COMPREHENSIVE FLOOD MANAGEMENT PLAN

MARAETAI CATCHMENT

prepared for

MANUKAU CITY COUNCIL
Water & Drainage

prepared by

MANUKAU CONSULTANTS

in conjunction with

Babbage
Babbage Consultants Ltd

JUNE 1993

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GLOSSARY

The glossary provided herein relates to general terminology. Detailed explanations of more technical terms are contained within the text.

AEP	Annual Exceedance Probability which is the probability of exceedance of a given discharge within a period of one year.
Catchment	The area draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.
Datum	Unless stated otherwise, all levels are referred to in terms of metres (m) above Department of Survey & Land Information Datum (which corresponds to about mean sea level).
Design Floor Level	A minimum flood level specified as part of a building control programme.
Detention Storage	Storage that captures some inflow for subsequent release, compared with a retention storage which captures flow for soakage into the ground.
Development	The erection of a building or the carrying out of work; or the use of land or a building for work; or the subdivision of land. Usually associated with an increase in urbanisation.
Discharge or Flowrate	Volume of water passing a given point during a specified time interval. It is to be distinguished from the speed of flow which is a measure of how fast the water is moving rather than how much is moving.
DOSLI	Department of Survey & Land Information.
Flood Hazard	Potential for flooding or erosion due to stormwater runoff.
Flood Management Plan	Programme to lessen the damaging effects of floods, maintain and enhance natural values, and make effective use of related water and land resources in the catchment.
Floor level	Floor level is taken to be the top of the structural floor.
Freeboard	Additional clearance above estimated flood level to allow for uncertainty.
Habitable Floor Levels	A living area such as a lounge room, dining room, rumpus room, kitchen, bedroom etc.
Hydraulic	The term given to the study of water flow in drain pipes and watercourses.

Hydraulic Grade Line (HGL)	The pressure head at all sections of a pipe plotted as vertical ordinates above the pipe centre line is called the hydraulic gradient, and its slope is equal to the total loss of head divided by the length of pipe.
Hydrograph	A graph which shows how the discharge changes with time at any particular location.
Hydrology	The term given to the study of the rainfall and runoff process.
Hyetograph	Graph illustrating the variation of rainfall intensity with time (same as storm profile).
ILSAX	Computer program to analyse stormwater drainage systems. Based on ILLUDAS-SA Illinois Urban Stormwater Area Simulator improved version, further enhanced by Geoffrey O'Laughlin University of Technology Sydney.
Mathematical Computer Models	The mathematical representation of the physical processes involved in runoff and stream flow. These models are run on computers due to the complexity of the mathematical relationships. It is noted that these are not physical models.
MSL	Mean sea level.
Overland Flowpath	Is the route along which stormwater will flow where it cannot be taken by a piped system.
Peak Discharge or Peak Flow Rate	The maximum discharge occurring during a flood event.
Primary, Secondary and Trunk drainage	Primary drainage is the initial conveyor of flow (eg a pipe); secondary drainage is the route taken by flows when the primary drainage capacity is exceeded (eg. overland flowpath) and trunk drainage is a combination of these (eg. detention reservoir).
Runoff	The amount of rainfall which actually ends up as stream flow, also known as rainfall excess.
Stormwater Flooding	Inundation resulting from the inability of urban stormwater drainage pipes or watercourses works to handle runoff.
Time of Concentration	Generally described as the time taken for a water particle to travel from the furthermost point of the catchment to the outlet.
TLA	Territorial Local Authority.

1.0 EXPLANATORY INTRODUCTION

1.1 STATUTORY FRAMEWORK FOR COMPREHENSIVE FLOOD MANAGEMENT

Both the Auckland Regional Council and Manukau City Council have statutory responsibilities in relation to the management of stormwater drainage and flood control.

The recommended procedure for effective execution of such responsibilities is described in Stormwater Quality Control, Guideline Sheet 1 (July 1992) prepared by the Auckland Regional Council Environmental & Planning Division for Comprehensive Catchment Planning.

This guideline has been developed for use by Territorial Local Authorities to support a comprehensive stormwater discharge permit. Refer to section 1.1.3 following.

1.1.1 Comprehensive Flood Management Planning

The aim of Comprehensive Flood Management is to identify, manage and control flooding and erosion on a catchment wide basis.

It provides information upon which future planning policies are based and recommendations made for protection works where problem areas are identified, under both existing and future development patterns.

A particular feature of the management plan approach is that the impact of future development, can be examined, and if in conflict with the desired objectives in other parts of the catchment, can be modified. This approach avoids piecemeal, often counter productive solutions to individual problems.

The production of a Comprehensive Flood Management Plan consists of two parts. The first part, the Management Study, provides the detailed technical information required to prepare the Management Plan.

Management Study

The study provides:

- assessment of existing and perceived future flooding and erosion problems within the catchment;
- hydrological analysis of the catchment under existing and possible future development;
- hydraulic analysis of predicted hydrologic events to determine defined boundaries of floodable and flood hazard areas, including flood heights and velocities, throughout the catchment;
- investigation of possible flood adjustment options that will modify the flood event i.e. flood protection works, or modify flood damage susceptibility i.e. planning controls.

Management Plan

The second stage of comprehensive flood management planning is the production of a Management Plan. The aim of a Comprehensive Flood Management Plan is to provide guidelines for the management and control of flooding in the overall best interest of the catchment with respect to flooding.

The Management Plan may then be used along with other factors to guide development within the catchment. The Management Plan will also form the basis for obtaining a Comprehensive Discharge Permit from the Auckland Regional Council.

1.1.2 Council Responsibilities

The territorial local authority is responsible for administering the provisions of the Local Government Act 1974, the Resource Management Act 1991, and the Building Act 1992.

Specific responsibilities in relation to stormwater drainage and flood control are:

a) Control of subdivision, building and earthworks standards so as to minimise problems on flood prone land or adverse effects to other property;

b) Control of nuisances and inappropriate interference with watercourses;

c) Maintenance of public drains and watercourses;

d) Undertaking of works to improve drainage and flood control;

e) Avoidance or reduction of danger, damage or nuisance caused by such things as flooding, landslip, subsidence and silting, i.e. to mitigate adverse effects.

1.1.3 Auckland Regional Council, Environment & Planning Division Responsibilities

This Division functions and has specific duties under the Resource Management Act 1991. Its general responsibilities in relation to management of stormwater drainage and flood control are:

a) To minimise and prevent damage by floods and by erosion.

b) To carry out the investigation and design of measures for the purpose of preventing or reducing damage by floods.

c) To ensure, through the discharge permit process that stormwater from development does not create or worsen flooding and erosion problems.

d) To supervise river and drainage works by TLA's (Territorial Local Authorities) and to guide TLA's with respect to their powers and duties as regards river and drainage works.

Auckland Regional Council Policies

The ARC (Auckland Regional Council) recognises that the control of flooding and responsibility for watercourses within the Auckland region is shared jointly by the ARC and the TLA's. The ARC believes the duties of both the ARC and Councils are most effectively carried out by the preparation and implementation of Comprehensive Flood Management Plans. The ARC therefore encourages the preparation of these plans with the following aims.

The following approach to Comprehensive Catchment Planning has been developed as a guide to District Councils. The general aim is to ensure that environmental attributes within an undeveloped catchment which can provide runoff attenuation, or treatment, are retained as features of the final urban landscape. It is based on an attitude of reducing catchment imperviousness and using natural features for treatment purposes.

Traditionally, land development planning for large catchment areas has placed most emphasis on engineering requirements for the increased hydraulic impacts (flooding). With the recognition that stormwater quality problems need to be dealt with to at least the same degree it is now important that development planning strives to reduce the potential generation of urban runoff. The following discussion presents a planning approach utilising environmental controls for aiding runoff attenuation and treatment which fits within the legislative requirements and controls of local authorities.

COMPREHENSIVE CATCHMENT PLANNING

Land development for large catchments is controlled by the District Councils and their long-term or strategic planning sets the frameworks for, and prejudices the success of, stormwater management within their control. A systematic approach to catchment planning is aimed at integrating landuse development and environmental aspects to reduce urban runoff problems.

In order to reduce the potential of an urban catchment to generate runoff a planning approach is required which encompasses the six following components:-

1. Master Planning:

Aim:- *To establish a development strategy which protects the natural runoff attenuation and treatment resources of a catchment yet still providing opportunity for community growth and expansion.*

Procedures

- *Evaluate, designate (prioritize), and protect natural resources which provide opportunities for control of urban runoff (wetlands, streams, natural or exotic bush etc).*
- *Identify relationship of protected resources with other activities (socio-economic and cultural aspects) and establish necessary requirements (use of resources both existing and potential).*
- *Develop understanding of various landuse zoning options configures around those resources to be retained and their environmental impacts (avoiding inappropriate development near sensitive areas).*
- *Establish catchment-wide stormwater management requirements for zoning scenarios and develop strategies for their establishment (100 year floodplains, detention dams, landscaping perimeters).*
- *Evaluate ability of Council to service requirements of development scenarios (maintenance requirements, etc).*
- *Ensure that community input is part of planning approach before final decisions are made.*
- *Prepare and adopt final Catchment Management Plan for land development (comprehensive catchment resource consents).*

2. General Development Restrictions (Static):

Aim:- *To establish a set of restrictions protecting and maintaining valued resources which will govern the development process.*

Procedures

- *Establish through ordinances (District Rules) restrictions on the development of resources eg. stream buffers, flood plains, steep slopes, tree slopes, tree cover, or open space requirements, etc.*
- *Ensure that continuity between natural resources is retained to allow habitat as contiguous (reserve corridors connected to allow movement of biota through catchment).*

3. Environmental Site Planning Techniques (Active):

Aim:- *To develop site planning techniques which minimise site imperviousness.*

Procedures

- *Promote or adopt ordinances (District Rules) on Cluster Development or Unit Developments, integration of runoff controls with landscaping, use or urban forestry, flexible road width and reserve requirements.*
- *Ensure plan review procedures check environmental impacts and have ability to modify proposals.*

4. Erosion and Sediment Control:

Aim:- *To set planning controls which minimise the degree of erosion from construction sites and capture sediments carried in runoff.*

Procedures

- *Limit area and time for construction by co-ordinating development to produce least impact.*
- *Immediately vegetate exposed areas*
- *Use detention basins and other techniques to contain soils on site.*
- *Maintain frequent site inspections and stringent enforcement of requirements set by Regional Council.*

5. Urban Stormwater Management Controls:

Aim:- *To establish local planning controls which reinforce post development stormwater runoff control requirements for individual developments.*

Procedures

- *Develop local planning review techniques which assess impacts of proposed stormwater management systems.*
- *Constitute health and safety requirements, and landscaping regulations for large retention and detention systems (urban lakes), or other treatment facilities.*
- *Establish maintenance and disposal requirements for developers including financial contributions.*
- *Ensure that long-term financial commitments are identified and appropriate for stormwater management systems maintenance and upgrades.*

6. Restoration Programs:

Aim:- *To establish a council and community based programme of activities works which provide for enhancing stormwater quality control in established areas.*

Procedures

- *Establish long-term stream trend monitoring to understand waterways dynamics and habitat.*
- *Assess opportunities of existing waterways for instream habitat improvements and implement restoration strategies.*
- *Retrofit existing detention/retention systems to modern standards.*
- *Provide additional treatment systems where appropriate.*
- *Initiate riparian zone restoration programs.*
- *Develop upland reforestation policies.*
- *Promote and utilise Stream Stewardship.*

Establishment of a land development strategy which anticipates and provides for urban runoff, and also includes suitable opportunity for input by the local community, District and Regional Council on social, economic, engineering and environmental issues ensures that District Councils are able to achieve the many requirements of the RMA (Resource Management Act).

Monitoring Comprehensive Discharge Consent:

Comprehensive Discharge Permits will be monitored on an annual basis to ensure compliance with special conditions of the permit.

On obtaining a Comprehensive Discharge Permit and after public notification of a General Authorisation for the catchment, Council will be able to authorise drainage works in accordance with the CFMP (Comprehensive Flood Management Plan). Developers or individuals who seek to obtain the relevant permit can do so almost immediately, whereas currently the discharge consent procedure takes 4-6 months.

1.2 MANUKAU CITY COUNCIL OBJECTIVES, POLICIES & STRATEGIES

1.2.1 Extract from District Scheme

8.4 STORMWATER DRAINAGE

8.4.1 Introduction

Extensive areas of hard surface create problems of stormwater disposal. In Manukau, stormwater disposal problems are compounded by the poor drainage capabilities of soils within the urban areas of the City. As well, in particular areas of the City, notably in parts of Otara, Manurewa and Mangere, existing stormwater pipes have insufficient capacity to cope with any additional runoff that would be created by future development or redevelopment of sites. This can lead to problems with flooding.

As a consequence, the Council places considerable emphasis on reducing water runoff at source, as well as disposing of excess stormwater through the natural drainage system. Particular emphasis is given to disposing of the excess near the source of runoff by using, for example, open areas to 'pond' excess stormwater.

Use of the natural drainage system is being utilised as part of the comprehensive planning of drainage and land uses now required for water discharge rights.

8.4.2 OBJECTIVE AND POLICIES

Objective:

8.4.2.1 To ensure the adequate disposal and control of stormwater.

Policies:

8.4.2.1.1 The use of natural attributes of water courses will be encouraged to ensure the disposal and control of stormwater.

8.4.2.1.2 Ponding areas will be utilised to encourage the retention of water in future development areas.

8.4.2.1.3 The Council will continue to investigate and utilise various methods of controlling stormwater in residential developments where practicable.

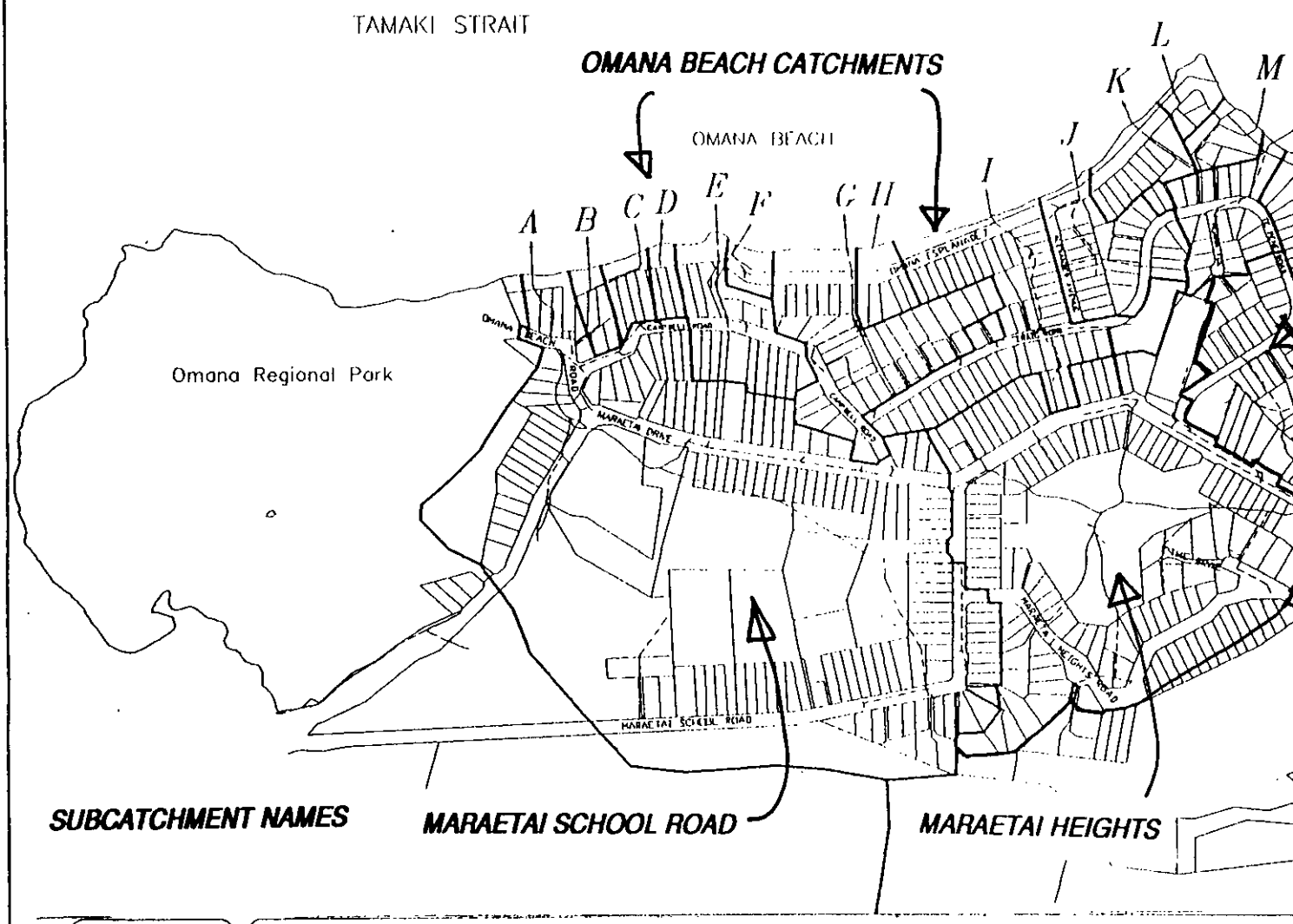
2.0 THE CATCHMENT

2.1 CATCHMENT DESCRIPTION

Maraetai is an isolated coastal urban development within the rural area of Manukau City. The catchment is predominantly zoned Residential R5 with an area of approximately 210 hectares and is bounded to the East and South by rural and forested land, to the West by the Omana Regional Park and fronts to the North on to the popular Omana and Maraetai Beaches. Refer to figure 1.

The Catchment is divided into six major subcatchments as follows:

Maraetai School Road Catchment	-	discharging to the sea at the eastern end of Omana Regional Park.
Omana Beach Catchment	-	a series of subcatchments north of Maraetai Drive discharging at several outfalls along Omana Beach.
Te Pene, Maraetai, and Rewa Road Catchments	-	discharging to the sea at the western end of Maraetai Beach.
Maraetai Beach Catchments	-	a series of subcatchments discharging at several outfalls along Maraetai Beach.



Maraelai Catchment Lay

MANUKAU CITY COUNCIL

2.2 CATCHMENT BACKGROUND

Maraetai originated as a beach holiday settlement but has now developed a generally suburban character with predominantly good quality single family homes of permanent residents.

The land was subdivided in stages from the late 1920s with 300 lots created in the first ten years. The 1945 census recorded a permanent population of 130. Most development has occurred since the 1950's. The 1991 Provisional Census recorded a population of 1249.

Approximately 55% of the area zoned residential is presently built on. The areas as yet undeveloped are mainly the lower areas of the valleys between the Rewa Road and Carlton Crescent, between Maraetai Drive and Maraetai Heights Road, and between Maraetai Drive and Maraetai School Road. Parts of these areas are very steep for housing.

A sewer reticulation system is now being installed and should be available for all lots within a few years. This will allow the subdivision of existing lots for infill housing which will increase the stormwater runoff. However, as many of the present lots of 1000m^2 or larger are very steep, the number which will be further developed for infill housing is likely to be small.

2.3 FUTURE STORMWATER RETICULATION

Refer to Figure 4.

As part of the Study a conceptual piped stormwater system was designed to provide piped connections to local upper areas of the main catchment and to the smaller catchments.

Most existing streets are sealed with kerbs and channels and have piped drainage from cesspits mainly in short runs to outfalls to the sea or to watercourses. In both main catchments the lower primary drainage lines are open channels, except for local piped culverts under roads. These channels are generally either through reserve land where the channels are unlikely to be piped in the future, or through land not yet developed. In this case it is not possible to predict whether any channel will be piped in the future or to presume the future drainage pattern for preliminary design for the future drainage system.

Generally therefore preliminary design for future stormwater drainage has been confined to local areas of upper catchments and to the smaller catchments, and to checking the effects of future development on the existing road culverts.

At present few lots have piped connections for drainage of roof and yard water. Generally sections are steep and rely on runoff or ground soakage for disposal of roofwater. Where lots slope to a street frontage surface flows to the street or roofwater connections to the street channel are unlikely to cause problems and it is considered that separate piped stormwater connections to such lots are not really necessary. Where lots drain to adjoining residential land it is considered that a piped system for collection of roof and yard water is desirable to avoid problems for neighbouring owners.

The following therefore forms the basis of preliminary design for the future stormwater drainage system:

i. Allows for all streets to be kerbed and channelled to normal MCC subdivisional standards.

ii. Allows for projected development, that is, all areas at present zoned residential subdivided, all lots developed with single unit housing and 50% of lots over 1000m^2 subdivided and developed with infill housing. (Note: The 1989 District Scheme has a minimum subdivisional requirement of 1500m^2 for Zone 5.)

iii. Allows generally for reticulation for a connection to each lot for roof water, etc, drainage, except where the lot drains naturally to a street frontage or to reserve land where drainage from the lot will not cause problems.

3.0 MANAGEMENT STUDY

This Catchment Management Plan is based on the findings of a Catchment Management Study carried out jointly between Manukau City Council Technical Services and Babbage Consultants Ltd. A brief summary of the analysis procedures used in the Study is included below:

3.1 HYDROLOGICAL & HYDRAULIC PARAMETERS

3.1.1 Modelling Technique

The catchment stormwater piping network and overland flow system was analysed using the Ilsax computer modelling technique.

3.1.2 Treatment of Rainfall

The Ilsax method applies a set of rainfall precipitation data to the hydraulic model.

The Auckland City Council "Model Rainstorms for Stormwater Runoff Analysis" was used as the basis for developing hyetographs. As these storms are based on Albert Park records, multiplication factors of around 0.9 were incorporated to attempt to represent likely rainfall in Manukau City. A series of model rainfall data for various durations and for summer and winter were applied to the catchment model.

3.1.3 Treatment of Losses

Allowances were made for the various loss factors considering surface depression storage, soil infiltration and initial soil wetness.

3.1.4 Catchment Makeup

Each subcatchment of the area was assigned an estimated ratio of impervious area. Allowance was made on the assumption that 50% of residential lots over 1000m^2 would be developed with future infill housing, being the assessed future most probable development of the catchment with infill housing as may be permitted by proposed revisions to the District Scheme Plan (1989). It is assumed that roof water will also go to the stormwater system.

3.1.5 Pipe Network

Refer to 2.3 for description of future stormwater reticulation.

4.0 SUMMARY OF DRAINAGE PROBLEMS

Most of the present piped stormwater drainage is in smaller pipes up to 300 diameter in upper reaches of catchments while the lower reaches of the primary system are open channels with culverts under roads. Nearly all the existing pipes have adequate capacity for the 20% AEP design storm flows, and where pipes are undersize, the resulting overflows are not likely to cause any serious problems.

Specific Drainage Problems

From the analysis carried out the following major problems have been identified:

- Maraetai Drive Culvert near Rewa Road
  The existing twin 1500 dia culverts under Maraetai Drive to the Maraetai Beach carpark are undersized for 20% AEP flows and the road is likely to flood to 150mm above the crown for a short period, due to ponding created because the carpark levels downstream are above the road crown. For the 1% AEP event flows will overtop the road for about 30 minutes to a depth of up to approximately 750mm.

- Rewa Road
  A short length of shallow open channel in lot No.122 north of the end of Rewa Road does not allow the downstream pipe (900 dia) to flow full before overland flow occurs.

  Northwest of the bend at the end of Rewa Road there is a short length of open channel and a branch channel upstream of a 1350 dia pipe. These channels do not allow the 1350 dia pipe to flow full before overland flow occurs.

Both of these problems could be reduced by completing the piping as part of the future reticulation works.

- Unserviced Areas
  There are a number of problems of local flooding nuisance due to the lack of piped house connections and the lack of kerbs and channels to control road drainage in some areas.

  These problems will be reduced when future reticulation and kerb and channel works are carried out.

5.0 MANAGEMENT OPTIONS

5.1 GENERAL MANAGEMENT OPTIONS

Management options consider various alternatives that may be appropriate to remove or alleviate existing problems or prevent or reduce the effects of flooding due to future property developments. Options categorise into Structural Options, which involve the construction or modification of existing drainage works, and Planning Options, which involve legislated or recommended restrictions, controls, precautions, etc., to minimise or avoid future problems.

The objective of the Maraetai stormwater study, apart from identifying specific drainage problems was to provide the basic design information for the future extension of the existing incomplete system to a full stormwater drainage reticulation system to M.C.C. standards including the envisaged future development of the urban area.

5.2 CONSULTATION

At the start of the Study a letter was delivered to all letter boxes within the Catchment to inform the public of the stormwater Management Study and requesting information on existing stormwater drainage problems or concerns that they may have.

The various management options considered in the Study were presented to Councillors, Community Board members, Tangata Whenua and a Community Liaison Committee, formed from Council elected members, Community, Environmental, Statutory groups and residents chaired by the Chairman of the Operations Committee.

A newsletter was sent to all properties on the overland flowpath informing them of the flowpath to provide more specific information and to give a further opportunity for discussion.

Internal consultation was carried out with various groups within Council.

The results of these consultations were taken into account in the selection of proposals as contained in this Management Plan.

5.3 PHILOSOPHY OF SELECTION OF OPTIONS

Options for proposed works have been selected on the basis of elimination of existing problems by constructing new works which will eventually become part of a future stormwater drainage system.

6.0 MANAGEMENT PLAN KEY FEATURES

The following items are the key features of the Management Plan.

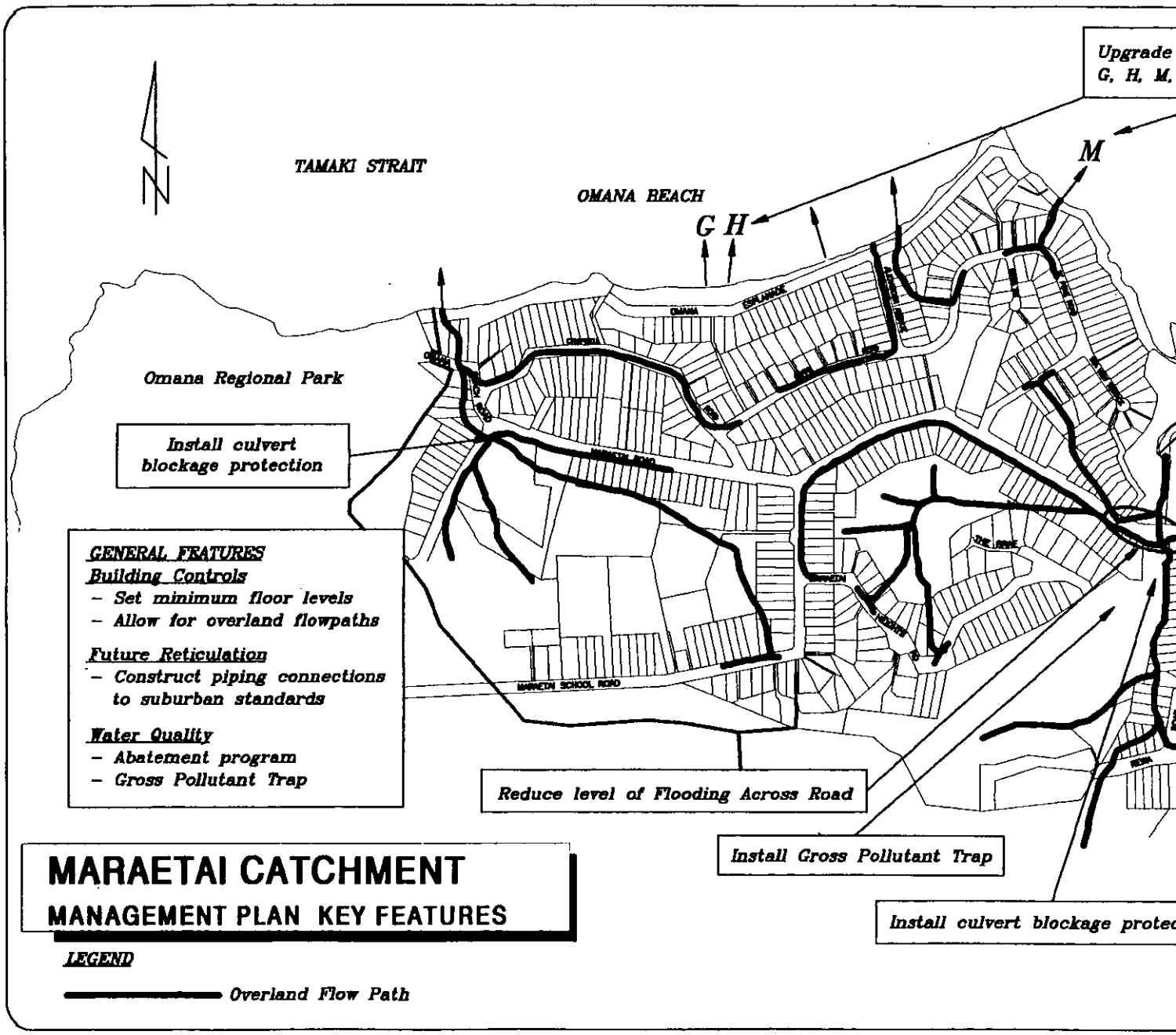
- Primary System Upgrading - installation of additional piping to provide full reticulation as required to suit existing and future development.
- Secondary System Modifications & Protection - of overland flowpath for flows not conveyed by pipe network
- Building Controls - restrictions imposed to minimise risk of flooding hazards
- Environmental Protection - reduction of detrimental effects of stormwater discharge
  - upgrade selected outfalls.

These are shown schematically on Figure 2.

Particular Management Principles

- Progressively install additional piping to upgrade the reticulation to MCC urban standards.
- Progressively construct kerb and channels to all streets to MCC urban standards.
- Protect all overland flowpaths so they can operate when required so as not to flood habitable floors.
- Impose building controls to protect floor levels of future developments.

Fig 2


TAMAKI STRAIT
OMANA BEACH
G H
M
Upgrade
G, H, M,
Omana Regional Park
Install culvert
blockage protection
GENERAL FEATURES
Building Controls
– Set minimum floor levels
– Allow for overland flowpaths
Future Reticulation
– Construct piping connections
to suburban standards
Water Quality
– Abatement program
– Gross Pollutant Trap
Reduce level of Flooding Across Road
Install Gross Pollutant Trap
Install culvert blockage protec
MARAETAI CATCHMENT
MANAGEMENT PLAN KEY FEATURES
LEGEND
Overland Flow Path

7.0 MANAGEMENT PLAN

7.1 SUMMARY

The Management Plan is shown on figure 3.

7.2 PRIORITIES

A suggested priority of works is included on the right hand side of figure 3.

The timing of the actual construction of the stormwater reticulation will depend on many factors, such as:-

i. the programme of construction of kerb and channel in existing streets and the consequent elimination of open drain water tables.

ii. the demands of development and the availability of funds. Some suggestions for priority categories are given in the Study Report Section 2.6 together with cost estimates. See summary in next clause.

iii. the subdivision of residential land at present undeveloped.

iv. the proposed construction of the sanitary sewerage system will possibly make it expedient and economic to provide stormwater reticulation to lots at the same time in some areas.

MARAETAI CATCHMENT MANAGEMENT PLAN

REFERENCE	DESCRIPTION	TOTAL	PRIORITY
MARAETAI DRIVE	Extra Cesspit and Piping to existing main outlet	$35,000	1
OUTFALLS	*OUTFALL*		
Upgrade selected outfalls	G Omana Esplanade	$7,500	1
	S Maraetai Beach	$7,500	1
	P Maraetai Bch Reserve	$2,000	2
	M Omana Esplanade	$2,000	3
	H Te Pene Point	$2,000	3
MARAETAI DRIVE near Omana Beach Rd	Blockage protection at road culvert	$5,000	3
MARAETAI DRIVE near Rewa Rd	Cut down local ground levels in reserve to reduce level of impounded overland flow flooding across Whitford – Maraetai Rd under extreme events	$30,000	3
	Blockage protection at road culvert	$5,000	2
	Gross Pollutant Trap	$5,000	3
BUILDING CONTROLS	Set minimum floor levels to prevent flooding of new developments and allow for overland flowpaths		
WATER QUALITY	– Abatement program		
	SUBTOTAL	**$101,000**	
	SUBCATCHMENT		
FUTURE RETICULATION (Indicative only)	REWA CATCHMENT	$220,000	(as funds permit)
	CARLTON CRES	$80,000	"
	MARAETAI BEACH	$130,000	"
	MARAETAI HEIGHTS	$260,000	"
	TE PENE CATCHMENT	$150,000	"
	MARAETAI SCHOOL RD	$560,000	"
	SUBTOTAL	**$1,400,000**	
	TOTAL	**$1,501,000**	

Fig. 3

7.3 FUTURE STORMWATER RETICULATION

Estimates of cost for carrying out new stormwater drainage work for extensions to the existing piped stormwater system as shown on Figure 4 are included below. The estimates are indicative only.

The estimates have been separated into three categories for the likely priority of the work to be done. Priority will also be governed by demands of development and according to availability of funds.

Category A : Early Priority

This is for work which should be carried out as soon as finance is available. This includes new work to relieve stressed reaches in the existing drainage system, and to alleviate present problems and also includes new pipelines to provide drainage connections for roof and yard stormwater for those lots which at present drain to adjacent developed properties.

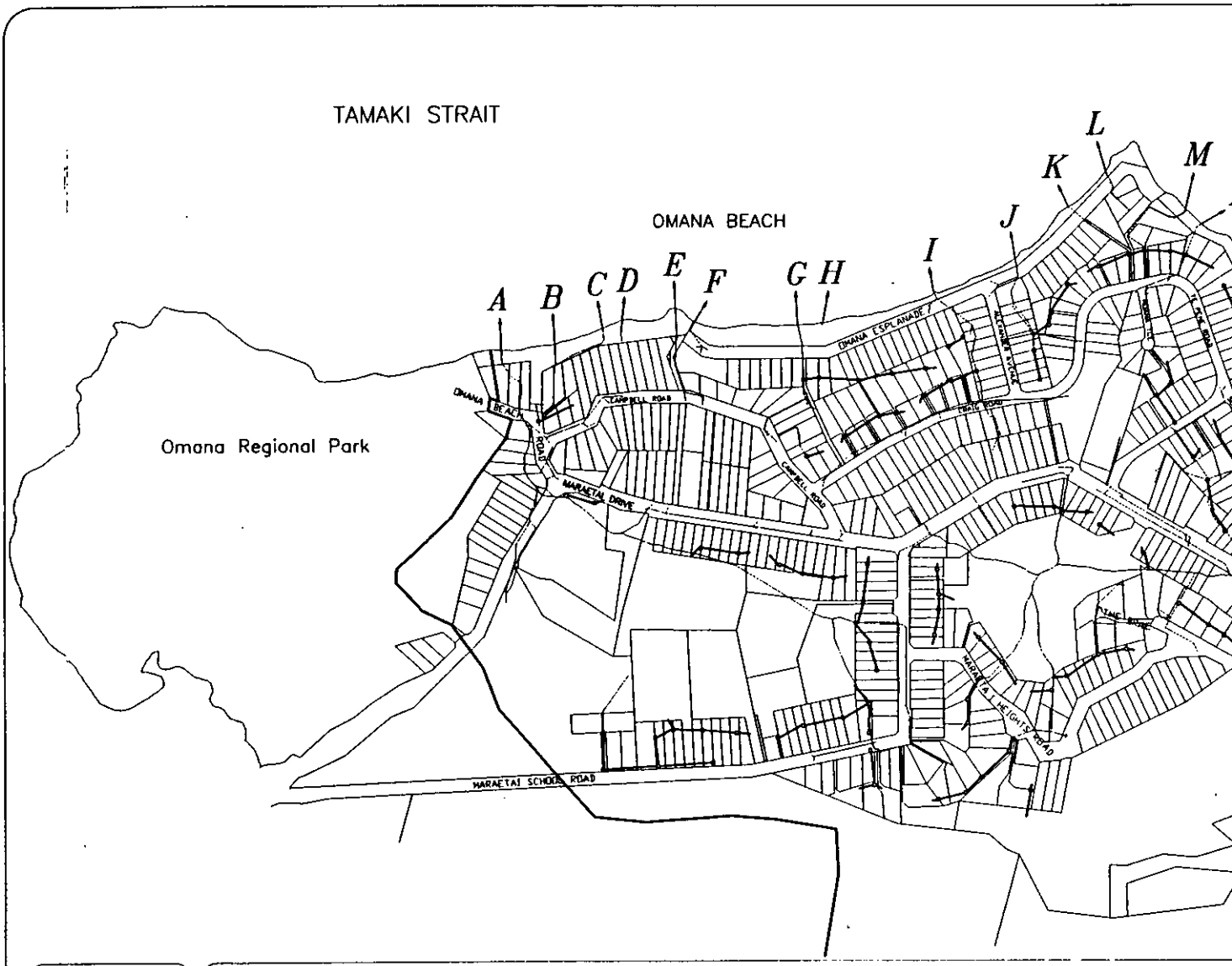
Category B : Lower Priority House Connection Drainage

This includes new pipelines to provide roof and yard stormwater drainage connections to those lots which drain to residential land which is at present undeveloped. This work will not necessarily be required until adjacent land is subdivided and developed but it may be economical for the work to be done at an earlier stage in conjunction with construction of sewerage reticulation pipelines.

Category C : Extensions to Street Drainage

This includes additional pipelines and cesspits required when existing streets not at present kerbed and channelled are upgraded.

Category A	Early Priority	Lower Priority	Extensions to Street Drainage
Rewa Catchment	100,000	60,600	60,000
Carlton Crescent	80,500		
Maraetai Beach	130,500		
Maraetai Heights	150,500	110,400	
Te Pene Catchment	150,500		
Maraetai School Road Catchment	270,000	200,000	90,000
	880,000	370,000	150,000
			1,400,000



MARAETAI CATCHMENT
Indicative Future Stormwater Reticula

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Fig. 4

8.0 PROPOSED WORKS

8.1 PRIMARY SYSTEM UPGRADING

8.1.1 Maraetai Drive Near Rewa Road

Refer to figure 5. The road has a low point near the culvert adjacent to the Maraetai Beach Reserve carpark. There is a risk of flooding to 150mm above the road crown for 20% AEP flows. At 1% AEP the road overflow is approximately 12m³/sec which would make the road impassable for about 30 minutes.

If in the future it is decided to raise the road to alleviate this flooding, a high level overflow culvert could be incorporated under the raised road. This culvert together with the existing twin 1500 diameter culverts should be designed to pass the 1% AEP flow without impounding the flood waters south of the road embankment to higher than say RL 4m which is approximately the existing situation. This would prevent additional flooding threat to upstream properties. Refer to figure 5.

It is anticipated that the road would need to be raised to about 1 metre above the adjacent downstream levels in the reserve. The overland flows for the west catchments could remain on the respective north and south sides of Maraetai Drive without flooding the road or requiring any piping upgrades. Raising of the road is considered to be the best long term option for solving the road flooding.

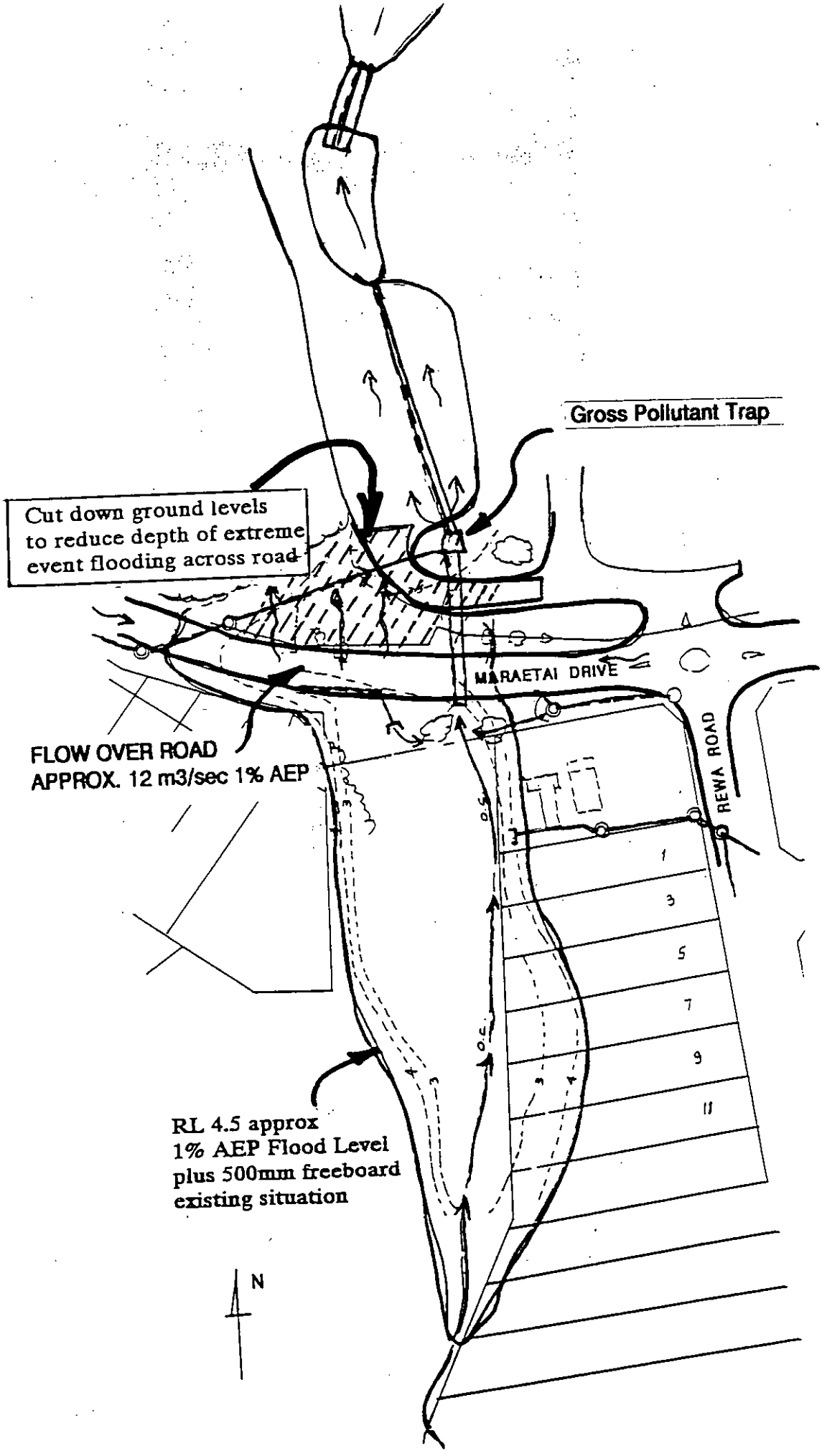
A considerably lower cost alternative proposal would be to cut down the ground levels over a small area of the reserve to reduce the depth of flooding which could occur across Maraetai Drive. This is the option included in this Plan. However, it is recommended that the above option of raising Maraetai Drive should be further considered prior to any works being carried out.

8.1.2 Property Connections

Progressively upgrade the reticulation to service all properties as determined by development pressure and availability of funds.

8.1.3 Street Drainage

Progressively construct street kerbs, channels and drainage. The priority of this will be as determined by the Roading Section of Council.



MARAETAI DRIVE / REWA ROAD
EXTENT OF FLOODING

Fig 5

8.2 SECONDARY SYSTEM MODIFICATION & PROTECTION

8.2.1 Overland Flowpaths General

Refer to Figure 9 and the Flood Hazard Map which indicate the major overland flowpaths within the catchment. It needs to be recognised that stormwater will flow generally along these paths whenever the piped system is unable to convey the runoff. Future building development including fences and landscaping should be controlled to prevent blocking of flowpaths. Floor levels should be established to ensure 0.500m minimum freeboard from water levels which can be estimated from the given flow rates or specifically calculated. Refer also to 8.3.6.

8.2.2 Forming of Overland Flowpaths with New Pipe Installation

Where new pipes are installed along overland flowpaths an improved overland flowpath should be formed as a depression in the ground along the pipe route where practical as part of the reinstatement works.

8.2.3 Kerbs & Channels

Where kerbs and channels are constructed across overland flowpaths, kerbs should be set at a level to maximise the capture of water by road cesspits and thereby reduce the overland flow in locations where it causes problems in adjacent downstream properties.

Driveway crossings in such locations should be constructed in such a manner to minimise the overflow of water from the road to private properties.

8.3 BUILDING CONTROLS

8.3.1 Floor Levels in the Vicinity of Overland Flowpaths

Locations of proposed buildings and levels of floors should take into account overland flow. In particular note the flowpaths shown on Figure 9 and the Flood Hazard Map. Buildings should not obstruct the overland flows and floor levels of buildings should have adequate freeboard (0.5m minimum) above potential flood ponding or flow levels which can be estimated from the flow rates. New buildings may be located in a flowpath provided any impeding of overland flow is not detrimental to other properties and provided care is taken to divert overland flow away from the building to prevent possible erosion danger to building foundations and to avoid excessive wetness under the building.

Where the flowpath is intercepted by roadways the local floor levels upstream of the roadway should also be a minimum of 1.0m above the roadway level.

The above recommendations should be confirmed at individual locations and can be modified where calculations can be provided to determine more accurate potential flood levels. A freeboard of 0.500 metres should be allowed in addition to estimated flood water levels. Refer also to 8.4.3.

8.3.2 Private Foul Water Drains

Gully traps on private foul water drains should be at such a level to exclude the entry of stormwater, but kept below habitable floor level.

8.3.3 Maraetai Road / Rewa Road Flooding

Refer to figure 5 which shows the extent of flooding upstream of Maraetai Drive due to the embankment formed by the level of the Maraetai Beach carpark (approximately RL 3.5). Habitable floors in the location shown should not be lower than RL 4.5 which is the approximately maximum flood water level plus a freeboard of 0.500 m.

8.3.4 Proposed Developments

Development proposals in areas where there is no existing piped stormwater system need not necessarily be disallowed prior to the proposed full reticulation works being carried out. However it will need to be demonstrated that such developments will not significantly cause or increase flooding or adverse effects to adjacent or downstream properties. At the time of such development it may be prudent to install local stormwater piping which will eventually be connected to the future reticulation system.

8.3.5 Allowance for Possible Sea Level Rise

A separate consideration to overland stormwater flows is related to possible sea level rise due to global climate changes.

Floor levels of new developments in low-lying areas of the catchment particularly at Maraetai Beach should be above the minimum levels as below:

Minimum Floor Levels	Minimum Floor Level above DOSLI Zero Datum
Separate garage	+2.35
Non-habitable floor or attached garage	+2.55
Habitable floor	+2.75

8.3.6 Property Information Register

Refer to Appendix for list of properties which should be identified on the P.I.R.

8.4 ENVIRONMENTAL PROTECTION

Refer to general principles of coastal protection contained in Part 21 of the 2nd Reviewed District Scheme 1993 and the Coastal Management Plan - Manukau City Council - 1991.

8.4.1 Slope Instability

At some locations the steep slopes within this catchment are subject to the risk of slope instability. A Geotechnical Investigation Report has been prepared by Fraser Thomas Partners January and September 1992 for the Sewerage Reticulation Scheme. Conclusions and recommendations of this report are appended to the stormwater study together with "Maraetai Stormwater Reticulation Geotechnical Issues". Extracts from the latter are appended to this Plan.

8.4.2 Precautions to be observed In Drain Construction Works

Slope instability as mentioned above can be adversely affected by infiltration of surface water into uncontrolled pipe trench backfill. The above-mentioned report contains recommendations to guard against this danger. Refer to appendix.

8.4.3 Preservation & Maintenance of Open Channels

Natural open channels and detention areas within the catchment should generally be protected to remain in their natural state as far as practical.

In line with the general objectives and policies set out in Section 6.1 of the Second Reviewed District Scheme, this Comprehensive Flood Management Plan recommends requirements to maintain and preserve significant gully and stream areas to enhance water quality and minimise the impact of urban development.

In order to protect the existing natural gully areas, development should not be permitted in these areas in a manner that would adversely affect the natural overland flow paths and storage characteristics which reduce the impact of urban development on the land drainage system.

The open gully systems should be maintained as close to natural condition as practical.

In particular, no building development, filling or other works should be permitted within that part of the existing natural stream valleys where water will flow in the predicted 1% AEP storm event.

In steep regions there exists potential for erosion. To provide acceptable control against such scour it should be the Council's policy to undertake and encourage private property owners to undertake protective planting as outlined below. In this regard the Council could make available, free of cost, to property owners plant material to achieve these objectives. In doing so the property owners involved for part, would be expected to plant, maintain and protect the gully areas in their natural state.

To encourage the re-vegetation of the gully areas the Council should advise all property owners concerned of the above policy and seek cooperation in maintaining the open waterways.

8.4.4 Debris Screen

The main culverts under Maraetai Drive at Omana Beach Rd and at Maraetai Beach Reserve near Rewa Rd should have debris screens installed to reduce the risk of blocking and subsequent flooding upstream and over the road.
Regular maintenance will be required particularly after major storms.
Refer to figures 6 and 7.

8.4.5 Gross Pollutant Traps

A gross pollutant trap should be installed near the culvert at Maraetai Drive near Rewa Road. Refer to figure 7.

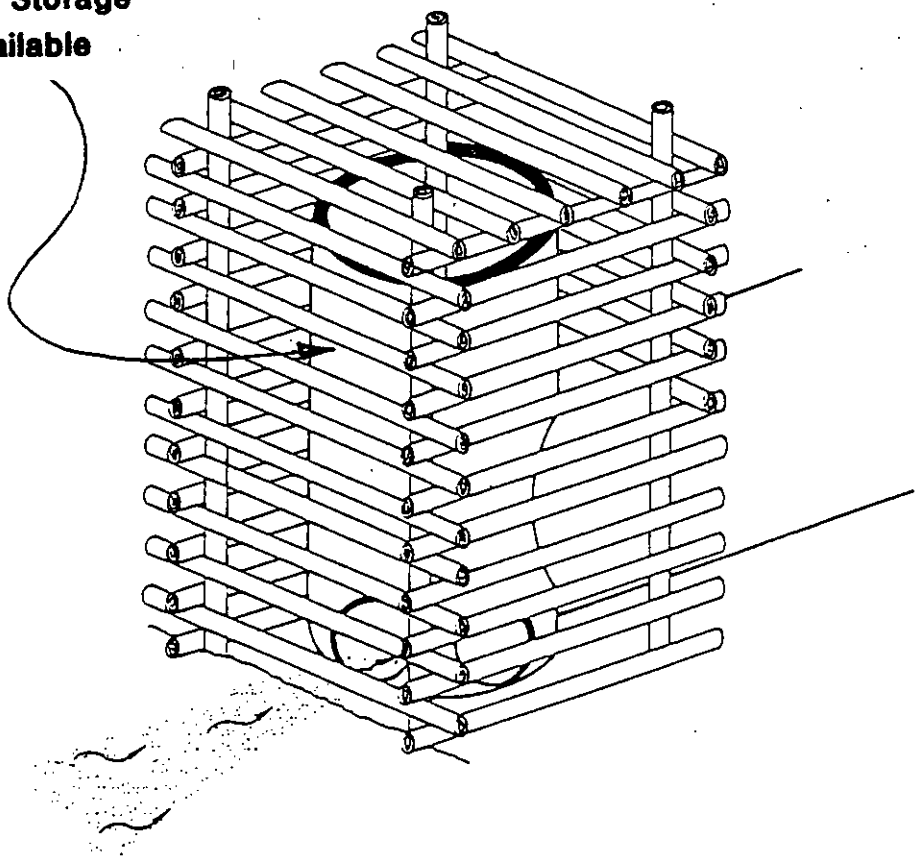
8.4.6 Stormwater Outfalls

This catchment has a number of outfalls consisting of pipes or open channels discharging at beaches. Prior to any construction of new piped reticulation systems, the particular outfalls should be inspected and approved for use if suitable,or modified,rebuilt or relocated as appropriate to comply with acceptable erosion protection and visual standards. The existing outfalls have been inspected and a summary report is included as an appendix to the Study.

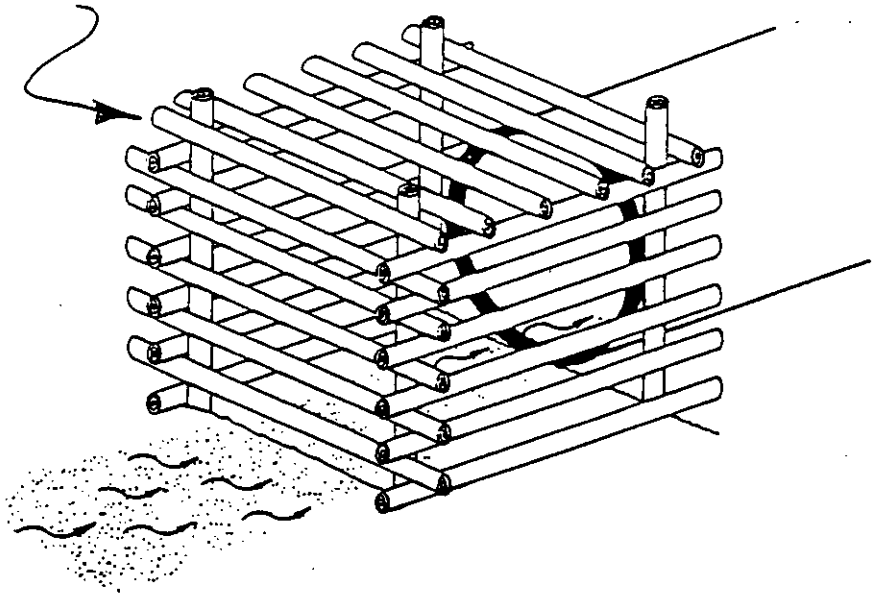
It is proposed that several of the outfalls should receive some rebuilding or maintenance attention. Refer to figure 8. These are designated as outfalls G,S,M,H and P, the locations of which are indicated on figure 2. Proposed works are as follows:

Outfall G (Omana Esplanade) : Remove existing 900 dia pipe from beach and terminate with an outflow manhole in the grass reserve. Connect the manhole with a low-flow (approx 20% AEP) connection to the emergency overflow pipe from the proposed sewer pump station.(upgrade the overflow pipe from 300 to 450 dia.) A specific discharge permit has been sought for this.

Riser : Allows Control of
Detention Storage
where available



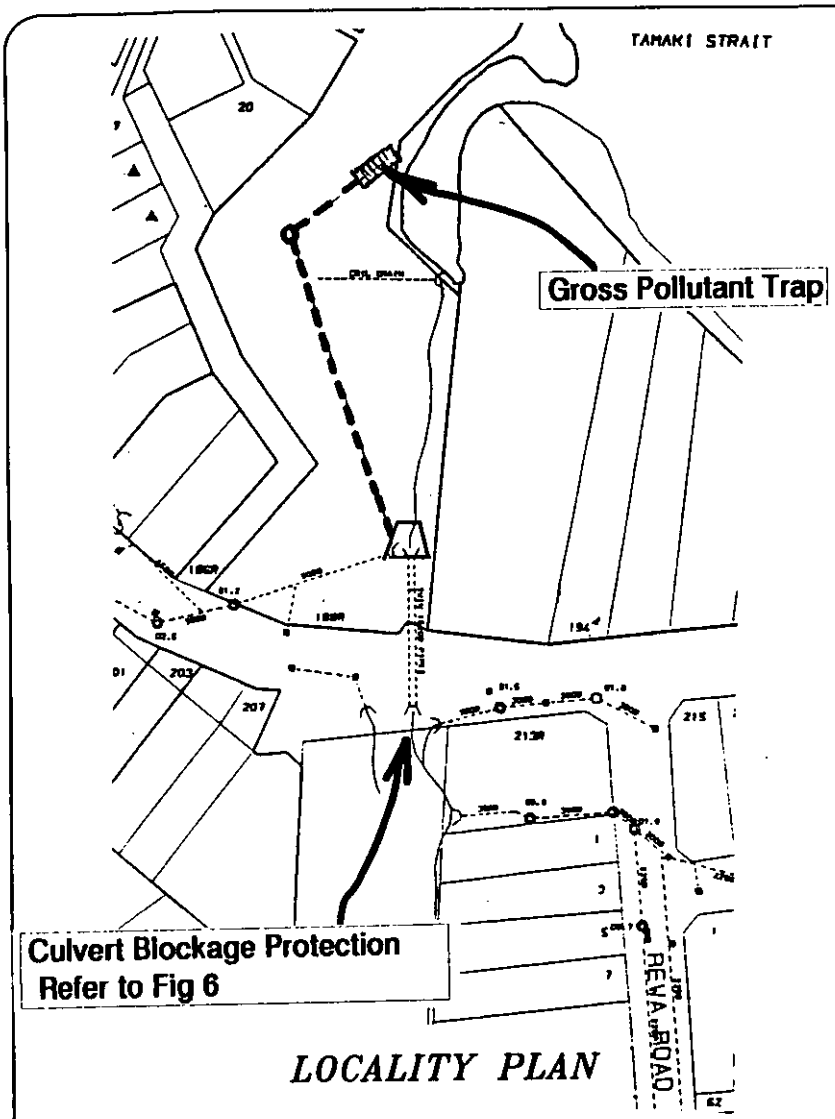
Debris Screen
100 x 100 or 100 dia
timber rails



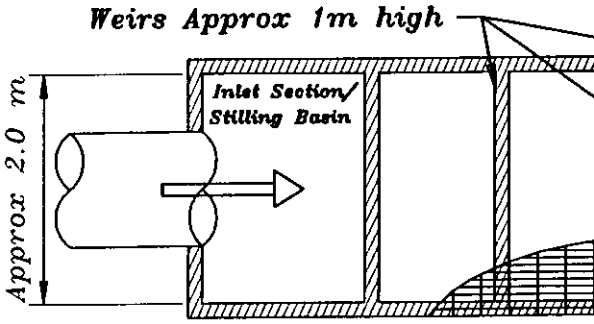
CULVERT BLOCKAGE PROTECTION

Fig. 6

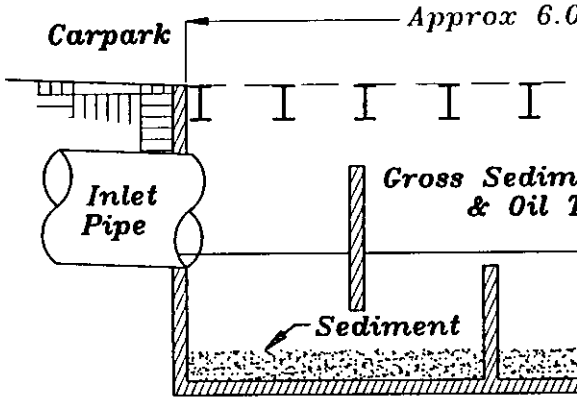
Fig 7



LOCALITY PLAN



PLAN



TYPICAL
Gross Pollutant

MARAETAI DRIVE / REWA ROAD
CULVERT BLOCKAGE PROTECTION & POLLUTA

MANUKAU CITY COUNCIL

Outfall S (Maraetai Beach) : Reduce the visual impact of the existing 600 dia pipe exposed on the lower half of the beach by constructing a gently sloping rock-faced encasement over the pipe.Place a marker pole at the end of the pipe.

Outfall M (On east side of Te Pene point between Omana & Maraetai) : Re-shape existing open channel across grass reserve to allow mowing maintenance.

Outfall H (Omana Esplanade) : Re-shape existing open channel across grass reserve to allow mowing maintenance.

Outfall P (Maraetai Beach Reserve) : Cut back exposed end of 900 dia pipe to finish flush with rock-faced embankment and tidy up with mortar or stone facing.

8.4.7 New Private Outfalls

Should individual properties require future drainage upgrades it is strongly recommended to connect to existing outfalls. On the other hand it is not considered necessary to absolutely restrict the construction of new beach-front or cliff outfalls. However these will require specific discharge and coastal permits. In some cases it may in fact be preferable to use new outfalls rather than to construct drains across the cliff tops or across steeply sloping land.

MARAETAI.WK3

STORMWATER OUTFALL UPGRADING
MARAETAI

Outfall	Photos	Size	Submerged	Flowpath	VISUAL APPEARANCE	SCOUR / EROSION		STRU
						Potential Consequences		Cons
			Assumed Weighting		5	4	2	3
G	7	900	high tide	beach	5	2	2	2
Comments:		Large outfall extending out on to beach, may silt up in times of low stormwater flows.						
S	19	600	high tide	beach	5	1	1	2
Comments:		Outfall exposed at bottom half of beach						
P	17	900	high tide	stream	5	1	1	1
Comments:		Well built outfall, however could be cut back flush with rock wall or extend wall flush with pip						
M	14	o/c	no	beach	4	1	2	1
Comments:		Open channel in grass reserve discharges onto beach.						
H	8	o/c	no	beach	4	1	2	1
Comments:		Open channel in grass reserve discharges onto beach.						

The above data has been selected from the Study report
and show those outfalls which are recommended for upgrading

Fig. 8

8.6 ALLOWANCE FOR FUTURE DEVELOPMENT

The proposed stormwater system upgrading (both primary and secondary) have made allowance for the most probable level of infill development up to the year 2011, on the same basis as that used as the basis for the sewerage scheme development. (Refer 2.3). Note that the "Beachlands/Maraetai Planning Study" prepared for the Council by Colleen Crampton July 1992 proposes a lower density of allowable developments.

When future developments are proposed for properties which are presently unserviced by direct stormwater connections the following matters should be considered:

- As a first preference, source control measures should be utilized to eliminate or minimise the increase in stormwater runoff from new developments. This will reduce the impact of new developments on stormwater flows in downstream regions of the catchment. Refer to section 8.7 for possible options.

- Installation of new piped connection to nearest public drain. This may include installation of branch drains and consequent downstream system improvements as indicated on the conceptual reticulation system shown in the Study Report.

- Refer also to 8.3.4.

8.5 ABATEMENT MEASURES

The Study Report, provides a conceptual stormwater system to provide connections to all properties. Refer to figure 4.

However, note that stormwater source abatement measures should be introduced where practical. Refer to sections 8.6 and 8.7 of this Management Plan.

8.5.1 Cesspit Cleaning and Street Sweeping

A maintenance programme which includes annual cleaning and sweeping should be maintained. It should be noted that cesspit cleaning and street sweeping not only removes obvious visual pollution, but also removes other environmental pollutants which would otherwise be discharged in the stormwater and contaminate the receiving waters.
Because the receiving waters are open with good flushing compared to an estuary, further treatment of stormwater discharge is not considered to be necessary for this catchment.

8.5.2 Collection and Disposal of Debris

There needs to be a programme for collection of debris from debris screens, wetlands, cesspit cleaning and street sweeping. Disposal of debris and contaminated silts should be in accordance with Auckland Regional Council guidelines. This will generally mean transfer to a controlled landfill site.

8.6 ALLOWANCE FOR FUTURE DEVELOPMENT

The proposed stormwater system upgrading (both primary and secondary) have made allowance for the most probable level of infill development up to the year 2011, on the same basis as that used as the basis for the sewerage scheme development. (Refer 2.3). Note that the "Beachlands/Maraetai Planning Study" prepared for the Council by Colleen Crampton July 1992 proposes a lower density of allowable developments.

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- Installation of new piped connection to nearest public drain. This may include installation of branch drains and consequent downstream system improvements as indicated on the conceptual reticulation system shown in the Study Report.

- Refer also to 8.3.4.

8.7 CONTROL OF STORMWATER RUNOFF FROM NEW DEVELOPMENTS

Restrictions or source control measures shall be utilised to eliminate or minimise the increase in stormwater runoff from new developments.

Consideration should include the following controls:

a) Prevent development in likely problem areas

b) Require some form of runoff control - detention tanks or ponds

c) Discourage the over-use of impervious ground cover

d) Paved areas should be kerbed and shaped to direct all runoff into cesspits and then into the piped or soakage system

e) Impose a levy to fund future drainage improvements, and possibly delay development until such improvements can be carried out.

f) Stormwater disposal by site soakage only. This will only be possible where ground conditions allow soakage and where suitable engineering designs are carried out. Seepage overflows must also be considered.

9.0 PERMITS

The comprehensive discharge permit for this Catchment will require the following:

9.1 DISCHARGE PERMIT

For the Auckland Regional Council "APPLICATION FOR PERMIT TO DISCHARGE STORMWATER" the following information will be required:

Outfall	Catchment Area	Pipe Size	Peak Flow l/sec 20% AEP	1% AEP
A	39.0	o/c	3550	7000
B	0.7	300	100	150
C	0.6	150	100	150
D	0.5	230	75	150
E	2.5	375	300	600
F	0.4	230	60	100
G	5.3	900	700	950
H	0.8	o/c	150	300
I	6.7	230	900	1500
J	3.0	230	450	900
K	1.5	230	200	350
L	0.6	230	100	150
M	0.9	o/c	150	200
N	2.3	300	300	550
O	3.5	230	500	850
P		900		
Q	132	2x1600	10500	25000
R	0.9	230	85	200
S	5.7	600	910	1500
T	1.0	230	50	100

Excludes minor outfalls.

9.2 COASTAL PERMIT

Coastal Permits will be required for any upgrading of outfalls which will have works below the mean high water level. Refer to 8.4.6.

Outfall C	Omana Esplanade	-	removal of 900 pipe from beach.
Outfall S	Maraetai Beach	-	encasement of exposed pipe.
Outfall P	Maraetai Beach Reserve	-	Reshape exposed end of 900 pipe.

10.0 FLOOD HAZARD MAP

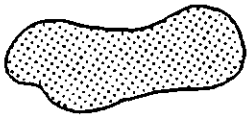
This map shows the major overland flowpaths within the Catchment. Minor overland flowpaths have not been shown. The expected flowrates (m^3/s) of the flowpath are as shown. The expected flowrates are based upon the existing pipe system and any upgrading work on the pipe network would decrease these figures. The location of the overland flowpath has been derived from field observation only, and exact location will need to be field inspected in detail.

No attempt has been made to estimate the width of the flowpath as this will vary with the local contour and any constructed structures within the indicated flowpath.

Locations of ponding have been indicated. On the flatter areas of the catchment in particular, the flowpaths cannot be easily defined.

KEY

Major overland flowpath



Pond

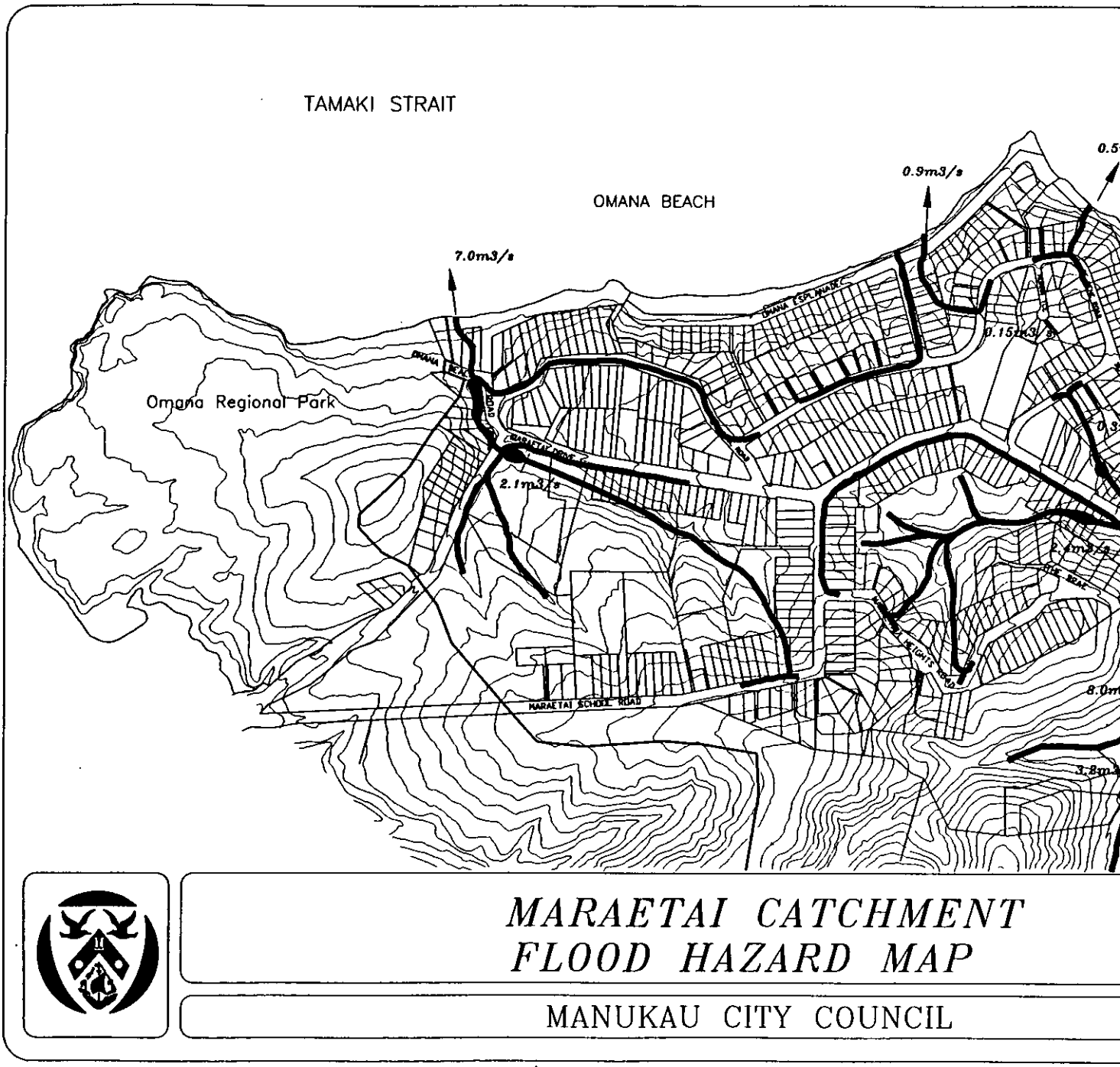
Q

Expected overland flowrate for 1% AEP

Catchment boundary

Localized overland flow direction

Properties affected by overland flow are defined as those where there is a risk of property flooding. This may occur where the flowpath is not confined to a deep gulley unlikely to overflow, or where the flowpath is impounded by embankment, possible culvert blockages, buildings or fences, etc.



MARAETAI CATCHMENT
FLOOD HAZARD MAP

MANUKAU CITY COUNCIL

Fig 9

EXTRACT FROM MARAETAI STORMWATER RETICULATION - GEOTECHNICAL ISSUES
FRASER THOMAS PARTNERS, OCTOBER 1992

The geotechnical issues relating to stormwater reticulation have been identified as follows:

a) *As stated in Section 1.1.13 of the CFM Study, the Auckland Regional Water Board (now the Auckland Regional Council Environmental and Planning Division) encourages the preparation of comprehensive flood management plans that include natural hazard mapping with "written identification of land subject to hazards such as erosion, flooding and land slip and the promotion of inclusion of such information in the relevant planning schemes". It is therefore our opinion that such features require to be identified and mapped along the alignments of the future proposed stormwater lines. Such features are currently being mapped as part of the investigations for the sewer reticulation scheme. Such features may, however, occur in areas traversed by proposed stormwater lines that will not be affected by the sewer lines.*

b) *Uncontrolled stormwater runoff is potentially a major contributory factor to slope instability and, in our opinion, is the main geotechnical issue relating to stormwater reticulation at Maraetai. Uncontrolled stormwater runoff, particularly from roofs, yards and sealed roads, presents the potential for concentrations in surface water flows, leading to erosion and shallow seated slope instability. As stated in Section 2.5.2 of the CFM Study, extensions to the existing stormwater system at Maraetai will be required to serve those streets as yet not kerbed and channelled and to provide for drainage connections to individual lots for collection of roof water and yard drainage.*

c) *Unless backfilled in a controlled manner, sewerline trenches present the risk of stormwater ingress through the backfill, resulting in ground saturation and possibly slope instability.*

d) *In order to provide stormwater reticulation to individual lots, several of the proposed future stormwater lines will be located on steep gully side slopes. It is therefore our opinion that the locations of the proposed stormwater lines should be appraised by a geotechnical engineer in order to determine whether or not the trenches will adversely impact on slope stability or whether the lines are located across areas of currently unstable ground. For example, the location of the proposed stormwater lines around the head of the gully immediately west of Maraetai School Road, on the north facing coastal slope above Omana Esplanade and the side slopes of the deeply incised gully system between Maraetai Heights and Maraetai Drive and on the side slopes of the deeply incised gully to the south of the southern limb of Carlton Cres.*

e) *As control of stormwater runoff across potentially unstable steep slopes will tend to mitigate against slope instability, it may prove desirable to provide stormwater lines in areas where no lines are currently planned. The potentially favourable impact of kerb and channelling of those parts of Rewa Road and Carlton Crescent that are not currently kerbed and channelled should be assessed and the priority of such kerb and channelling should be determined.*

In summary, the geotechnical issues relating to stormwater reticulation at Maraetai concern slope instability and are as follows:

(i) Existing slope instability which could adversely affect proposed stormwater pipes that traverse such areas.

(ii) Mitigation of existing slope instability by controlling stormwater runoff by stormwater reticulation.

(iii) Slope instability caused by infiltration of surface water into uncontrolled trench backfill along the proposed stormwater lines.

INFORMATION FOR PROPERTY INFORMATION REGISTER (P.I.R.)

In order for the Council to meet its obligations under section 35(5)(j) of the Resource Management Act, a property information register base has been provided to record information known to the Council in respect of any property, with particular regard to identified natural features of land stability and flood ways.

Under Section 35 of the Resource Management Act the Council is required to gather information and monitor such natural features in order to carry out its effective function under the Act. In this regard the RM Act requires the Council to Refuse the grant a consent for the subdivision of land (including cross leasing) where the land is likely to be subject to material damage by erosion, slippage or inundation. In the same manner section 106 also requires consent to be refused if the subdivision is likely to accelerate, worsen or result in damage to other land from subsidence or inundation.

In the same manner the building Act requires the Council to refuse consent under similar grounds to the above.

To meet the requirement of both the Resource Management Act and the Building Act the properties listed on the following page(s) should be placed on the Council's property information register with the accompanying description and reference.

OVERLAND FLOW PATHS

All properties containing an overland flow path, in particular as identified in this stormwater plan (Refer to Flood Hazard Map) will need to be assessed if development is proposed. The requirements of Section 106 of the Resource Management Act and Section 36 of the Building Act may require the imposition of appropriate restrictions on development.

MARAETAI CATCHMENT
INFORMATION FOR PROPERTY INFORMATION REGISTER

Property	*Lot*	*DP No.*	*Comments*
60 Craig Road	*117*	*48253*	*Basement could flood from overland flow.*
62 Craig Road	*116*	*48253*	*Basement could flood from overland flow.*
41 Rewa Road	*118*	*19097*	*Basement could flood from overland flow.*
26 Maraetai Heights	*67*	*41214*	*Habitable floor could flood from overland flow.*
48A Maraetai Heights	*5*	*41214*	*Basement could flood.*
180 Maraetai Drive	*533*	*20292*	*Garage could flood.*
159 Maraetai Drive	*11*	*34466*	*Habitable floor could flood.*
213 Maraetai Drive	*97*	*17095*	*Property could flood (St John's Station)*
225 to 265 Maraetai Drive			*In addition to other considerations these beachfront properties should have future habitable floor levels not lower than RL. 2.75 to allow for possible future sea level rise. Some of these properties have ground levels below the road and are therefore at risk of surface flooding.*