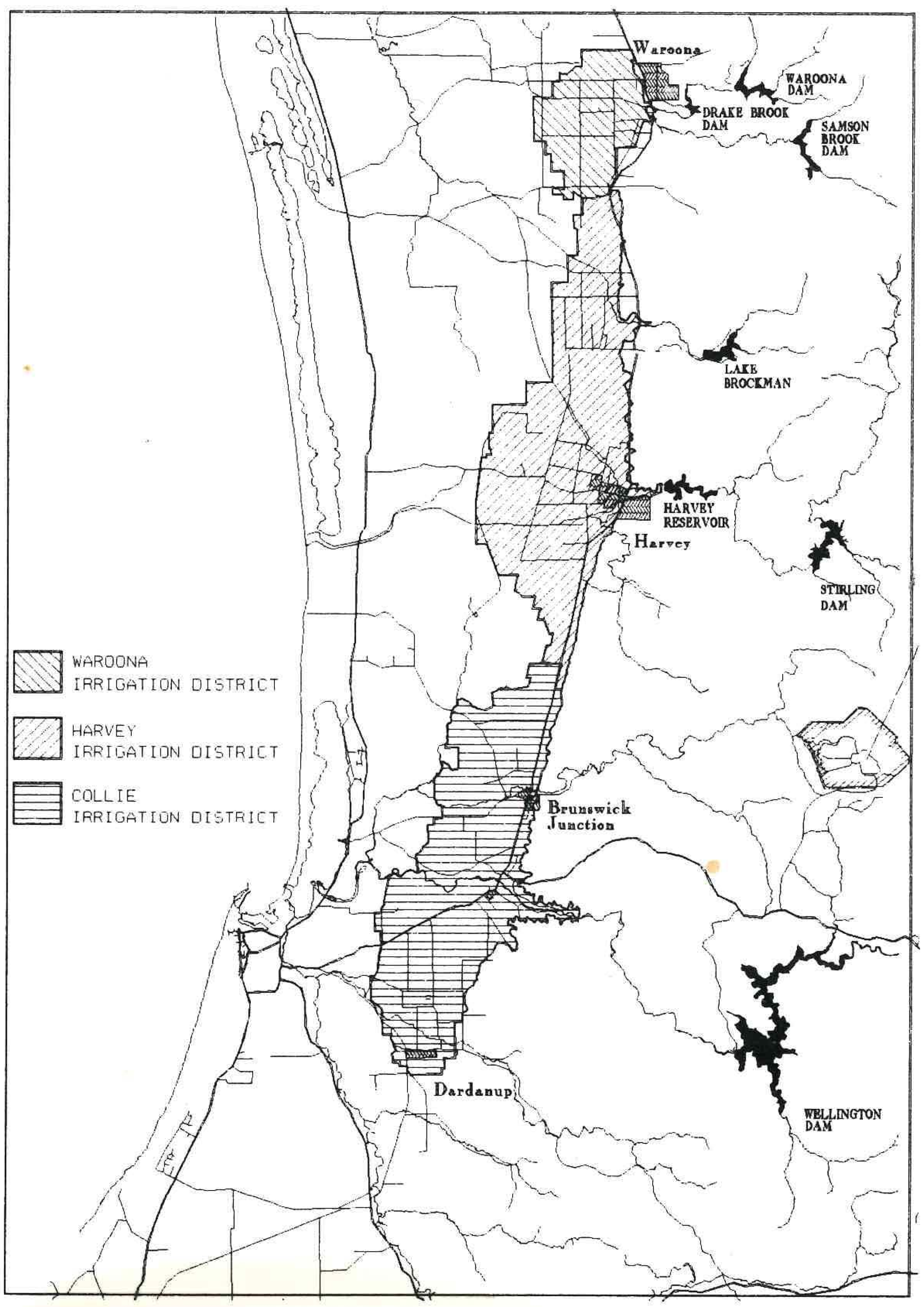
THE IRRIGATION STRATEGY STUDY SOUTH-WEST WESTERN AUSTRALIA

PHASE 1 REPORT

Summary of background papers and identification of issues



Consultative Committee to the Irrigation Strategy Study

July 1990

THE IRRIGATION STRATEGY STUDY
SOUTH-WEST WESTERN AUSTRALIA

PHASE 1 REPORT

Summary of background papers
and identification of issues

Prepared for
the Consultative Committee
to the Irrigation Strategy Study

by the Technical Working Group

Report No. WP95
Water Authority of Western Australia

July 1990

Produced and available from
Water Authority of Western Australia
Water Resources Directorate
John Tonkin Water Centre
629 Newcastle Street
Leederville, WA 6007

Report No. WP95
IBSN 0 7309 3715 1

CONTENTS

EXECUTIVE SUMMARY

INTRODUCTION

The Irrigation Strategy Study is aimed at assisting Government develop a strategy for the rehabilitation and/or modernization of the irrigation systems serving the Waroona, Harvey and Collie River Irrigation Districts. The study is being guided by a Consultative Committee with wide local representation. This Committee is supported by a Technical Working Group composed of staff from relevant government agencies and consultants.

This report summarizes the outcome of the initial background data gathering and issue identification carried out in Phase 1 of the study. The detailed background papers which support this report are available from the Water Authority of Western Australia (Water Authority), the Department of Agriculture and shire libraries in the south-west.

THE IRRIGATION SUPPLY SYSTEM

Many of the dams and a large part of the irrigation channel system in the south-west were originally constructed in the 1930s. Most of the early timber structures were replaced in masonry or concrete and most of the channels enlarged to meet current demands during the period 1950-1970. Almost all of the system was designed at a time when both construction and maintenance was carried out almost entirely by manual labour.

Much of the channel lining is no longer effective in preventing seepage, and leakage from the system is increasing. Many of the structures and Dethridge meters are nearing the end of their effective lives. The facilities have now deteriorated to the stage where major expenditure on a programme of rehabilitation and reconstruction is required. The channel systems have a replacement value of $81 million, but preliminary estimates by the Water Authority suggest that expenditure of around $25 million on rehabilitating and modernizing parts of the channel system may be sufficient to allow the system to operate satisfactorily for another twenty to thirty years.

Many dams in Western Australia, especially the older ones, require modification to meet the new Australian design standards for flood forecasting and earthquake resistance. The preliminary estimate of expenditure required on modifications to the dams serving the irrigation areas is $16.9 million over the next ten years.

IRRIGATION REVENUE - COST BALANCE

Revenue from rates and water charges in 1988-89 was $2.1 million, while operation and maintenance expenditure was $2.4 million.

This loss on operation and maintenance has largely been produced by a 17% reduction in the area irrigated and water consumed by farmers since 1981-82. Since 1983-84, irrigation rates and charges have remained fairly constant in real terms but due to the reduced consumption revenue has declined $764,000 in real terms. The full reasons for this decline are not yet understood but increased productivity per dairy cow and declining beef herd numbers due to price trends are amongst the factors which will be examined in Phase 2 of the study.

The Water Authority has increased the productivity of its operations and maintenance activities to offset this loss of revenue, reducing staff by 23% and achieving cost savings of $331,000. However, 10% of maintenance funds are now being spent on 'patching up' facilities which should be replaced and there is evidence of a mounting backlog of essential maintenance.

SALINIZATION AND LAND DEGRADATION

Surveys by the Department of Agriculture have shown that yields are being depressed to varying degrees by increasing soil salinity over up to 33% of the area. This is supported by Geological Survey studies of the salinity of the water table under the irrigation areas. The yield depression is being caused by a rising groundwater table and increasing pressure in the deeper aquifers, resulting mainly from leakage from the channel system and overwatering on farms. In addition, 40% of the area served by Wellington Reservoir is being irrigated with water which in many years has a salinity of 1,000 mg/L. This is too high for long-term sustainable agriculture without very good drainage.

Salinity management must be an essential element of any strategy for the future of irrigation in the south-west. Preliminary estimates of the type and cost of works necessary to rehabilitate all of the affected areas suggest that total capital expenditure of around $45 million could be required by farmers and the Water Authority.

AGRICULTURE IN THE REGION

Dairying is the major enterprise, with 45% of the State's milk produced by irrigation area farms. There are 168 dairy farms using 64% of the water and accounting for around 70% of the output value of the area. The irrigation of pastures for beef and sheep uses a further 30% of the water.

Horticulture in the area declined from 1950-70 but subsequently stabilized with a small increase in the area used for orchards. Horticulture accounts for approximately 2% of water used.

ECONOMICS OF DAIRY PRODUCTION

Because of the dominance of dairying the economics of production in the area have been examined in some detail using statistics from the Dairy Industry Authority, the Australia Bureau of Statistics and a special survey commissioned for this study. The Department of Agriculture's dairy farm model has also been used to examine the economic effects of pricing and policy changes.

The data indicates that dairy farms in the irrigated areas, in comparison to non-irrigated farms between Serpentine and Capel, are:

- significantly larger
- can produce milk 1.7 cents/litre cheaper
- have larger sideline income from grazing.

The irrigation area farms are expected to improve their relative cost advantage over the next few years as the Dairy Industry Authority progressively phases out the uniform transport charge previously applicable to all milk produced in the south-west.

ECONOMIC VIABILITY OF REHABILITATION AND MODERNIZATION

ACIL Australia Pty Ltd have carried out a preliminary analysis of the economic and financial viability of rehabilitating and modernizing the irrigation area. This has been done by comparing the costs and benefits which would be involved in rehabilitation to the costs which would be incurred if the system were to be closed down. Figures are then expressed in net present value terms using the 6% discount rate normally applied by the Water Authority in evaluating capital expenditure proposals. The principal benefit arising from the rehabilitation case is the retention of increased production resulting from irrigation.

Economic Analysis

The results of the initial analysis show that:

- The present value of the benefits to the farmer of rehabilitating the irrigation system is $63.6 million.

- The present value of the cost of maintaining/rehabilitating the irrigation system is $58.7 million.

- The present value of the cost of closing down the system is $27.2 million.

- The nett benefit of rehabilitation is therefore $32.1 million.

- The present value of the cost of rehabilitating all of the salinity affected areas is $51.4 million.

On these preliminary figures, rehabilitation is economically attractive provided salinity mitigation costs are low. Inclusion of the proposed comprehensive salinity management program would render the rehabilitation uneconomic. Therefore, the extent and cost of salinity management will be key issues in developing a strategy for the future of irrigation in the south-west.

If the system were closed down, water in the reservoirs would become available for other uses, either in the south-west or metropolitan areas. A preliminary estimate of the value of this water, based on gradually increasing metropolitan use after the year 2005, is $10 million . This factor needs to be included in economic evaluations of the options to be developed in Phase 2 of the study.

Financial Analysis

At present usage levels, the cost of water to the farmer would have to increase to $50 per megalitre to fully fund the rehabilitation programme. This is approximately double the amount currently paid by the average dairy farm.

KEY ISSUES

Future markets

Any rehabilitation of the scheme has to be designed for the agriculture of the future.

The studies to date indicate an expected 60% growth in demand for market milk over the next thirty years which the irrigation area is well placed to produce. Thirty-five percent of milk produced is used for the manufacture of milk products which are subject to competition from the Eastern States and overseas.

The extent of beef production in the area is to some extent determined by the world market demand for Australian beef.

Studies of the demand for horticultural production in Western Australia indicate that after the year 2000 there could be a growing use of up to 2,000 hectares of the better soils in the irrigation districts for horticulture.

Development of alternative market scenarios for these major products of the areas will be an important part of the Phase 2 studies.

Funding of the rehabilitation of the system

The preliminary data gathered to date suggests that dairying and horticulture could pay the higher charges for water necessary to fund the rehabilitation of the system without being placed at a cost disadvantage compared with their dry-land competitors. However, using irrigated pasture for beef production is only marginally viable at current prices and an increase in the water price to fund the rehabilitation would cause most beef producers to cease irrigating. Options for determining the future extent of irrigation and developing an equitable charging structure will be addressed in Phase 2.

Substitution of purchased feed for irrigated pasture

The practice of purchasing feed as an alternative to irrigated pasture has grown among dairy farmers in recent years.

Despite this the farmers have indicated a strong desire to have the irrigation service maintained. Resolution of this issue will be a key part of Phase 2.

Salinity management

A salinity management plan for the area is essential if irrigated agriculture is to continue into the future. Development of an economically viable salinity management plan will be a key element of the Phase 2 studies.

Environment

Ninety-two percent of the irrigated area drains to either the Peel–Harvey or Leschenault Estuary. Recent evidence suggests the nutrient discharge from the irrigated areas may be higher than previously thought. Development of a plan for management of nutrient discharge will be included in the Phase 2 studies.

PHASE 2 OF THE STUDY

In Phase 2 of the study it is proposed that the Consultative Committee will develop a number of scenarios for the future of the irrigated area. From these scenarios and with input from local communities, government agencies, and industry and farmer groups, the Consultative Committee will develop future options for irrigated agriculture, and the supply and drainage systems. The economic, financial, social and environmental aspects of each option will be studied in detail during Phase 2.

Chapter One

INTRODUCTION

1.1 BACKGROUND AND AIM OF THE STUDY

In 1989 the Water Authority of Western Australia (Water Authority) initiated a study to assist in the development of a Government policy on the long-term direction of public irrigation in the south-west of Western Australia. The Water Authority recognized that many structures associated with irrigation were reaching or had exceeded their design life, and that significant capital investment would be necessary to maintain the scheme over the next thirty years.

The Water Authority also recognized that any major decision to invest significant capital in irrigation went well beyond the scope of the Water Authority alone. The study would need to address agricultural, economic, environmental, social and engineering issues. From the beginning, the study was planned to be multi-disciplinary and to actively involve the local communities in the study region.

The primary objective of the study is to develop a long-term strategy for the rehabilitation and/or modernization of current irrigation systems and practices, subject to the constraints of:

- economic sustainability
- financial feasibility
- social and environmental acceptability.

The study should provide a basis for ongoing planning of:

- the redevelopment, operation and maintenance of the Water Authority's irrigation supply systems over the next thirty years;

- farm redevelopment and operations.

1.2 STUDY APPROACH

The study has been divided into six distinct phases, which are described in more detail in Appendix A.

Phase 1: Background Development and Issue Identification
Phase 2: Option Development and Analysis
Phase 3: Public Review of Future Strategy Options Report
Phase 4: Review of Submissions and Preparation of Draft Strategy
Phase 5: Environmental Protection Authority Review of Draft Strategy
Phase 6: Adoption by Government of Long Term Irrigation Strategy.

1.3 PHASE 1 REVIEW

Phase 1 of the study has been guided by a Consultative Committee which includes six local representatives (Appendix A). This committee is supported by a Technical Working Group consisting of staff from government agencies and consultants.

The Technical Working Group has prepared eight background papers for the Committee. The objective of these papers is to provide background data and analysis to assist the development and detailed analysis of strategy options in Phase 2. These background papers are:

1. Current and future problems facing the operation and maintenance of the south-west irrigation services.

2. Review of irrigation water policy issues.

3. Economics of irrigated agriculture.

4. Engineering cost estimates for the continued operation and maintenance of the south-west irrigation service.

5. Potential changes in irrigated agriculture.

6. Environmental and land degradation problems.

7. Farmers, families and irrigation: some social considerations in planning for the South-West Irrigation Districts.

8. Distribution efficiency.

Copies of these background papers have been placed in shire libraries and Water Authority and Department of Agriculture offices in the area for detailed study by interested persons.

This report summarizes the data in the background papers and is intended for use as a resource document by the following groups:

- the Consultative Committee
- the local community
- interested government authorities and departments
- industry organizations.

1.4 PHASE 2 TIMETABLE

Identification of the key options for study and analysis is expected to be completed by 30 September 1990, and detailed evaluation of these options is programmed for completion by 31 January 1991.

Chapter Two

CURRENT ISSUES FACING THE IRRIGATION INDUSTRY

2.1 WATER SUPPLY SYSTEM

2.1.1 CONDITION OF THE IRRIGATION SYSTEM

A large part of the irrigation system in the south-west was constructed in the 1930s and was designed for lower water demands than exist today (Policy Papers nos 1 and 2). Most of the early timber structures were replaced with concrete and masonry in the period 1950-70 and the channels enlarged to meet increased demand. The exception is the Harvey no. 2 district, which was constructed in the period 1946-55. Installation of Dethridge meters commenced in the 1960s. The system was designed at a time when both construction and maintenance were carried out entirely by manual labour.

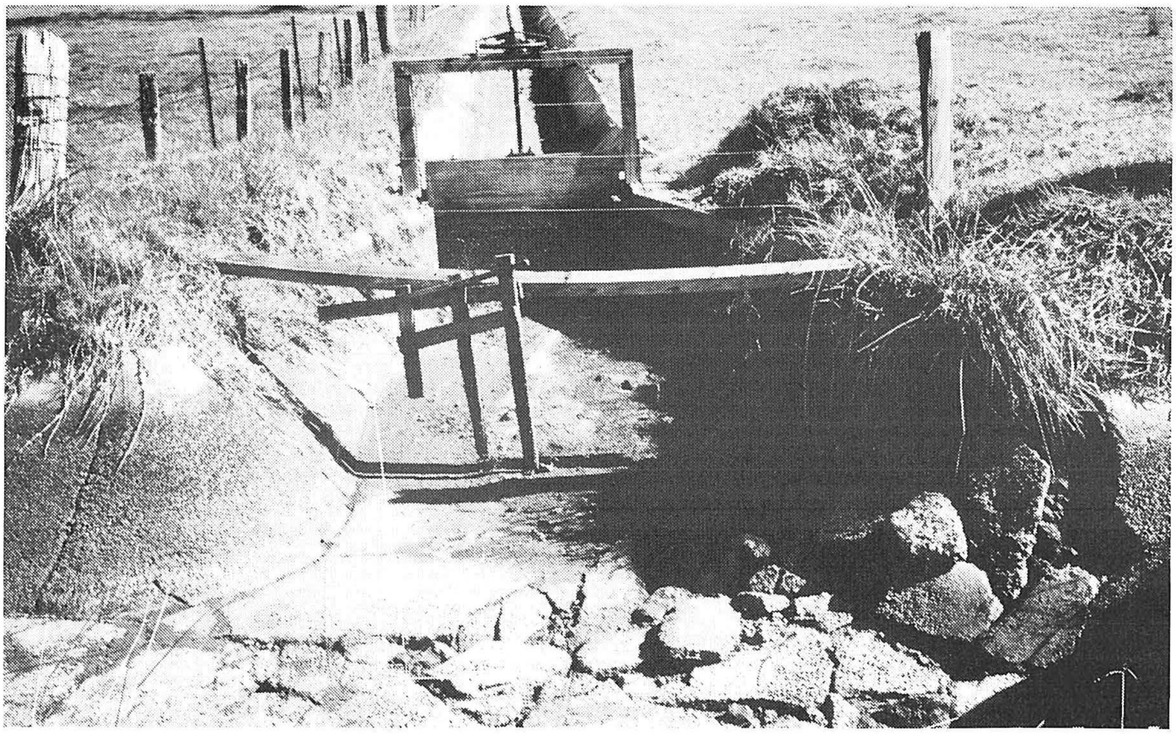
The channel lining is twenty to forty years old and much of it is no longer effective in preventing seepage. Many of the structures, which had an expected life of fifty years, are now forty to fifty years old. The Dethridge meters, with an expected life of twenty years, are twenty to thirty years old and are in need of regalvanizing and shaft replacement. In addition, some earth channels in the Collie District that were never reconstructed to meet today's demands have inadequate capacity and leak into adjoining farms. Water loss from the channel system is increasing and 25% is now lost, compared to 20% in the mid 1970s.

As indicated by the attached photographs, parts of the system cannot continue to operate without replacement of many components, and this need will increase rapidly over the next ten years. Already, 10% of maintenance expenditure is incurred on 'patching up' facilities which should be replaced.

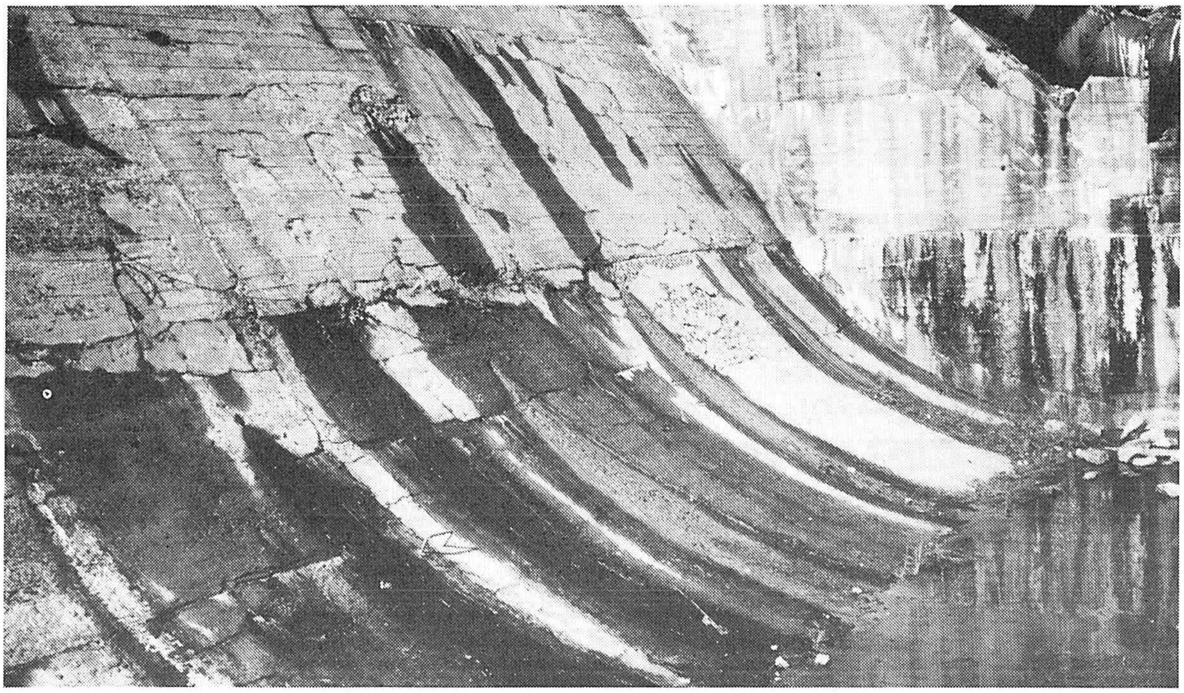
Some of the dams supplying the district are now over fifty years old and will require expenditure within the next thirty years, especially on outlet works and spillways.

2.1.2 DEMAND FOR WATER

The area being irrigated by farmers has contracted from 14,690 hectares in 1981-82 to 12,225 hectares in 1988-89, the smallest area irrigated since 1964-65 (with the exception of the 1987-88 drought year). Water use has declined commensurate with the decline in the area irrigated, although there have been seasonal variations (Figure 2.1). Preliminary figures for 1989-90 indicate a further slight reduction in water usage during 1988-89.



A typical example of deteriorating channel lining and a cattle stop in very poor condition.



The Harvey Weir needs expensive and regular maintenance to keep it safe and serviceable over the next thirty years. The photo shows seepage and the poor concrete condition at the toe of the spillway.

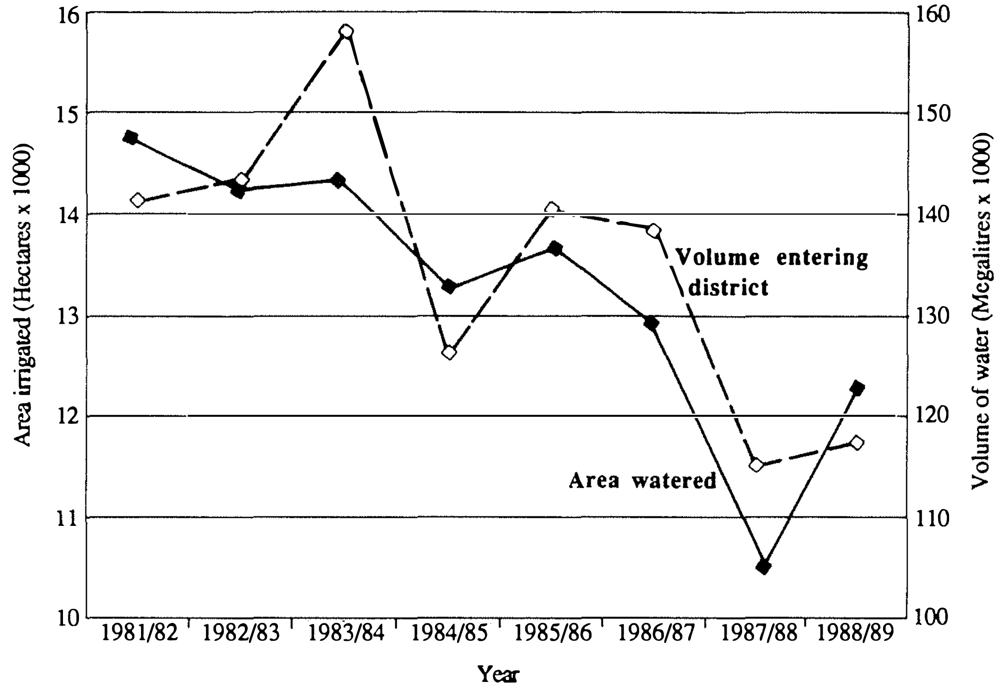


Figure 2.1
AREA IRRIGATED AND VOLUME OF WATER ENTERING DISTRICT FROM 1981/82 TO 1988/89

2.1.3 IMPACT ON REVENUE

The decline in water usage has resulted in revenue available to the Water Authority being reduced in real terms from $2,828,392 (December 1989 values) in 1983-84 to $2,064,221 in 1988-89, a reduction of $764,171 or 27%. A productivity campaign in the Water Authority has successfully reduced operating expenses from $2,738,397 (December 1989 values) in 1983-84 to $2,407,077 in 1988-89, a saving of $331,320 or 12%. To achieve this the workforce was reduced by 23%. Despite these efforts, the decreasing demand for water has resulted in the small surplus on operating achieved in 1983-84 being converted to a loss of $318,109 in 1988-89.

2.2 EASTERN STATES EXPERIENCE

The problems facing the south-west are not unique and have been encountered by irrigation districts in South Australia, Victoria and New South Wales (Background Paper no. 2).

In these states, charges for irrigation have historically been set to recover only operations and maintenance costs, with no allowance for replacement of assets or a financial rate of return on the public investment in irrigation facilities. As a result, irrigation schemes have deteriorated in recent times to a condition similar to that in Western Australia. The response of the State governments has been to adopt policies designed to place irrigation charges on a more commercial basis, with a view to achieving commercial viability in approximately twenty years. In Victoria and New South Wales it has been decided to fund rehabilitation of the system through direct revenue rather than by borrowing. In South Australia and New South Wales the governments have met part of the cost of rehabilitation at the beginning of the programme.

In Queensland the irrigation schemes are newer and charges have been set to achieve a contribution towards headworks cost and asset replacement. The Water Resources Commission of Queensland receives rent or payment for irrigation land which was resumed from pastoral leases prior to construction of irrigation facilities. In recent years the Commission has also auctioned extra water rights and achieved prices of up to $375 per megalitre.

In Western Australia, the Water Authority no longer receives a government grant to cover losses on country operations and water resources management. As a result, operating, maintenance and depreciation costs must be recovered through charges to customers. Where charges to one group of customers are insufficient to cover costs, another group has to be charged more to compensate.

In addition, the Australian Water Resources Council has set a water industry target of 4% for the real rate of return on the public's investment in water supply facilities. At present, both irrigation and rural drainage revenue is insufficient to meet even operating and maintenance costs, indicating a negative return on the public's investment in these facilities.

All four eastern States have introduced systems of transferable water rights, to allow water to be transferred to more profitable enterprises and productive soils which are better able to pay the increased water prices. The adoption of transferable water rights in Western Australia has been examined by the Water Resources Council. The Council has recommended to the Minister for Water Resources that transferable water rights be introduced in Western Australia, commencing with a trial in the Collie Irrigation District.

2.3 AGRICULTURE IN THE IRRIGATION AREA

Dairy farming is the major industry in the South-West Irrigation Districts, with 168 dairy farms utilizing 58% of the rated area and consuming 64% of the water supplied (Table 2.1). The next largest activity is grazing principally beef cattle, with 106 farms utilizing 31% of the rated area and consuming 28% of the water supplied. Together, these two activities are practised on 90% of the area and consume 91.5% of the water. There are 132 part time/hobby farms in the irrigated area but these utilize only 6% of the rated area.

Table 2.1 **Farm enterprise statistics**

Type of farm	Number with rating	Rated area	Water consumed on-farm
Dairy Farms	168 (38.5%)	58.3%	63.5%
Grazing – non-dairy	106 (24.3%)	31.4%	28.0%
Grazing and hort.	18 (4.1%)	3.6%	3.0%
Hort. only	12 (2.8%)	0.8%	0.5%
Part time/hobby	132 (30.3%)	5.9%	5.0%
Total	**436 (100.0%)**	**100%**	**100%**

2.3.1 DAIRY FARMING

The irrigation area is an important sector of the milk industry, responsible for approximately 45% of the milk produced in the State. Since negotiable milk quotas were introduced, the Waroona and Harvey Shires have slightly increased their quota while Dardanup has lost quota and farmers in the irrigation shires now hold 49.5% of the issued quotas. The total area controlled by the irrigation farmers is 78,256 hectares which is 2.25 times as large as the irrigation districts. This results from most irrigation farms having run-off blocks used mainly for the non-milking part of the herd. The dairy farms are relatively profitable at this time (Section 4) and are expected to become more profitable as the Dairy Industry Authority progressively removes the previous cross-subsidization of transport costs of dairy farmers further south (Background Paper no. 5). This will ultimately result in farms in the irrigation area paying 1.7 cents per litre less for transport and will provide an incentive for milk production to remain in the area.

Productivity per dairy cow has increased steadily in recent years. The number of cows and the area of pasture irrigated has declined by 10% during the last four years, while milk production has increased by 5% in the same period. This productivity increase appears to derive partly from increased use of grain and concentrate feeds.

In the 1989-90 season, the premium paid by the dairy companies for late summer milk was increased significantly (Background Paper no. 5) and in response, milk production in February-March-April increased by 45%. These higher premiums are again on offer for the 1990-91 summer. The irrigation areas have advantages in the production of summer milk. Milk processing and manufacturing plants are established at Harvey and Brunswick Junction.

2.3.2 BEEF PRODUCTION

Beef production is the second most important industry in the irrigated area, with approximately 120 farmers grazing beef as their major activity. In addition, turn-off of beef animals is an essential side line of the dairy industry. The majority of beef produced in the irrigation area is consumed locally but some beef cuts and cow beef is exported, principally to the United States and Taiwan markets.

The number of beef cattle in the area has been slowly declining over the last ten years, in conformity with the nation-wide trend. The outlook for beef is now favourable following the announced opening up of the Japanese and Korean markets, which is expected to lead to increased prices for Australian beef. Cattle numbers are expected to increase slightly in response to this trend. Major abattoirs are established at Harvey and Waroona that process beef from all parts of the State.

2.3.3 HORTICULTURE

The area planted to fruit and vegetables has varied over the years but has been relatively small since the introduction of pasture in the early 1930s. The highest levels of vegetable production occurred around 1950 when a significant quantity of potatoes were grown in the irrigation area. This area has declined steadily since 1950, especially the proportion planted to potatoes which is now insignificant. The area of orchards remained almost static from 1936-70 but has subsequently increased. In 1988-89 there were 110 hectares of orchards and 111 hectares of vegetable crops grown in the irrigation area. Only 94 hectares was grown by specialist horticulture producers, the remainder being sideline production on grazing properties and part time/hobby farms. Horticulture production provides the farmer with gross margins of approximately $3,000 per hectare compared with approximately $320 for dairying.

2.4 ENVIRONMENTAL, SALINIZATION AND LAND DEGRADATION ISSUES

2.4.1 WATER LOGGING AND SALINIZATION

Surveys carried out by the Department of Agriculture (Background Paper no. 6) indicate that the area severely affected by water logging and salinization increased from 3% to 17% of the irrigation area between 1970 and 1986 (Figures 2.2 and 2.3). These severely affected areas consisted mainly of heavy clays with high subsoil salinity and were often areas of outflow from the deeper, more saline groundwater. The 1986 survey also identified a further 16% of the irrigated area as showing evidence of depressed clover yields.

A detailed survey of 1,000 hectares identified as severely affected in the Dardanup area showed that 25% of the area had soil salinity high enough to reduce clover yields by 50% or more. Over a further 35% of the area, clover yields would be reduced by 25%–50%.

In addition, the Collie District is irrigated with water from Wellington Reservoir, which in many years has a salinity of around 1,000 mg/L. Studies at Dardanup have shown that at this level, approximately three times as much salt is applied in the irrigation water as runs off in the drains, and approximately 9 tonnes of salt per irrigated hectare passes into the groundwater.

A recent report by the Geological Survey (Report No. 1988/5) on groundwater on the Coastal Plain south of Mandurah has shown that the irrigation area is now underlain by brackish groundwater at a depth of 1-2 metres (Figure 2.4). At the end of winter and following each irrigation, the water table is nearly on the surface in some areas. The salinity of this groundwater is over 4,000 mg/L in much of the Harvey and Collie Districts and exceeds 10,000 mg/L in the northern portion of the Collie and the north-western portion of the Harvey District.

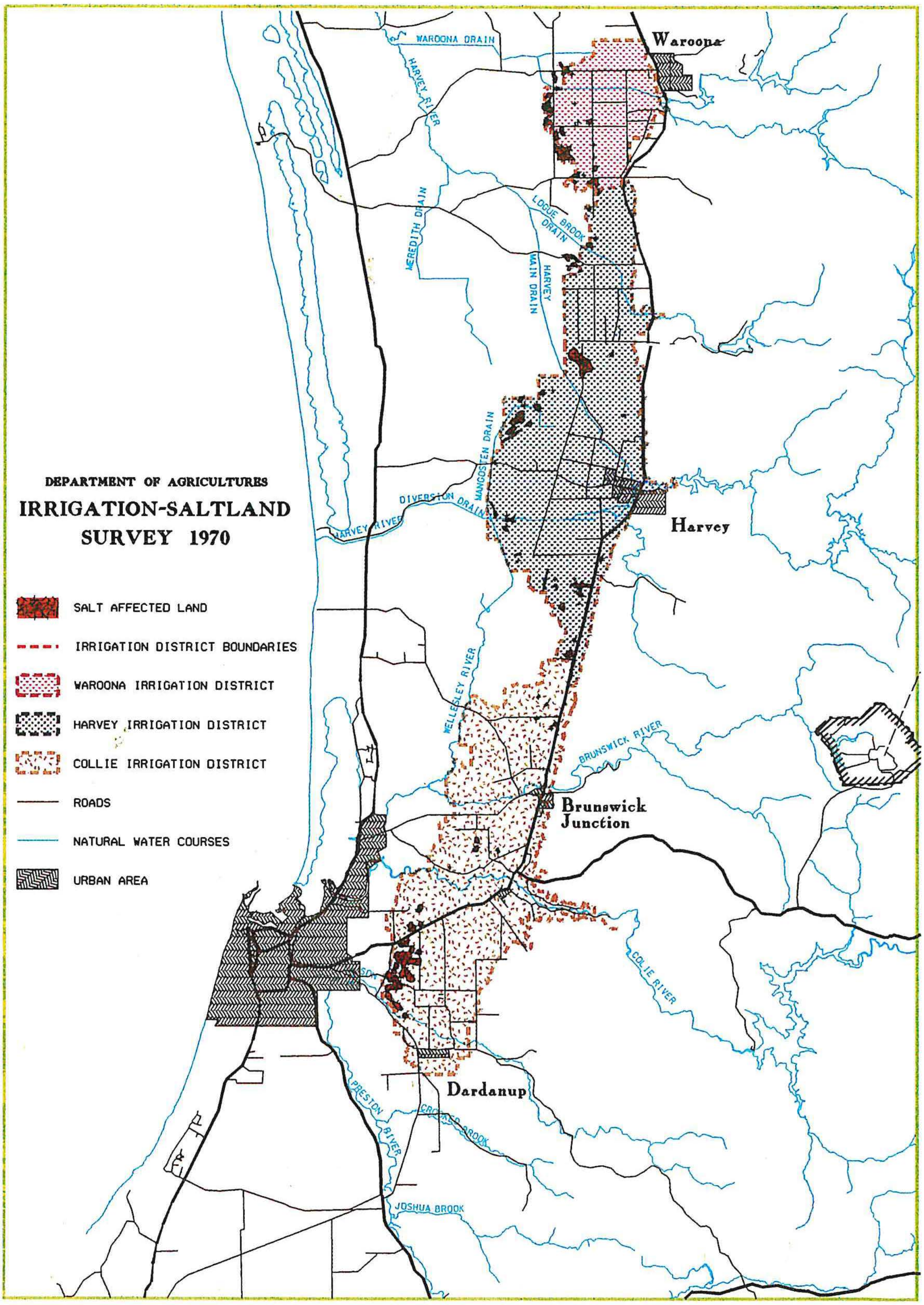


Figure 2.2
IRRIGATED SALT LAND SURVEY 1970
DEPARTMENT OF AGRICULTURE

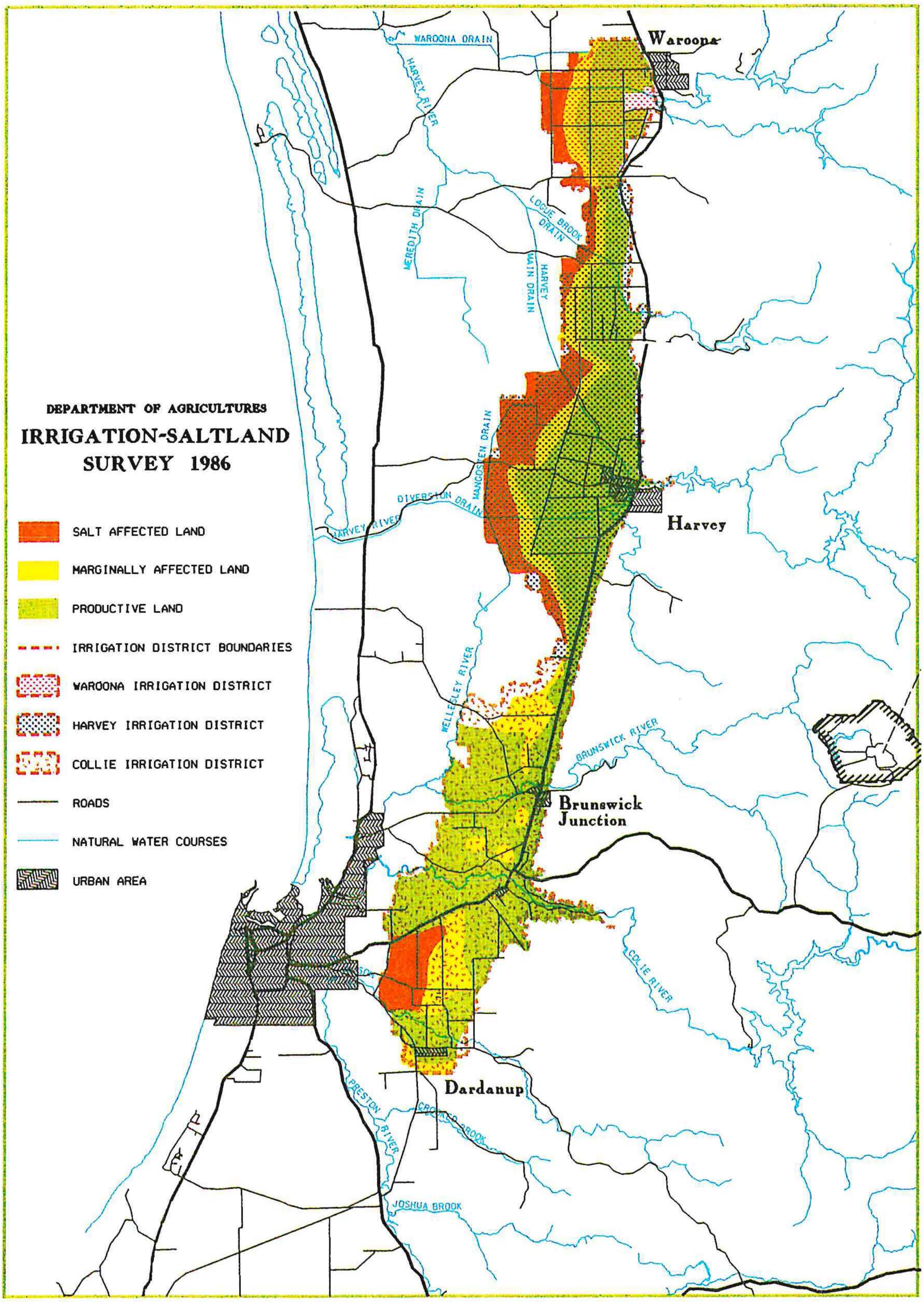


Figure 2.3
IRRIGATED SALT LAND SURVEY 1986
DEPARTMENT OF AGRICULTURE

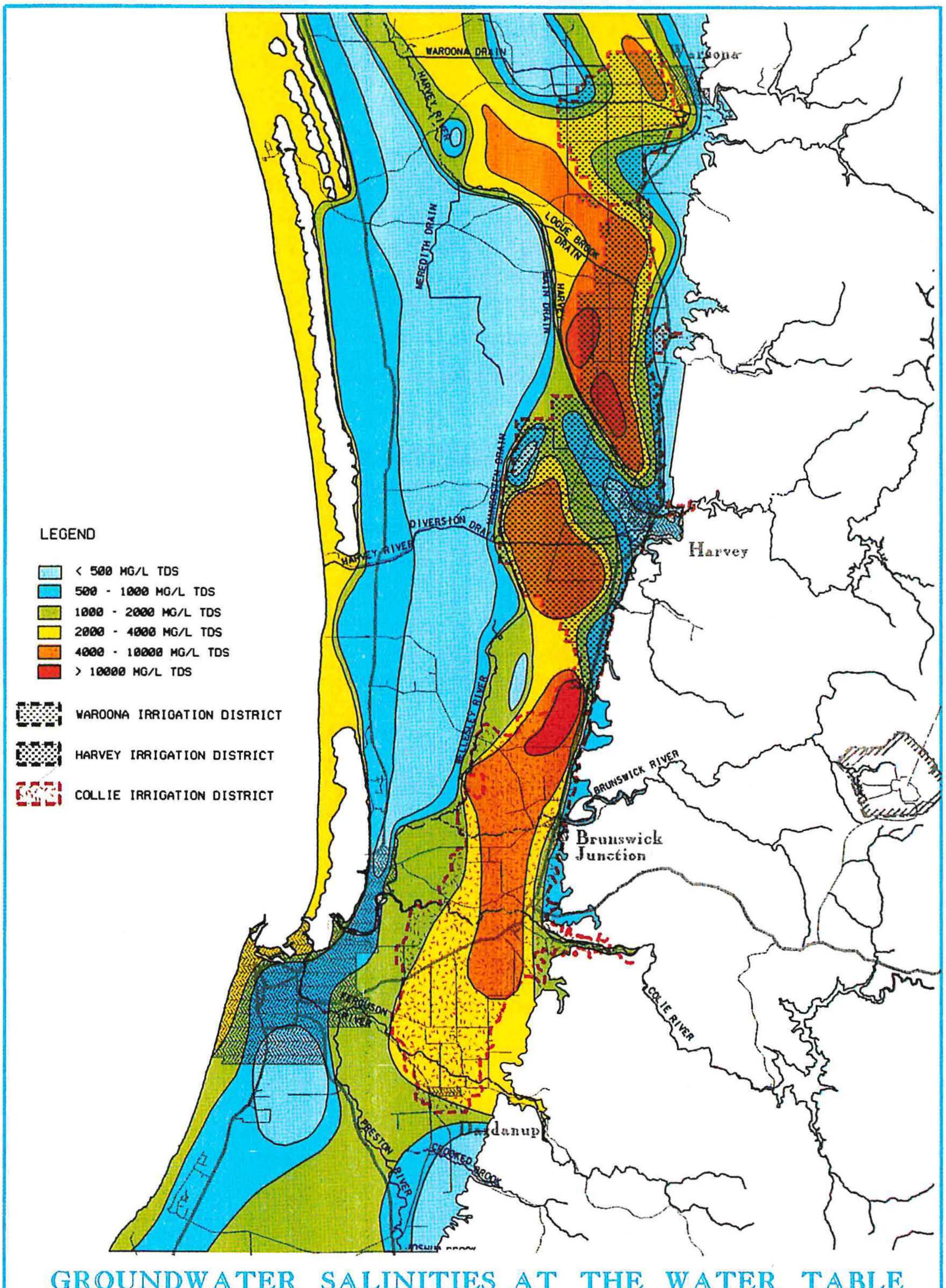


Figure 2.4

CONTOURS OF SALINITY AT THE SURFACE OF THE SHALLOW AQUIFER (GEOL. SURVEY REPORT NO. 1988/5)

These salinity levels are high enough to reduce clover yields if the water table is allowed to rise close to the surface during irrigation. Measurements at Dardanup in the mid 1970s indicated that the water table was rising by 0.1 of a metre per annum during a period of below average rainfall.

The basic cause of the rising groundwater table and increasing piezometric pressure in the deeper groundwater is excess water leaching into the groundwater system as a result of leakage from the channel system, overwatering on farms and possibly clearing on the ridge hill shelf upstream of the irrigated areas (Background Paper no. 6). The worst affected areas are generally those where discharge to the surface from the deeper aquifers occurs.

Salinity management must be an essential element of any strategy for the future of irrigation in the south-west.

Management of salinity will involve improved on-farm drainage, better water management and probably piping of critical channel sections. Using preliminary estimates (Background Paper no. 6), Table 2.2 outlines the cost of a comprehensive management programme to ensure that irrigation can be sustained on the total area for the next thirty years.

Table 2.2 **Estimated cost of managing salinity**

	Area (ha)	Area to be treated (ha)	Cost per hectare	Total Cost
On-farm subsurface drainage and improved water management:				
• severely affected area	5,700	5,700	4,500	$ 25,650,000
• moderately affected area	5,700	1,900	2,000	$ 3,800,000
• remainder of district	22,600	7,100	1,125	$ 8,000,000
	Total on farm			$ 37,450,000
Piping main channels:				
Contour channels upslope from severely salt affected land				$ 8,000,000
Total cost				**$45,450,000**

The costs of subsurface drainage used in this estimate are 30-50% below current rates in the eastern States and could only be achieved if sub-surface drainage was installed over an area in excess of 500 hectares per annum, which would allow the employment of a large trenchless plow drainage machine.

These costs also assume that the farmer will be allowed to discharge water from his sub-surface drains into the existing surface drainage system. As discussed in Section 2.4.2, there is evidence that the irrigation areas are significant contributors of phosphorus to the Peel-Harvey and Leschenault Estuaries. If sub-surface drainage leads to increased phosphorus discharge from the farms it may be opposed by the Environmental Protection Authority. The environmental impact of the disposal of drainage waters from irrigation districts is a major issue in many countries and in a number of cases drainage discharge has to be conveyed to evaporation basins.

If a similar policy applied in Western Australia or if discharge was only permitted to the ocean via the Harvey Diversion, significant additional costs for a collector system would be involved. An economic technical solution might not be possible and it may be necessary to cease irrigation on the badly salinized areas and restructure the farms as is occurring in the eastern states.

2.4.2 NUTRIENT DISCHARGE FROM IRRIGATED AREAS

The seriousness of the nutrient problems of the Peel-Harvey Estuary are well known. Algae growth problems in the Leschenault Estuary are also developing. Drainage from the irrigation areas is:

- 58% to Leschenault Estuary
- 8% through the Harvey Diversion
- 34% to the Peel–Harvey Estuary.

The light soils to the west of the irrigation districts have the highest concentration of phosphorus in their stream discharge of any coastal plain area. The Meredith Drain Catchment to the west and north of Harvey is a typical example. Most attention has been directed to reducing the nutrient discharge from such areas.

However, it is now clear that although the nutrient concentration in streamflow draining the irrigation clay/loam soils is much lower, the water yields are higher. Consequently the overall nutrient (phosphorus) discharge per hectare of cleared, irrigated land is as high and possibly higher than typical light, sandy non-irrigated soils.

Table 2.3 contrasts the phosphorus export per unit of cleared land in the Meredith and North Samson Brook Catchments.

Table 2.3 **Phosphorus discharge from irrigated and non-irrigated land**

Year	Merredith Catchment (Sandy soils non-irrigated low drainage density) kg/cleared ha of phosphorus	North Samson Brook Catchment (irrigated high drainage density) kg/cleared ha of phosphorus
1983	2.429	2.443
1984	1.244	3.135
1985	1.687	1.897
1986	.770	1.547
Average	1.533 (1)	2.256 (1)

Note: (1) Preliminary figures from G. Bott - EPA.

The current irrigated areas are therefore likely to be more closely scrutinized than in the past. In addition, any redevelopment of irrigation which involves more intensive fertilization and/or increased drainage will need to be closely evaluated for its nutrient discharge potential.

2.5 SOCIAL BACKGROUND OF THE STUDY AREA

The 1976, 1981 and 1986 census details for the South-West Irrigation Districts have been analysed (Background Paper no. 7) to establish recent population trends in the study area. The statistics quoted refer to collector districts and therefore differ from the whole shire statistics normally used by planners. The region was divided into four areas surrounding and including Waroona, Yarloop-Harvey, Brunswick Junction and Dardanup. The trends in these areas are shown in Table 2.4 which indicates a growth in population of 10.3% between 1976 and 1981. The trend slowed to an increase of only 3.5% between 1981 and 1986.

Table 2.4 **Population in South-West Irrigation Districts**

Collector district	1976	1981	1986
Waroona	1,742	2,169	2,214
Yarloop-Harvey	3,263	3,474	3,774
Brunswick Junction	2,031	2,129	1,915
Dardanup	1,062	1,162	1,344
Total	**8,098**	**8,934**	**9,247**

The 3.5% overall population growth of the South-West Irrigation Districts between 1981 and 1986 is considerably less than population growth in the South-West Statistical Division as a whole, which increased 16.7% in the same period.

Changes in the population of the towns and rural areas between 1981 and 1986 have also been examined. Changes in collector districts prevent 1976 being included. Table 2.5 shows that despite overall growth, population declined during the five-year period in the rural areas of Waroona and Brunswick and in the towns of Yarloop and Brunswick Junction.

Table 2.5 **Rural and town population changes 1881-86**

Area	1981	1986
Waroona		
• Town	1,462	1,567
• Rural	707	547
Yarloop-Harvey		
• Yarloop Town	553	455
• Harvey Town	2,203	2,310
• Rural	718	921
Brunswick Junction		
• Town	889	823
• Rural	1,240	1,092
Dardanup		
• Town	219	241
• Rural	943	1,103

Examination of age distribution statistics indicate that the irrigation districts have a slightly lower proportion of people over sixty than the south-west as a whole. However, the number of residents over sixty in Waroona increased markedly during the period in question and the same trend was evident at Dardanup.

The irrigation districts in 1986 accounted for 13.1% of agricultural employment in the south-west compared with 14.5% in 1981. The percentage employed in agriculture in both the irrigation districts and the south-west was declining at approximately 1% per annum.

The farming community is very static. Sixty-seven per cent of farmers surveyed had taken over from their fathers and over 80% expected that their farms would remain in the family. Seventy per cent of farmers surveyed had more than twenty years' experience as irrigation farmers.

The farmers were optimistic about the future of farming in the irrigation districts and 70% intended upgrading their on-farm irrigation/drainage system in the next three years. The average expected expenditure per farmer over this period was $9,900. Over 80% of farmers regarded it as important that dairying be maintained in the area. Around 70% acknowledged that dry-land dairy farming could be profitable.

Despite the stability of the farming community there have been significant changes in agricultural processing industries in the irrigation districts during the past thirty years. The manufacture of milk based products at Harvey and Coolup ceased and the receival depot at Wagerup closed. Major abattoirs have been established at Harvey and Waroona. The Harvey Fresh factory, processing orange juice and milk products, has recently been established at Harvey.

Chapter Three

REHABILITATION AND RECONSTRUCTION OF THE IRRIGATION SYSTEM AND BASE CASE

The recent decline in demand for water has resulted in revenue being insufficient to adequately maintain the system. The facilities have now deteriorated to the stage where major expenditure on a program of rehabilitation and reconstruction is required. The facilities serving the South-West Irrigation Districts have the following replacement values:

- Dams $87 million
- Channel system $81 million.

The value of the farms in and associated with the irrigation districts is approximately $300 million.

Irrigation is not essential to dairying or beef production and farmers are already on average spending as much on feed as on water (Background Paper no. 3). The attitude survey (Background Paper no. 7) shows that farmers would use less water if the price was increased to fund rehabilitation and reconstruction:

- 15-20% less for a 50% price increase
- 30-40% less for a 100% price increase.

However, farmers have indicated a strong desire to see the irrigation service continued.

Resolution of this dilemma is central to the studies being carried out for the Consultative Committee in Phase 1, and considerable data has been gathered for inclusion in the economic evaluation summarized in Section 5.

3.1 REHABILITATION OF CHANNEL SYSTEM

Much of the channel system is now forty to fifty years old and experience has shown that little of the channel lining and few of the structures will last beyond sixty years. Earth channels, if well maintained, have an almost indefinite life. It is clear that major expenditure on replacing channel lining and structures will be required over the next twenty years.

Different degrees of rehabilitation have been considered and preliminary cost estimates prepared in Background Paper no. 4. The purpose of these investigations was to provide an estimate of the order of costs which could be involved in rehabilitating the system. These should not be seen as accurate cost estimates of proposed future options. It is intended that future scenarios for the irrigation area will be developed in Phase 2 of the study, which will allow options for rehabilitation to be developed on a rational basis. More accurate estimates of the extent and timing of the work required will be developed at that stage of the study. The degrees of channel rehabilitation are:

- major upgrade case
- minor upgrade case
- minimum maintenance case.

3.1.1 MAJOR UPGRADE CASE

Preliminary cost estimates for the major upgrade scenario are summarized in Table 3.1.

Table 3.1 **Channel system rehabilitation - major upgrade case**

	$ millions (Dec 89 values)
Relining 97.5 km of channel	12.87
Piping 32.1 km of channel	8.54
Replacement 800 Detheridge wheels	1.06
Replacement 120 Detheridge emplacements	0.09
Installation of 52 automatic flow controllers	1.92
Upgrading 600 minor checks	6.00
Upgrading 21 major checks	1.05
Construction of 720 fail safe bypasses	0.72
Construction of 418 km of access tracks	10.64
Contingency and adminstratiin	7.70
Total	**50.6**

3.1.2 MINOR UPGRADE CASE

An alternative programme, which could allow the system to last another twenty to thirty years, omits the channel relining and the construction of access tracks and is estimated to cost $24.6 million.

3.1.3 MINIMUM MAINTENANCE CASE

A third alternative, which is used in the economic evaluation in Section 5, is known as the Minimum Maintenance Case. In this scenario the costs of the Minor Upgrade programme are distributed over the next twenty to thirty years and added to maintenance expenditure. The various works in the programme would be undertaken progressively as the priorities of the time dictated. Annual maintenance expenditure would initially be increased from $2.41 million to $2.6 million to overcome the backlog of work, and a further $0.85 million provided to commence the thirty year programme of progressive reconstruction and modernization. Total initial annual cost is therefore $3.45 million, which gradually tapers off as the backlog of maintenance is overcome.

3.1.4 MODERNIZATION OF CHANNEL SYSTEM

The present system was mostly designed when construction and maintenance was by hand, and vehicular access was not provided. In many situations this makes mechanical maintenance impossible and chemical spraying expensive. Watermen spend 20% of their time walking to structures and supply points. The major upgrade case provides for construction of 418 km of access tracks. However, the economics of this appear marginal and are still being investigated.

Systems are available which allow channel systems to be automated but up to now these have been expensive by Australian standards and not suited to the steep grades of the channels in Western Australia. Electronic systems have recently been developed which appear very promising and two gates have been ordered from Canada for trial. In the next thirty years it is highly likely that such systems will become cheaper and more reliable and the upgrade cases provide for this. Pipelines also operate automatically and offer labour savings. These are not usually enough to justify piping except where there is considerable head or the route can be shortened. The operational savings which might be achieved as a result of the upgrades have been estimated in Background Paper no. 4 at approximately $1.25-1.5 million annually when the upgrade is complete.

3.2 DAMS

In recent years new standards relating to flood forecasting and earthquake resistance have been adopted for use in design of major dams. The designs of all dams constructed in Western Australia have been reviewed by the Water Authority and most dams, especially the older ones, need modification to meet the new standards.

A preliminary estimate of the cost of this work which it is proposed be carried out mainly over the next ten years (Background Paper no. 4), is set out in Table 3.2 and totals $16.9 million. The ten year programme to bring the dams up to acceptable Australian standards is considered essential and is included in all cases considered in the economic evaluation.

Table 3.2 **Preliminary cost estimate of dam modifications to meet new Australian standards for floods and earthquakes**

		$ millions
Year 1	Harvey Weir re-tensioning	1.0
	Wellington diversion	0.3
Year 2	Logue Brook (spillway)	2.6
Year 3	Waroona (part spillway)	2.3
Year 4	Waroona (part spillway & toe stability)	2.3
Year 5	Samson spillway	2.7
Year 6	Harvey spillway (epoxy)	2.0
Year 7	Stirling spillway	0.6
Year 8	Drakes Brook	0.3
Year 9		0.0
Year 10	Re-tensioning of Harvey	1.0
Year 20	Re-tensioning of Harvey	1.0
	Administration	0.8
Total		**16.9**

3.3 MINIMUM MAINTENANCE CASE

The Minimum Maintenance Case has been adopted as the rehabilitation scenario to be used in the economic analysis (Section 5) for comparison with the Base Case. The expenditure required is summarized in Table 3.3.

Table 3.3 **Estimated costs of minimum maintenance case**

	$ millions	
Irrigation system		
Adequate level of planned essential maintenance	2.6	per annum initially
Gradual replacement of channel control structures and Dethridge meters with modern equivalents over 20-30 years	13.8	
Systematic programme of piping channels where cost justified over 20-30 years	10.8	
	24.6	spread over 20-30 years commencing at $0.85 million in year 1
Dams		
Dam modifications over ten years to meet Australian standards for floods and earthquakes	16.9	
Total capital expenditure	**41.5**	

3.4 BASE CASE

To measure the economic effect of expenditure on rehabilitation of the irrigation system, it is necessary to have a base from which to measure changes in expenditure and revenue both within the irrigation system and on the farm.

Currently only elements of the channel system which threaten public safety (e.g. bridges) are being replaced and maintenance funds are being diverted to 'patch up' other parts of the system which require replacement. Continuation of funding at this level will lead fairly rapidly to the system not being able to meet peak demands, and ultimately to failure of sections. It is not possible to predict with any accuracy how and when these failures will occur and establishing realistic costs for such scenarios is very difficult.

To simplify the initial cost/benefit estimates a rapid close down of the system has been adopted as the base case. For the purpose of the study it is assumed that the irrigation system will be closed down over a twelve month period although works associated with the close down will continue over three years.

The costs incurred in a rapid close down are larger than those which would occur in the slow, haphazard close down scenario. Consequently this approach will place the rehabilitation options in a slightly more favourable light. This approach has also been used for similar studies in the eastern States. The direct costs which would be incurred if the system were closed down are summarized in Table 3.4 and include:

- the channel system
- Water Authority staff redeployment
- on-farm stock, dairy and domestic water supplies
- on-farm conversion to dry-land pasture.

3.4.1 CHANNEL SYSTEM

In some cases, the channel system and its winter reliefs divert water from its natural course into the Authority's drainage system. If the channel system is to be abandoned this water will have to be diverted back to its natural course. It would also be necessary to fill in parts of the channel system through town sites to avoid dangers to children, and to replace or remove old timber bridges. Some steel structures would also need to be removed. The cost of these works is estimated at $2.03 million.

3.4.2 WATER AUTHORITY STAFF

There are the equivalent of six salaried staff and thirty-three wages staff engaged on irrigation activities who would be redundant if irrigation ceased. The studies have shown that all of the salaried staff and most of the maintenance staff could be absorbed with some training into positions becoming vacant elsewhere in the Water Authority. Some of the older men would probably prefer early retirement with redundancy payments under the usual arrangements. The Water Authority has estimated the likely costs of relocation, retraining and redundancy at $360,000.

Table 3.4 **Estimated cost of base case**

	$ Millions
By Water Authority	
Bringing dams up to acceptable Australian standards for flood and earthquake and risks - over ten years	16.91
Channel system - making safe and re-establishing winter flows	2.03
On-farm water supply - provide system where not possible for farmers due to salinity	0.48
Design and supervision costs	0.75
Retraining, relocation and redundancy payments to Water Authority staff	0.36
	20.53
By Farmers	
On-farm stock, dairy and domestic water	5.30
Changes to pastures and farm facilities to convert to dry-land operation	3.06
Total cost	**28.89**

3.4.3 ON-FARM STOCK, DAIRY AND DOMESTIC WATER SUPPLIES

Farmers in the irrigation area rely on the irrigation system to provide 50-60% of water used for livestock purposes. The remainder is supplied from bores, dams, creeks and soaks and is used to a lesser extent for household purposes. If the irrigation system were shut down alternative water supplies would have to be developed. This issue has been examined by I.A. Laing of the Department of Agriculture (Background Paper no. 4) who concluded that:

- Secure household supplies based on rain water tanks could be developed at reasonable cost.

- Over most of the area farmers could develop dams and/or groundwater at normal on-farm cost levels to supply livestock drinking and dairy water requirements.

- Over a small area of the Harvey District the salinity of the water in both the superficial aquifer and the Leederville aquifer was too high to allow an on-farm supply to be developed and a reticulated supply involving 12 km of pipe would have to be provided.

The cost of producing the alternative water supplies was estimated at:

- On-farm supplies $5.3 million
- Reticulated supply $0.48 million.

3.4.4 ON-FARM CHANGES TO CONVERT TO DRY-LAND PASTURE

The permanent irrigated pastures would have to be spayed, cultivated and reseeded to annual pasture species. Head ditches would also need to be filled in and some adjustments made to fencing. This would cost $200-300 per hectare.

In addition some farmers may need to increase the size of their hay sheds and hay machinery to handle the significant increase in the quantity of hay which would have to be made and fed.

The total cost of these activities is estimated at $3.06 million.

3.4.5 SOCIAL COSTS

The dairy farm model (Section 4.3) indicates that milk production on the average farm is not likely to decrease if irrigation ceased. The model predicts that farmers would buy more feed to replace the irrigation pasture. The major negative social impact would therefore be on the Water Authority's staff and its contractors. Feed merchants and their cartage contractors and suppliers of silos etc., would have increased business. However, the smaller sized or more intensively irrigated farms might not be able to maintain production and some restructuring might be required. This will be evaluated in Phase 2 and a cost has not been included in this preliminary analysis.

3.4.6 OTHER BENEFITS

If the irrigation system were closed down the water stored in reservoirs would be available for industrial and domestic purposes.

Data in the Water Authority's current twenty-five year source development programme indicates that for a minimum period of fifteen years, increased demand for water in Perth and Mandurah could be met at least cost by developing ground and surface water sources close to the city. On preliminary data it appears that extension of a trunk main to unused irrigation storages might become the cheapest means of obtaining additional water after the expiration of this period.

There may also be options to use the water for industrial development in the south-west if irrigation was closed down.

The opportunity value of domestic and industrial use of the water has been calculated for use in the economic analysis outlined in Section 5, on the basis of an increase in demand of 7,000 megalitres per annum after year fifteen with a cost advantage of 5 c/kL over the next cheapest source.

Chapter Four

ECONOMICS OF THE DAIRY INDUSTRY IN THE IRRIGATED AREA

The dairy industry accounts for around 70% of economic activity in the South-West Irrigation Districts and an understanding of the economics of the industry is essential to assessing the regional impact of any strategies for the future of irrigation.

The Technical Working Group has gathered data about the farms in the irrigation districts from the Australian Bureau of Statistics, the Dairy Industry Authority, the Water Authority and from an ACIL Australia Pty Ltd survey commissioned specifically for this study. The Department of Agriculture has also upgraded its dairy farm model using this data to allow scenario predictions of likely changes in use of water and profitability.

4.1 DAIRY INDUSTRY SURVEY

The Dairy Industry Authority surveyed milk producers in 1987-88. Analysis of the results of this survey included a comparison of the profitability of milk production on irrigated and dry-land farms between Serpentine and Capel.

This analysis (Table 4.1) shows that on average irrigation farms are 65% larger than dry-land dairy farms but produce only 13% more milk. The average irrigated farm's total income was 25% higher than its dry-land counterpart, reflecting higher sideline income. The cost of producing milk on the irrigated farm was 1.7 cents/litre less than on the dry-land farm. The Water Authority's records suggest that this survey may be biased towards the larger sized farms.

Other features of the analysis are:

- The proportion of market milk quota production to total milk production was similar at around 65%.
- Dairy income as a proportion of total income was higher on dry-land properties than irrigated properties (91% compared with 81%).
- Total liabilities on irrigated farms was around 50% of that of dry-land farms ($64,000 compared with $136,000).
- The average level of equity was substantially higher on irrigated farms that dry-land farms (95% compared with 86%).

Table 4.1 **Comparison of the profitability of milk production - 1987-88**

	Irrigated farms (cents/litre)	Dry-land farms (cents/litre)
Average returns - all milk	27.9	27.9
Cost of production		
Cash costs		
- feed	4.3	6.6
- stock	0.9	1.1
- shed	0.9	0.9
- machinery	2.1	2.5
- labour	1.3	0.2
- overheads	2.9	2.4
Total cash costs	12.4	13.7
Imputed costs		
- depreciation	2.0	1.5
- operator labour	4.5	5.8
- family labour	4.0	3.6
Total imputed costs	10.5	10.9
Total costs	**22.9**	**24.6**
Net cash return	15.5	14.2
Net return (to pay capital & profit)	5.0	3.3
Opportunity cost on difference in assets*	1.3	
Adjusted net return	3.7	3.3
Other relevant survey data for the average farm		
Number of farms surveyed	12	10
Area farmed (ha)	339	206
Concentrates purchased ($)	6,527	19,092
Milk production (litres)	469,400	415,000
Market milk quota production (litres)	302,016	268,214
SMP milk quota production (litres)	73,562	68,209
Manufacturing milk production (litres)	93,866	78,546
Total income ($)	175,700	140,000
Dairy income ($)	142,700	127,600
Assets - land and buildings ($)	885,200	562,900
Total assets ($)	1,395,600	941,400
Liabilities ($)	64,300	136,100

Source: *Dairy Industry Authority Survey 1987-88 - farms between Serpentine and Capel*

* *Calculated by ACIL - based on rate of return (2 year bond rate) on the difference in assets per litre of milk produced between irrigated and dry-land farms.*

4.2 ACIL SURVEY

The ACIL survey was carried out in conjunction with the CSIRO social issues survey and part of the data is reported in Background Paper no. 7. Some of the data gathered is set out in Table 4.2. Fifty-five commercial farms were surveyed.

This survey shows that there are significant variations in farm size and activity between the districts of Waroona, Harvey and Collie. In addition, grazing beef and sheep are much more important activities in the small Waroona district than in the larger Collie and Harvey districts.

Collie farms are on average twice as large as Harvey farms and run over three times as many beef cattle. The Harvey farmers have milk quotas some 35% larger than farmers in Waroona and Collie and tend to specialize in milk production.

To allow calibration of the Department of Agriculture dairy farm model, the fifteen specialist milk producers in the sample were analysed and it was found that the average dairy farm over all three districts comprised:

- an irrigated farm of 194 hectares;
- a run-off block of 120 hectares;
- thirty-two hectares of permanent pasture and 11 hectares of early germination.

Table 4.2 **Statistics from ACIL survey - mean of all farms surveyed**

	Waroona	Harvey	Collie
Irrigated farm			
Mean irrigated area (hectares)	33.6	45.5	52.9
Mean dry-land area (hectares)	209.8	98.5	211.6
Mean uncleared/unusable (hectares)	3.2	6.2	5.1
Mean area other property	48.6	150.5	190.8
Total area of property	253.9	206.8	411.3
Mean supplementary feed			
Hay (tonnes)	319.2	208.6	139.2
Sileage (tonnes)	0	0	800.0
Grain/prepared feed (tonnes)	386.7	75.5	87.4
Dairy enterprise			
Mean market milk quota (litres)	994	1,353	1,025
Mean cows milked/day	93	114	107
Total beef animals on farms	9,201	1,491	4,763
Total sheep on farms	12,246	2,290	1,557

The area being irrigated by specialist dairy farmers is only 77% of their rated area and as a result the cost of water to these farmers averaged $26.57 per megalitre, compared to $21 per megalitre for a farmer using his full basic allocation of 9.2 megalitres/rated hectare.

The Water Authority's records suggest that the ACIL survey was also biased towards the larger properties (Background Paper no. 3).

A further survey is currently being undertaken by the Western Australian Farmers Federation to clarify this issue and provide additional input to the Dairy Farm Model.

4.3 WESTERN AUSTRALIAN DAIRY FARM MODEL

This computer model of dairy farms in the south-west has been developed by George Olney of the Department of Agriculture and used in recent years to evaluate the economic effects of changes to farming practices or policy changes affecting costs or prices. It is an improvement on the earlier model developed in the 1970s by David Morrison which was used for similar purposes.

The model has been used by the Technical Working Group to evaluate the impact on farm practices, water use and farm income of:

- increasing the price of water and maintaining current management and productivity;
- increasing the price of water but with improved management and/or production from the farm to optimize profitability;
- converting the average irrigated dairy farm to a dry-land operation under both current and improved management and/or production levels.

The model indicates that:

- the average irrigated dairy farm is around $15,000 per annum more profitable than a dry-land operation on the same area under both current and improved management and production levels;
- the water price would have to increase by well over 100% before the irrigated farm would be more profitable converting to dry-land production;
- if the price of water was increased by 100% use of water should decline by 32% for optimum profitability, confirming the farmer prediction in the CSIRO attitude survey (Section 3).

Chapter Five

ECONOMIC EVALUATION

5.1 INTRODUCTION

The objective of the economic evaluation is to indicate whether investment in the rehabilitation and continued operation of the three irrigation districts is economically justifiable.

In order to make such an assessment comprehensive, the benefits and costs associated with all the rehabilitation options would have to be compared to those for a Base Case of rapidly closing down the irrigation systems. However, at this stage of the study only one rehabilitation option, the Minimum Maintenance Case, has been evaluated. This case allows a standard of service, similar to that currently being provided, to continue over the next thirty years. Other cases, including those suggested at the farmer workshops, will be examined in detail in Phase 2 of the study.

The Base Case of rapid close down, rather than a prolonged running down of the systems, is used because it makes estimation of the benefits of rehabilitating the systems much easier. Additionally, it results in the maximum value being placed on rehabilitation.

The benefits attributable to both the Base Case and the Minimum Maintenance Case largely relate to the value of agricultural/horticultural production within the irrigation districts. The assessment of the net benefit from the Minimum Maintenance Case has been largely confined to the higher productivity achievable on irrigated land by comparison to dry-land productivity in the Base Case. Other impacts on the wider community have not been assessed in this preliminary analysis.

Costs associated with the Minimum Maintenance Case include:

- capital costs of rehabilitation, including the costs of bringing the dams up to acceptable Australian standards;

- annual costs of operating and maintaining the systems;

- costs of salinity mitigation works necessary to maintain or improve the productivity of irrigation land.

Costs associated with the Base Case include:

- costs of rapidly closing down the system, including the costs of bringing the dams up to acceptable Australian standards;

- the costs of developing on farm water supplies and converting irrigated pastures to annual species.

5.2 OVERVIEW AND METHODOLOGY

To permit economic evaluation, models of each of the three irrigation districts were constructed for both the Base Case and the Minimum Maintenance Case.

A large number of assumptions were required for these models, many of which will be further refined as the study progresses and more detailed and relevant information becomes available. Details of these assumptions are provided in Background Papers nos 3 and 4.

The models allow a comparison to be made of the agricultural output and rehabilitation/closedown expenditures (the 'cashflows') of the two cases over the thirty year life of the project. As the size and timing of these cashflows differ for the two cases, standard cost/benefit project evaluation techniques have been used to place them on a comparable basis, that is, their Net Present Value (NPV).

NPV's are obtained by discounting cashflows to take account of when they occur. Discounting recognizes that money spent or received early in a project's life has a greater value than money received or spent later, and reduces future benefit and cost streams to their NPV. For the purposes of this study, a 6% real discount rate has been used, reflecting the rate of return the Water Authority uses in evaluating its capital works projects. A real discount rate excludes the effects of inflation.

Two methods are used to compare the options. The first simply subtracts the NPV for the Base Case from the NPV for the Minimum Maintenance Case to get the additional benefit obtained by rehabilitation. If this is greater than zero, then the rehabilitation case is economic; if it is less than zero then it is not. In comparing alternative rehabilitation options, the larger the additional benefit, the more economically attractive the option.

Using the second method, a benefit/cost ratio is derived for the Minimum Maintenance Case by dividing the present value of the additional benefits of rehabilitation by the present value of the additional costs. If the ratio is greater than or equal to one then rehabilitation is economic. The greater the ratio, the more attractive the project.

5.3 ESTIMATION OF ADDITIONAL AGRICULTURAL BENEFITS

The agricultural benefits of rehabilitation under the Minimum Maintenance Case is the difference in output from land under irrigation compared to that which could be achieved under dry-land conditions. As the value of irrigation will vary for different enterprises, the overall benefits will depend on the mix of enterprises utilizing the districts.

An estimate of the enterprise mix on irrigated land in the three irrigation districts was derived using data obtained from the ABS and ACIL surveys. Table 5.1 presents this estimated enterprise mix for the three districts.

Table 5.1 **Enterprise mix on irrigated land**

Enterprise	Waroona ha	Harvey ha	Collie ha	Total ha
Dairying	187	3,447	3,123	6,757
Beef	1,097	1,491	1,845	4,433
Sheep	250	406	229	885
Vegetables	23	35	29	87
Citrus	–	52	9	61
Other horticulture	–	–	2	2
Total	**1,557**	**5,431**	**5,237**	**12,225**

The difference between irrigated and dry-land production for each enterprise was obtained using a number of approaches. The additional value of dairy output from irrigation was based on the results obtained from the dairy farm model. The model provides an estimate of the current value of irrigation per hectare, assuming the continuation of existing production levels and management.

The additional values for beef and sheep production were estimated from the difference in the stock carrying capacity between dryland and irrigated pasture multiplied by the gross margin per unit of stock carrying capacity. Carrying capacity and gross margins have been estimated from surveys within the districts and from similar areas in Australia (Background Paper No. 3).

In the case of horticulture, the value was assumed to be the full gross margin of the enterprise. This assumes that without irrigation, horticulture production would not be possible. This may overestimate the benefits of irrigation as alternative water sources could be used in some cases. However, the level of overestimation would be offset to some degree by the cost of these alternatives.

The additional value of agricultural production attributable to the Minimum Maintenance Case is given in Table 5.2.

Table 5.2 **Incremental value of agricultural production attributable to irrigation ($000s) per annum**

Enterprise	Waroona ($)	Harvey ($)	Collie ($)	Total ($)
Dairying	97.4	1,794.3	1,627.1	3,518.8
Beef	150.5	188.9	230.3	569.7
Sheep	39.6	59.4	33.0	132.0
Vegetables	69.0	105.0	87.0	261.0
Citrus	–	156.0	27.0	183.0
Total	**356.5**	**2,303.6**	**2,004.4**	**4,664.5**

Of the estimated annual additional value of $4.66 million, dairying is the major enterprise contributing around 75%. Beef is the next largest, contributing 12%, followed by horticulture with 10% and sheep with 3%.

With the exception of the higher horticultural production in Harvey, the additional value for irrigation in Harvey and Collie are similar. In Waroona this value is considerably lower, and beef rather than dairying is the main enterprise in terms of additional value created by irrigation.

5.4 COMPARISON OF AGRICULTURAL BENEFITS WITH COST STREAMS

Rehabilitation and continued operation of the irrigation systems will be economically viable if the present value of additional agricultural output attributable to the Minimum Maintenance Case is greater than the present value of the additional costs for this case over the Base Case.

Table 5.3 provides the present value of the costs for the rapid close down Base Case and for the Minimum Maintenance Case when salinity mitigation costs are excluded. By subtracting the Base Case from the Minimum Maintenance Case the additional costs for each irrigation district have been obtained.

Table 5.3 **Present values of cost streams**

Cost stream	Present value ($ million)			
	Waroona	Harvey	Collie	Total
Minimum Maintenance	11.2	27.0	20.5	58.7
Base Case (rapid close down)	7.8	13.3	5.7	26.8
Incremental Cost Stream	**3.4**	**13.7**	**14.8**	**31.9**

The present rehabilitation cost of the Minimum Maintenance Case is greater than for the Base Case in each district, and has a total present value of $31.9 million for rehabilitation of all three districts. The lower present values for Waroona reflect the smaller size of this district.

The higher values for Harvey for both the Base Case and Minimum Maintenance Case reflect the higher capital expenditure required on the dams serving that district. As these costs occur in both cases, the bottom line additional cost is not affected.

Converting the annual benefits from Table 5.2 into their present values over the project's thirty years, and combining them with the costs from Table 5.3, allows calculation of the present value of the Minimum Maintenance Case and its benefit/cost ratio. These are given in Table 5.4.

Table 5.4 **Present value and benefit/cost ratio of the minimum maintenance case ($million). Excluding salinity mitigation**

Item	Waroona	Harvey	Collie	Total
P.V. of agric. benefits	4.9	31.3	27.4	63.6
P.V. of incremental cost stream	3.4	13.7	14.8	31.9
P.V. of Minimum Maintenance Case	1.5	17.6	12.6	31.7
Benefit Cost Ratio	1.4	2.3	1.9	2.0

As a preliminary analysis, it appears that the Minimum Maintenance Case is economically justified in each of the three districts. The present value is greater than zero for each, and the benefit/cost ratios are greater than one.

This does not necessarily mean that the Minimum Maintenance Case is the most economic solution. Other options for rehabilitation and restructuring need to be evaluated and it is possible that some of these may show greater benefits. This analysis will be carried out in Phase 2 of the study.

Additionally, continuation of irrigation will require certain salinity mitigation works to be implemented to enable agricultural productivity to remain at or near current levels. The cost of these works should therefore be included as a cost against the Minimum Maintenance Case. Table 5.5 extends the result from Table 5.4 by including the preliminary costs for a comprehensive salinity mitigation programme outlined earlier.

Table 5.5 **Present value of minimum maintenance case, including salinity mitigation works ($million)**

Item	Waroona	Harvey	Collie	Total
P.V. Minimum Maintenance Case excluding salinity	1.5	17.6	12.6	31.7
P.V. of salinity works including operation costs	5.6	26.9	18.9	51.4
P.V. of Minimum Maintenance Case including salinity	-4.1	-9.3	-6.3	-19.7
Benefit/cost ratio	0.5	0.8	0.8	0.8

Inclusion of these estimates for salinity mitigation makes the Minimum Maintenance Case uneconomic. The present values are less than zero and the benefit/cost ratios are less than one. While it should be stressed that these figures are preliminary, they do illustrate that salinity mitigation will be a significant factor in assessing the long-term viability of irrigation in the south-west area.

5.5 CONCLUSIONS

At the outset it should be stressed that the evaluations undertaken at this stage of the study are preliminary in nature. Many of the assumptions and much of the data on which the analyses are based will need to be refined and improved upon as the study progresses. Notwithstanding these limitations, the analyses do provide a number of useful guides as to the economic viability of rehabilitating the irrigation infrastructure in the south-west.

5.5.1 ECONOMIC VIABILITY OF REHABILITATION

Taking into account only the incremental benefits attributable to the Minimum Maintenance Case and the direct incremental costs associated with the irrigation infrastructure, i.e. omitting salinity mitigation costs, the Minimum Maintenance Case appears to be economic. This is particularly so in Harvey, largely reflecting the higher agricultural benefits generated in this district. The net present values for the Minimum Maintenance Case range from $1.5 million in Waroona to $17.6 million in Harvey, with the benefit/cost ratios ranging from 1.4 to 2.3.

5.5.2 SALINITY MITIGATION

Continuation of irrigation will require salinity mitigation works to be undertaken in order for irrigation productivity to remain at or close to existing levels. Preliminary analyses show that inclusion of these costs is likely to substantially reduce the economic viability of options for upgrading the irrigation infrastructure. However, the actual impact will depend on a wide range of factors, including:

- the salinity impact on agricultural productivity under dry-land conditions, that is, following closure of the irrigation system;

- the salinity impact on agricultural productivity under irrigated conditions;
- the type of treatment, area treated and the cost of implementing salinity mitigation measures under both dry-land and irrigation conditions.

5.5.3 ALTERNATIVE USES OF WATER

Taking account in the analyses of the $10 million value which might be obtained if the irrigation water was to be used elsewhere after fifteen years (Section 3.4.6) would reduce the economic viability of the irrigation options, and reduce further the amount which could be spent on salinity mitigation if rehabilitation is to be economically viable.

5.5.4 COST RECOVERY

If the Water Authority were to charge full cost recovery on all capital and operating expenditure incurred in implementing the Minimum Maintenance Case the cost of water would double from the existing $26 per megalitre paid by dairy farmers to around an average of $50 per megalitre. This increase in costs would have to be paid irrespective of water use. If a 6% return on the capital invested in the existing works was required the cost would be approximately $100 per megalitre. At these levels, the cost of water would outweigh the value of the increased agricultural output achievable through irrigation by comparison to a dry-land operation.

Chapter Six

FACTORS TO BE CONSIDERED IN DEVELOPMENT OF FUTURE OPTIONS

6.1 INTRODUCTION AND KEY ISSUES

The basic purpose of an irrigation system is to improve the agricultural productivity of an area. A rehabilitated irrigation system will last for around fifty years and therefore should be designed for the agriculture of the future, which may not be the same as current agriculture with respect to crops or irrigation practices. Rehabilitation of the system must incorporate the very latest technology where economically viable. It should also try to forecast future technology and be designed so that such technology can be adopted when it eventuates and becomes economically viable.

The studies carried out to date have shown that a very complex situation exists in the irrigation areas. The preliminary economic analysis indicates that rehabilitation and modernization of the irrigation systems is economically viable and that dairying and horticulture could afford the increase in charges necessary to fund the rehabilitation. However, the purchase of feed is an alternative to irrigated pasture production for dairying and the recent trend has been in this direction. At the higher water prices required, dairy farmers to optimise profit would reduce water usage by approximately 30% and beef producers would mostly cease irrigating.

A programme of salinity management is essential if irrigated agriculture is to be sustained in the future. Preliminary estimates of the cost of rehabilitating all of the land already affected or threatened by salinity indicate that this would be uneconomic.

The following sections detail the key issues which will need to be considered in developing future options for rehabilitation/modernization of the irrigation system and farm practices in Phase 2 of the study.

6.2 AGRICULTURE OF THE FUTURE

6.2.1 DAIRY INDUSTRY

The demand for dairy products is forecast to double in the next fifty years. Fresh milk products account for approximately 65% of dairy production in Western Australia. Will this situation continue or will UHT milk, imported from the eastern States or New Zealand, be competitive in the next thirty years? What will be the impact of changes in the European Economic Community on prices for manufactured milk products?

Seasonal milk quotas have been discussed for a number of years. Are these likely to be introduced and what effect would this have?

Will the irrigation areas be able to produce the increased milk likely to be required or will this come from other areas?

6.2.2 HORTICULTURE

Background Paper no. 5 examines the demand for horticulture in the future and concludes that by the year 2000 an additional 5,256 hectares of horticultural land will be required in Western Australia. The unused area of land on the Swan Coastal Plain between Lancelin and Dunsborough with groundwater resources available for irrigation is thought to be only about 3,000 hectares.

In addition, the existing horticultural areas are under some threat from urban development and concern over the impact on the environment around coastal wetlands of the high fertilizer application inherent in vegetable production.

The irrigation areas, with their adequate water supply, appear well placed to make up the deficit of 2,000 hectares. Will this take place on the lighter soils in the irrigation districts or immediately above the channel in some areas, or will pressures develop to transport water onto the coastal sands to allow greater areas to be irrigated there? Alternatively can this demand be met by the Manjimup vegetable growers?

6.3 SALINITY MITIGATION

The estimated cost of completely rehabilitating the 5,700 hectares of badly salt affected land along the western fringe of the irrigated districts is $25.65 million. This probably exceeds the value of the land and appears uneconomic.

Some farmers are producing good pastures in the western fringe of the district without subsurface drainage. Can less expensive salinity mitigation techniques be used to restore productivity? Or should irrigation on this land cease? What policies would be needed to facilitate this option? Would transferable water rights assist?

6.4 ON-FARM IRRIGATION PRACTICES

Surface irrigation is still the most widely used method of applying water in the world and there has been considerable research into improving its efficiency. On heavy soils, with even grades like those which occur over much of the irrigated area, a well managed surface system has potential to be as efficient as many sprinkler systems in Western Australia's windy summer climate.

Currently the efficiency of surface irrigation in the irrigation districts is not as high as desirable with many pastures irrigated at longer than optimum intervals and with excess water applied. As a result the water table rises close to the surface during irrigation and takes many days to retreat. An improvement in water management is essential if salinity problems threatening the area are to be overcome.

Although many farmers have laser levelled their pastures to improve water management, not all are using higher flows at the more frequent intervals required to achieve optimum production and keep the water table below the root zone.
The use of sprinkler irrigation has expanded rapidly in many countries and in some areas has supplanted surface irrigation. Sprinklers are used mostly on undulating areas and lighter soil types but have also been introduced on level, heavier soils to achieve better water and fertilizer management on crops in areas where water is the limiting resource. Modern sprinkler systems require less labour than surface irrigation.

In the last decade the use of micro irrigation world-wide has quadrupled. However, its use is still generally confined to areas of high cost or scarce water and labour. It is also used on areas difficult to irrigate by other means, such as hillside orchards.

Is a change in irrigation practices likely to occur in the immediate or distant future. Should sprinkler irrigation be considered as part of a salinity management strategy.

6.5 PRODUCTIVITY OF IRRIGATION PASTURES

There is some scope to increase the productivity of the irrigation pastures (Background Paper no. 5). Currently, the average irrigation pasture is only producing around ten tonnes of dry matter/hectare compared with around fourteen tonnes/hectare produced in equivalent areas in Victoria. Climatic differences may account for some of the difference but the lower production is also partially due to the prevalence of kikuyu in pastures in the south-west. Kikuyu does not produce as well as paspalum and suppresses white clover. It is also more salt tolerant than paspalum or white clover.

Achievement of higher levels of pasture production primarily requires better water and pasture management. This involves laser levelling, larger head ditches, improved drainage including mole drainage and in some cases subsurface drainage. More frequent replanting of pastures and more attention to watering practices is also required; the latter can be helped by limited automation. Background Paper no. 5 suggests that the total capital investment required for optimum water management on a 150 hectare irrigated farm is approximately $50,000, and shows that this would be profitable.

This increased productivity would improve the economics of rehabilitating the irrigation system. What are the factors which discourage farmers from achieving this higher level of production and will they still be present in the future? Are any changes required to the operation of the supply system to achieve optimum on-farm production?

6.6 PURCHASE OF FEED VERSUS IRRIGATED PASTURE

The dairy farm model indicates that at current prices, farmers should be irrigating a larger area and buying more feed than at present to achieve higher production off their farms.

Is the model correct? What are the factors which have caused farmers to reduce the area irrigated by 17% since 1981/82? Will these factors be present in the future or will the demand for water return to the level of the early 1970s? Increased usage will lead to a reduction in the price per megalitre required for the irrigation system to be viable.

6.7 ENVIRONMENTAL CONSIDERATIONS

It is now apparent that irrigation farmers as well as dry-land farmers in the Peel-Harvey Catchment will be asked to modify farming practice to reduce nutrient input into the estuaries. Will the cost of this be significant enough to depress the advantage of irrigation over dry-land farming? What are the options which should be evaluated?

6.8 SOCIAL IMPACT

Are there significant social impacts associated with any of the options suggested which should be evaluated in detail in Phase 2? What impact would the Base Case have on land prices - would this affect the community?

6.9 FINANCIAL IMPLICATIONS

Governments around Australia appear to be moving in the direction of 'user pays' and 'levelling the playing field'. The case for continuing the present subsidy to the irrigation section of the dairy industry by charging less than the full cost of water appears weak, especially as it has been decided to phase out the transport cross-subsidization. As a result of these trends and irrespective of rehabilitation, irrigation charges will probably continue to rise in real terms for many years. Is there any economic justification for continuing the subsidy?

6.10 ORGANIZATION AND MANAGEMENT

What impact will the nation-wide trend to commercialization of government activities have? Should privatization of the operation of the irrigation districts be considered?

Alternatively, should the Water Authority continue to be the operating body but with more farmer involvement in maintenance and water delivery policy at the district level?

Chapter Seven

FRAMEWORK FOR THE DEVELOPMENT OF FUTURE OPTIONS

As set out in the introduction, this Background Review Report has been produced to summarize the information gathered by the Consultative Committee and the Technical Working Group about the South-West Irrigation Districts. It also contains information on the key issues to be considered in developing a long-term strategy for the rehabilitation and/or modernization of the current irrigation systems and practices.

The report completes Phase 1 of the study and is intended to be a resource document for use by the community and other stakeholders in developing key options for more detailed study in Phase 2 of the study. Details of Phase 2 and subsequent phases of the study are set out in Appendix A.

7.1 PARTICIPATION IN OPTION DEVELOPMENT PROCESS

Members of the community and stakeholders can participate in the option development process by participating in workshops being arranged for farmers and other community members during August 1990.

People who have already registered for the workshops will be receiving a copy of this report together with additional workshop material. Anyone wishing to register for the workshops can contact either:

- Mr Graham Holtfreter, Water Authority, Bunbury, Tel: (097) 910400; or
- Mr I. Loh, Water Authority, Perth, Tel: (09) 420 2429 or 420 2642.

It is planned to hold the workshops between the second and fourth weeks of August. Anyone unable to attend the workshops but wishing to indicate future options that should be included in the study can write to:

- the Consultative Committee c/- Mr I. Loh, Project Manager, Irrigation Strategy Study, Water Authority of Western Australia, PO Box 100, Leederville, WA, 6007.

The specific views of key stakeholders will also be sought. These include the Western Australian Farmers' Federation, the Dairy Industry Authority, local government authorities in the Irrigation Districts, government agencies such as the Department of Agriculture, the Environmental Protection Authority, State Treasury and the Office of Cabinet, the Water Authority Board, and representatives from the Horticultural Industry.

Following collation of the workshop outcomes and other stakeholder input a draft set of key options for subsequent analysis in Phase 2 will be prepared. A range of stakeholders representing farmer and other groups are to be invited to a seminar/second workshop to discuss the proposed key options. The Consultative Committee will then finalize the key options.

7.2 GENERAL INPUT TO THE STUDY

Anyone wishing to provide input to the study at any stage about any aspect of the programme should not hesitate to contact:

- Mr I. Loh, Project Manager, Irrigation Strategy Study, Water Authority of Western Australia, PO Box 100, Leederville, WA, 6007, Tel: (09) 420 2429 or 420 2642.

Appendix A
THE IRRIGATION STRATEGY STUDY

THE IRRIGATION STRATEGY STUDY

PHASE 1 - BACKGROUND DEVELOPMENT AND ISSUE IDENTIFICATION

Project Management:	–	Water Authority
Project Guidance/Consultation	–	Broad based Consultative Committee with significant farmer representation
Major Tasks	–	Information gathering
	–	Identification of issues and quantification of factors relating to these issues
	–	Communication of this background to the affected community
	–	Preparation of Background Review Report
Completion Time for Phase 1	–	27 July 1990

PHASE 2 - OPTION DEVELOPMENT AND ANALYSIS

Project Management	–	Water Authority
Project Guidance/Consultation Major Tasks	–	Broad based Consultative Committee with significant farmer representation
	–	Development and adoption of key options for subsequent detailed study. Carried out jointly with the community affected and other stakeholders in the study (Completion Time - September 30, 1990)
	–	Analysis of key options (completion time - November 30 1990)
	–	Production of public report on Future Options (completion time - January 31, 1991)
Completion of Phase 2	–	1 February 1991

The second phase of the study will develop key strategy options or alternative futures for the irrigation areas jointly with the community. Economic, financial, social and environmental aspects of each option will be detailed and compared and a report prepared on Strategy Options for the Future of Public Irrigation in the South-West.

As the first part of this second phase, a series of workshops/seminars is to be held throughout the region to discuss and develop these alternative futures. The Background Review Report from Phase 1 will form the basis of information around which the workshops will be developed.

Workshops are planned to be held during August and key options for detailed analysis finalized by the end of September.

PHASE 3 - PUBLIC REVIEW OF FUTURE STRATEGY OPTION REPORT

Project Management	–	To be decided on completion of the options report from Phase 2.
Project Guidance and Support	–	Project Manager of Phases 1 and 2 if required
Major Tasks	–	Publicity of report and promotion of submissions from major stakeholders
	–	Collation and summary of submissions (N.B. submissions would be expected to comment on all options, identify preferred option and explain why. Submissions would be expected from the major government agencies, including the Water Authority, Environmental Protection Agency and Department of Agriculture as well as farmer, industry and environmental groups)
Completion Time	–	30 April 1991 (i.e. 3 months review period)

PHASE 4 - REVIEW OF SUBMISSIONS AND PREPARATION OF DRAFT STRATEGY

Project Management	–	To be decided on completion of the options report from Phase 2.

PHASE 5 - EPA REVIEW OF DRAFT STRATEGY (ASSUMED TO BE A REFERABLE DOCUMENT UNDER THE ENVIRONMENTAL PROTECTION ACT)

PHASE 6 - FINAL ADOPTION OF LONG-TERM IRRIGATION STRATEGY

THE CONSULTATIVE COMMITTEE FOR PHASES 1 AND 2

The Water Authority of Western Australia is responsible for project management up to the production of the Future Strategy Options report. A Consultative Committee has been formed to guide the direction of the study through these early stages. Members of the Committee are as follows:

Mr B. Sadler	– Chairman and Director, Water Resources, Water Authority of Western Australia
Sir D. Eckersley	– South-West Development Authority
Mr D. Norton	– Irrigation Farmer, Benger and Western Australian Water Resources Council Member
Mr C. Rigg	– Irrigation Farmer (Dairying) - Wokalup
Mr G. Edwards	– Irrigation Farmer (Dairying) - Waterloo
Mr C. Capogreco	– Irrigation Farmer (Horticulture) - Harvey
Mr L. Snell	– Irrigation Farmer (Beef) - Waroona
Mr G. Luke	– Resource Management Division - Department of Agriculture of Western Australia
Mr G. de Chaneet	– Bunbury Region, Department of Agriculture of Western Australia
Mr R. Harvey	– Acting Manager, Water Resource Planning, Water Authority of Western Australia
Mr L. Werner	– Financial Planning Branch, Water Authority of Western Australia
Mr C. Elliott	– Regional Manager, South-West, Water Authority of Western Australia
Mr G. Holtfreter	– Senior Irrigation Officer, Water Authority of Western Australia
Mr I. Loh	– Project Manager for the Irrigation Study, Water Authority of Western Australia
Mr I. Longson	– ACIL, Australia - Agricultural Economic Consultants
cc	– Office of Cabinet