John Anderson
Aqua Irrigation
(H)

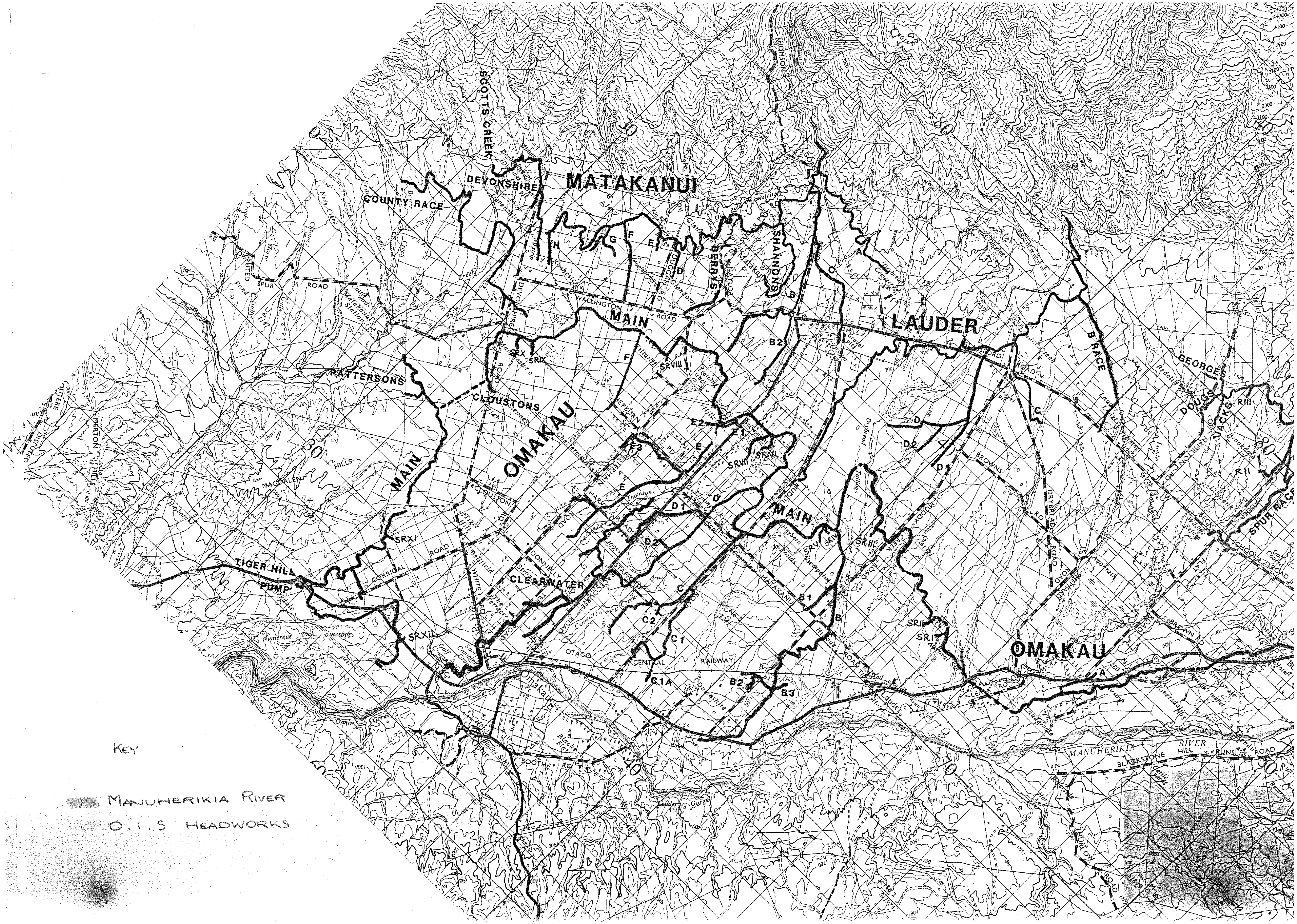
NATIONAL WATER AND SOIL
CONSERVATION AUTHORITY

REFURBISHMENT OF OMAKAU IRRIGATION SCHEME HEADWORKS

ENGINEERING FEASIBILITY REPORT

Ministry of Works
and Development Dunedin

Dec 1986



MATAKANUI
LAUDER
OMAKAU
OMAKAU
MAIN
MAIN
MAIN
SCOTTS CREEK
DEVONSHIRE
COUNTY RACE
PATTERSONS
CLOUSTONS
SHANNONS
BERRYS
B RACE
GEORGES
DOUGS
JACKS
SPUR RACE
TIGER HILL PUMP
CLEARWATER
SRX
SRIX
SRVIII
SRVII
SRVI
SRV
SRIV
SRIII
SRII
SRI
SRXI
SRXII
RIII
RII
B2
B1
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C1A
C1
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D1
D2
E1
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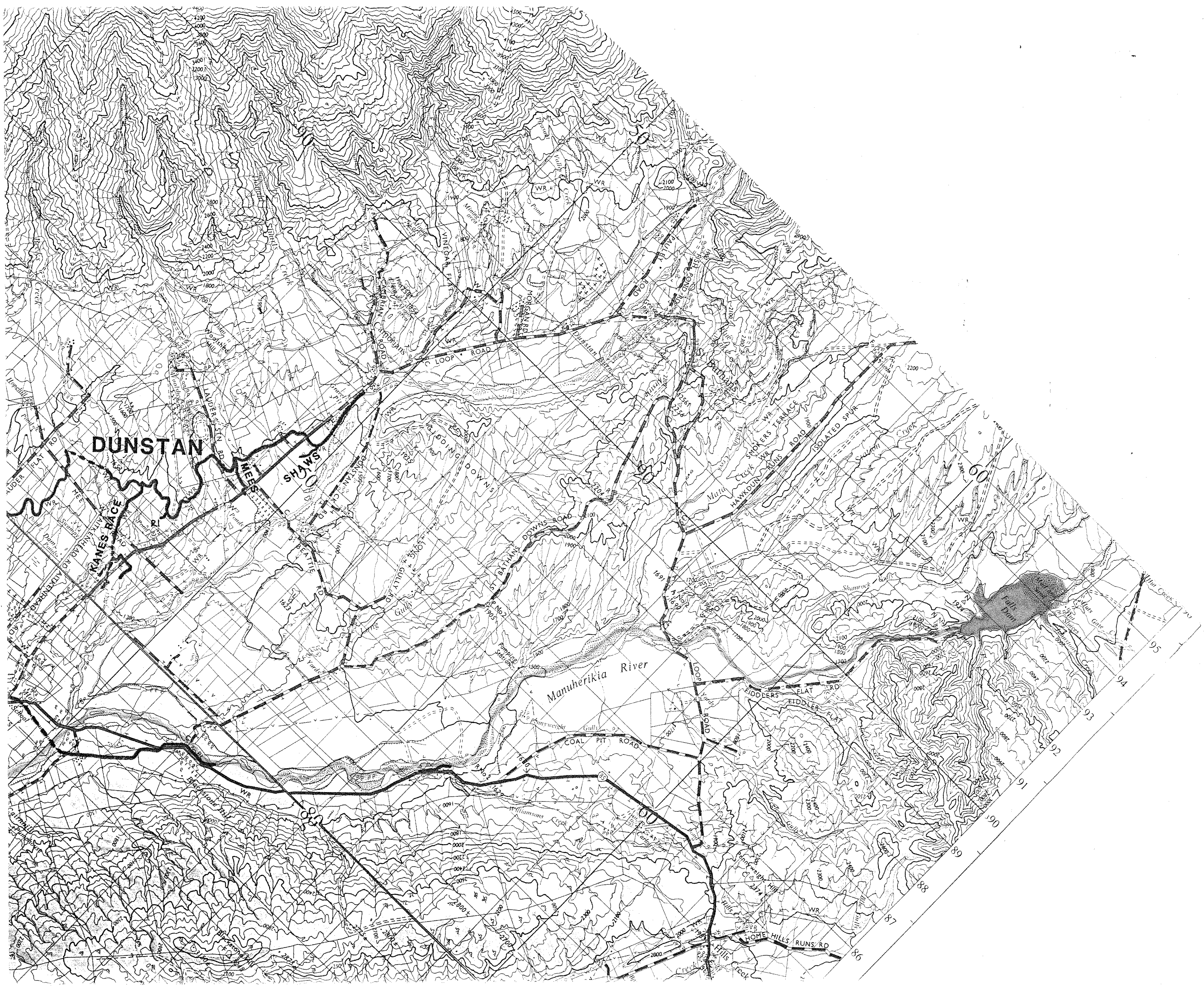
E3
KEY
MANUHERIKIA RIVER
O.I.S HEADWORKS



DUNSTAN
KANES RACE
MEES
SHAWS
LOOP ROAD
BEATTIE
ST BATHANS DOWNS ROAD
SHOWERS TERRACE
HAWKDUN RUNS ROAD
ISOLATED SPUR
St Bathans
Dunstan
Manuherikia River
Pumping Station
COAL PIT ROAD
FIDDLERS FLAT RD
FIDDLER FLAT
LOOP ROAD
Williamsons Creek
Falls Dam
Shamrock Gully
HOME HILLS RUNS RD
Hills Creek
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1 INTRODUCTION

1.1 GENERAL

This report has been produced in response to a request from the Water and Soil Directorate's Dunedin office for feasibility studies for the refurbishment of the primary structures in the headworks of the Omakau irrigation scheme, (Appendix 1). The study is to include Falls Dam.

It deals principally with the civil engineering works required to maintain the level of service as defined in the brief.

It is not the intention of this report to cover the agricultural or hydrological aspects of the scheme. Similarly the town and country planning aspects, farm extension work and scheme charging are not covered.

1.2 SCHEME DESCRIPTION

A general scheme description can be found in Chapter 1 of the preliminary Omakau Scheme Report (reference 4).

1.3 OBJECTIVES

The principal aim of this study is to identify the options which would satisfy the requirements of the Water and Soil brief. These are to recommend the most economic means of continuing the historical level of service of the scheme headworks up to the year 2000.

The scheme components covered in this report are those within the first 14.5 km of the Omakau main race, that is, from the intake structure to the flow control structure at distributary SRII.

The brief has defined the required level of service as the ability of the system to deliver a flow ranging from 0 cumecs to 2.1 cumecs throughout the headworks.

1.4 STANDARD OF WORKS

The standard of works for any proposed refurbishment is required to be in line with the existing scheme works and the definition of refurbishment works accepted for all Central Otago irrigation schemes under review.

2 REFURBISHMENT PROPOSAL

2.1 GENERAL

The engineering pre-feasibility report for the Omakau scheme (reference 3) has already forwarded a refurbishment proposal for the scheme as a whole. This report proposed solutions to problems that had been identified in the Phase 1 inventory. The work was carried out to ROC estimating standards. It has been assumed that all the primary structures requiring attention in the headworks were addressed in the pre-feasibility report. This report reassesses those problems previously identified and considers further solutions.

Due to the PAC estimating standard required in this report, some pre-feasibility solutions have changed.

The structures covered in this study are:

Falls Dam and Spillway
Omakau Main Race Intake Structures
Becks Syphon
Lauder Syphon

The problems that have been identified in the brief regarding these structures fall into two categories. These are given below.

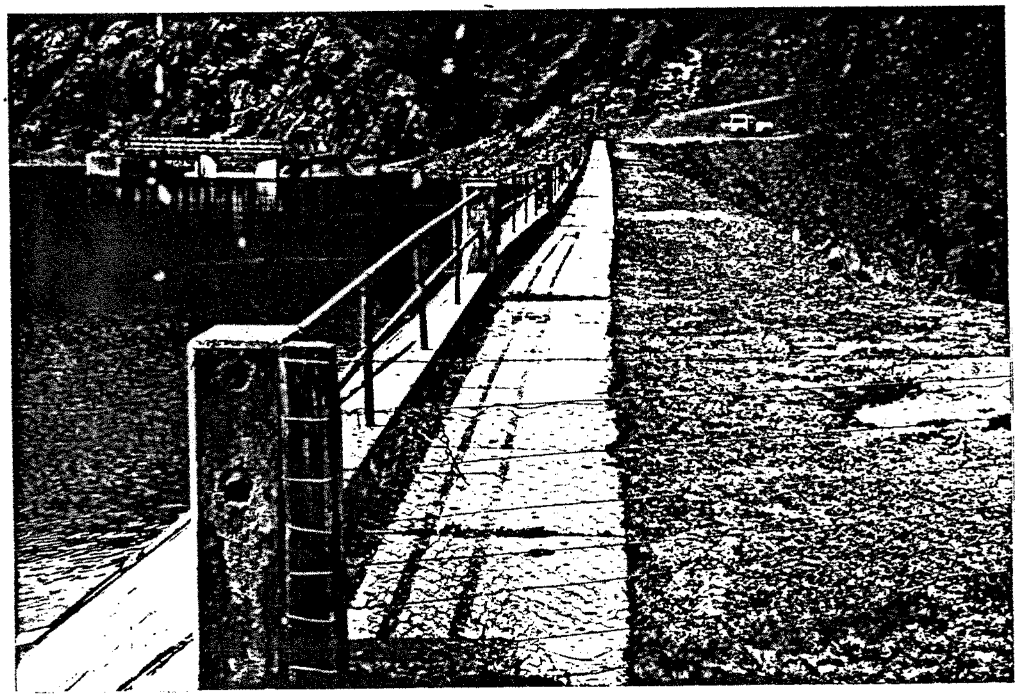
a The increasing probability of failure, or decreasing level of service of some primary structures.

b The operational efficiency of the intake and control system.

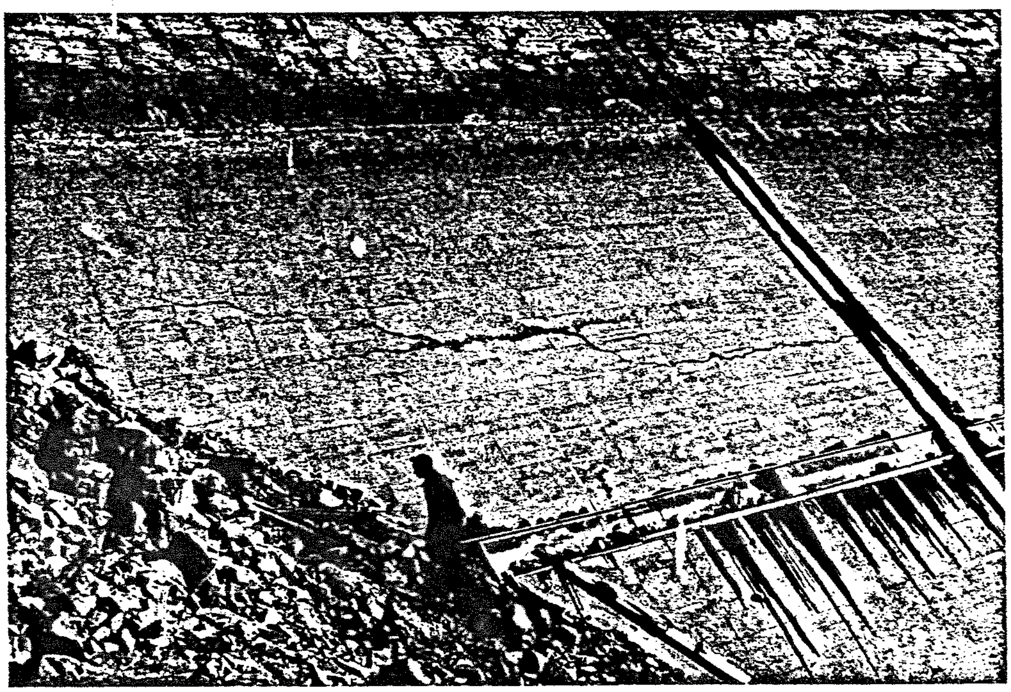
2.2 FALLS DAM

2.2.1 General

Falls Dam is situated approximately 20 km upstream of Becks on the Manuherikia River. It is a rock fill dam standing 33.5 metres above the stream bed and is faced with a reinforced concrete membrane on the upstream side. (Photograph 1). The flooding spillway is of the Morning Glory Hole type which is excavated through the rock of the left abutment and discharges 75 metres downstream of the toe of the dam. Irrigation water is drawn from the reservoir through a diversion tunnel and a needle valve and is discharged into the spillway tunnel.



Photograph 1 : Falls Dam



Photograph 2 : Dam Membrane

2.2.2 Dam Membrane

The dam membrane is in reasonably good condition. Because it is relied on to control the leakage from the dam it is important that the membrane is well maintained. With the dam full the leakage flow was observed and was estimated to be in the order of 10 litres/s. This flow is considered acceptable.

Problems associated with the dam membrane include minor cracking and surface damage generally above normal water level. The cracking of a panel adjacent to the left abutment has been caused by settlement but it is not considered a serious problem. The surface damage to the membrane is due to wave action at normal water-line where the concrete has been eroded, and frost-action above normal water-line where surface spalling has occurred.

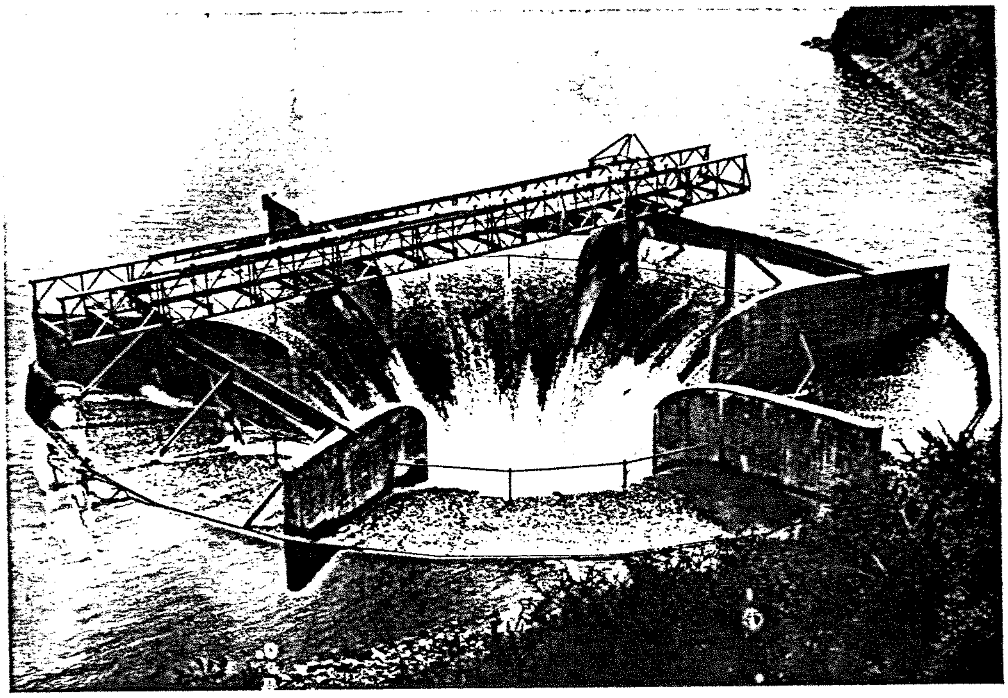
It is recommended that although the damage to the membrane is not major, repair work is warranted to ensure the impermeability of the membrane.

It appears that an attempt has been made in the past to repair the spalled areas. The repair concrete is now also spalling. Repairs in the future should utilise latex-modified concrete or a similar material which forms a good bond with old concrete. Furthermore, the water-cement ratio must be controlled to reduce shrinkage effects. Shrinkage in this environment may lead to a weakened bond and the intrusion of moisture. This would subsequently lead to spalling of the repair areas under frost conditions. This concrete should be used for both crack and surface repairs to ensure a durable and lasting repair.

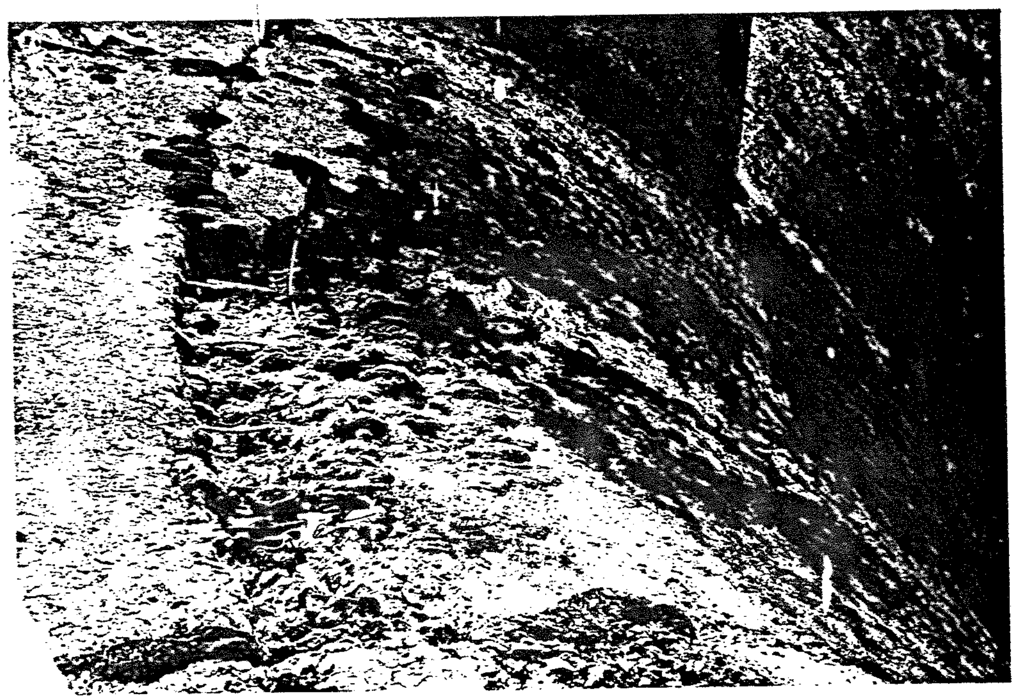
The construction joints between the concrete panels are required to be impermeable. At present the joints are sealed by copper strips cast into the concrete, filled with pitch and covered with a neoprene strip, (photograph 2).

When the lake level is low, the pitch heats up and flows down the joints. This has caused bulging and splitting in the neoprene seal. This seal will need to be modified in the near future to prevent movement in the pitch and prevent a potential leakage problem.

It is proposed that hardwood planks will be used to cover the joints. The insulating properties of the timber should prevent the pitch from melting. This system was originally used when the dam was built and is known to perform well.



Photograph 3 : Morning Glory Hole Spillway



Photograph 4 : Typical Damage to Spillway Lining

2.2.3 Glory Hole Spillway

The concrete lining of the spillway is badly worn in areas, especially around the bell mouth. Some panels have been badly eroded and at the construction joints frost action has aggravated the damage, exposing the reinforcing steel. (Photograph 3 and 4). If repairs are not carried out in the near future further damage will result.

The repairs involve chipping out the damaged areas back to clean concrete or rock and filling with latex-modified concrete. In the bad joints it will be necessary to tie the repair concrete back to the rock with steel rods to ensure the area is sound. Most panels will need some resurfacing to ensure a smooth surface. This will reduce the risk of cavitation. Remedial work to repair the lining is programmed for 1987. This work will be carried out by Operations and Maintenance staff from Alexandra Residency. At present $15 000 has been budgeted for the most urgent work. However, extensive work will be necessary in the near future to repair all damaged areas throughout the tunnel. A detailed inspection of the spillway was made in 1985 and it is summarised in reference 5.

A farmer's access track has at some time been installed between the spillway and the rock face by the left dam abutment. It is recommended that the level of this track where it passes the spillway and for at least 10 m on either side, be lowered to at least that of the intake wall and preferably down to platform level. This would enable water to be drawn from all sides evenly and not be restricted as it presently is. The present situation could promote serious damage to the spillway in high flood conditions because of dynamic effects.

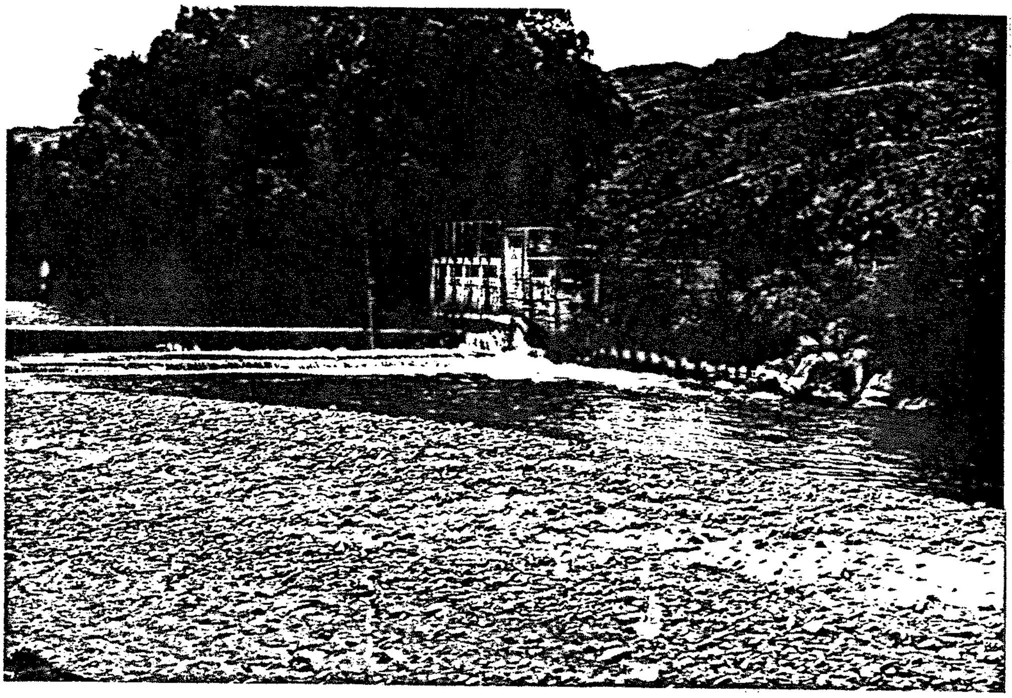
2.2.4 Mechanical Gear

The mechanical gear is in sound working condition. The nosing cone of the needle valve was replaced in 1986 as the old one had become severely cavitated.

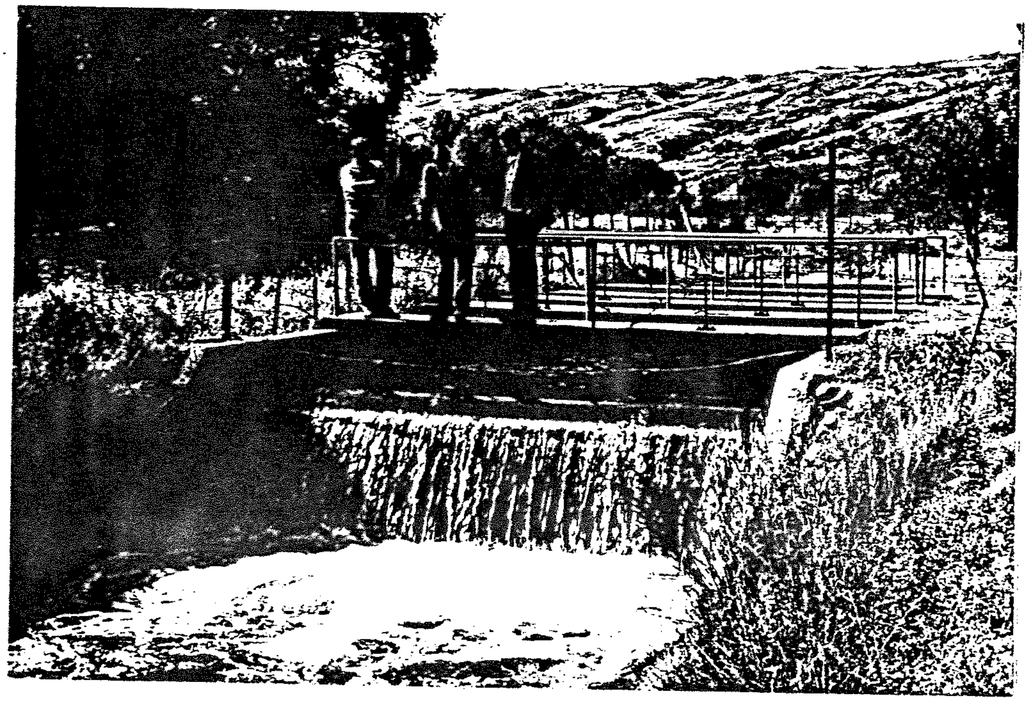
2.3 INTAKE STRUCTURES

2.3.1 General

The present intake structures for the Omakau main race comprise a concrete weir across the Manuherikia River, an intake structure behind the weir, a pipeline and a control structure (see figure 1). The control structure incorporates a measuring weir and silt-scour facilities.



Photograph 5 : Omakau Main Race Intake



Photograph 6 : Omakau Main Race Control Structure

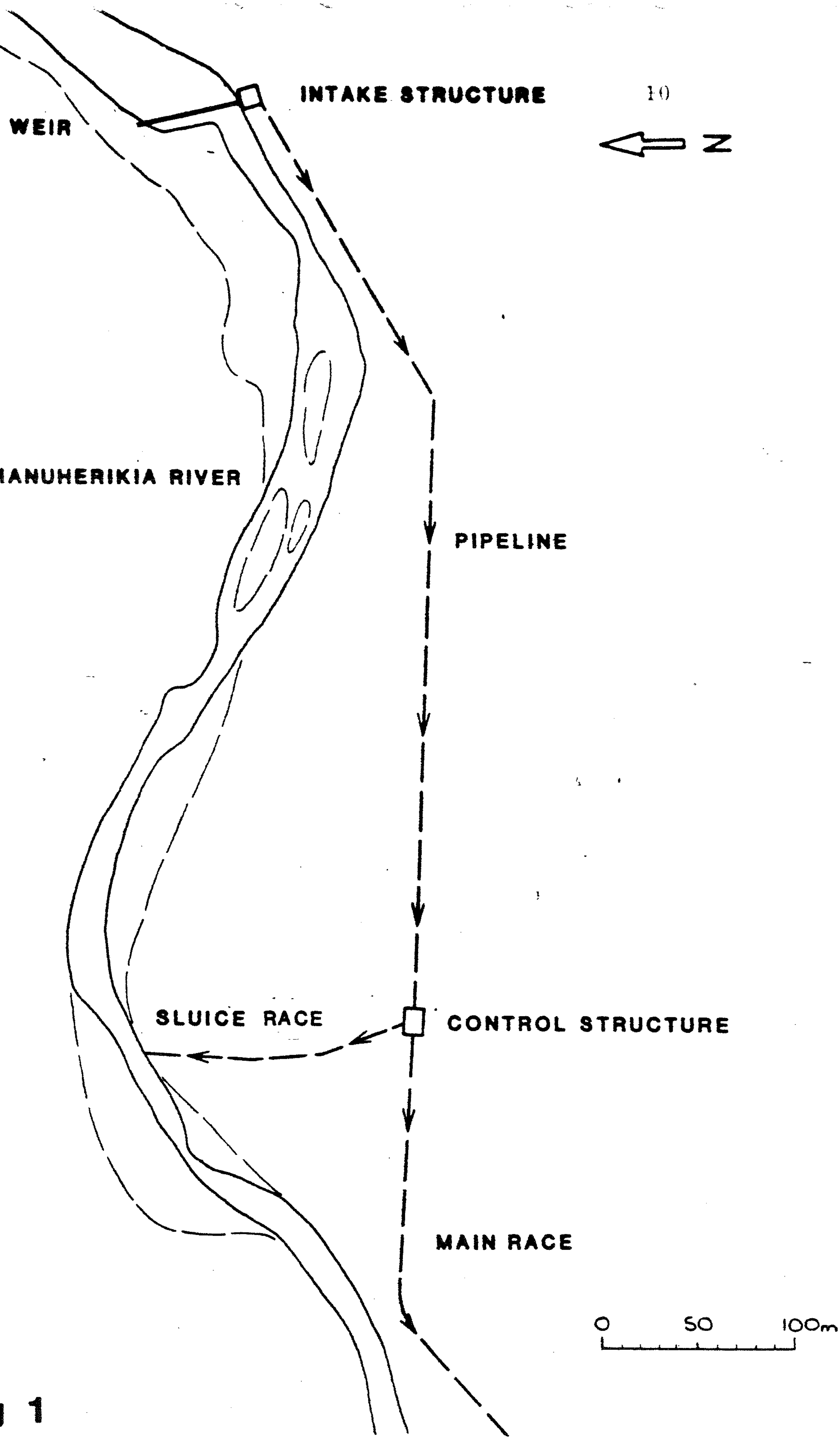


Fig 1

OMAKAU MAIN RACE INTAKE STRUCTURES

The intake system is required to carry out two functions. These are:

a To control the discharge into the race system, restricting the maximum discharge to 2.1 cumecs.

b To remove silts from the incoming water and discharge them back into the river.

2.3.2 Weir

The weir, although worn, still appears to be sound. There is evidence of significant scour on the downstream side and this may have been aggravated by the addition of a thick topping slab on part of the apron.

The only work proposed for the weir is to fill the scour hole with some large rock. The hole should be filled no higher than the surrounding bed level so that the problem does not merely move downstream further. This repair would best be carried out during summer when the river is low.

2.3.3 Intake Structure

The intake is a concrete structure with four steel knife gates set behind the weir. The gates and the structure are in good condition and only minor repairs are required to the concrete work. However, the major problem here is that there is no automatic throttling system to prevent increased flows entering the system when the river rises significantly. In a major flood, more than 3.0 cumecs could flow into the system which is designed for a maximum of only 2.1 cumecs.

When the river is low, the intake acts as a series of weirs. As the water level rises, the weirs drown out and begin to act as orifices. Under normal operation the intake acts as a series of orifices under little head. Generally only two gates are used to achieve a 2.1 cumec flow. As the river rises further, the change in head above the orifices causes a comparatively large increase in flow. The pipeline does not run full until 2.5 cumecs enters the intake and so it does not throttle the flow either.

Two solutions are available:

a Do nothing at the intake and remedy the situation downstream at the control structure.

b Total replacement using an overflow weir intake, silt-trap and bywash structure.

The options for the intake system as a whole are discussed in section 2.3.6.

2.3.4 Pipeline

This 610 m long 1.37 m diameter concrete pipe runs from the intake structure to the control structure.

All options considered below retain this pipeline.

Since the pipeline is normally under no head it is unlikely to fail catastrophically in the next 15 years. However at present there are several open joints and the invert is badly worn.

It is proposed therefore to repair the joints and the invert with either an epoxy mortar or latex-modified concrete to stop leakage and to ensure its integrity in the medium term.

2.3.5 Control Structure

This concrete structure is situated at the end of the intake pipeline. It has ten scour holes in the floor which drain into a scour channel leading back to the river. There is also a measuring weir in the downstream wall of the structure.

At present the control structure is used as a "fine-tuning" facility. Once the gates are set at the intake structure the scour gates at the control are partially opened to adjust the level of water behind the measuring weir and thus the flow down the main race.

The concrete work still appears structurally sound. However its silt-scour facility does not function properly. Currently only three of the ten scour holes are operable. These frequently become blocked and require hand-cleaning.

Because of the present operational difficulties it is proposed that a new silt-scour facility be incorporated into the control structure. This would involve removing the existing scour gates and demolishing the scour conduits. The existing scour channel would be extended back to the side wall of the control and three scour gates would be installed in the side wall. Since access must be retained across the channel, a new crossing must be provided.

2.3.6 Changes to Intake System

Whenever the river rises significantly the raceman is required to drive to the intake structure and either adjust or shut the intake gates. The result of overloading the system is localised flooding caused by overtopping, and scouring of the race banks.

Various options were considered for providing an automatic throttling system and bywash as proposed in section 2.3.3. These options involve:

1 Replacing the intake structure with one incorporating an overflow weir intake, silt-trap and bywash.

2 Retaining the intake structure and installing a bywash at the control structure. This would bypass excess flow into the extended scour channel.

3 Installing low level knife gates in the wall of the existing measuring weir and the bywash as described above in option 2. The measuring weir wall would be raised to the level of the side walls.

4 Replacing the present measuring weir with a battery of baffled radial gates. The bywash described earlier would also be used for this option.

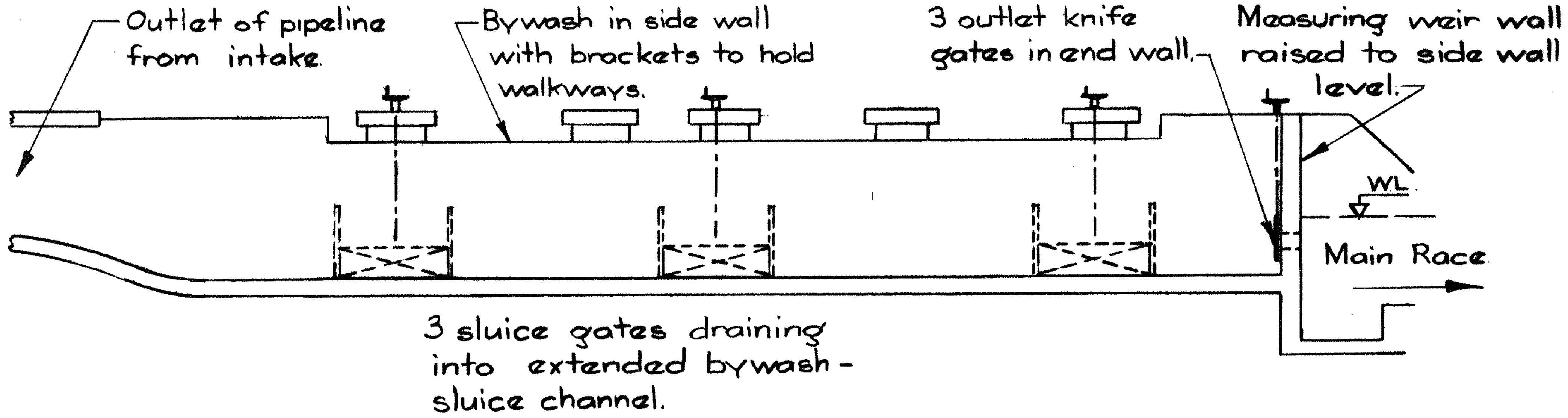
The PAC estimates for these options are included in Appendix 5 and head-discharge curves for the latter three options are in Appendix 2.

Comparing the four options it can be seen that Option 1 would be the best hydraulic solution but also the most expensive. Option 2 is the least cost option and also the least favourable option hydraulically. With the present geometry of the control structure, matching a weir bywash against the measuring weir gives an insufficient control of the flow in the race.

Option 3 is considered the best option. It provides an adequate throttling of the flow under a flood situation and is considerably cheaper than options 1 and 4. There is a good matching of the weir against the gates which results in efficient bywashing and good control of in-race flows.

However, the construction cost of this work (excluding the cost of the new silt-scour gates) would be $23 500. The operational cost of the present manual system over the next 20 years (discounted at 10%) was estimated conservatively as $10 200. (Appendix 3).

This operation cost is not high enough to warrant improvements to the intake system. Therefore it is recommended that a "status quo" option be adopted and that the present means of operation be retained. The new scour gates should still be installed and the scour race extended.



OMAKAU MAIN RACE DESILTER / CONTROL STRUCTURE

Showing alterations required for option 3

SIDE ELEVATION

Not to scale.

Figure 2

2.4 BECKS SYPHON

This syphon is a 1130 m long concrete and concrete-lined steel pipeline which crosses the Manuherikia River, (Figure 2). The structure was listed as of "major" concern in the Phase 1 report.

The first stage is a 40 m long 910 mm diameter concrete section down to the river. This section is leaking badly and it is proposed that it be replaced with RCRRJ pipes. A new intake with improved hydraulic performance should be installed to ensure drowning and reduce air entrainment.

The second stage consists of 157 m of 910 mm diameter concrete-lined steel pipe on concrete pedestals across the river. This section is in a satisfactory condition with little visible corrosion and no significant leakage. This section should last through the refurbishment period given some maintenance to the flanged joints and the expansion joint.

The final section consists of 217 m of 910 mm diameter and 716 m of 1070 mm diameter concrete pipe. This section appears to be in good condition with no obvious signs of leakage. At present, this section needs no work.

2.5 LAUDER SYPHON

This syphon is 1630 m long and crosses Lauder Creek. It consists of concrete and concrete-lined steel pipes. (Figure 3). Repairs to this structure were considered "urgent" by the Phase 1 report.

The first stage of the syphon is an 873 m long 1070 mm diameter concrete pipeline. Leakage from parts of this section has caused the ground to become swampy. As is the case with most of the concrete syphons on this scheme, the pipes are rigid jointed. The pipes are plain-ended with a concrete coupling and concrete plastered joints. Hardwood pegs were used during construction to centre the couplings. These are now rotting out resulting in leaks. This leakage is saturating the surrounding ground causing the pipes to settle thereby aggravating settlement and leakage. Concrete blocks have been cast around some of the worst joints but these repairs have generally been unsuccessful. Plastering the inside of the joints with an epoxy mortar is another method being used. This is more successful but the joint remains rigid. The repair is susceptible to further cracking if more settlement takes place.

The bottom 70 m of the downhill leg of this section are leaking quite badly and this has resulted in small slumps and large cavities where the bedding and cover material has been washed out. The extent of the undermining of these pipes is not known. It is quite possible that this section could fail in the next few years. This section therefore from a manhole near station 11720 to the bottom of the hill at station 11790 should be replaced.

STA 12200-12310 at the end of this section should also be replaced. This length is buried in an embankment about 2 m high and leakage has been aggravated by serious settlement. Numerous concrete blocks have been cast around leaking joints. Many of these blocks are now cracked and leaking badly.

The second stage is a 910 mm diameter concrete-lined steel pipeline 233 m long, crossing the creek on low pedestals. The spread of willow trees across the creek bed has led to aggradation of the bed, reducing the clearance beneath the pipeline. In the past, floodwaters have backed up behind the pipeline, threatening to move it off its pedestals.

Ten pipes in this section have recently been replaced with 910 mm diameter plain steel pipes and a channel has been excavated downstream of the syphon to accelerate the creek flow through the willows.

Investigations were carried out on the remaining original steel pipes to assess their condition. The steel condition was assessed using a UTM 20 thickness meter and the concrete lining by visual inspection.

In general the steel is in good condition and little corrosion has taken place over the years. The corrosion that has occurred is localised, resulting in pin-holes which the thickness meter could not detect. It therefore is difficult to predict whether or not a certain pipe will fail. The investigation showed however that there would be sufficient steel thickness surrounding a failed area to make a satisfactory repair.

The concrete lining is not in good condition. The invert area is badly worn in most pipes, especially towards the joints. In the pipes which were damaged in a blow-out, the lining is in worse condition with large areas of concrete having spalled. The concrete lining however does not greatly affect the performance of the structure and with continued maintenance as required, this section of the pipeline should last through the refurbishment period without replacement.

It is possible that the pipeline could be damaged again by a flood even though excavation of a clear river channel has reduced this risk considerably. Consideration was given to either burying the line, raising the pedestals or relocating the pipeline altogether. However, until it is necessary to replace the majority of the remaining pipes, it is not considered necessary to move the pipeline. A remedial solution would be either to fix the pipes to the pedestals or to drive railways irons into the riverbed on the downstream side of the pipeline.

It is recommended that a hydrological study be carried out on Lauder-Creek in the vicinity of the syphon. If this study can show that there is a significant risk to the pipeline then it should be moved. A contingency sum for burying the pipeline is included in the estimates, (Appendix 5).

The third stage of the syphon is a 524 m long 1070 mm diameter concrete pipeline and is in good condition. There are two obvious leaks that need to be repaired. One is under the highway embankment near the bend in the pipe and the other is close to the access road to the DSIR station. These pipes may be cracked and may need to be replaced. Apart from this, no other work is necessary on this section.

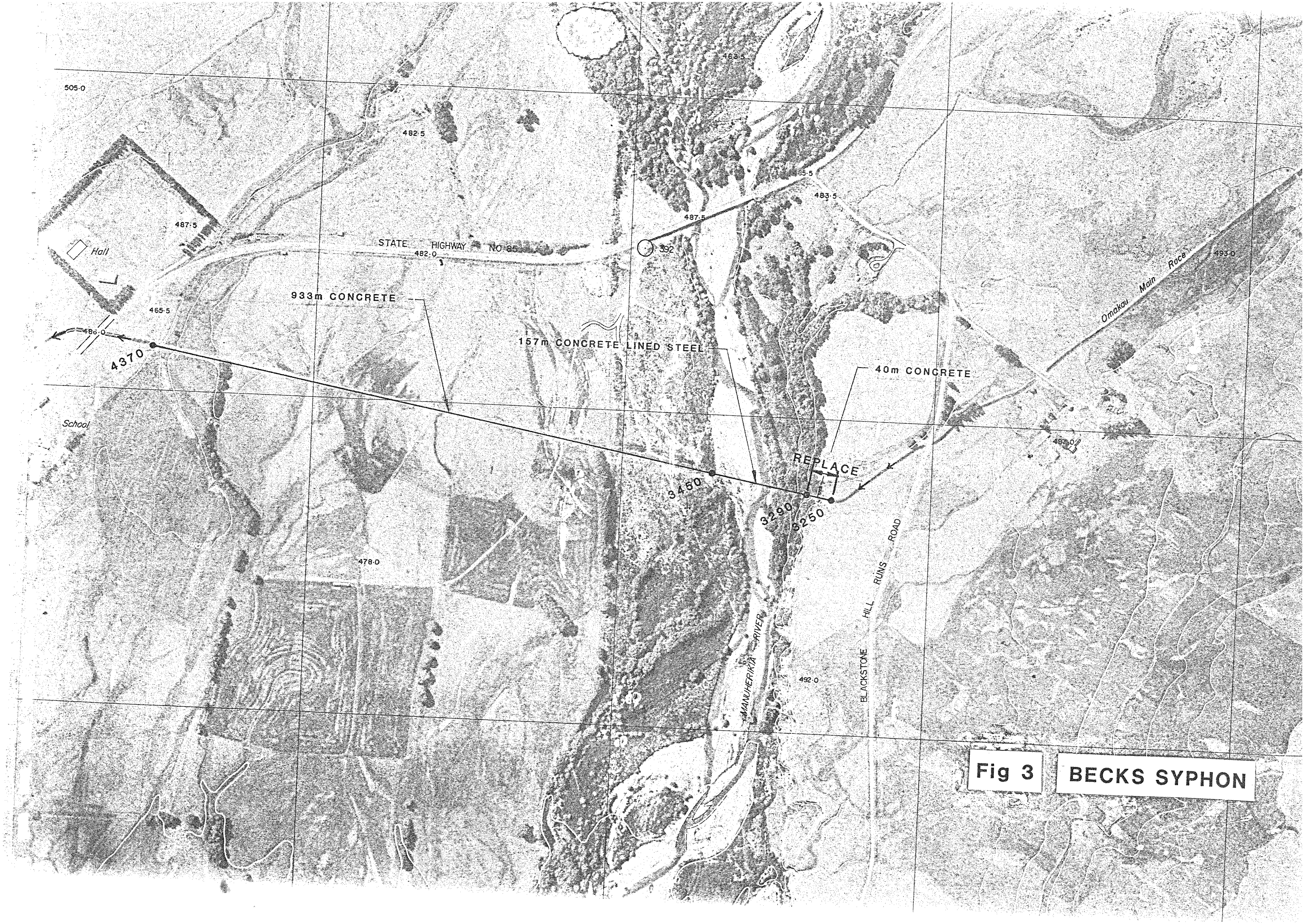


Fig 3 BECKS SYPHON

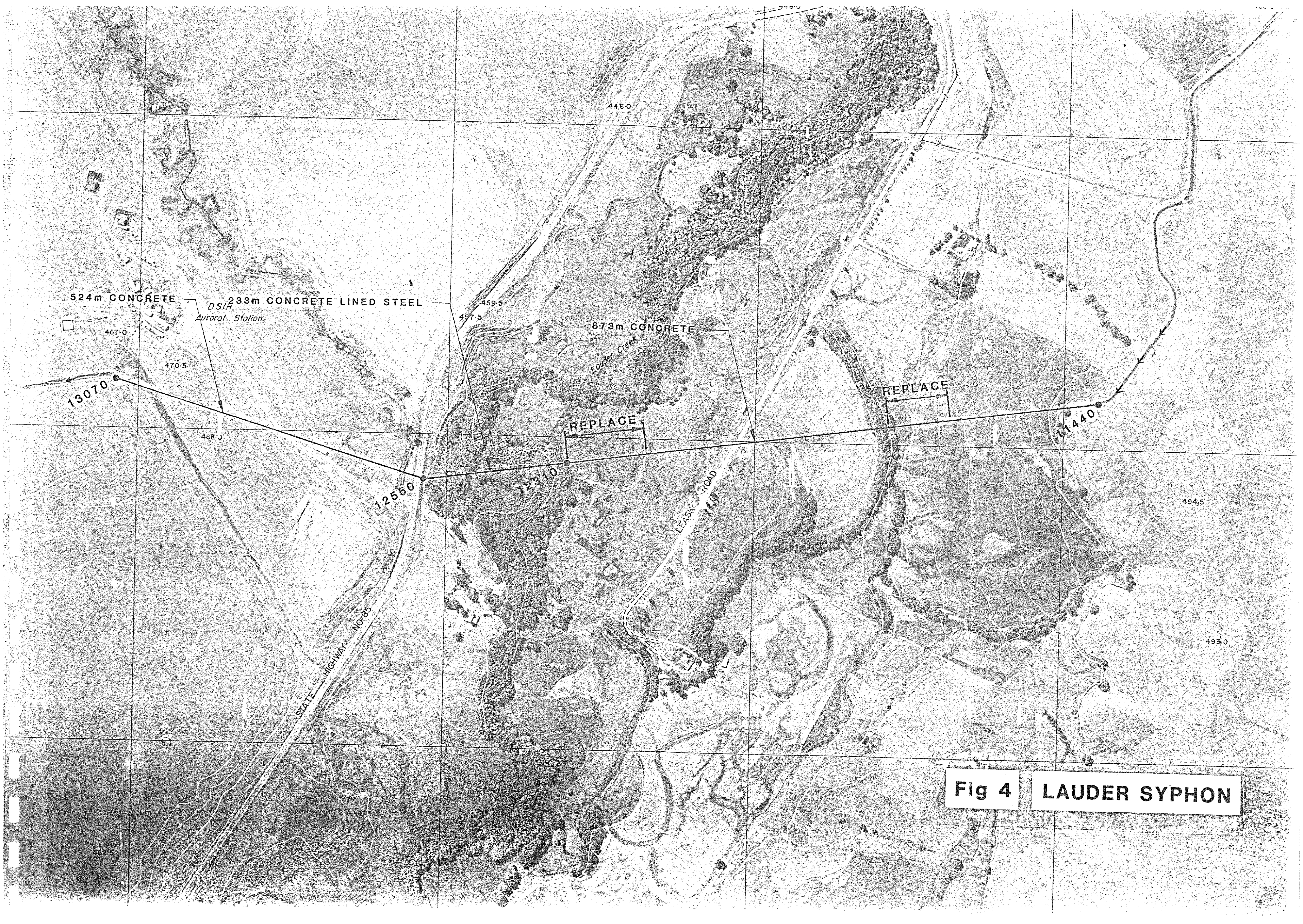


Fig 4 LAUDER SYPHON

3 CONCLUSIONS AND RECOMMENDATIONS

3.1 SUMMARY OF WORKS

The civil engineering works required to maintain the level of service defined in the brief are summarised below.

1. The upstream concrete membrane of Falls Dam requires minor repairs. The joint sealing system should be repaired. The spillway lining is in need of major refurbishment, in the way of filling eroded construction joints and resurfacing the concrete panels.

2. The intake system as a whole needs only minor repairs. A scour hole downstream of the intake weir should be filled. The intake structure and pipeline require only minor concrete repairs. The major cost item is in installing new scour gates at the control structure.

3. The first 40 m of Becks Syphon should be replaced using 900 mm RCRRJ pipes. The inlet should also be replaced.

4. Two sections in the first leg of Lauder Syphon require replacement. These sections combined consist of 180 m of 1075 mm RCRRJ pipes.

3.2 ESTIMATED COSTS

The estimated costs are based on a Ministry of Works and Development Construction Cost Index of 2650. No allowance has been made for the Goods and Services Tax. The costs have been estimated to Preliminary Assessed Cost standard. The estimate for each scheme item includes a contingency sum of 15%.

Engineering on-costs and client on-costs have been estimated for the work and the percentages are similar to those estimated in comparative reports. The scope of the engineering on-costs is shown below:

Investigation	0.9%
Design	5.4%
Construction Supervision	5.7%
Commissioning	0.5%
Engineering On-cost	12.5%

The on-costs have been included as a percentage of the basic construction estimate on the table below. They do not appear on the individual estimate sheets.

The estimates for Option 1 for the intake system and for repairing the Falls Dam spillway were based on work carried out by D W Richards.

Scheme Item	Cost $
Falls Dam and Spillway	360 000
Intake Structures ("status quo")	29 500
Becks Syphon	30 500
Lauder Syphon	122 000
Subtotal	542 000
Engineering on costs (12.5%)	67 500
Client on costs (2.5%)	13 500
TOTAL CONSTRUCTION ESTIMATE	623 000
Likely range (-5%, +15%)	$592 000 - $716 000

3.3 IMPLEMENTATION OF WORKS

The failure or decreased level of service of Falls Dam, Lauder Syphon or Becks Syphon would affect virtually all irrigators who take water from the Omakau main race. Therefore it is recommended that all the above works be carried out as soon as possible.

Prepared by G H Webb 5/2/87
Assistant Engineer

Confirmed by G N Martin 13/2/87
District Water and Soil Officer

Recommended by D I Jackson 16.2.87
District Design Engineer

Approved by R B Frost 20.2.87
District Civil Engineer

Head Office Audit Approval:

Refer Telex N187 HO-DN
of 11 February 1987

REFERENCES

1 Richards D W and Walsh I G (1984), Manuherikia Valley Irrigation - Pre-feasibility Report on Civil Engineering Aspects of Irrigation Options; Civil Design, MWD, Dunedin.

2 Rhodes K et al (1985), Omakau Irrigation Scheme, Review of Old Central Otago Irrigation Schemes, Phase 1, Scheme Description and Inventory of Components; Alexandra Residency, MWD.

3 Mulvihill P T (1985), Refurbishment of Omakau Irrigation Scheme, Pre-feasibility Report; Civil Design, MWD, Dunedin.

4 Meldrum G (1985), Refurbishment of Old Central Otago Irrigation Schemes, Omakau Scheme Report, Preliminary; Water and Soil, MWD, Dunedin.

5 Richards D W (1985), Falls Dam, Report on Site Visit of 24 April 1985; Civil Design, MWD, Dunedin

LIST OF APPENDICES

REFURBISHMENT OF OLD CENTRAL OTAGO IRRIGATION SCHEMES

OMAKAU IRRIGATION SCHEME MAIN RACE

Brief to DDE, Dunedin.

1 INTRODUCTION

This brief outlines the requirements for engineering feasibility studies for refurbishing Falls Dam and the first 13 km of the main race of the Omakau irrigation scheme.

2 SCOPE OF BRIEF

This study will address the refurbishment of primary works to preliminary assessed cost estimate standard. Specifically this brief applies to works for Falls Dam and for Omakau main race from the intake on the Manuherikia river to the flow control structure for distributary race SR II.

The definition for refurbishment works is;

The minimum necessary work to ensure the level of service defined in this brief at least cost can be provided until the year 2000. Changes to the existing supply works should be considered when an alternative form offers either.

a The minimum cost option for replacing the works with a residual life of less than 15 years, or

b Is the most economic means of continuing supply.

In this context 'most economic', means greatest nett present value discounted at say 10% for all costs and benefits over a period of 20 years.

This brief will specifically address recommendations a and b of section 4.2 of the "Refurbishment of Old Central Otago Irrigation Schemes - Omakau Scheme Report - Preliminary," ie, in particular Falls Dam, the intake and Lauder syphon and any significant associated problems with the race system.

3 LEVEL OF SERVICE

The level of service to the area served by the Omakau main race is constrained by the Manuherikia River water resource. The main race system capacity is stated in the scheme report as 7500 m^3/hr (2.1 m^3/s). This is the design flow to be delivered from the intake to the flow control structure at distributary SR II. This system can be expected to operate at this capacity for the irrigation season from the 1 September to 30 April the following year. The flow range is 0-2.1 m^3/s. The operating requirements of SR I and SR II flow control structures will be advised if considered relevant during the study.

The study will address operation of the intake and desilter structures to determine the most economic means of continuing supply. The position of, eg, bywashes and the operation of the Omakau main race system as a whole will be reviewed in subsequent briefs along with the secondary structures such as turnouts and access crossings.

4 REPORTING REQUIREMENTS

The results of this study will be presented in a report by 21 November 1986. For the purposes of this brief the client is the Water and Soil Directorate Refurbishment Supervisor, Gary Dent. Richard Kolkman is the Water and Soil Directorate Job Manager and is the day to day contact for technical, financial and programme matters.

COPY OF MEMORANDUM FROM WATER AND SOIL TO CIVIL DESIGN

15/24

OMAKAU I.S. POST PHASE II STUDIES

Re your memo of 17.10.86.

Continuous flows are required at the intake/desilter structure. In practice this would require say, 5 cusec (140 l/s) incremental flows from 15 cusecs (425 l/s) to a maximum of 75 cusecs (2100 l/s) or a similar arrangement if one gate is inpractical to give continuous flows and multiples are required.

Multiple gates were not originally envisaged as being necessary as it was assumed that a single gate with weir combination would allow variable flows if these were required. A variable control is necessary so that when irrigation demand is low (concurrently river levels will be relatively high) the required amount of water can be passed at the desilter.

Richard Kolkman

20 October 1986

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COPY OF MEMORANDUM FROM WATER AND SOIL TO CIVIL DESIGN

15/24

OMAKAU POST PHASE II HEADWORKS STUDIES

Re our discussion of 28.10.86.

The replacement of the weir at the desilter by sluice gates or neyrpic gate is not considered to be an improvement to the scheme as the additional cost will be offset by a reduction in operational cost as flood flows will be effectively bywashed.

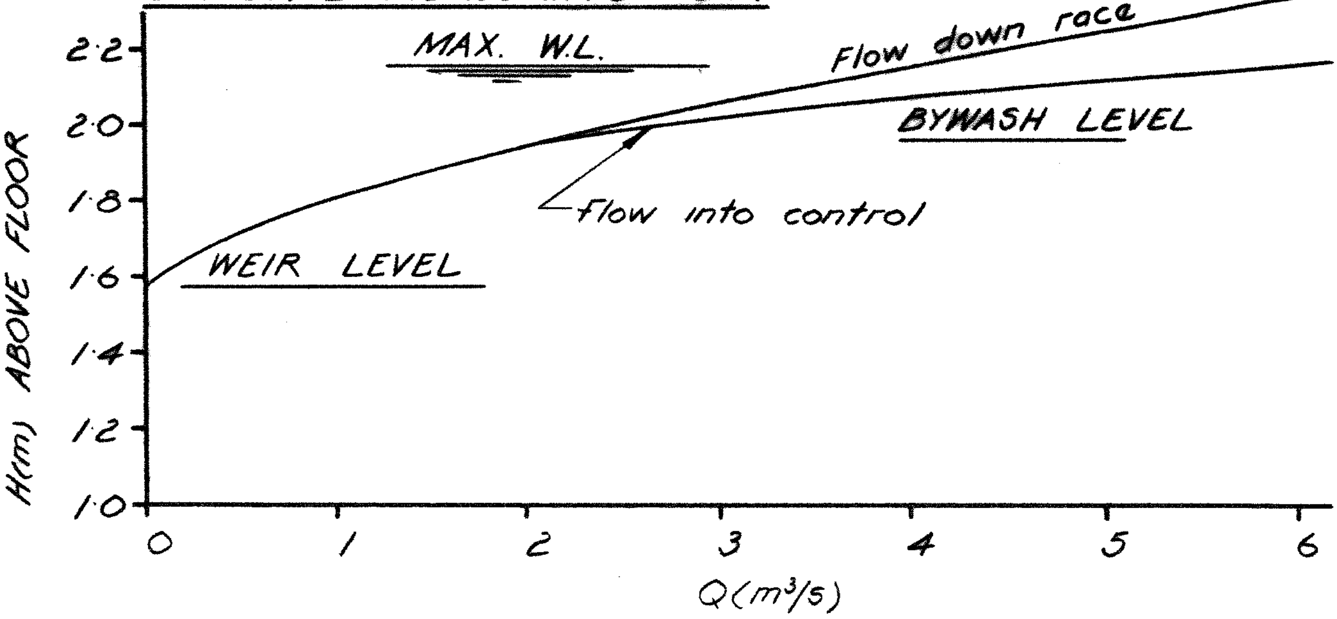
Hence this work is appropriate under the current headworks brief.

R Kolkman
Water and Soil

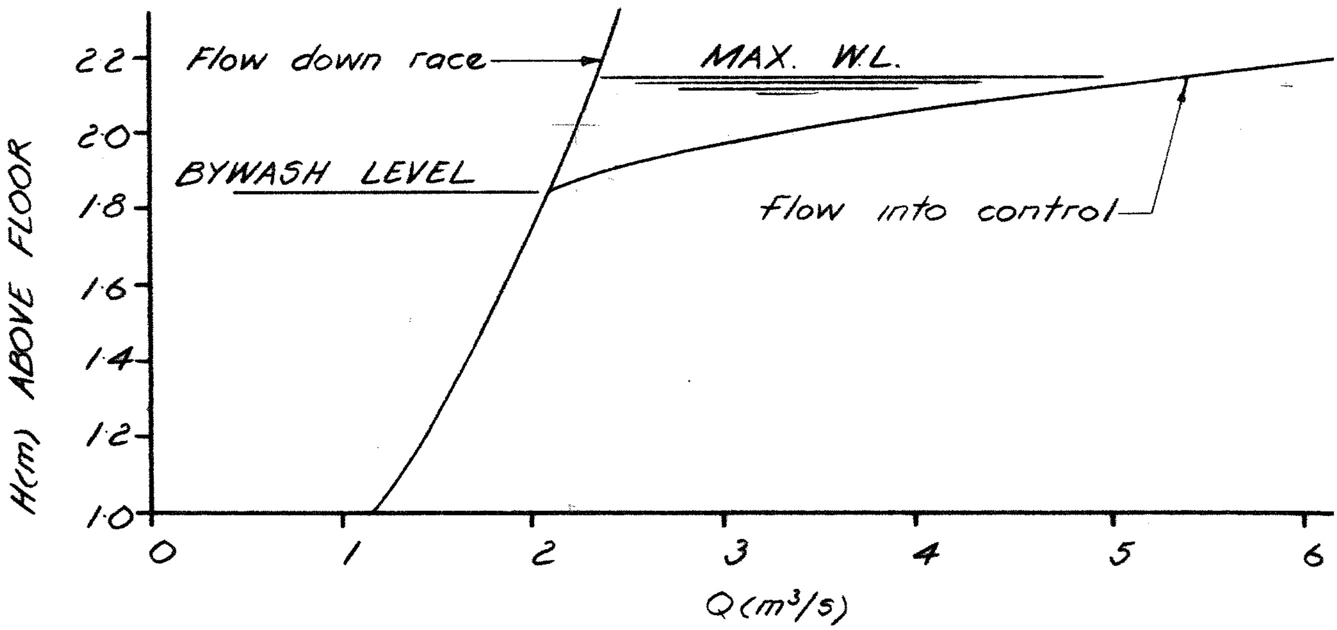
5 November 1986

HEAD DISCHARGE CURVES FOR REFURBISHED CONTROL STRUCTUR
(ASSUMING A 10·0m LONG BYWASH WEIR)

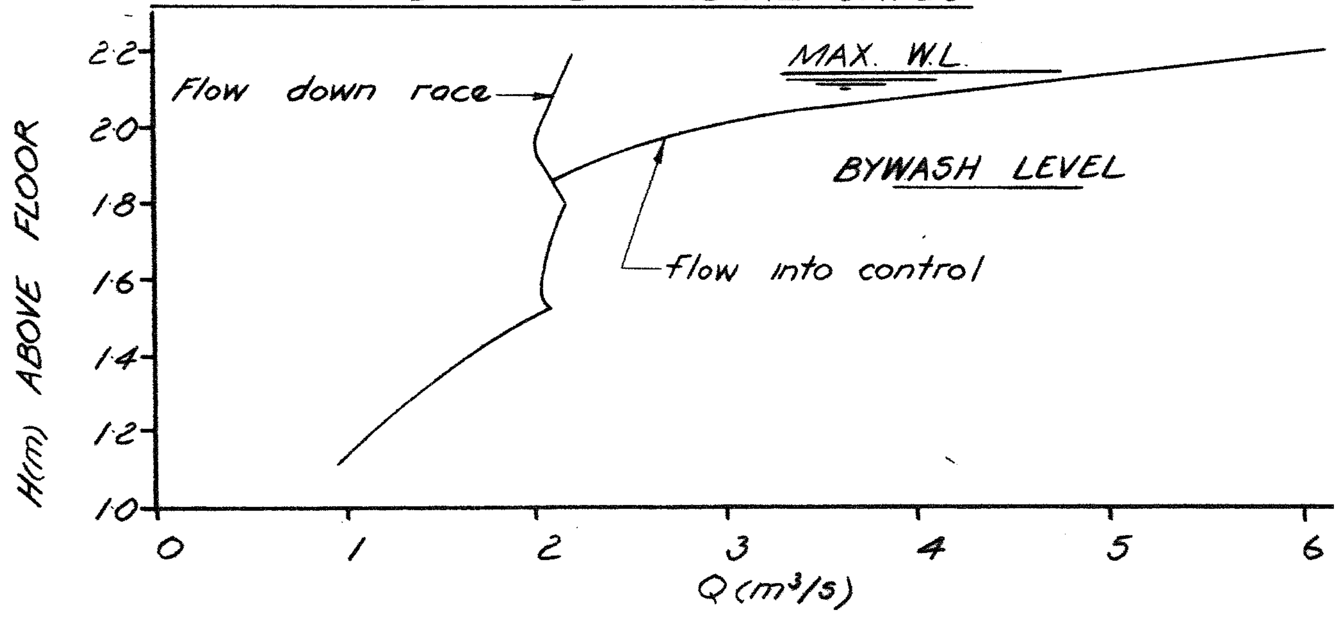
OPTION 2 : MEASURING WEIR



OPTION 3 : KNIFE GATES



OPTION 4 : BAFFLED RADIAL GATES



CONTROL STRUCTURE - ASSESSED OPERATING COSTS BEFORE AND AFTER REFURBISHMENT

At Present

- Raceman Charge-Out Rate

  say $\frac{20\ 000 \times 1.9}{1540} = \$25/hr$

  ∴ for a callout outside normal working hours $50/hr

- Assume time to drive to intake, shut gates, and return will be 1.5 hours including 50 km travel.

- Cost of one callout = (1.5 x $50) + (50 x $0.40) = $95
  say $100/callout

- Over irrigation season (October-March = 6 months) expect
  say 2 callouts per month = 12 callouts per season
  $1200/season

- Total cost over 20 years discounted at 10%
  Present Value = $1200 x 8.514 = <u>$10 200</u>

After Refurbishment

- Cost of callouts outside working hours = $0

- Cost of refurbishing control structure to include:

  Bywash
  extended sluice race
  knife gate outlets
  access crossing

  is approximately <u>$23 500</u> (from estimates)

A4(i)

15/24

16 September 1986

① → GKWEBB

② → (F)

Mr P Mathewson
Civil Design Office
DUNEDIN

OMAKAU IRRIGATION SCHEME
LAUDER SYPHON INVESTIGATIONS

Thickness tests were taken at random along the welded steel pipeline section of the above irrigation scheme. The measurements were recorded using a UTM 20 thickness meter.

About three quarters of these measurements were recorded at various spots around the outside circumference of the pipe. The other quarter of the line is lying in a swamp with only the top half of the pipe being accessible to take measurements. The condition of this buried section is not known.

The thickness measurements recorded along the pipeline form a pattern. The bottom sections WHERE accessible to get readings seem about the same as those recorded on the top and sides.

It was observed one section of pipe had isolated pinholes along the bottom section. Measurements recorded surrounding these pinholes showed the steel thickness satisfactory to the rest of the line.

As these pinholes are small in diameter the ultrasonic probe could only pick up the "peaks" of the internal corrosion. This means the "valleys" the thin areas of this corrosion type can go undetected. The extent of this internal pitting which can lead to isolated pinholing is very hard to determine as the pipes are concrete lined.

Of all the thickness measurements recorded no measurement was under 2 mm.

The bitumen coating on the exterior of the pipes from the bottom to halfway up the sides is in reasonable condition. The top sides have weathered over the years but the corrosion is only surface. The only sign of pitting is around the flanges underneath vegetation covering the pipe and where the pipe is submerged in the swamp.

Overall this steel welded pipeline is in reasonable condition as to the years of service it has provided. The condition of the pipe wall thickness is that if minor repairs were required there would be sufficient steel thickness surrounding the failed area to make a satisfactory on site repair.

B W Wilson
Inspector Steel Structures

A5

Ministry of Works and Development

OFFICE: DUNEDIN CIVIL DESIGN

FILE:	Sh 1 of 8 shs
STATUS: ~~XXXXXXX~~/Preliminary assessment/~~XXXXXXXX~~	
PURPOSE: Appraisal/~~XXXXXXXXXXXXXXXXXX~~	

	Prepared	Checked	Date
Quantities	[signature]	[signature]	2/12/86
Rates—extn			2/12/86
Approved:	[signature]		5/2/87

ESTIMATE OIS : Headworks Refurb. Falls Dam and Spillway

Dwg: CCI = 2650 Recomd: [signature]

No.	Item	Unit	Quantity	Rate	$	$
1	ESTABLISHMENT					20 000 00
2	REPAIRS TO DAM MEMBRANE					
2.1	Concrete Repairs	LS			8 300 00	
2.2	Replace Joint Seals	m	650	40	26 000 00	34 300 00
3	SPILLWAY REPAIRS					
3.1	Scaffolding	m²	2500	16	40 000 00	
3.2	Compressor and Air Tools	day	60	720	43 200 00	
3.3	Generator	day	80	200	16 000 00	
3.4	Crane	day	80	485	38 800 00	
3.5	Excavator	day	2	500	1 000 00	
3.6	Concrete and Steel Supply	m³	120	350	42 000 00	
3.7	Transport to and from site	day	80	300	24 000 00	
3.8	Labour	day	80	675	54 000 00	259 000 00
	Subtotal					313 300 00
	Contingencies (15%)					46 700 00
	TOTAL ESTIMATE					360 000 00

Ministry of Works and Development

OFFICE: Dunedin Civil Design

FILE: | Sh 2 of 8 shs

STATUS: XXXXXXXX/Preliminary assessment/XXXXXXXXXX

PURPOSE: Appraisal/XXXXXXXXXXXXXX/Contract

ESTIMATE OIS : Headworks & Reburb.
Intake Structures- Option 1

Dwg: CCI = 2650 Recomd: [signature]

	Prepared	Checked	Date
Quantities	[signature]	[signature]	2/12/86
Rates—extn			2/12/86
Approved:		[signature]	5/2/87

No.	Item	Unit	Quantity	Rate	$	$
1	ESTABLISHMENT	LS				6 000 00
2	INTAKE STRUCTURE					
2.1	Demolish Present Structure	LS			3 000 00	
2.2	Structural Concrete	m³	75	900	67 500 00	
2.3	Baffled Gates - Supply and Install	LS			13 000 00	
2.4	Sluice Gates - Supply and Install	ea	2	3000	6 000 00	
2.5	Walkways - Supply and Install	LS			1 000 00	90 500 00
3	PIPELINE					
3.1	Fill Joints and Repair Invert	m	610	6.5		4 000 00
4	CONTROL STRUCTURE					
4.1	Excavation	m³	80	5	400 00	
4.2	Demolish Existing Sluices	LS			1 500 00	
4.3	Concrete for Sluice Extension	m³	7	900	6 300 00	
4.4	Sluice Gates - Supply and Install	ea	3	3000	9 000 00	
4.5	Access Crossing	LS			2 000 00	19 200 00
	Sub Total					119 700 00
	Contingencies (15%)					18 300 00
	TOTAL ESTIMATE					138 000 00

Ministry of Works and Development

OFFICE: Dunedin Civil Design

FILE: | Sh 3 of 8 shs

STATUS: XXXXXXXXX Preliminary assessment XXXXXXXXX

PURPOSE: Appraisal XXXXXXXXXXXXXXXXXX

	Prepared	Checked	Date
Quantities	[signature]	[signature]	2/12/86
Rates—extn			2/12/86
Approved:	[signature]		5/2/87

ESTIMATE

OIS : Headworks Refurb.

Intake Structures - Option 2

Dwg: CCI = 2650 Recomd: [signature]

No.	Item	Unit	Quantity	Rate	$	$
1	ESTABLISHMENT					1 500.00
2	INTAKE STRUCTURE					
2.1	Concrete and Scour Repairs	LS				1 000.00
3	PIPELINE JOINTS					
3.1	Fill Joints and Repair Invert	m	610	6.5		4 000.00
4	CONTROL STRUCTURE					
4.1	Excavation	m^3	80	5	400.00	
4.2	Demolish Existing Sluices	LS			1 500.00	
4.3	Concrete for Sluice Extension	m^3	9	900	8 100.00	
4.4	Sluice Gates - Supply and Install	ea	3	3000	9 000.00	
4.5	Access Crossing	LS			2 000.00	
4.6	Install Bywash	LS			1 000.00	22 000.00
	Sub Total					28 500.00
	Contingencies (15%)					4 500.00
	TOTAL ESTIMATE					33 000.00

PW 376A (Rev. 12/82)

23431E—1,000pads/9/84MK

Ministry of Works and Development

OFFICE: Dunedin Civil Design

FILE: | Sh 4 of 8 shs

STATUS: ~~Project~~/Preliminary assessment/~~Final estimate~~

PURPOSE: Appraisal/~~Financial authority/Contract~~

	Prepared	Checked	Date
Quantities	[signature]	G.J.A	2/12/86
Rates—extn			2/12/86
Approved:	[signature]		5/2/87

ESTIMATE

OIS : Headworks Refurb.

Intake Structures- Option 3

Dwg: CCI = 2650 Recomd: [signature]

No.	Item	Unit	Quantity	Rate	$	$
1	ESTABLISHMENT					2 500 00
2	INTAKE STRUCTURE					
2.1	Concrete and Scour Repairs	LS				1 000 00
3	PIPELINE					
3.1	Fill Joints and Repair Invert	m	610	6.5		4 000 00
4	CONTROL STRUCTURE					
4.1	Excavation	m^3	80	5	400 00	
4.2	Demolish Existing Sluices	LS			1 500 00	
4.3	Concrete for Sluice Extension	m^3	9	900	8 100 00	
4.4	Sluice Gates - Supply and Install	ea	3	3000	9 000 00	
4.5	Access Crossing	LS			2 000 00	
4.6	Install Bywash	LS			1 000 00	
4.7	Knife Gates - Supply and Install	ea	3	3000	9 000 00	
4.8	Downstream Baffle	LS			1 400 00	32 400 00
	Sub Total					39 900 00
	Contingencies (15%)					6 100 00
	TOTAL ESTIMATE					46 000 00

Ministry of Works and Development

OFFICE: Dunedin Civil Design

FILE:	Sh 5 of 8 shs
STATUS: Rough cost/Preliminary assessment/Firm estimate	
PURPOSE: Appraisal/Financial authority/Contract	

	Prepared	Checked	Date
Quantities	[signature]	[signature]	2/12/86
Rates—extn			2/12/86
Approved:		[signature]	5/2/87

ESTIMATE

OIS : Headworks Refurb.

Intake Structures- Option 4

Dwg: CCI = 2650 Recomd: [signature]

No.	Item	Unit	Quantity	Rate	$	$
1	ESTABLISHMENT					2 500 00
2	INTAKE STRUCTURE					
2.1	Concrete and Scour Repairs	LS				1 000 00
3	PIPELINE					
3.1	Fill Joints and Repair Invert	m	610	6.5		4 000 00
4	CONTROL STRUCTURE					
4.1	Excavation	m^3	80	5	400 00	
4.2	Demolish Existing Sluices	LS			1 500 00	
4.3	Concrete for Sluice Extension	m^3	9	900	8 100 00	
4.4	Sluice Gates - Supply and Install	ea	3	3000	9 000 00	
4.5	Access Crossing	LS			2 000 00	
4.6	Install Bywash	LS			1 000 00	
4.7	Baffled Gates - Supply and Install	LS			16 500 00	38 500 00
	Sub Total					46 000 00
	Contingencies (15%)					7 000 00
	TOTAL ESTIMATE					53 000 00

Ministry of Works and Development

OFFICE: Dunedin Civil Design

FILE: | Sh 6 of 8 shs

STATUS: ~~Rough cost~~/Preliminary assessment/~~Firm estimate~~

PURPOSE: Appraisal/~~Financial authority/Contract~~

	Prepared	Checked	Date
Quantities	[signature]	[signature]	2/12/86
Rates—extn			2/12/86
Approved:		[signature]	5/2/87

ESTIMATE

OIS : Headworks Refurb.

Intake Structures

'Status Quo' Option

Dwg: CCI= 2650 Recomd: [signature]

No.	Item	Unit	Quantity	Rate	$	$
1	ESTABLISHMENT					1 500 00
2	INTAKE STRUCTURE					
2.1	Concrete and Scour Repairs	LS				1 000 00
3	PIPELINE					
3.1	Fill Joints and Repair Invert	m	610	6.5		4 000 00
4	CONTROL STRUCTURE					
4.1	Excavation	m^3	80	5	400 00	
4.2	Demolish Existing Sluices	LS			1 500 00	
4.3	Concrete for Sluice Extension	m^3	7	900	6 300 00	
4.4	Sluice Gates - Supply and Install	ea	3	3000	9 000 00	
4.5	Access Crossing	LS			2 000 00	19 200 00
	Sub Total					25 700 00
	Contingencies (15%)					3 800 00
	TOTAL ESTIMATE					29 500 00

PW 376A (Rev. 12/82) 23431E—1,000pads/9/84MK

Ministry of Works and Development

OFFICE: Dunedin Civil Design

FILE:		Sh 7 of 8 shs
STATUS: ~~Roughcost~~/Preliminary assessment/~~Firm estimate~~		
PURPOSE: Appraisal/~~Financial authority/Contract~~		

	Prepared	Checked	Date
Quantities			2/12/86
Rates—extn			2/12/86
Approved:			5/2/87

ESTIMATE

OIS : Headworks Refurb.

Becks Syphon

Dwg: CCI = 2650 Recomd:

No.	Item	Unit	Quantity	Rate	$	$
1	ESTABLISHMENT					1 500 00
2	DEMOLITION					
2.1	Remove Existing Pipes and Intake	LS				1 000 00
3	PIPEWORK 900 mm RCRRJ					
3.1	Supply and Lay Pipes	m	40	375		15 000 00
4	CONCRETE					
4.1	Intake Structure	m^3	4.5	900	4 050 00	
4.2	Anchor Blocks, Cut off Collars	m^3	5.5	900	4 950 00	9 000 00
	Sub Total					26 500 00
	Contingencies (15%)					4 000 00
	TOTAL ESTIMATE					30 500 00

PW 376A (Rev. 12/82)

23431E—1,000pads/9/84MK

Ministry of Works and Development

OFFICE: Dunedin Civil Design

FILE: | Sh 8 of 8 shs

STATUS: ~~Rough Cost~~/Preliminary assessment/~~Firm Estimate~~

PURPOSE: Appraisal/~~Financial Authority/Contract~~

ESTIMATE

OIS : Headworks Refurb.

Lauder Syphon

Dwg: CCI = 2650   Recomd:

	Prepared	Checked	Date
Quantities			2/12/86
Rates—extn			2/12/86
Approved:			5/12/87

No.	Item	Unit	Quantity	Rate	$	$
1	ESTABLISHMENT					5 000 00
2	DEMOLITION					
2.1	Remove Existing Pipes and Intake	LS				4 000 00
3	PIPEWORK - 1075 RCRRJ					
3.1	STA 11720 - 11790 : Supply and Lay	m	70	450	31 500 00	
3.2	STA 12200 - 12310 : Supply and Lay	m	110	450	49 500 00	81 000 00
4	CONCRETE					
4.1	Intake Structure	m^3	5	900	4 500 00	
4.2	Anchor Blocks, Cut off Collars	m^3	11	900	9 900 00	14 400 00
5	REPAIR OF LEAKS					
5.1	Concrete Pipe Repairs - Third Stage	LS				1 500 00
	Sub total					105 900 00
	General Contingencies (15%)					16 100 00
	Sub Total					122 000 00
	Contingency sum for new buried					
	stream crossing					
	STA 12310 - 12540 : Supply and Lay					
	900 mm steel pipe	m	230	900	207 000 00	
	Anchor blocks	m^3	3.3	900	3 000 00	210 000 00
	TOTAL ESTIMATE					332 000 00