WATER & SOIL

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Waimea East Irrigation Scheme Information Booklet

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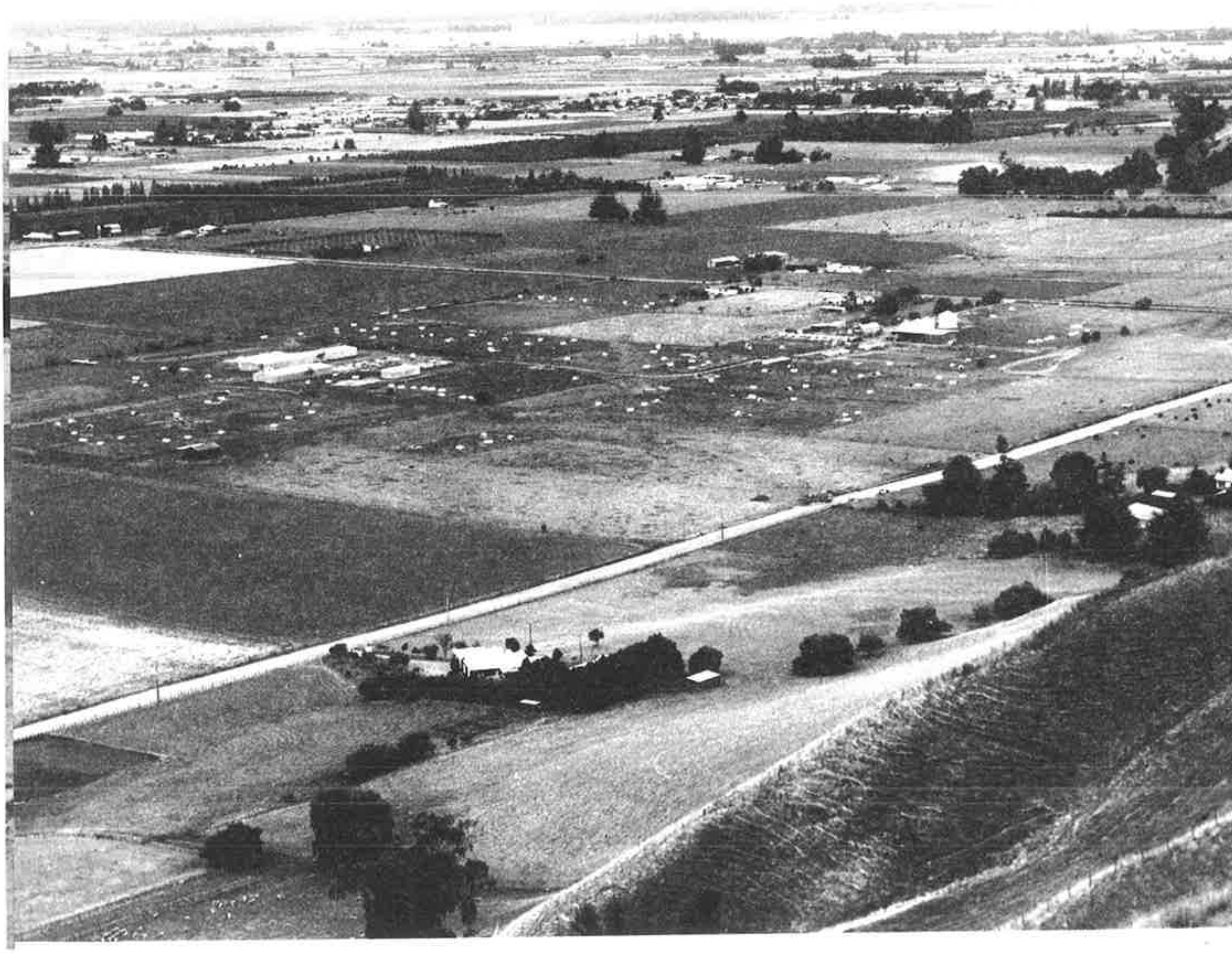

WATER & SOIL MISCELLANEOUS PUBLICATION NO. 16

Waimea East Irrigation Scheme Information Booklet

Prepared by the

District Commissioner of Works, Wellington

assisted by the

Nelson Committee of Officials for
Irrigation and Rural Water Supply
and the
Ministry of Agriculture and Fisheries

WELLINGTON 1980

Waimea East Irrigation Scheme Information Booklet

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Section 1 gives the current Government policy on commercial irrigation schemes.

Section 2 describes in detail the proposed Waimea East Irrigation Scheme.

Section 3 outlines briefly the conditions for on-farm development assistance.

An Appendix (contributed by MAF) gives on-farm design examples for the Waimea East Scheme.

A map at 1:16 000 shows the scheme coverage and individual properties.

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Contents

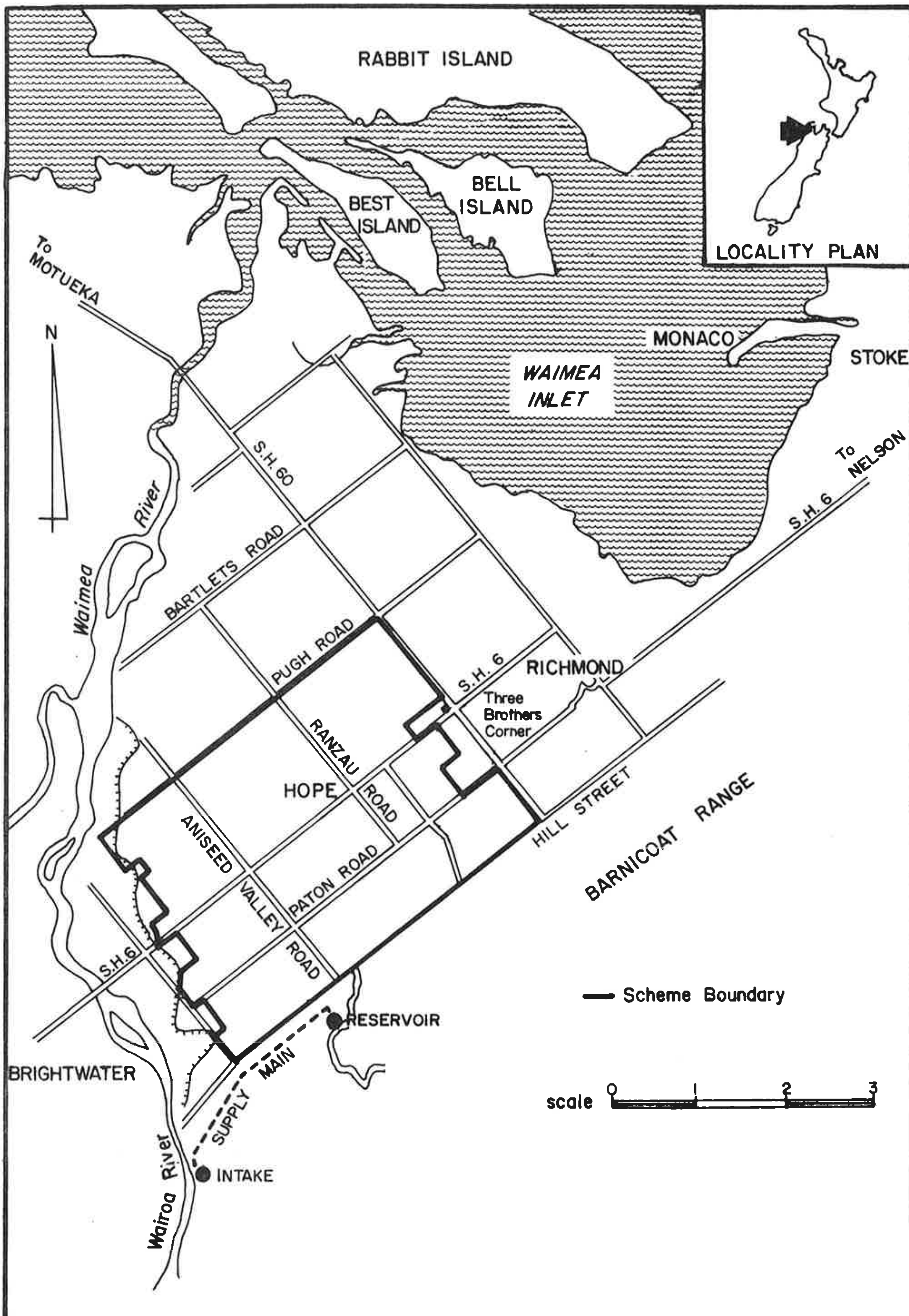


Figure 1 Locality map

Waimea East Irrigation Scheme
Summary of Information

Scheme Area	1157 hectares (2859 acres)
(Area of properties larger than 2 hectares)	
Assessed Irrigable Area	1100 hectares (2718 acres)
Design water application rates	
Spray application	38mm (1½") per week
Trickle application	28mm (1⅛") per week

Design flow rates

Spray – 38mm applied using 2 × 11hr sets per day, 7 days per week

Trickle – 28mm applied over 24hr per day, 7 days per week

Supply pressure (generally)	320kPa (45psi)
Total number of water units available	2450
(1 water unit = 1 cubic metre per hour)	
Irrigation season	15 September to 30 April

SECTION 1
Government Irrigation Policy

1.1 General

The Public Works Amendment Act 1975 states current Government policy on irrigation.

This amendment was passed to encourage communal irrigation schemes, and provides both initial capital and grants for the investigation of possible schemes and the construction of approved schemes.

To gain approval a scheme must show a satisfactory economic return on the capital invested, both to the nation and to the individual, in terms of increased productive potential.

If initial investigations show that a scheme is worthwhile to the nation, a landowner poll is held to gauge support for the scheme and a 60% majority in favour is required for the scheme to proceed any further.

The Act requires that initial charges for water and conditions of supply be set prior to this poll. These charges are fixed for seven years after water is made available to all landowners. No charge is made for water during the first two years and during the five following years the charges rise gradually to those fixed and advertised. Subsequent adjustments can be made as necessary to recover actual costs.

To ensure the recovery of non-grant Government capital a minimum charge per hectare is set for all irrigable land within a proposed scheme. Additionally the cost of supplying water to irrigators must be recovered (see Sections 1.4.1 and 1.4.2).

1.2 Government grants

1.2.1 Headworks

The total cost of the construction of the headworks is paid for by the Government. Headworks include dams and reservoirs, main supply pipelines, and pumps.

1.2.2 Distribution works

These include all the pipes, canals, valves, and controls that are used to distribute the water from the headworks to the boundaries of individual properties.

Initially they are all paid for by Government grant. However one half of the total cost of these works is recovered over a forty year period. Interest is charged on the outstanding amount at current Rural Bank and Finance Corporation (RBFC) rates, so that this is really a Government loan to the scheme with a forty year term.

1.2.3 On-farm development

Grants for on-farm work depend upon whether the item is fixed, e.g. a buried main, or whether it is portable, e.g. a hand move spray line.

Fixed items receive a Government grant of 50%; in this case in the form of a suspensory loan which will be written off after 10 years provided the original occupier or his immediate family remain owners of the land for that period.

Finance for portable items and the second half of the cost of fixed items is available from RBFC subject to its normal terms and conditions for development lending.

No Government grant is available for portable items.

1.2.4 Overall finance

Figure 2 shows how the total finance of a scheme (such as Waimea East) is provided. The estimated cost of on-farm development is based on developing the whole irrigable area from scratch.

1.3 Irrigation District

Before a poll of the landowners in a proposed irrigation scheme can be conducted the Act requires that an *Irrigation District* comprising all properties in the scheme is formally and legally defined.

This enables a roll of all ratepayers within the Irrigation District to be compiled. All ratepayers who own 2 hectares (4.94 acres) or more are entitled to vote in the poll, and must pay the Basic Charge if the scheme proceeds.

1.4 Scheme Charges

These charges, originally advertised at the time of the poll, are set to cover the cost of supplying water and to recover half the cost of the distribution works (see Section 1.2.2).

1.4.1 Water Availability Charge

This is the charge paid by irrigators in the scheme, and is a *charge per water unit.* It is a *contractual* charge made on the basis of *agreed allocation* of water and *not* on usage of water.

A Water Availability Agreement is drawn up

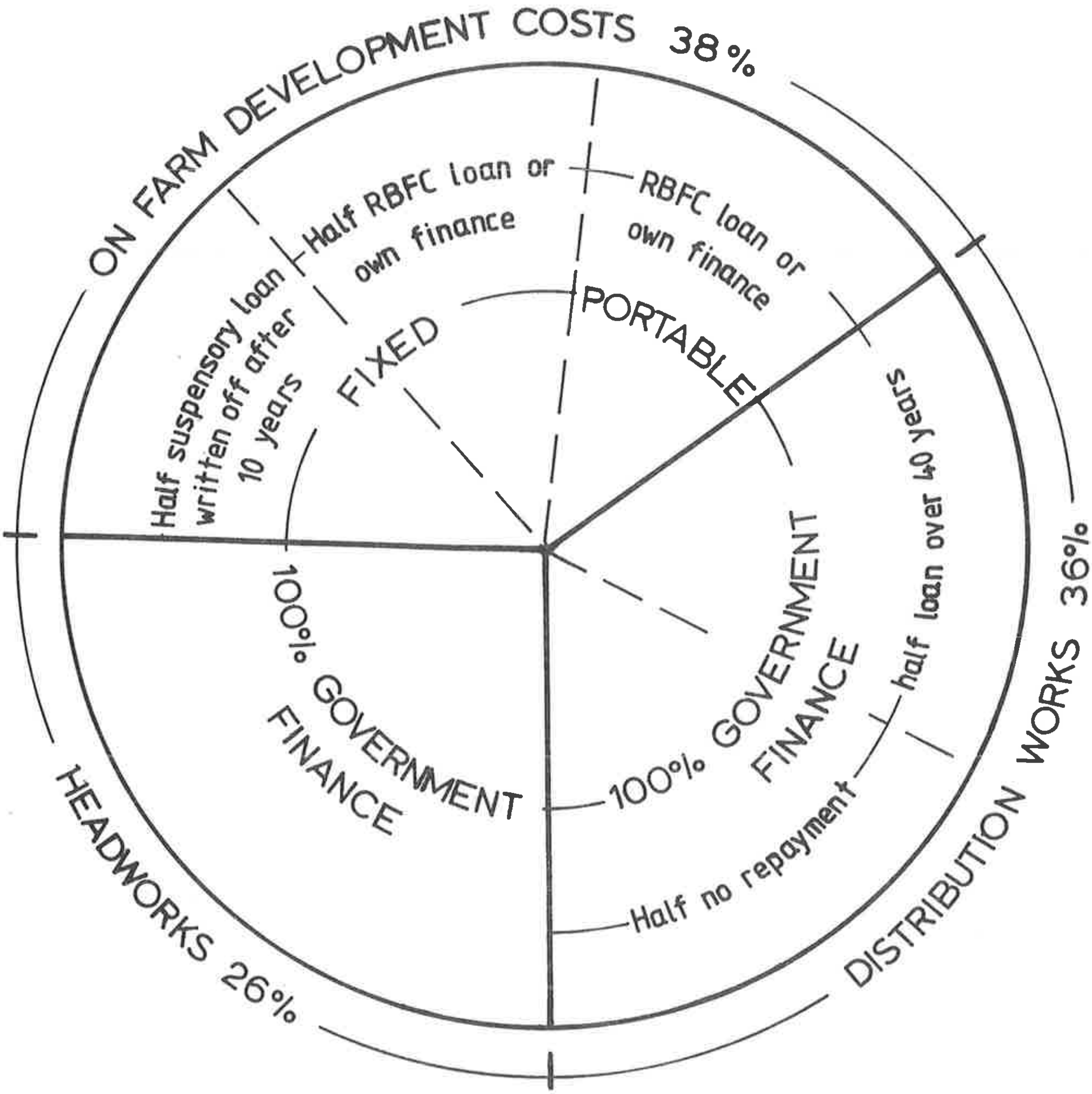


Figure 2 Finance diagram

This shows how the different components of a scheme are financed. The percentages are based on the Waimea East Irrigation Scheme.

for each irrigator and co-signed by him and the Minister of Works and Development. This states the number of water units which will be available to the farmer and the conditions of supply (e.g. pressure, flow rate) and requires the irrigator to agree to pay for these water units, irrespective of whether he uses only part of the flow for part of the time, or all of the flow for the whole irrigation season.

The reason for this system is that in the Waimea East scheme the pipes and pumps must be big enough to make a certain *flow* of water available. The total *amount* of water that a farmer uses has little effect on the sizes of pipes required. Thus the cost of the scheme is mainly governed by design flows rather than amounts of water.

The Water Availability Charge goes towards paying back half the cost of the distribution works and also covers the cost of operating and maintaining the scheme.

1.4.2 Basic Charge

The *Basic Charge* (generally paid by non-irrigators) is levied on *irrigable* land which is not irrigated by the scheme. Every owner of a property greater than 2ha must pay the greater of the Basic Charge on his irrigable area or the Water Availability Charge if he is an irrigator.

In this way all land benefitting in any way from the scheme contributes to the cost of establishing the scheme.

The Basic Charge does not include any of the costs of operating and maintaining the scheme.

1.4.3 Irrigable Area

To assess the total Basic Charge for which a property is liable, the Irrigable Area of each property is assessed to the nearest 0.1 hectare (¼ acre).

This is the area of the property which is suitable for farming under irrigation which can be supplied by the scheme and will not include areas which are too steep to be irrigated, have unsuitable soils, or perhaps are under some form of permanent development (not requiring irrigation). Small areas such as driveways, dwellings and sheds are not considered.

On most ordinary farms the irrigable area will be only slightly less than the gross area.

1.4.4 Graduation of charges

Any major change in the pattern of farming a property incurs a delay time between establishing the new pattern or crop and receiving returns from it.

This is recognized by the provisions for graduated charges contained in the Act which apply to both the Water Availability Charge and the Basic Charge. The charges are graduated as follows:

1st year	no charge
2nd year	no charge
3rd year	20% charge
4th year	40% charge
5th year	60% charge
6th year	80% charge
7th year	100% charge

The "1st year" is the year that water is available to the whole scheme or a substantial part of it and the 100% charge is the charge advertised prior to the poll of ratepayers (see Section 1.5.1).

No alteration can be made to these charges until the eighth year. From this year on, the charges can be adjusted to recover actual costs of constructing, running, and maintaining the scheme. The scheme must break even over forty years.

1.5 Poll of ratepayers

1.5.1 Notification of Proposed Irrigation Scheme

The Act requires the following information to be publicly notified prior to a poll of ratepayers being conducted:

(i) The land included in the Irrigation District

(ii) The Basic Charge

(iii) The Water Availability Charge

(iv) The scale of reductions in charges for initial years

(v) The general conditions of supply of the water

(vi) The irrigation season (normally 15th September to 30th April).

1.5.2 Voting

A special roll which includes all ratepayers within the defined Irrigation District who own 2 hectares (4.94 acres) or more is prepared by the County Council.

The poll is conducted on the basis of this roll and may be by means of polling booths and ballot boxes or it may be a postal ballot.

In order for the scheme to proceed, at least 60% of the valid votes cast must be in favour of the scheme and the Minister must sanction the vote.

1.6 On-farm development

1.6.1 Rate of development

As large amounts of scarce Government capital are invested in irrigation schemes it is important that full use of water is made as soon as possible after commissioning.

The scale of graduated charges over the first few years is intended to encourage rapid on-farm development.

1.6.2 Approval of development plans

In order to ensure, as far as possible, that water use on the farm is reasonably efficient and compatible with the scheme as a whole, on-farm development plans must be approved by the Ministry of Works and Development. Full development of the land is encouraged, again to ensure adequate return on the capital invested (in terms of increased production, exports etc.)

A scheme must be designed with pipes large enough to cater for the full potential of the land they serve, and so their cost is fixed. If only a small flow of water is drawn off then the fixed cost has to be divided amongst this small number of units of water flow; hence the cost per unit flow of water will be greater than it would be if the full design flow was utilized.

1.6.3 Finance

The grants and loans available for financing on-farm development are outlined in Section 1.2.3 and described in more detail in Section 3.1.

SECTION 2
The Waimea East Scheme

2.1 Proposed Irrigation District

2.1.1 Boundaries

The proposed boundaries of the scheme are given on the plan showing the general layout of the distribution system at the back of this booklet.

They have also been defined legally and this definition forms part of the formal "Notification of Proposed Irrigation Scheme".

2.1.2 Properties larger than 2 hectares

The owners of all properties larger than 2 hectares will be included on the roll of ratepayers (see Section 1.5) and are also liable to pay the Basic Charge (see Section 1.4.2 and 2.7.2) if the scheme is built.

2.1.3 Properties smaller than 2 hectares

The owners of properties smaller than 2 hectares are not on the roll and are not liable for the Basic Charge.

However they may be able to buy water from the scheme, if they can be conveniently supplied and their proposed on-farm development is approved. Each case would be treated individually on its merits and water could be supplied under terms at least equivalent to those of the scheme.

2.2 Concept of the Scheme

2.2.1 General

The basic concept of the Waimea East Scheme is that water is drawn on demand from the Wairoa River and supplied under pressure in much the same way as a normal urban domestic water supply. This concept has been developed following study of a number of alternatives.

2.2.2 On-farm

Trickle and spray application methods are appropriate on the Waimea Plains for three reasons:

(i) They use water more efficiently than flood irrigation. This is particularly so for trickle.

(ii) They are appropriate to the horticultural development presently taking place and which must accelerate to justify an irrigation scheme.

(iii) Some property owners, at least, are familiar with the application and management techniques required by trickle and/or spray irrigation.

2.3 Design flows

2.3.1 Basis of selection of equivalent rainfall depths

The equivalent rainfall depths given below have been selected partly on the basis of known soil/plant/water relations and climate data and partly on the basis of current irrigation practice in the Nelson area and elsewhere in New Zealand.

2.3.2 Spray application

The design application rate selected for spray systems is:

Equivalent rainfall = 38mm/wk (1½ inches)

In terms of pipe sizes the most economical way to supply this water is on a 24 hr per day, 7 day per week basis. However it is recognised that this is not practicable and so a 2 × 11 hr set day and 7 day week has been adopted, and it is on this general basis that water allocations will be made.

A depth of 38mm applied in this way corresponds to a flow of 2.5 cubic metres/hr/hectare or *2.5 water units per hectare,* since a water unit of one cubic metre per hour ($1m^3/hr$) is being adopted for the Waimea Scheme.

One water unit applied as described above is equivalent to 15mm of rainfall on one hectare per week.

2.3.2 Trickle application

Because trickle irrigation is generally more efficient than spray, a lower application rate is adequate. This has been taken as:

Equivalent rainfall = 28mm/wk (1⅛ inches)

It is possible to run a trickle system continuously, particularly if automatic valves are used to switch the water from block to block. On this basis trickle irrigation requires *1.67 water units per hectare* or $1.67m^3/hr/ha$.

One water unit applied as described above is equivalent to 17mm of rainfall on one hectare per week.

2.4 Supply pressure

Water will be supplied to most properties at a pressure of about 320kPa (approx 45psi). The pressure available to properties near the toe of the foothills will be slightly lower, and that available to properties on the lower slopes of the foothills between Paton Rd and Hill Rd will be significantly lower. The actual pressure available to a particular property in this area will depend on the height of the main pipe at the point where the supply is tapped off. In a few cases a small pressure boosting pump will be required.

At times of reduced draw-off from the system the pressure losses in the pipes will be reduced and hence the supply pressure will rise slightly. This may slightly increase the output of sprinklers etc, but the effect will be largely eliminated by the flow controllers at each "farm gate" (see Section 2.6.3).

2.5 Headworks

2.5.1 General

The headworks of the Waimea East Irrigation Scheme consist of an intake structure situated on the edge of the Wairoa River just above the mouth of the gorge, a 750mm (2ft 6in) supply pipe from there to a small reservoir, and the reservoir itself.

All these works will be paid for in full by Government grant (see Section 1.2.1).

2.5.2 Intake works

The intake structure is essentially a tall concrete box with a chamber at the bottom into which water flows direct from the river (see Figure 3). Three pumps in the chamber, driven by 200hp electric motors mounted on top of the box, will pump the water up vertical pipes inside the box into the main supply pipe.

Screens protect the pumps from debris and stones and the concrete box protects the pumps and motors during flooding.

There will be a small building on the bank to house electrical switch gear, controls, and instruments.

2.5.3 Reservoir

The proposed reservoir is in a gully in the foothills above Haycock Rd. It will be created by a simple earth embankment up to 11m (36ft) high built across the gully and will store approximately 3000 cubic metres (660 000 gallons) of water.

The prime functions of the reservoir are to act as a header tank (i.e., maintain the pressure in the distribution system) and to regulate the pumps. The storage provided is sufficient to maintain the full design flow to the scheme for one hour. This is necessary because the pumps will be run on cheaper off-peak power which is not available between 5pm and 6pm during summer. During spring and autumn this off period is extended to 2 hrs between 4.30pm and 6.30pm, but it is not expected that the demand at this time of the year will be great enough to drain the reservoir.

A safety cut-out switch will guard against overtopping and an emergency spillway and channel will be provided to keep waters under control in the unlikely event of the controls failing.

The embankment will be designed to high safety standards.

2.5.4 Water supply controls

The flow required by the scheme will vary all the time, and float switches in the reservoir will switch one, two or three pumps on or off as required to supply the water required at any particular time.

Not all the water will flow through the reservoir. Most will flow direct to the main distribution pipe, but as one, two, or three pumps working will only very rarely exactly match the demand from the scheme it is necessary to have a reservoir to provide or accept the small shortage or excess. Pumps will be switched on and off to maintain the design water level in the reservoir.

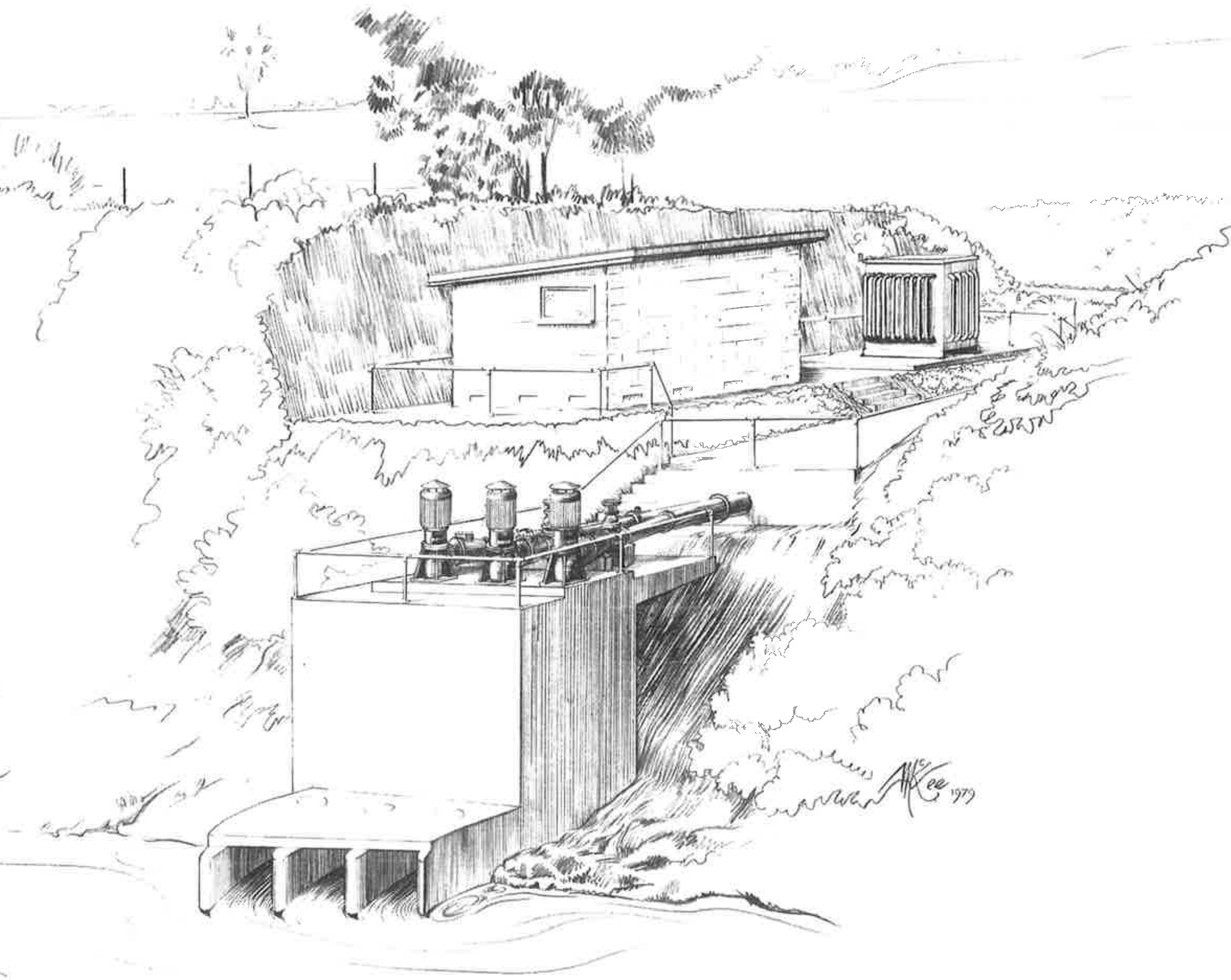


Figure 3 The proposed intake for the Scheme, on the edge of the Wairoa River just above the mouth of the gorge.

2.6 Distribution system

2.6.1 General

The distribution system is a series of pipes laid from the reservoir out onto the plains, gradually reducing in size as water is led off to individual properties. The general layout of the pipes is shown on the plan at the back of this booklet.

2.6.2 Distribution pipes

The pipes range in size from 825mm (2ft 9in) just below the reservoir, down to 100mm (4in) and in a few cases 80mm (3in).

The biggest pipes will be spun reinforced concrete, the middle sizes (300mm to 600mm) either concrete or asbestos cement, and the smaller sizes (200mm and below) either asbestos cement or plastic.

The pipes will generally be buried close to fence lines with about 600mm (2ft) cover.

Drains and valves will be provided so that sections of line can be isolated and drained for maintenance purposes.

2.6.3 Flow controllers

Excessive drawoff (i.e., significantly more than design flows) to any particular property could lower the supply pressure to adjacent properties. For this reason, and to ensure that nobody can draw off a greater flow of water than he has paid for, a control device will be incorporated in each farm turnout. This will control the water flow to within a few percent of that allocated. Although not adjustable the devices are available for a large number of different flow rates, and are interchangeable to a certain extent. The device selected for each property will provide a flow matching the on-farm design and water application rates, which will be the basis for calculating water charges.

The water charge will be:

Water charge = Water Availability Charge × number of water units (flow rate in m^3/hr)

As stated in Section 1.4.1, the water charge levied is based on the flow of water which is *allocated and available,* not on the *actual amount used.*

No metering is envisaged, but a meter could easily be incorporated should a farmer wish to record the amount of water he was using, for management purposes. Meters indicating rate of flow could also be incorporated, but these would be more expensive.

On bigger properties (more than 8 to 10 hectares (20 to 25 acres)) the flow controls, consisting of a simple on/off gate valve, a strainer and a "flow controller", will be mounted in a small open concrete chamber set into the ground.

Similar controls will be mounted on a concrete slab above ground on smaller properties (less than 8 hectares (20 acres)).

2.7 Water charges

2.7.1 Water Availability Charge

The charges which will be made on the Waimea East Scheme for water are as follows:

Year*	*Water Availability Charge per water unit***	*Assessed charge per hectare* Spray	Trickle
1	no charge	no charge	no charge
2	no charge	no charge	no charge
3	\$22	\$55	\$37
4	\$44	\$110	\$73
5	\$66	\$165	\$110
6	\$88	\$220	\$147
7	\$110	\$275	\$184

*taken from the time the scheme becomes operational
**1 water unit = $1m^3/hr$

The Water Availability Charge cannot be altered until after year seven. Thereafter annual adjustments will probably be necessary to make allowance for any differences between the estimated cost of building the scheme and the actual cost, and the effect of changes in operating and maintenance costs. Once any initial adjustment for construction cost has been made further adjustment will only be necessary to cover increases in running costs, with increases in the cost of power probably having the most effect.

The charge is made up approximately as follows:

Capital repayment	50%
Operation and maintenance:	
Supervision, maintenance, etc.	25%
Power	20%
Replacement Fund	5%

From this breakdown it can be seen that if the price of power goes up by say 50% the corresponding increase in the Water Availability Charge is only 10%.

As mentioned in Section 1.6.2 a second factor affecting the cost of water is the number of water units which are allocated and available. Since the capital cost of pipes etc., and to some extent the cost of maintenance, are independent of the actual flow of water in the pipes, the cost per unit of water is dependent on the number of water units sold. The charges listed above are based on certain assumptions of water use.

If less water is sold than has been assumed, Water Availability Charges will have to be increased after year seven in order to recover the capital expended within the 40 year statutory period.

Conversely, greater usage will slightly reduce the charges.

2.7.2 Basic charge

The Basic Charge is levied against all properties larger than 2 hectares until a Water Availability Agreement (see Section 1.4.1) is signed, starting from the time water is available from the scheme.

The scale of charges is:-

Year	*Basic Charge per hectare*
1	no charge
2	no charge
3	$18
4	$36
5	$54
6	$72
7	$90

This scale of charges cannot be altered until after year seven when an adjustment to make allowance for any differences between the estimated construction cost and the actual construction cost may have to be made. Thereafter changes to the Basic Charge will only occur with changes in ruling interest rates.

Once a farmer starts taking water he begins paying the Water Availability Charge instead of the Basic Charge so long as the Water Availability Charge is greater than the Basic Charge. If not, he continues to pay the Basic Charge.

2.8 Reliability and Water Right

2.8.1 Water Right Application

Before water can be taken from the Wairoa River a right to do so must be granted to the Minister of Works and Development by the National Water and Soil Conservation Authority.

Application for this right has been made, submissions called for and heard, and reported on by the Nelson Regional Water Board.

The Board report and recommendation will be considered by the Authority in making its decision.

2.8.2 Reliability

There is not enough water in the river to supply the design requirements at all times. To protect other water users and the river itself some rationing will be necessary.

However it can be said that this necesity for rationing will be minimal. Once the scheme is fully utilised slight restrictions may be necessary about 1 year in 5 and every 10 years or so a period of rationing of from 1 to 2 weeks is likely, with about half the total water requirement still being available at the end of that period.

It is envisaged that a Scheme Management Committee will be set up which will include representatives of the farmers. Rationing policy and implementation would be the responsibility of that committee.

2.8.3 Existing water rights

The Nelson Regional Water Board has adopted the following policy with respect to existing water rights within the proposed Irrigation District:

> "A review of all water allocations of the Waimea Plains is scheduled for May 1981, by which date the Board will have a more precise evaluation of all the aquifers of the Waimea Plains.
>
> *"Aquifers Underneath the Irrigation District*
>
> "As part of the water allocation policy, the Board proposes that no water can be drawn from the underground aquifers in the irrigation district once that supply commences.
>
> "The upper confined aquifer at present provides irrigation water for 96ha within the proposed irrigation district. The maximum yield is estimated at 129 l/s and the sustained yield may be 60 l/s. There are many alternative lands beyond the irrigation district and above the upper confined aquifer where this water supply could be required for irrigation.
>
> "The lower confined aquifer provides irrigation water for 200 ha within the proposed irrigation district. The maximum yield is estimated at 164 l/s and the sustained yield may be 80 l/s in that locality.
>
> "At the northern end of this aquifer, Richmond Borough draws its urban water supply from six wells. At an unknown distance further north, the aquifer is believed to discharge into the sea. The possibility of sea water contaminating the Borough's supply cannot be overlooked, particularly as the artesian pressure in the Borough's wellfield was reduced appreciably below mean sea level in the height of the last two irrigation seasons. It may be prudent for the Board to delay any re-allocation of this supply until the mechanics of the aquifer are better understood."

Source: Nelson Catchment Board 7/8/1 of 13.12.79. "Waimea Plains water resources relevant to MWD application for irrigation water supply."

SECTION 3
On-farm development

3.1 Finance

3.1.1 Fixed works

Fixed works attract a 50% subsidy in the form of a suspensory loan written off over ten years of continuous ownership (see Section 1.2.3). They include:-

(i) Fixed underground pipe reticulation networks.

(ii) Sprinkler facilities permanently fixed to the reticulation network.

(iii) Electricity service lines for on-farm pumping facilities.

(iv) Reinstatement of any farm services disrupted by the construction of the above.

(v) The cost of any surveying or construction supervision associated with the construction of subsidiseable on-farm works.

Pumps and motors for on-farm pumping are specifically excluded, but where these are required to boost the supply pressure up to that of the rest of the scheme (see Section 2.4) it will be possible to make special arrangements. In this case some form of security or bonding would probably be necessary. Fencing is also excluded from the subsidy provision.

If required, RBFC finance will be available for the second half of the cost of fixed development, in the form of a normal table mortgage development loan.

Existing fixed irrigation works may be eligible for subsidy based on an agreed valuation *provided* they can be successfully integrated into an approved on-farm plan. Advice on eligibility in any individual case will be available from MAF (Nelson) when farm plans are drawn up.

3.1.2 Portable equipment

Finance for portable items such as spray lines and mobile irrigators will be available from RBFC if required.

No Government grant is available.

3.2 Design of on-farm development

3.2.1 General

The objective of community irrigation schemes in general is to promote more efficient and intensive use of land resources by injecting capital to provide water to increase production. This aim can only be achieved if the concept of a scheme is carried right through to the point where the water hits the ground and all the elements of the scheme are designed as an integral whole. For this reason it is necessary that all on-farm development plans are approved by the Ministry of Works and Development. The Government also has a responsibility to ensure that public funds are spent wisely.

Ministry of Agriculture and Fisheries (MAF) personnel will be available to draw up on-farm development plans for individual properties in consultation with the owner. Consultants or suppliers representatives may also be involved.

3.2.2 Sample on-farm designs

A series of on-farm designs has been prepared by MAF Advisory Officers. They detail alternative methods of developing actual properties within the scheme and include both total and annual costs for the alternatives. A discussion of the designs is also presented. This information is found in the Appendix.

The objective of these sample designs is to allow farmers to assess the type of development which might be appropriate for their properties under the scheme and what the costs of that development are likely to be.

APPENDIX

Waimea East Irrigation Scheme On-farm design examples

A1.0 Basic design water allowance

The scheme has been designed to supply a total water depth of 28 mm per week for trickle systems and 38 mm per week for spray irrigation systems. The lower supply for trickle systems reflects the higher application efficiency and the fact that not all the area must be watered under trickle.

In general the water will be supplied so that there will be sufficient pressure to operate a conventional trickle system or irrigation sprayline without the need to boost the pressure by pumping on-farm. There may, however, be some exceptions where sufficient pressure is not available. The pressure delivered in most cases will be about 32 metres head of water (approximately 320 kPa (45 psi)).

To convert the depth of water applied to a flow rate, we can go through the following exercise for sprinkler irrigation:

38mm over 1 square metre	= 38 litres
38mm over 1 hectare	= 380 cubic metres (m^3)
$380m^3$/week	$= \frac{380}{7 \times 24}$ m^3 per hour
	= $2.26m^3$/hr per hectare

An allowance has been made for "down time" while the sprinklers are being shifted, of 2 hours per day (i.e. 2 shifts per day) and the flow has been correspondingly increased to $2.5m^3$/hr per hectare of irrigable area.

With trickle irrigation, the water is able to be used 24 hours per day, so the design supply rate is 2.26 x 28/38 = $1.67m^3$/hr per hectare.

A2.0 Water management

At the peak of the irrigation season all systems will have to operate 7 days per week if the whole irrigable area of the farm is to be irrigated.

The frequency of watering each area depends on the soil moisture holding capacity and the amount of depletion of this capacity allowable before re-irrigating.

A2.1 Trickle irrigation

With microtube or microjet irrigation it is possible to irrigate the required amount every day or every two or three days as desired. The water holding capacity of the soil is not such an important factor. In the soils on the Waimea East Irrigation Scheme, however, the spread of the water under trickle irrigation can be a limiting factor. In an orchard situation, for example, it may be necessary for each tree to have:

(a) Multiple outlets (drippers), and/or
(b) High flow rates per outlet, or
(c) Microjets.

These techniques will enhance the spread of water and allow the trees a greater root volume from which to absorb their water and nutrients.

If water was supplied at a *very* low rate it would be theoretically possible for the whole reticulated area of the farm to be irrigated at once. To allow soil aeration (between irrigations), to enhance the spread of the water and have system flexibility, it is desirable to cut the farm or orchard up into irrigation blocks. Each block is capable of using the full design flow. The higher the flow rate per outlet or per tree, the greater the number of blocks the area must be divided into. The minimum number of blocks would usually be two; however, it is more likely to be between four and twelve blocks.

It is not always necessary that the block boundaries correspond with, say, changes in type of tree, because the adequate water supply will allow the grower to simply irrigate on a cycle and maintain the whole of the area in a well irrigated condition. It could be desirable in some situations, e.g., where there is a marked change in soil type, or where it was required to selectively supply nutrients through the irrigation water, that the tree variety or soil type boundaries may also be block boundaries.

A2.2 Sprinkler irrigation

With sprinkler irrigation using mobile spraylines and other mobile units, the soil moisture holding capacity in the plant root zone is most important. The greater the depth of plant roots, the greater the water stored in the root zone.

The objective of the irrigation system is to fill the root zone soil moisture to full capacity (called "field capacity") and return to the same site before the soil moisture has dropped to unacceptable levels. Depending on the sensitivity of the crop the soil moisture could be between 50% and 80% depleted. A normal irrigation cycle time could be about 12 days on the Waimea East Irrigation Scheme.

Since the supply rate to each farm is constant, the grower has the choice of applying a small volume per irrigation setting and returning often, or applying a larger amount and returning less often up to the maximum cycle time. Increasing the number of spraylines using the fixed total flow leaves correspondingly less per sprayline and hence each sprayline must stay in each position for a longer time period, but the overall cycle time is not affected.

The number of sprayline shifts per day can influence the length of sprayline required. Two shifts per day would be desirable in most cases. Three shifts per day (with a correspondingly higher application rate per hour) will require about ⅔ of the length of sprayline but will involve more labour and additional time while the sprinklers are not being used. The shape and layout of the property will have a large bearing on the actual cycle time and the convenient length of sprayline to use.

A3.0 On-farm design examples

A3.1 Example No 1 – **Trickle irrigation of a 5 hectare block**

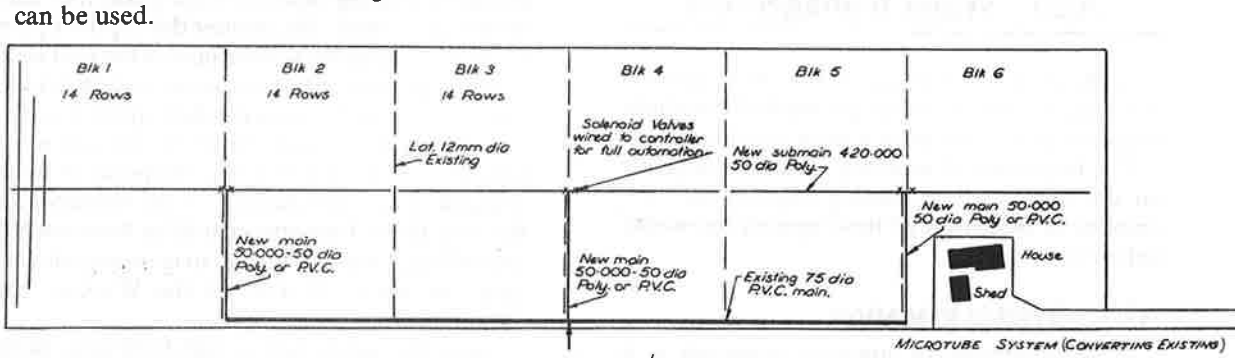
Three schemes have been prepared for trickle irrigating a 5 hectare orchard already under irrigation:

(i) Converting the existing trickle scheme (it is presently functioning less than adequately).
(ii) A new microtube system.
(iii) A new microjet system (microjets are miniature sprinklers or "misters").

(i) Converting the existing trickle scheme

The existing scheme could be supplied directly from the new scheme but several modifications would make it water more evenly. The main problem is that the 12mm diameter laterals are too small to take the flow when supplied from one end. The pressure loss is too great and so the flow per outlet is severely cut back at the end away from the main supply line.

It would be possible to vary the length of the microtubes along the laterals to compensate for this pressure variation. For simplicity however the laterals could be fed at their mid-points. This halves the flow per lateral and reduces the pressure variation along the line to be within acceptable limits so that a uniform length of microtube can be used.

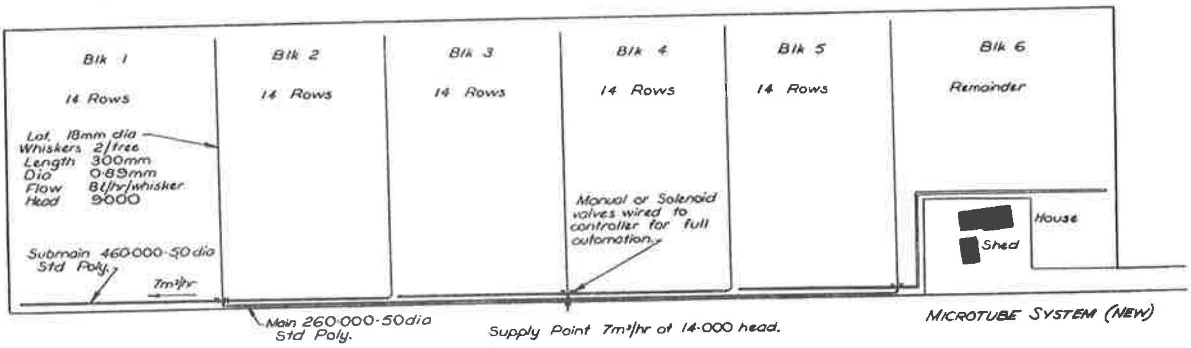


(ii) New microtube system

If a new system using microtubes was installed the layout would be very similar to the existing layout except that the area would be divided into a minimum six blocks and the laterals would be 18mm diameter.

The supply to each block could be manually controlled or automatically controlled, using electrically operated valves.

The main line down the side of the block allows more convenient operation of the system if it is manually operated, as well as easier inspection.

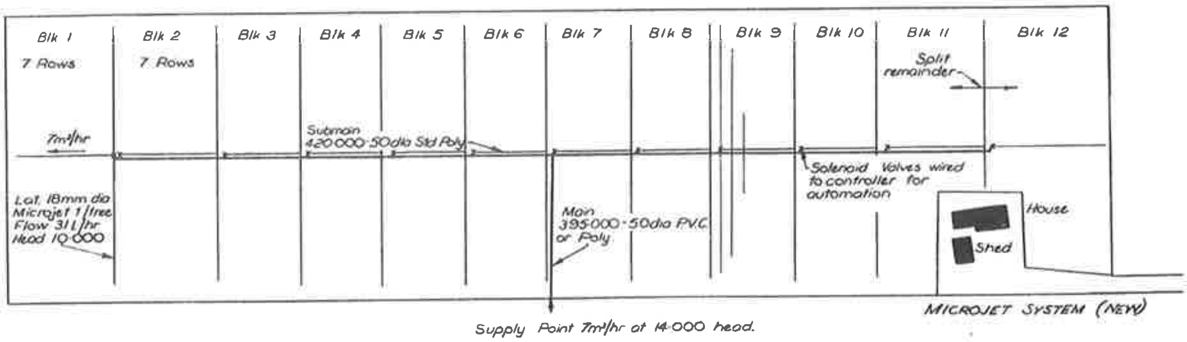


(iii) New microjet system

If, for reasons of spread, it was decided to use a microjet system, it would again be desirable to centre feed the laterals. But since the flow of each microjet (31 litres/hrs) is much higher than would normally be used for microtubes (2 at 8 litres/hr), the diameter of the lateral must be increased from 12mm to 18mm diameter.

Because of the higher flow rate, the number of blocks has increased from six with microtubes to twelve with microjets. The supply to each block could be manually or automatically controlled with electrically operated valves.

It has been assumed in this exercise that there was no planting on the block at the time of installation so that it is convenient to lay the main line down the centre of the block without interfering with the trees.



Total costs (as at June 1979)

(i) Converting the existing trickle scheme

	Before subsidy	*After subsidy*
Mainline 150m 50ϕ std poly	$300	$150
Submain 420m 50ϕ std poly	840	420
Automation 6 blocks & controllers, etc.	1500	750
Installation	200	100
	$2840	$1420

(ii) New microtube system

	Before subsidy	*After subsidy*
Main 260m 50ϕ poly or p.v.c.	$520	$260
Submain 460m 50ϕ poly	920	460
Lateral 8400m 18mmϕ poly	2520	1260
Whiskers 1600m 0.89mmϕ	40	20
Automation controller, 6 solenoid valves, wire installation	1500	750
Installation 4.85ha at $125/ha	600	300
	$6100	$3050

(iii) New microjet system

	Before subsidy	*After subsidy*
Main 395m 50ϕ P.V.C. or poly	$790	$395
Submain 420m 50ϕ std poly	840	420
Laterals 8400m 18mmϕ poly	2520	1260
Microjets 2600	1300	650
Automation 12 solenoid valves, controller & wire, and installation	3000	1500
Installation $125/ha	600	300
	$9050	$4525

Annual costs (not including capital repayment)

	Converted microtube	*New microtube*	*New microjet*
Interest	$142	$305	$452
Depreciation	60	60	90
Repairs & maintenance	60	60	100
TOTAL	$262	$425	$642

Water Availability Charges

Seven water units, or a flow of 7m³/hr, are required for this property. The water charges would therefore be:-

Year	*Annual water charge*
1 & 2	no charge
3	$154
4	$308
5	$462
6	$616
7	$770

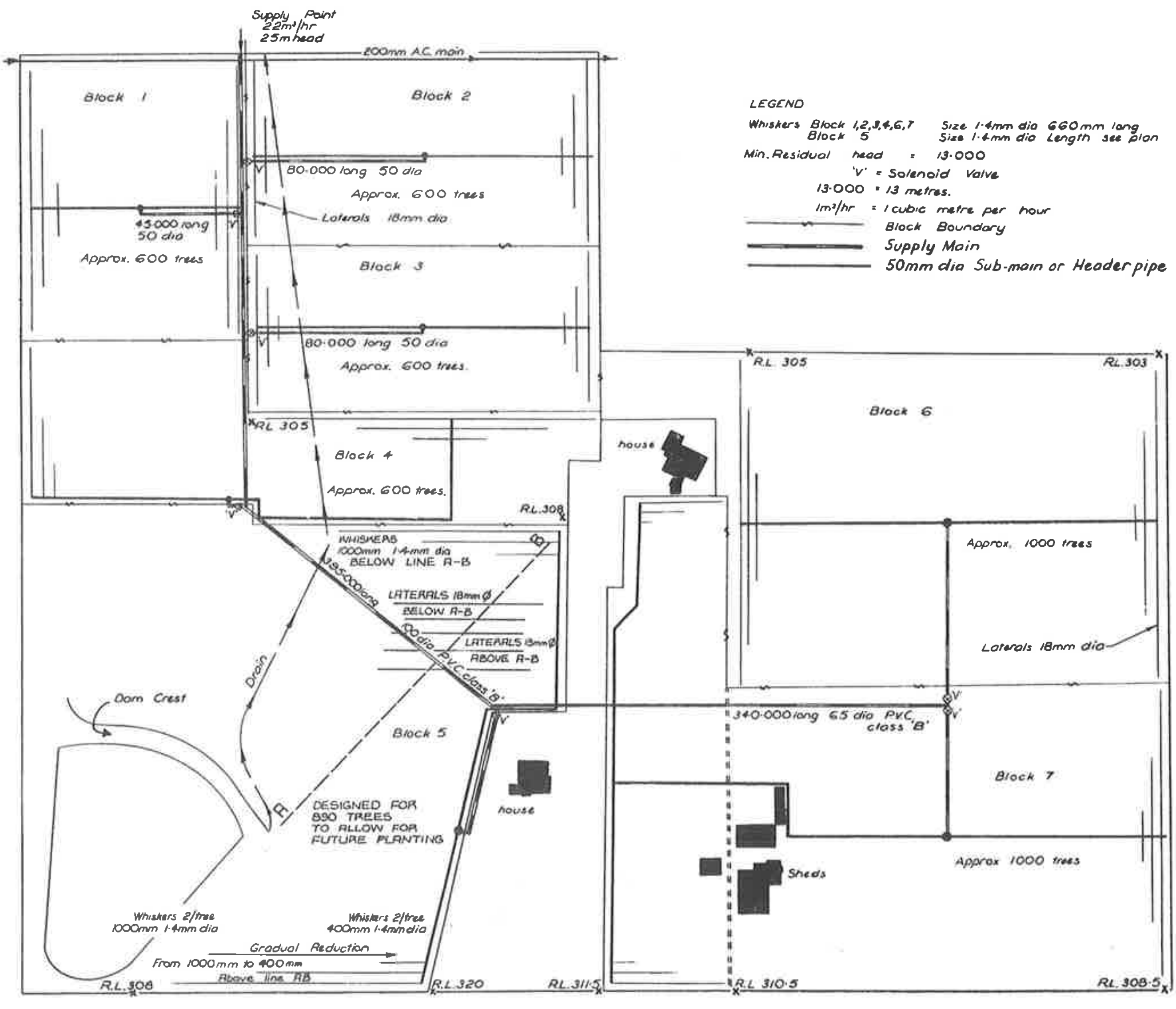
A3.2 Example No 2 — **Trickle irrigation of a 15 hectare block**

This is an example of a more complex microtube irrigation layout.

The property has approximately 14 hectares of orchard on mostly even topography but with one small area of hillside.

The soil type on this orchard is generally heavier than the bulk of the Waimea Plains Irrigation Scheme area so microtube irrigation is considered suitable. One of the blocks is on very light land so it has been made smaller than the rest to allow a higher application rate in that area.

The design considerations are very similar to Example No 1 but the wider tree spacing has meant a greater flow per tree with the same overall flow to the area.



NEW MICROTUBE IRRIGATION SCHEME

Total costs (as at June 1979)

	Before subsidy	*After subsidy*
Mainline		
125m 50ϕ std poly or P.V.C.	$ 250	$ 125
350m 65ϕ P.V.C. C	897	448
395m 100ϕ P.V.C. B	1868	934
Laying — mainline at 80c/m	800	400
Submain		
1520m 50ϕstd poly	3040	1520
Laterals Block 5: 4000m 13mmϕ	1000	500
Remainder: 18,600m 18mmϕ	5580	2790
Whiskers 4000m 1.4mmϕ	100	50
Installation at $125/ha for 14ha	1750	875
Automation: controller — 7 valves wire and installation estimate	2500	1250
	$17785	$8892

Annual costs (not including capital repayment)

Interest on $9,000 at 10%	$ 900
Depreciation	250
Repairs & maintenance	200
TOTAL	$1350

Water Availability Charges

Twenty-two water units are required.
Water charges would be as follows:

Year	*Annual water charge*
1 & 2	no charge
3	$ 484
4	$ 968
5	$1452
6	$1936
7	$2420

A3.3 Example No 3 — **Spray irrigation of a 25 hectare mixed farm**

This property is on the flat and is a mixed market gardening, sheep, and cattle grazing enterprise. Four alternative methods of spray application have been considered.

(i) Hand move irrigation

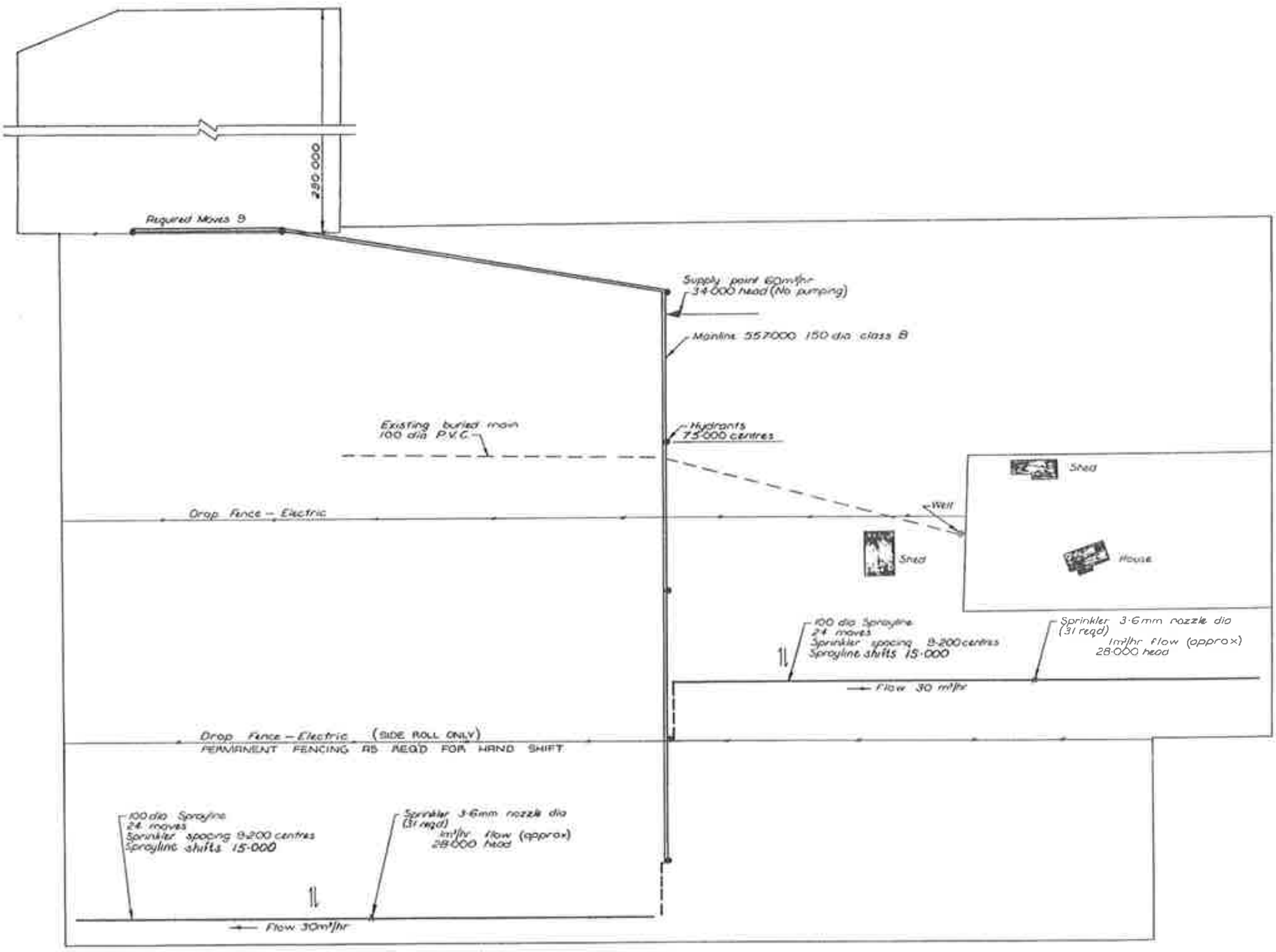
Because of the shape of the property a very convenient layout was not possible. Had the property been rectangular and without irregularities caused by the house and sheds a shorter length of sprayline and a slightly lower water demand would have been possible.

For a market garden enterprise uniformity of water application is important to promote even crop growth. Small sprinklers spaced at 9m along the lines and shifted 15m twice daily were adopted. These small sprinklers were also necessary to match the total flow with the maximum length of sprayline which has to be used to cover all the property.

Because of the physical constraints of the number of sprayline positions, the cycle time for 100% irrigation is 14 days. Although this appears to be a long cycle time for these light soils it is unlikely to be necessary to irrigate 100% of the property in any one cycle so it should be a practical system.

It may be possible to decrease the cycle time by increasing the spacing between spraylines. This may reduce the uniformity of application to unacceptable levels.

The addition of one extra sprayline would decrease the cycle time but this would require extra water which is not available from the scheme. Without the extra water the additional sprayline would not decrease the cycle time because the flow would be correspondingly lower. It would be quite possible to shift the sprayline more than twice per day when irrigating shallow rooted crops. This would decrease the cycle time.



HAND SHIFT SPRAY IRRIGATION OR SIDE ROLL IRRIGATION

(ii) Side roll irrigation

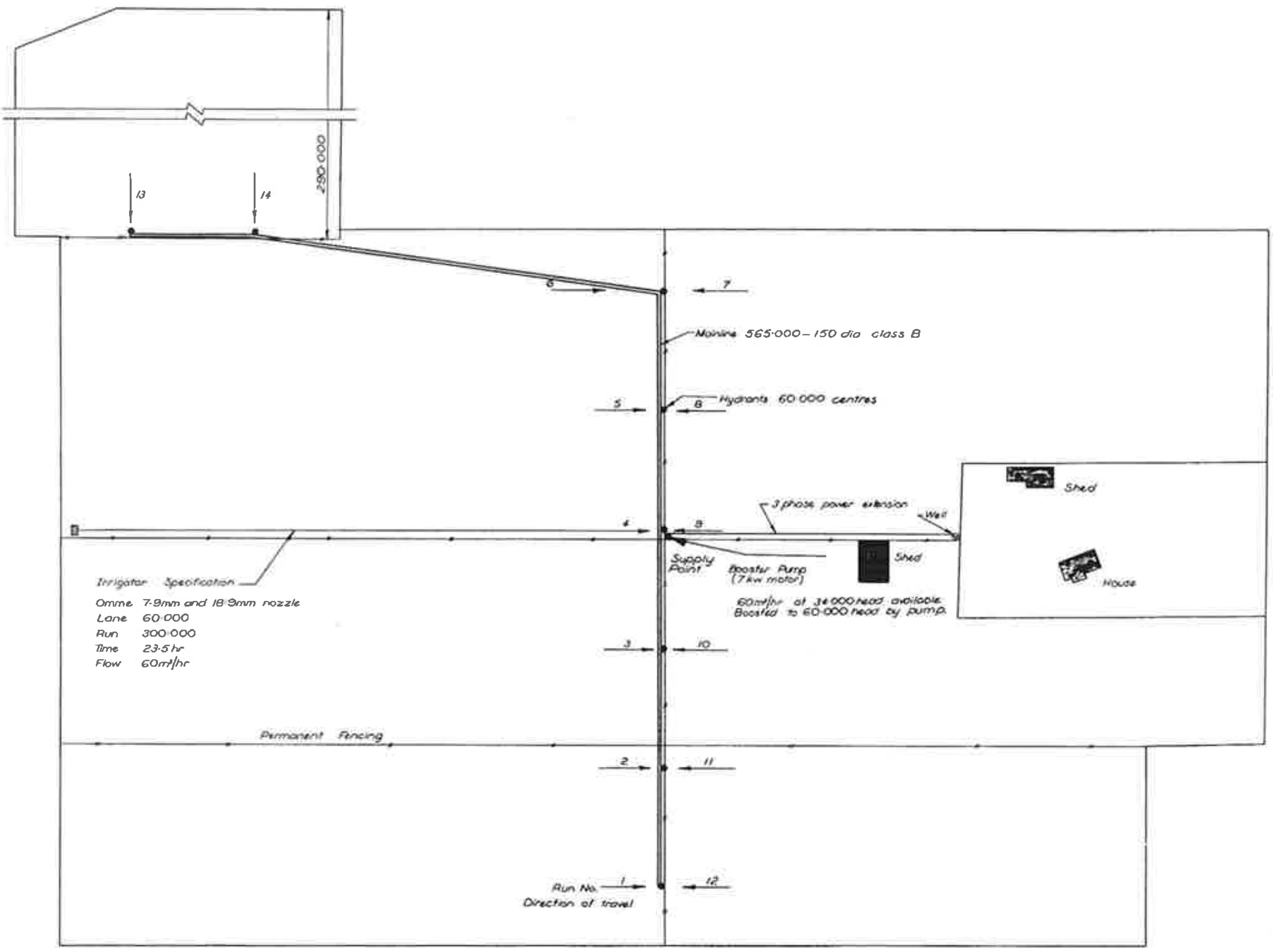
All the comments above for hand move irrigation also apply to the side roll irrigation system. The method of shifting the pipe is to roll it sideways on large wheels which use the pipe as an axis. The labour of each normal shift is reduced but the shifting of pipes around the house will take additional labour.

The sub division fences should be portable electric or lay-down fencing to allow the side roll irrigator to pass over it.

(iii) **Travelling boom irrigator**

This is a self-propelled irrigator, is well suited to this size of property, and because it continuously moves while it is irrigating it should apply a very uniform water application. Because it can negotiate around the house and sheds more easily the cycle time is reduced by one day.

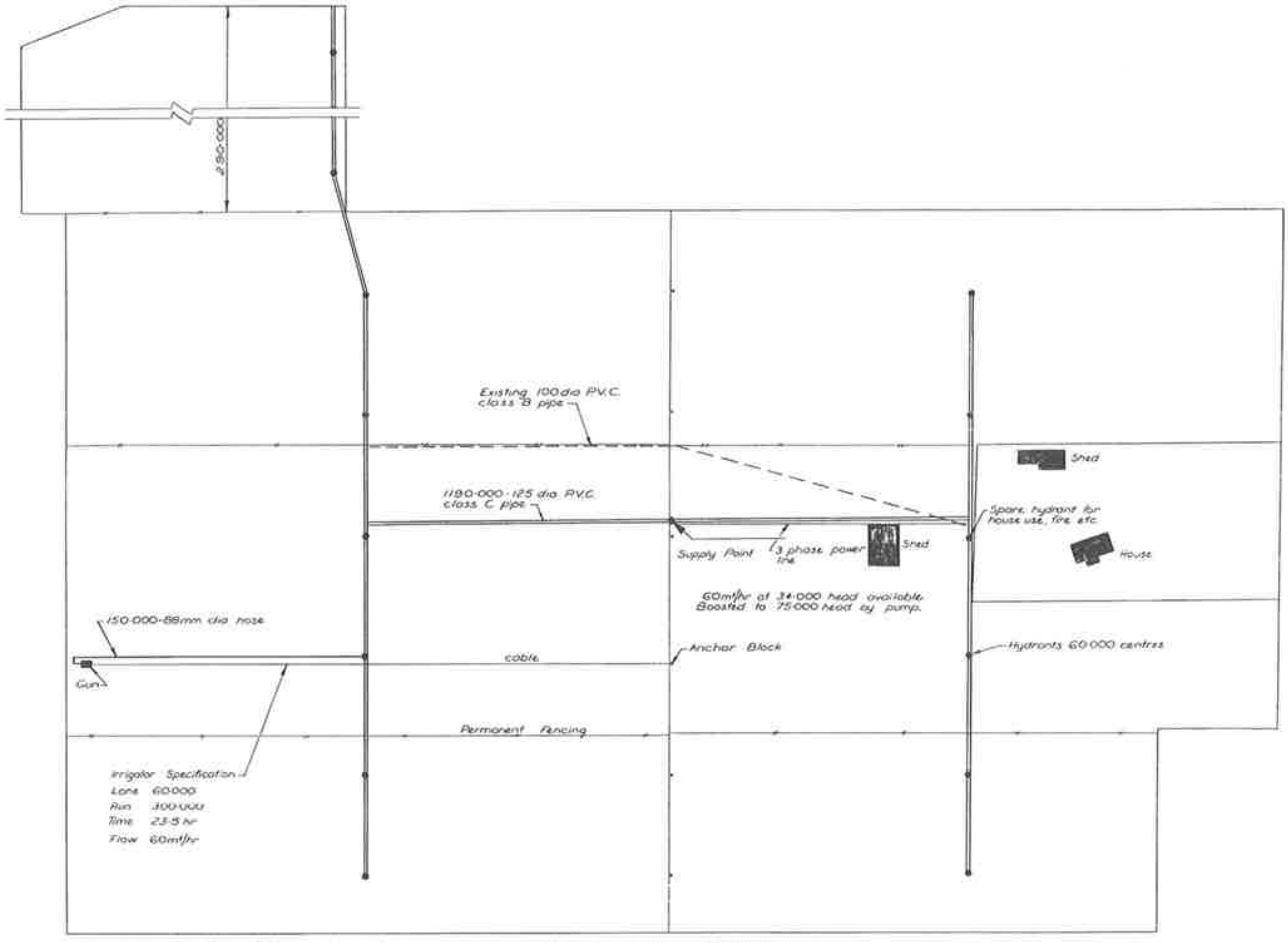
Because of pressure losses in the hoses and a higher working pressure at the nozzles the supply pressure from the scheme would have to be boosted by on-farm pumping.



TRAVELLING BOOM IRRIGATION

(iv) **Travelling gun irrigator**

This is also a self-propelled irrigator. Most of the comments for the travelling boom irrigator also apply. The uniformity of water application under windy conditions may be less than the travelling boom because the travelling gun uses a single sprinkler. The pressure would need to be boosted slightly higher than the travelling boom irrigator.



TRAVELLING GUN IRRIGATION

Total Costs (as at June 1979)

(i) Hand move

Sprayline and submain (complete)

Two (294m x 100ϕ alloy)	$ 9564
Hydrants 7 (150 x 100)	1050
Mainline 557m — 150ϕ — B	4929
Installation: (main) $1/m	557
	$16100

Comments

Energy —The scheme supplies all its energy needs

Labour —*Move* two lines *twice* each day

Fencing —Permanent fencing may be used

Moves —15 metres and is static until the next move

(ii) Side roll

Sprayline and submain (complete)

Two (294 x 100ϕ)	$19314
Hydrants: 7 x (150 x 100)	1050
Mainline: 557m — 150ϕ — B	4929
Installation; (mains) $1/m	557
	$25850

Comments

Energy —The scheme supplies all its energy needs

Labour —Moves two lines twice per day
Moves around house and to other block
Requires half a day for each major move

Fencing —Portable, electric and/or flexi fencing is required
Permanent fencing requires extra labour to move spraylines

Moves —15 metres and is static until the next move

(iii) Travelling Boom "Omme" (Booster required 6.5 KW)

Travelling boom complete	$18000
Hydrants 8 x (150 x 100)	1200
Mainline 565m — 150ϕ — B — AC	5000
Installation:	565
Power: 3ϕ estimate 150m extension	300
Pump, motor, and switch gear	1925
	$27000

Comments

Energy —Extra energy is needed for this unit. An Ajax 2MS — driven with 7.5 KW motor consuming 6.5 KW

Labour —*One unit* to shift once every 24 hour period

Fencing —Any form of permanent fencing may be adopted, so long as it is in parallel to the direction of travel

Moves —This unit has its hose run out, runs towards the hydrants, stops, then is relocated with its hose run out ready for the next 300m run.

(iv) Travelling gun : (NB: Booster required 10 KW)

If 150 — ϕ — Class B — A.C. is used, Hardies state a maximum working pressure of 84m head. This would lower the head by 4.5 metres to 70.5m head (see plan).

Travelling Gun	$ 7800
Hydrants 18 (125 x 100)	2340
Mainline: 1190m — 125ϕ — Cl C. P.V.C.	10770
Installation:	1190
Power: 150m — 3ϕ — extension	300
Pump, motor, and switch gear	2000
	$24400

Comments

Energy —Extra energy is needed. An Ajax 2L — D/D at 2880 rpm with 12.5 KW motor consuming 10 KW

Labour —One shift every 24 hours so long as there is no fence along buried main. Suggest hydrants in middle of paddock marked with a *post.*

Fencing —Any type used in parallel with the direction of run.

Moves —This unit moves from one end to the other by pulling itself up on a cable. It drags its hose so maintenance is higher on the hose.
—High proportion is subsidised.
N.B. Costs of fencing are not included.

Summary of total costs

System	*Before subsidy*	*After subsidy*
(i) Hand move (two lines)	$16 100	$13 000
(ii) Side roll (two lines)	25 850	22 650
(iii) Travelling boom — "Omme" (Booster reqd 6.5Kw)	27 000	23 750
(iv) Travelling gun (Booster reqd 10Kw)	24 400	17 300

Annual costs (not including capital repayment)

(i) Hand move

Interest	10%	= 14% on	
Depr	2%	$13 000	$1820
R & M	2%		
		TOTAL	$1820

(ii) Side roll

Interest	10%	= 14% on	$3170
Depr	2%	$22 650	
R & M	2%		
		TOTAL	$3170

(iii) Travelling boom "Omme"

Interest	10%	= 14% on	
Depr	2%	$23 750	$3325
R & M	2%		
Power (extra)			200
		TOTAL	$3525

(iv) Travelling gun

Interest	10%	= 14% on	
Depr	2%	$17 300	$2420
R & M	2%		
Power			300
		TOTAL	$2720

Water Availability Charges

60 water units are required for this property. Water charges would be:

Year	*Annual water charge*
1 & 2	no charge
3	$1320
4	$2640
5	$3960
6	$5280
7	$6600

A3.4 Summary of costs

Summary of development costs

System	*Area*	*Total cost* (subsidized)	*Total cost/ha*	*Total annual dev. cost*	*total annual dev. cost/ha*
Example No 1					
Converted microtube	4.7	$1420	$302	$262	$56
New microtube	4.7	$3050	$649	$425	$90
New microjet	4.7	$4525	$963	$642	$137
Example No 2					
Microtube	14	$8892	$635	$1350	$96
Example No 3					
Hand move	25	$13000	$520	$1820	$73
Side roll	25	$22650	$906	$3170	$127
Travelling 'Omme' boom	25	$23750	$950	$3525	$141
Travelling gun	25	$17300	$692	$2720	$109

Note: Water Availability Charges are not included.

Total annual costs

Figures 4 and 5 show total annual costs of development *plus* Water Availability Charges for various property sizes and various means of application. Figure 4 relates to trickle application and Figure 5 to spray.

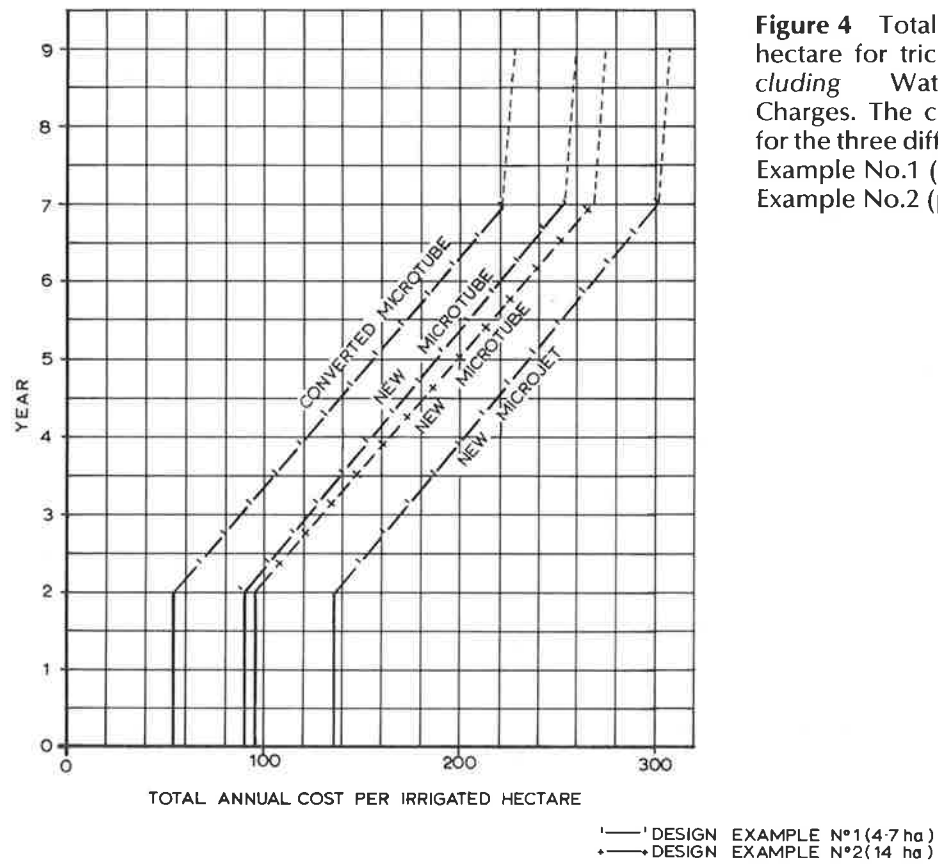


Figure 4 Total annual costs per hectare for trickle irrigation, *including* Water Availability Charges. The costs graphed are for the three different methods of Example No.1 (page 16), and for Example No.2 (page 19).

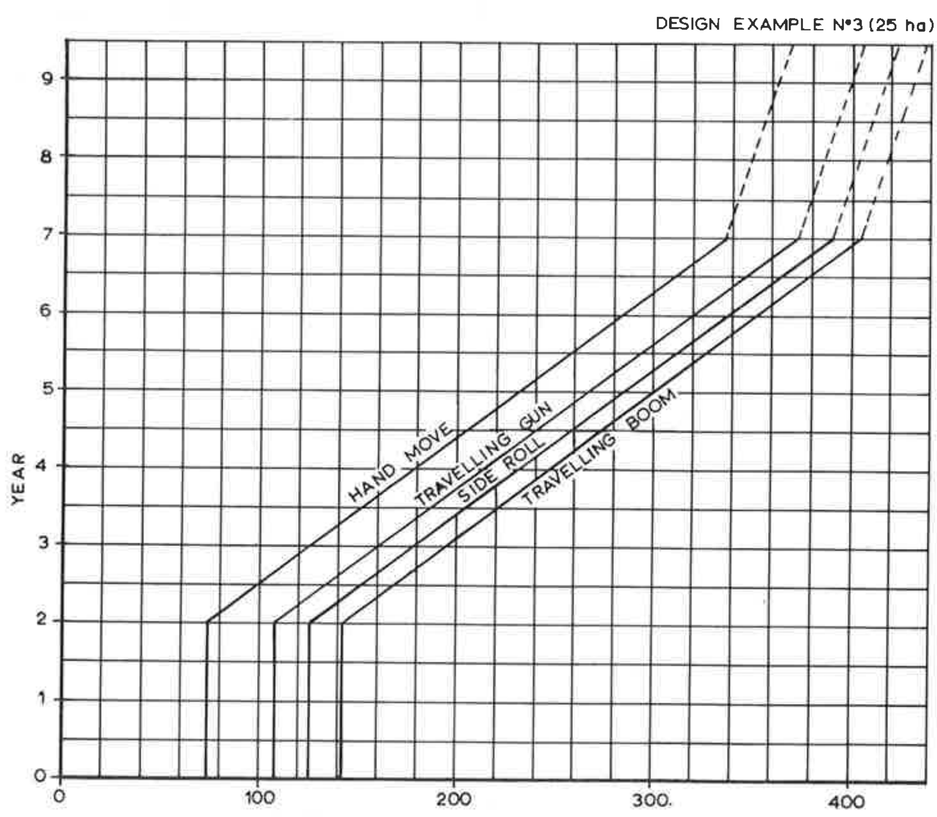
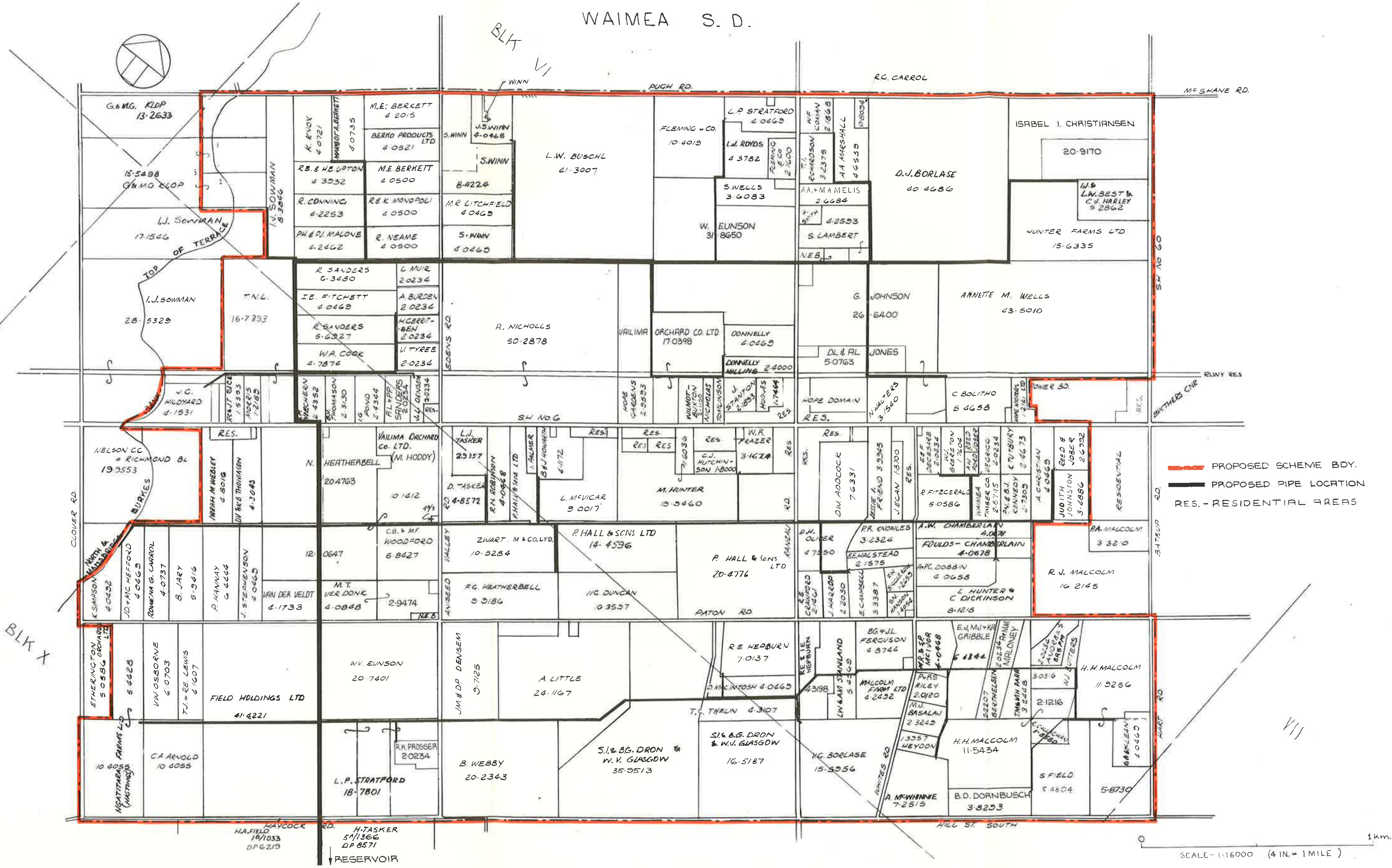
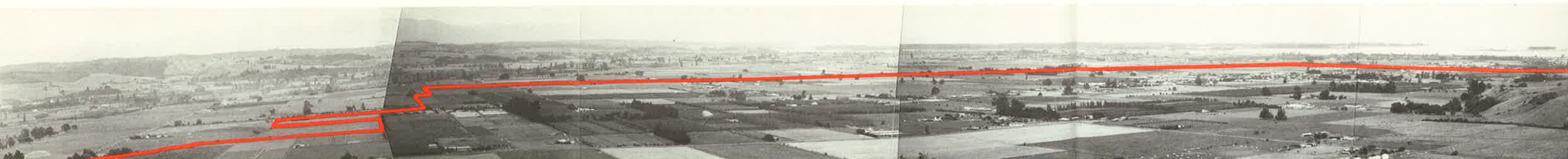
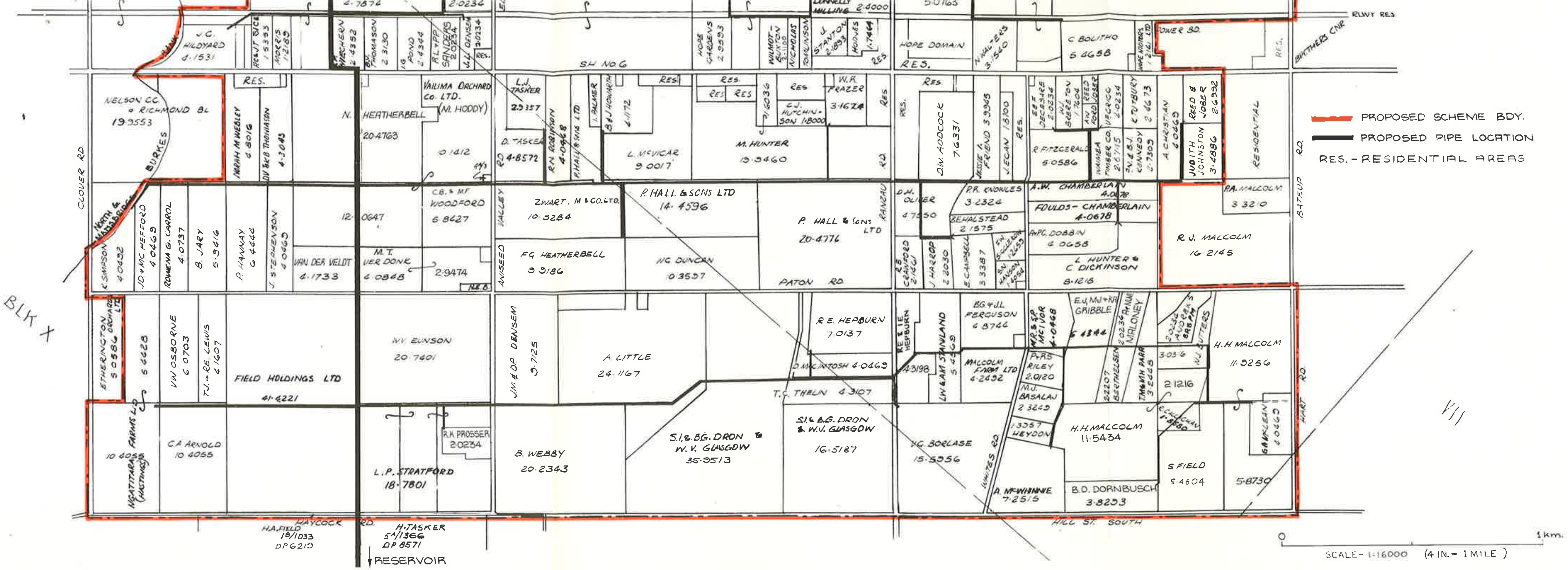
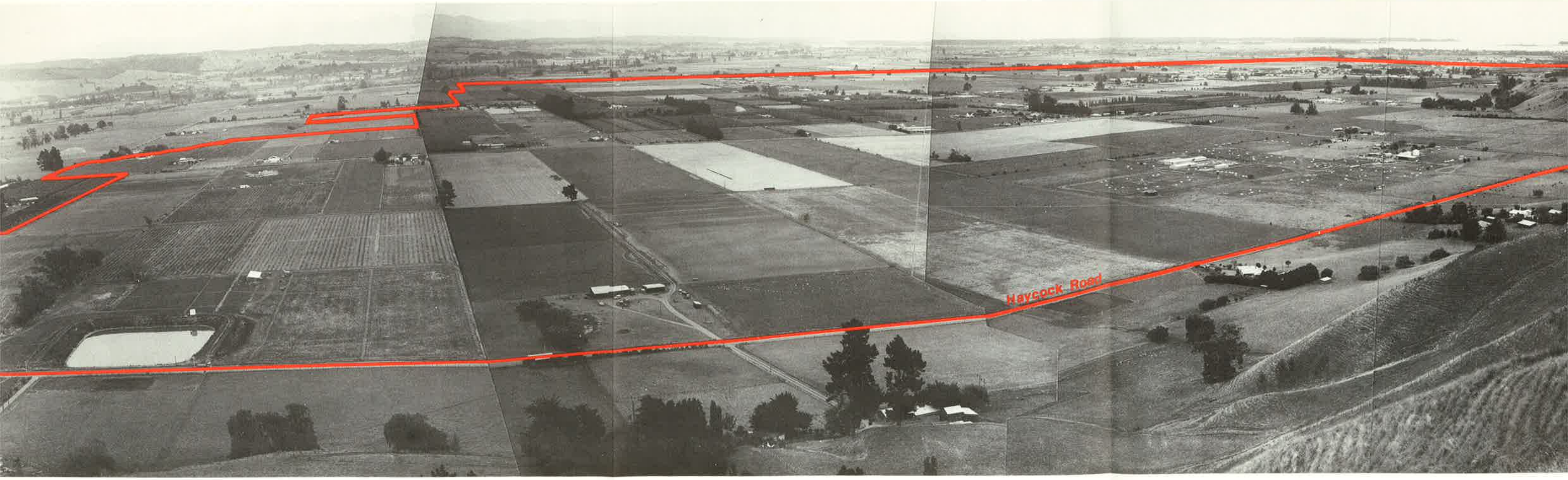


Figure 5 Total annual costs per hectare for spray irrigation, *including* Water Availability Charges. The costs graphed are for the four alternative methods of Example No.3 (page 21).


WAIMEA S.D.
BLK VI
BLK X
VII
PUGH RD.
R.G. CARROL
McSHANE RD.
SH No 60
RUNY RES
BROTHERS CNR
SH No 6
CLOVER RD
BURKES
EDENS RD
VALLEY RD
ANSEED RD
RANZAU RD
PATON RD
WHITES RD
BATEUP RD
HART RD
HAYCOCK RD.
HILL ST. SOUTH
TOP OF TERRACE
G.&M.G. KLOP 13·2633
15·5498 G&MG KLOP
I.J. SOWMAN 17·1546
I.J. SOWMAN 28·5329
T.N.L. 16·7893
I.J. SOWMAN 8·3546
K. KNOX 4·0721
M.E. BERKETT 4·2015
BERKO PRODUCTS LTD 4·0521
R.B. & H.E. UPTON 4·3932
M.E. BERKETT 4·0500
R. CONNING 4·2253
R & K MONOPOLI 4·0500
P.H. & P.J. MALONE 4·2462
R. NEAME 4·0500
S. WINN
J.S. WINN 4·0468
WINN
8·4224
M.R. LITCHFIELD 4·0469
S. WINN 4·0469
L.W. BUSCHL 41·3007
FLEMING & Co. 10·4019
L.P. STRATFORD 4·0469
L.J. ROYDS 4·3782
S. WELLS 3·6083
W. EUNSON 31·8650
A.A. MARSHALL 4·6539
A.A. & M. AMELIS 2·6684
S. LAMBERT
D.J. BORLASE 40·4686
ISABEL I. CHRISTIANSEN 20·9170
L.W. BEST & C.J. HARLEY 5·2862
HUNTER FARMS LTD 15·6335
R. SANDERS 6·3480
I.E. FITCHETT 4·0469
R. SANDERS 5·6327
W.A. COOK 4·7874
C. MUIR 2·0234
A. BURDEN 2·0234
V. TYREE 2·0234
R. NICHOLLS 50·2878
VAILIMA
ORCHARD CO. LTD 17·0398
DONNELLY 4·0469
DONNELLY MILLING 2·4000
G. JOHNSON 26·6400
ANNETTE M. WELLS 43·5010
DL & RL 5·0763
JONES
J.C. HILDYARD 4·1531
HOPE DOMAIN
N. WALTERS 3·1540
C. BOLITHO 5·4658
POWER SD.
RES.
NELSON CC & RICHMOND BC 19·9553
N. HEATHERBELL 20·4763
VAILIMA ORCHARD CO. LTD. (M. HODDY)
10·1412
L.J. TASKER 2·3357
D. TASKER 4·8572
L. McVICAR 9·0017
M. HUNTER 19·5460
W.R. FRAZER 3·1624
D.W. ADDCOCK 7·6331
R. FITZGERALD 5·0586
RESIDENTIAL
P.A. MALCOLM 3·3210
R.J. MALCOLM 16·2145
12·0647
C.B. & M.F. WOODFORD 6·8627
ZWART, M & CO. LTD. 10·5284
P. HALL & SONS LTD 14·4596
P. HALL & Sons LTD 20·4776
A.W. CHAMBERLAIN
FOULDS-CHAMBERLAIN 4·0678
L. HUNTER & C. DICKINSON 8·1218
VAN DER VELDT 4·1733
M.T. VER DONK 4·0848
2·9474
F.G. HEATHERBELL 9·3186
W.G. DUNCAN 10·3537
ETHERINGTON ORCHARD LTD 5·0586
V.W. OSBORNE 6·0703
FIELD HOLDINGS LTD 41·4221
W.V. EUNSON 20·7401
J.M. & D.P. DENSEM 9·7125
A. LITTLE 24·1167
R.E. HEPBURN 7·0137
D. McINTOSH 4·0469
T.C. THEUN 4·3107
MALCOLM FARM LTD 6·2632
H.H. MALCOLM 11·9256
C.A. ARNOLD 10·6055
10·6055
NGATITARA FARMS LTD (HASTINGS)
R.H. PROSSER 2·0234
L.P. STRATFORD 18·7801
B. WEBBY 20·2343
S.I. & B.G. DRON & W.V. GLASGOW 35·9513
S.I. & B.G. DRON & W.J. GLASGOW 16·5187
V.C. BORLASE 15·5356
A. McWHINNIE 7·2515
H.H. MALCOLM 11·5434
B.D. DORNBUSCH 3·8293
S. FIELD 5·4604
5·8730
H.A. FIELD 18/1033 DP 6219
H. TASKER 5M/1366 DP 8571
RESERVOIR
PROPOSED SCHEME BDY.
PROPOSED PIPE LOCATION
RES. - RESIDENTIAL AREAS
0
1 km.
SCALE - 1:16000 (4 IN. = 1 MILE)







Panoramic view (photographic montage) of the Waimea East Irrigation Scheme area, looking roughly northwards. The Scheme boundary is shown in red.
The angle of the photos has given distortions in the foreground and made it difficult to indicate the boundary precisely in the background.