Lagoon**	**Wetlands and adjacent land**
Farming	o	o	o
Water Abstraction	---	---	x
Nursery for Coastal Fisheries	xxx	xxx	xxx
Nursery for Wildlife (including wild fowl)	xxx	xxx	xxx
Fishing	-	-	-
Shooting	o	-	-
Boating	o	xx	-
Motor Boating	o	--	---
Off Road Vehicles	---	---	---
Picnics , Sight Seeing	xx	xx	-
Camping	o	o	-
Bach owning (Seasonal use)	o	-	--
Permanent Residency	o	-	---
Services for baches (Roads, power, sewage water supply, rubbish disposal)	o	---	---
Flood protection for Baches (Stopbanks, rock, plantings)	---	---	---

Key
- --- High incompatibility
- -- Medium
- - Low
- o Neutral
- x Low compatibility
- xx Medium
- xxx High

Table 2

IDENTIFICATION OF EXISTING CONFLICTS - OPIHI RIVER LAGOON

USES	Sustainable Habitat Management		
	River Mouth and Coast	**River Lagoon**	**Wetlands and adjacent land**
Farming	o	o	o
Water Abstraction	---	---	x
Nursery for Coastal Fisheries	xxx	xxx	xxx
Nursery for Wildlife (including wild fowl)	xxx	xxx	xxx
Fishing	-	-	-
Shooting	o	-	-
Boating	o	xx	-
Motor Boating	o	--	---
Off Road Vehicles	---	---	---
Picnics , Sight Seeing	xx	xx	-
Camping	o	o	-
Bach owning (Seasonal use)	o	-	--
Permanent Residency	o	-	---
Services for baches (Roads, power, sewage water supply, rubbish disposal)	o	---	---
Flood protection for Baches (Stopbanks, rock, plantings)	---	---	---

Key
- --- High incompatibility
- -- Medium
- - Low
- o Neutral
- x Low compatibility
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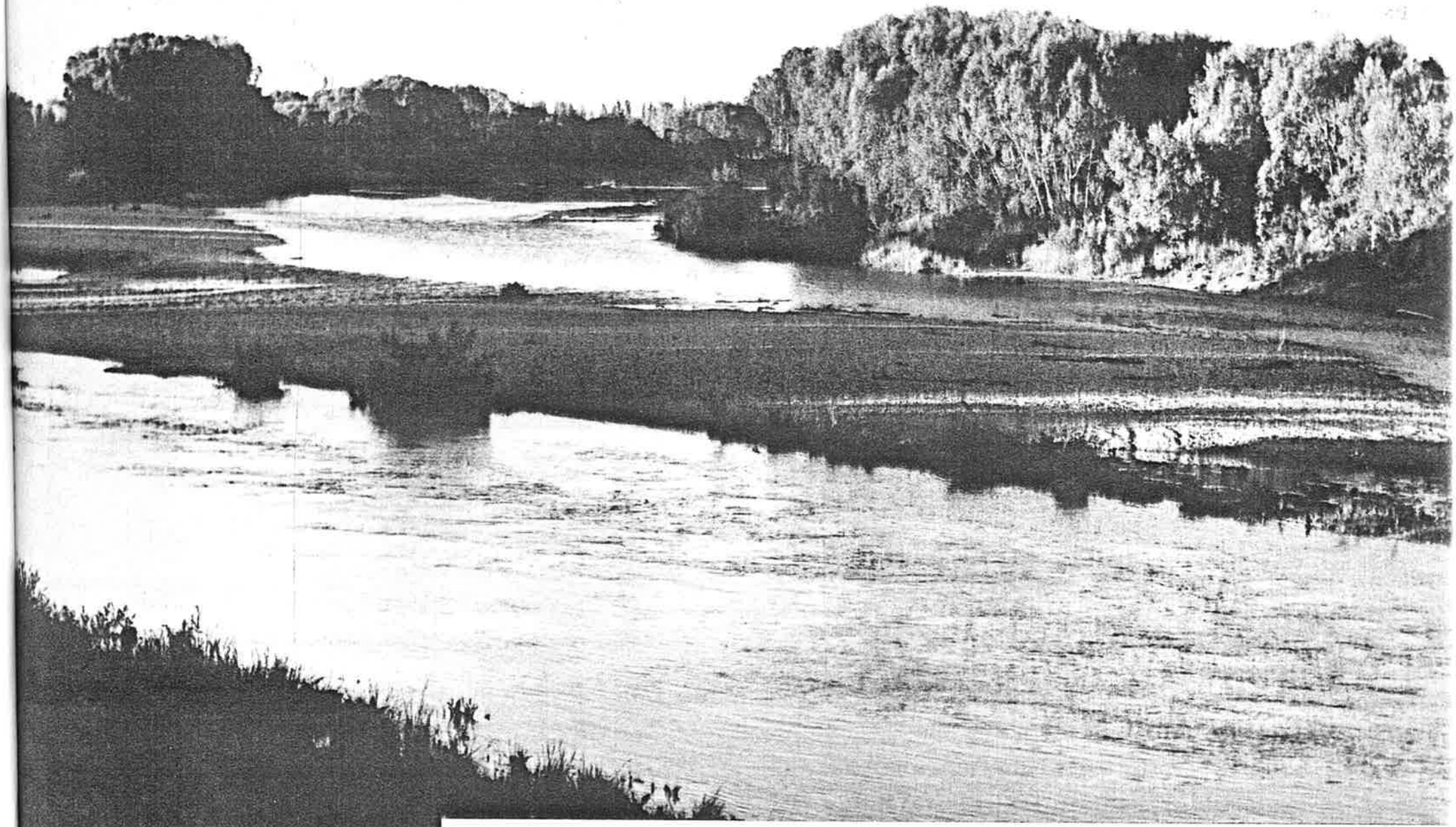


2.2 Opihi and Temuka River Low Flows

2.2 Opihi and Temuka River Low Flows

Background

This section addresses the issue of the occurrence of low river flows within the Opihi and Temuka Rivers, and presents a number of options that could be used to provide an equitable sharing of those resources. While concentrating largely on how the resource should be managed and shared during low flows, the options and principles presented here should also be considered in conjunction with sections 2.5 and 2.7 which present options for enhancing water quality and quantity by using various land management options and making the best use of water.

The surface water resources of the Opihi and Temuka Rivers have been previously documented. From these studies it is clear that the occurrence of summer low flows combined with irrigation abstractions and effluent discharges impact adversely on the water quality of the lower river, particularly the Opihi River Lagoon. An important objective of water management within this catchment is to maintain the water quality and quantity at the Opihi River Lagoon at the highest possible level. Although the basic principles of sharing and managing the resource are similar, the hydrology and low flow regimes of the Opihi and Temuka Rivers are sufficiently different to warrant individual consideration. This point is further highlighted by the need to set minimum flow rates on both the Opihi River at Saleyards Bridge and the Temuka River at State Highway One (SH1) Bridge in order to maintain acceptable water quality and quantity in the Lagoon. Figure 4 shows the location of the flow monitoring sites.

Temuka River Hydrology

The Temuka River Catchment consists predominantly of farmland with intensive cropping, dairying and horticulture on the flood plains. Such land uses contribute significantly to a downgrading of water quality within the catchment, especially in nitrate and nutrient leaching to the shallow groundwaters which, in turn, supply the lower Waihi and Temuka Rivers.

The headwaters of the Temuka River drain the eastern slopes of the coastal foothills and lowlands between the Orari and Opuha Rivers. With the majority of the catchment lying within the coastal and surrounding lowland areas, the impact of snow melt (which sustains spring flows within the neighbouring catchments) is limited. During the summer, low flows within the lower reaches of the river are sustained almost wholly by groundwater from springfed creeks within the Waihi River. With an average annual flow of approximately 6.7 m^3/s at the SH1 Bridge, the summer flow can be expected to reduce to 1.4 m^3/s and once in every fifty years that flow could be as low as 0.3 m^3/s. The lowest recorded flow (0.25 m^3/s) occurred during the 1985 drought.

Opihi River Hydrology

The Opihi River (excluding the Temuka) drains the eastern slopes of the Hunters Hills (Tengawai River), Rollesby and Two Thumb Ranges (Opihi and Opuha Rivers). Automatic water level recorders have been established on the Tengawai at Cave (1982), Opihi at Rockwood (1965) and Opuha at Skipton Bridge (1965). Although a recorder was temporarily installed during 1973-74, river bed instability at the Saleyards Bridge site precludes the establishment of a permanent recorder station at this site. A synthetic flow record has been produced for the Opihi River at Saleyards Bridge using flow correlations with the Rockwood and Skipton recorder sites.

In contrast to the Temuka River, the Opihi and Opuha Rivers have a greater proportion of their headwaters lying above the winter snow line (1200 metres), thus the influence of snow melt within these rivers results in higher spring flows which can extend into early December. With an average annual flow at Saleyards Bridge of approximately 19 m^3/s, the annual summer low flow can be expected to reduce to 3.2 m^3/s and once in every 50 years that flow can be expected to be as low as 1.0 m^3/s. The minimum gauged flow at Saleyards Bridge is 1.56 m^3/s.

Losses from the surface water resources occur below the Saleyards Bridge site. Such losses, principally to the channel shingles and shallow aquifers bordering the main channels, tend to be temporary by nature and are in the main recovered as spring flow below the Temuka River confluence.

Effects of Low Flows

Low flows within the catchment have a detrimental effect on the fisheries, birdlife, and aquatic fauna and flora of the rivers as well as impacting on the visual, recreational and cultural values of the population. The major impacts of these low flows are:

a) Reduction in flow volumes and rates, which in turn reduces the rivers ability to assimilate wastes.

b) Reduction of quality (increased temperature, decreased oxygen content) due to lack of aeration when rapids and turbulent flow disappear.

c) Loss of habitat for fisheries, wildlife, birdlife and flora.

d) Visual impacts.

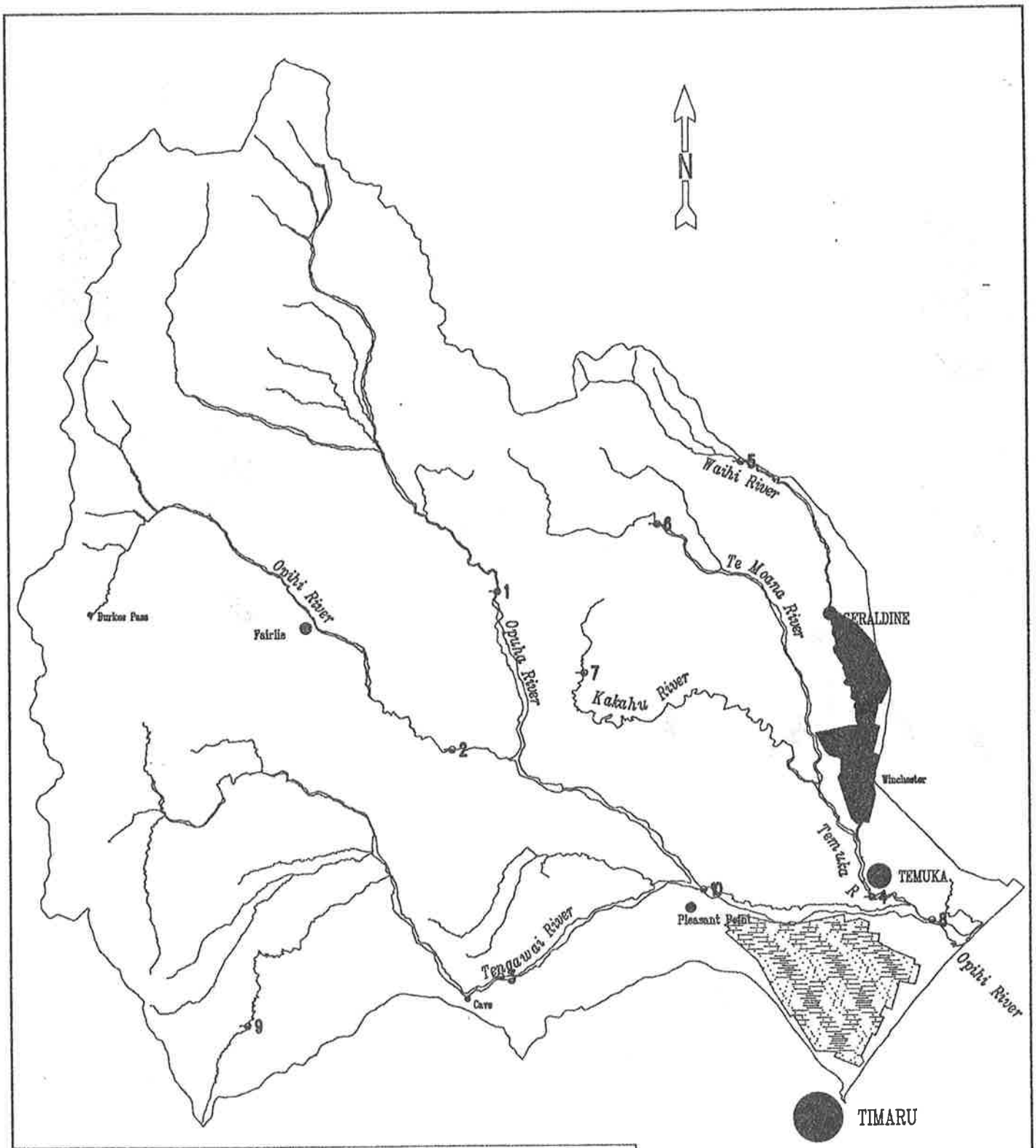
The major causes of low river flows have been identified as:

a) Lack of sufficient rainfall during summer. (Refer to Figure 6 Mean Annual Rainfall)

b) Abstraction of water for stock, domestic, public supply, agricultural and industrial uses.

c) Modification and reduction of the catchment water holding capacity through land management practices of drainage of wetlands, cultivation of downlands into crop and pasture, and the introduction of cattle into the upper catchments.

d) Loss of surface flows to either shallow groundwater or channel "underflow" (ie river flow remains within the channel confines, but flows underneath the river gravels).



LEGEND

Flow Monitoring Sites

1 Opuha at Skipton
2 Opihi at Rockwood
3 Tengawai at Picnic Grounds
4 Temuka at SH1
5 Waihi at gorge
6 Te Moana at Glentohi
7 Kakahu at Mulvihills
8 Opihi at Waipopo
9 Rocky Gully at Rockburn
10 Opihi at Saleyards (Gauging Site only)

- Ground Water Protection Zone
- Levels Plains Irrigation Scheme
- Flow Monitoring Site

SCALE

0 km 5 km 10 km 15 km

Opihi – Temuka Catchment Management Plan

JSC 6/12/90

Figure 4 OPIHI FLOW MONITORING SITES

The Canterbury Regional Council have a number of ways to reduce the adverse effect of water abstractions in the Opihi and Temuka river systems. These include:

a) Other than for firefighting, individual household water supplies and provision for stock water, water rights are required for all purposes other than stock, domestic or fire fighting purposes for all abstractions where the flow volume would exceed 500 m^3/week, or the flow rate exceeds 10 l/s, or the total farm area exceeds 3 hectares.

b) Within the catchment, water right applicants are allocated a maximum water volume of 250 m^3/ha/week for the area of farm to be irrigated. This allocation applies to all irrigation application methods and equates to a water depth of 25mm per week from irrigation.

c) The use of "water efficient" irrigation methods are encouraged. Spray and trickle methods are encouraged over wild flooding and border dyke systems.

d) The use of groundwater is encouraged over surface water extraction throughout those areas where a sustainable groundwater resource exists.

Recently the Council has ensured that water rights are issued at realistic quantities, and that the volume of water and rate of abstraction accurately reflect the applicant's ability to exercise that right.

Objectives

The following objectives are proposed:

Objective 1 *The maintenance of sustainable flows by controlling and limiting the total quantity of water abstracted from surface water resources.*

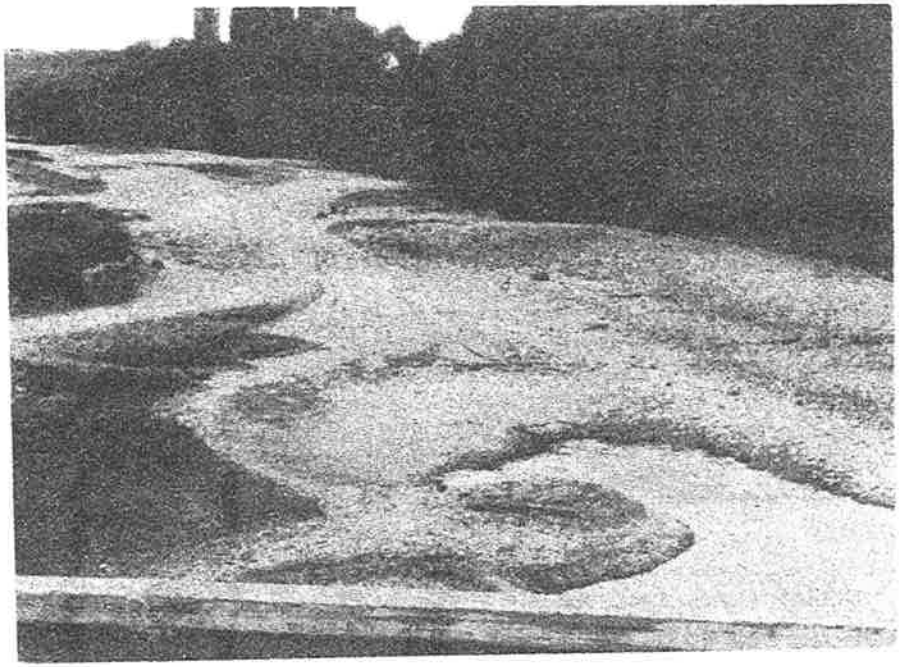
Objective 2 *The maintenance of minimum flow levels at selected sites to provide adequate flows for as long as possible for aquatic and wildlife habitats, and to meet water quality standards.*

Objective 3 *Equitable sharing of the surface water resources between in-stream and abstractive uses during times of low flow.*

Objective 4 *Effective monitoring of the sharing rules.*

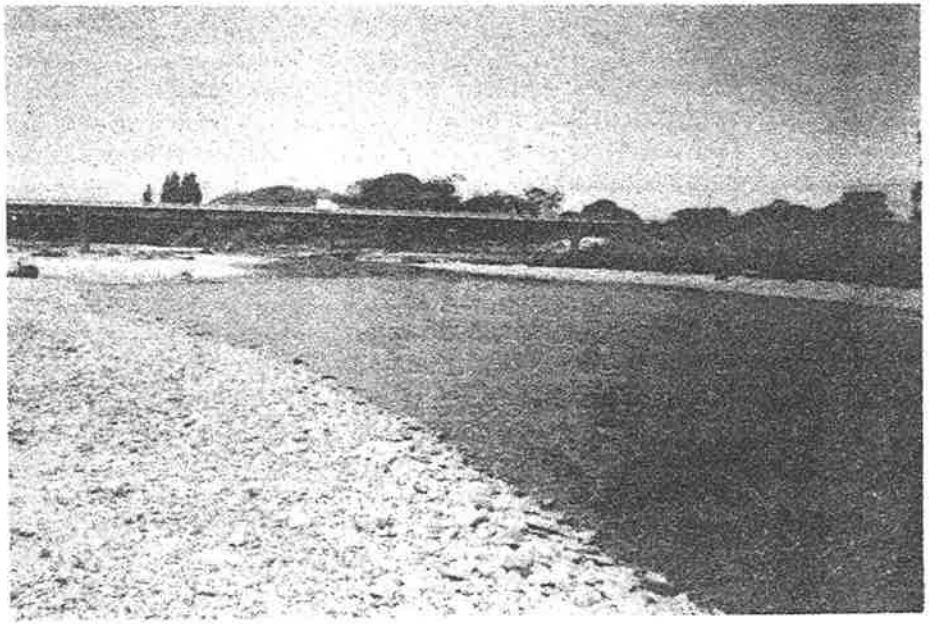
Minimum flows are required to be set at strategic sites on the river tributaries to maintain minimum standards of water quality and aquatic habitat. Under the existing water management policies, minimum flows have been established on the Opihi River at Saleyards Bridge (SYB) and on the Temuka River at State Highway One (SH1) Bridge. After consultation, the Council will set minimum flows below which all abstractions must cease, other than for domestic, stock and firefighting purposes.

To aid the understanding of the effect of restrictions three options are demonstrated using Temuka River flows. Figure 5 shows the flow record for the Temuka River at State Highway One Bridge for the period September 1984 to August 1985. This



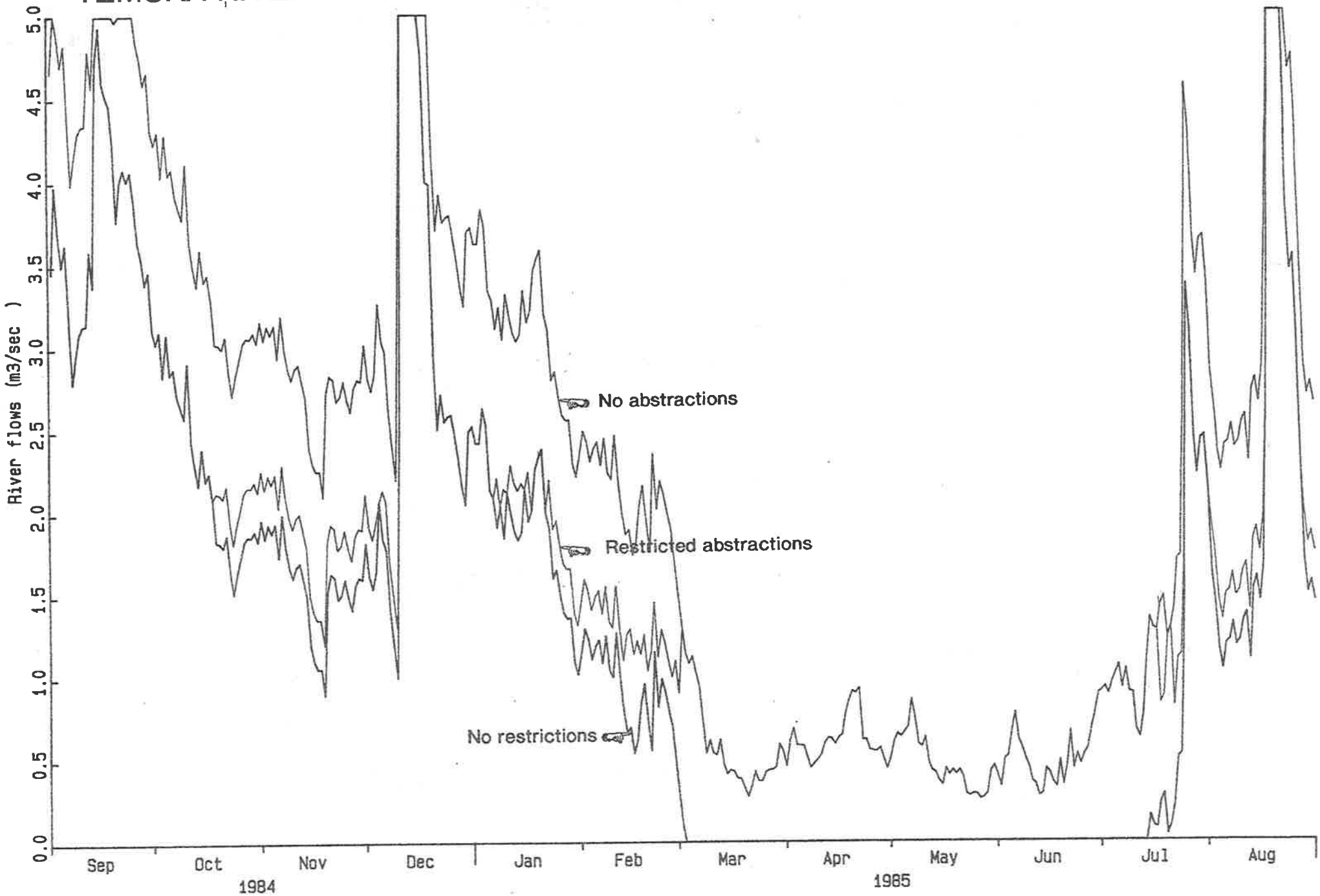
The Opihi River at SH No. 1. During the severe drought of January-April 1982 (approx a 1 in 80 year event), the river was dry between Butlers Road and the Temuka River confluence; a distance of 14km, and extensive fish rescue operations carried out by the South Canterbury Acclimatisation Society was necessary.

The Water Management Plan seeks to ensure that a residual flow between Butlers Road and the Temuka River confluence is maintained at all times, and to this end has set a minimum flow of 2.0m^3/s at Butlers Road whereby all irrigation abstraction ceases when the flow in the river depletes to that level.



TEMUKA RIVER FLOW RESTRICTION OPTIONS

Figure 5



period, which covers the well remembered "1985 Drought" and displays river flows that could have occurred under various options.

The uppermost line ("No abstraction") shows the river flows that could have occurred if there were no abstractions from the Temuka River, and indicates that the river would have receded to approximately 0.35 m^3/s to 0.40 m^3/s at the height of the drought. The bottom line ("No restriction") shows that if no restrictions were placed on abstractions, the river flows would have been lower during the entire irrigation season, and would have been dry from early March to mid July. With some form of restriction (the middle line of figure 5) it would have been possible to maintain "natural" low flows during the height of the drought.

The 1984 Opihi River Water Management Plan proposed that all right holders who abstracted more than 2500 m^3/week would be required to purchase and install in-line flow meters or other such flow measuring equipment of approved design. Following further submissions from the Opihi Water Users Committee, and after extensive field tests, it was accepted that provided an irrigation plant had been suitably flow calibrated (by comparing the volume of water pumped to the power consumption or pump motor engine hours), the recording of weekly power consumption (or engine hours for diesel units) could provide water usage data of sufficient accuracy to enable policing of water rights. The return of water use monitoring cards from irrigators has been poor in recent years.

Options

The following options are proposed:

Option 1 Do not restrict abstractions once water rights granted.

Under this option, water abstraction would only be limited by the Council's decision to either grant or decline an application. Once a water right was granted there would be no restrictions imposed.

Advantages

- If water is available, this will allow water right holders to fully exercise their allocations.

Disadvantages

- Zero flows for longer periods, with habitats lost or not maintained.
- Unequal sharing between abstractors upstream getting more water than abstractors downstream.
- Recreation and environmental demands and interests are not satisfied.
- Does not meet objectives.

Option 2 Restrict all abstractors during times of low flows.

This option involves the setting of a minimum flow capable of maintaining fisheries and wildlife to an acceptable level at some selected sites. Once this flow is reached, all abstractions for non-essential uses would be banned until a suitable recovery of flows occurred. Flows naturally reduce even though abstractions have ceased, so the setting of a minimum flow of 2 m^3/s, for example, does not guarantee that this flow is maintained. The minimum flow also has a downstream impact on the Opihi Lagoon water quality. This option is dealt with more fully under the scenario presented later in this section.

A series of "trigger levels" are required to be determined whereby users are progressively restricted. Regional Council staff would then monitor the river flows on a daily basis and notify users when various restriction levels were required.

Advantages

- Ensures allocation of surface resources to in-stream uses during low flows.
- Maintains "natural" low flows once the minimum flows are reached.

Disadvantages

- Reduces the amount of water available to irrigation.
- Involves Council staff in administering restrictions.

Option 3 Allow users to form water user groups who would be responsible for creating rosters and managing their abstractions in such a way that the river flow exceeds established minimum flows at strategic sites.

Under this option, river flows would be monitored by Regional Council staff who would inform the user groups when rostering was required. When the established minimum flows were reached all irrigation and industrial abstractions from the river would cease.

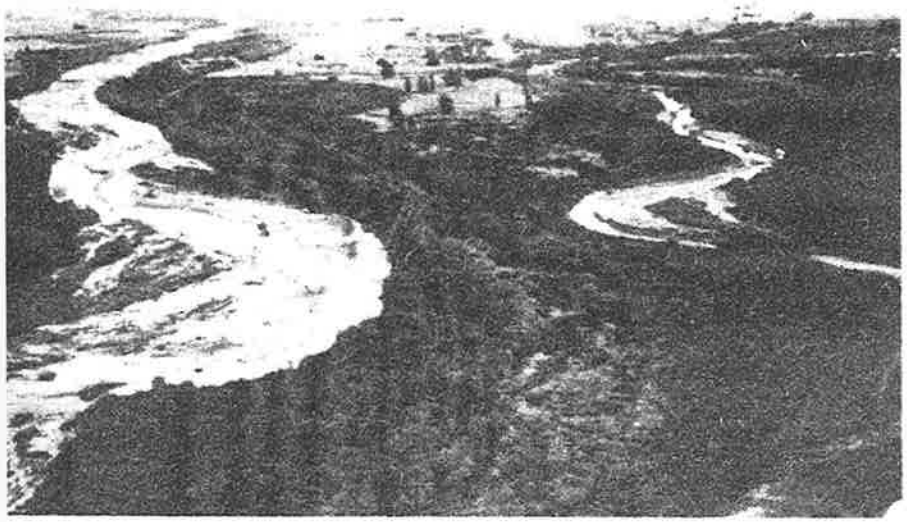
Advantages

- As for Option 2 above
- Involves users in resource management, thus increasing their awareness of the issues.
- Allows irrigators more flexibility in exercising their allocations to suit their water needs.

Disadvantages

- May result in rivers being maintained artificially at flow values near the minimum flow.

Option 4 Restrict abstractions on a "location" basis such that users on any named tributary may abstract water for three days out of seven.



View of the Opihi River above the Temuka confluence. The Temuka River is to the right, and Temuka township is on the extreme right.

View of the Opihi-Tengawai confluence from the Saleyards Bridge.

This option could be used in conjunction with Option 2 or Option 3 above to reduce the abstraction rate within any given tributary to ensure that natural flows occur for four out of seven days per week.

Advantages

- Ensures "natural" river flow in streams and tributaries for four out of seven days.
- Would be easily policed.
- Would enable irrigators to plan their irrigation schedules with more certainty.

Disadvantages

- Encourages excessive irrigation during days on.

Option 5 No abstractions.

Under this option, no abstractions other than stock and domestic supplies would be allowed.

Advantages

- Would ensure in-stream needs receive maximum available water.
- Would lead to improved water quality.

Disadvantages

- Clearly, this would be unacceptable to both the agricultural and industrial users as well as those who rely on public water supplies.
- Would not meet objective 3.

Option 6 All water right holders abstracting more water than 2,500m^3/week record the total abstraction per week by a method to the satisfaction of the Canterbury Regional Council.

Advantages

- Would ensure that abstractors are complying with water right conditions.
- Would provide information to irrigators and the Council on efficiency of water use.
- Would provide information on actual use of the natural water resource.

Disadvantages

- Cost to irrigators.

- Administrative cost to the Council.

- Some irrigators may not submit returns (for example during the 1989/90 season there was only a 30% rate of return) for the Opihi catchment.

- Possible loss of water rights by irrigators not submitting returns.

Option 7 Do not grant any further water rights for additional abstraction from surface water (except for renewals of current water use).

Advantages

- Protects existing abstractors.

- Limits environmental effects to current low flow situation.

Disadvantages

- Does not allow abstraction by users at non critical times of the year, when there is adequate water in the river.

Option 8 Grant all new water right applications for additional abstraction with minimum flows twice that proposed in scenarios (minimum low flow of 6.4 m^3/s for scenario B).

Advantages

- Would limit the duration of current minimum flows to that already experienced.

- Provides opportunity to take water for storage at non critical times of the year.

Disadvantages

- Favours existing users, rather than giving preference to new progressive water users.

Option 9 Cancel water rights or portions of water rights not used, for a period of five years after the granting of rights.

Advantages

- Discourages applications for water rights where there is no intention to exercise rights.

- Avoids retention of unused water rights as "insurance".

Disadvantages

- Need for sensitivity, due to changing circumstances relating to farm ownership or management.

- Can encourage inefficient use of water merely to retain water right.

- Under current law need to wait for the expiry of water rights before being able to place conditions on water rights to effect this option.

Scenarios for Sharing Low Flows

Under Option 2 a series of "trigger" levels for the restricting of abstractions in Tables 3 and 4 is proposed. The effects of each scenario on the abstractive users are given which show the numbers of days when total restrictions are predicted.

Opihi River at Saleyards Bridge

Scenario A Status quo which has a minimum low flow of 2m^3/s at Saleyards Bridge. These restrictions are set out in the 1984 Water Management Plan and are as follows:

Flow (m^3/s) at Saleyards Bridge	Levels Plains Irrigation Scheme	Private Irrigation	Comments
Less than 10.0	3.06	1.0	No filling of out-of-river storages
GT 7.0	3.06	1.0	
7.0	1.98	1.0	
5.0	1.13	0.6	'S' rights suspended
3.0	0.5	0.3	'A' rights halved
2.3	0.5	0	Suspension of private rights
2.0	0	0	Total suspension

A flow of 2 m^3/s at Saleyards Bridge is sufficient to keep a small but continuous flow down to the confluence with the Temuka. This flow is not sufficient to provide for fish passage between the Opihi River Lagoon and Saleyards Bridge.

Scenario B Raise the minimum flow from 2 to 3.2 m^3/s as outlined in the of the proposal to divert water from Lake Tekapo. In order to do this, it would be necessary to eliminate the present 0.5 m^3/s allocation to the LPIS under Scenario A and the 0.3m^3/s allocation to private irrigators.

The 3.2 m^3/s flow was proposed by the Ministry of Agriculture and Fisheries (Sagar 1988) as the minimum flow for fishery purposes at Saleyards Bridge. Below 3.0 m^3/s the area of habitat favoured by fish and invertebrates declines rapidly.

Table 3 summarises the numbers of days of total irrigation restrictions applying to the Levels Plains Irrigation Scheme resulting from scenarios A and B.

Table 3: Opihi River - Comparison between Scenarios A and B of the number of days with total Levels Plain Irrigation Scheme restrictions.

Season	Scenario A (1984 Plan) 2.0 m^3/sec flow	Scenario B 3.2 m^3/sec flow
1965-66	0	0
1966-67	0	0
1967-68	0	0
1968-69	8	40
1969-70	0	21
1970-71	0	25
1971-72	22	61
1972-73	50	91
1973-74	5	32
1974-75	0	10
1975-76	1	52
1976-77	0	15
1977-78	10	51
1978-79	0	36
1979-80	0	0
1980-81	0	19
1981-82	43	74
1982-83	8	46
1983-84	0	0
1984-85	59	89
1986-86	0	5
1986-87	0	17
1987-88	5	48
1988-89	0	25
Maximum	59	91
Minimum	0	0
Average	9	32
Seasons with no restriction	14	5
Seasons with less than 7 day restrictions	17	6

Temuka River at SH1 Bridge

Scenario C The restrictions on current water rights are as follows:

100% allocation above 1.0 m^3/s
50% allocation at 1.0 m^3/s
No abstraction at 0.7 m^3/s

Notes: 0.7 m^3/s is equivalent to a one in five year (1:5) year low flow.
Abstractions are suspended until the flow recovers to 1.0 m^3/s.

Scenario D Proposed restriction:

100% allocation above 1.8 m^3/s
50% allocation at 1.8 m^3/s
25% allocation at 1.0 m^3/s
No abstraction at 0.6 m^3/s

This scenario was supported by the South Canterbury Fish and Game Council.

Notes: This proposal gives a higher initial "trigger" level but allows for some "strategic" irrigation to continue to a lower minimum flow.

Scenario E Proposed restrictions:

100% allocation above 1.8 m^3/s
75% allocation at 1.8 m^3/s
50% allocation at 1.2 m^3/s
No abstraction at 1.0 m^3/s

This scenario was supported by the South Canterbury Branch of the New Zealand Salmon Anglers.

Table 4 shows the effects of irrigation restrictions that would occur under these scenarios.

Table 4: Number of days of total irrigator restriction for options on Temuka River.

Season	Scenario C	Scenario D	Scenario E
83/84	0	0	0
84/85	60	52	62
85/86	0	0	0
86/87	0	0	0
87/88	1	1	8

GROUNDWATER RESTRICTIONS

Allied to the issue of river water restrictions is the manner in which shallow groundwater in the near vicinity of surface water (rivers and streams) is to treated. As the utilisation of groundwater throughout the catchment is an important issue, the topic of groundwater restrictions is treated separately in section 2.4

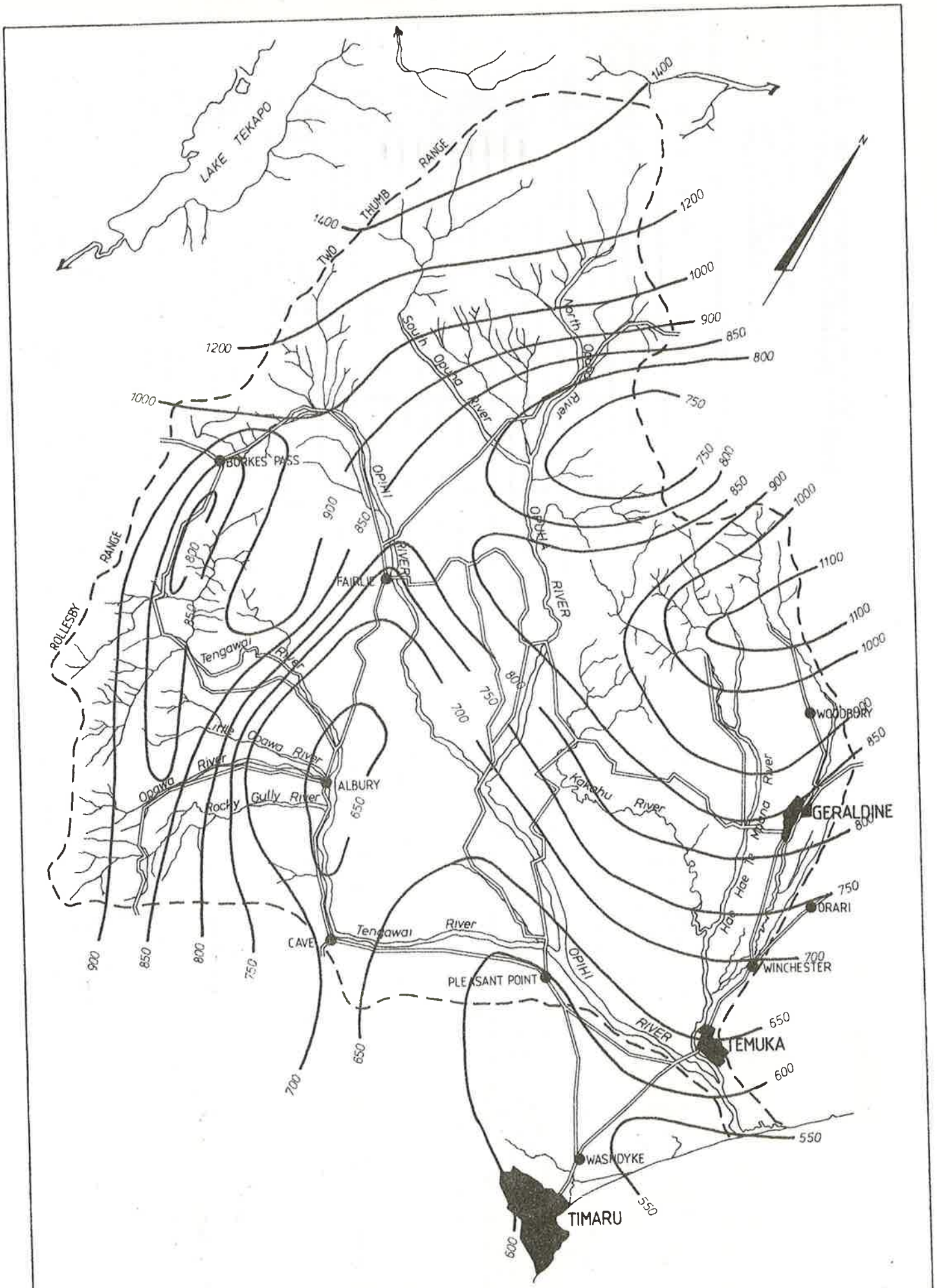
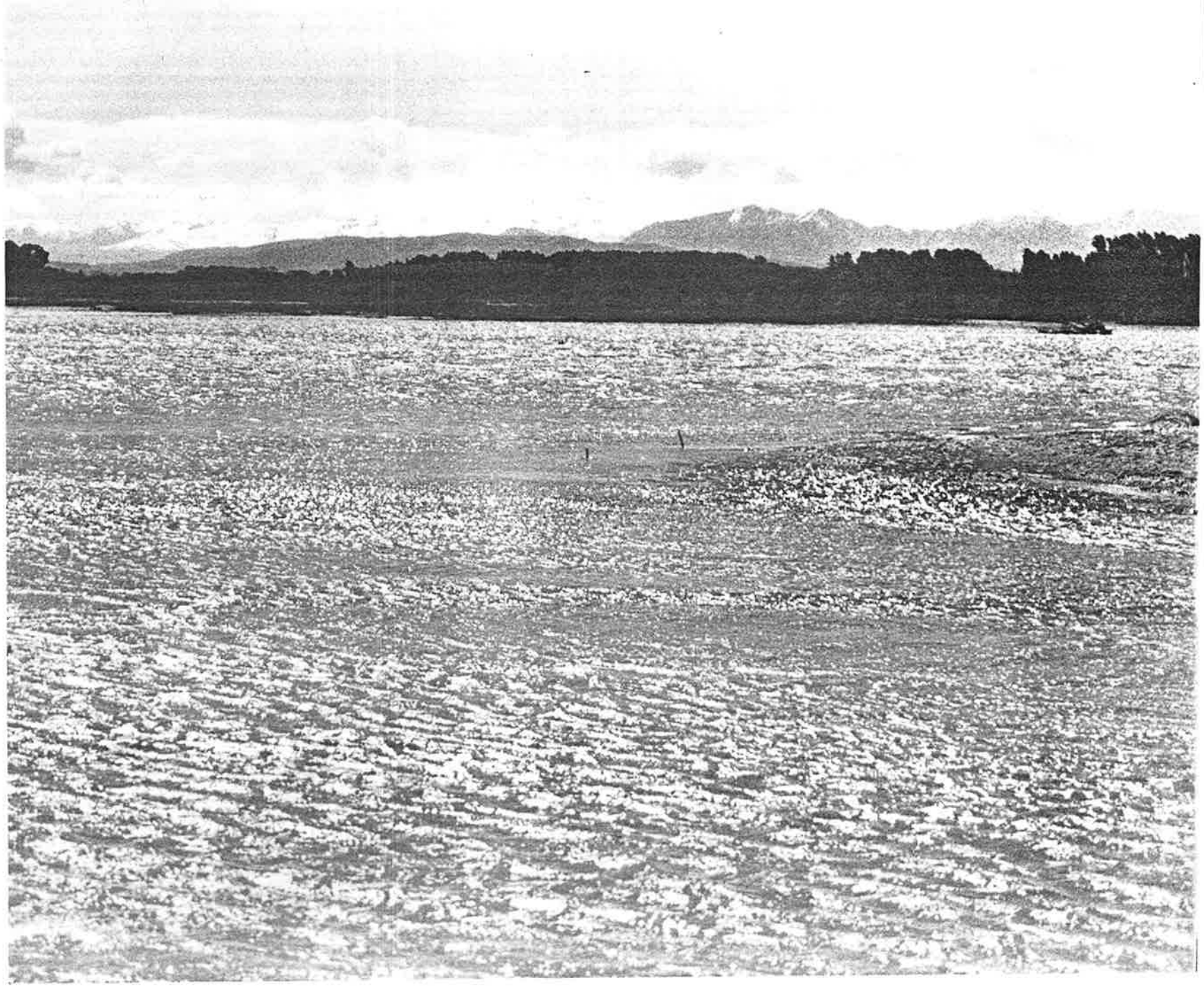


Figure 6 Mean Annual Rainfall



2.3 Opihi and Temuka Water Quality

2.3 Opihi and Temuka Water Quality

Background

Water in the Opihi -Temuka catchment comes from the following distinctive areas:

1. Areas of the upper catchment including retired tussock grasslands which, because of their remoteness, altitude, or incapacity for development remain in their natural state. The waters in these areas would have no significant sources of pollution other than those which occur naturally.

2. Areas of the catchment comprising developed tussock blocks, extensive pastoral areas and exotic forests, within which are water courses having a relatively high standard of water quality which can be reasonably maintained because of the relative absence of polluting agents other than naturally occurring processes.

3. Areas of the catchment comprising downland intensively farmed country, in some areas having a potential for further development, where the likelihood of pollution (by fertilisers, animal wastes, land management practices etc) is much greater than above.

4. Areas of the catchment including the flood plain, intensively farmed or irrigated areas, urban and semi-urban areas, the waters of which, because of relatively high population density, farming practice, and industrial developments are at greater risk of pollution than those above.

Opihi waters above Fairlie come from areas 1 and 2. Downstream from Fairlie to the confluence of the Temuka River, water comes predominantly from area 3 with small areas of area 4 around the townships of Fairlie, Albury, Cave and Pleasant Point. Waihi waters above Geraldine and Te Moana waters above the confluence of the Waihi River come from predominantly areas 1 and 2. Kakahu waters and Waihi waters downstream of Geraldine come from areas 2, 3 and 4.

Prior to 1974 no water quality data was collected for the Opihi (and Temuka) river system. Over the ensuing years a strong data base has been collected ensuring good assessment of the water quality in the Opihi.

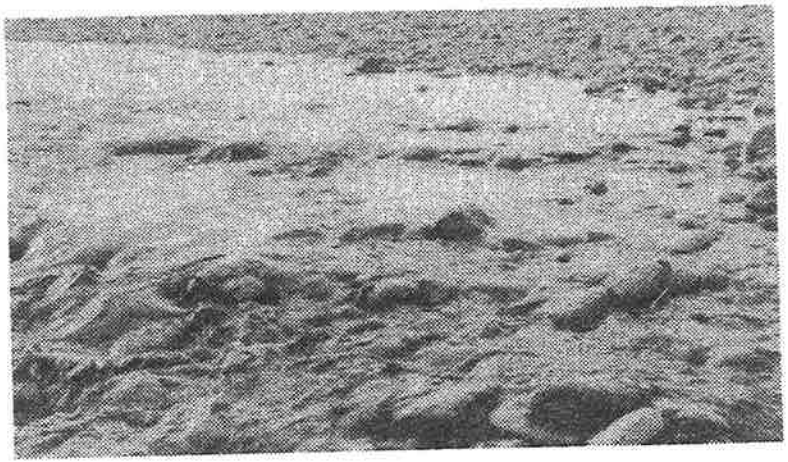
Sampling sites have been principally chosen with regard to industrial and municipal waste discharges into the surface waters.

Recently this has been extended to include sites where flow related water quality data can be collected and the estimation of the effluent from non-point discharges, (agricultural, urban run-off and groundwater infiltration).

Opihi Water Quality (excluding Temuka)

Discharges

Three major waste discharges exist in the Opihi. These are the wastewater that emanates from Burkes Pass, Fairlie and Pleasant Point oxidation ponds. Burkes Pass is a single stage oxidation pond (currently servicing up to 50 people) that treats the



Caddisfly found under an upturned stone, Opihi River above the Temuka confluence January 1989. This is a good indication of river condition

effluent to a secondary standard, . Evaporation during the summer period significantly reduces the period when a discharge to the Opihi River system occurs. The current water right allows a discharge of up to 69m^3/day. Fairlie has a two stage oxidation pond that treats the effluent to a tertiary standard. The sewerage scheme services a peak summer population of 800 people. The ponds are located adjacent to the Opihi River about 2 km downstream from Fairlie township. Discharge from the ponds is directly into the river. The water right authorises 314m^3/day to be discharged. Pleasant Point has a two stage oxidation pond that treats the effluent also to a tertiary standard. The Sewerage Scheme discharges to the Opihi River at a point upstream of the Levels Plain Irrigation Scheme intake structure at Butlers Road. The water right is for a discharge of up to 243 cubic metres per day

The contaminates from the sewage discharges in the Opihi River are restricted to nutrient and bacteria because the source is principally domestic. Effluent from non-point discharges such as urban and agricultural run-off from farming operations also occurs.

Table 5 shows the average water quality for the Opihi River (excluding the Temuka) while figure 7 shows the location of sampling sites.

Table 5 Average Water Quality for the Opihi River (excluding the Temuka River) - 1980-90

Site	Faecal Coliforms m/100 ml	Phosphate mg/l	Nitrogen mg/l
1 Opihi Lagoon*	140	0.04	0.61
2 Waipopo Huts*	142	0.03	0.40
3 Grassy Banks	34	0.02	0.31
4 Butler Road	61	0.03	0.35
5 Saleyards Bridge	69	0.02	0.31
6 Hanging Rock	103	0.03	0.68
7 Raincliff	75	0.02	0.63
8 Rockwood**	46	0.08	0.59
9 Tandros Rd	64	0.01	0.66
10 Allandale Bridge	36	0.03	0.53

* Sites below the confluence with the Temuka River.
** Only three samples to date.

Faecal Coliforms

The levels of bacteria in the Opihi River as measured by faecal coliform are relatively stable above the confluence of the Temuka River. The influence from the sewerage schemes has tended to be minimal and restricted to summer low flows. The Temuka confluence tends to dominate the Lower Opihi water quality with values for faecal coliform significantly higher below the confluence of the Opihi and Temuka Rivers.

Faecal coliforms within the river system are sufficiently low for body contact recreation (less than 200). Opihi River water however fails to meet the higher standard of less than 20 of faecal coliforms that is expected for water supplies used for drinking water purposes without further treatment. The data to date indicates that the bacterial levels increase during the periods of higher temperature which corresponds to low flows. It can therefore be expected that during the summer recreation period the water quality becomes marginal for recreational activities.

Nutrients

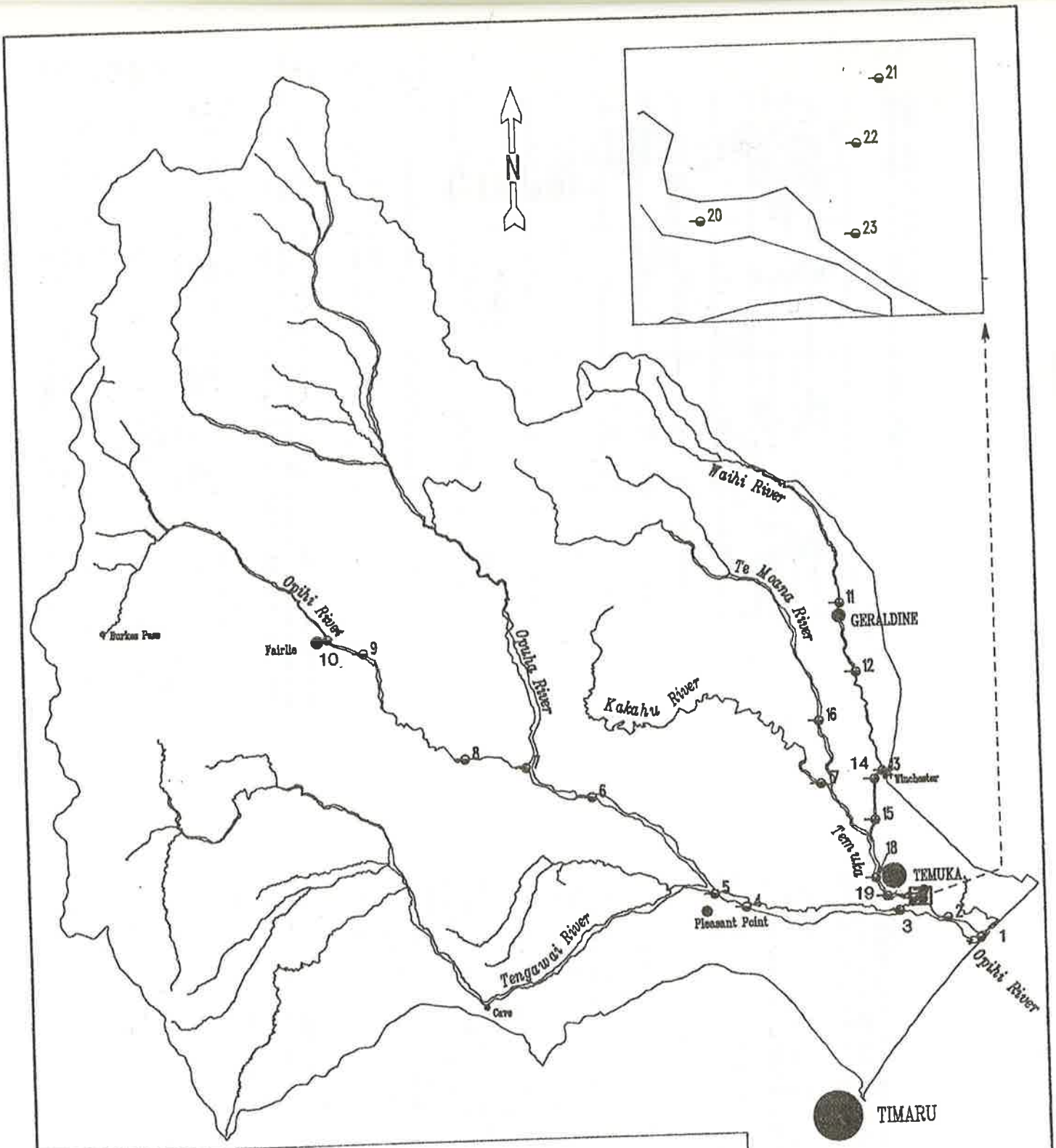
Nutrient values are typically represented by the nitrate (nitrogen) and phosphate (dissolved reactive phosphate). Values attained from analysis of the water can be used to determine the susceptibility of water to eutrophication, (growth and proliferation of algae and aquatic plants/vegetation). Values greater than 0.3 mg/l for nitrate and 0.01 mg/l for dissolved reactive phosphorus indicate the potential for growth of algae and other vegetation. Their growth is also limited to temperature, light availability and flow. Summer periods when low flows, high temperatures and greater sunshine hours are evident is the critical time for prolific growth to occur.

The Opihi River does not currently exhibit seasonal algae growths to the extent of the Temuka system. Values of phosphate are typically 0.01-0.03 mg/l which are sufficiently low to inhibit growth unless sustained low flows occur. Nitrate is also seen to be limiting at a number of sites, however values over 0.3 mg/l are typical. The river system in general is in a balanced state but conditions are approaching those for seasonal algal growths to become common.

Eutrophication could become a problem that unless steps are taken to reduce nutrient input to streams. Because of the relatively short time over which data has been collected the establishment of a trend has not yet been possible. Overall, the quality of the Upper Opihi River system is good.

Other sources of contaminates arising from urban and rural run-off, including the utilisation of the water courses for grazing and cultivation of the riparian strips are all adding to the potential problem.

The proposal to augment the Opihi River could affect the water quality of the Opihi River (not Temuka). Extra flow would provide extra dilution of wastes entering the river thereby improving water quality. The augmentation proposal is elaborated on in section 2.8.



LEGEND

Water Quality Monitoring Sites

1 Opihi Lagoon
2 Waipopo Huts
3 Grassy Banks
4 Butlers Rd
5 Saleyards Bridge
6 Hanging Rock Bridge
7 Raincliff
8 Rockwood
9 Tondros Rd
10 Allandale
11 Waihi at Geraldine
12 Waihi at Coach Rd
13 Waihi at Winchester
14 Waihi below Scour
15 Waihi at Te Awa Bridge
16 Te Moana at Earls Rd
17 Kakahu at Earls Rd
18 Temuka at Manse Bridge
19 Temuka at SH1
20 Temuka above Taumatakahu
21 Milford Rd
22 Rooneys Culvert
23 Temuka below Taumatakahu
Sampling Site

SCALE

0 km 5 km 10 km 15 km

Opihi – Temuka Catchment Management Plan

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Figure 7 OPIHI WATER QUALITY MONITORING SITES

Temuka Water Quality

Table 6 Average water quality for the Temuka River (1987-90)

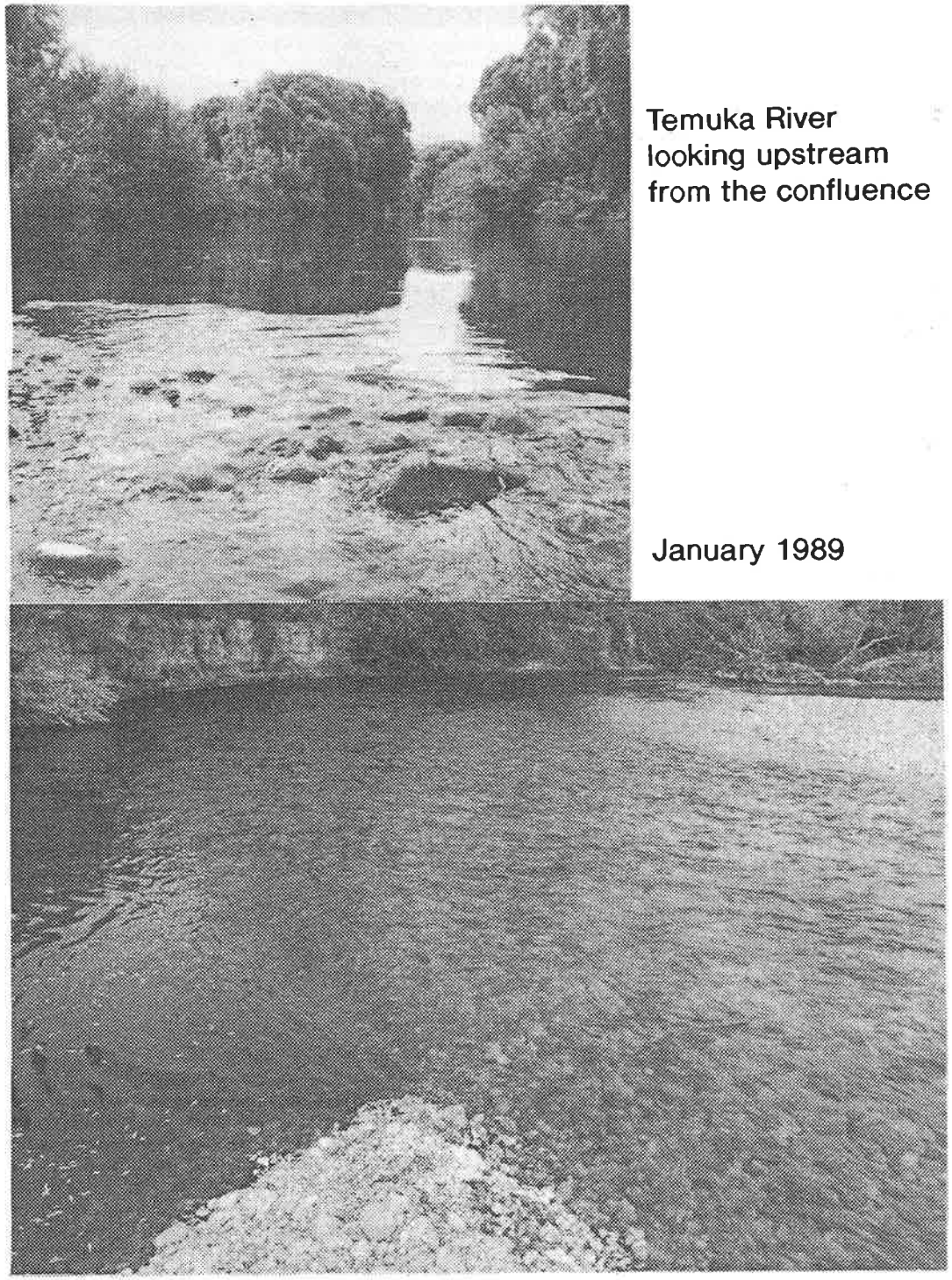
Site	Facael Coliforms m/100ml	Phosphate mg/l	Nitrogen mg/l
11 Waihi-Geraldine	67	.046	.59
12 Waihi-Coach Rd	294	.098	.66
13 Waihi Winchester	120	0.038	0.75
14 Waihi below scour	108	0.03	0.93
15 Waihi Te Awa Bridge	181	.030	0.76
16 Hae Hae Te Moana Earls Rd			
17 Kakahu Earls Rd	190	.016	.57
18 Temuka Manse Bridge	63	.043	.62
19 Temuka SH1	46	.025	.92
20 Temuka above Taumatakahu	94	.070	.57
21 Taumatakahu Milford Rd	1104	.04	.75
22 Taumatakahu Rooneys Culvert *	614	0.07	0.05
23 Temuka below Taumatakahu *	148	0.055	0.93
2 Waipopo Huts *	142	0.03	0.40

* Results after commissioning of Temuka oxidation pond.

Discharges

The major discharges in the Temuka river system are sewerage schemes, woolscours and an insulator manufacturer.

The Geraldine sewage treatment plant comprises a two stage oxidation pond system that treats the effluent to a tertiary standard. Commissioned in 1987 it services a population of up to 2700. The water right allows a discharge up to 243m^3/day into the Waihi River at a point just upstream of the Coach Road bridge. At the point of



Temuka River looking upstream from the confluence

January 1989

Temuka River (Dark algae) Confluence Opihi River (clear)

effluent to a secondary standard, . Evaporation during the summer period significantly reduces the period when a discharge to the Opihi River system occurs. The current water right allows a discharge of up to 69m^3/day. Fairlie has a two stage oxidation pond that treats the effluent to a tertiary standard. The sewerage scheme services a peak summer population of 800 people. The ponds are located adjacent to the Opihi River about 2 km downstream from Fairlie township. Discharge from the ponds is directly into the river. The water right authorises 314m^3/day to be discharged. Pleasant Point has a two stage oxidation pond that treats the effluent also to a tertiary standard. The Sewerage Scheme discharges to the Opihi River at a point upstream of the Levels Plain Irrigation Scheme intake structure at Butlers Road. The water right is for a discharge of up to 243 cubic metres per day

The contaminates from the sewage discharges in the Opihi River are restricted to nutrient and bacteria because the source is principally domestic. Effluent from non-point discharges such as urban and agricultural run-off from farming operations also occurs.

Table 5 shows the average water quality for the Opihi River (excluding the Temuka) while figure 7 shows the location of sampling sites.

Table 5 Average Water Quality for the Opihi River (excluding the Temuka River) - 1980-90

Site	Faecal Coliforms m/100 ml	Phosphate mg/l	Nitrogen mg/l
1 Opihi Lagoon*	140	0.04	0.61
2 Waipopo Huts*	142	0.03	0.40
3 Grassy Banks	34	0.02	0.31
4 Butler Road	61	0.03	0.35
5 Saleyards Bridge	69	0.02	0.31
6 Hanging Rock	103	0.03	0.68
7 Raincliff	75	0.02	0.63
8 Rockwood**	46	0.08	0.59
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* Sites below the confluence with the Temuka River.
** Only three samples to date.

Faecal Coliforms

The levels of bacteria in the Opihi River as measured by faecal coliform are relatively stable above the confluence of the Temuka River. The influence from the sewerage schemes has tended to be minimal and restricted to summer low flows. The Temuka confluence tends to dominate the Lower Opihi water quality with values for faecal coliform significantly higher below the confluence of the Opihi and Temuka Rivers.

Faecal coliforms within the river system are sufficiently low for body contact recreation (less than 200). Opihi River water however fails to meet the higher standard of less than 20 of faecal coliforms that is expected for water supplies used for drinking water purposes without further treatment. The data to date indicates that the bacterial levels increase during the periods of higher temperature which corresponds to low flows. It can therefore be expected that during the summer recreation period the water quality becomes marginal for recreational activities.

Nutrients

Nutrient values are typically represented by the nitrate (nitrogen) and phosphate (dissolved reactive phosphate). Values attained from analysis of the water can be used to determine the susceptibility of water to eutrophication, (growth and proliferation of algae and aquatic plants/vegetation). Values greater than 0.3 mg/l for nitrate and 0.01 mg/l for dissolved reactive phosphorus indicate the potential for growth of algae and other vegetation. Their growth is also limited to temperature, light availability and flow. Summer periods when low flows, high temperatures and greater sunshine hours are evident is the critical time for prolific growth to occur.

The Opihi River does not currently exhibit seasonal algae growths to the extent of the Temuka system. Values of phosphate are typically 0.01-0.03 mg/l which are sufficiently low to inhibit growth unless sustained low flows occur. Nitrate is also seen to be limiting at a number of sites, however values over 0.3 mg/l are typical. The river system in general is in a balanced state but conditions are approaching those for seasonal algal growths to become common.

Eutrophication could become a problem that unless steps are taken to reduce nutrient input to streams. Because of the relatively short time over which data has been collected the establishment of a trend has not yet been possible. Overall, the quality of the Upper Opihi River system is good.

Other sources of contaminates arising from urban and rural run-off, including the utilisation of the water courses for grazing and cultivation of the riparian strips are all adding to the potential problem.

The proposal to augment the Opihi River could affect the water quality of the Opihi River (not Temuka). Extra flow would provide extra dilution of wastes entering the river thereby improving water quality. The augmentation proposal is elaborated on in section 2.8.

2.3 Opihi and Temuka Water Quality

Background

Water in the Opihi -Temuka catchment comes from the following distinctive areas:

1. Areas of the upper catchment including retired tussock grasslands which, because of their remoteness, altitude, or incapacity for development remain in their natural state. The waters in these areas would have no significant sources of pollution other than those which occur naturally.

2. Areas of the catchment comprising developed tussock blocks, extensive pastoral areas and exotic forests, within which are water courses having a relatively high standard of water quality which can be reasonably maintained because of the relative absence of polluting agents other than naturally occurring processes.

3. Areas of the catchment comprising downland intensively farmed country, in some areas having a potential for further development, where the likelihood of pollution (by fertilisers, animal wastes, land management practices etc) is much greater than above.

4. Areas of the catchment including the flood plain, intensively farmed or irrigated areas, urban and semi-urban areas, the waters of which, because of relatively high population density, farming practice, and industrial developments are at greater risk of pollution than those above.

Opihi waters above Fairlie come from areas 1 and 2. Downstream from Fairlie to the confluence of the Temuka River, water comes predominantly from area 3 with small areas of area 4 around the townships of Fairlie, Albury, Cave and Pleasant Point. Waihi waters above Geraldine and Te Moana waters above the confluence of the Waihi River come from predominantly areas 1 and 2. Kakahu waters and Waihi waters downstream of Geraldine come from areas 2, 3 and 4.

Prior to 1974 no water quality data was collected for the Opihi (and Temuka) river system. Over the ensuing years a strong data base has been collected ensuring good assessment of the water quality in the Opihi.

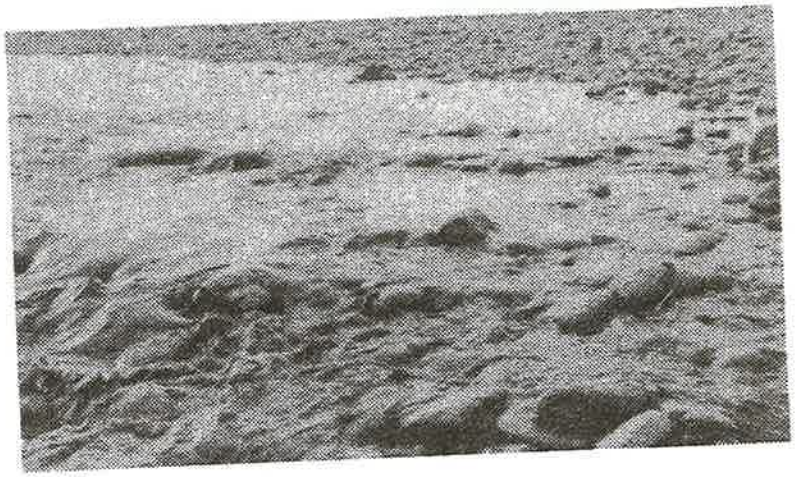
Sampling sites have been principally chosen with regard to industrial and municipal waste discharges into the surface waters.

Recently this has been extended to include sites where flow related water quality data can be collected and the estimation of the effluent from non-point discharges, (agricultural, urban run-off and groundwater infiltration).

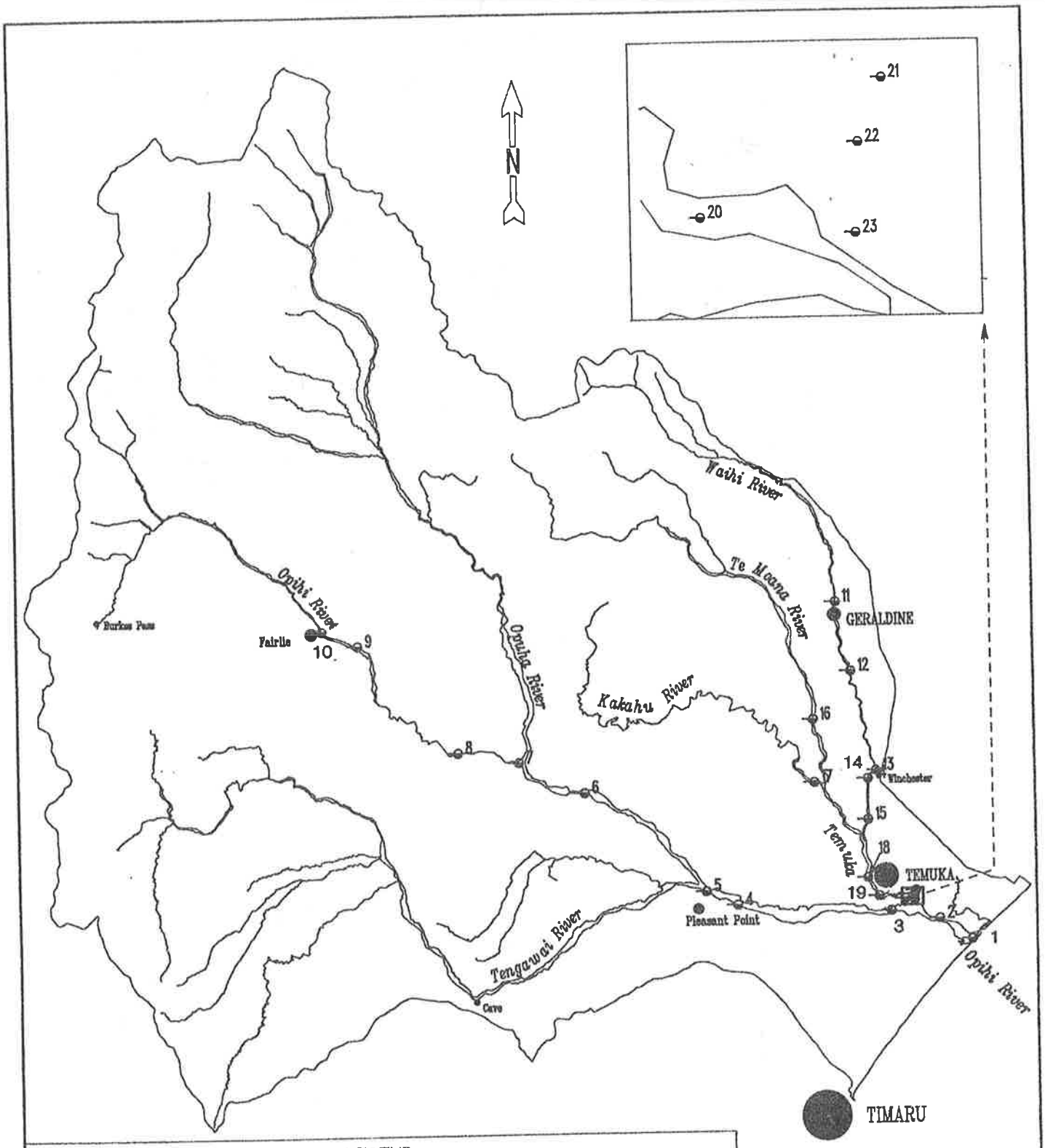
Opihi Water Quality (excluding Temuka)

Discharges

Three major waste discharges exist in the Opihi. These are the wastewater that emanates from Burkes Pass, Fairlie and Pleasant Point oxidation ponds. Burkes Pass is a single stage oxidation pond (currently servicing up to 50 people) that treats the



Caddisfly found under an upturned stone, Opihi River above the Temuka confluence January 1989. This is a good indication of river condition



LEGEND

Water Quality Monitoring Sites

1	Opihi Lagoon	13	Waihi at Winchester
2	Waipopo Huts	14	Waihi below Scour
3	Grassy Banks	15	Waihi at Te Awa Bridge
4	Butlers Rd	16	Te Moana at Earls Rd
5	Saleyards Bridge	17	Kakahu at Earls Rd
6	Hanging Rock Bridge	18	Temuka at Manse Bridge
7	Raincliff	19	Temuka at SH1
8	Rockwood	20	Temuka above Taumatakahu
9	Tondros Rd	21	Milford Rd
10	Allandale	22	Rooneys Culvert
11	Waihi at Geraldine	23	Temuka below Taumatakahu
12	Waihi at Coach Rd		Sampling Site

SCALE

0 km 5 km 10 km 15 km

Opihi – Temuka Catchment Management Plan

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Figure 7 OPIHI WATER QUALITY MONITORING SITES

Temuka Water Quality

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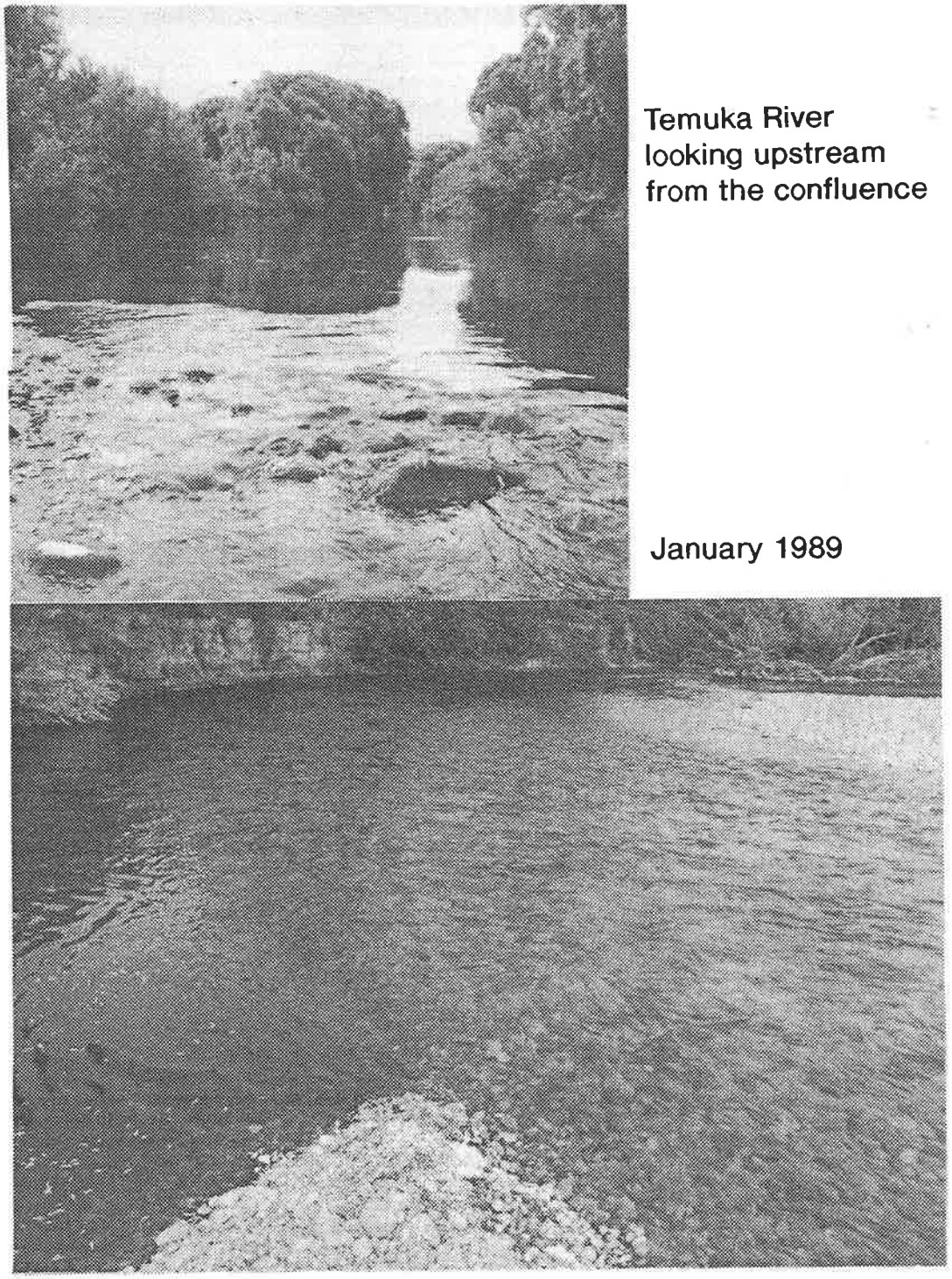
* Results after commissioning of Temuka oxidation pond.

Discharges

The major discharges in the Temuka river system are sewerage schemes, woolscours and an insulator manufacturer.

The Geraldine sewage treatment plant comprises a two stage oxidation pond system that treats the effluent to a tertiary standard. Commissioned in 1987 it services a population of up to 2700. The water right allows a discharge up to 243m^3/day into the Waihi River at a point just upstream of the Coach Road bridge. At the point of



Temuka River looking upstream from the confluence

January 1989

Temuka River (Dark algae) Confluence Opihi River (clear)

discharge, the Waihi River is often dry for extended periods during summer, and the discharge dissipates into the riverbed.

The Temuka sewage treatment plant has a single stage oxidation pond discharging into the Temuka River via a pilot scale wetland. Commissioned in April 1990 it has replaced the previous inadequate imhoff tanks that discharged to the Taumatakahu stream.

Ferrier Woolscour discharges 9000m^3/week of rinsewater (20 litres per second) from its scouring operation into the Waihi River at a point downstream of the SH72 Bridge at Winchester.

Temuka Woolworks discharges up to 10000m^3/week of woolscour rinsewater into the Taumatakahu stream upstream of the flood protection culvert.

Both woolscours separate heavy scour liquors from the rinsewater. The highly contaminated heavy liquors are trucked away for land disposal. The rinsewaters are discharged into the river.

NZ Insulators discharges up to 500m^3/week of wastewater into the Temuka River via the Vine St drain. The wastewater consists of mostly colloidal clay materials held in suspension.

Other sources of contaminates are from urban and rural run off and other farming operations (non point discharges).

Faecal Coliforms

Increased faecal coliforms bacteria levels occur immediately downstream of the discharge outlet of the Geraldine and Temuka oxidation ponds. Here the waters are not suitable for body contact recreation directly below the discharges i.e. at the Coach Road site and Rooneys culverts site. (Refer to Table 6.)

Following the commissioning of the Temuka oxidation pond (February 1990) there has been a decrease in the levels of faecal coliform to date within the Lower Temuka, after the commissioning of the new Temuka oxidation pond. However data have only been collected during the autumn and winter period when flows are typically greater. The Temuka is however influenced from both the Temuka oxidation pond and from the Taumatakahu Stream and it would be to early to state as to the general effect the new pond has had.

Nutrients

The nutrients represented by the nitrates and phosphates are notably high at the discharge points and throughout the whole Temuka river system. Nutrient surveys carried out during 1987-1989 have shown that the greater influence appears to originate from non-point sources. As the areas these rivers drain are used intensively for sheep farming and dairying both the effect of runoff and farming practices has created high nutrient levels. The levels of nutrients are in excess of that needed for growth of algae and other organisms responsible for eutrophication. The sources of the Te Moana and Waihi show low levels of these contaminates reinforcing the view that the developed nature of the land is contributing significantly to the problems created during the summer period.

The Temuka River system has been influenced strongly in the past from inadequately treated discharges and insufficient constraints in farming practices and neighbouring waterways. The seasonal algal blooms are an area of major concern down grading the water quality and its recreational potential. Nitrate is contributed from diffuse agricultural sources. The phosphate comes from these sources and from the Geraldine and Temuka sewage discharges and the Temuka Woolworks.

Throughout much of the Temuka River system, the faecal coliform levels are typically in excess of 100/100ml. As such, the water resource is, without treatment, unsuitable for domestic water supply purposes. During periods of low flows in summer, the river is marginal for recreational activities.

Figure 8 shows the uses that can be made of the river system at present. Notably swimming should not occur for some distance downstream of discharges or in any of the Taumatakahu Stream. None of the river system below our sampling sites is generally safe for food gathering or water supply schemes.

Groundwater Quality

Groundwater quality data has been restricted to a small number of surveys conducted in and around 1985.

Investigations into the level of nitrate are continuing. The source of this is through decomposition of organic material as soils do not bind this ion so it is readily leached into the ground water. High nitrate levels also can indicate too high an application of fertilisers or irrigation water. The leached nitrates tend to concentrate in the underlying groundwater.

Nitrate levels may be sourced from chemical or organic fertilisers, land application of farm and industrial waste waters and decomposition of other organic material..

Existing data does not allow conclusions to be made on the effect that land use has had on groundwater quality. Further work needs to be carried out to determine confidently, the current quality of groundwater, whether or not the quality is decreasing and what remedial measures would be necessary.

Objectives

The existing objectives as set out in the 1984 Opihi River Water management Plan are:

- *To protect water quality in those areas where the existing quality meets the standard for contact recreation (Class C) or better.*
- *To review, on expiry, those rights to discharge including the conditions to any new rights to effect, where possible, an improvement in the water quality up to a contact recreation standard.*

The proposed objectives for the whole catchment are:

Objective 1 *The review (on expiry) of all rights to discharge, with conditions placed on any new right to effect an improvement of water quality up to the standard set for the receiving waters.*

Objective 2 *The issuing of at least two years notice to all holders of rights to discharge, of the proposed standards to be set for the receiving waters.*

Objective 3 *The Opihi and Temuka river water quality standards defined in Figure 9, be met by the year 1995*

Objective 4 *The standard of receiving waters for the whole catchment be up to the standard for water supply and food gathering by the year 2000, as depicted in Figure 10.*

Objectives proposed, by the use of incentives, promotions and education:

Objective 5 *The retention of silt, organic matter and nutrients on farms by appropriate conservation practices.*

Objective 6 *The prevention of nutrient losses from farm production to the groundwater by appropriate conservation practices.*

Options

The following options are proposed to meet the above objectives:

Option 1 All sewage, wool scour effluent and waste water treatment plants discharge according to the water quality standards of the receiving waters as depicted in Figure 9 by 1995, and to the standards in Figure 10 by 2000.

Advantage

- Improvement in water quality, allowing a wide range of uses of the river.

Disadvantages

- Cost of construction and maintenance of for example tertiary treatment ponds, constructed wetlands plus irrigation plants to meet standards.
- Potential risk of contamination of groundwater if not designed or operated correctly.

Option 2 Fencing off of stream and river embankments to maintain a well vegetated riparian buffer zone free of any damage or pollution from grazing or browsing animals.

Advantages

- Increase in water quality and reduced damage to the aquatic environment. Vegetation, once retired from grazing, will act as a buffer zone and provide increased breeding opportunities and habitat for wildlife.

Disadvantages

- Cost, of fence erection and maintenance, and possible need to provide an alternative piped stock water supply in some areas. Fences in riparian areas can be easily damaged during floods. Location of fences to avoid damage, may involve loss of grazing land.
- Weed infestation of riparian area.

Option 3 The maintenance of existing wetlands, and/or the construction of new wetlands on farms to trap and store silt and nutrients.

Advantages

- Improvement in water quality in the longer term, with reduction of the total amount of nutrients feeding into the river system. The retention of silt and nutrient can naturally enhance the productivity of the wetlands. Wetlands can be drained when full of silt and organic matter, with the sludge used for fertiliser on areas short of top soil. Creation of wildlife refuges.

Disadvantages

- Cost. (Can be minimised with use of on farm machinery.) Need to maintain wetlands, requiring knowledge of natural wetlands. Wetlands need to be fenced from stock. Unfenced ponds can result in stock health problems with, for example, toxic algae blooms. Loss of productive land.

Option 4 Effective monitoring of groundwater quality.

Advantages

- Identification of potential problems of contaminates in the groundwater.
- Establishment of a water quality data base for predicting trends.
- Identification of the effect of land use, land use practices, and industrial uses have on water quality and hence will define need for action.
- Identification of suitability of groundwater for industrial and domestic use.
- Identification of problems.

Disadvantages

- Cost of establishing monitoring.
- Uncertainty in predicting trends.
- Need for time (eg five years or longer) to establish trends.
- Application of a conservative approach to protecting the quality of the groundwater resource, until the need for such an approach is either confirmed or rejected.

Figure 8. EXISTING WATER QUALITY

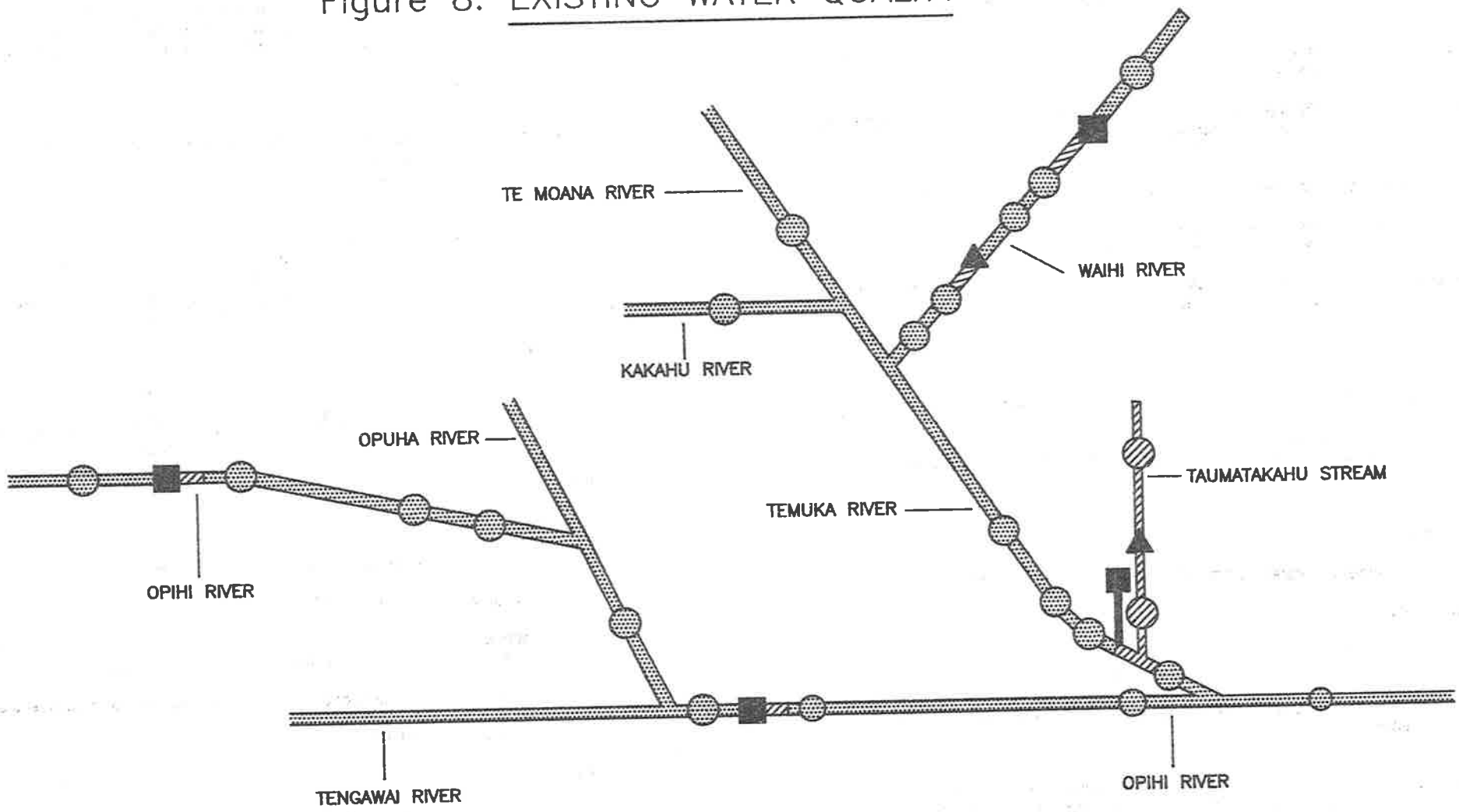


Figure 9. WATER QUALITY TO BE ACHIEVED BY 1995

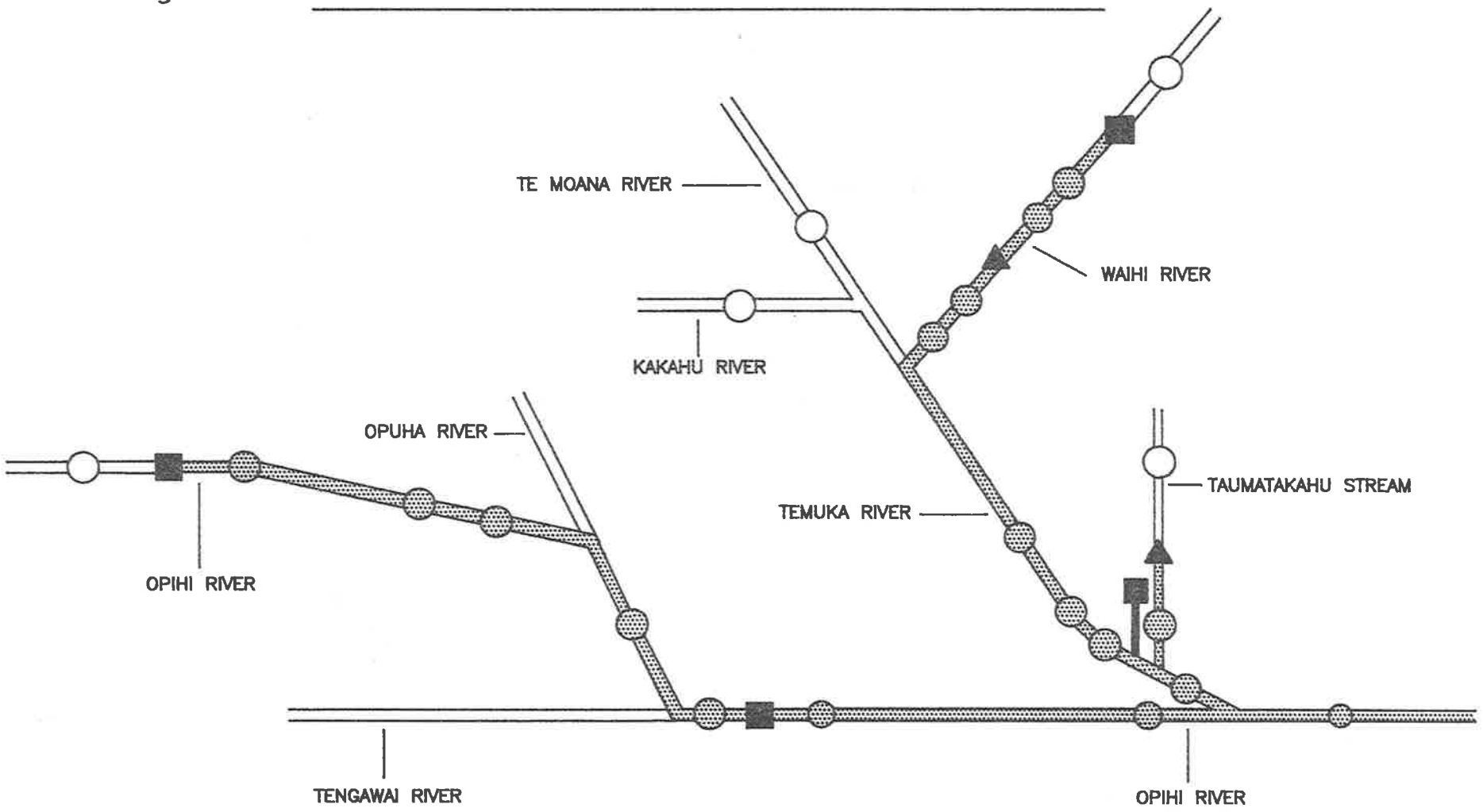
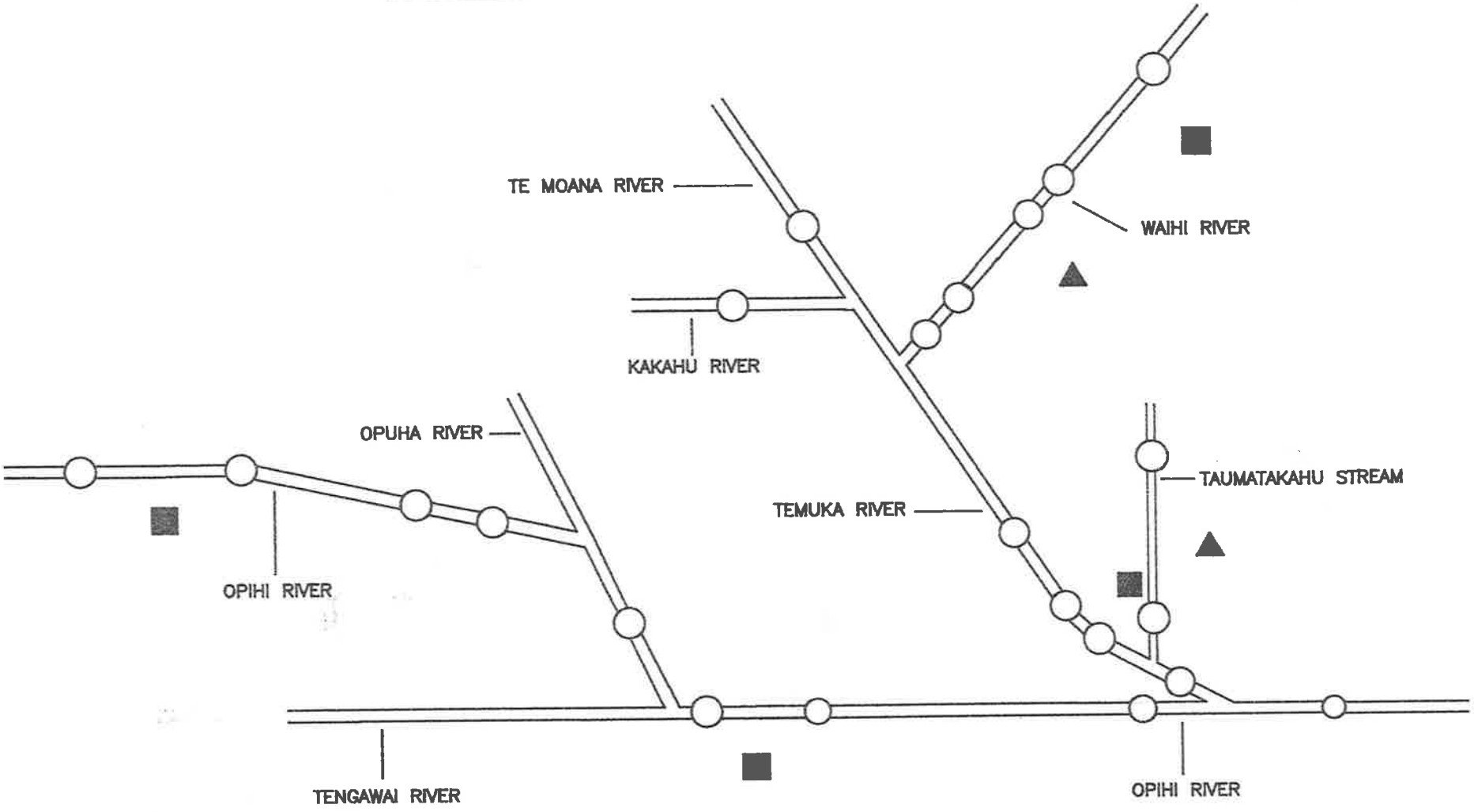


Figure 10. WATER QUALITY TO BE ACHIEVED BY 2000



2.4 Use and Management of Groundwater

2.4 Use and Management of Groundwater

Background

Where available, groundwater within the Opihi catchment is primarily used for domestic, industrial and irrigation purposes. Water quality is generally of a high standard, with little or no treatment being required to provide potable supplies.

In contrast to the Ashburton - Rakaia Plains area where irrigation from deep groundwater is widely practised, groundwater utilisation for irrigation within the Opihi catchment has traditionally been on a low cost shallow bore basis with the majority of bores being less than 12 metres deep. The majority of presently utilised irrigation bores are generally located close to old river channels or flood plains and are constructed by placing steel liners within a dug hole and backfilling the annular space with a graded gravel pack. Because of the shallow unconfined nature of the aquifers, groundwater is most commonly extracted by use of centrifugal pumps, many of which are of the transportable tractor-driven type.

The basement rocks within the catchment consist of schist, greywacke and argillite which form the mountainous regions of the Hunters Hills, Two Thumb Range and Four Peaks Range. These rocks are strongly compacted and may be discounted as a source for irrigation water supplies.

Overlying these rocks are fine grained marine sediments (coal measures, mudstone, sandstone and limestone) which dip towards the east at approximately 10 degrees. These sediments (which are estimated to be up to 650 metres thick near Kakahu) have extremely low permeabilities and may generally be discounted as a potential source for irrigation.

The most recent deposits within the catchment consist of glacial outwash or recent river gravels and are generally poorly sorted, have a moderately high clay content and have a moderate to low permeability. In areas adjacent to the river channels, these gravels tend to be cleaner, better sorted, more permeable and generally produce higher yields. The gravel deposits range in thickness from 1 or 2 metres near Cave to an estimated 200 metres near the coast.

Within the Opihi catchment, known groundwater resources are mainly contained within the shallow gravels bordering the river valleys and on the coastal flood plains. The major exploitation of groundwater for irrigation purposes is carried out in the Levels Plains and Seadown areas, and in the Waihi River Flats. Other areas where limited groundwater resources occur are within Totara Valley, Opihi Valley and Tengawai River Valley.

Studies into the known and potential groundwater resources within the catchment have been carried out and reported on by the South Canterbury Catchment Board. These studies included the collation of existing bore log data, geophysical surveying to map the thickness of the potentially water bearing gravels, depth to groundwater surveys, and test drilling. In addition to collating existing information, investigation bores were drilled within the Ashwick Flat area (to 100 and 71 metres), Sutherlands area (to 12.5 and 11 metres) and in Waitohi Flat (to 84 metres). Apart from minor quantities of shallow groundwater, all bores failed to locate any aquifers that would yield sufficient water for irrigation purposes. A deep well drilled by the South Canterbury Catchment Board in late 1989 to a depth of 82 metres at Seadown also failed to locate deep groundwater.

From the above studies, the following conclusions have been made:

"In most areas, groundwater of limited yield is extracted from shallow unconfined gravel aquifers of limited storage. Recharge of these aquifers is mainly from rainfall infiltration with localised areas being recharged from river flows."

"Specific investigations into the potential of the Sutherlands, Ashwick Flat, and Waitohi Flat areas have shown that, while limited supplies may be available for domestic and stock use, the underlying gravels are of low permeability and are generally poor aquifers."

Although high yielding aquifers have been located near the coast to the north of the Opihi River, exploratory drilling to depths of up to 130 metres have failed to encounter any such aquifer within the Cave to Seadown areas.

Investigatory well drilling for commercial supplies of groundwater near the coast to the immediate north of the Opihi River mouth has revealed the presence of confined aquifers at depths of 35 metres, 58 metres and 61 metres. Yields and artesian pressures increase with depth and it is estimated that the deepest aquifer is capable of yields in excess of 130 l/s. To date, evaluation of the aquifers has been restricted to limited pump testing only, thus the extent and full potential of the aquifer is as yet unknown. While it is known that the aquifers extend inland to the north of the Orari River, investigatory drilling at Seadown (82 metres), Waitohi Flat (84 metres) and Levels Plains (130 metres) have failed to encounter them.

Within the Temuka River Catchment, the only known successfully utilised deep bore is currently that used by Ferrier Woolscours at Winchester. This bore abstracts water from aquifers of limited yield at depths of 19 to 22 metres and 28 to 34 metres.

To summarise, although it is known that there are deep groundwater resources, such resources are of unknown extent and appear to be confined to the northeastern and northern boundaries of the catchment. It would appear that, at present, there are no alternative deep groundwater resources within economic drilling depth.

Objectives

The following objectives are proposed:

Objective 1 *The Canterbury Regional Council maintains the present long-term mean groundwater levels by controlling and limiting the total quantity of water abstracted.*

Objective 2 *The Canterbury Regional Council reduces abstractive use of the limited surface water resources by encouraging the sustainable use of groundwater.*

Objective 3 *The maintenance of minimum river flows by controlling groundwater abstractions adjacent to these rivers.*

Objective 4 *The protection of the shallow groundwater resources between the Orari and Waihi Rivers to ensure sufficient recharge to the Waihi River.*

Objective 5 *The maintenance of the highest possible groundwater quality by controlling the direct disposal or discharge of wastes onto land or into confined and unconfined groundwater.*

Objective 6 *The Canterbury Regional Council produce a groundwater management plan for the Levels Plains area by June 1994.*

Objective 1. Water rights are required for the abstraction of groundwater for purposes other than fire fighting, stock or domestic water supply. The Regional Council may append conditions to any water right to ensure that abstraction rates and volumes are not exceeded and that the exercise of the right does not place undue demand on the resource.

Under the terms of its Underground Water Bylaw 1990, it is necessary to obtain a permit from the Regional Council **before** drilling or altering any bore. This requirement allows the Regional Council to control the siting and depth of ALL bores regardless of end use. The bylaw also controls wasteful use of groundwater, prevention of pollution, keeping of records, inspection and maintenance of bores, and the fitting of recording apparatus to bores.

The Regional Council may impose restrictions on the exercising of any groundwater water right during times of low water levels. Under policies of the Opihi River Water Management Plan (1984), abstractions for purposes other than stock or domestic purposes from shallow bores (ie those screened at depths of less than 15 metres) within 400 metres of the main river channels or within 50 metres of any minor tributary is restricted in accordance with the sharing rules as set out in the Management Plan.

Objective 2. To ensure sufficient river flows to maintain fishlife, wildlife and water quality standards, the sustainable abstraction of groundwater is encouraged. This encouragement is reflected in the lack of restrictions placed on abstractions which occur away from the river channels.

Generally it can be stated that the present abstraction of groundwater is being maintained within sustainable levels and it should be emphasised that the above mentioned irrigation restrictions are enforced on groundwater bores solely because of the influence that pumping has on the surface water resources. Should it be shown that future groundwater abstractions are leading to a permanent depletion of an aquifer, steps would be taken to restrict groundwater use to maintain sustainable levels. Such steps would include the banning of future well drilling within the aquifer, and the imposition of water level restrictions.

Objective 3. Shallow bores located near streams derive their water from natural recharge, storage, interception of groundwater flow, and induced infiltration. Whether water is derived by interception or induced infiltration, the reduction on stream flow will be the same, thus stream depletion is defined as EITHER the direct depletion of the stream OR the reduction of groundwater flow to the stream.

If certain assumptions on the aquifer characteristics are made, it is possible to calculate the depletion of flow in a nearby stream caused by pumping from a bore. The required characteristics which define the degree of hydraulic connection between the aquifer and the stream are the transmissivity (a measure of the rate at which water will flow through an aquifer) and the specific yield (a measure of the volume of water released from the aquifer for a unit drop in water level). These characteristics can be determined from controlled test pumping of the aquifers.

In the absence of sufficient detailed information on the shallow aquifer characteristics within the Opihi/Temuka Catchments, the former South Canterbury Catchment Board adopted a policy of restricting shallow groundwater abstraction within 400 metres of major and 50 metres of minor river tributaries for all shallow wells screened at depths of less than 15 metres. Using typical values for shallow gravel aquifers it can be shown that while the "400 metre" rules gives protection against stream depletion, the restriction does not recognise that variations in abstraction rates and pumping periods also influence depletion.

For most lower yield abstractions (ie those 30 l/s or less) the "400 metre" rule is too restrictive and it is proposed to reduce the required distance from 400 to 250 metres from a major tributary for all abstractions at rates of less than or equal to 30 l/s. The 50 metre restriction on minor river tributaries will remain in force. A pumping period of 20 hours was assumed for this catchment.

Objective 4. The importance of Orari River recharge to the Waihi and Temuka River system has been previously documented within the Opihi and Temuka Water Resource reports. It is estimated that when the Temuka River flow at SH1 Bridge reduces to approximately 1.2 m^3/s, the inflow from groundwater would account for some 75% to 90% of the total flow at that site. From flow gaugings undertaken by Regional Council staff on the springfed creeks (Dobies, Worners, Raukapuka and Smithfield), it has been possible to identify those areas within the Waihi River where the major source of stream flow is from groundwater recharge. This zone, which is referred to here as the Waihi River protected groundwater zone, is shown in figure 4.

Objective 5. While present chemical analyses indicate that the groundwaters throughout the catchment are generally of excellent quality, the shallow nature of the aquifers increases the risk of contamination from pollutants and discharges. The following have been identified as being capable of causing groundwater pollution:

. Leachate discharges from waste disposal sites.
. Offal pits.
. Septic tank discharges.
. Effluent disposal from dairy, piggery, poultry farming, and woolscours.
. Leaching of fertilisers from pastures and land.
. Spillage of whey and dairy products - either by accident or from industrial action.

The Regional Council attempts to minimise the pollution of underground water by way of its Bylaw No. 2, Underground Water, 1990. Under this bylaw, unless by dispensation, it is an offence to place on or discharge onto, or into the ground any matter which affects or is likely to affect detrimentally the groundwater quality.

Effluent disposal from agricultural uses are controlled through the issuing of water rights whereby controlled disposal onto land is favoured over discharges to surface waters. Conditions attached to these water rights control the method, location and

allowable discharge volumes. Discharges from domestic septic tanks are presently controlled by way of a General Authorisation which permits the discharge of domestic wastes into groundwater. Specifically excluded from this Authorisation are disposal within 200 metres of any public or community water supply bore and within 1000 metres in an upstream direction of any public water supply bore which draws water from an unconfined aquifer.

The non point source of pollution of groundwater from the leaching of nutrients from land is not controlled by the Water and Soil Act. In order to reduce this non-point source of pollution, the Regional Council encourages sound land management practices which minimise nutrient leaching (eg efficient fertiliser application - types, quantity and timing, reducing stock densities - especially in feedlot management).

There is potential to pollute groundwater through spillages of industrial or agricultural products, either accidentally or through industrial action. Council staff will continue to monitor all incidents of spillage and shall instigate legal proceedings where it is considered appropriate.

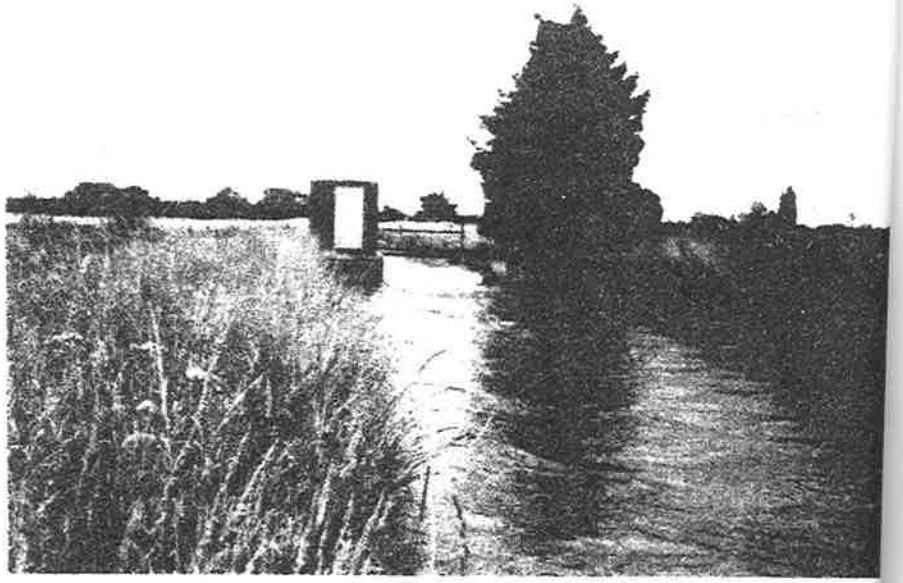
Objective 6. Groundwater is abstracted from within the Levels Plains Seadown area by approximately 30 private irrigators. In addition, the Ministry of Works and Development drilled some 24 investigatory bores to enable those farmers within the LPIS to utilise groundwater during periods of water restrictions on the main intake from the Opihi River.

Groundwater levels throughout the Levels Plains area are highest in the period December to May of each year, which suggests that water infiltration from the borderdyke areas is the major contributor to groundwater recharge. The extent to which this rise can be attributed to the LPIS recharge, and the relative contributions of rainfall, borderdyke application, spray application and distribution channel losses is unknown. Irrespective of the source of the recharge, a number of land owners have opted to withdraw from the LPIS and now rely on groundwater for their irrigation needs.

A major facet of the recent LPIS upgrade is the use of groundwater within the Levels Plains area. The Scheme holds water rights to discharge Scheme water into some bores for the purpose of recharging the aquifer. It is proposed that this recharge take place early in the irrigation season in an effort to raise the groundwater to sufficient levels as to enable the use of groundwater in those periods when surface water restrictions are imposed.

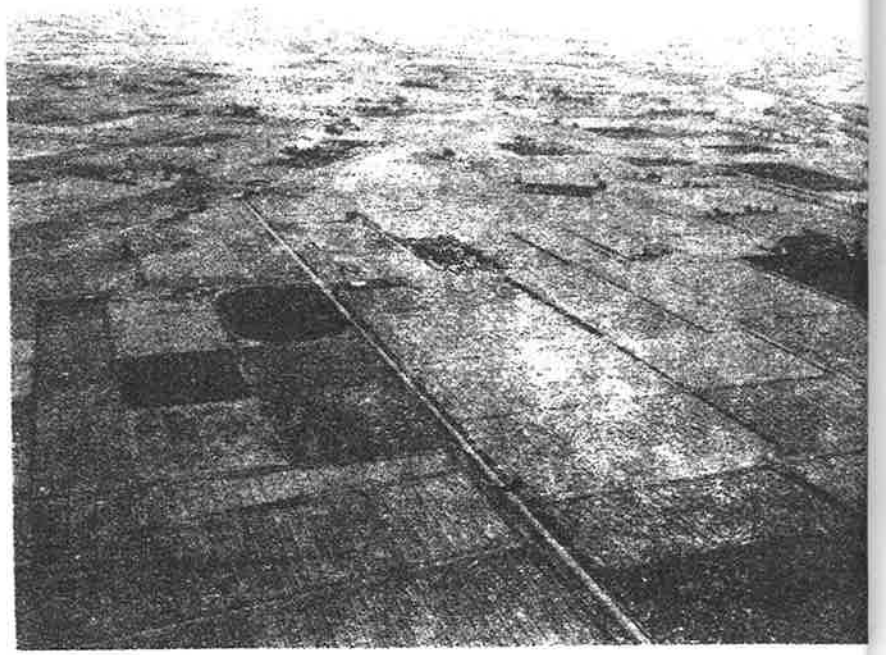
Concern has been expressed by proponents of the Irrigation Scheme that private well owners are now benefiting from the Scheme through groundwater availability and are not paying their share towards the maintenance and continued operation of the Scheme. If there were many withdrawals from the Scheme in favour of abstracting groundwater, the cost to those remaining in the Scheme would continue to rise, threatening its viability and eventually leading to a reduction in groundwater recharge which in turn would threaten the groundwater resource.

Because of this increasing demand and competition for the groundwater resources of the Levels Plains area requests have been made to the Regional Council to prepare a water management plan to better integrate the utilisation of the available surface and groundwater resources. The groundwater rights that have been recently issued to the Irrigation Scheme are to expire in 1995 and it is proposed that all other groundwater



Irrigation is a major use of water in the Opihi catchment. The Levels Plains Irrigation Scheme abstracts up to 3m³/s which passes through a measuring flume where the flow is recorded continuously.

Border-dyke irrigation is the major form of irrigation on Levels Plain. The scheme area currently includes about 2,300 ha, of which 54% is spray irrigated, 39% is border-dyke, and 7% is by other methods.



rights issued in the area also expire at that time. Investigations are presently being undertaken with the intention of producing a draft management plan by June 1992. It is proposed to incorporate a Levels Plains groundwater management plan into the Opihi Water and Soil Management Plan by 1995.

Options

The following options are proposed:

Option 1 Continue to monitor all groundwater usage, behaviour and quality throughout the Catchment.

Option 2 Continue to restrict water for irrigation purposes on the basis of 250 m^3/hectare/week irrespective of land use.

Option 3 Continue to impose the same restrictions as for surface takes on groundwater abstractions from all irrigation bores within 400 metres of major rivers or within 50 metres of minor tributaries.

Advantages

- Ensures protection of surface resources during low flows.

Disadvantages

- For abstractions of 30 l/s or less, the restriction is too severe, resulting in the inability of right holders to exercise their abstractions to the fullest.

Option 4 For all irrigation abstractions of 30 l/s or less, impose the same restrictions as for surface takes from all bores within 250 metres of major rivers or within 50 metres of minor tributaries.

Advantages

- Allows a fuller exercising of those rights without unduly affecting the surface resource during low flows.

Disadvantages

- Would require staff resources in policing those rights where abstractions were in excess of 30 l/s, especially in times of restrictions.

Option 5 Consideration could be given to those applicants wishing to take at a rate greater than 30 l/s or closer than 250 metres of major rivers, with the provision of certain information

In such cases the applicant will be required to arrange for and meet the full costs of a controlled pump test which is of sufficient accuracy for Council staff to calculate the parameters required to determine the stream depletion rate.

Because of the complex nature of the data required, all applicants considering this course of action should first contact staff from the Groundwater Section of the Regional Council.

Advantages

- Allows for a more accurate appraisal of the influence that individual abstractions have on the groundwater and surface water resources.

- Enables individual water right holders the opportunity to more fully exercise their total water allocation.

Disadvantages

- Each applicant will be required to meet the full costs of carrying out the pumping tests.

- Will involve increased staff resources in providing information, analysing the test data, and policing of individual water rights.

Option 6 In order to preserve and maintain recharge to the river, all irrigation abstraction from bores screened at depths of less than 15 metres which are within the Waihi River protected groundwater zone shall be restricted to half their weekly allocation when the flow of the Temuka River at State Highway One Bridge reduces to the determined minimum flow. (Abstracts closer than 250 metres from a major tributary or closer than 50 metres from a minor tributary shall be restricted as for surface takes.)

All groundwater abstractions that are located outside the protected groundwater zone and are situated at greater distances than 250 metres of a major tributary or 50 metres from a minor tributary shall continue to be unrestricted within the allocation specified on the water right.

Advantages

- Reduction in the abstraction rate of groundwater during periods of low flows.

- Maintaining of surface resources during low flows.

Disadvantages

- Imposition of additional restrictions on some abstractions.

- Increase in staff resources for policing of restrictions.

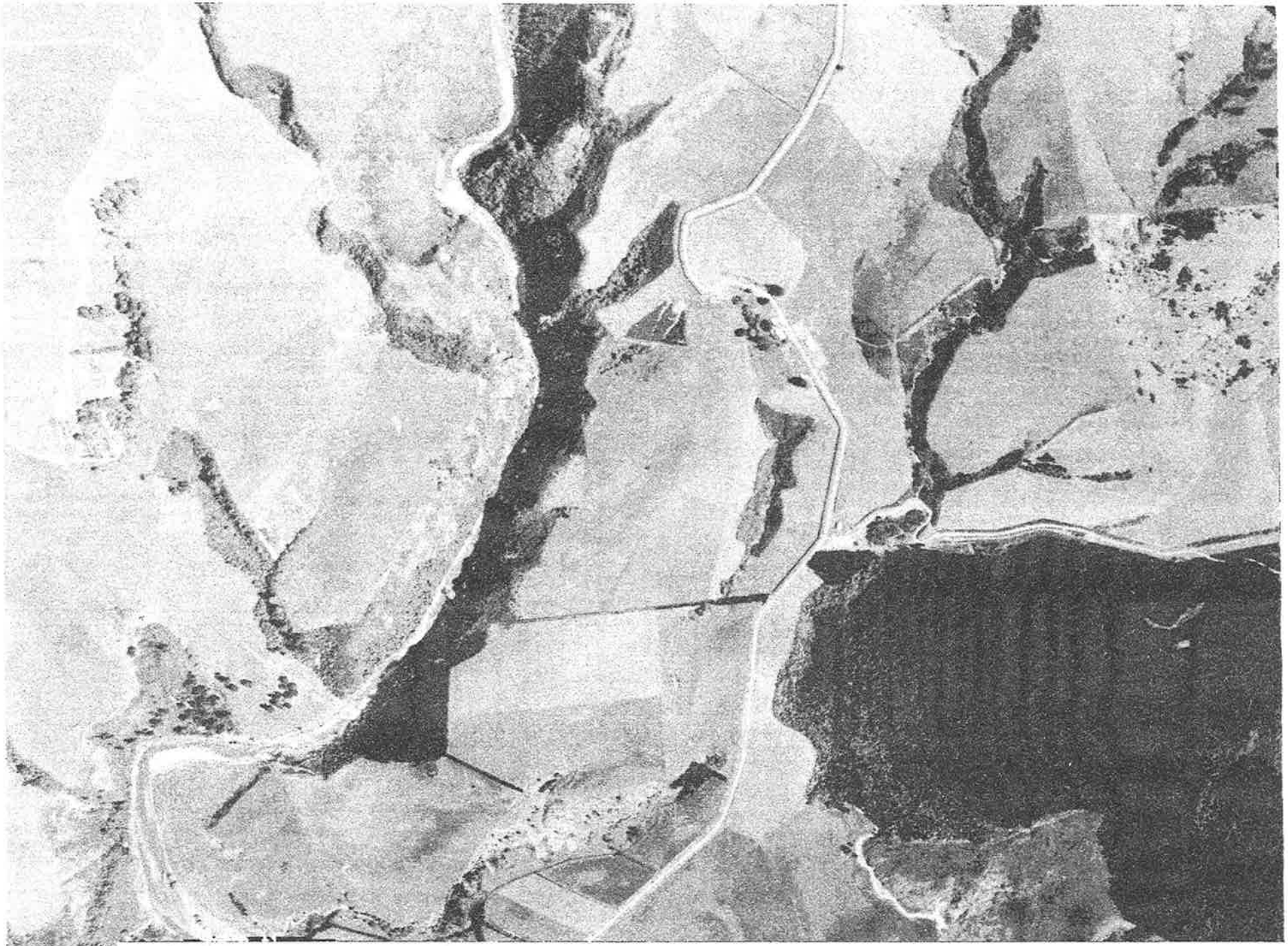
Option 7 Continue to require all effluent discharges onto land or into groundwater to be authorised either by way of General Authorisation or water rights. Conditions will continue to be placed on such authorisations to ensure the minimum impact on water quality.

Advantages

- Increased groundwater quality
- Increased surface water quality

Disadvantages

- Increased costs for some users.



2.5 Land Use, River Flows and Water Quality

2.5 Land Use, River Flows and Water Quality

Background

An important objective of catchment management is the integration of land use and land management practices with the conservation of the land and water resources. This requires understanding of the impact of management actions on the land (refer to Figure 11) and the land use potential or capability (refer to Figure 12). Conservation is achieved by the use of each area of land (defined by Land Use Capability units) so that its inherent qualities for sustained production, yield of clean water, food gathering, wildlife habitats, and recreation are unimpaired.

To define the impact of land use and management practices in quantitative terms, the land and water resources need to be monitored over a relatively long period of time. This type of research is expensive and hence the data base is limited. Records of historical events and understanding of changes in the use of the land over time, assists our understanding of what are the sustainable limits to the use of the land and water resources, and the interaction between the use of land, and the use of water.

History of Land Use

The Opihi Temuka catchment was settled by pastoralists over one hundred and fifty years ago. Since that time, land development for agricultural production has passed through phases of exploitation, expansion, intensification and diversification.

		Phases
1840*	Treaty of Waitangi signed Kemp purchase (of Canterbury) Extension pastoralism with burning of bush, tussocks, sowing of grasses	Exploitation
1860	Goldrushes Cultivation of land for wheat production, oats for horses, wool	Extensive pastoralism
1880	Fencing wire Refrigeration Depression	
1900	Most bush cleared, wetlands drained, depletion of soils World War I	Expansion (wool, meat, dairy products, crops)
1920	Tractors Fertilisers Breeding for genetic improvement Land development by cultivation Irrigation World War II	Intensification (application of science and technology)
1940	Aerial topdressing Forestry	Diversification
1960	Electric fencing	
1980	Horticulture Deer, goats	

* Note. Prior to 1840 the whole catchment was Mahika Kai: that is, the whole area was a gathering place for natural resources including food, fibre, wood.

The clearance of the indigenous vegetation, including the grazing and burning of the tussock grassland, drainage of wetlands, burning and grazing of bush, resulted in accelerated erosion, depletion of fertility, eutrophication, siltation and sedimentation of water courses, wetlands and other changes which follow vegetation clearance can be summarised as follows:

River Flows	Stream & Riverbeds	Hills	Water Quality
Faster runoff Increased frequency and magnitude of flood Decreased base flows Increased frequency of low flows	Localised changes in bed levels decreasing channel capacity Enlargement of riverbed Decreasing stability of channels and riverbed	Accelerated localised erosion Reduced infiltration rates Sheet erosion	Deterioration in water quality with increase in suspended sediment plus nutrient runoff

Changes in vegetative cover, with increased farm production, have occurred in the upper catchment over the past forty years, resulting in changes in the areal extent of bare ground.

Changes in the erosion status of Upper Opihi Catchment from 1944-1972 are as follows:

	Year of Survey		
Erosion Severity	1944 % area	1960 % area	1972 % area
Nil - slight	49	56	67
Moderate-severe	36	29	15
Very severe-extreme	15	16	18

The changes in the nil to slight category have occurred on the lower elevation zones (less than 900 m) throughout the catchment, but were most pronounced in areas of lower rainfall (less than 1000 mm) and on shady faces within this zone.

Watershed Protection

The retirement, rehabilitation and management of snowgrass swards for catchment protection has been promoted by the South Canterbury Catchment Board through Soil

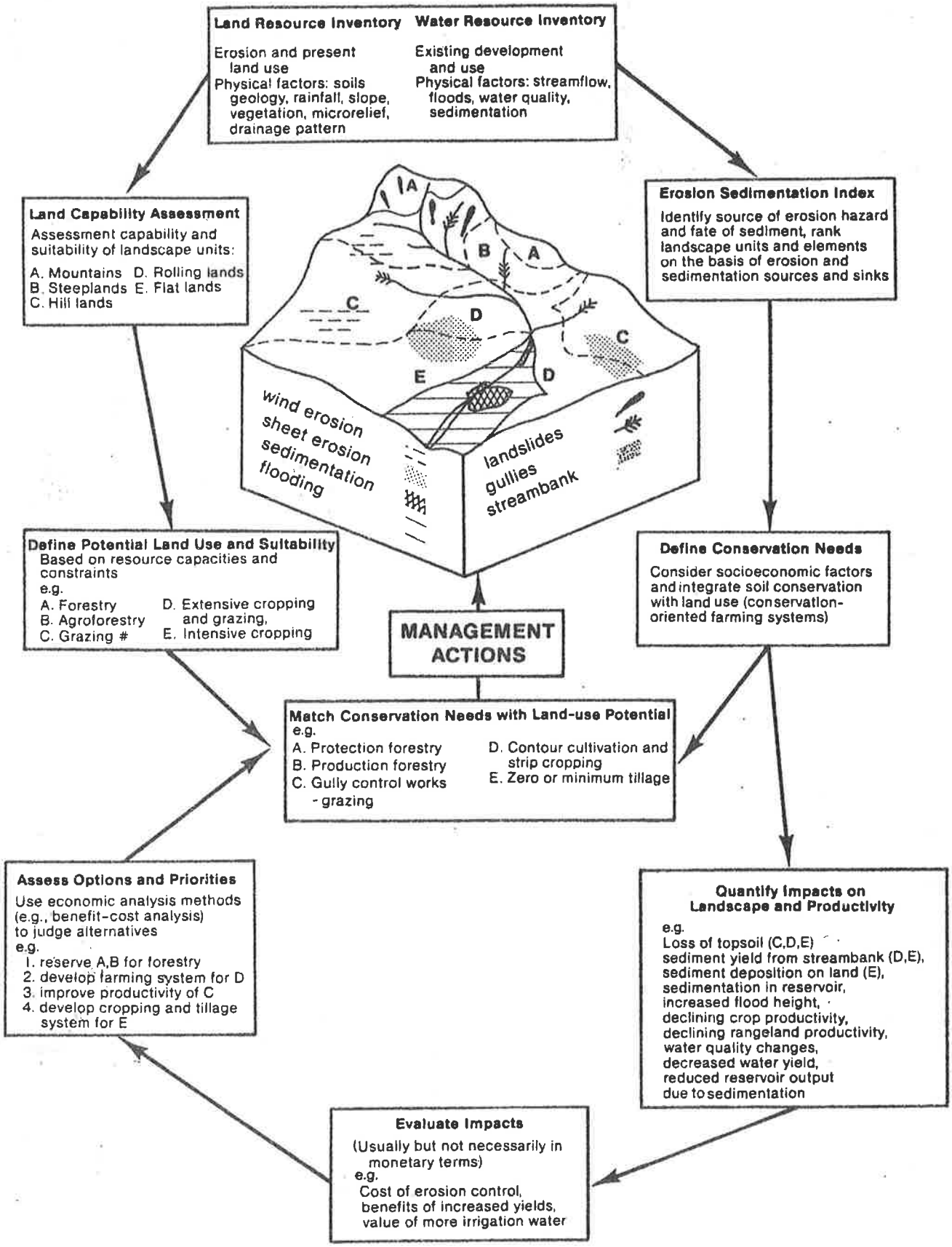
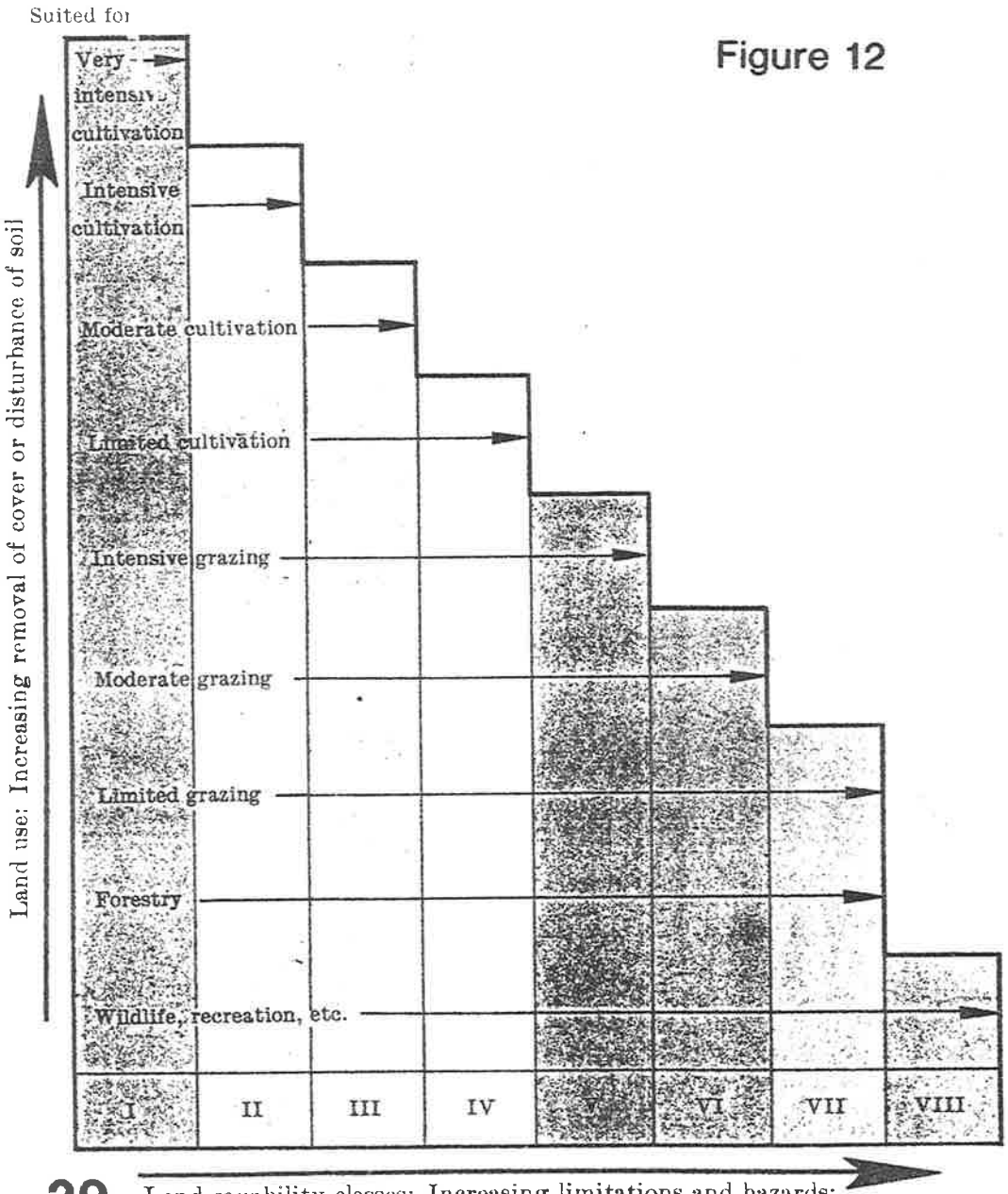


Figure 11 Impact of management actions on land and water

(After Perrens and Trustrum 1984)

Relationship of land limitations and land-capability classes to sustainable land use

Figure 12



and Water Conservation Plans. However there are areas of tussock grasslands where there is continuing degradation of vegetative cover and wetlands. Rank snowgrass increases interception and infiltration of precipitation compared with exposed and eroding sites. Continuing degradation of wetlands and snow tussock swards probably contributes to reduced low river flows.

The estimated annual yields of detritus into the main rivers as bed loads have been estimated as follows:

	Annual Yield (m^3)
Opuha catchment	24,000
Opihi	16,000
Tengawai	21,000
Total	61,000

If this gravel is moved, say, with a 10 year (10% probability) storm, affecting the whole catchment, then the result is 600,000 m^3 of shingle moving down to the flood plain. Excessive bedloads during floods causes damage to stopbanks, initiates or accelerates further bank erosion downstream and creates localised aggradation in the flood fairways, lowering the standard of flood protection.

Indigenous Bush Areas

The few remaining scattered areas of indigenous bush are largely unfenced. Without regeneration and freedom from grazing and browsing pressure these areas will gradually disappear. Indigenous bush is present in riparian areas of the Kakahu, Waihi and Te Moana catchments, shading the streams and protecting the stream banks. The prevention of erosion and the maintenance of high water quality requires a healthy forest and bush environment, free of damage from stock, particularly cattle and goats.

Cropland

Cropping occurs throughout the catchment with the intensity of cultivation varying from occasional cropping with pasture renewal through to intensive mixed cropping with rotations that include grass and clover for seed production.

Cropping has the potential to cause high nitrogen losses to groundwater (and the rivers) along with losses of nutrients and suspended soil material with high surface runoff.

Means of reducing these losses include:

- minimising exposure of bare soil (direct drilling/ minimum tillage/conservation tillage)
- contour cultivation
- leaving swales and water courses in permanent pasture
- reducing frequency of cultivation with increasing slopes (up to a maximum of 15 °)
- fencing out various slope classes, to enable each to be used to their capability.

Gullying and slipping in upper catchment

Detritus from this gully feeding directly into stream

- rotations
- nutrient (including organic matter) management (optimal timing and rates of fertiliser applications)
- Irrigation that minimises leaching and maximises up take of fertiliser by the crop
- created wetlands to trap and utilise runoff
- trees, carefully sited, can provide protection for the soil and crops and increase crop production, combined with grassed waterways, swales and stream banks.

These soil conservation measures have been promoted by the Catchment Board over the past forty years, but the rate of adoption by farmers has been slow, highlighting the need for a long term commitment to educational objectives.

Grassland

Surface runoff of fertiliser and nutrients from grazing animals is one of the major causes of reduced water quality in the Opihi-Temuka catchment. Means of reducing these losses include:

- accurate spreading of fertilisers avoiding direct entry to water ways
- timing of applications to avoid heavy rainfall and coincide with periods of vigorous pasture growth
- avoidance of applications to heavily grazed pastures
- adjustment of fertiliser requirements to the pasture requirements based on the results of soil tests

Reduction in the effect animals have on water quality can be achieved as follows:

- exclusion of stock from wetlands, streams and streambanks to prevent direct entry of nutrients (and some pathogens, diseases) and maintain protective vegetation
- exclusion of cattle from damp hill slopes and other areas prone to trampling damage
- avoidance of overgrazing and exposure of bare soil during droughts and in areas subject to severe frost (frost lift)
- avoidance of the concentration of high stock numbers in areas of high infiltration and high water tables
- care taken on dairy farms and feedlots to avoid run off from tracks and impervious areas
- rotations that maximise grass production while maintaining good cover, good earthworm activity, with minimum damage from trampling
- irrigation that minimises leaching and matches the requirement of the pasture

Application of the above measures is compatible with maintaining and increasing quantity and quality of production, profitability, while protecting the environment. The practices that have been addressed in the catchment include the fencing of riverbanks and the disposal of dairy wastes. There is a need to promote fencing of streams, wetlands and other sensitive areas and maintain adequate buffer zones and vegetative filter areas.

Forestry

Forestry land use in the catchment is as follows:

Plantations	Total
Kakahu Catchment	2630
Te Moana Catchment	1960
Raincliff	84
Mackenzie District Council	340
Farm Forestry (private land)*	500
	5514
Indigenous Forest	
DOC lands (including covenant areas)	708
Private Land *	200
	908
* Estimated	
Total	6422 (3% of total catchment)

The use of land for relatively large scale plantation forestry with short rotation (less than 40 years) and clearfelling operations can cause the following problems:

- reduction in base flows of the rivers and the drying up of small streams during droughts
- increase in silt loads and nutrients with runoff during land clearance, tracking and road construction
- increase in silt loads and nutrients with runoff at clearfelling
- loss of soil and soil compaction at landing sites
- risk of damage to existing protective vegetation with the use of fire, herbicides and heavy machinery.

The extent and severity of the above problems is influenced by the scale and rate of completion of operations, access, steepness of slopes, erodibility of soils, ground cover and length of rotations. That is, for known forest management regimes, market demand and knowledge of Land Use Capability, the problems are largely predictable and hence controllable.

There are perceived problems with forestry as a land use in predominantly pastoral areas. Increasing production from the land in water short areas such as the Opihi-Temuka catchment utilises available rainfall which is a natural input to crop growth. This is as true for forestry as it is for pasture, grain, seed and horticultural production. Forest regimes now place greater emphasis on wider spacing of trees and a more open canopy fewer but larger logs per hectare and shorter rotations.

The benefits of forestry include reduction in flood hazards and soil erosion, increased water quality and lower water temperatures during the summer.

Agroforestry as a land use, provides opportunities to achieve the Council's objectives, by balancing the use of trees in water short areas.

Urban Land Use

Townships (Temuka, Geraldine, Pleasant Point, Fairlie) contribute to water quality problems in the Opihi Temuka catchment. The sources of pollution are outflows from sewage treatment plants, septic tank outflows, rubbish tips, runoff (from streets, houses, businesses, industrial sites) and earth works, and dumping of rubbish into water courses. Runoff from urban and industrial areas is generally highly contaminated with oil, organic matter, heavy metals, nutrients (from animal wastes, leaves).

The means of dealing with these problems include upgrading sewage treatment to include wetlands and/or land disposal, upgrade the use and operation of septic tanks, relocate and upgrade rubbish tips, treat storm water runoff including the installation of silt traps and control rubbish disposal into streams (strategic placement of waste transfer stations, education and regulations).

Pollution from Toxic Chemicals

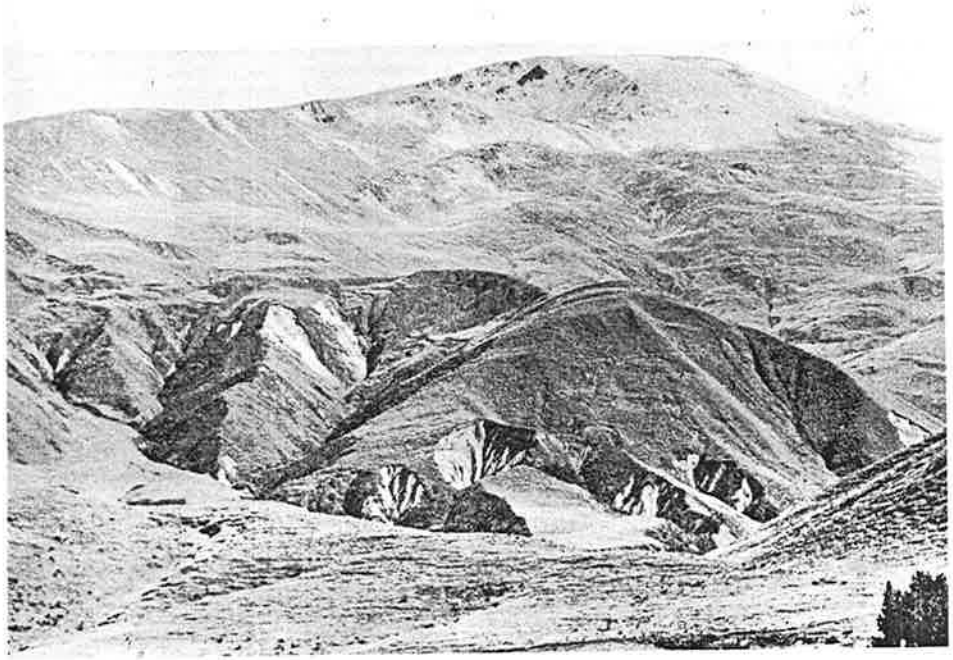
The sources of pollution can be diffuse (associated with land uses) or from localised or point sources. Chemicals used by agriculture, forestry and horticulture find their way into waterways. Precautions include safety procedures to cope with spillages in areas where chemicals are stored or mixed and equipment cleaned, designated areas for disposing of hazardous substances and avoidance of application too close to water courses and wetlands. Part of the problem is not knowing about the level of pollution in the environment, unless there are obvious signs, symptoms or spillages in public places. The range of possible chemical pollutants is very wide making environmental monitoring difficult. Existing monitoring procedures need to include levels of pollutants in food chains.

The Canterbury Regional Council administers Acts (Soil Conservation and Rivers Control Act 1941, Soil and Water Conservation Act 1967 and sections of the Town and Country Planning Act) which have over the past fifty years been amended in continuing attempts to provide solutions to problems arising from land uses and land management. In addition the District Council also administers Acts with statutory powers to provide solutions. However the problem of sustainability of land use has not been fully addressed.

The Resource Management Bill is proposed as a means of facilitating solutions. Key points of Resource Management Law Reform include delegation of responsibility to the regions, increasing accountability for achieving environmental outcomes and services, and the efficient expenditure of resources to achieve them. Greater accountability to the community, and the ratepayer, should result in recognition of all values and uses of natural resources.

The Canterbury Regional Council Corporate Plan sets out objectives to involve the community in its works and approach its responsibility in resource management in a way that recognises the inter-relationships between all the parts making up the whole environment. It is from this philosophical base, that the following objectives are put forward for the Opihi-Temuka catchment.

Headwater of catchment. Left branch of the South Opuha River.



Stable screes and well covered tussock grasslands interspersed with severe localised erosion at lower altitudes

Objectives

Proposed objectives to achieve the goal of sustainable use of the land and water resources of the catchment are as follows:

Objectives for the watershed management land.

Objective 1 *The protection of the soil resource.*

Objective 2 *The protection of tussock grasslands.*

Objective 3 *The protection of indigenous bush and forest.*

Objective 4 *The protection of riparian vegetation.*

Objectives for pastoral land (including those above)

Objective 5 *Afforestation of severely eroded and erosion prone land.*

Objective 6 *Establishment of trees for protection of the land from wind and water erosion.*

Objective 7 *Maintenance and enhancement of wetlands to retain and utilise nutrients and sediment from runoff.*

Objectives for cropping land (including those above)

Objective 8 *Establishment of permanent grass cover in intermittent water courses*

Objectlve 9 *The separation by permanent contour fences of land classes subject to high erosion risk under cultivation from land subject to medium to low risk from erosion*

Objectives for forestry land (including those above)

Objective 10 *Protection of watershed catchment areas to maintain base flows*

Objectives for urban land

Objective 11 *The protection of riparian land of urban streams and wetlands.*

Objective 12 *No sewage discharges into water courses.*

Objective 13 *No rubbish in riverbed.*

Objective 14 *The maintenance of water quality downstream of urban areas to a standard equal to that upstream.*

Objectives for a pollution free environment

Objective 15 *The designation of locations for the safe disposal of chemical pollutants.*

2.6 Conservation of Wetlands

2.6 Conservation of Wetlands

Background

Prior to European settlement the Opihi-Temuka catchment contained a number of significant wetlands which played a role in maintaining low flows in the rivers intercepting silt and nutrients, and reducing the impact of high intensity storms, slowing runoff. The wetland habitats were home to numerous and diverse species. This valuable natural resource, through drainage, reclamation and other forms of development has diminished. The significant remaining wetlands include rivers, lagoon swamps, marshes, flushes, stream sides, upland swamps, peatlands, bogs and tarns.

Braided Rivers of the Opihi Temuka drainage system

These wetlands are characterised by seasonal variations in river flows, changing the width, location and number of "braids". Fauna and flora have adapted to this constantly changing environment and the habitat has a high ranking for overall wildlife value. The wetlands are particularly vulnerable to water abstraction (loss of habitat) and pollution and invasion by aggressive woody weeds (gorse, broom). Channelisation of the main rivers has markedly reduced the area of this unique form of wetland.

Opihi River Lagoon

This lagoon is characteristic of lagoons along the Canterbury Bight, having no tidal backflow or delta and a mouth which closes with the drift of gravel along the coast. The lagoon is noted for its wildlife and fisheries, diversity of habitats, mahika kai (food gathering area for the Takata whenua) and has been identified by the Ministry of Agriculture and Fisheries as a wetland of national importance for fisheries.

Lowland Swamps, Marshes, Flushes and Stream Sides

The flax and raupo swamps have all but disappeared, leaving in their place a system of drains and streams dissecting low lying land, intensively farmed. If examples of the sedge, flax and raupo wetlands are to be conserved for future generations then urgent action needs to be taken to protect and enhance the wetlands. Throughout the catchment in low lying areas there are numerous small swamps, flushes and stream sides which are part of the seasonal food chain for a wide range of migratory species, as well as being vital reservoirs of life during dry periods. The quality of wildlife (diversity, presence, successful breeding) in the rural areas can be assessed in part by the density (per square kilometre of catchment) of these wetlands, areal coverage and water quantity/quality (closely linked to available runoff, seepage, ground water levels and/or stream flows).

The survival of these diverse wetlands is very much in the hands of private land owners. Diffuse pollution occurs from farm runoff. Any effort to address the issue of diffuse pollution during low flows could usefully involve an assessment of the role of wetlands within the catchment.

Upland Swamps, Peatlands, Bogs and Tarns

These wetlands are found at higher altitudes within the catchment. They are acidic and nutrient poor due to poorer soils, higher rainfall and lower temperatures. Plant form has adapted to the alpine environment including shrub bog and heath land, restiad bog and tussock land, cushion bog, montane flush, tussock and moss bogs. These wetlands are vulnerable to damage caused by fire, over grazing by sheep and browsing animals including cattle. The upland wetlands are an integral part of the remaining indigenous tussock grasslands. Their survival depends on farm management, the values and priorities of land owners (including the Crown). Changes in land use, from extensive pastoralism (fine wool production) to more intensive meat and wool production (with subdivision, fertiliser, new pasture species sown, rotational grazing) has resulted in diminishing tussock grasslands, including wetlands. The remaining wetlands are subject to diffuse pollution from increasing nutrient runoff from grazing animals and fertilisers.

Values of wetlands within the Opihi-Temuka catchment:

-	Trapping and storage of nutrients, silt, sediment (and water)	Wetlands are capable of stripping or extracting nutrients from water passing through them. By removing dissolved fertiliser and livestock effluent, downstream water quality is protected, albeit often resulting in damage to the wetlands if overloaded. Wetlands also act as sponges, having the ability both to lessen water flow during heavy rains or snow melt and to release water gradually.
-	Birds	Many bird species depend for their survival on largely unaltered wetlands. Migratory birds depend on wetlands as resting and feeding grounds on the flyways. The perimeter of wetlands are breeding areas for many species.
-	Fish	Many coastal fish depend on the river lagoons intertidal zone for spawning and early stages of development. The whitebait fishery in the Opihi is dependent on successful spawning in the ever diminishing grass areas covered by high water levels in the lagoon. Wetlands are highly productive and if these prolific areas are damaged or destroyed we can expect lower catches of fish.

Mahika Kai	Prior to 1840 the whole of the Opihi and Te Umu Kaha (Temuka) was mahika kai (place for gathering food and other resources) of the Takata Whenua. Wetlands were a major source of tuna (eels) inanga (whitebait) kanakana (lamprey) patiki (flounder) numerous species of birds (source of eggs, feathers) plus fibre from harakeke (flax) and many other swamp plants including watercress and raupo.
- Plants	Wetland plants are specifically adapted to survive in aquatic environments where aeration may be a problem along with low acidity. The number of successful species is not large. Many wetlands are distinguished by their distinctive vegetation (eg flax, raupo, sedges, rushes). Loss of wetlands means loss of these species.
- Ecosystems	The various types of wetland along with resident fish, birds and plants, form complex ecological systems. How they function is not yet known. They are of immense interest and value to scientists, the Takata whenua, naturalists, fishermen and shooters. What is known, is that if one part is damaged or destroyed, the result can be to alter the character of the entire system. These ecosystems are an important part of New Zealand's natural heritage, with most wetland species being unique to New Zealand.
- Recreation	The wetlands of the Opihi-Temuka catchment provide recreational opportunities for a wide range of activities and participation by a large number of people (population within 20 minute drive of SH1 bridge of over 30,000). The most popular activities include trout and salmon fishing, whitebaiting, shooting, swimming, boating, picnicking, tramping.
- Education	Schools use the wetlands for biological studies. Complex food webs, sources of nutrients, life cycles and functions of an ecosystem can be observed within defined small areas.
- Visual Landscape	The wetlands are an integral part of the landscapes within the catchments often being focal points or special features within otherwise developed scenery. The experience of wetlands including the sight and sounds of birds, seasonal life cycles, are a vital part of rural life and outdoor experiences for city dwellers.
- Historical Records	Some wetlands contain records of the past. The preservative qualities of some wetlands have ensured that pollen, bones, wood, plant material and artefacts remain in good condition. The coastal wetlands of the Opihi Temuka are a remnant of a much larger system lost to coastal erosion.

The values of wetlands have been recognised by government with legislation providing, to varying degrees, statutory responsibility to regional and local government, and the Department of Conservation to protect these values.

The proposed objectives are:

Objective 1 *The Opihi River lagoon be protected in its natural state.*

Objective 2 *The protection of all remaining wetlands.*

Objective 3 *Publication by the Council of a resource audit of wetlands, and the possible impact of the protection and enhancement of wetlands on the quantity and quality of river flows of the Opihi-Temuka Catchment, by June 1992.*

Options

The resource audit will identify of opportunities for the protection and enhancement wetlands. Protection could be achieved by the following options:

Option 1 Use of statutory powers of the Council by:

(a) Issuing of water rights for the drainage or reinstatement of wetlands.

(b) Setting of water levels for significant wetlands.

(c) Control of development in or around wetlands by issuing consents under section 34 and section 35 of the 1941 Soil Conservation and Rivers Control Act 1959 Amendment.

(d) Control of development in or around wetlands using Council Bylaws under section 150 of the Soil Conservation and Rivers Control Act 1941.

Advantages

Existing legislation allows some discretionary power for the Council to act on national, regional and community values, including scientific, cultural, recreational, hydrological, pollution control concerns and conservation interests. The procedures facilitate public input, (include the right of appeal) and provide a forum for the resolution of conflict. The conflict may be, for example between land owners seeking

to drain and lower water levels to develop land and public interest groups and downstream residents who want to maintain wetlands with high natural water levels. The forum also allows the participation of advocates of conservation, including government departments. The range of options presented also covers the means by regulation to change the utilisation of land, to meet the objects set out in the 1941 Soil Conservation and Rivers Control Act.

Disadvantages

Cost, including allocation of limited Council staff time to enforce the regulations and monitor outcomes. Resentment may arise from land owners and lessees due to possible over reliance on regulation as an option. Cost benefit ratios may show that purchase or compensation may be cheaper, should landowners appeal and oppose the regulations. Effective controls by regulations depend on community support.

Option 2 Purchase or leasing of wetlands by community organisations, Department of Conservation, District Council, or Regional Council.

Option 3 The placement of guardianship of wetlands with community, district, regional or national organisations.

There is statutory authority to declare wetlands reserves (Soil Conservation & Rivers Control Act 1941, Forests Act 1949, Land Act 1948, Local Government Act 1974, Marine Reserves Act 1971, Public Works Act 1981, Reserves Act 1977, Wildlife Act 1953) and with some provisions for compensation. The preparation of management plans (including land use of the catchments upstream of the wetlands) is an integral part of proposals to purchase or lease wetlands.

With respect to the placement or transfer of guardianship, the mechanisms available to carry out this option include open space covenants (QEII National Trust Act 1977), designation as a protected area (Reserves Act 1977, Department of Conservation), Soil Conservation Reserve (Soil Conservation and Rivers Control Act 1941, Canterbury Regional Council), Wildlife Refuge (Wildlife Act 1953) lease by a Charitable Trust or Incorporated Society, vesting land in the District or Regional Council, Community or National Organisations (including for example Fish & Game Council, Royal Forest & Bird Society) identification and zoning by District Councils (Town & Country Planning Act 1977), transfer of Crown land (including SOE land) to the Department of Conservation.

Advantages

Full recognition is given by these two options to community, regional and national values relating to wetlands. It allows resources, including scientific and management expertise to be applied to actions which have a direct outcome. Best use can be made of limited resources available to manage the wetland resources. Landowners receive recognition and assistance with respect to their role as guardians of wetlands. This option can be more cost effective than the use of statutory regulations where the outcome may still be the continuing loss and degradation of wetlands, and the loss of goodwill of land owners. The cost to the Council can be minimised, with a positive role of advocation and promotion, backed up by expertise, knowledge and experience in the benefits to the catchment of maintaining and enhancing wetlands.

Disadvantages

Cost, if the Regional Council acts directly on these two options. If the Regional Council is successful in an advocacy role and supportive of community initiatives, then successful outcomes become dependent on factors outside the Council's control, including for example community fund raising and resources available to Department of Conservation or the Fish and Game Council to purchase or lease wetlands.

Option 4 The application of Soil and Water Conservation (S & WC) Plans in priority wetland catchment areas.

Soil conservation is the wise management of land to maintain versatility and production, yielding balanced and sustainable benefits to present and future generations. The protection of wetlands is an integral part of Soil and Water Conservation. The basis of S & WC Plans is a Land Resource Inventory (LRI) which is used to derive maps, including a Land Use Capability (LUC) Map. Land Use Capability classification defines areas according to its suitability for permanent productive use, taking into account various physical limitations to use which the land may have. This information can be used to derive programmes of operations to maintain and enhance wetlands. Examples include:

(a) Fencing wetlands, including perimeter buffer zones, vegetation filters and riparian strips.

(b) Revegetation within fenced areas.

(c) Grazing management within catchment to minimise impact on wetlands.

(d) Revegetation programme within catchment to reduce sediment and nutrient loadings.

(e) Control structures to maintain water levels and storage capacity for floods and droughts.

(f) Sediment control structures, including vegetation filters.

(g) Protection and rehabilitation of indigenous vegetation including pest and weed control, maintaining dense woody cover on steep slopes and in gullies.

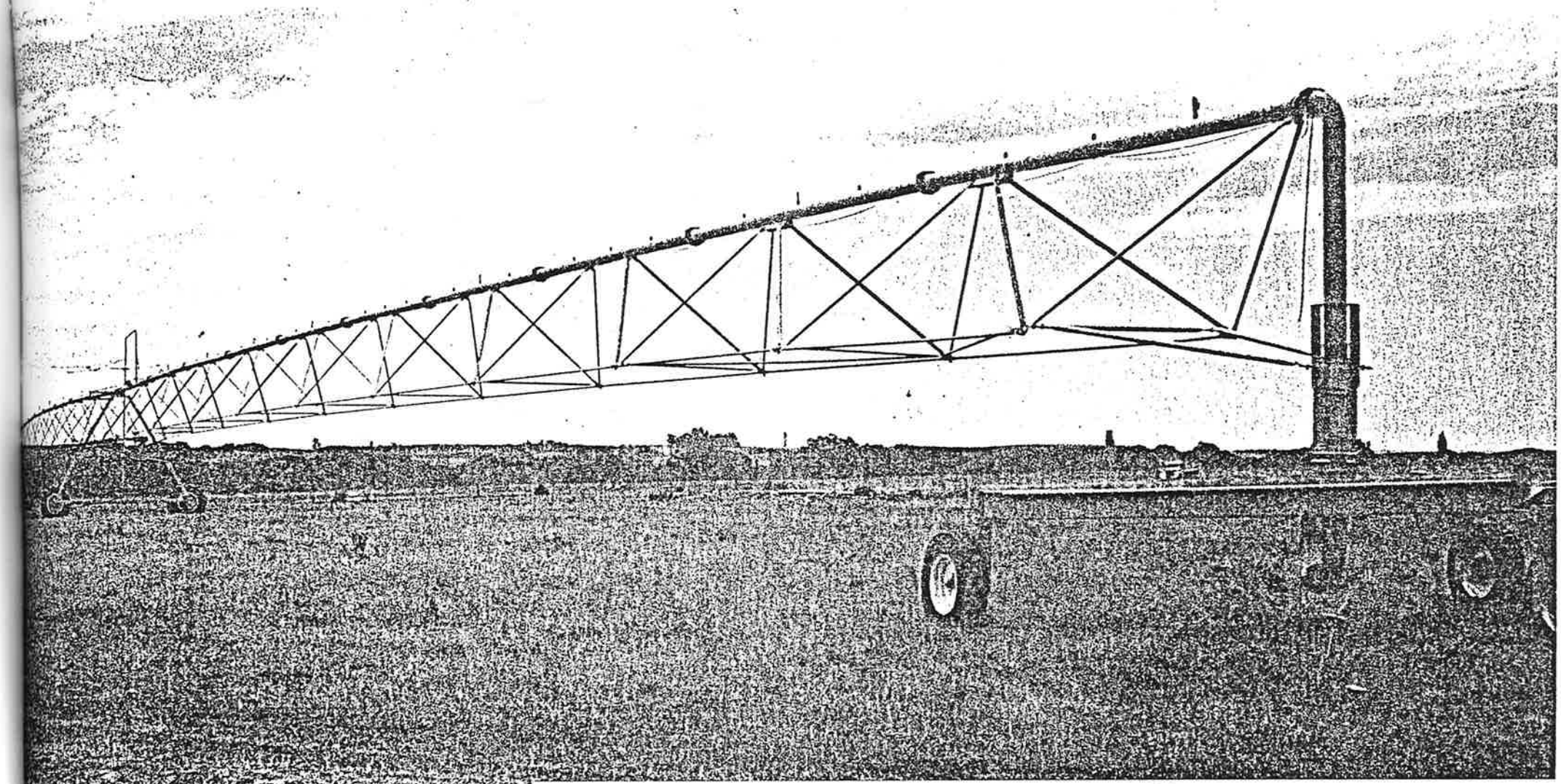
(h) Erosion prevention programme, including direct drilling, contour fencing of cultivatable land, limiting cropping to flat to gently sloping areas, contour cultivation with grass waterways in water courses.

(i) Application schedules for fertilisers, herbicides and pesticides based on requirements of each Land Use Capability Unit with recommended types, rates, timing and methods of applications to minimise impact on wetlands.

Advantages

Managing land to conserve wetlands requires knowledge of the land and water resources, and specialist land management skills and experience. The Council has already these resources, (including soil and water conservation plans for most tussock runs), which have developed with close working relationships with landowners. The best and most enduring results will come from a partnership approach with landowners identifying joint goals with the Council.

Disadvantages Cost and additional demands on limited staff resources



2.7 Best Use of the Water Resource

2.7 Best Use of the Water Resource

Background

The purpose of the Water and Soil Conservation Act 1967 administered by the Council includes:

- making better provision for the conservation, allocation and use of natural water
- promoting and controlling multiple uses
- ensuring adequate account is taken of the needs of industry, water supplies of local authorities, fisheries, wildlife habitats and all recreational use of natural water

Sections of the Act refer to "best uses of natural water", "efficient transfer and use of natural water" and "most beneficial use of natural water".

What are the "best uses" and "most beneficial uses of natural water"? Who decides, using what criteria?

A total of 229 abstraction water rights are current in the catchment, accounting for a maximum weekly abstraction of 4.2 million m^3 at a maximum rate of 9.5 m^3/s. Maximum abstraction rate includes 3.3m^3/s for borderdyke irrigation, 2.2m^3/s for spray irrigation from surface water, 2.8 m^3/s for spray irrigation from underground water and 0.6 m^3/s for public water supply.

The use of water for irrigation of pasture, crops and berry fruit is widespread throughout the coastal plains from Geraldine to Timaru and also within suitable river valley flats of the Tengawai, Opihi and Opuha Rivers. Currently, irrigation accounts for 87% of all current registered water uses. The most common method employed is spray irrigation, with border-dyke and wild flooding being mainly confined to those irrigators within the Levels Plain Irrigation Scheme (LPIS) and to those in the Ashwick Flat and Kimbell areas. Trickle irrigation is used for stone and berry fruit crops.

To protect fisheries and recreational use during low flow periods, the Catchment Board had imposed special conditions on water rights issued for the abstraction of surface waters for irrigation on the Opihi River and its tributaries. These special conditions restrict the taking of water for irrigation purposes when flow rates recede below specified magnitudes at selected sites.

There is now increasing awareness of the links between land and water and environmental values in general. Assistance from Government has been substantially reduced, with Local Government made more accountable (refer to CRC Corporate and Annual Plans) with greater emphasis on efficiency and effectiveness in achieving stated objectives. The farming community has gone through major restructuring with profitability and survival dependent on efficiency, product quality and market driven production.

The opportunity exists, with changes in farming, local government and the current state of play with respect to the Opihi augmentation proposal, for the Council to define what are "most beneficial uses" and options including the use of Council's statutory powers to achieve "best uses". The Council can encourage and promote more efficient and effective irrigation practices.

Objectives

The following objectives (using a range of means including promotions, incentives and education) are proposed:

Objective 1 *The most beneficial uses of the natural water abstracted within the Opihi Temuka catchment.*

Objective 2 *The most efficient transfer of natural water for abstractive uses to site of usage by water right holders.*

Objective 3 *The most efficient use of water by water right holders.*

Objective 4 *All water rights (past, present and future) renewed, using the same procedures.*

Objective 5 *All abstractions greater than 2500 m^3/week be effectively monitored (and metered if necessary), during periods of low river flows.*

Objective 6 *The renewal of existing water rights and granting of new rights to achieve most beneficial uses of natural water in the Opihi Temuka catchment by the year 2000.*

Objective 7 *The publication by Council of a report on the Feasibility and Impact of Applying Beneficial and Best Use criteria to the allocation of water in the Opihi-Temuka catchment by June 1992.*

The fourth objective covers the historical anomalies within the present legislation including water rights issued prior to 1967, and the water rights for the LPIS.

Objective five recognises the needs by Council to collect data necessary for it to effectively manage the water resource.

Objectives six and seven recognise that changes need to be made gradually to allow irrigators to assess the impact of changes on their own operations and plan ahead with certainty and confidence.

Objective seven recognises also the need for public participation in the debate of what are the most beneficial uses of natural water. The marginal value of every cubic metre of water during dry irrigation seasons and low river flows is high in monetary terms, to those irrigating (holding water rights) and intending to irrigate (seeking water rights) and high intrinsic values, including the abundance, diversity and survival of life in the river ecosystem.

Options

The following options are proposed:

Option 1 The Council allocates priorities for water use as follows:

Local authority, rural water supplies	Priority 1
Industrial	Priority 2
Horticulture	Priority 3
Cropping, pastoral	Priority 4

This option could be implemented by groups being restricted during low flows in priority order. Also the priorities could be used for determining whether or not future applications for water rights are granted.

Option 2 The Council allocates maximum rates of water use on an industry by industry basis (including horticulture, arable cropping, dairying) using industry averages for efficient water use.

These two options can be considered together.

Advantages

- Recognition is given to more efficient uses of water and the greatest benefit from the use of water.

Disadvantages

Loss of income by farmers who may have invested heavily in irrigation. Compensation is not an option. Changes would need to be gradual to minimise any financial losses or hardship. Setting maximum rates for industries can be impractical unless water is reticulated.

Option 3 Irrigation schemes within the Opihi-Temuka catchment be required by Council to meet minimum efficiency ratios of the transfer and distribution of water.

Examples:

(a) Overall efficiency ratio

$$\frac{\text{Volume actually used by evapotranspiration}}{\text{Volume of water at source}}$$

(b) Efficiency of transfer and distribution

$$\frac{\text{Volume of water distributed per parcel of land}}{\text{Volume of water at source}}$$

(c) Efficiency at paddock or farm level

$$\frac{\text{Volume of water actually used by evapotranspiration}}{\text{Volume of water distributed to each parcel}}$$

(parcel of land = land irrigated by water right holder or applicant)

Advantages

This option sets standards for the gradual upgrading of irrigation schemes to meet conditions essential for the renewal (or granting) of water rights.

Disadvantages

May be prohibitively costly to inefficient irrigators and schemes if the ratios are set high. Changes may need to be gradual and certain to maintain investor confidence in irrigation. High ratios may be set to encourage sealing of races or use of pipes to transfer water.

Option 4 The setting of expiry dates of all of water rights within the catchment so they expire on a common date in the year 1999.

Advantages

This option allows ten years for the Council to report and act on options to achieve the most beneficial uses of the natural waters of the Opihi Temuka catchment. This time can be used to achieve levels of efficiencies and possible readjustment of irrigation practices once all water rights are considered together, there is the possibility that longer term rights could be considered.

Disadvantages

Peak work load, processing all water rights over a short period of time.

Option 5 The Council allows the transfer of water between areas, when issuing or renewing water rights.

Advantages

This option allows market forces to sort out "most beneficial uses" in monetary terms. Allows the most successful irrigators to expand and develop.

Disadvantages

The actioning of this option could result in anomalies and abuses, focusing valuation on the water right itself rather than beneficial use of the water. There would need to be strict policing of conditions (at a cost to the Council) which may discourage investment in higher levels of production.

Option 6 The promotion by Council of the formation of water user groups or organisations.

Advantages

This option would benefit private irrigators in the Opihi-Temuka river system within defined sub catchments. The successful setting up and running of these groups or organisations could result in delegation of some responsibilities by Council and facilitate participation in decision making and management of local water resources. There is the potential for cost savings by both Council and water right holders. As a

group, irrigators may be able to have more control and certainty over the question of continuing access to water.

This option is about seeking the full co-operation of water right holders who have common interests in the collective benefits of equity of distribution and allocation, efficient land and water use, ensuring some members do not obtain benefits at the expense of other members.

Disadvantages

The Council will need to assist such groups or organisations. The greater the number and spread, the greater the cost.

Option 7 The Council promote water conservation measures.

These measures could include:

(1) Storage (on farm small scale dams, community storage facilities)

(2) Establishment of designed shelter systems

(3) Crops and cropping systems that do not have peak demands during periods of low river flows.

(4) Monitoring services to irrigators, analysing performance (processing information from irrigation returns or meters plus additional information provided by irrigators)

(5) Information services on irrigation technology, including performance of different types of plant and irrigation systems

(6) Design services for storage and distribution facilities

(7) Water use audits carried out on request by water right holders. Information specific to the water right holders would remain confidential.

(8) Daily reports during dry periods in newspapers and on radio of soil water deficits, irrigation demand, water supply and timing of restrictions

(9) Demonstrations organised jointly by Council and selected irrigators of optimal use of water using physical and financial criteria

(10) Effective communication on the efficient management of the use of natural water (including contribution to education curriculum).

The above measures could be carried out by:

a Differential water monitoring charges.

b part refund of costs incurred meeting Council criteria or designs (first two measures)

c allocation of staff resources to provide carefully targeted planning, design and/or management services to meet monitored outcome (all the above measures)

d joint operations with other organisations (eg MAF, private consultants, companies, firms, Federated Farmers) sharing resources

e sponsorship from commercial firms

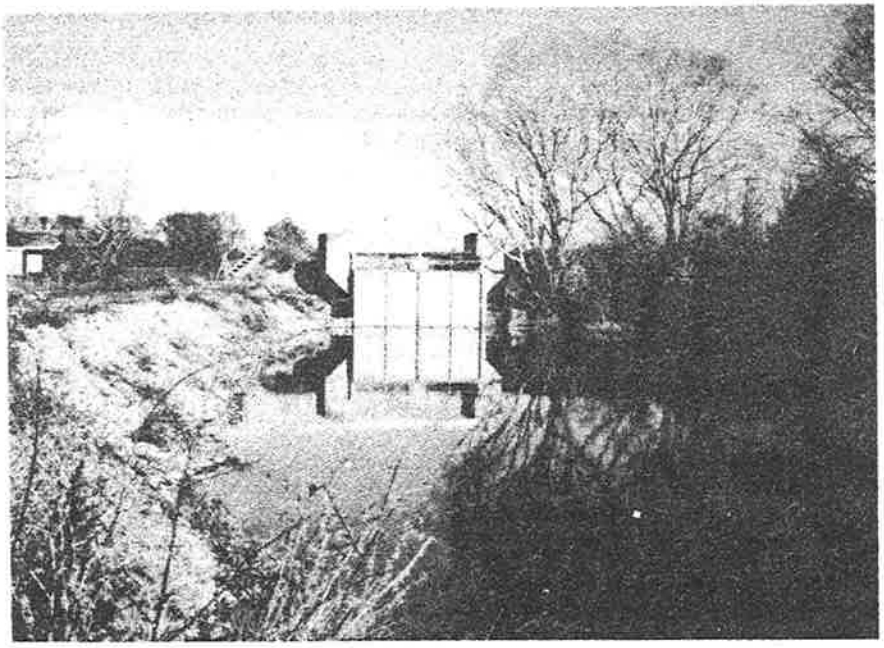
f competitions for conservation awards initiated by Council with prizes from commercial firms, conservation or educational organisations or institutions

Advantages

This option may be one of the most effective means of achieving the objectives. There could be savings from reduced cost of administration, monitoring and policing.

Disadvantages

Cost including the allocation of staff resources.



Intake structure Levels Plain Irrigation Scheme

2.8 Opihi Augmentation

2.8 Opihi Augmentation

Background

The Opihi is a water short catchment. Potential peak water demand exceeds the ability of the river to supply this demand. This situation has encouraged investigation into how flows within the Opihi River might be augmented to increase the availability of water during the irrigation season.

The 1983 Opihi Soil and Water Resource Development "SWORD" Report addressed options available for augmentation of river flows. This report recommended an incremental development strategy with three specific phases.

Phase I focussed on management strategies encouraging development of groundwater resources, out of river storage, prioritising water allocation for more intensive uses such as horticulture and preferring spray irrigation ahead of border dyke irrigation.

Phase II proposed construction of a dam on the Opihi River, development and expansion of irrigation schemes, diversion of waters from the Opihi dam to the Tengawai River.

Phase III proposed the transfer of water from Lake Tekapo over Burkes Pass and further expansion of irrigation schemes. **(Refer to the Transver Route Figure 13)**

The previous Opihi Water Management Plan sought to address parts of Phase I. At the same time the Opihi Augmentation Society was formed with the preferred intention of transferring water from Lake Tekapo.

This option of augmentation of the Opihi by transfer of water from Lake Tekapo has been the subject of recent feasibility studies. These reported that it is:

- feasible from an engineering perspective
- possible with some environmental impacts
- sensitive from a Maori cultural view

The economic viability was not finalised and a review using a reassessment of the engineering option and broader parameters to assess the benefits and spread of costs is being undertaken.

The Environmental Impact Assessment makes comments with regard to the future river management plan. A particular comment is that "if the multiple use objective of this scheme is to be achieved at least in part then the forthcoming review will have to critically review the minimum low flow requirements for instream use".

Low flow is discussed as a separate issue in this report. A critical consideration however which needs to be determined is should a minimum flow be set in anticipation of augmentation potential or regardless of that potential? Setting the minimum flow at a level which anticipates a top up with augmentation may lessen the need for augmentation. Setting it at a higher level now will lessen the availability of water for out of stream uses and perhaps heighten the need for augmented flows for these out of stream uses.

There are other options which address enhancement of flows rather than augmentation. These include promotion of the best use of water and prioritising allocation, utilising groundwater and shifts in farming practice towards less reliance on irrigation. These are discussed in other sections.

A management plan will not in itself achieve any of these augmentation options but it can establish the rules and parameters within which it should occur if it is to occur.

It will be necessary for the management plan to consider whether an augmented flow should be anticipated and therefore whether lesser instream flows can be accepted with this option in mind.

Objective

The objective for the augmentation of the Opihi River is suggested as being:

> *To secure and have available at all times sufficient water to meet demand and preferably to enable optimisation of productive opportunities within the Opihi catchment while keeping sufficient quantities of water in stream to maintain the instream values of the Opihi River.*

Options:

To achieve this objective, the options put forward are:

Option 1 Attainment of the optimum river flows for all uses by augmenting the Opihi River from Lake Tekapo

Advantages

Transfer of water could be managed to achieve an increase in the instream quality of the Opihi River. Increased irrigation opportunities and so increased development to catchment and wider surrounding area. Increased instream water will assist in management of the mouth; increased recreational opportunities; community confidence with increased options for development.

Disadvantages

The transfer of water from one catchment to another is a sensitive issue to the Maori community and is contrary to their wishes. To justify the economic input significant changes in agricultural practices would need to be made. Environmental impacts could be undesirable.

Option 2 Attainment of optimum river flows for all uses by establishing instream storage.

Advantages

The 40 million m^3 capacity instream storage option is capable of achieving storage which could satisfy a 5 cumec irrigation demand. Doesn't require taking of water from

another catchment but with 4 cumec augmentation from Lake Tekapo 9.2 cumec irrigation demand could be satisfied. Some recreational potential.

Disadvantages

High economic cost. Development of this option may prohibit economic development of augmentation from Tekapo though these are of mutual benefit. Environmental impacts of storage dam may be detrimental eg visual impact, impact on migratory wildlife. Varying levels of storage may not make it attractive as a recreational lake.

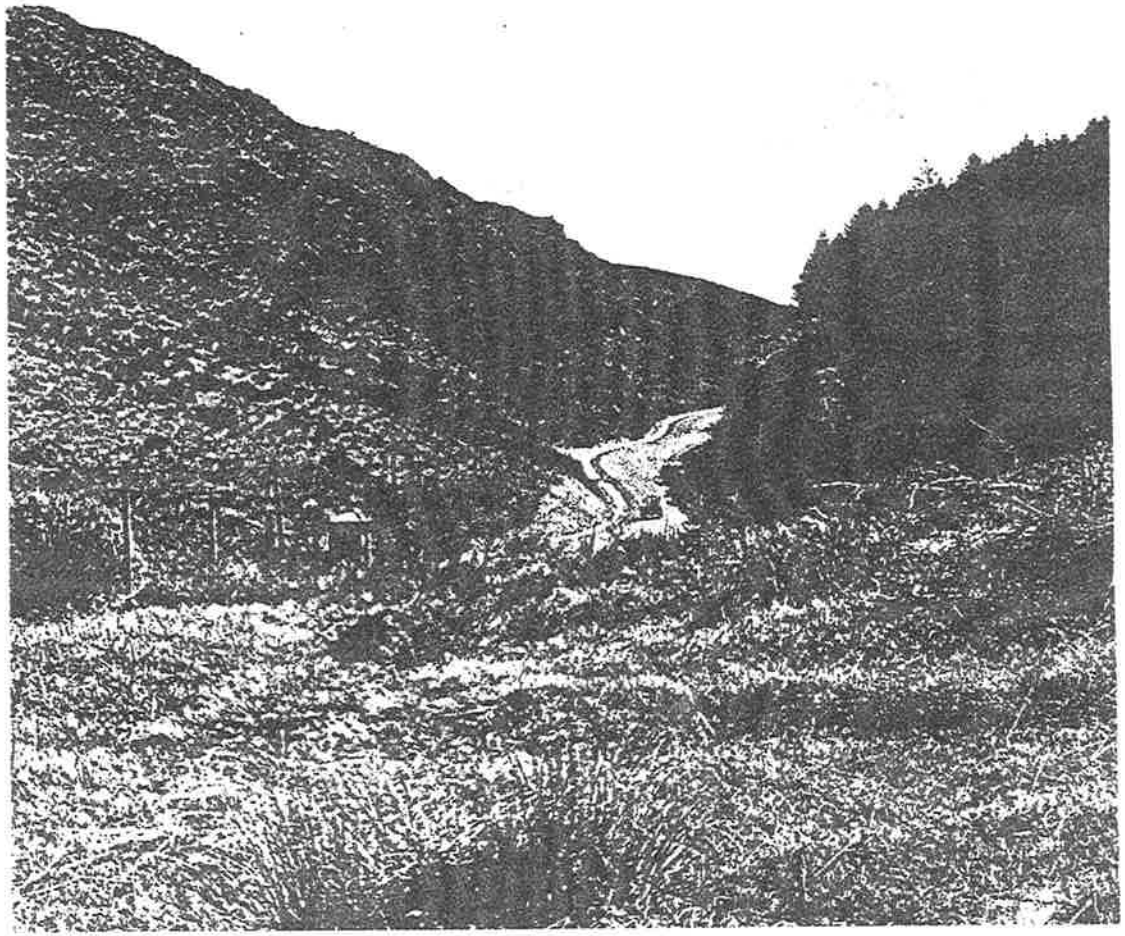
Option 3 Attainment of optimum river flows for all uses by establishing out of stream storage.

Advantages

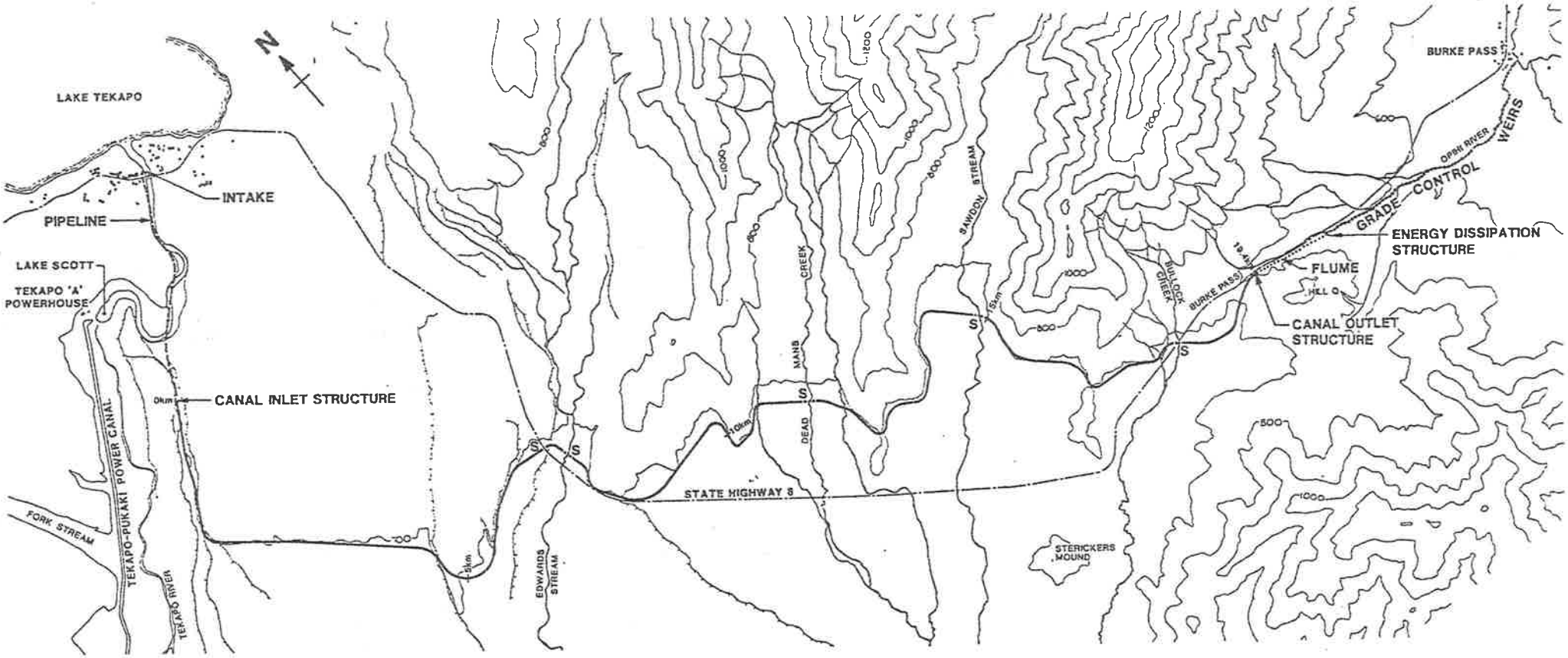
Out of stream storage can commence immediately on an individual or collective basis. Scale and cost can be determined subject to needs and productive intentions and ability to pay of the particular farmer. No impact on instream values. Provides insurance against drought for the particular farmer.

Disadvantages

Small scale and disjointed development may occur. Achievement of irrigation needs on individual farms may discourage support for larger schemes which could provide wider benefits. Unlikely to make significant contribution to meeting potential irrigation demand.

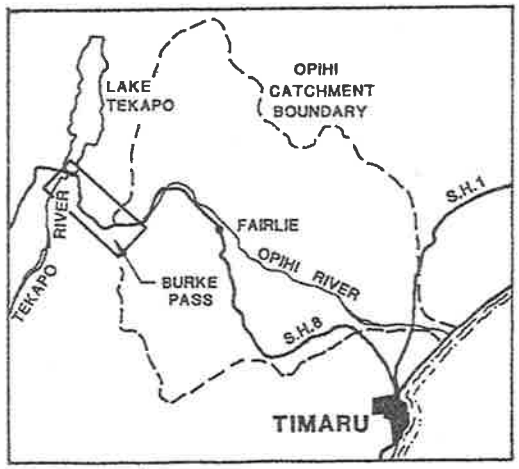


Proposed Canal Route Burkes Pass



KEY

- S — Inverted Syphon
- Canal
- Contours at 100m intervals
- Pipeline
- Flume
- Grade Control Weirs

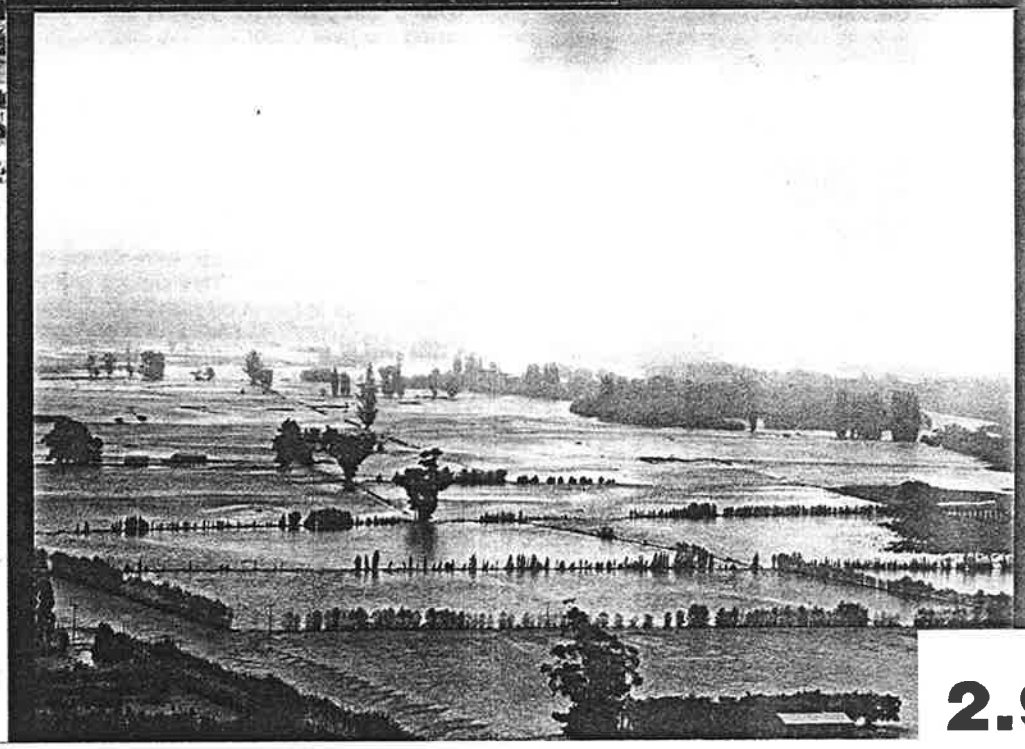


SWORD Feasibility Stage I

WORKS

Figure 13

TRANSFER ROUTE



2.9 Flood Hazard

2.9 Flood Hazard

Background

The flood hazard within the Opihi-Temuka Catchment can be defined as the interaction of settlement, human use of the plain, and the physical flood event. The benefits of settlement, and use of the flood plain must be weighed up against the costs incurred due to floods and flood protection. The Canterbury Regional Council and its predecessor, the South Canterbury Catchment Board, has built stopbanks and maintained flood fairways. The cost of this structural response to the flood hazard has, up to now, been heavily subsidised by central Government. Flood protection using stopbanks and channelisation of rivers is expensive, with the availability of capital (and the ability or willingness to repay loans) limiting the level of protection. The losses which have occurred when the stopbanks are overtopped and the river extends outside the designed flood fairway, have also been heavily subsidised by central government. Insurance companies pay on losses to their policy holders. People have gone back to their repaired homes and places of work. There has been increasing dependence on flood protection and flood loss payouts. Spending more money, increasing investment on the flood plain and providing increasing structural protection is increasing the flood hazard. The flood hazard potential has become dependent more on the property damage, social disruption, human casualties, than the natural characteristics of the floods. The long term solution lies with extending the ways flood hazards can be dealt with by adjustment of human use of flood plain.

Current Flood Protection

There are two catchment control schemes within the Opihi-Temuka Catchment.

(1) Opihi Catchment Control Scheme.

Current scheme objectives to mitigate flooding by:

- Preventing flooding of the lower river flood plain from floods up to a 50 year (2% probability pa) return period.
- Mitigating the erosion in the upper catchment for onsite as well as offsite (downstream) benefits. The lower flood plain protection involves stopbanking and channelisation of the river. The upper catchment works involve retirement of eroded areas and gravel control works including tree planting.

The capital cost of scheme to date is $27,387,000 (1990 $ value). The Scheme is completed as specified in the published revision March 1984 and the standard of protection upgraded as a result of flood damage restoration after the 1986 flood. There is a review date of 1996. However central government funding of the 70% subsidy expires March 1991. This is resulting in the critical reappraisal of structural design objectives, work methods, need for upper catchment works and prioritisation for maintenance.

(2) Waihi-Temuka flood control scheme.

Current scheme objectives are to mitigate flooding by:

- Safely containing the Waihi and Temuka Rivers within their respective channels for up to Q50 year discharges (return period of 50 years).
- Safely contain the Waihi and Temuka tributaries within their respective channels, up to a Q10 year discharge (return period of 10 years) where it is economic.
- Including upper catchment works to reduce the cost of flood damage to lower river works. The scheme is completed as specified in the revision published 1978.

Capital cost of the Waihi-Temuka works to date is $7,645,000 (1990 $ value). The Waihi-Temuka scheme lower catchment boundary is the stopbank on the north bank of the Opihi River which prevents flood waters (Q50 discharge) from the Orari-Waihi-Temuka river system joining the Opihi flows.

As with the Opihi Scheme the loss of central government subsidy is resulting in the critical reappraisal of the scheme objectives including the justification of upper catchment works, sediment transport and storage, work methods and prioritisation for maintenance.

Flood Hazard Information

Flood hazard maps have been published (SCCB 1986) covering the area between the Waitaki and Rakaia catchments, including the Opihi-Temuka catchment. This series of maps, published at a scale of 1:50,000 was based in part on historical records of flooding and provide an insight into the direction in which floodwaters will flow upon leaving the river channel. This information has been used by:

- People buying properties
- Local Authorities for inclusion in District Schemes
- Regional Council for comments on flood hazard requested by District Councils
- Insurance Companies
- Valuation Companies and valuers
- The General Public

A service is also provided, with advice on flood hazard of all new subdivisions and Planning Applications. This service can include recommendations on floor heights for new buildings in the flood plain.

Flood Plain Management Plans

The Council has taken steps towards an integrated approach to flood hazard although limited to urban areas. A Flood Plain Management Study has been published for the Temuka Borough (SCCB 1989) and Flood Plain Management Plan for Pleasant Point is due for release November 1990. The Pleasant Point Draft Plan has identified options beyond raising stopbanks and increasing channel width. The options presented include flood warning and community preparedness and flood zoning (planning and building controls).

In summary the time has come, with the reduction in government funding, to look at what options are available over the whole catchment that are practical, affordable and address the issue of flood hazard.

Theoretical Range of Options

An overview is required of all adjustment to flood hazards to identify possible future options for the Canterbury Regional Council. (Refer to Table 7).

Seventeen possible options have been identified. Of these the South Canterbury Catchment Board actioned in the main, six with the emphasis being on engineered structures. What is often overlooked, is that the most damaging effects of floods is the loss of top soil, through either scour or bank erosion. Buildings can be repaired or replaced. Not so the top soil.

Objectives

Six objectives are proposed for the Opihi-Temuka Catchment Management Plan:

Objective 1 *Conservation of the soil resource.*

Objective 2 *Prevention and mitigation of erosion.*

Objective 3 *Prevention of damage by floods.*

Objective 4 *Change in the utilisation of land to achieve the above three objectives.*

Objective 5 *Zoning of land which is prone to severe lateral bank erosion*

Objective 6 *Publication by the Canterbury Regional Council of a report on flood corridors by June 1992.*

Options

The options proposed:

Option 1 Use of secondary stopbanks, levees and flood walls.

Advantages

Increased level of protection for areas outside the flood corridors.

Disadvantages

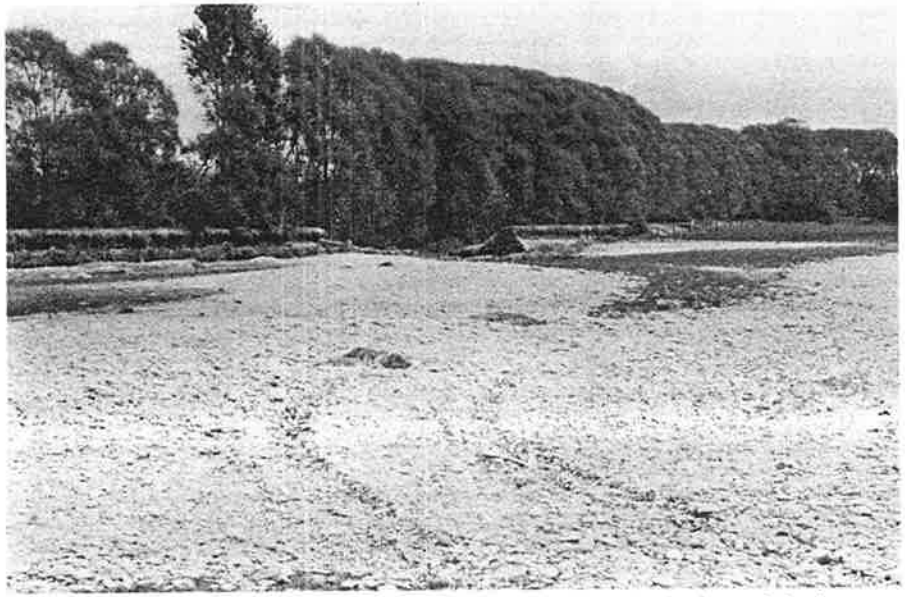
Cost, limitation in land use and development within corridors.

Option 2 Modification (and in some cases removal) of major obstacles in the path of flood waters. This includes embankments (road and rail), irrigation/ water races, drainage system, coastal stopbanks.

Te Moana River from Temuka (right foreground) looking upstream towards Geraldine.

Flood protection along Tengawai River (to left of photo) overtopping and flood-waters inundated Pleasant Point township. Looking towards coast, lower Opihi River in top left.

Stopbank (true right bank) immediately upstream from Saleyards Bridge (Opihi River) demonstrating process of stopbank failure. Flow overtopping the bank erode the stopbank from the top back towards the river side of the bank (mid photo) until eventually the bank is totally breached (top left photo).



Shingle deposited onto farmland carried by flow through the breach in the stop-bank (mid photo).

Advantages

Increased level of protection

Disadvantages

Cost

Option 3 Change in land use within the flood corridor to pastoral farming with carefully planned and designed agroforestry.

The trees protect the soil, control sedimentation and can change flow direction and water velocities. The pastures under the trees allow water to flow with minimal resistance.

Advantages

Conservation of soil, minimal damage following floods, attractive productive landscape,with trees producing timber, pollen/nectar, nuts, wildlife habitats.

Disadvantages

Cost, limitations in land use (eg no cropping) and development (no erection of buildings)

Option 4 Identification of areas subject to the highest risk of flooding, damage and soil loss.

(This can include the identification of flood corridors in district schemes, use of land improvement agreements to protect the land and erosion/flood control improvements and visible permanent markers along the flood corridor.)

Advantages

Protection and confidence for people buying land subject to flooding, greater community awareness of the natural hazard, greater adaption by land owners and the community, greater preparedness for the next flood.

Disadvantages

Possible limitations in land use and developments (buildings, structures), loss in some property values and changes in insurance rates.

Note: Providing the adjustments are made gradually, minimising any hardship or disadvantages faced by **existing** land owners, this option offers probably the best and most effective adjustment to the flood hazard in the long term.

Option 5 Flood proofing service provided by the Council and private industry.

With a greater degree of certainty in the location and depth of future flood waters, individual property owners can be encouraged to undertake a range of flood proofing measures. For example, flood walls and gates, raising foundations and/or water proof

doors and walls, relocated wiring and appliances, renovating with damage resistant materials.

Advantages

People are free to choose their own type and amount of flood protection, possible lower insurance premiums, greater awareness and preparedness for the next flood, lower flood losses, sense of achievement and control over the situation.

Disadvantages

Cost, particularly for lower income families.

Note: One of the positive aspects of this option is that the cost can be lowered where people are prepared to do the work themselves, with expert advice.

Option 6 Relocation of stopbanks in areas identified (zoned) as subject to severe lateral bank erosion.

This option applies to land on the south bank of the lower Opihi River, below Highway 1 bridge. This land is subject to deep scouring.

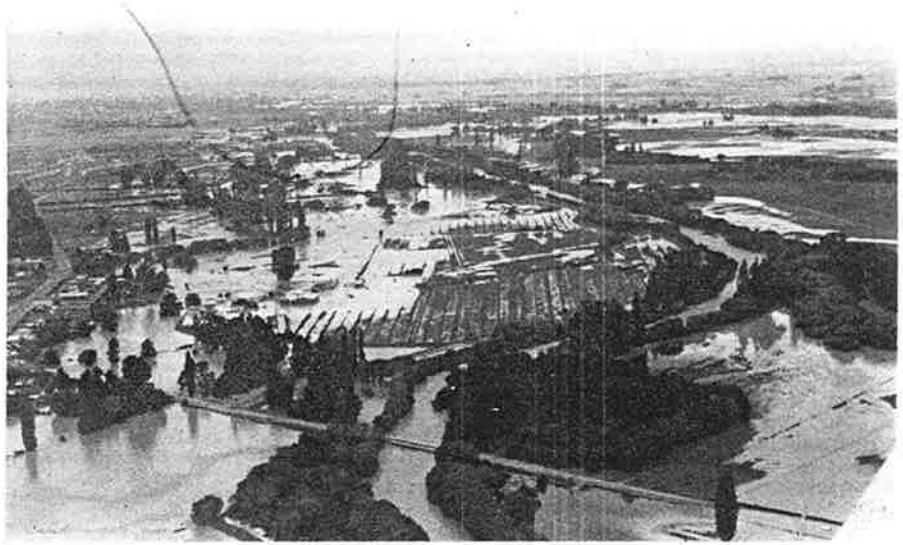
Advantages

Enables the long term planning for the replacement of stopbanks to proceed. Will protect future improvements by ensuring location out of the erosion prone areas.

Disadvantages

Limitations of land use. Relocation of road and some huts at Waipopo.

Out-of-channel flows caused major soil loss with some paddocks adjacent to the stopbanks being stripped completely bare down to the underlying shingle material.



Waihi River. View south from SH72 towards Temuka in background. Winchester township in left foreground. Note the flooding along Dobies Creek to left of main river channel UEB (Waihi) Woolscour complex (centre of photo).

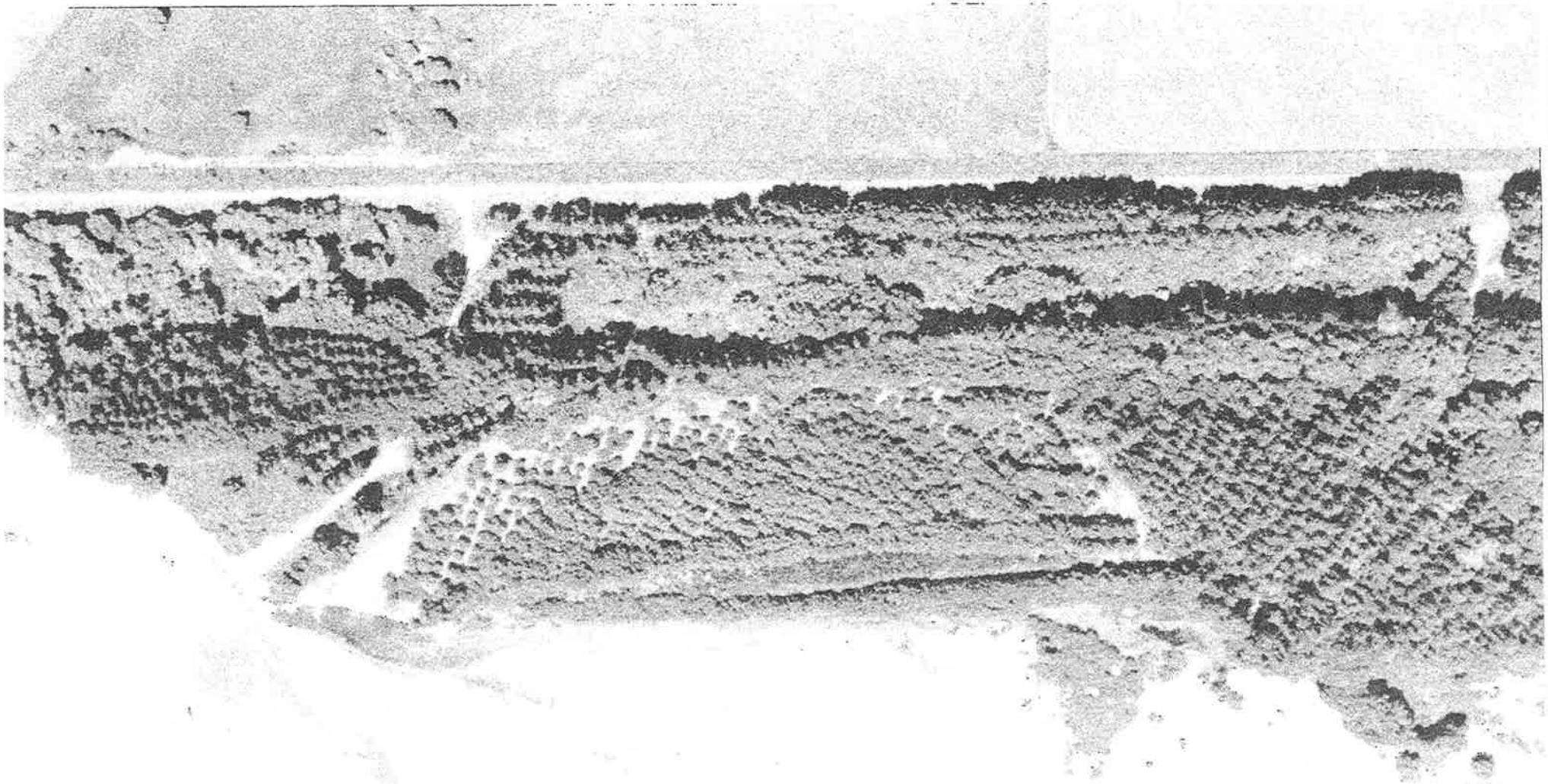
Table 7 Options for Adjustments to Floods

Adjusting the Floods

	Catchment Brd (to 1989)	Regional Council	Timaru District Council	Urban residents	Rural Residents	Possible Regional Council Options?
Afforestation	✓	✓	-	-	✓	
Conservation farming	✓	✓	-	-	✓	Yes
Onsite ponding	-	-	-	-	-	Yes
Dams & Reservoirs	-	-	-	-	-	Yes
Stopbanks & flood walls	✓✓✓	✓✓	-	-	-	Yes
Channel improvements	✓✓✓	✓✓✓	-	-	-	Yes
Wide grass waterways	✓✓	✓✓	-	-	✓	Yes
People Adjusting to Floods						
Public Education	-	✓	-	-	-	Yes
Information Service	-	✓	-	-	-	Yes
Zoning ordinances	-	-	✓	-	-	NA
Catchment Bylaws	✓✓✓	✓✓✓	-	-	-	Yes
Subdivision Regulations	✓	✓	-	-	-	NA
Building Codes	-	✓	✓✓	-	-	
Public acquisition of land	✓✓✓	✓	-	-	-	Yes
Floodplain Management Plans		✓✓✓	✓✓	-	-	Yes
Raise buildings, floor levels	-	✓	✓	-	✓	Yes
Floodproof buildings	-	-	-	-	-	NA
Flood forecast-ing & warning system	✓✓✓	✓✓✓	✓	✓	✓✓✓	Yes
Rescheduling activities	–	–	–	–	✓✓✓	Yes
Evacuations	✓✓	✓✓	✓✓	✓✓	✓✓✓	Yes
Flood fighting	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	Yes
Adjusting Flood Losses						
Insurance payouts	-	-	-	✓✓✓	✓✓✓	NA
Government & other relief funds	✓✓✓	✓✓	✓✓	✓✓✓	✓✓✓	Yes
Temporary shelter for victims	-	-	-	✓✓✓	✓✓✓	NA
Rehabilitation services	-	-	-	✓✓✓	✓✓✓	NA
Tax deductions	-	-	-	✓✓✓	✓✓✓	NA

✓✓✓	strong adoption
✓✓	moderate adoption
✓	weak adoption
-	not actioned
NA	not applicableto the CRC

(17 options)



2.10 Multiple Use of Riverbed Land

2.10 Multiple Use of Riverbed Land

Background

What is a riverbed? The natural process of formation of the Canterbury Plains include the transport by rivers of sediment (rocks, gravel, sands, silts) from eroding sites in the upper catchment to the lower catchment and flood plains. Within decreasing gradient down the rivers there is increasing deposition of sediment, resulting in the formation of the flood plain. There is a sorting process during floods with finer material deposited in areas where the flood waters are ponded or slow moving. Large volumes of material are moved and deposited during the biggest floods. These deposits are subsequently eroded during smaller, more frequent floods, with the rivers and streams changing direction with the continual reworking of the sediment deposits. This constant change and redistribution of sediments is a distinctive natural characteristic of Canterbury braided riverbeds.

Distinctive features of the Opihi-Temuka Catchment include the capacity of the rivers to scour banks, particularly from the mouth up to the top of the Levels Plains. This is due to the relatively steep gradients of the flood plain and riverbed. (Fall of 70 metres over 19 kilometres from Pleasant Point to the sea.)
There has been a substantial investment in stopbanks and instream training works by the South Canterbury Catchment Board, in the catchment over the past forty years.

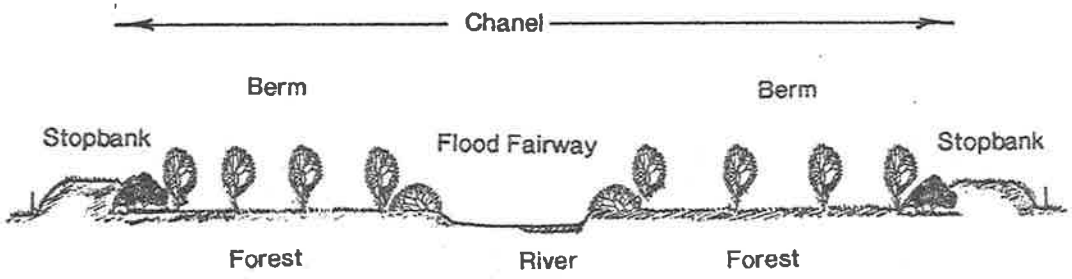
The cost of this investment can be summarised as follows:

	Capital Cost (1990 $ Value)		
River	Stopbanks	Instream Works	Total
Waihi	$2,038,000	$2,165,000	$4,203,000
Temuka	433,000	1,172,000	1,605,000
Waihi & Temuka tributaries	8	806,000	806,000
Opihi Lower L Bank	178,000	853,000	1,031,000
Lagoon	55,000		55,000
Lower Opihi	2,681,000	8,662,000	11,343,000
Upper Opihi	637,000	13,374,000	14,011,000
	6,022,000	27,032,000	33,054,000

81% of total investment has been in instream works. This includes channelisation of the rivers with the clearance of fairways, and the planting of the bermland. Repairs to this investment after the March 1986 flood amounted, in 1990 values, to $4,495,000.

Riverbed lands had been delineated by the South Canterbury Catchment Board by placing fences on both sides of the riverbed, maintained to permanently keep stock out. The presence of trees and shrub vegetation (predominantly blackberry, broom, gorse and lupins) between the fences now provides a clear visual demarcation of this land. Within this destocked riverbed land there are stopbanks, access tracks, flood channel layered willows along the edge of the fairways, and bermland both planted (mainly willow and poplar) and unplanted (mainly shrub vegetation)

Example of cross section of the Opihi River.



The current area and use of the riverbed is summarised as follows:

River	*Total Area Riverbed Land (ha)	Area of Flood Channel(ha)	Balance of Area River berms
Opihi	2740	1060	1680
Opuha	1096	493	603
Tengawai	930	236	694
Temuka	1507	562	945
	6273 (100%)	2351 (37%)	3922 (63%)

* Area under the jurisdiction of the Canterbury Regional Canterbury.

The vegetation of the river berms is: shrubs, weeds, gorse, broom, blackberry (2960ha) willows (840 ha) and poplars (122ha).

Land use practices within riverbed land are subject to prohibition, regulation or restriction, of any change affecting the conservation of soil, the stability of detritus, the depositing of materials in watercourses or flooding, through implementation of Section 34 of the Soil Conservation and Rivers Control Amendment Act 1959.

The predominant existing use of riverbed land in the Opihi-Temuka catchment is a water course for the discharge of flood waters. However, the Council recognises the many other uses by the community and adjacent land owners and residents.

Existing and potential uses of riverbed land include: discharging floodwaters, drainage, wildlife habitats, recreation, forestry, Mahika Kai, gravel source, firewood gathering, honey from beekeeping, pasture and fodder.

The benefits that could arise from the potential uses are considerable. The benefits to the Opihi-Temuka Catchment , the rating district ratepayers and residents in realising the potential uses of riverbed land are:

(1) Generation of income from forestry operations. Potential income from the sale of logs would range from $3000 to $30000 per hectare, depending on stumpages ($5-$100m^3) per hectare. Funding for river control and catchment management schemes can be derived from forestry income.

(2) Reduction in scheme management costs. The objectives of river control minimising erosion and maintaining design flood capacity in the fairways and between stopbanks can be compatible with:

(a) Income generated from harvesting wood, including firewood (willows are a prolific coppicing species). This income could be generated either by the Council itself, community organisations, private contracts and/or joint ventures.

(b) Decreased cost of vegetation clearance, weed control, bank protection and increased channel storage by joint land use with adjoining farmers, foresters or interested investors.

(3) Enhancement of wildlife habitats, recreational activities, mahika kai and fisheries. Riparian zone management can be compatible with scheme objectives and open up a range of opportunities for management, including the development of breeding or nursery areas.

(4) Enhanced landscape. The riverbed lands of the Opihi Temuka catchment are naturally highly productive and have evolved over the past forty years into a distinctive forest landscape. The visual landscape is appealing and the source of experiences of what is natural, wild, teaming with life, and constantly changing with the seasons.

Objectives

The existing objectives of the Council which cover management of riverbed lands are:

Objective 1 *Maintenance of the flood channel for a flood with a return period of fifty years.*

Objective 2 *Revision of the flood control objectives and works procedures by June 1991.*

The proposed objectives are:

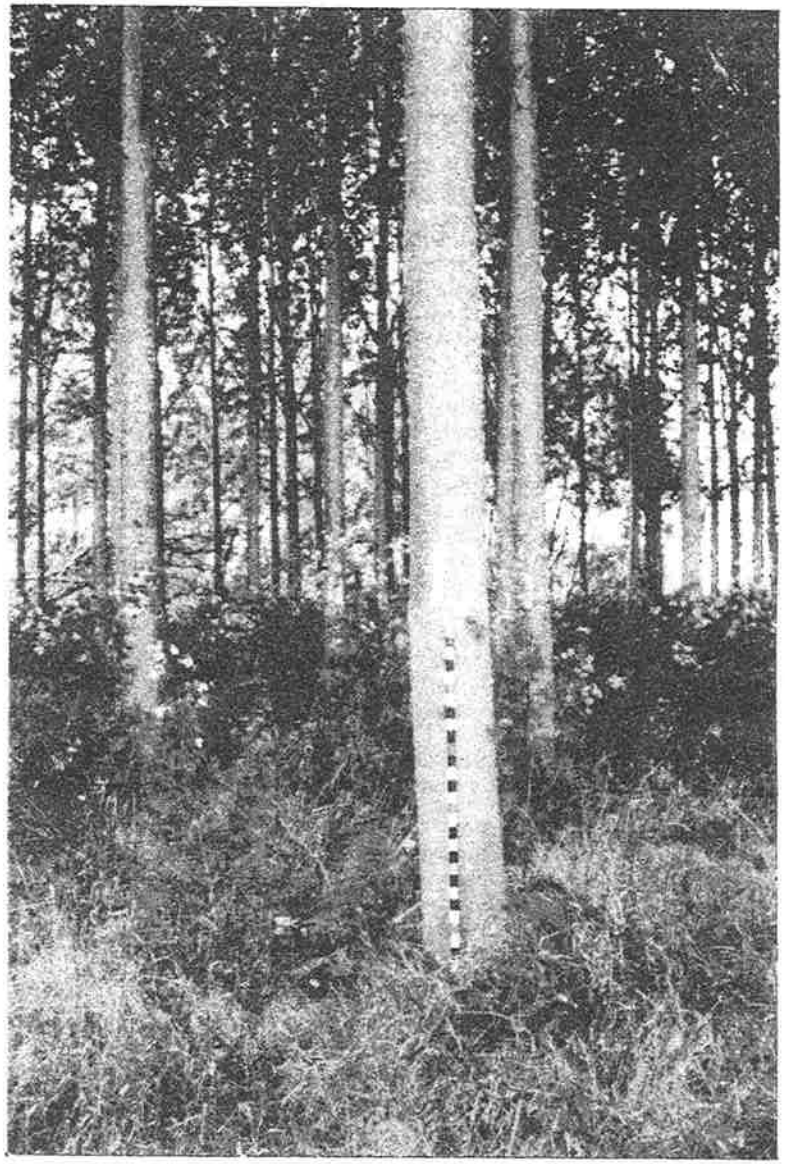
Objective 3 *Multiple use afforestation (erosion/flood control, wood production) of riverbed land of the Opihi-Temuka .*

Objective 4 *Sustained management of the existing poplar and willow forest.*

Objective 5 *Joint management with interest groups and organisations of the riparian zone for the maintenance and enhancement of wildlife and fisheries.*

Objective 6 *Joint management with the Timaru and Mackenzie District Councils of recreation areas.*

Objective 7 *Provision for joint management of riverbed land by adjoining land owners as a source of forage and fodder during droughts.*



Hybrid Poplar (Populus androscoggin) age 18 years, height 24 m, diameter (DBH) 40cm. The bottom logs (pruned) are suitable for veneer,

Options

The options proposed are :

Option 1 The public tendering of the management of selected riverbed lands for multiple use afforestation.

Advantages

The possible achievement of Opihi catchment management objectives at minimal or no cost to the Council and with greater participation by the community. Existing Canterbury Regional Council resources can be reallocated to complete more work in high priority areas. There are existing community groups and organisations, adjoining land owners, commercial organisations, contractors and investors who may meet Council objectives and requirements

Disadvantages

Management of the catchment is a long term commitment. The Council itself is able to undertake long term objectives. People, groups, firms and organisations may have a short life, lacking the resources to maintain a long term commitment and having a tendency to favour short term outcomes. There would need to be a trial period to evaluate this option. This option would not include freehold land, wetlands, high hazard areas and any land with high environmental and cultural values within the stopbanks.

Option 2 The council carries out afforestation of riverbed lands, jointly with other landowners, to meet catchment objectives and provide income for future catchment works, reducing or eliminating future rates.

This option involves at this point in time either allocating staff resources to afforestation or working with constraints of existing income generated from riverbed lands (royalties, rents, log sales).

The Catchment Board had been investigating over the past ten years, the feasibility of afforestation of bermlands and utilisation of poplar wood. This option would be the next stage of this work, utilising existing experience, information and expertise, while meeting the requirements for logs by local industry. This option would be the realisation of investment by the Catchment Board in bermland afforestation since the commencement of the Opihi Catchment Control Scheme in 1967.

Advantages

This option offers the best use of existing Council resources within existing budgets.

Disadvantages

Cost. Dependent of product development and market demand for poplar wood. High cost of transporting logs out of area to alternative markets.

Option 3 Production of a report, jointly with the Fish and Game Council, Department of Conservation, Takata Whenua and other interested people, on riparian zone management by June 1992.

Advantages

Establishment of environmental guidelines and procedures for the management of riverbed lands.

Disadvantages

- Cost, though minimised due to existing sharing of resources.

Option 4 The joint maintenance and development of Opihi-Temuka riverbed lands with the Timaru and Mackenzie District Councils for recreational and multiple use forestry

Advantages

This option recognises the strengths and expertise of each organisation to achieve joint objectives. Cost efficiencies can be achieved through sharing resources and reducing overheads.

Disadvantages

Each organisation has its own objectives, priorities and budget constraints which can discourage joint work for the benefit of the community. There is a mutual need for a long term commitment to sharing resources while maintaining accountability.

Option 5 The gradual transfer of all AMF rights and part titles of riverbed land and riparian strips to the Regional Council, District Council or Department of Conservation, where appropriate.

Advantages

A reduction in the administrative and legal difficulties in carrying out the Council's role, enabling faster, more cost effective management of riverbed lands. Reduction in the cost of administering consents procedures.

Disadvantages

Cost, including legal and survey costs. This option is dependent on the goodwill of farmers, unless the Council can provide an incentive to transfer AMF rights and reinstate riparian strips.

Option 6 The implementation of a range of statutory powers, including section 34 notifications to all riverbed areas of the Opihi-Temuka catchment.

Advantages
Extends the existing Section 34 areas and addresses land and water problems.

Disadvantages

Cost, including allocation of staff resources.

3. Public Participation and Summary

Background

What are the Opihi and Temuka Rivers and the catchment all about?

Why do people live there?

Why do people go there?

What resources do people use?

What problems arise from the use of the catchment resources?

There are in a sense no catchment problems, only people problems.

Planning is about people, and people talking with people. In its broadest sense, public participation means the involvement of people in making decisions that affect their lives. There are conflicts that need to be identified, resolved or minimised. Table 8 summarises the conflict by indicating which uses affect water and which uses require water. Existing legislation ensures that communication is established and the right of citizens to be informed about land and water use proposals protected. This includes the right to defend their interests by objecting against specific proposals. However, this confrontational approach does not help in the reconciliation of people's opposing interests. The process is heavily weighted in favour of people with the time, money and understanding necessary to win an appeal or succeed with an objection. The process is costly, time consuming and disrupts timetables and commitments. The participative approach gives people the opportunity to speak, and to heard before decisions are made. Conflicts and differences can be openly discussed, agreements obtained, differences respected. In the end, the Regional Council will have the task of making some hard decisions. The decisions may or may not be appealed or accepted. At least through the participative process, steps are taken to try to resolve differences without resorting to legal processes.

Objectives

Objective 1. Community confidence in the resource management decisions of the Council.

Objective 2. An informed community able to monitor the Council's performance.

Objective 3. An informed staff, aware of community values.

To meet the above objectives, the Council has embarked on the release of this Issues and Options document.

Objective 2 is about accountability, monitoring outcomes or objectives. That is, the Council states publicly what it is going to do, how it is going about it, when it will be completed, and at what cost. The timetable (section 1) shows the steps to be taken to involve the public and achieve the objectives. The following options are put forward to achieve objective 2, with respect to monitoring the outcomes and objectives of the Opihi-Temuka Catchment Management Plan. This monitoring includes for example, checking water quality and low flows, and the checking that reports are prepared by certain dates.

Option 1 The objectives of the plan are monitored by an existing standing Council Committee.

Advantages

Use of the Southern Area Committee or the South Canterbury Constituency Committee which are already resourced by Council and familiar with catchment issues. A subcommittee could be formed with co-opted members from the catchment area providing additional experience and expertise when required.

Disadvantages

Cost, with possibly more frequent meetings, particularly if all catchments are to be monitored in the same way. The committees may not have first hand knowledge and experience with the catchment.

Option 2 Form an Opihi-Temuka catchment Committee specifically to monitor the plan.

Advantages

Use of existing Community Liaison Group, and other people involved in the participative process. Best use of local experience and expertise, with wide community representation. The job of monitoring is carried out directly by the people most directly affected.

Disadvantages

Cost of setting up and resourcing yet another committee. Requires yet more time to be given up by community minded people. Possible use of the committee as a platform to promote narrow interests from the most affected or active group.

Table 8 Summary of Land and Water Uses Affecting and Requiring Water in the Opihi-Temuka Catchment

Water Quality & Quantity Characteristics

Uses Affecting Water	Floods	Low Flows	Nutri-ents	Dis-solved Oxygen	Bacteria	Sedi-ments	Toxic Dis-charges	High Temp-eratures
Abstraction - Irrigation		•						
Septic Tanks		•	•		•			
Sewage Plants		•	•	•	•			
Rubbish Tips	•		•	•	•		•	
Forest		•				•		
Cropping			•		•	•		
Pastoral runoff		•	•			•		
Pastoral point discharges		•	•	•	•			
Industrial discharges			•	•	•		•	
Urban runoff		•		•	•	•	•	•

• Means that use (left hand column) can affect water. For example abstractors for irrigation affects low flows by removing water from the river.

Water Quality & Quantity Characteristics

Uses requiring Water	Floods	Low Flows	Nutri-ents	Dis-solved Oxygen	Bacteria	Sedi-ments	Toxic Dis-charges	High Temp-eratures
Sustainable ecosystem	•	•	•	•		•	•	•
Cultural/spiritual values	•	•	•	•	•	•	•	•
Swimming		•	•	•	•	•		
Fishing		•	•	•		•	•	•
Domestic water supply		•			•	•	•	
Irrigation		•				•	•	
Livestock		•			•	•	•	

• Means that use (left hand column) requires water. For example, swimming requires that a minimum low flow be retained in the river during summer.

4. Appendices

4.1 Acknowledgements and References

The following organisations' submissions on the South Canterbury Catchment Board Waihi-Temuka River Management Plan are acknowledged; South Canterbury Acclimatisation Society, (now the Fish and Game Council); New Zealand Salmon Anglers Association Incorporated, South Canterbury Branch; Department of Conservation Canterbury; Aorangi United Council (now Canterbury Regional Council); New Zealand Insulators Limited; and the Waihi-Temuka River Users Group.

The Council thanks those people who prepared these submissions.

The work of D. Todd is acknowledged including his assistance with the options for maintaining an open mouth for the Opihi River Lagoon.

Thanks to F. Scarf for assistance with editing and K. Anglem for the use of photographs from his evidence on pollution given before the Waitangi Tribunal.

4.2 Bibliography

CONNELL, R.J. "Flood Plain Management Study Temuka Borough" SCCB Pub. No. 63 (1989)

CONNELL, R.J. "Flood Plain Management Plan (Draft) Pleasant Point" CRC Unpub. Report (1990)

CUFF, J.R.I. "Erosion in the Upper Opihi Catchment" Pub. SCCB (1974)

DACKER, W. "Belonging here/Toi Taketake. The People of the Place : Mahika Kai" Pub. NZ 1990 Commission (1990)

de JOUX, R.T. "The Water Resources of the Orari River" SCCB Pub. (1980)

de JOUX, R.T. "An Assessment of the Groundwater Resources within the Opihi Catchment" SCCB Pub. (1988)

de JOUX, R.T. "The Water Resources of the Temuka River" SCCB Pub. No. 58 (1981)

de JOUX, R.T. "The Water Resources of the Opihi and Temuka Rivers" SCCB Pub. No. 28 (1981)

EVANS, A.S.D. "Report on Poplar Growing in South Canterbury" SCCB Unpub. Report (1984)

FOWLES, C.R. "Some Effects of Low Flow Conditions on the Invertebrae Fauna of the Opihi River South Canterbury" SCCB Pub. (1972)

PALMER, K.L. & SAGAR, P.M. "Initial Assessment of Implication to Benthic and Fisheries Habitat. SWORD Feasibility Study Stage 3" Unpub. Report MAF Freshwater Fisheries Centre Christchurch (1990)

PERRENS, S.J. & TRUSTRUM N.A. "Assessment and Evaluation for Soil Conservation Policy" Pub. East-West Environment and Policy Inst. Hawaii (1984).

SCARSBROOK, M.R. "Organic Pollution in the Waihi-Temuka-Opihi River System and its Effect on the Species Composition of the Micro-Invertebrae Bottom Fauna" Dept. Zoology University of Otago Unpub. Report (1988)

SEVICKE-JONES G.T. et al
"Eutrophication of the Waihi-Temuka River System"
SCCB Pub. No. 58 (1989)

_____ CRC
"Canterbury Regional Planning Scheme. Second Review. Section 1 (Aorangi)"
CRC Pub. (1989)

_____ CRC
"Canterbury Regional Council Annual Plan 1990-1991"
CRC Pub. (1990)

_____ CRC
"Canterbury Regional Council Corporate Plan 1990-1993. For Community Comment"
CRC Pub. (1990)

DEPT. L & S
"Opihi Rivermouth Study"
Dept. Lands and Survey Pub. (1979)

_____ SCCB
"Opihi Scheme Review"
SCCB Pub. No. 40 (1984)

_____ SCCB
"Opihi River Water Management Plan 1984-1990"
SCCB Pub. (1984)

_____ SCCB
"Report on Flood - 13 March 1986"
SCCB Pub. No. 47 (1987)

_____ SCCB
"Temuka River Water Management Plan (First Draft)"
SCCB Unpub. Report (1989)

_____ (OAS)
"SWORD Feasibility Study Stage I. Vol. 1 Hydrological Component" NZAEI and "Vol. 2. Engineering Component"
Works Consultancy Service (1989)

_____ (OAS)
"SWORD Feasibility Study Stage II. Economic Feasibility"
MAF and NZAEI (1990)

_____ (OAS)
"SWORD Environmental Impact Assessment of Diversion of Lake Tekapo Water to Opihi River. Feasibility Study Stage III"
Davie Lovell-Smith and Partner (1990)

(OAS Opihi Augmentation Society)

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D.A. Prouting	"The Tui" R.D. 20 PEEL FOREST	(03) 696 3894
F.B. Ross	R.D. 3 TIMARU	(03) 688 2331
D.R. Scott	Rangitata Island R.D. 26 TEMUKA	(03) 693 9428
M.G. Smith	19 Braemar Place TIMARU	(03) 688 3915
R.J. Underdown	Kingsdown R.D. 1 TIMARU	(03) 612 6855

OPIHI-TEMUKA COMMUNITY LIAISON GROUP

Takata Whenua

Jacko Reihana Upoko Runanga AROWHENUA	1 Huirapa Street Arowhenua TEMUKA	(03) 615 7906
Wiki Baker	Main Road South AROWHENUA	(03) 615 8636

S.C. Fish and Game Council

Graeme McClintock Senior Field Officer	30 Richard Pearse Drive TEMUKA	Bus.(03) 615 7584 (03) 615 8001
Mark Webb Field Officer	30 Richard Pearse Drive TEMUKA	Bus.(03) 615 7584 (03) 615 9362

N.Z. Salmon Anglers Association

Murray McMurtrie	R.D. 2 TIMARU	(03) 612 6769
Barry Stone	23 Cook Street TIMARU	(03) 688 3468
R.M. Hobbs	2 John Street TEMUKA	(03) 615 8067

S.C. Branch Royal Forest and Bird Protection Society

Fraser Ross	R.D. 3 TIMARU	(03) 688 2331
Peter Washbourn	R.D. 4 TIMARU	(03) 686 1653
Allan Evans	34 John Street TEMUKA	(03) 615 7420

Department of Conservation

George Hadler Field Centre Mgr	Private Bag TIMARU	Bus. (03) 684 8320

Graham Crump Cons. Officer	Private Bag TIMARU	Bus. (03) 684 8320

Irrigators

Waihi-Temuka Users Group

Doug Kelman	R.D. 21 GERALDINE	(03) 693 9347
Murray Hyndman	R.D. 25 TEMUKA	(03) 615 9209
D.M. Jones	Wilks Road, R.D. 25 TEMUKA	(03) 693 9378

Opihi Private Irrigators

Peter Clarke	90 Tengawai Road PLEASANT POINT	(03) 614 7205
Hurstal Ulrich	Rock Farm CAVE	(03) 614 3856

Levels Plain Irrigation

Lyn Thomson	R.D. 3 TIMARU	(03) 688 2338
John Brosnahan	R.D. 3 TIMARU	(03) 618 2564

Industry

Steven Harrison Ferrier Woolscour Manager	P.O. Box 10 WINCHESTER	Bus. (03) 615 9540 (03) 615 9217
S.R. Paul Ferrier Woolscour	P.O. Box 10 WINCHESTER	Bus. (03) 615 9540

MAF Fisheries

Geoff Allinson Snr Fish. Officer	P.O. Box 516 TIMARU	Bus. (03) 688 9184

Timaru District Council

Bill Robertson District Planner	P.O. Box 522 TIMARU	Bus. (03) 684 8199
Don Binney Water & Drainage Engineer	P.O. Box 522, TIMARU	Bus. (03) 684 8199

Canterbury Regional Council

David Stringer Land & Water Resource Planner	P.O. Box 550, TIMARU	Bus. (03) 688 9069 (03) 688 1612
Malcolm Miller Regional Planning Officer	P.O. Box 550, TIMARU	Bus. (03) 688 9069

Milford Hut Holders

Mark Clark	56 Wai-iti Road TIMARU	Bus. (03) 684 3719 (03) 688 9018

Waipopo Huts

Mrs Daryrl Evans	Waipopo Road R.D. 3 TIMARU	(03) 615 9011

Temuka Community Board

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G.R. Smith	143 Domain Avenue TEMUKA	(03) 615 7877

4.4 Glossary of Terms

Balance : The exclusion of undue dominance of any one type (of land use, activity). Balance is determined by society and is a reflection of society's views at a particular time.

Benefits : The economic and social advantages that accrue to individuals and communities resulting from the use of land and water. Types of benefits include - food, fibre, minerals, income, aesthetic, emotional, scientific and spiritual values and improved social services and facilities.

Berm : Area of river bed inside the stopbanked area, covered in vegetation, e.g. trees, hence berm planting. Its function is to protect the stopbanks from fast flowing, erosive water velocities.

Channel Improvements : Work undertaken on a river channel to improve its capacity to pass water. Within the definition in this report it applies to all works except stopbanking.

Conservation : The use and management of resources to yield the greatest sustainable benefits to present generations while maintaining the potential to meet the needs of future generations.

Environment : "Includes:
(a) Ecosystems and their constituent parts;
(b) All natural and physical resources; and
(c) The social, economics, aesthetic, and cultural conditions which affect the environment or which are affected by changes to the environment." Environment Act 1986.

Ecological (Processes) : Life support systems which transfer energy from sunlight to plants. The long term survival of all plant and animal communities depends on these natural processes. The whole interaction and inter-relationship of plants and animals.

Flood Plain : The flat area usually toward the lower end of a river system where periodical flooding has deposited river borne materials to form the area in question. In flood plain management, the term has a broader meaning and includes all parts of the valley, whether flat or otherwise and regardless of geological origin, that are subject to flooding by the maximum probable flood.

Flood Plain Management : Operation of a programme intended to make effective use of land resources within the flood plain, while lessening the damaging effects of floods, and maintaining and enhancing natural values.

Flood Walls : A waterproof wall of concrete or earth to protect a building from flooding.

Floodway : An area away from the natural river course designated to be kept free of development to provide for the passage of flood flows. The floodway may be flanked by stopbanks or natural high ground.

Hydrology : The detailed study of the occurrence of water in rivers and lakes and in underground sources such as artesian and other wells, together with its setting, measurement, use and storage for use.

Land : The integration of all land components - geology, topography, climate, soils, water, flora and fauna.

(Land) Enhancement : The alteration of any property of the land in such a way that it beneficially affects the land's productivity and/or versatility.

(Land) Productivity : The ability of land to yield measurable and harvestable products of economic value on a sustained basis - pasture dry matter, wool, milk fat, grain, timber, water.

(Land) Capability : An assessment of the productivity and versatility of the land for all potential land uses after taking account of all limitation to use.

(Land) Versatility : The suitability of land for a range of potential land use types, systems and practices on a sustained basis.

Landscape : The expression of the inter-relationship of the natural and cultural world, the character of land as seen, shaped and experienced by society.

Objectives : Specific aims which can be defined and are measurable.

Policy : A course of action or method of acting to achieve a mission statement or stated objectives (may be general or specific).

Outcomes : A general result or product of a policy or strategy which is readily available and measurable in terms of the quality of the environment.

Resources : Resources for which the Council has some statutory responsibility including land, water, air, soil, minerals, energy, plants and animals (whether native to New Zealand or introduced), and structures.

Return Period : A statistical expression of the average time period between floods equalling or exceeding a given magnitude. For example, a 100 year flood has a magnitude expected to be equalled or exceeded on the average of once every hundred years; such a flood has a one per cent change of being equalled or exceeded in any given year. Often used interchangeably with 'recurrence interval' or 'flood frequency'.

Sediment Transport : The transport of sediment (silts and gravels) by river flood flows.

Stopbanks (levees) : An artificial banks, or length of raised ground, constructed along a stream to confine flood water to the main waterway and so protect land further away.

Structural Measures : Flood control works such as dams, stopbanks (levees), channel alterations etc. that are designed to keep water away from developed and populated areas, or to reduce flooding in such areas.

Non Structural Measures : All flood plain management measures other than structural measures. Including floodwarning, relocation regulations etc.

Sustainable Use : When a resource is consumed at a rate no greater than that at which it can be renewed by natural processes.

Sustainable Land Use (Economic) : A land use which returns a positive gross margin.

Sustainable Land Use (Physical) : A use of land at a level which is physically possible to maintain in perpetuity.

Zoning : The practice of controlling development using the Town and Country Planning Act, by specifying appropriate activities in defined areas.

Maori Terms and Concepts :

Iwi - Tribe;

Hapu - Sub-tribal grouping;

Kaitiaki - refers to those who guard, conserve, or care for an object, person, resource, skill, sphere of knowledge etc. Those charged with such responsibilities may be individuals, whanau, hapu and even whole tribes. The mana of the kaitiaki may be determined in part by how well they exercise that responsibility.

Mana - is a concept with strong spiritual connotations implying power over, dominion over, influence over, prestige, standing, ownership. Mana is everything - for the individual, the whanau, the hapu and the iwi, and threats to personal mana can become threats to the iwi's mana. Mana can be threatened or lost in a number of ways - for example, by defeat or being out-witted in battle, by insult, by loss of tribal resources etc.

Mauri - is a concept commonly held among indigenous peoples, but not easily explained to those of Western European cultural tradition. Mauri refers o the essential life-force which is forever present in all living entities from birth to death. The concept is also applied to inanimate things including natural objects and geographical features (mountains, lakes, rivers, streams), raw materials such as greenstone and artifacts fashioned therefrom.

Mauri is the sum of an entity's innate and acquired characteristics; it may be regarded as the persona of that object. Mauri and mana are linked concepts; sometimes the serious loss of mana is akin to having been abandoned by one' mauri.

In the tribal sense the same arguments can be applied. Tribes derive their mana in part from the mauri of the geographical features and resources of their tribal area. Therefore the security of tribal mana depends on the conservation and protection of those resources and resource areas, to ensure sustainable exploitation and use by its own members, and sometimes for use by others as well. Tribal mana may be judged by how well its members have carried out their roles as kaitiaki of tribal resources and the mauri thereof.

Rahui - is a mark to warn people against trespassing and is used to indicate places which may be tapu, or to conserve resources by restricting food-gathering to certain seasons. The term is also used to indicate prohibition for a period of time, or even indefinitely.

Runaka/Runanga - tribal or pan-hapu committee - usually for a district or regional body to incorporate the interests of all tangata whenua in that area.

Tangata Whenua - are the "people of that land", i.e. the people whose tribal origins, resources and interests are found within the district of interest. Maori people with tribal origins in other parts of the country, who may be visiting or even residing permanently in another tribe's district, are called "manuhiri". While for most current social issues in the community there may be no differences in the interests and rights of tangata whenua and manuhiri, the former have priority rights or possibly even exclusive rights in matters pertaining to traditional lands and resources within their tribal area.

Toanga - treasures, valued things.

(Sources: R. Gracie, "Customs and Concepts of Maoridom". SIAN Newsletter, April 1990;

Mitchell Research, "Some Traditional and Modern Structures of Maori Society and the Westland Situation", for L & M Mining Ltd, Nelson, February 1989).

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