SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

WATER RACE SUBCOMMITTEE

Agenda

NOTICE OF MEETING

An ordinary meeting will be held in the Council Chambers, 18 Kitchener Street, Martinborough, on Thursday 13 February 2020 at 4:00pm. The meeting will be held in public (except for any items specifically noted in the agenda as being for public exclusion).

MEMBERSHIP OF THE SUBCOMMITTEE

Colin Olds (Chair), Cr Rebecca Fox, Jim Hedley, Justine Thorpe, Paul Harvey and Frank van Steensel and Mayor Alex Beijen.

Open Section

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

WATER RACE SUBCOMMITTEE
Minutes from 12 December 2019

Present:	Colin Olds (Chair), Paul Harvey, Jim Hedley, Frank van Steensel, Mayor Alex Beijen and Cr Rebecca Fox.
In Attendance:	Bill Sloan (Waters Project Officer) and Suzanne Clark (Committee Advisor).
Conduct of Business:	The meeting was held in the Supper Room, Waihinga Centre, Martinborough and was conducted in public between 4:00pm and 5:25pm.

Open Section

A1. Apologies

WATER RACE SUBCOMMITTEE RESOLVED (WR2019/01) to accept apologies from Justine Thorpe.

(Moved Mayor Beijen/Seconded Cr Fox) Carried

A2. Conflicts of Interest

Outside of this Subcommittee, Mr van Steensel gave advice on land use and could potentially have a conflict of interest.

A3. Public Participation

There was no public participation.

A4. Actions from Public Participation

There were no actions from public participation.

A5. Extraordinary Business

There was no extraordinary business.

B Decision Reports from Chief Executive and Staff

B1. Adoption of Water Race Subcommittee Terms of Committee

Members noted that the Subcommittee had a Longwood Water Race member vacancy and discussed increasing representation for the Longwood Water Race to three members. A change in membership was not moved forward as it was acknowledged that the Moroa Water Race covers a larger land area.

WATER RACE SUBCOMMITTEE RESOLVED (WRS2019/02):

1. To receive the Adoption of Water Race Subcommittee Terms of Reference Report.

   (Moved Olds/Seconded Cr Fox) Carried

2. To adopt the Water Race Subcommittee Terms of Reference.

   (Moved Cr Fox/Seconded Harvey) Carried

Mr Hedley voted against the motion.

C Information and Verbal Reports from Chief Executive and Staff

C1. Challenges Ahead

Mr Sloan tabled a water race presentation and discussed the challenges with regards to obtaining a Longwood Water Race consent renewal from Greater Wellington Regional Council (GWRC) by April 2020 (the consent for Moroa Water Race expired in 2025).

Council were aiming to lodge a status quo consent application with GWRC for Longwood Water Race by the end of the year with the expectation that consent conditions would start to be negotiated early 2020. It was anticipated that following a water race review, administration of the network would be taken over by Wellington Water. There was not expected to be an increase in cost associated with the change in administrators.

Mr Sloan answered members' questions on the high cost to service the Longwood Water Race, Wellington Water skill and experience with water races and availability of historical information on the water races.

Members agreed to undertake a field trip of the network in February 2020.

Members noted that water race maintenance costs were in addition to rates, that the water races provided aquifer recharge, that should the water races be shut down users would need time to provide other methods for stock watering, that there was a specific issue around the Greytown urban area with regards to the water race system being used as a stormwater system, and that water race flow rate information should be notified to users. Obtaining the names of all water race users was discussed.

WATER RACE SUBCOMMITTEE NOTED:

1. Action 279: Send out a regular water race newsletter to all water race ratepayers; H Wilson
2. Action 280: Send a link to the water race bylaws to Subcommittee members; H Wilson
3. Action 281: Update the Greytown Community Board at their next meeting on the status of the Moroa Water Race; H Wilson

Confirmed as a true and correct record

……………………………………….(Chair)

……………………………………….(Date)

SOUTH WAIRARAPA DISTRICT COUNCIL

13 FEBRUARY 2020

AGENDA ITEM B1

WATER RACE SUBCOMMITTEE APPOINTMENT

Purpose of Report

To seek approval from Council to make elected member and committee appointments.

Recommendations

Officers recommend that the Subcommittee:

1. *Receives the Water Race Subcommittee Appointment Report.*
2. *Recommends to the Assets and Services Committee the following external member be appointed to the Water Race Subcommittee: Dennis Hodder (representing Longwood Water Race).*

1. Background

Schedule 7 of the Local Government Act 2002 provides for local authorities to hold the meetings that are necessary for the good government of the region or district (clause 19); to appoint the committees, subcommittees and other subordinate decision-making bodies that it considers appropriate, including joint committees with other local authorities (clause 30); and to appoint or discharge any member of a committee or subcommittee (clause 31). Clause 31 (3) allows for the appointment of external members to a committee or subcommittee if *' in the opinion of the local authority, that person has the skills, attributes, or knowledge that will assist the work of the committee or subcommittee.'*

On the 20 November 2020 Council mayor Beijen created the Water Race Subcommittee and member appointments were made. The Water Race Subcommittee reports to the Assets and Services Committee so member endorsement will be sought from them on the 19 February 2020.

2. Discussion

2.1 Water Race Subcommittee

The Subcommittee Terms of Reference (TOR) outlines membership makeup and how representation is to be sought prior to the end of every triennium, but not how a vacancy will be filled should one arise (refer Appendix 1). The situation is that a vacancy currently exists for a Longwood Water Race representative and the Subcommittee are being asked to endorse the new member application.

All water race ratepayers were written to in 2019 seeking expressions of interest to sit on the Subcommittee. Only two Longwood Water Race ratepayers put their names forward for selection. Subsequently one of the applicants withdraw from appointment due to a perceived conflict of interest.

Council officers have since received two expressions of interest obtained as a result of word of mouth advice that a position was available. One applicant has only a small section of water race running through their property, the other applicant has a much larger section of water race running through their property and the family has farmed commercially in the Featherston area over a long period of time. Dennis Hodder for these reasons is the preferred candidate. The Water Race Subcommittee Chair has been consulted.

3. Appendices

Appendix 1 – Water Race Subcommittee TOR

Prepared by: Suzanne Clark, Committee Advisor

Reviewed by: Euan Stitt, Group Manager Partnerships and Operations

Appendix 1 – Water Race Subcommittee TOR

SOUTH WAIRARAPA DISTRICT COUNCIL
Kia Reretahi Tātau

WATER RACE SUBCOMMITTEE

TERMS OF REFERENCE

Subcommittee of:	Assets and Services Committee
Chairperson:	Colin Olds
Membership:	One councillor, one external appointee, three representatives from Moroa Water Race area, two representatives from Longwood Water Race The councillor appointee will oversee Council's interests in current and future consents.
Appointments 19-22:	Colin Olds, Cr Rebecca Fox, Jim Hedley, Justine Thorpe, Paul Harvey, Frank van Steensel, plus one vacancy Longwood Water Race Mayor Alex Beijen (ex-officio)
Meeting Frequency:	Minimum of three times per year
Quorum:	Four members

1. Purpose

For Council to meet its consent conditions to extract water from the Waiohine and Tauherenikau Rivers that feed the South Wairarapa water race network, a number of conditions need to be met. An oversight group or committee must act as an interfacing agent between water race users and Council.

The purpose of the Subcommittee is to oversee the following:

- To assist in the governance and management of the Longwood and Moroa Water Race systems.
- To assist in the provision of an effective interface and communication mechanism for dialogue between water race users and Council.
- To assist in the on-going review of the relevance and functionality of both the Longwood and Moroa Water Race systems existing and future design; including their general purpose, operating and maintenance principles and management. This includes the establishment of and any future application of a formal process for the closure or correction of channels.

- To provide user-based consideration into all resource consents, by-law amendments, code of practice documents, rating requirements and any other related matters as needed.

2. Delegations

The Committee is delegated the Power to Act:

- From time-to-time to represent users and Council at relevant district forums such as Fonterra, Federated Farmer, Greater Wellington Regional Council and others as the Subcommittee deems appropriate or necessary.
- To review and agree an annual water race report, as prepared by officers, for release to all water race users.

The Committee is delegated the Power to Recommend:

- To make recommendations to the Assets and Services Committee on how properties with water races are to be rated, resource consent applications, by-law amendments and code of practice documents and any other matter falling within the purpose of the Subcommittee.
- To prepare recommendations on all water race matters for consideration by the Assets and Services Committee. Recommendations are to be provided to the Committee no later than January of each year (this date will enable SWDC to factor any required activities into Annual Planning processes).
- To consider implications and make recommendations to the Assets and Services Committee on Greytown urban waters and storm water channels.

3. Membership

At the end of the triennium, Council officers will write to water race users seeking expressions of interest in being appointed to this Subcommittee. Council officers, the Mayor the councillor appointee and Chair will select representatives from submitted expressions of interest giving preference to candidates who have not served more than two terms.

3.1 Chairperson

The chair will be appointed by the Mayor, or if an external appointee the Council, for the period of the triennium.

AGENDA ITEM B2

WATER RACE RATEPAYER ENGAGEMENT AND GENERAL UPDATE REPORT

Purpose of Report

To update the Subcommittee on water race matters and seek agreement to conduct a survey of all users.

Recommendations

Officers recommend that the Subcommittee:

1. *Receive the Water Race Ratepayer Engagement and General Update Report.*
2. *Agree and request that the Assets and Services Committee approve the water race engagement actions and that a survey of all water race ratepayers be undertake in March/April with the objective of reporting back to the next available Assets and Services Committee meeting.*

1. Water Race Ratepayer Engagement and Water Races Future

The Council has expressed its wish to engage more fully with water users and ratepayers this year to amongst other things:

1. Establish the current needs of water races users and extent of usage throughout the water race systems for stock watering needs for now and the immediate future.

2. Identify the willingness for exclusion of all stock from the confines of the waters races by whatever means possible and practicable. This is a component of “best practical means” tools stated in the Code of Practice aimed at reducing wastage and environmental pollution (Code of Practice attached).

3. Advise of the regulatory and affordability difficulties facing Council as it progressively renews its resource consents given the changes in the regulatory environment.

4. Identify any other needs currently not permitted as of right under the Bylaw and COP e.g. deferred storage or a take for a reticulated stock water system.

It is recommended that a full survey be undertaken with Councils Water Race Ratepayers targeted to address the above and any other matters of relevance and concern.

A 2016 (April Version 1) report on Water Race Land Use is appended for the committee's consideration.

2. Greytown Urban Northern Section Stormwater Matters Rural Property

A property owner on the northern boundary of the Greytown Urban area has over a period asked Council to reconsider the rating imposed on the property given the non-use of the system for stock-watering. The water race systems in this location also provide a conduit for stormwater flows for the northern part of the urban area.

The matter of rating for water races is a priority item for this committee's consideration and fuller reporting will be available later in the year. Different funding models will be developed for the Subcommittee's consideration.

3. Longwood Resource Consent New Application Update

The application was lodged on 12th January 2020. We expect that by the time of the meeting further information will be to hand and will be made available to the Subcommittee.

The Subcommittee is advised that this is likely to be a protracted process.

4. Five River's Development Proposal Greytown

Details of the proposed water race diversion for the Subcommittee's information and comment are attached. Brief consideration was given to closing this leg however there are several ratepaying users down catchment and other challenging issues associated with this option. It was originally proposed that the developer build over the race which neither officers or the bylaw would not support, hence the diversion option as offered up.

As at the time of reporting some minor details required clarification and are expected to be resolved prior to the committee's meeting.

5. Greytown Urban Stormwater Issues

The mix of stormwater disposal and race continuity through the urban area and a look forward to potential alternatives including a progressive upgrading of hard infrastructure to better cope for urban flooding events.

The water race system at best provides primary protection only for stormwater collection and disposal with several capacity restrictions throughout the area confined in the main to undersized pipes in the road reserves.

A “Greytown Stormwater Management Plan” was developed by Evans Consulting Engineers in 1997 some 20 plus years previously, identified the problems and delivered an improvement programme which then was estimated to cost $1.3M.

Since then only a small number of improvements have been delivered and whilst the plan should be updated to reflect urban growth since and current extensions to the urban area, the principles and inadequacies of the status quo remain the same.

The committee may consider that in depth external reporting, updating and reviewing other options such as diversion etc ought to be explored further. Any such reporting and associated costs should be funded equally by Moroa water race ratepayers and the Greytown Urban Community.

6. Appendices

Appendix 1 – Water Race Land Use 2016 Reporting (to be tabled)

Appendix 2 – Code of Practice (CoP) Moroa and Longwood Water races and Moroa and Longwood Water Race Bylaw

Appendix 3 - Five Rivers Medical Centre WR diversion details

Appendix 4 - Greytown Stormwater Management Plan (Evan Consulting Engineers 1997)

Contact Officer: W H Sloan
Reviewed By: Euan Stitt, Group Manager Operations and Partnerships

Appendix 1 – Water Race Land Use 2016 Reporting (to be tabled)

Code Of Practice (CoP) – Moroa And Longwood Water Races

Revised by Water Race Users Group – 16 October 2017

Status: A CoP is essential if the council is to comply with the Wellington Regional Council's consent to take water. The CoP should be read in conjunction with the Moroa Water Race Bylaw 2007 and Longwood Water Race Bylaw 1936

Best Practical Means: This Code of Practice is based on encouraging users to adopt a "best practical means" of meeting the main purposes of reducing wastage and minimising pollution. What this means is that there may be several ways of addressing a particular problem, and each property owner may select the way which best suits their particular situation. Stopping stock wading in the race, for example, could be met by;

- ☐ fencing off the race and pumping water from the race to stock troughs,
- ☐ locating an electric wire along the centre of the race, allowing stock to access the edge for drinking but not into the race for wading and wallowing,
- ☐ create drinking bays allowing stock to access while minimizing contamination
- ☐ regular cleaning
- ☐ tree planting near the water race with approval (keep access clear on one side for maintenance access.
- ☐ return any eels, fish upstream while cleaning water race.

To assist with determining the best practical means, the Water Race Users Group will provide an advisory service, either through their members or with assistance from the South Wairarapa District Council, depending on the needs of individual race users. Information is available and contact details for members are available on the council website. http://www.swdc.govt.nz/south-wairarapa-water-race-users-group-wrug

Acting in accordance with this code of practice, the race users intend that negative effects and practices associated with the races can be minimised, allowing users and the environment to continue to receive the benefits of access to the race waters.

Purpose: This code of practice is designed to minimise:

- the wastage of water from the Moroa and Longwood Water Races,
- the input of contaminants from various farming and land activities to these races.
- other adverse environmental impacts from the race systems and their associated operation.

Minimising Race Water Contamination:

The Moroa Race water starts at the Waiohine River, and the Longwood race at the Tauherenikau River. Where these waters leave their source rivers, they are of high quality. As the water flows along the races, however, it is progressively degraded to a lower quality.

This is from such causes as:

- **Stock wading** along the races instead of just accessing them from the edge for drinking,
- **Drainage ditches** and pipes that may be directed to the races, adding to the contaminant load the race waters carry,
- **Stock driving races** which pass over the water race and the runoff from these when it rains flowing into the water race,
- **Vehicle and stock crossings** passing through the water race, stirring up sediment and washing debris from tires and vehicle undercarriages into the races
- **General land drainage**, putting contaminants such as; sediment, microbes, and nutrients from fertilizers into the water race,
- **Sediment, weeds or inappropriate herbicides** from race clearing activities,
- **Fertilizer application**, being undertaken too close to the race or too steep banks to the race.
- **Stormwater** from roads and urban areas

While some of these activities are hard to avoid, it is possible to minimise their effect and monitoring of the water races have shown an improvement.

The poor water quality which currently occurs in the lower reaches of many branches of the race can create stock health problems for the users in these areas, and can have a significant impact on the water quality of the rivers and streams that the race branches eventually flow into.

Where the quality of these receiving waters is currently not high, the intention is to gradually improve this quality with. This improvement will not occur straight away, but will happen over a matter of years, if the individual discharges of effluent and contaminated waters to the waterways are reduced. Such district wide improvements are already starting to happen with the South Wairarapa District Council obtaining new consents to upgrade the community wastewater treatment facilities for Greytown, Martinborough, and Featherston, and continual improvements in farming practices.

Minimising Environmental Impacts:

The race systems have been in existence for so long that although man made, they have now become an important part of the natural ecosystem. In particular they are home to various fish life including eels, kokopu, and brown mudfish. During drain cleaning activities, all eels and other fish should be returned to the race up stream of the cleaning activity

Minimising Water Wastage:

The resource consent to take water from the Waiohine River for the Moroa Water Race allows for a maximum take of 500 litres per sec when there is normal flow in the river, reducing to 350 litres per sec during low flow conditions.

Similarly there are reducing water volumes allowed to be taken from the Tauherenikau River for the Longwood Water Race as the river flow drops. For Longwood the maximum take is 240 litres per sec at normal river flow reducing to 100 litres per sec during low flow conditions.

Even with the maximum allowable takes the flows at the ends of the races are minimal and stock can be deprived of water. It is therefore important to make the best use of the water and not to waste any, particularly during low flow conditions in summer.

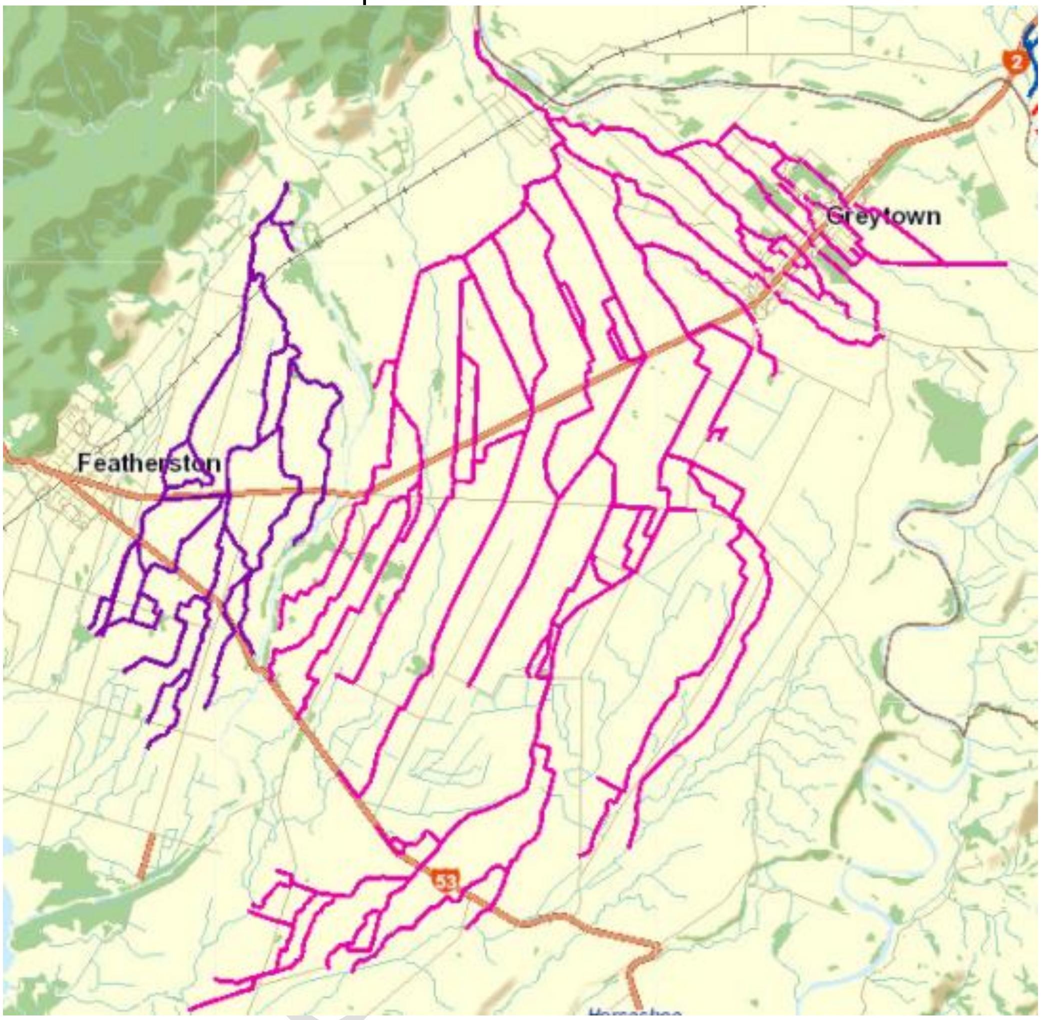
Water wastage can be minimized by the following practices:

- **Not Allowing** the race to become wider and shallower than is necessary to handle the flow and provide stock access. A wider race has a larger surface for evaporation. For every 100km of race length, a doubling of the race width from say 1m to 2m, would provide an extra 500m³ of water loss by evaporation per day on a dry windy day. The Moroa Race is 240km long and the Longwood Race is 31km. A shallow race with low freeboard, (the height between the top of the race bank and the water level), can also allow water to escape onto surrounding land, and may create rather than remove flooding during high rainfall events.
- **Not Allowing** the base and sides of the race to become more permeable for water to seep into the surrounding ground. This could be by cracking, having a gravelly base with permeable soils below, or could be occurring at a moderate rate through the existing soils. Such losses can be reduced by appropriate maintenance and repairs, including lining the race with low permeability soils such as clay or synthetic lining materials.

Advice on cleaning, maintenance and repair of the race to make best use of the water is available from farmers on the Water Race Users group, Council's Contractors, and the South Wairarapa District Council.

http://www.swdc.govt.nz/south-wairarapa-water-race-users-group-wrug

Background: The South Wairarapa District Contains two water race systems that total some 300 km in length, as shown in map below. The Longwood race takes water at some 250 litres per second from the Tauherenikau River; the Moroa race takes 400 litres per second from the Waiohine River.



The Moroa and Longwood races have resource consents which allow them to take water for the race (for stock watering purposes), and discharge contaminants to waterways at the end of the race branches. Although some people who have the races passing through their land do not want them there, surveys of users have shown that most people do want them. The races were created to allow dry land to be farmed. For some users their existence is still vital and without them many farmers could not sustain their current farming practices.

The water-race systems also provide an important service in run-off control and management of stormwater. They have developed their own individual ecosystems and are an established part of the environment.

For those with alternative water sources or who do not farm their land intensively, costs for upkeep of the race systems can seem a burden. However, the fact remains that the best option for the community as a whole, is to keep the races, and the races cannot continue to function within their consented conditions unless all people whose land the race passes through understand and adopt this voluntary code of practice.

Landowner Checklist:

Take a fresh look at your races and fill in the Landowner checklist.

Listed are the most common causes of excessive water wastage and entry of contaminants.

Consider how you could make improvements to reduce wastage and contamination of the water in the race as it passes through your property.

Landowners may choose their own preferred solution or seek assistance. WRUG provide an advisory service, either through their members or with assistance from the South Wairarapa District Council, for both water races.

This Code of Practice provides an opportunity for the farming industry, representatives of which have frequently complained of excessive regulations and controls, to demonstrate their ability to voluntarily adopt common sense and workable solutions to a common problem, and ensure the continuance of the races for the benefit of the community as a whole.

Compliance with the code of practice will also significantly contribute to improving and sustaining the quality of water in the waterways of the South Wairarapa District.

Landowner Checklist:

Property: **Owner:** **Occupier:**

Date: **Number of Race Branches:** **Total Length of Race:**

Minimising Water Wastage:

Problem	Current State on Property	Preferred Fix of Problem	Date Fixed
Race Width (should be as narrow as possible).			
Race Freeboard (side height above water level)			
Water Loss Through Race (assistance can be provided to measure this)			
Water Used for Other Purposes.			

Minimising Race Water Contamination and Other Effects:

Problem	Current State on Property	Preferred Fix of Problem	Date Fixed
Stock wandering in races			
Drainage feeding into race			
Stock races draining into race			
Vehicle crossing in race			
Race cleaning			
Fertilizer application (application to be kept away from race and steep banks leading to race)			

Appendix 3 - Five Rivers Medical Centre WR diversion details

PROJECT:	NEW MEDICAL & HEALTH WELLBEING CENTRE	SHEET:	Indicative Site Plan
CLIENT:	FIVE RIVERS HEALTH CENTRE	STATUS:	CONCEPT DESIGN (REV 8 (DRAFT))
ADDRESS:	BIDWILLS CUTTING ROAD, GREYTOWN		

REVISION SCHEDULE

REF.	DESCRIPTION	DATE

DRAFT

DATE: 7/11/2019

SCALE: 1 : 250 at A1 (HALF SCALE at A3)

SHEET: 11-01

REV:

JOB NO: M1933

SILVERWOOD ARCHITECTS

MASTERTON: 06 378 6332
24 Church Street, Masterton, P.O Box 120
www.silverwoodarchitects.co.nz

WELLINGTON: 04 972 1906
Suite 3, L2, 182 Vivian Street, Wellington
info@silverwoodarchitects.co.nz

Appendix 4 - Greytown Stormwater Management Plan (Evan Consulting Engineers 1997)

SOUTH WAIRARAPA DISTRICT COUNCIL

GREYTOWN STORMWATER

MANAGEMENT PLAN

JUNE 1997

EVANS CONSULTING ENGINEERS
CONSULTING CIVIL & STRUCTURAL ENGINEERS
Ranfurly House - 28 Perry St. Phone (06) 378-7797
P O Box 246 - MASTERTON Fax (06) 378-8050

In conjunction with Montgomery Watson - Hamilton

1.0 INTRODUCTION

1.1 Background

Greytown is situated on an alluvial plain between Waiohine and Ruamahunga Rivers. The town area has no distinctive natural drainage channels and the stormwater reticulation has developed piecemeal around the water race system initially installed for stock water. Records of the drainage system are poor and no reliable plan of the reticulation existed. Previous flooding in Greytown has been mainly caused by overflow from the Waiohine River, but with increased development and the sealing and channelling of roads, local stormwater runoff has become a problem. This problem has been compounded by poor maintenance of the water race channels due to the decreased need and use of these for stock water.

1.2 This investigation was commissioned by the South Wairarapa District Council to achieve the following goals:-

- update the records of the existing stormwater reticulation.
- Evaluate the hydrology of the area and establish design guidelines for storm flows.
- Identify deficiencies in the current reticulation, investigate and recommend solutions.
- Provide cost estimates, identify priorities and provide a timetable for carrying out the work.
- Assess the environment effects of the proposals and apply for the necessary resource consents.

1.3 Newton-King, O'Dea, Gibson and Evans *(now Evans Consulting Engineers)* in conjunction with Royds Consultancy of Hamilton *(now Montgomery Watson)* were appointed to carry out this investigation. Evans Consulting Engineer have been responsible for the site investigation and assessing and compiling the management plan. Montgomery Watson have carried out the assessment of the hydrology and hydraulics. Their hydraulic assessment is included in this management plan as Appendix A.

Greytown. Residents in the upper catchment of Wood Street reported that water appeared to seep out of the ground and although this is possible it is more likely that what was observed was the rainfall grossly exceeding the infiltration rate of the soil and flowing off in sheets.

3.0 CURRENT DRAINAGE & WATER RACE SYSTEM

3.1 The stormwater system in Greytown predominantly uses the water race system. In most cases the water race channels and culverts are sized only to take the water race flows and are inadequate for stormflows. Only race 4 *(see Hydrology Appendix A and the drawings for race numeration and location)* which follows the course of the Papawai Stream has been upgraded and has culverts larger than 450 mm diameter.

3.2 The water races that run through Greytown are part of the Moroa water race system which derives its water from the Waiohine River upstream of the railway. There is a manually operated gate which controls the flow to the water race between the intake and the railway. This gate is regulated by the water race foreman who lives in the council owned house nearby.

3.3 The natural fall of the land is in a southeast direction and generally parallel with Humphries, Wood and Kuratawhiti Streets. The Catchment grade is approximately 6 m in 1000 m and there is little division and difference in level between adjacent catchments. The East/West roads form the Catchment boundaries and the water races generally follow the natural water courses.

In certain areas the races cut across the natural catchments and divert water from one catchment to another. This creates some difficulty in defining the individual Catchment areas above Greytown. In small storms the water races will divert water from one Catchment to another, but in large storms the races become over whelmed and the storm flows follow their natural course. In our assessment we have generally adopted the natural Catchments as the contributing drainage area.

3.4 There is a danger that during a heavy storm the water race system will divert additional flood water from the river into Greytown. At present the water race flow is shut off during a flood so that no additional water is

10 year flood. Overall this flood was greater than a 10 year event and larger than our adopted design standard. A repeat of this storm will still cause some flooding even after the proposed stormwater improvements are implemented.

5.0 THE PROBLEMS

5.1 The stormwater disposal problem in Greytown is such that almost all the stormwater and water race culverts are undersized and inadequate for even moderate flows. Table 1 illustrates the current culvert sizes and those required for the design *(10 year)* flood.

5.2 The only lines that have sizes close to requirement are race 4 *(Wood St)* and the stormwater line up Jellicoe Street and these were over whelmed in the 1994 flood.

5.3 In addition to the inadequate pipe sizes the open channel sections of the network are generally under size for the stormflows, poorly maintained and often constricted at boundary lines. This poor maintenance is largely due to the fact that each property owner is responsible for the maintenance of the channel in their property and many see the water race as an unwanted intrusion on their property. The water race channels cause a security gap in boundary fence lines and often the channels are restricted at this location so that pets, etc. do not escape.

5.4 The water race channels are generally carrying race water when storms occur and this further restricts the capacity of the races to pass stormwater. The normal race flow is probably about $^1/_4$ to $^1/_2$ the ultimate capacity of the race system. During long storms there is time to turn off the race water but this is ineffectual for the short 1 or 2 hour storms that can cause flooding in the town. Where races are not needed, permanently closing off those races and using them solely for stormwater would be beneficial, but would not solve the problem.

5.5 Greytown's flooding problem is mitigated by the fact that the east/west streets run with the ground slope and there are little to no deep depressions. This means that excess stormwater can only pond to road level at the upstream side of the north/south running streets. Once water overflows the road, the water continues down the east/west streets with little flooding of down slope properties. The crowns of most of the streets are approximately 300 to 400 mm above the general ground level. Most house floor levels are above this level and at the ground slope of 0.006 the water level diminishes quickly upslope of road *(i.e. approximately 100 mm every 16m)*.

There is little potential for life threatening flooding and the amount of material damage is limited to floors and coverings. For this reason we believe that a 10 year design period is appropriate for culverts as long as the road overflow paths are properly identified. During future road reconstruction the road crown levels should be decreased where possible, at least at strategic locations.

6.0 OPTIONS & RECOMMENDATIONS

We have addressed the following broad options for upgrading the stormwater system.

- Reducing or diverting the flows arriving from the rural catchment.
- Upgrading the existing water race system to be an effective stormwater disposal system.
- Constructing new independent stormwater systems.

These options are discussed in more detail below.

6.2 DIVERTING FLOWS:

Because Kempton and West Streets run almost parallel with the ground contour there is little scope to divert water to the north or south of Greytown. Any diversion would involve considerable negotiation with property owners through whose properties the diversion passed, plus upgrading exiting water courses downstream of Greytown to take the extra introduced flow. In the south there is no existing watercourse to which flows could be diverted. To the north the Apple Barrel spillway area could be suitable and there may be scope to divert the rural portion of catchments 7 & 8 to this.

6.2.1 There may be options of diverting some of the upper rural catchments to the Waiohine but these are near the upper extremes of the catchments and would provide little to no benefit in the town.

especially when greater than design flood conditions occur.

When piping sections of open channel, secondary overflow paths will need to be identified and provided for.

6.3.3 Good maintenance of the stormwater system is essential. The current system where each property owner maintains their section of race is not effective and prejudicial to good flood control.

We recommend that the Council take over the responsibility for maintaining the race/stormwater system within the town. This will enable full sections of drains to be maintained on a regular basis and this will greatly improve the performance of both the existing and upgraded system.

6.4 NEW STORMWATER DRAINS:

The existing races are evenly spaced throughout the town (approximately 200m centres) and the road drainage has generally been graded to the water races. The 200m spacing is adequate for road drainage and provided the races have adequate capacity no additional lines are needed.

6.4.1 New drainage lines would need to be formed along existing streets and this would necessitate full piping. Because this will generally be more expensive than upgrading existing culverts and channels it is not the recommended option.

6.4.2 Where access makes upgrading a section particularly difficult, or it requires full piping, then laying a new stormwater drain in the street may be more economic. It is likely that in certain circumstances this will be the preferred option particularly if it can be carried out in conjunction with other road or service upgrading works.

6.4.3 Upgrading the capacity of the existing drains will not necessarily fix all the local flooding problem and additional sumps and services lines will likely be needed. These have not been identified in this plan, but our estimates include some new sumps during the upgrade and additional service lines to remedy specific local problems.

Table 2

Greytown Stormwater Management Plan

COST SUMMARY

		PRIORITIES			TOTAL
	1	2	3	4	
Upgrading Existing	$ 142,700	$ 338,330	$ 407,750	$ 136,560	$ 1,025,340
Water race intake					
New structure & gate	$ 8,000				$ 8,000
Automatic control		$ 4,000			$ 4,000
New sumps and Services	$ 36,900	$ 36,900	$ 36,900		$ 110,700
Sub Total	$ 187,600	$ 379,230	$ 444,650	$ 136,560	$ 1,148,040
Engineering 10%	$ 18,760	$ 37,930	$ 44,470	$ 13,660	$ 114,810
Property negotiations 6%	$ 11,260	$ 22,760	$ 26,680	$ 8,200	$ 68,890
TOTALS excl GST	**$ 217,620**	**$ 439,920**	**$ 515,800**	**$ 158,420**	**$ 1,331,740**

8.0 ENVIRONMENTAL IMPACT

8.1 The impact of the scheme will be:-

- Increased peak flows in water courses;
- Disturbance to property and some water courses during construction;
- possible introduction of contaminants into water races.

8.2 The larger sized culverts and channels will increase the peak flows but as all the proposed pipes are still of a moderate size, this increase in flow will be small.

The downstream channels will be upgraded to take these flows.

For large floods (return periods greater than 20 years) or overflows from the Waiohine, the downstream flows will not be altered. Currently these floods overwhelm the town system and most of the flow is over land. Because of this the flows arriving in the downstream catchment are little effected by the towns reticulation.

8.3 The upgrading of the system will involve some disturbance to roads and property. All work in private property will require full discussion with and approval of the owner. As the water in the water races can be temporarily turned off, most work can be carried out in the dry and dirty water flows which may effect downstream fish should not be a problem.

8.4 During upgrading work all discharges will need to be investigated to ensure that only stormwater is being discharged to the system. Where stormwater could become contaminated, controls will need to be instituted to ensure that the water quality always meets the standards required.

<table>
<tr><td rowspan="2">Montgomery Watson
Greytown Hydrology & Hydraulics</td><td>Prepared by:</td><td>Hugh MacMurray</td></tr>
<tr><td>Reviewed by:</td><td>Simon Matthews</td></tr>
<tr><td>Quality Assurance Statement
Project Manager: Hugh MacMurray</td><td>Approved for issue by:</td><td>Project Manager
June 1997- RZMHLH03.doc</td></tr>
</table>

1994 storm, the general extent of surface flooding allowed a qualitative calibration.

The 1994 storm included a 1 hour rainfall of 5 - 10 year ARI at its most intense period. Over the most intense 3 hour period, the rainfall was 67 mm, which is approximately a 50 year ARI event, and over 24 hours the rainfall was 212 mm, which is in excess of a 100 year ARI event. The HYCEMOS model showed discharges of between 0.5 and 3.6 m3/s from the rural catchments. These flows were considered consistent with the degree of surface flooding experienced, taking into account the quite small capacity of most of the water culverts. The HYCEMOS model results showed that in the 1994 storm, most of the flooding was due to the rural catchment discharges.

The design rainfalls were taken from the HIRDS software developed by NIWA. The HIRDS values were checked against the rainfall frequency diagram for 2 hour storm duration for the Phelps rain gauge provided by Wellington Regional Council staff, and found to be in good agreement.

For the 10 year and 50 year design events, it was assumed that a 3 hour storm on the rural catchment would coincide with a 1 hour storm on the urban catchment. The 1 hour duration has been found worst in other comparable urban stormwater investigations, and has been assumed to be worst for the urban area in this case also. For the rural area the HYCEMOS model showed that worst duration was 2 or 3 hours depending on the saturated hydraulic conductivity. Longer storms of the same ARI have rather low peak runoff rates. The probability of the assumed composite storm of 1 and 3 hour durations is debatable, particularly since the assumption also includes spatial extent. The average recurrence interval of the composite storm must be greater than the nominal 10 or 50 years, and therefore the results are somewhat conservative.

The routing effect of the individual subcatchment flows is automatically calculated by HYCEMOS. The effect is most important for the rural subcatchments, with their long distance from the top to the catchment outlet. Concerning routing effects in the town, the distance between the upslope and the downslope side of the town is relatively small. Further, the flood detention available within the town is relatively small, being mainly due to

2. Methodology

Rainfall depth duration frequency information for Greytown was obtained from the HIRDS software produced by NIWA. The resulting rainfalls were used as input to the rainfall runoff model HYCEMOS-U, also produced by NIWA. The total catchment area was divided into 8 rural and 34 urban subcatchments, so that a discharge at the upslope side of each of the water race culverts could be calculated.

The subcatchments have been chosen using the wet weather directions of flow in the cross slope street gutters obtained by ECE and by taking the crowns of the cross slope streets as catchment dividing ridges. The rural catchments were chosen using ridges identified on the ground, from aerial photos, and from local knowledge about flow paths (observed during the 1994 storm).

The HYCEMOS model allows two hillslopes contributing to a single gutter. This allows urban subcatchments to be divided into separate pervious and impervious hillslopes, with the impervious hillslopes representing the house roofs, and paved areas.

If the model is built in this way, the impervious area runoff reaches the subcatchment outlet without passing over pervious ground. This is the case in many New Zealand areas, where roof runoff is piped direct to the street gutter.

However in Greytown normal practice is to send roof runoff to soak pits. Therefore a "speckled slope" model has been chosen, with pervious and impervious areas on the same hillslope, one of whose describing parameters is the percentage of impervious area. In this kind of model, all the runoff passes over pervious area, and opportunity for infiltration is therefore greater.

Inspection of the 1:5000 aerial photos, indicated that the impervious area percentage in the residential areas of Greytown was similar to that of an area previously studied in Gisborne, for which MWNZ has 1:1000 photos on hand. In both cases the section sizes are relatively large. The impervious area of the Gisborne area had been quantified by planimetering sample areas. Based on this data, a value of 25 % has been selected to

14.4 mm/h respectively for the urban areas. The hillslope Manning's n values refer to overland flow. The gutter Manning's n values for the urban and rural catchments were set at 0.02 and 0.05 respectively. These gutter resistance parameters refer to flow in defined channels, such as water races in the rural catchments, or street gutters in the urban catchments. These selections were based on evidence and published typical values as described below under November 1994 storm.

3. Subcatchments

The subcatchment have been named according to the cross slope street on their down slope side, and according to the water race to which they contribute. Thus the subcatchment MAIN6 for example contributes flow to the culvert across Main Street on water race 6.

"Lower Street" refers to the street perpendicular to McMaster Street and Jellicoe Street at the downslope end of Mahupuku Street. "Lowest Street" is in fact not a street, but may be interpreted as the bank of the water race which runs perpendicular to McMaster Street and Jellicoe Street at their downslope ends.

The saturated hydraulic conductivity selected for the rural catchments was 14.4 mm/hour. According to Bowler (The Drainage of Wet Soils, 1980) this value would apply to soils of moderately slow infiltration, such as silty clay loam. The Manning's n for overland flow selected was 0.2. This is high by open channel standards, but is in the range expected for flow overland at small depths through pasture.

Using these parameters the rural catchment discharges ranged between 0.5 and 3.6 m3/s, as may be read from Table 1. These discharges were about 40% of the rainfall rate averaged over the worst 3 hours of the 1994 storm (meaning 40% of 67 mm per 3 hours, multiplied by the catchment area). This 40% may be interpreted as a Runoff Coefficient of 0.40, and is a value which could be expected on a "flat" rural catchment in a storm of about 50 years ARI.

The Regional Flood Estimation Method (NWASCO Publication No. 20) was applied to the rural catchments. This gave discharges between 1.38 and 4.34 m3/s for the 100 year ARI flood discharges. These are considered too high, as they are based on river data, which is influenced by considerable areas of hill catchment.

On a recent study undertaken by MWNZ of the flat Raupare stream catchment in Hawkes Bay, it was similarly concluded that the RFE method results, being based on data for the region's major rivers, were not directly applicable to such a catchment on the alluvial plain. A similar approach was taken in that case, of hydrological modelling supported by anecdotal evidence of typical flood levels.

In the pervious areas of the urban subcatchments the saturated hydraulic conductivity has been taken as 14.4 mm/hour, and Manning's n as 0.35. The higher roughness compared with the model of the rural areas reflects the complexity and density of ground cover in the typical urban environment.

Greytown soils overlay alluvial gravel and sand, and there may be areas of high infiltration. However the 1994 storm discharges produced by the model are of the necessary order to cause the degree of surface flooding experienced, and any greater infiltration in the model would lead to flows which would not cause flooding as experienced. Further anecdotal evidence suggests that in

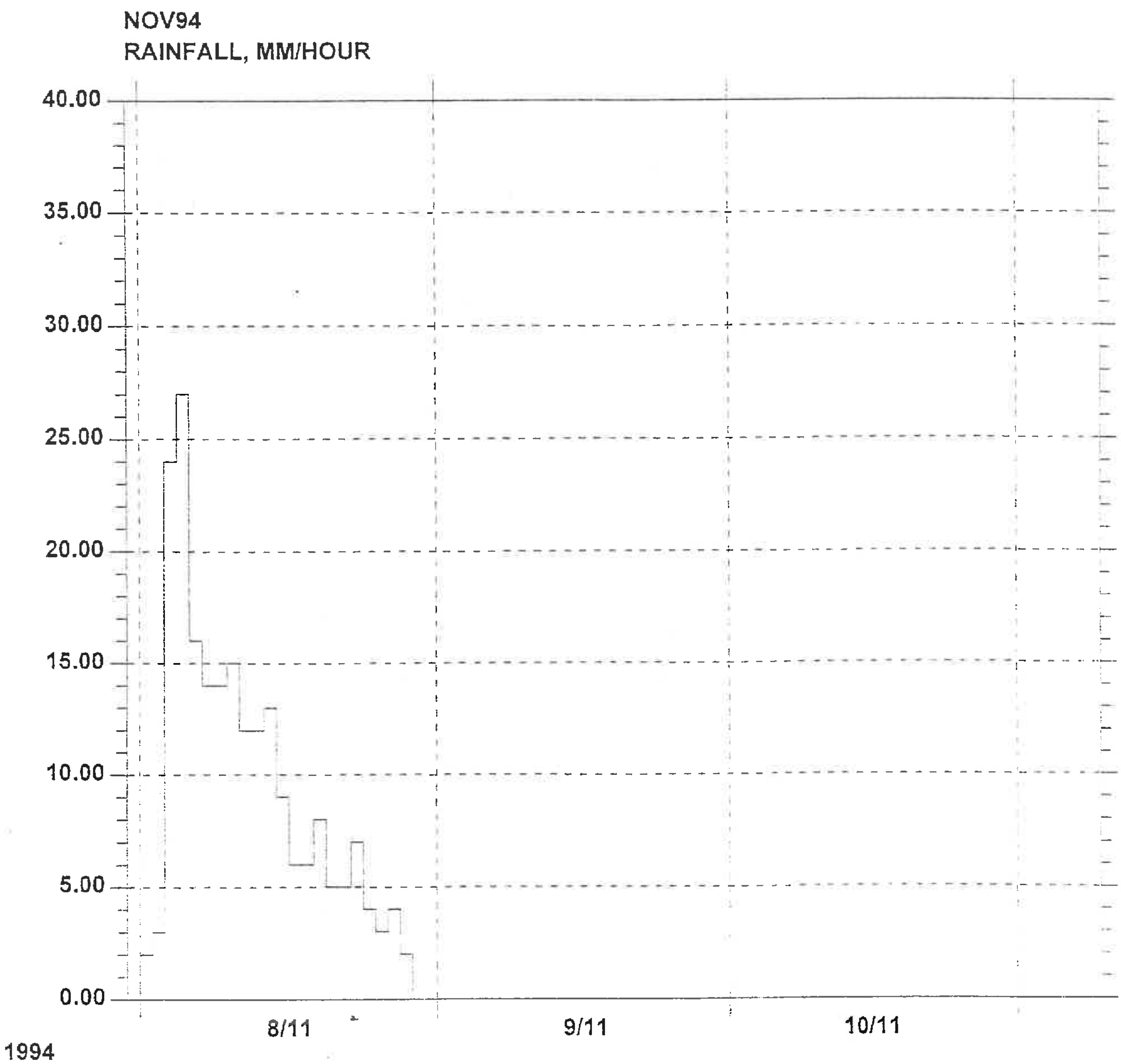

NOV94
RAINFALL, MM/HOUR
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
8/11
9/11
10/11
1994

Table 2a

Greytown stormwater management plan

10 year ARI design event: storm durations 1 hour urban, 3 hour rural

Discharges in l/s, pipe sizes in mm
10y1h08.xls

Catchment	Race1			Race 2			Race3		
	HYCEMOS	Sum	Pipe reqd.	HYCEMOS	Sum	Pipe reqd.	HYCEMOS	Sum	Pipe reqd.
Rural	450	450		150	150		150	150	
Kempton	83	533	675	0	150	450	155	305	525
West	110	643	675	100	250	525	140	445	600
Main	115	758	750	115	365	600	120	565	675
East	115	873	825	125	490	600	95	660	675
Reading	0	873		0	490		0	660	
Lower	0	873		0	490		0	660	
Lowest	0	873		0	490		0	660	

Catchment	Race 4			Race 5			Race 6		
	HYCEMOS	Sum	Pipe reqd.	HYCEMOS	Sum	Pipe reqd.	HYCEMOS	Sum	Pipe reqd.
Rural	960	960		360	360		360	360	
Kempton	0	960	825	0	360		0	360	
West	59	1019	825	71	431	600	95	455	600
Main	78	1097	825	71	502	675	480	935	825
East	90	1187	900	68	570	675	180	1115	825
Reading	100	1287	900	61	631	675	180	1295	900
Lower	0	1287		0	631		58	1353	900
Lowest	0	1287		0	631		90	1443	900

Catchment	Race 6A			Race 7			Race 8		
	HYCEMOS	Sum	Pipe reqd.	HYCEMOS	Sum	Pipe reqd.	HYCEMOS	Sum	Pipe reqd.
Rural	0	0		210	210		210	210	
Kempton	0	0		0	210		0	210	
West	0	0		70	280	525	64	274	525
Main	0	0		68	348	600	190	464	600
East	0	0		65	413	600	190	654	675
Reading	0	0		65	478	600	195	849	750
Lower	90	90	375	0	478		0	849	
Lowest	0	90		0	478		0	849	

pipe. This assessment of pipe sizes assumes that pipes will be aligned without sharp bends.

7. Design storm 50 year ARI

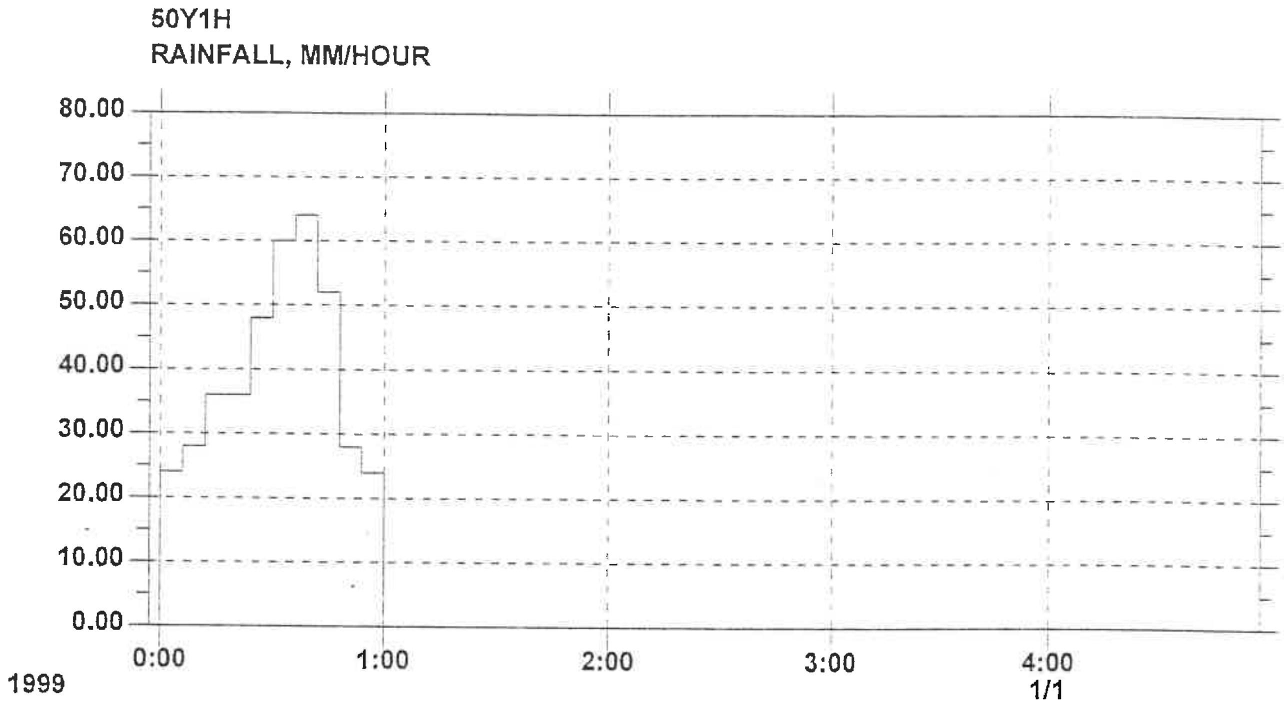
The 50 year ARI design storm has 1 hour duration on the urban areas and 3 hour duration on the rural areas, as for the 10 year ARI scenario. The NIWA temporal distribution has again been applied, and the hyetographs are given as Figure 3.

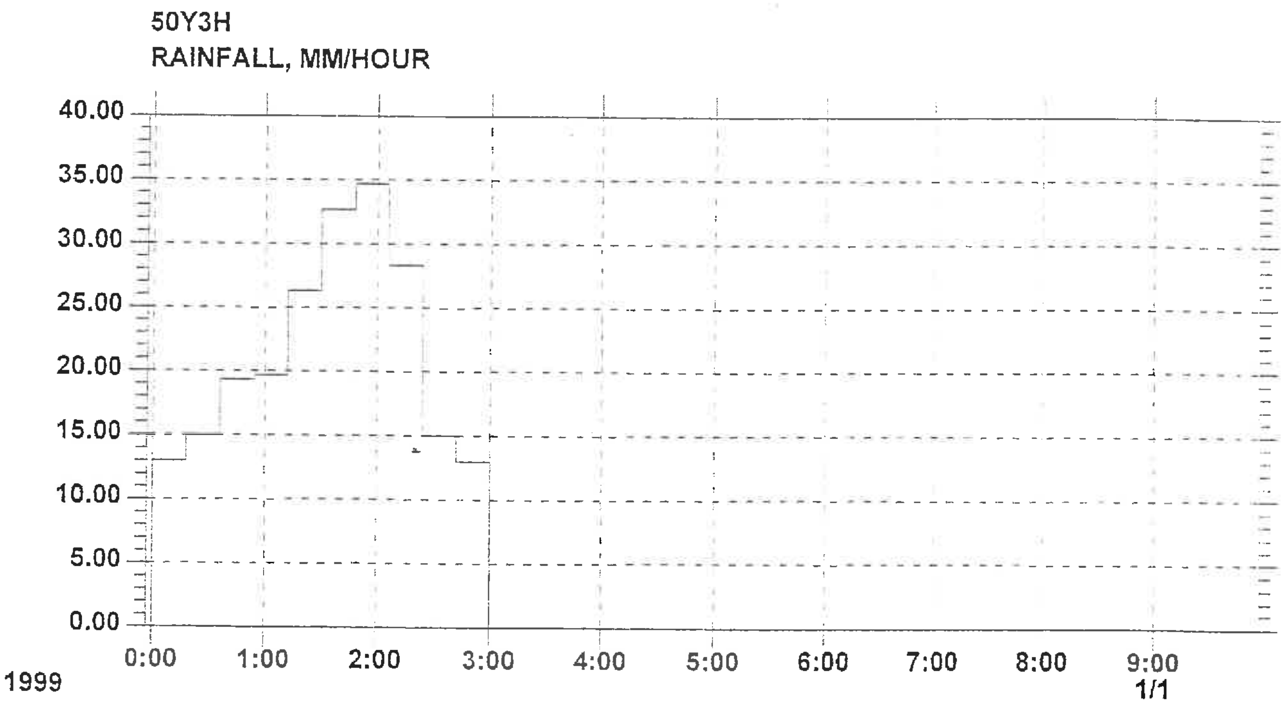
The spreadsheet shows the peak flows from each subcatchment and the sum of the peaks along the water races. Pipe sizes have not been estimated as it is accepted that in the 50 year event the piped system will have insufficient capacity, and the secondary flow paths will carry a substantial proportion of the discharge (which is standard practice in New Zealand urban areas).

The rural catchment peak discharges are approximately the same as those given by the simulation of the November 1994 storm, corresponding to runoff coefficients of about 0.4. The calculated discharges at the downstream ends of the water races are in most cases of the same order as those assessed for the November 1994 storm. Widespread surface flooding must be expected, with water levels immediately upstream of the cross slope streets controlled by their crown levels.

8. Conclusions

Design discharges at the each of the culverts on the eight main water races have been estimated for events of 10 year and 50 year ARI, using a kinematic wave hydrological model. The model has been shown to produce results consistent with observed flooding in the storm of November 1994. Pipe sizes have been estimated for the 10 year design event.

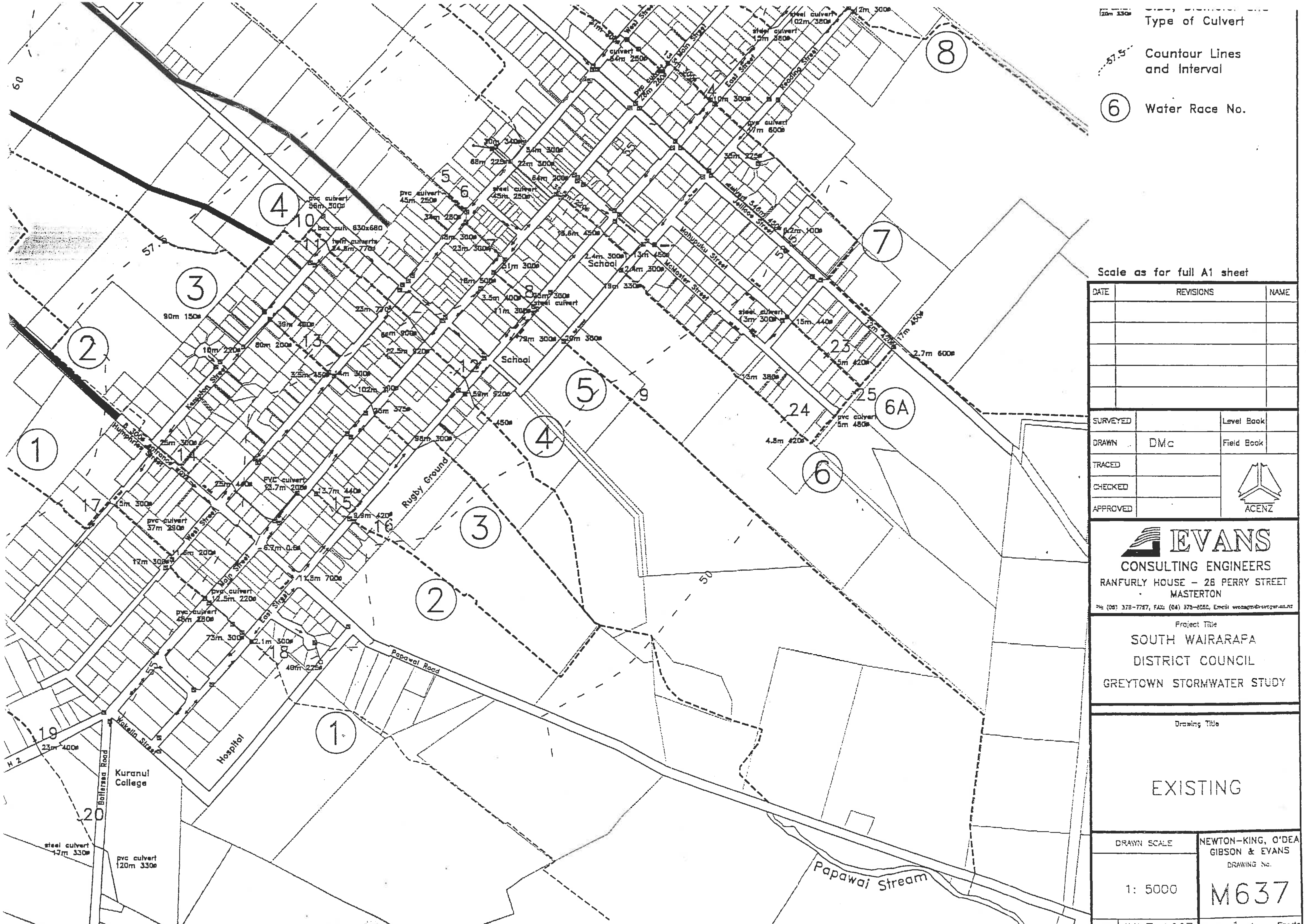

50Y1H
RAINFALL, MM/HOUR
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0:00
1:00
2:00
3:00
4:00
1/1
1999

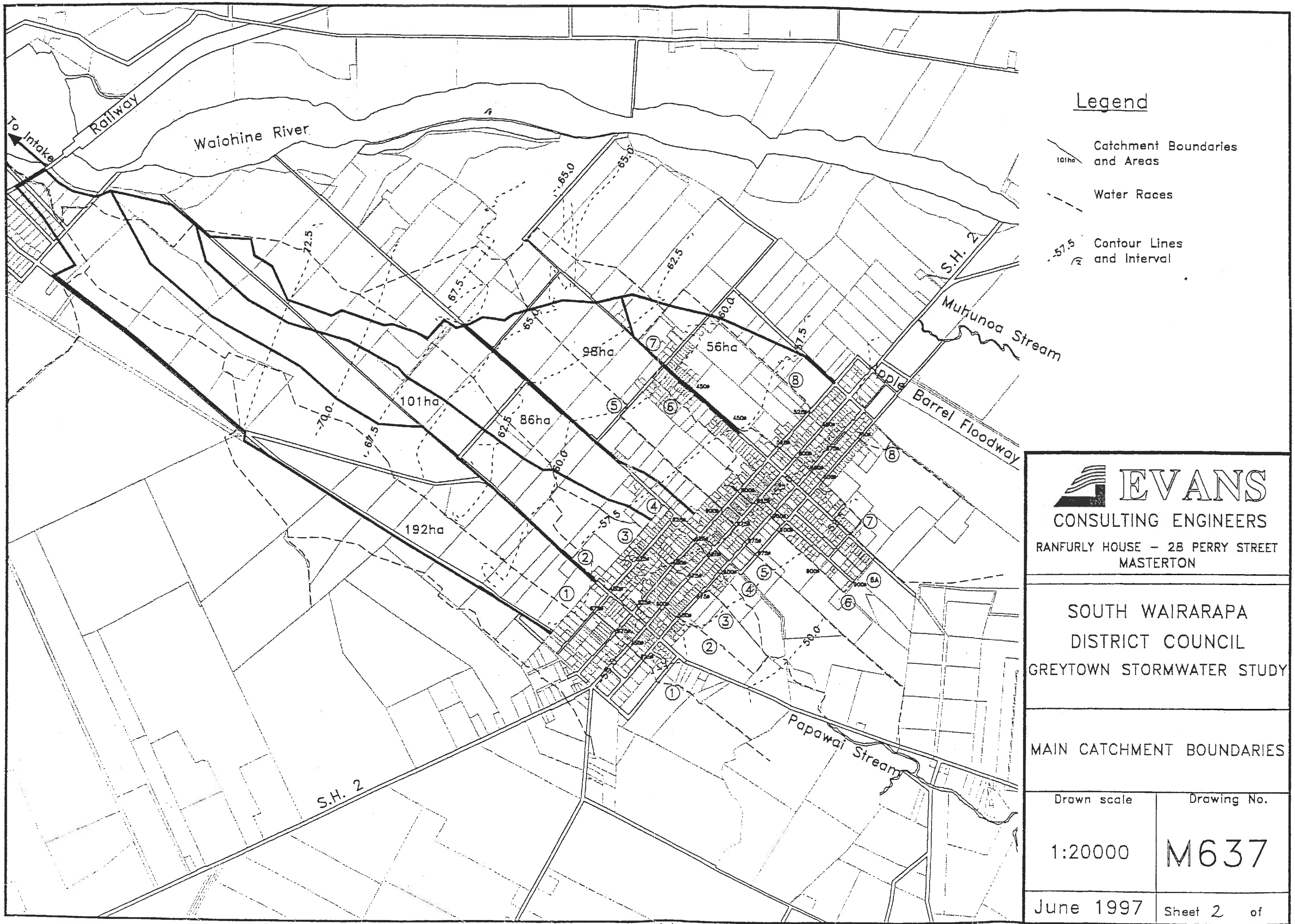

50Y3H
RAINFALL, MM/HOUR
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
1/1
1999

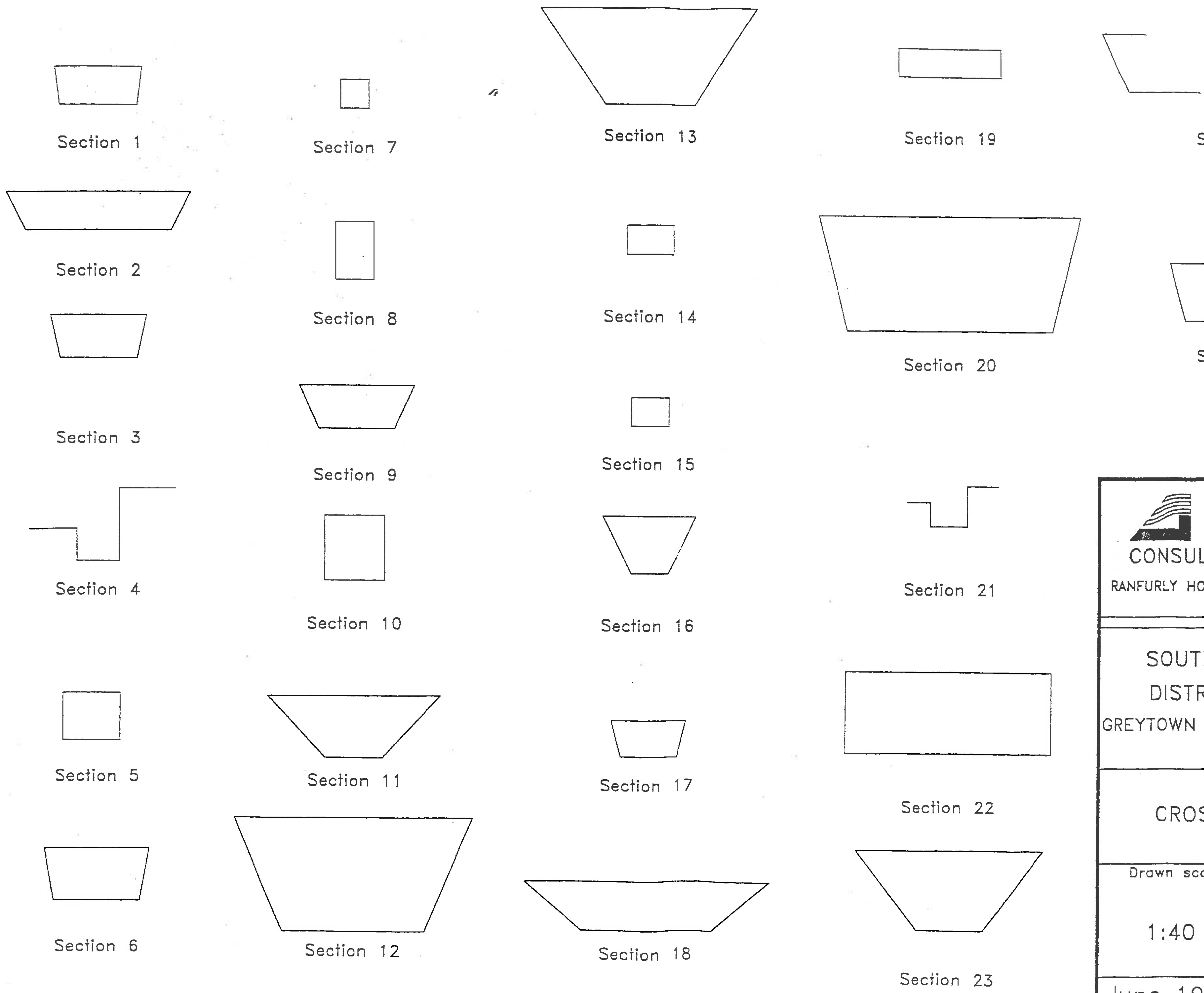
Catchment	Area (km²)	Gutter Parameters				Slope parameters		
		Length (km)	Slope	Width (m)	n	Slope	Length (km)	n
West8	0.010	0.13	0.003	3	0.02	0.006	0.05	0.35
Main8	0.058	0.37	"	"	"	"	0.1	"
East8	0.058	0.4	"	"	"	"	0.1	"
Reading8	0.045	0.24	"	"	"	"	0.075	"
Rural1	0.8	3.5	0.006	5	0.05	0.003	0.2	0.2
Rural2	0.2	1.1	"	"	"	"	0.2	"
Rural3	0.19	1.1	"	"	"	"	0.2	"
Rural4	1.48	3.25	"	"	"	"	0.2	"
Rural5	0.49	1.5	"	"	"	"	0.2	"
Rural6	0.49	1.5	"	"	"	"	0.2	"
Rural7	0.28	1.1	"	"	"	"	0.2	"
Rural8	0.28	1.1	"	"	"	"	0.2	"

HYCEMOS-U simulation files

Catchment data: .hyc	Boundary data: .bsf	Output database	Simulation time/time step (h/min)	Result Spreadsheet
grss9	h10y1&3h	10y1&3s	6/3	10y1h08.xls
grss9	h50y1&3h	50y1&3s	6/3	50y1h03.xls
grss9e	hnov94	nov94s	24/15	94nov05.xls


Type of Culvert
Countour Lines and Interval
Water Race No.
Scale as for full A1 sheet
DATE
REVISIONS
NAME
SURVEYED
Level Book
DRAWN
DMc
Field Book
TRACED
CHECKED
APPROVED
ACENZ
EVANS
CONSULTING ENGINEERS
RANFURLY HOUSE – 26 PERRY STREET
MASTERTON
Project Title
SOUTH WAIRARAPA
DISTRICT COUNCIL
GREYTOWN STORMWATER STUDY
Drawing Title
EXISTING
DRAWN SCALE
1: 5000
NEWTON-KING, O'DEA
GIBSON & EVANS
DRAWING No.
M637
DATE JUNE 1997
Sheet 1 of Sheets
Papawai Road
Papawai Stream
Rugby Ground
School
Hospital
Kuranui College
Main Street
West Street
East Street
Jellicoe Street
McMaster Street
Mahupuku Street
Kempton Street
Humphries Street
Wakelin Street
Battersea Road
Reading Street


Legend
Catchment Boundaries and Areas
101ha
Water Races
Contour Lines and Interval
57.5
Railway
To Intake
Waiohine River
S.H. 2
Muhunoa Stream
Apple Barrel Floodway
Papawai Stream
192ha
101ha
86ha
98ha
56ha
72.5
70.0
67.5
65.0
62.5
60.0
57.5
50.0
EVANS
CONSULTING ENGINEERS
RANFURLY HOUSE - 28 PERRY STREET
MASTERTON
SOUTH WAIRARAPA
DISTRICT COUNCIL
GREYTOWN STORMWATER STUDY
MAIN CATCHMENT BOUNDARIES
Drawn scale
1:20000
Drawing No.
M637
June 1997
Sheet 2 of

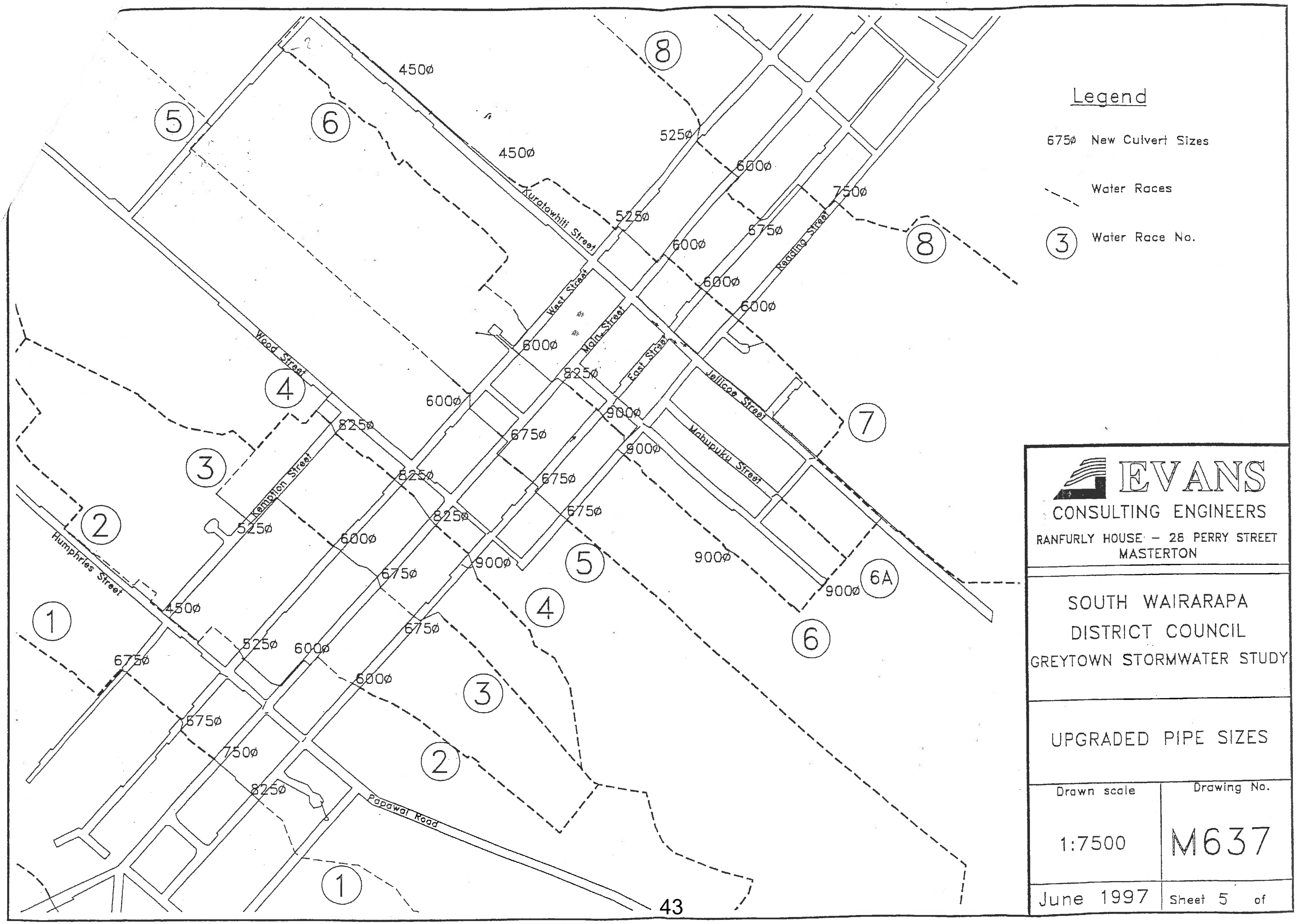


EVANS
CONSULTING ENGINEERS
RANFURLY HOUSE – 28 PERRY STREET
MASTERTON

SOUTH WAIRARAPA
DISTRICT COUNCIL
GREYTOWN STORMWATER STUDY

CROSS SECTIONS

Drawn scale	Drawing No.
1:40	M637
June 1997	Sheet 4 of


Legend
675ø New Culvert Sizes
Water Races
3 Water Race No.
EVANS
CONSULTING ENGINEERS
RANFURLY HOUSE – 28 PERRY STREET
MASTERTON
SOUTH WAIRARAPA
DISTRICT COUNCIL
GREYTOWN STORMWATER STUDY
UPGRADED PIPE SIZES
Drawn scale
1:7500
Drawing No.
M637
June 1997
Sheet 5 of
Kuratawhiti Street
West Street
Main Street
East Street
Jellicoe Street
Mahupuku Street
Reading Street
Wood Street
Kempton Street
Humphries Street
Papawai Road
450ø
525ø
600ø
675ø
750ø
825ø
900ø
1
2
3
4
5
6
6A
7
8