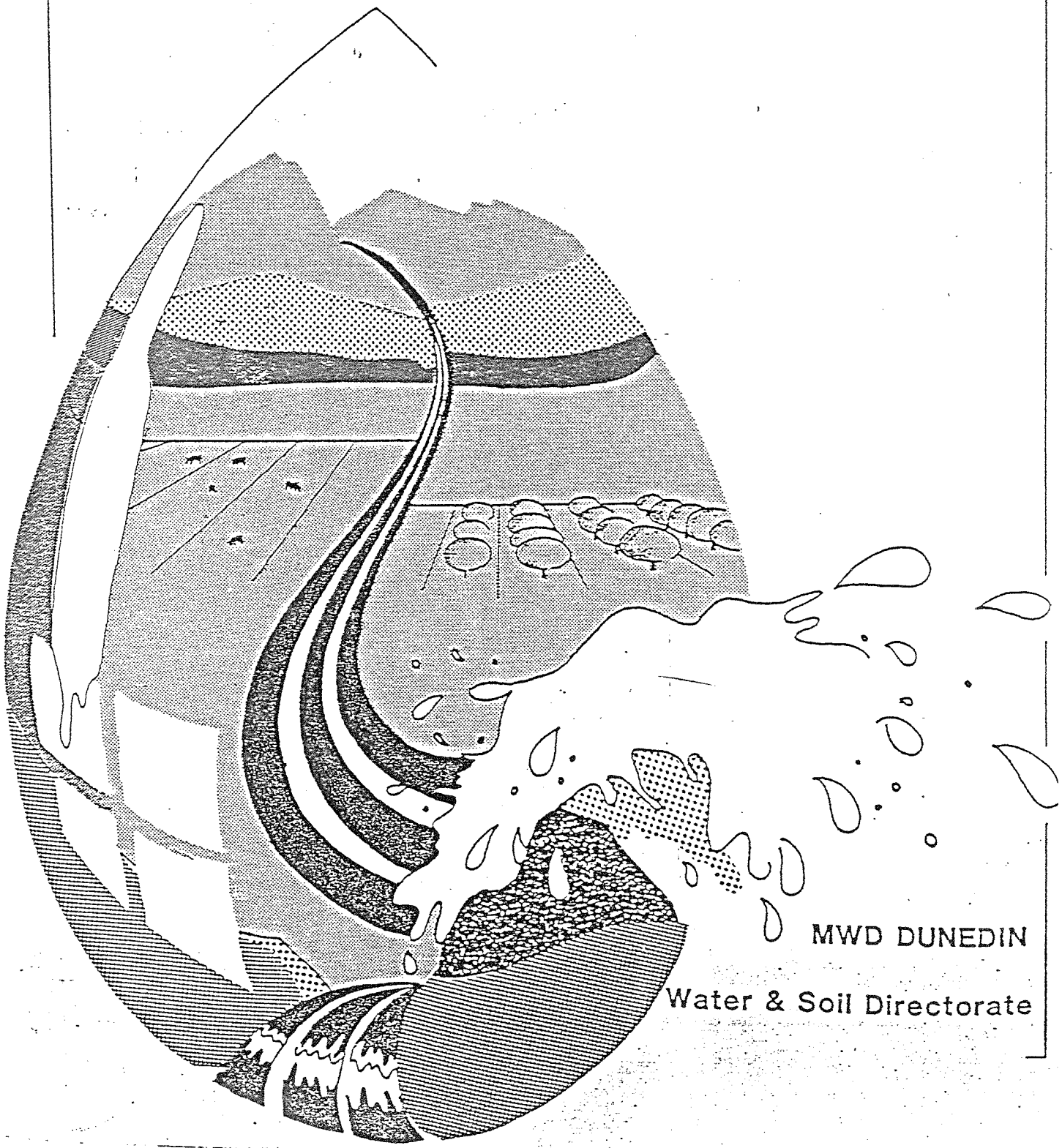
Refurbishment of Old Central Otago Irrigation Schemes

Manuherikia Scheme Report

FEASIBILITY



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Water & Soil Directorate

MANUHERIKIA IRRIGATION SCHEME FEASIBILITY REPORT

January 26th, 1988

Water and Soil Directorate
Ministry of Works and Development
DUNEDIN

Preface

This feasibility report forms part of a four phase refurbishment programme for the refurbishment of 13 old Central Otago irrigation schemes. The following programme was initiated late in 1984:

Phase 1 Inventory of scheme works

Phase 2 Technical assessment of schemes for funding and programming for refurbishment (completed March 1986)

Phase 3 Feasibility reporting on individual refurbishment proposals

Phase 4 Design and construction of the works

There are two parts to this report:

Part I focuses specifically on the refurbishment of the Manuherikia Irrigation Scheme;

Part II defines the refurbishment concept, traverses the options considered and summarises the recommendations for all the schemes in the refurbishment package.

The investigations up to the completion of these reports have been funded by government. The feasibility reports have been prepared as support to decisions on the future of individual schemes.

This report is not a statement of government or National Water and Soil Conservation Authority policy.

All estimates of cost that appear in this report are based on the Ministry of Works and Development Construction Cost Index at 30th September 1986 of 2650. The estimates DO NOT include any allowance for Goods and Services Tax (GST).

Acknowledgements

Part I of this report was prepared by Philip Walker of the Water and Soil Directorate, Dunedin, with invaluable inputs from the District Design staff and the staff of the Alexandra Residency irrigation section. Specific parts of the report background were contributed by various people as follows:

Secondary Works

John Anderson and his operating staff in Alexandra provided the estimates - these were collated by Mark Hely of the Water and Soil Directorate.

Primary Works

Peter Mathewson and his staff of the Dunedin District Design team provided civil engineering advice and estimates.

Post Refurbishment Operations

Gary Dent of Water and Soil Directorate modified and collated estimates to fit two possible future operating modes, with background provided by Dale Patterson of Alexandra.

Report production and computer compilation of the reports and estimates ran very smoothly to the credit of Stephen Aldridge and Murray Doak of Water and Soil Directorate. Mark Hely's detailed knowledge of the schemes and technical assessments of problems and Philip Walker's input into the detailed briefing were important contributions to the exercise.

Part II: Summary of Feasibility Studies was prepared by Gary Dent.

Special acknowledgement is accorded to Graeme Martin for his guidance throughout and in particular his comments on the first draft of the reports.

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CHAPTER 1: GENERAL SCHEME DESCRIPTION

1.1 BACKGROUND

The Manuherikia Irrigation Scheme, situated immediately north of Alexandra and east of Clyde, consists of the Main Race system drawing water from the Manuherikia River and the Borough Race system supplied by Chatto Creek. The area commanded by the scheme is 3190 ha of which 1854 ha is under irrigation agreement to 158 properties in the 1986/87 irrigation season.

1.1.1 Scheme topography

The scheme is bounded by the Clutha and Manuherikia Rivers in the southwest and southeast respectively and by the Dunstan Mountains in the north. This is an area of mixed topography. High terraces have been formed to the west by the Clutha River. In the north, fans formed by streams from the lower Dunstan Mountains have formed fertile soils while in the extreme north near Chatto Creek there are rolling hills.

1.1.2 Scheme layout

Falls Dam on the Manuherikia River approximately 40 km upstream of the Manuherikia main intake provides storage for the Omakau, Manuherikia and Galloway schemes. It is used at times of low flow to augment the natural river flows.

The Manuherikia Main Race draws water from the Manuherikia River at the Ophir Gorge. The flow is carried through an elaborate series of headworks to the Chatto Creek syphon. From Chatto Creek the main race travels to Springvale and then moves in a westerly direction towards Clyde township. Numerous distributary races extend from the Main Race in a southwest direction.

The Borough Race abstracts flow from Chatto Creek and travels in a southwest direction to irrigate the terrace above the Manuherikia River. The Borough Race is able to utilise water which has been bywashed from the Manuherikia Main Race resulting in more water being sold from the Borough Race than is put in at Chatto Creek.

The race systems are shown on the scheme map included with this report.

1.1.3 Brief history

This irrigation scheme was the first in Central Otago that was not founded on the remains of mining enterprise, in that the main race system was entirely new. The scheme does, however incorporate some mining races and early water rights.

Construction of the scheme commenced in 1917 and was substantially completed in 1922, deliveries of water being commenced that year.

The Borough Race was constructed in 1864 as a mining race and was acquired by Alexandra Borough for a town supply. In 1922 it was acquired from the Borough by the Crown in exchange for a delivery of 57 litres per second at the Borough boundary.

In 1936/37 a troublesome section of concrete lined race in the Ophir Gorge headworks was replaced by a 1580m long tunnel.

1.1.4 Scope of the scheme

Approximately 2.5 cumecs can be supplied from the schemes two intakes. This is supplemented at times of low flow by the 10.4 million cubic metres of storage behind Falls Dam, which is a resource shared between Omakau, Manuherikia and Galloway irrigation schemes. Water is available

to the main race from the Manuherikia River intake and to the Borough Race from main race bywashes.

At present, there are 158 agreements for taking water for irrigation on an area basis. There are also 72 agreements for taking water by means of a pipe supply.

The irrigated areas on individual properties are generally very small. There are approximately 110 properties with less than 10 hectares in their irrigation agreement. This is due to the large number of small properties around Alexandra and to the number of orchards in the scheme area.

The annual water quota is a variable depth of between 760 mm and 914mm over the irrigable area with extra water being made available as flows allow. The average water usage over the eight seasons from 1975 to 1983 was 1204mm (minimum 937mm in 1978/79 and the maximum 1351 in 1977/78).

The irrigation season begins on 15 September and ends on 30 April the following year. The early season demand is primarily for horticultural frost protection while pastoralists begin irrigation generally around late October to early November.

The scheme is operated by three racemen. They supply water to the farmers usually on demand except when stored water is being used at which time water is rostered. The area around Clyde and Alexandra is rostered throughout the year.

1.2 WATER RESOURCE

The scheme draws water from two main sources:

a. Manuherikia River

The Manuherikia River carries runoff from the St. Bathans, Hawkdun, Ida Valley and Raggedy Ridge Ranges in a southward direction to join the Clutha River at Alexandra. The river provides water for the Omakau, Manuherikia and Galloway irrigation schemes. Low summer flows in the river are supplemented by use of 10.4 million cubic metres of storage in Falls Dam reservoir. Storage is used from around the end of December until it runs out, or the end of the irrigation season. In a particularly dry year storage can be exhausted in as little as six weeks.

The Manuherikia scheme draws up to 2.36 cumecs from the river at the Ophir Gorge. The water is carried by the Main Race as far as Clyde township and can also bywash into the main Borough Race at several places.

b. Chatto Creek

Chatto Creek has its catchment on the south eastern slopes of the Dunstan mountains. Runoff is carried in a south easterly direction to join the Manuherikia River.

The Borough Race extracts up to 0.17 cumecs from an inlet on Chatto Creek approximately 6 km upstream of its confluence with the Manuherikia River. From here it is carried below the Main Race to the outskirts of Alexandra.

In addition to these two main sources of water there are six minor sources from creeks running into the race system. The maximum inflow from these sources varies between 0.03 cumecs and 0.14 cumecs.

1.2.1 Water rights

Eight Crown water rights are held for the scheme for a total of 3.62 cumecs. The two major rights are for 2.63 cumecs from the Manuherikia River and 0.28 cumecs from Chatto Creek.

1.2.2 Future water sources

With the filling of Lake Dunstan behind the Clyde Dam another possible gravity water source will be created. At this stage there are no plans to develop this resource for the scheme.

1.2.3 Water resource users outside the scheme

There are a number of water users who abstract water directly from the Manuherikia River. As the Crown currently hold the dominant rights on the river, users outside the scheme suffer shortages during periods of low river flow.

1.3 SOILS

Reference 7 should be consulted for detailed information.

The principal landforms are fans and high and low terraces. In general the best soils are already irrigated and most are already producing stonefruit.

a. High terraces

The high terrace soils have a limited potential for irrigation due to their shallow nature and the existence of a clay pan. To successfully irrigate these soils requires small irrigations at frequent intervals. Over irrigation results in waterlogging.

There are a few high terrace areas with deeper soils where irrigation can be successful.

b. Fans

Almost all fan soils are irrigated at present. Ripponvale and Blackmans soil sets are ideally suited to production with almost all areas of these soils near Alexandra under orchard. Springvale soils in the region north of Springvale have an underlying clay pan which restricts root growth thus making the soils generally unsuitable for horticulture.

c. Low terraces

Low terrace soils from Alexandra to Clyde are mainly shallow stony Molyneux soils, very little of which is irrigated. Under irrigation some of the deeper soils could support horticulture.

Water holding capacities of the soils range from below 20mm up to 75mm with the average range being around 25-50mm. This indicates that small, frequent irrigations is the most efficient means of applying water in this region.

d. Dispersive soils

Some areas within the Manuherikia scheme are known to form "swallow holes". These are localised depressions caused by soil dispersion in the presence of water. Becks soils have been identified in the Maniototo Basin as being particularly prone to this and those in the Manuherikia Valley may also cause problems under irrigation.

1.4 LAND USE

Land use on the Manuherikia scheme is limited to semi-intensive pastoral farming, horticulture, vegetable production, cropping and grazing horses.

1.4.1 Pastoral

Most of the area irrigated from the scheme, as with the rest of Central Otago, is used for sheep production.

Pastoral farms within the Manuherikia scheme area have, on average, only 37% of the total area irrigated. This is often used for winter feed production for stock on higher level hill paddocks.

Farming potential with irrigation is in the range of 12-15 stock units per hectare. Actual stocking rates are however often lower than this because the lack of a reliable water supply in dry years has reduced farmer confidence. Production is good and gives better than average returns for sheep. This result is dependent on reliable winter feed production hence irrigation is important.

Cattle production is rare. Some farmers in recent times have diversified to deer and goats.

1.4.2 Cropping

Approximately 5% of the irrigated area is used for cereal crops with oats and barley being the principal crops grown. The reason for the lack of cropping may be that the most suitable soils are developed for horticulture.

1.4.3 Horticulture

Approximately 10% of the irrigated area is developed for horticulture at this stage. There is potential for further development but the risk of failure of water supply may have a stifling effect. This is evident in lack of replacement of ageing orchards.

The common fruits grown are apricots, nectarines, cherries and apples giving yields of up to 18 t/ha for stonefruit, 10 t/ha for cherries and 78 t/ha for apples.

1.4.4 Irrigation methods

The predominant methods of irrigation for pastoral use are wild flooding and contour dyking. Borderdyking has been established on about 25% of irrigated land and would appear to be viable on the high terraces. However, the shallow clay pan prohibits this form of development. Mobile spray irrigators have not generally found favour with farmers on the scheme.

Horticultural irrigation is generally a combination of borderdyke and fixed spray which also provides frost fighting capability. Some orchardists are arranged into syndicates which divert and draw from a common storage reservoir.

1.4.5 Future development

There is a very real possibility for horticultural development within the present scheme area. According to the Ministry of Agriculture and Fisheries (MAF) up to 750 ha is suitable for orcharding and only about 200 ha is presently used. This would depend on reliable water supply and the provision of on-orchard storage.

1.4.6 Land use changes

Over recent years subdivision around Alexandra and Clyde has given rise to a number of four hectare and smaller properties. Some of these properties use the scheme for domestic (and occasionally irrigation) water supply while others are on urban reticulation schemes. Those on scheme supply place a high demand on the racemen in relation to their unit area.

CHAPTER 2: OFF FARM SYSTEM

2.1 GENERAL DESCRIPTION

The off farm systems of the scheme are made up of 72.3 km of races, 35.6 km on the Main Race and 43.8 km of distributary races. Within these races are 2.8 km of syphons and two tunnels totalling 2.05 km.

Structures within the race system total 867 at 691 sites, of which 229 are access crossings, 254 are turnouts, 111 are pipelines/syphons and the remaining 273 are made up of intakes, bywashes, drops and other miscellaneous structures.

A list of race lengths and capacities can be found in Appendix A and a map of the scheme can be found at the beginning of this report.

2.2 LEVEL OF SERVICE

With refurbishment

With refurbishment the irrigators can expect a continued reliable supply at currently accepted flows or the original capacities. The reliability of supply will be constrained by the availability of water in the summer months.

Without refurbishment

Without refurbishment silting up of races, slips and structural failure will disable the scheme. It will only be a matter of time before headworks failure stops water supply to the Main Race. There have been major outages in the headworks in recent years which have taken significant time, funds and resources to overcome and there is little doubt that these will happen again.

The Borough Race has a more hopeful future. However races will silt up and the extra flow the race receives from the Main Race would no longer be available and the resource would be stretched beyond its limit. The maximum area able to be irrigated at the present quota would be about 800 ha. This assumes that 0.28 cumecs is drawn from Chatto Creek throughout the season. A more realistic area is likely to be less than half of this.

Current status

The distribution system of the Manuherikia irrigation scheme is in sound condition with only a number of small structures requiring attention. However the same is not true of the Main Race headworks which are in serious danger of failure. Failure within the headworks would directly affect flow to 65% of the scheme area and indirectly effect the remainder.

At present there are two main features which provide constrictions to the Main Race system. These are:

1. Sections of the Main Race downstream of the desilter which are overtopped when the flow is greater than 2.3 cumecs.
2. The Chinky Gully flume has a capacity of 2.3 cumecs. This flume is in poor condition and will require replacement during the refurbishment period (or earlier).

Another area of concern is the lack of control of water intake at the headworks. This problem is particularly noticeable at the Borough race intake.

CHAPTER 3: REFURBISHMENT PROPOSAL

3.1 INTRODUCTION

This proposal is the result of a detailed identification of structures in need of refurbishment and an assessment of work required to bring the scheme up to its original level of service. The work proposed will maintain the scheme in a good operating condition through to year 15. The scheme estimate is to PAC standard.

In order to complete this phase of the work efficiently it was found necessary to adopt a slightly different categorisation of structures than was used for the Phase 2 exercise. Structures have again been split into two categories called 'Primary structures' and 'Secondary structures'.

3.1.1 Primary structures

These are structures in need of refurbishment that are essential to the efficient functioning of a significant proportion of the scheme (generally at least 10%) and/or which could cause significant damage if they failed. These structures usually have a significant design input and are the more expensive structures on the scheme.

These structures were examined in the field and the least cost solution developed to keep these structures in sound operating condition for a minimum of 15 years.

3.1.2 Secondary structures

Secondary structures are the remaining structures in need of attention within the next five years. This may be due to deferred maintenance or because the structure is near to failure. These are low cost structures which would normally only be renewed when they failed or at the end of their life. Failure only results in local damage and inconvenience.

At the end of the refurbishment construction programme the scheme will be capable of meeting the original or currently accepted level of supply. Primary structures can be expected to function without trouble for at least 15 years. Secondary structures will require only normal maintenance in the years from the end of the construction period through to the end of the 15 year period. This will include the replacement of some minor structures as they come to the end of their life.

Structure numbers referred to in this report relate to the scheme inventory (ref 2 and Appendix B).

3.2 SCHEME PROPOSAL

3.2.1 Headworks

The Manuherikia scheme has an extensive headworks system that stretches from the Ophir gorge intake to the Chatto Creek syphon. This has reached the stage of requiring fairly urgent repair. The section of race and pipeline through the gorge is particularly vulnerable to damage from slope failure.

Civil design were briefed in September 1984 to report on a solution that would meet a given set of outage conditions and be the least cost solution over 40 years (appendix D).

The Civil Design report (ref 4) sets out several options with estimated costs for consideration. These are as follows:

	Cost	Range
1. Right bank pipeline	$4.7m	$3.7m-$6.3m
2. Right bank tunnel	$4.1m	$2.9m-$6.5m
3. Tunnel towards Chatto Ck	$4.2m	$2.8m-$6.8m
4. Left bank pipeline	$5.4m	$4.4m-$7.3m
5. Left bank tunnel	$4.0m	$3.0m-$5.7m
6. Weir and pump lift	$5.1m	$3.8m-$7.3m

The three tunnel options are preferable to a right bank pipeline on the grounds of lower overall cost and greater security of supply. Civil Design recommends adopting the tunnel towards Chatto Creek although the final choice would depend on further assessment at the time of proceeding.

Thus the headworks (primary works) proposed for refurbishment are:

Ophir gorge intake

This is a basically sound structure requiring attention only around the gates which leak badly and to the flood protection system. It is proposed to rebuild the gates and their guides and to provide a flood check control system. This would be achieved by using tripable flap gates positioned in front of the slide gates.

No 1 Tunnel & Desilter

The proposel is to return the tunnel floor which is badly scoured to its original condition and to reline the desilter. Three scour valves may also need to be replaced and have been allowed for in the estimate.

Gorge section

It is proposed that the troublesome gorge section should be bypassed with a tunnel since this is the least cost long term solution. The tunnel entry and exit points depend on the option chosen. The shorter tunnel options require greater sums to be spent on access and the left bank tunnel option requires access across the river.

Chinky Gully crossing

The main problem with this flume is the lining which is extremely thin in places. The support structure also has a limited life. The proposal is to replace this flume with a causeway and a cutting through the ridge immediately downstream of the flume. With the tunnel towards Chatto Creek option, a shorter syphon would replace Chinky Gully flume.

Chatto Creek Syphon

This syphon is in a poor state of repair and urgent replacement of the pipeline is required. The proposal is to keep the existing inlet and outlet structures which are in reasonable condition and completely replace the rest. Steel pipe would be used on the slopes and RCRRJ pipes across the valley floor.

3.2.2 Distribution works

Generally the distribution system is in reasonable condition with few major structures requiring complete replacement.

3.2.2.1 Primary structures

The following structures have been categorised as primary structures and require major work.

Borough race structure no 91 - Pipeline

This pipeline failed in late 1986 as a result of groundwater causing further movement of an old slip. The proposal is to reinstate the raceline along the length of the slip with a parallel drain to remove groundwater. It may be that this work will need to be done before refurbishment monies are available

Main distributary 11 - Structure 13

Leakage from Waikerikeri Gully Syphon is evident in several places, the source being fractured rigid pipe joints. The central section of pipe which spans the creek is also highly vulnerable to damage from floods. The proposal is to replace the whole syphon burying it throughout the flood plain.

3.2.2.2 Secondary structures

The most commonly recurring secondary works include renewal or repair to the shorter syphons, replacement of measuring boxes and redecking of bridges. Besides this there are varied minor works including repair to bywashes, stops, gates and small pipelines. Items such as the staircase drops which were previously classed as 'primary works' have now been reclassified as 'secondary structures' needing only remedial concrete work for continued serviceability.

Borough Race Intake

It is proposed to refurbish the intake controls and initial section of the Borough race. This would include a new control gate and bywashing facilities, some race realignment and replacement of a syphon. This would allow the race to operate to its full capacity and reduce damage during times of flood flow. The cost of this work is estimated at $33460.

Road Crossings

It is proposed to replace several State Highway and County road crossings that do not meet the current standard with regard to cover over the pipe and length of pipe through the road reserve.

Borough race	distrib 1	- structure no 6
	distrib 2	- structure no 3
	distrib 7	- structure no 1
Main race	distrib 5	- structure no 3
	distrib 11A	- structure no 4
	distrib 11A	- structure no 6

Concrete Step Drops

The concrete step structures show signs of general deterioration with cracking and spalling of concrete in places. These structures are :

Main race
- structure no 120
- structure no 123
- structure no 124

The defects in these structures does not place them in any immediate jeopardy of loss of service but they need to be repared to prevent further deterioration. It is proposed to carry out some remedial concrete work and application of elastomeric compounds to ensure at least a further 15 years of life.

3.2.3 Cost summary

The summary estimate presented here is to Preliminary Assessed Cost (PAC) standard for most items and is based on a Ministry of Works and Development Constuction Cost Index (CCI) of 2650.

The tunnel estimate to Rough Order Cost (ROC) standard is for the Right Bank tunnel. A slightly different breakdown of costs applies for the other tunnel options.

The estimate for Primary structures includes contingencies of 15% and 15% for engineering and administration costs. For the Secondary structures the contingency is estimated at 15% while engineering and administration costs add a further 14%. GST is not included.

	$	$
Headworks		
Ophir gorge intake	59 500	
No 1 tunnel & desilter	113 600	
Gorge section(tunnel & access)- ROC	3 180 000	
Chinky gully causeway	254 200	
Chatto Ck syphon	811 200	
SUBTOTAL		$4 418 500
Distribution Works		
Primary structures		
Borough race structure no 9	8 500	
Main distributary no 13	20 000	
SUBTOTAL		$28 500
Secondary structures		
Borough race	56 540	
Borough race distrib.1	9 050	
Borough race distrib.2	9 050	
Borough race distrib.7	1 330	
Borough race distrib.9	13 000	
Borough race distrib.11	6 690	
Main race	38 920	
Main race distrib.5	4 370	
Main race distrib.10	3 200	
Main race distrib.10C	3 340	
Main race distrib.11A	19 230	
Main race distrib.11A branch	19 040	
Main race distrib.11B	57 530	
Main race distrib.12	30 290	
Main race distrib.13	11 930	
Main race distrib.13A	2 800	
Assessed minor works	32 250	
Contingency 15%	48 040	
Administration cost 14%	51 400	
SUBTOTAL		$418 000
TOTAL REFURBISHMENT ESTIMATE		$4 865 000

NB. A provisional allowance of $500 000 for improvements has been included in the estimate for the package of 13 schemes (ref Part II, Tables A.1 and A.2).

3.4 TIMING OF CONSTRUCTION

Refurbishment of both Primary and Secondary structures would be programmed for completion within the minimum construction time of 5 years. Most of the work on the secondary structures would be completed during 1989 with construction on the headworks programmed for 1990-91.

Figure 3.1 shows the expected pattern of expenditure. Appendix C gives additional cashflow information.

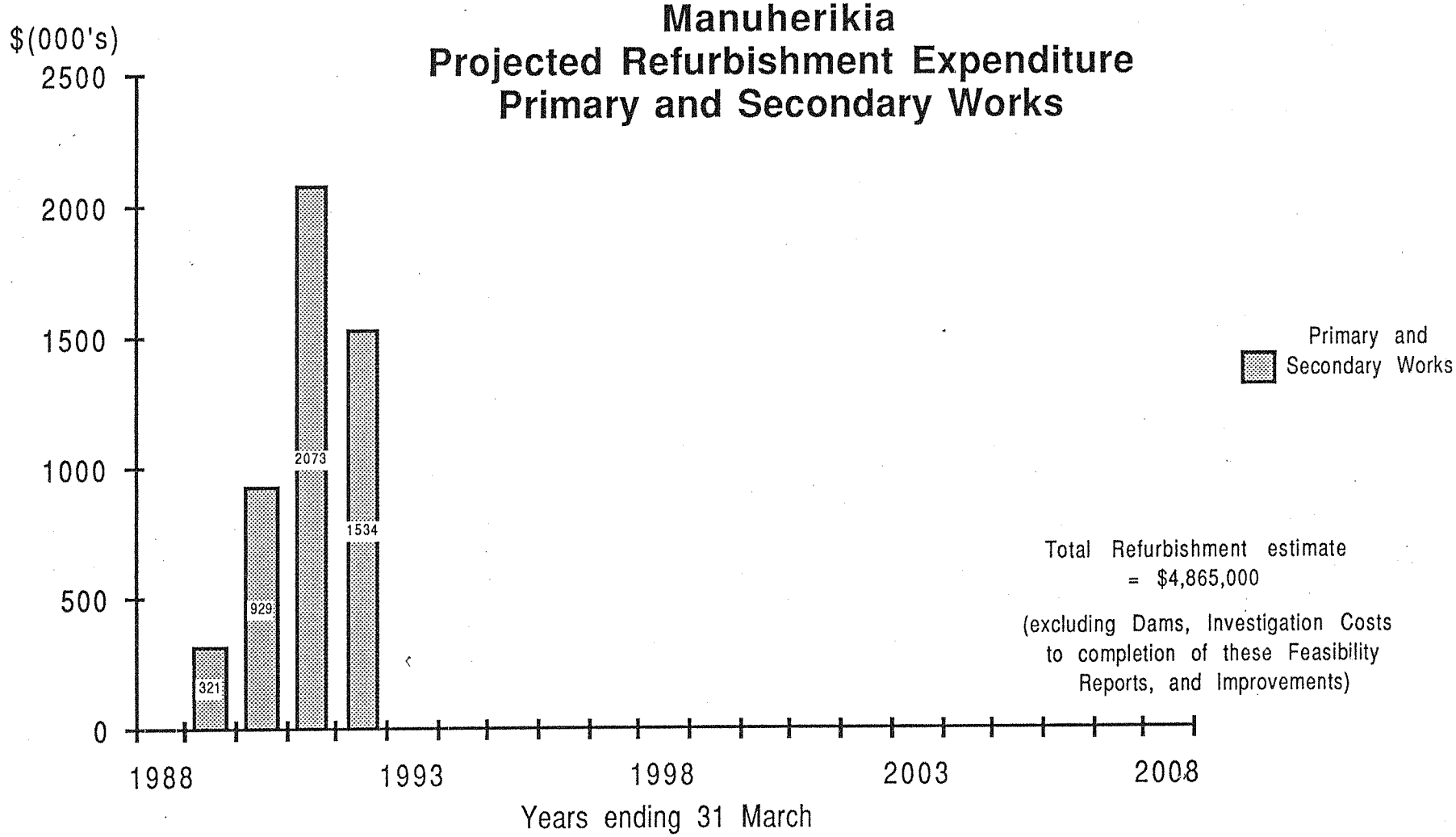

Figure 3.1 Proposed Refurbishment Cashflow

CCI 2650

CHAPTER 4 : POST REFURBISHMENT OPERATION

4.1 INTRODUCTION

The objective of this chapter is to present the information supplied from the operational staff in terms of the resource requirements for operation and maintenance (manpower, plant and materials) in terms of two possible post refurbishment operating modes presented in this chapter.

The two scenarios presented here are:

a. Contract service
b. Contract with free farmer assistance

For a description of operation activities and general comparisons between the possible future modes and the historic modes (pre 1984) refer to Part II Chapter 3 and in particular, Tables 3.1 and 3.2.

Before each of the refurbishment proposals is presented for approval in principle it is recommended that the irrigator committees should be invited to critically examine the current operating mode and redefine the contract services they consider are appropriate. The estimates assume that the schemes have been refurbished.

a. Mode 1 - Contract service

With this mode scheme operation, maintenance, repair and renewal would all be done on a contract basis. Virtually all the turnouts would be operated by the raceman but there would be a minimum of surveillance. The scheme would operate strictly according to supply roster.

b. Mode 2 - Contract with free farmer assistance

With this mode farmers would provide assistance at no cost to the scheme for:

- Operation of secondary distribution structures and all turnouts according to the roster.
- Distribution works operational maintenance (clearing debris and in season race clearing activities).
- Winter handcleaning with farm labour.
- Weedspraying.

The other duties would be done as in mode 1 by contract.

It is recommended that the following areas be reconsidered by the irrigators in terms of the cost and effectiveness of contract services currently available.

Operations

- Farmer operation of turnouts
- Roster operation versus costs of on demand supply mode and implications on water sales recording for irrigation and other water users.
- Farmer operation of distribution and some headworks structures.
- Race surveillance practices.
- Water policing.
- Water supply during the winter season.

Maintenance

- Local availability of farm labour and plant in winter for race cleaning activities.

- Weed spraying activities.
- Supply of materials - spray, tools, vehicles, etc.
- Supervision of works.
- Effectiveness of cleaning activities and their frequency in relation to alternative levels of service.

Repairs and replacements

- The general standard and types of structures especially turnouts and flow modules available.
- Policies on scheme fencing and access.

It is evident from our studies that there is very little readily available information on the service performance of secondary structures, ie, annual repair cost against age, data on the life of exposed and buried concrete pipes, etc.

The assumptions used for the replacement cost predictions are based on comments from Alexandra construction staff and general data on the life of concrete structures. A job recording system interfaced with the existing computerised structure inventory could be employed to provide cost performance data to support future repair and replacement programming and annual estimates.

4.2 PRESENT OPERATION

4.2.1 Scheme operation

Irrigation supplies are drawn from two main water resources, the Manuherikia River and Chatto Creek. In addition a small water supply is drawn from Younghill Creek throughout the winter to provide domestic water to the Alexandra/Clyde irrigators and as a consequence the scheme remains partially operational thoughout the year.

The scheme is currently operated by four racemen on a demand basis but with roster supply to irrigators around the Alexandra/Clyde area. They are responsible for the control of the main race intakes, water distribution in the scheme and arranging water sales to individual irrigators. In the winter season they undertake race maintenance and repair work.

The scheme can be divided into two distinct categories of irrigator.

1. Rural farmers - the larger landowners situated between the headworks and the Alexandra/Clyde group of irrigators. These irrigate approximately eighty per cent of the scheme area.
2. Rural residential farmers - mostly the smaller landowners situated around Alexandra and Clyde and who irrigate approximately twenty per cent of the scheme area. The amount of service demanded by these landholders is excessive in relation to the land area compared to the rest of the scheme and consequently the actual cost per hectare of supply is higher than for the larger properties.

Access

Access within the scheme is generally good with the exception of the main intake sited in the Ophir gorge which requires a long time consuming journey to check and adjust.

The racemen currently make heavy use of motorcycles for transport.

4.2.2 Maintenance

Periodic cleaning of the races is required to clear them of water weed and brush. Most of this work is done using mechanical diggers and vehicle mounted spray units.

Mechanical cleaning occupies 2.5 weeks in winter and 2.5 weeks in summer allowing 140 km of race to be cleaned on a 3.5 year cycle. The summer cleaning helps eliminate localised water weed build up which cannot be removed by chemical sprays because of orcharding and horticultural activities downstream.

Handcleaning takes approximately 9 man weeks to complete and at present is done by the racemen.

Weedspraying takes 2 men 3.5 weeks to complete.

4.2.3 Repairs and renewals

At present 18 man weeks are allocated to this activity.

The cost of repairs and renewals has fluctuated over the last three years. The costs adjusted to a CCI of 2650 are as follows:

1983/84	$16 300
1984/85	$88 100
1985/86	$35 500

The high figure for 1984/85 reflects the work that was required on the Borough Race with renewal of syphons and pipes. The extraordinary costs of the two major slips that occured in the Manuherikia gorge in 1983 are not included in the above total. These cost $115 000 and $169 000 respectively (CCI 2650) to remedy.

4.2.4 Scheme Costs and Charges

Scheme expenditure for 1985/86, exclusive of adminstration, management overheads and interest on capital was as follows:

	$
Racemen	102 974
Plant hire	57 432
Materials/misc	58 233
Total	$ 218 639

Scheme revenue of $113 340 resulted from the following charges:

Basic charge	$37.71-41.18 per hectare
Extra water	$3.86 per 1000 cubic metres

Thus at present there is a substantial gap between expenditure and revenue.

The water charges set for 1986/87 were

Basic supply (750-900mm)	$51.92 per hectare
Extra water	$ 6.92 per 1000 cubic metres

4.3 FUTURE OPERATION

Following refurbishment it is probable that the full annual operating costs will have to be met by the irrigators.

The estimates for the two proposals put forward cuts the annual operating costs to a practical minimum and assumes respectively minimal and maximum levels of assistance from the irrigators. Should a more comprehensive service than defined for mode 1 be required by the community then the costs and charges would inevitably be higher. Alternatively, the community may wish to take

on more operation and maintenance duties themselves. The desired balance of contract and farmer input is expected to eventually lie somewhere between these two modes.

Suggestions for scheme improvements are also made with some indication of the saving that would result.

4.3.1 Mode 1 - Contract service

4.3.1.1 Operation

Racemen

It is believed that the scheme could be operated with 8 days of racemans time per week.

Roster

The on demand basis for providing water to the larger landowners would be replaced by a roster (possibly a variable roster) to provide more efficient use of the racemans time. The rural residential irrigators would continue to be served by roster as at the present.

Alexandra/Clyde area

In the long term it is proposed that this section of the scheme should be operated by approximately half a racemans input. To achieve this it would be necessary for this group of irrigators to assume much more input to the scheme than they have done in the past.

One difficulty here is that this group of properties has seen rapidly changing ownership over the past few years with new owners having little understanding of irrigation operation and so expecting the raceman to provide a total service. Should additional racemans time be required for this section of race due to these 'service demands' this should be reflected in the charge levied.

It is also assumed that supply costs to those areas serviced within the Alexandra Borough and from races which pass through the Clyde township are additional to the estimated costs in this report.

Small pipe supplies

It is suggested that small pipe supplies should be reviewed to determine the true cost of servicing these supplies and costs be recovered from the users. At present there are numerous pipe supply agreements and the income currently derived from this source is approximately $5 000 annually. The cost of providing this service however is substantially higher than this. The majority of operational difficulties and disputes relate to these pipe supplies and the efficiency of race maintenance programmes is reduced for two main reasons, firstly because it is not possible to totally shut down the scheme for race cleaning and secondly because there have been limitations placed on weedspraying activities.

With the proposed reduction in the number of racemen it would no longer be possible to adequately service pipe water supplies.

Operational Improvements

1. Bywashes

   The lack of sufficient bywashes has meant in the past that the raceman has had to dump excess water onto farmers paddocks in times of emergency such as excessive rainfall, race failure or unwanted supplies. With a reduced number of racemen this would no longer be practical and it would be essential to ensure that the scheme incorporates a sufficient number of suitably sized bywashes.

2. Telemetry

   Monitoring and adjustment of the Main race intake and inspection of the headworks race in the Manuherikia gorge currently requires an input of approximately two hours daily. This is a quarter of a raceman for the irrigation season.

   To cut down this input it is proposed to install full telemetric controls at the desilter at the outlet of the first tunnel. The cost of this is estimated $15 000 initially and thereafter $2 000 annually. The estimated annual saving is $6 000.

4.3.1.2 Race maintenance

Measures proposed to reduce the cost of race maintenance are as follows:

1. Use of a mechanical weed trimmer and rake fitted to a small tractor where spray cannot be used. This should be able to gain access to places not possible with an excavator and so save on manual race cleaning.

2. Discontinuing supply to smaller properties within the Alexandra Borough and Dunstan Flats areas would reduce the manual cleaning required of the Borough race.

3. By irrigators themselves providing some help in maintenance.

The future labour requirement for handcleaning and weedspraying is expected to be much as at present (section 4.2.2). In view of the heavy water management input and maintenance costs associated with areas in the Alexandra Borough and Dunstan Flats near Clyde, a new rural water supply or supply from the Alexandra Borough may be an attractive alternative supply option. Smaller properties with mixed farming practices are dominant in these areas on the southern extremity of the scheme.

4.3.1.3 Repairs and renewals

Immediately following refurbishment there should be little replacement required. Primary structures will have been repaired or replaced so as to need little attention for a minimum of 15 years. However during the post refurbishment period 5-15 years it can be expected that maintenance costs for secondary structures would increase. This would include such work such as bridge redecking, minor culverts, older measuring boxes and general patching works.

The average annual maintenance cost for these items is estimated at $22000 per annum. This allows for plant and materials with the additional labour requirement being supplied primarily by the two operational racemen. The labour requirement for this work is estimated at 15-16 man weeks per annum.

Flood damage

Generally the scheme is not vulnerable to flood damage and refurbishment will limit flood damage in the intake areas. Debris washed into the intake is usually removed during the normal cleaning programme. It is proposed that an occasional flood damage reserve fund of $20000 be established to cover this contingency.

4.3.1.4 Management Services

Part II figure 3.3 shows a proposed organisation structure for providing management services to Central Otago irrigation schemes and upon which costs to individual schemes have been based.

This service would coordinate the various resource inputs required to operate and maintain the scheme including management of the water resource, programming and control of financial expenditure and arranging technical advice and engineering supervision where necessary.

4.3.1.5 Water Charge Costs

These are the estimated costs of operating a scheme account including sending individual invoices twice per annum, recieving payment and preparing financial reports for audit.

4.3.1.6 Projected Costs and Charges

Given the above mentioned changes and improvements to scheme operation then the projected annual costs post refurbishment are as follows:

	after 5 yrs $	after 15 yrs $
Renewals & replacement	0	59 400
Repairs	55 000	55 000
Maintenance	44 500	44 500
Operations		
operations	49 900	49 900
operation maint.	15 100	15 100
water charge costs	12 000	12 000
Administration	4 400	4 400
Total	$ 180 900	$ 240 300

NB Total area under agreement is 1854 ha.

4.3.2 Mode 2 - Contract service with free farmer input

It is feasible to reduce direct costs by farmer input into the following activities:

	Potential savings ($ per annum)
Maintenance: handcleaning and weedspraying	13 200
Farmer operation of turnouts according to roster and some secondary distribution structures	24 900
Operational maintenance	9 000
TOTAL SAVINGS PER ANNUM	$47 100

4.3.3 Concluding Remarks

The Contract Service mode 1 and Contract Service with Free Farmer Assistance mode 2 represent opposite ends of the spectrum for costs of service for a rostered supply. Assuming that schemes adopt the roster approach the post refurbishment operational costs should fall somewhere between these modes.

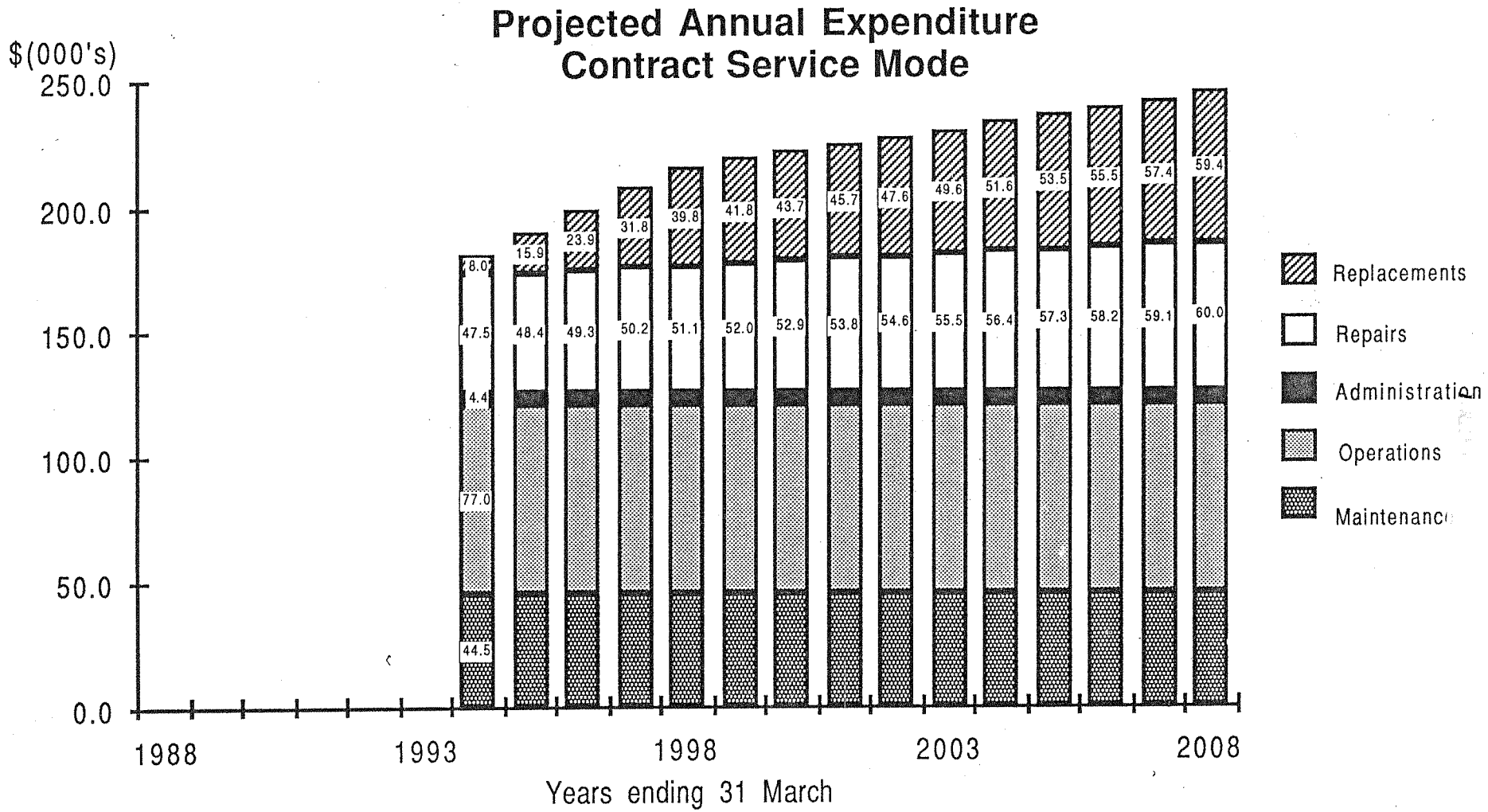

Figure 4.1 Manuherikia CCI 2650

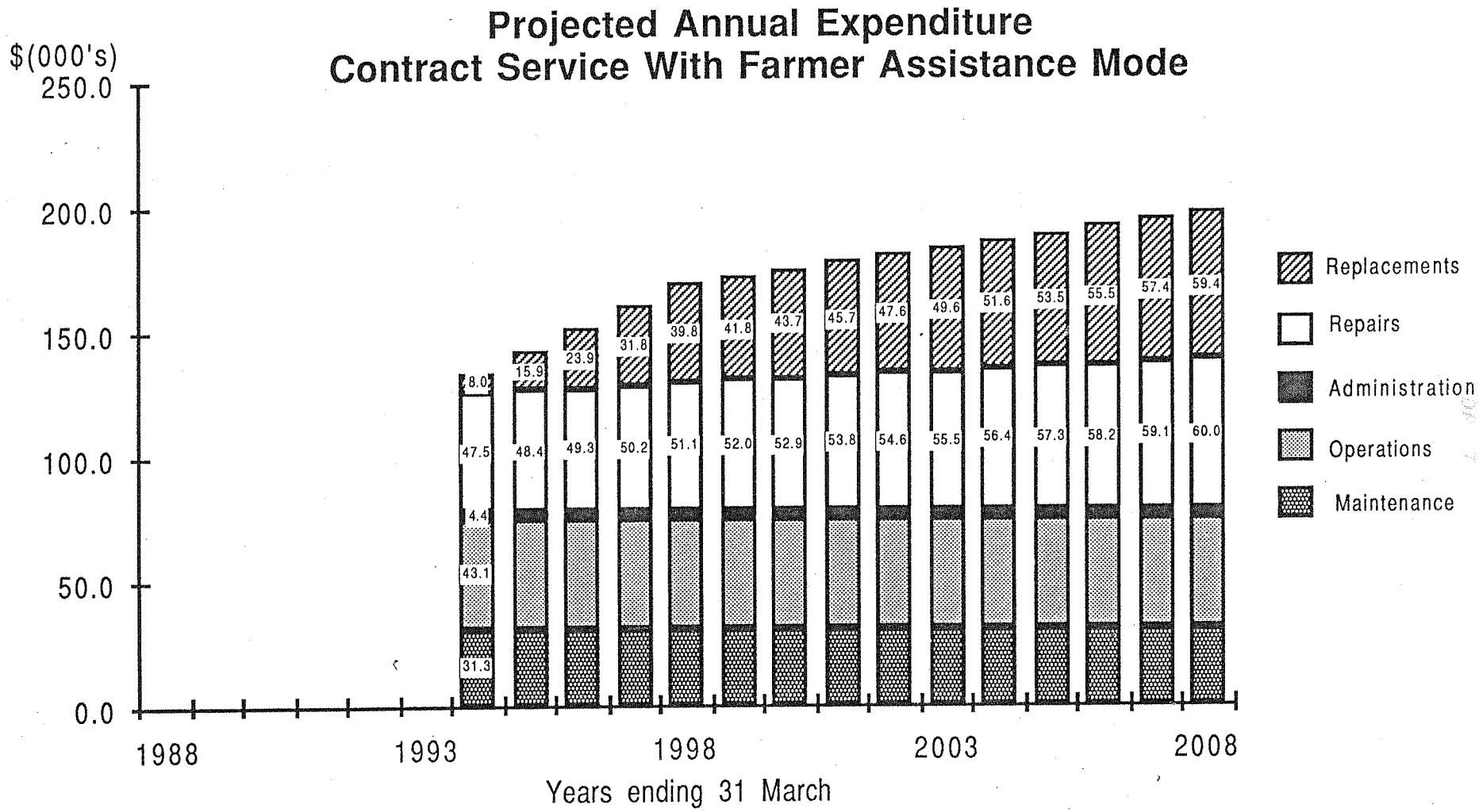

Figure 4.2 Manuherikia CCI 2650

CHAPTER 5: CONCLUSIONS

The races and structures within the distribution system are in good condition due to the maintenance in recent years with few major structures requiring complete replacement. There are however varied minor works required to ensure continued serviceability of the scheme over the next 15 years.

The schemes headworks are in a different category and require fairly urgent upgrading if further outages and emergency repairs are to be avoided.

Civil engineering studies have shown that the most economic way of achieving security of supply is to construct a tunnel bypassing the troublesome gorge section of race. If this is not done then there will almost certainly be continued high repair and maintenance costs with periods of outages.

The proposed refurbishment work would enable the present level of service to be maintained for the next 15 years without further major injection of funds. The scheme would be well placed to cover its own expenditure at a reasonble cost to the farmer and be on a sound footing for contract operation.

SCHEME REPORT DATA SHEET

Irrigation Scheme ...Manuherikia.....

Date of Construction ..1917-1922.....

Area Commanded ..3190....ha Irrigable Area..1854 ha (1986/87)

Number of Racemen .....4..(1986/87).....

Water Users:
Irrigators .....158....(1986/87).....
Pipe Supplies.....72....(1986/87).....

Length:
Main Race .....66.7..... km
Distributaries ...43.9..... km

Principal Water Sources:
Storage .....10.4..... million m3
Run of River ..2.53..... m3/s
Pumped .....-..... m3/s

Water Quota .....762, 838, 914.....mm

Water Usage MWD Records 1975/76 - 1982/83:
Average .....1181..... mm
Range .....810-1404..... mm

Land Use	Pasture	Horticulture	Cropping
%	85	10	5
Irrigators	-	-	-

Irrigation Methods .Pastoral irrigation is approximately 75% contour dyke/wild flood and 25% borderdyke. Horticultural irrigation is borderdyke and spray.....

Accumulated Loss to 15 May 1986 $....3 049 775.....

Average O&M 1970/71-1985/86

(CCI = 2650) $..310 938..... ($.....168..../ha)

Refurbishment Capital Cost (CCI = 2650)

Primary Works	$ 4 447 000.
Secondary Works	$ 418 000.
TOTAL	$ 4 865 000.
	($ 2 620 /ha)

REFERENCES

1 BLAKE I M (1974), Manuherikia River - Catchment No.752630 Water Resources, Preliminary Feasibility Report on Irrigation Development; W & S, MWD, Dunedin.

2 ALDRIDGE A (1985), Manuherikia Irrigation Scheme, Review of Old Central Otago Irrigation Schemes, Phase 1, Scheme Description and Inventory of Components; Alexandra Residency, MWD.

3 RICHARDS D W and WALSH I G (1984), Manuherikia Valley Irrigation - Prefeasibility Report on Civil Engineering Aspects or Irrigation Options; Civil Design, MWD, Dunedin.

4 RICHARDS D W and WALSH I G (1985), Refurbishment of Manuherikia Irrigation Scheme Headworks - Feasibility Report; Civil Design, MWD, Dunedin.

5 MELDRUM G (1985), Refurbishment of Old Central Otago Irrigation Schemes, Manuherikia Scheme Report - Preliminary; W & S, MWD, Dunedin.

6 BAYFIELD P (1987), Refurbishment of Manuherikia Irrigation Scheme, Primary Structure Review; Civil Design, MWD, Dunedin.

7 McCRAW J D (1964), Soil Bureau Bulletin 24, Soils of Alexandra District; DSIR

Appendices

This section contains the following appendices:

Appendix A. Selected Scheme Data

A.1 Race Lengths and Capacities

Race names	Length(km)	Capacity l/s	Capacity (cusecs)
Main Race	30.1	2410	85
Distrib 2	0.04	230	8
Distrib 3	0.6	255	9
Distrib 4	0.1	115	4
Distrib 5	0.2	230	8
Distrib 6	0.1	115	4
Distrib 7 (Kellihers drop)	0.4	255	9
Distrib 8 (Kellihers race)	0.3	230	8
Distrib 9 (M-N race)	3.6	230	8
Distrib 10 (F-K race)	6.8	230	8
distrib 10a (Mackies race)	0.4	57	2
distrib 10b	0.8	57	2
distrib 10c	0.9	115	4
distrib 10d	0.4	57	2
distrib 10e	0.1	57	2
Distrib 11 (A-G race)	6.3	200	7
distrib 11a	1.3	170	6
distrib 11a (branch)	0.6	57	2
distrib 11b	1.8	85	3
Distrib 12 (L-M race)	3.0	230	8
distrib 12a (Orchardists race)	0.4	57	2
Distrib 13	5.6	230	8
distrib 13 branch race	-		-
distrib 13a	0.2	57	2
distrib 13b	0.2	57	2
distrib 13c	0.01	57	2
Borough Race	36.6	170-425	6-15
Distrib 1 (Ashtons race)	0.9	170	6
Distrib 2 (Maxwells chute)	0.4	170	6
Distrib 3	1.1	170	6
distrib 3a	0.3	170	6
Distrib 4 (Keddells race)	1.1	230	8
Distrib 5 (Attfields race)	0.5	57	2
Distrib 6 (Marslins Point race)	0.4	115	4
Distrib 7 (McDonnells no.1 race)	0.07	57	2
Distrib 8 (McDonnells no.2 race)	0.6	115	4
Distrib 9 (McDonnells no.3 race, Whitakers pt.)	0.5	115	4
Distrib 10 (Montgomery race)	2.1	115	4
Distrib 11 (Poplars race)	1.7	115	4
Springs Race	0.1		-

	River, Creek or Dam	Map Series 177, 177A Map No.	Co-ordinates N	Co-ordinates E	Authority	Usage (Cusecs) Summer	Usage (Cusecs) Winter	Max. Discharge	
MANUHERIKIA SCHEME									
Intakes	Manuherikia River	S 134	360850	333000	WR 915 C	100	-		
	Chatto Creek	S 134	363270	328010	WR 1540	10	5		
	Younghill Creek	S 134	358420	326610	WR 1125	5	1		
	Brassknocker Creek	S 134	355200	324220	WR 2777	3	2		
	McArthurs Creek	S 133	354910	319950	P.W. Act	-	2		
	Waipuna Creek	S 133	354420	316570	WR 221C	1	1		
	Brassknocker Creek	S 134	354310	324460	P.W. Act	5	1		
	Scrubby Gully (Unnamed Creek)	S 134	350780	321550	WR 1124	4	1		
Bywashes	No.1 to Manuherikia River	S 134	360480	331880				100	
	No.2 Chatto Creek	S 134	359250	329420				80	
	No.3 Younghill Creek	S 134	358650	326460				60	
	No.4 Brassknocker Creek	S 134	355920	324450				25	
	No.5 Unnamed Gully	S 134	352000	321600				12	
	No.6 Aerodrome	S 133	351280	317350				8	To open paddock.
	No.7 Waikerikeri Creek	S 133	351450	315800				30	
	No.8 Borough Boundary	S 133	346700	318950				4	
	No.9 Letts Gully	S 144	347470	320480				10	
	No.10 Manuherikia River	S 144	346000	319820				4	

Appendix B. Refurbishment Estimates

MANUHERIKIA IRRIGATION SCHEME

BASE RATE ASSUMPTIONS

	Item	Rate
LABOUR		
	ex Alexandra Residency Irrigation Staff	$25 /hr
PLANT		
	D5 Bulldozer	$70 /hr
	D7 Bulldozer	$90 /hr
	8 cubic metre Tip Truck	$60 /hr
	Backhoe	$50 /hr
MATERIAL		
	Concrete (ex Alexandra yard)	$90 /m3
	500mm Measuring box (ex Alexandra yard)	$1000 ea
	750mm Measuring box (ex Alexandra yard)	$1700 ea
	Sealing material	$15 /m3
PIPES (RCRRJ)	(x 2.44m length)	
	375mm	$115 (includes ring)
	450mm	$145 " "
	525mm	$175 " "
	600mm	$215 " "
	675mm	$285 " "
	750mm	$370 " "
	825mm	$410 " "
	900mm	$530 " "
	1075mm	$690 " "
	1200mm	$845 " "
	1350mm	$985 " "
	1600mm	$1205 " "

******* ALL COSTS EXCLUDE GST *******

M A T E R I A L I N D E X

Abbreviation	Material
A	Armco
AC	Asbestos Cement
B	Butynol
C	Concrete
E	Earth or Sod
P	Polythene
PVC	Polyvinyl Chloride
R	Rock, Stone or Masonry
S	Steel, Tin or Galvanised Iron
W	Wood

C O N D I T I O N I N D E X

Abbreviation	Condition
B	Bad, Very Bad, Major or Minor
F	Fair
G	Good
O	Okay
P	Poor, Very Poor, Suspect or Rough

TYPE INDEX

Abbreviation	Type of Structure
AB	Anchor Block
AT	Abutments
AX	Access Crossing
BR	Bridge
BY	Bywash
CH	Chute
DA	Dam
DR	Drop
EX	Expansion Joint
FL	Flume
FX	Fence Crossing Race
GT	Gate
IN	Intake
MB	Measuring Box
OV	Over Race Structure
PL	Pipeline
PU	Pump
RL	Race Lining
RX	Road Crossing
SC	Surge Chamber
SK	Skimming Board
SN	Screen
SP	Supports
ST	Stop
SW	Spillway
SY	Syphon
TO	Turnout
TU	Tunnel
UN	Under Race Structure
VL	Valve
WE	Endwall
WH	Headwall
WR	Weir
WW	Walkway

MANUHERIKIA IRRIGATION SCHEME

SECONDARY WORKS — DATE PREPARED: 28/11/1986

RACE: BOROUGH — AREA SERVED:

DESCRIPTION	LAB $	PLANT $	MATL $	TOTAL $	SCHEME/ RACE	STRUC NO	DIST	C	USE	MATL	LEN	DIA	WID	D'TH	COMMENT
INTAKE SECTION. Controls,Replace syphon Realign race	17300	10000	12100	39400	MAN/B	1-10									
Pipe crossing	690	225	460	1375	MAN/B	23	4350	P	AX	S	2.44	914			
500 mm M/B	290	150	1100	1540	MAN/B	26	4600	O	MB	C				500	
750 mm M/B and concrete	290	150	1870	2310	MAN/B	47	6500		MB				750		
					MAN/B	47.1	6500		TO	C	3.7	381			TO DISTRIB 1
Bridge repair	690	225	680	1595	MAN/B	58	8280	P	BR	W/S	3.7		3400		59
750 mm M/B	580	200	2200	2980	MAN/B	108	17080	O	MB				750		TO DISTRIB 4
					MAN/B	109	17100	O	ST	C				0	
500 mm M/B	290	150	1100	1540	MAN/B	147	22070	O	MB					375	TO DISTRIB 7
500 mm M/B and stop	290	150	1870	2310	MAN/B	148	22550	O	MB					500	DISTRIB 8
Pipe crossing 7.2m x600mm	380	250	1100	1730	MAN/B	199	34790	F	AX	C	7.9	600			
End of race bywash (Miscellaneous)	480	1000	280	1760	MAN/B	208	36060	F	BY	E	0		0		
SUBTOTALS	21280	12500	22760	56540											

MANUHERIKIA IRRIGATION SCHEME

SECONDARY WORKS

DATE PREPARED: 28/11/1986

RACE: BOROUGH DISTRIBS

AREA SERVED:

DESCRIPTION	LAB $	PLANT $	MATL $	TOTAL $	SCHEME/ RACE	STRUC NO	DIST	C	USE	MATL	LEN	DIA	WID D'TH	COMMENT
SH crossing	5000	1300	2750	9050	MAN/B/1	6	620	O	RX	C	9.8	375		UNDER SH 85
SH Crossing	5000	1300	2750	9050	MAN/B/2	3	180	O	RX	C	7.3	450		UNDER SH 85
Clyde-Springvale Crossing	580	200	550	1330	MAN/B/7	1	20		RX	C	31.1	150		STR 147 BOROUGH,CL-S
20 pipes - 375 mm	6340	2700	3960	13000	MAN/B/9	3	500	P	PL	C	14	375		
Earthworks between structures 1 and 2	950	3100	2640	6690	MAN/B/11									
SUBTOTALS	17870	8600	12650	39120										

MANUHERIKIA IRRIGATION SCHEME

SECONDARY WORKS DATE PREPARED: 28/11/1986

RACE: MAIN AREA SERVED:

DESCRIPTION	LAB $	PLANT $	MATL $	TOTAL $	SCHEME/ RACE	STRUC NO	DIST	C	USE	MATL	LEN	DIA	WID	D'TH	COMMENT
500 mm M/B	380	200	1210	1790	MAN/M	5	910	F	TO		0	375			TO PARALLEL RACE
500 mm M/B	380	200	1210	1790	MAN/M	10	1820	O	MB				500		
500 mm M/B	380	200	1210	1790	MAN/M	28	5280	F	MB				500		
750 mm M/B	580	200	2200	2980	MAN/M	30	5730	O	MB				750		
500 mm M/B	380	200	1210	1790	MAN/M	84	19650	O	MB				500		
500 mm M/B	380	200	1210	1790	MAN/M	85	20080	O	MB				500		
500 mm M/B	380	200	1210	1790	MAN/M	98	24300	O	MB				500		
500 mm M/B	380	200	1210	1790	MAN/M	113	28690	F	MB				750		
Dynabolt cracked beam	380	150	60	590	MAN/M	119	29380	O	GT				1800		
Remedial concrete work	9610	2000	3300	14910	MAN/M	120	29560	F	DR	C	180		2100	1680	9/SIDEWALLS POOR
Remedial concrete work	3840	500	1650	5990	MAN/M	123	29960	F	DR	C	25.6		2100	1680	
Remedial concrete work	950	250	280	1480	MAN/M	124	30060	F	DR	C	35.1		2100	1680	
Weld control gate	380		60	440	MAN/M	125.6	30100		GT						TO DISTRIB
SUBTOTALS	18400	4500	16020	38920											

MANUHERIKIA IRRIGATION SCHEME

SECONDARY WORKS DATE PREPARED: 28/11/1986

RACE: MAIN DISTRIBS AREA SERVED:

DESCRIPTION	LAB $	PLANT $	MATL $	TOTAL $	SCHEME/ RACE	STRUC NO	DIST	C	USE	MATL	LEN	DIA	WID	D'TH	COMMENT
Road crossing	2880	500	990	4370	MAN/M/5	3		O	RX	C	18.6	450			UNDER SH85
500 mm M/B	290	150	1100	1540	MAN/M/10	14	4840		MB	C			500		TO DISTRIB 10C
Bury 128m PVC line	380	400	880	1660	MAN/M/10	26	6320	O	DR	PVC	0.13	150			PIPE
Replace pipeline	2080	600	660	3340	MAN/M/10C	1	30	F	PL	S	44.8	450			FROM STR14,DISTRIB 1
Road Crossing	5380	1500	3300	10180	MAN/M/11A	4		P	RX	C	9	375			CLYDE SPRINGVALE ROA
Road Crossing	5000	1300	2750	9050	MAN/M/11A	6			RX	C	15.9	380			26C/WAIKERIKERI RD.
Replace with 200 mm PVC and gate valves	3840	2000	13200	19040	MAN/M11AB	1	80		DR	C/R	6			900	FROM STR8, DISTRIB 1
Realign race, replace with pipeline - 500 m 375 mm RC	19230	13000	25300	57530	MAN/M/11B										
Renew syphon 41m x 375mm	3840	3000	16500	23340	MAN/M/12	21	1430	P	RX	C	41.2	375			UNDER RAILWAY
500 mm M/B	290	150	1100	1540	MAN/M/12	27	2530	O	MB				500		
Realign race	1930	1500	1980	5410	MAN/M/12	28-32									
Pipeline. Road Crossing	3630	730	3820	8180	MAN/M/13	10.1-10.2									LAID IN BRANCH RACE
Remove trees and repair wall	2500	700	550	3750	MAN/M/13	9	870	F	DR	C	97.5		1800	15.9	43,44/DR IN M, 45 ST
Pipe crossing	1540	600	660	2800	MAN/M/13A	3	220	F	AX	S	10	400			
SUBTOTALS	52810	26130	72790	151730											

MANUHERIKIA IRRIGATION SCHEME

SECONDARY WORKS DATE PREPARED: 3/2/87

ASSESSED MINOR WORKS

DESCRIPTION	UNIT	QTY	RATE	TOTAL $
Headgates	EA	25	370	9250
Measuring boxes	EA	10	150	1500
Pipes	LS			5000
Backhoe	HOUR	100	50	5000
M/B complete	EA	10	250	2500
Stops, etc	LS			3000
Fencing / gates	EA	30	200	6000

SUBTOTALS	32250

MINISTRY OF WORKS AND DEVELOPMENT
OFFICE: ALEXANDRA

SUMMARY FILE: 15/3

STATUS: PRELIMINARY ASSESSED COST
PURPOSE: APPROVAL IN PRINCIPLE

ESTIMATE PREP'D CHECKED

QUANTITIES
MWD CCI 2650 RATES/EXTENSIONS

RECOMMENDED: APPROVED:

MANUHERIKIA IRRIGATION SCHEME

SECONDARY WORKS

DATE PREPARED: 28/11/86
UPDATED: 10/4/87

RACE	LAB $	PLANT $	MATL $	TOTAL $
Borough Race	21280	12500	22760	56540
Borough Distribs	17870	8600	12650	39120
Main Race	18400	4500	16020	38920
Main Distribs	52810	26130	72790	151730
Assessed Minor Works				32250
SUBTOTAL	110360	51730	124220	$318,560

Contingency	15%	$48,040
		$366,600
Engineering Supervision, and Administration	14%	$51,400
TOTAL		$418,000

MINISTRY OF WORKS
AND DEVELOPMENT
OFFICE: DUNEDIN

SUMMARY FILE: 15/3

STATUS: PRELIMINARY ASSESSED COST
PURPOSE: APPROVAL IN PRINCIPLE

ESTIMATE

MWD CCI 2650

MANUHERIKIA IRRIGATION SCHEME

PRIMARY WORKS DATE PREPARED: 30/1/87

RACE	TOTAL $
Main Distrib 11 (str 13) - Waikerikeri syphon	17500
Borough Race (str 91) - pipeline	7360
SUBTOTAL	$24,860
Engineering On-costs 12.5%	$3,110
Administration costs 2.5%	$530
TOTAL	$28,500

MANUHERIKIA IRRIGATION SCHEME

SUMMARY OF PRIMARY & SECONDARY WORKS

MINISTRY OF WORKS AND DEVELOPMENT, DUNEDIN & ALEXANDRA

STATUS: PRELIMINARY ASSESSED COST MWD CCI 2650
PURPOSE: APPROVAL IN PRINCIPLE

DATE PREPARED: 30/1/87 FILE: 15/3
UPDATED: 10/4/87

RACE	TOTAL $
Borough Race	82600
Borough Distribs	51300
Main Race	51000
Main Distribs	219300
Assessed Minor Works	42300
SUBTOTAL (PAC)	$446,500

HEADWORKS ESTIMATE (ROC) - prepared December 1986

(nb - CCI adjusted to 2650)

Ophir Gorge intake	59500
No 1 tunnel & desilter	113600
Gorge section (tunnel & access)	3180000
Chinky Gully causeway	254200
Chatto Creek syphon	811200
SUBTOTAL (ROC)	$4,418,500
TOTAL ESTIMATED COST - ALL STRUCTURES	$4,865,000

Appendix C. Manuherikia Operational Cost Estimates

ANNUAL EXPENDITURE ($000's)	MANUHERIKIA																				
CONTRACT SERVICE MODE																					
	MWDCCI = 2650																				
Prepared 4/6/87																					
Revised 12/6/87	*Years ending 31 March*																				
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	TOTAL
																						4235.5
REFURBISHMENT - Construction		130.3	745.3	1938.8	1421.1																	516.9
Engineering on-costs		157.1	155	109.2	95.6																	112.4
Administration costs	8.3	33.2	28.8	24.5	17.6																	4864.8
TOTAL REFURBISHMENT COST	**8.3**	**320.6**	**929.1**	**2072.5**	**1534.3**																	
(excl. costs to Mar '88)																						
REPLACEMENTS (S)							6.0	12.0	18.0	24.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	390
(P)							2.0	3.9	5.9	7.8	9.8	11.8	13.7	15.7	17.6	19.6	21.6	23.5	25.5	27.4	29.4	235
Subtotal							8.0	15.9	23.9	31.8	39.8	41.8	43.7	45.7	47.6	49.6	51.6	53.5	55.5	57.4	59.4	625
REPAIRS							47.5	48.4	49.3	50.2	51.1	52.0	52.9	53.8	54.6	55.5	56.4	57.3	58.2	59.1	60.0	
MAINTENANCE							44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	
OPERATIONS																						
Water management							49.9	49.9	49.9	49.9	49.9	49.9	49.9	49.9	49.9	49.9	49.9	49.9	49.9	49.9	49.9	
Operational maintnce							15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	
Water charge admin.							12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
Subtotal							77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	
ADMINISTRATION (Legal,Policy)							4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	
TOTAL OPERATION COST							**181.4**	**190.2**	**199.1**	**207.9**	**216.8**	**219.7**	**222.5**	**225.4**	**228.1**	**231.0**	**233.9**	**236.7**	**239.6**	**242.4**	**245.3**	
CONTRACT SERVICE WITH FREE FARMER ASSISTANCE MODE																						
	MWDCCI = 2650																					
Prepared 4/6/87																						
Revised 12/6/87	*Years ending 31 March*																					
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	TOTAL
																						4235.5
REFURBISHMENT - Construction		130.3	745.3	1938.8	1421.1																	516.9
Engineering on-costs		157.1	155	109.2	95.6																	112.4
Administration costs	8.3	33.2	28.8	24.5	17.6																	4864.8
TOTAL REFURBISHMENT COST	**8.3**	**320.6**	**929.1**	**2072.5**	**1534.3**																	
(excl. costs to Mar '88)																						
REPLACEMENTS (S)							6.0	12.0	18.0	24.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	390
(P)							2.0	3.9	5.9	7.8	9.8	11.8	13.7	15.7	17.6	19.6	21.6	23.5	25.5	27.4	29.4	235
Subtotal							8.0	15.9	23.9	31.8	39.8	41.8	43.7	45.7	47.6	49.6	51.6	53.5	55.5	57.4	59.4	625
REPAIRS							47.5	48.4	49.3	50.2	51.1	52.0	52.9	53.8	54.6	55.5	56.4	57.3	58.2	59.1	60.0	
MAINTENANCE							31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	
OPERATIONS																						
Water management							25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Operational maintnce							6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	
Water charge admin.							12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	
Subtotal							43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.1	
ADMINISTRATION (Legal,Policy)							4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	
TOTAL OPERATION COST							**134.3**	**143.1**	**152.0**	**160.8**	**169.7**	**172.6**	**175.4**	**178.3**	**181.0**	**183.9**	**186.8**	**189.6**	**192.5**	**195.3**	**198.2**	

MWDCCI 2650

Table C.1 : Cashflow of Scheme Expenditure (excluding Dams)

Appendix D. Brief for Manuherikia Irrigation Scheme Headworks Repairs

CIVIL DESIGN SECTION

JOB REQUISITION

Job Title: Manuherikia Irrigation Scheme major Repairs

Initiating Division: Water & Soil

Initiating Officer: DWSO

File Reference: 15/3 Financial Authority No: To Be Advised.

Date Required: 15 Sept 84

Related Reports, Sketches and Drawings

1) Repair estimates by CDO Dn 1983

2) Manuherikia Valley Irrigation. Report by CDO Dn of January 1984.

Site Information: (location, survey, foundations etc)

Description of and Comments on Work Required:
(include all design parameters, dimensions, loading, flows etc; if necessary continue on a separate sheet).

Requirement is for a detailed feasibility report on repair of the Manuherikia intake system from Ophir Gorge to the outlet of the Chatto Creek Syphon. The report to be of adequate status to be used for Government Approval in Principle and final approval. Costings must be of sufficient accuracy and detail to be used in a poll of irrigators.

Special conditions to be noted are

i) The opportunity for HEP generation exists if the gorge section is piped. This must be discussed with COEPB and any special provisions to utilise this opportunity should be seperately costed and identified in detail.

ii) Repairs must be worked around the irrigation season.

The above details are confirmed and approval is given to proceed with, feasibility report, investigations/design statement/final design/working drawings/specification/contract documents (NB final design and draughting to proceed only after approval of design statement.

DWSO 8/3/84

Signature of Initiating Section Head

in particular the irrigation supply must not be disrupted in the months September to March inclusive.

iii) A program of investigation, design and reports is required (together with an estimate of costs involved) by 30/3/84

iv) The feasibility report must include a detailed programme to complete design by 1/9/85 such that work may commence in the 85/86 construction season

v) It is desirable that the actual repair works take not more than 4 years to complete

vi) Throughout this feasibility report stage of work a monthly report (end of each month) of progress is required by DWSO.

General Observations are

i) Because of the limitations of farmer finance to pay for repairs the repairs must be to minimal cost (capital and O&M optimised) over a 40 year investment period. Nevertheless safety and security of supply (to standards consistent with horticultural use) must be maintained.

ii) Flexibility in design for future developments should be considered and agreed with DWSO before commitment.

iii) DWSO staff will handle farmer liason as necessary.

15/3/1

D.D.E, attention:-

Mr D Richards
DUNEDIN

MANUHERIKIA IRRIGATION SCHEME
HEADWORKS REPAIRS

Your note of 14 May 1984.

RISKS OF FAILURE

1 Standpoints

1.1 Reliability of repaired headworks needs not be significantly greater than reliability of main race but a little so, to allow for some improvements.

1.2 Probability and duration of acceptable outages during frost-fighting season (August-September-mid October) would theoretically only be attainable by works of a significantly heavier nature than envisaged so far. Incremental risks for orchardists should therefore be dealt with by on-farm storage considerations as an on-farm economic investment decision. (RBFC development loans are available for this type of work.)

1.3 Reliability requirements for combined power agreement could be greater, but in that case power should pay that part.

2 Service Requirements

2.1 Following 'acceptable' levels of risk are therefore for both pastoral and horticultural August-April and apply after "settling down" of capital repair works.

Annual Probability of Occurrence Within Season (August-April)	Acceptable Outage	Maximum Acceptable Cost of Repairs
	(days)	($)
— annually	5	—
0.20	7	*
0.10	7	*
0.05	20	*

* Total "repair" costs due to "events" (rather than normal O&M) should not result in a > 15% increase in water