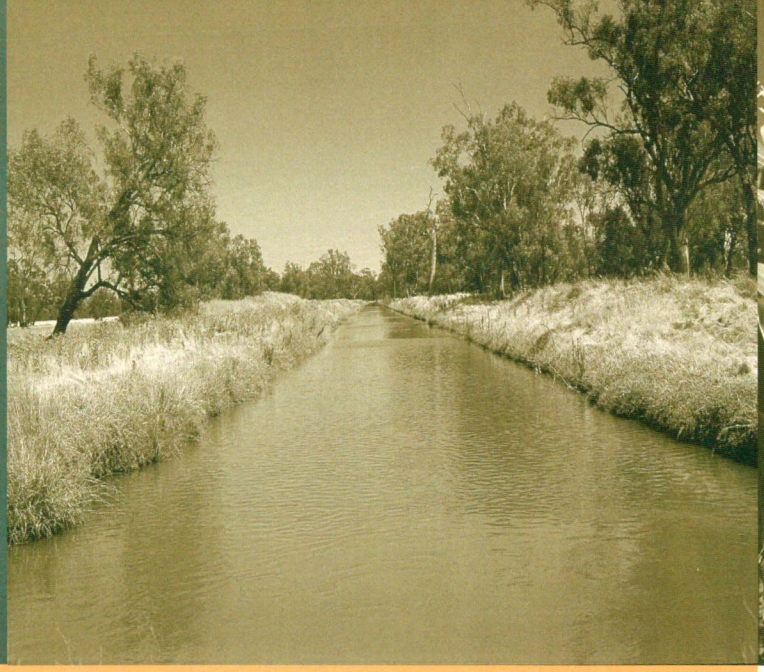
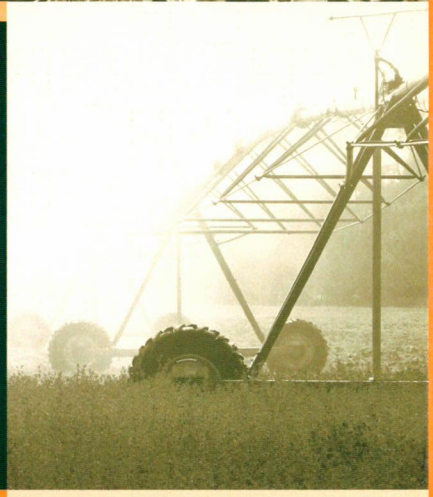
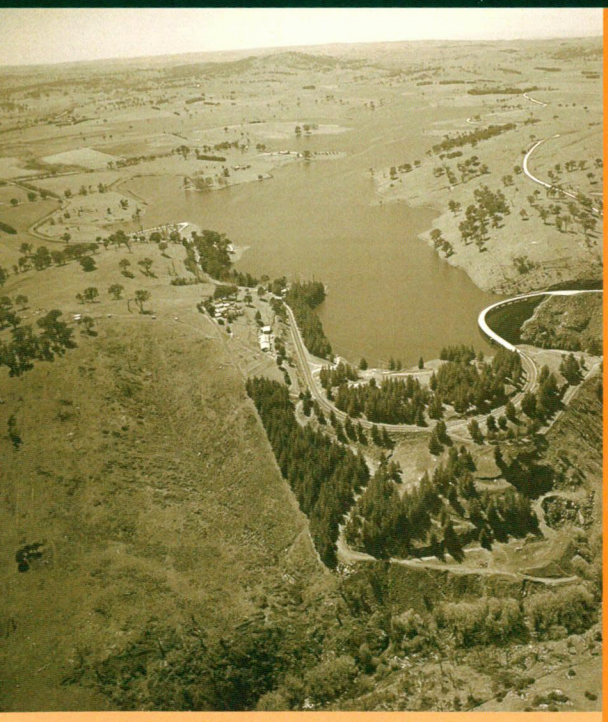


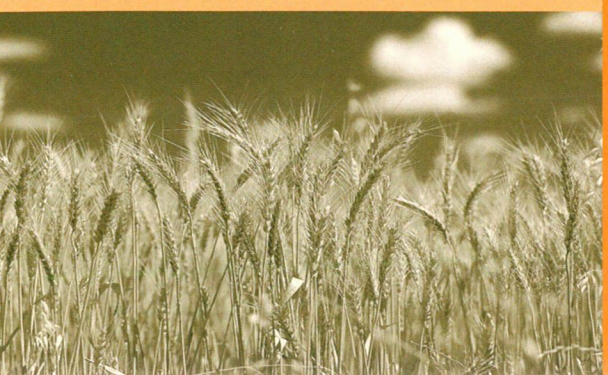
The on-farm impacts of environmental flow rules in the Lachlan Valley





Report to the Lachlan River Management Committee

August 2001



NSW Agriculture

The on-farm impacts of environmental flow rules in the Lachlan Valley

Report to the Lachlan River Management Committee

August 2001

Rohan Jayasuriya[1], Jason Crean[1] and Rendle Hannah[2]

NSW Agriculture

[1] Economist, NSW Agriculture, Orange
[2] Agricultural Coordinator – Water Reform, NSW Agriculture, Orange

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The authors acknowledge the contribution of all those who have assisted with the completion of this study. Thanks particularly to members of the Socio-Economic Sub Committee of the Lachlan River Management Committee and members of various Local Consensus Data groups in the catchment for their contribution in eliciting the representative farm data. Thanks also to a number of NSW Agriculture staff for their contribution including Ian Smith, Irrigation Officer, Forbes and Rob Young (Program Leader, Economic Resource Policy). Thanks to Tahir Hameed and Shahadat Chowdhury (Hydrologists, DLWC) for the provision of simulated hydrology information.

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Table of contents

List of Tables

List of Figures

1. Introduction

River regulation and water extractions have contributed to a decline in the health of inland rivers across NSW. Environment flow policies introduced by the NSW Government in 1997 attempt to address this problem through reallocating a portion of water normally used by extractive uses back to the environment. The NSW Government developed interim environmental flow rules for a number of river systems to address river health needs, while keeping the impact on water users within 10 per cent of their average annual diversions. Water Management Committees (WMCs) on regulated river systems have reviewed the rules, and in most instances, have developed their own set of flow rules which continue to be adjusted as better information becomes available on their effects.

Environmental flows attempt to provide environmental benefits in the form of improvements in water quality and the health of natural ecosystems and aquatic biodiversity. These benefits may be achieved through the protection of low flows, providing triggers for fish and bird breeding events, mimicking natural flow variability and restoring a portion of freshes and high flows. The economic benefits attached to these environmental improvements may be significant. However, the economic trade-offs involved in obtaining environmental benefits may also be large.

The extent of trade-offs associated with establishing environmental allocations is an issue in the Lachlan Catchment. There are important river health issues in the catchment as well as a large irrigation industry dependent upon secure irrigation supplies. This study focuses on the likely impacts of environmental flows on broadacre irrigation farms[3]. The intention is to provide information and analyses to assist the Lachlan River Management Committee (LRMC) in its decision-making processes.

A combination of representative farm and hydrology simulation modelling is used to assess the impacts on agriculture from the implementation of different flow scenarios. These impacts are assessed by quantifying the difference in farm profitability between a base case (without environmental flows) and different environmental flow scenarios each involving reduced water availability. This study reports on the findings of that assessment and also complements an analysis being undertaken by DLWC on the wider regional socio-economic effects associated with changes in water management policy.

The general structure of the report is as follows. Section 2 contains an overview of irrigated agriculture in the Lachlan Valley. Section 3 describes the environmental flows proposed by the LRMC. Section 4 details the approach taken to assess on-farm agricultural impacts of the environmental flow rules. Section 5 presents the results of the analysis with respect to alternative management options, while Section 6 summarises the main findings of the report.

[3] Environmental flows impact on general security rather than high security water allocations. Irrigation farms relying on general security water supplies are predominantly involved in broadacre agricultural production rather than permanent horticultural production.

2. The Lachlan Valley

2.1 Location

The Lachlan River Valley is located in Central Western NSW and covers an area of 84,700 square kms (DLWC, 1996). The Lachlan River begins on the slopes of the Great Dividing Range east of Gunning and flows north-west to Forbes and Lake Cargelligo through the Central Western Slopes and Plains. From Lake Cargelligo, the river flows south-west to the Great Cumbung Swamp where it occasionally joins the Murrumbidgee River (see Figure 1). Major tributaries of the Lachlan include the Abercrombie, Crookwell, Boorowa and Belubula rivers and Mandagery Creek which all join the Lachlan river above Forbes. Downstream of Forbes the main river channel diminishes and breaks down into a large number of effluent channels. The major water storages in the valley are Wyangala and Carcoar dams.

2.2 Irrigated agriculture

The Lachlan Valley is a significant agricultural area and much of the irrigation in the region is by licensed diverters from the Lachlan River. The only exception is the Jemalong Irrigation District which is a significant irrigation scheme lying to the west of Forbes. The Lachlan Valley has a licensed water entitlement of 665 GL (50 GL high security and 615 GL general security) although overall usage is usually around just 40-50 per cent of this. While the annual average allocation for general security licences has been in the vicinity of 80 percent over recent years (LIRAC, 1997), this is likely to decline as currently inactive licences are activated within the constraints of the Murray Darling Basin Commission (MDBC) Cap. The long-term cap diversion target for the Lachlan is 254 GL, just 40 per cent of licensed entitlement.

Irrigated agriculture in the Lachlan Valley is diverse. In the higher eastern area, upstream of the major storages, irrigated crops are dominated by horticulture and viticulture with some lucerne production in association with grazing enterprises. In the middle reaches of the Lachlan, the dominant users of irrigation water include canola, lucerne, maize, soybeans and horticulture as well as winter cereal crops. The lower reaches of the valley are dominated by summer crops such as maize and cotton; however, horticultural crops including citrus, viticulture, potatoes and others are also produced on suitable soils. This lower section of the valley is currently undergoing a rapid expansion in irrigated cropping (LIRAC, 1999).

The areas of crops and pastures irrigated from regulated supplies in the Lachlan catchment are shown in Figure 2 .The areas relate to the 1999/2000 season and are taken from the crop return card data collected by DLWC at Forbes. The major crops are winter cereals, oil seeds and lucerne, each occupying around 17,000 - 20,000 hectares, and winter pasture and summer cereals with around 10,000 hectares each. There is about 5,000 hectares of summer pasture, around 2,000 hectares of vegetables and 1,500 hectares of winegrapes. The irrigation sector is an important contributor to the local economy with annual irrigated production valued at $149 million (Donovan, 1998). Also, any economic impact on irrigated agriculture is likely to have flow-on impacts for regional income and employment. Similarly, many economic activities dependent on environmental quality, such as tourism and recreation, may also generate flow-on benefits for the regional economy.

Figure 1: Lachlan Catchment – Production Zones

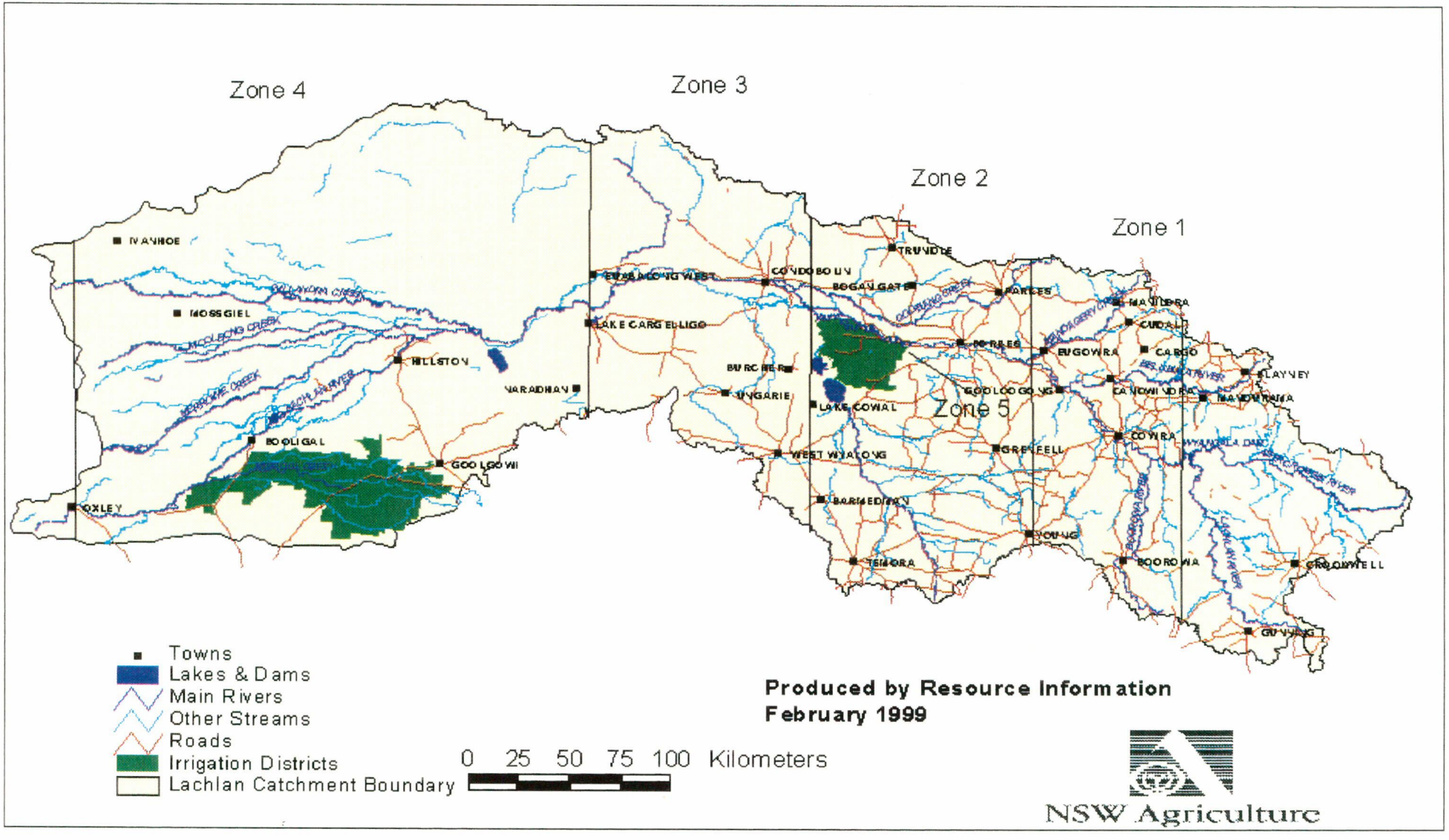
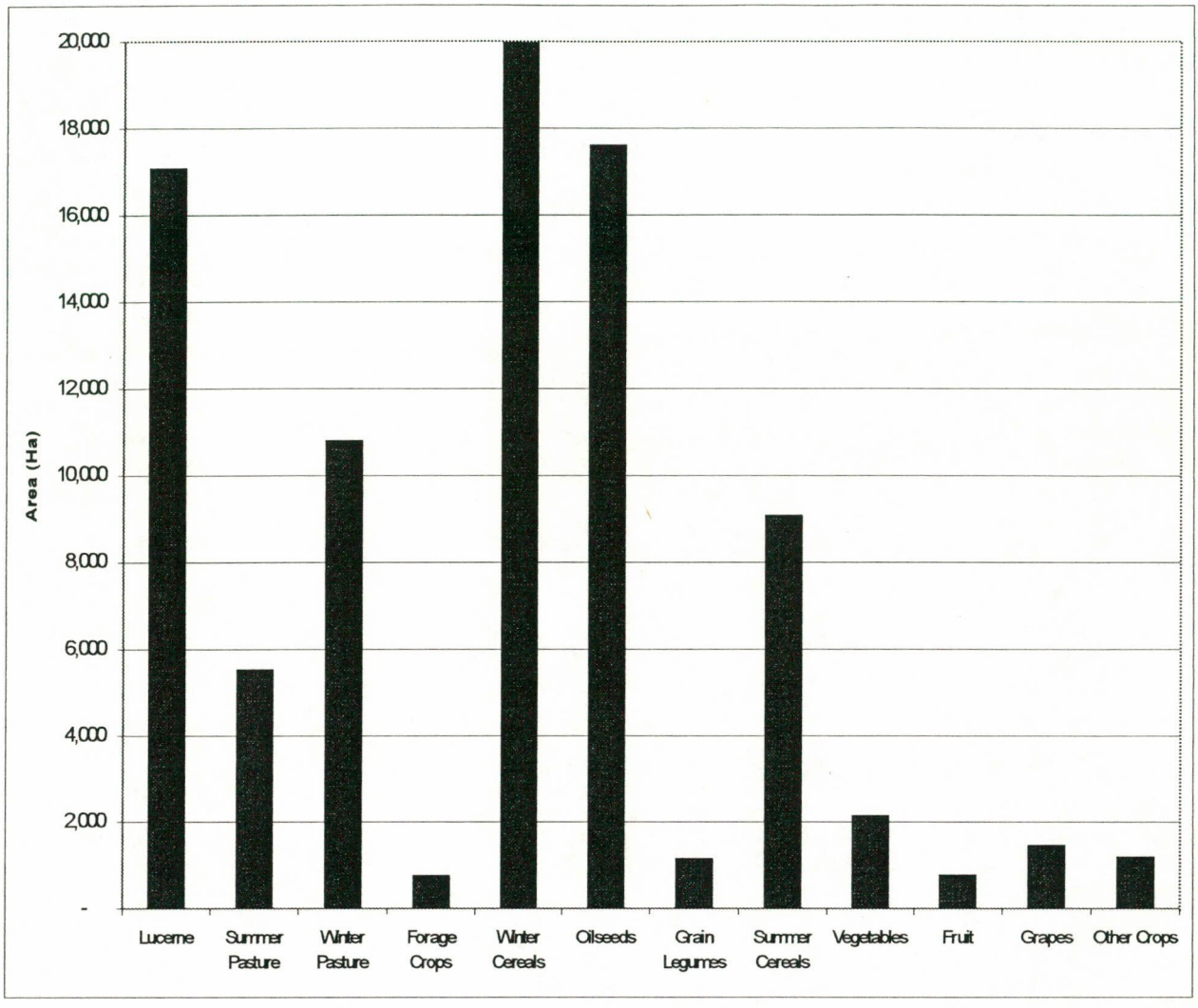


Figure 2: Total area irrigated in the Lachlan Valley



Source: Estimated from crop return card data collected by DLWC, 2001

The main features of irrigated agriculture in the Lachlan Valley can be best described with reference to five principal production zones moving from east to west (Figure 1). Soil types have been classified as either being light soils (loams, alluvial, self-mulching) or heavy soils (clays). The main irrigation technologies are surface irrigation (landformed and non-landformed), spray and trickle irrigation systems. The characteristics of these production zones are briefly outlined below.

Zone 1: Wyangala Dam to Payten's Bridge near Eugowra (including the Belubula River);

The main enterprises in this zone include vegetables (asparagus, tomatoes, sweet corn), winegrapes and lucerne (seed, hay and pasture). Spray irrigation is the dominant irrigation system. A mixture of soil types exists including deep alluvial, light red and loam soils. The licensed entitlement is around 82,000 megalitres with 11,000 hectares laid out to irrigation. It has the highest rainfall of any of the zones and the lowest temperature maximums. The mean annual rainfall for Cowra is 611 millimetres.

Zone 2: Payten's Bridge to Island Creek off-take (above Condobolin);

In Zone 2, the main enterprises are wheat, canola, maize, lucerne (seed, hay and pasture), sub-clover and deciduous fruits (apples, peaches). Flood irrigation is dominant irrigation method. Deep alluvial soils dominate the zone. The licensed entitlement for Zone 2 is around 107,000 megalitres with 19,000 hectares laid out to irrigation. The mean annual rainfall for Forbes is 524 millimetres.

Zone 3: Island Creek off-take to Lake Cargelligo;

The main enterprises in Zone 3 are wheat, canola, maize, lucerne (seed, hay and pasture) and sub-clover. Flood irrigation is dominant in this zone and, most irrigation blocks are landformed. The main soil types in this zone are grey clays and deep alluvial soils. The licensed entitlement for region 3 is around 145,000 megalitres with 15,000 hectares laid out to irrigation. The mean annual rainfall for Lake Cargelligo is 425 millimetres.

Zone 4: Lake Cargelligo to Oxley;

In Zone 4, the main enterprises are wheat, canola, maize, lucerne (seed, hay and pasture), sub-clover and cotton. Flood irrigation is again dominant irrigation method. The main soil types in this zone are clays, loams and alluvials. The licensed entitlement for Zone 4 is around 206,000 megalitres, with 56,000 hectares laid out to irrigation. It has the lowest rainfall of any of the zones and the highest temperature maximums. The mean annual rainfall for Hillston is 361 millimetres. There has been a significant increase in irrigated agricultural output in Zone 4 in recent years, particularly in cotton production.

Zone 5: Jemalong Irrigation District

The main enterprises in Zone 5 are again wheat, canola, maize, lucerne (seed, hay and pasture) and sub-clover. Flood irrigation is dominant in this zone, with the majority of irrigation country landformed. The licensed entitlement for Zone 5 is around 80,000 megalitres with 42,000 hectares laid out to irrigation. The mean annual rainfall for the Jemalong Irrigation District is similar to that of Lake Cargelligo.

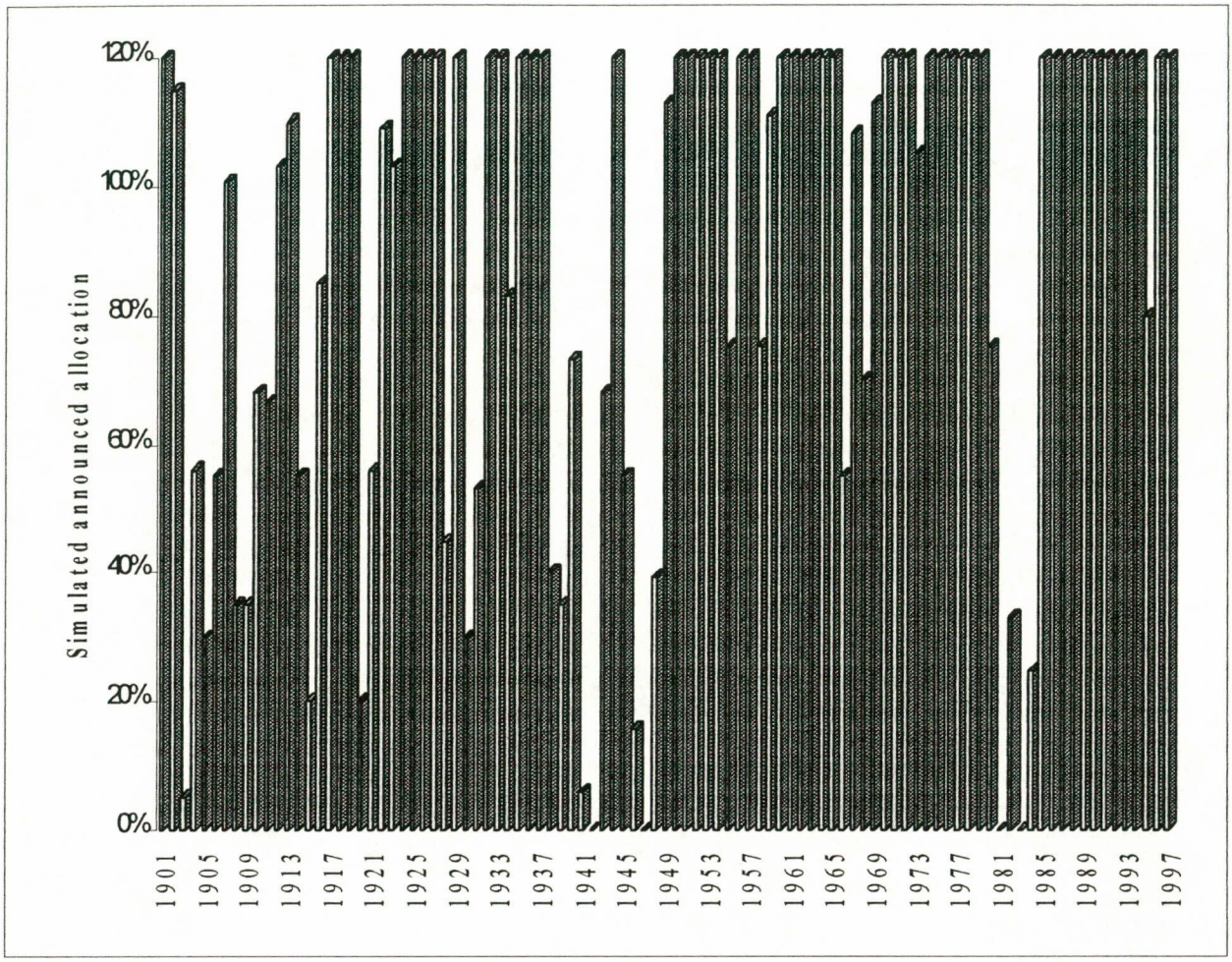
2.3 Reliability of irrigation supplies

Simulated hydrology data provided by DLWC (through IQQM Model) provides an indication of the reliability of irrigation supplies in the Lachlan Valley under historical climatic conditions, with current levels of development. Under base case conditions (without environmental flows), irrigators could expect to receive their full allocations or above in 62 per cent of years while they could receive less than 50 per cent allocation in 20 per cent of years (see Figure 3).

As with each regulated system within the State, the allocations provided to irrigators in the Lachlan depends upon the resources currently available in storage and those resources expected to be available during the season. An initial allocation made by DLWC at the commencement of the season is updated continuously to reflect rainfall conditions in the catchment. The allocation

Figure 3: Simulated Lachlan Valley January announced allocation percentages (1901-1997)

(For the Base Case " C 71A" - without off-allocations)

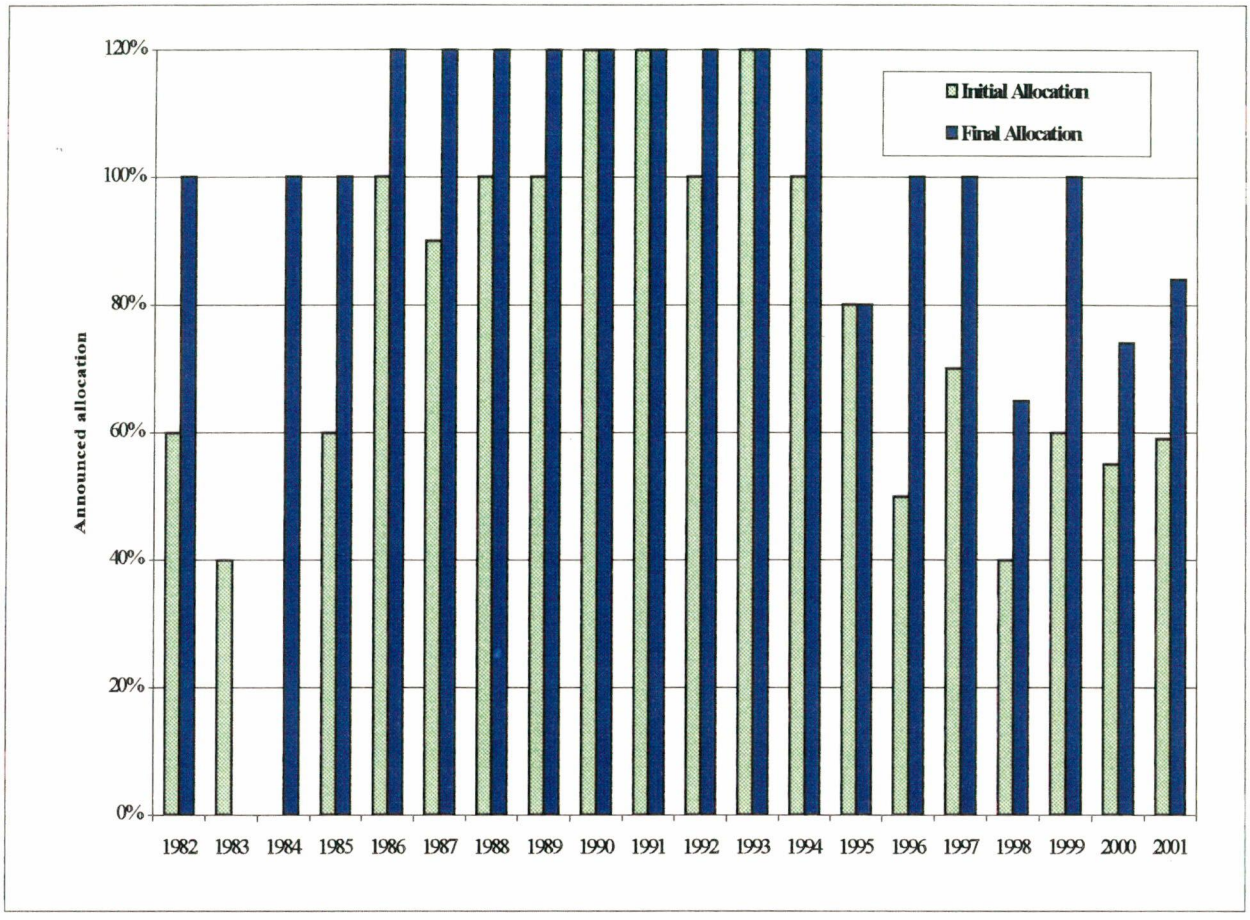


assessment procedure is structured conservatively so that allocations will not need to be subsequently reduced during an irrigation season unless conditions realised are more severe than the worst recorded drought on record. As the period of record for critical streamflow statistics in most parts of NSW is around 100 years or so, the minimum-recorded streamflow sequence generally has about a 1 in 100 chance of occurring. That implies there is a 99 per cent chance that the announced allocations will not be reduced.

Not surprisingly, **actual** allocations announced at the start of the season generally have not been revised downwards (except in the worst recorded drought in 1982-83) since the introduction of volumetric allocations in the Lachlan in the early 1980's. Historical allocation announcements actually show that initial allocations were either set at their maximum level (100 per cent or higher) at the start of the irrigation season or set at a lower level and then considerably increased as the season progressed (Figure 4). Looking at those years where less than 120 per cent allocations were announced at the start of the irrigation season and excluding 1982-83 (drought year) and 1983-84 (initial announcement being zero), the average (15 out of 20 years) upward

revision in allocation was 41 per cent. The lower allocation levels[4] experienced since 1995 reflect a mixture of both seasonal and policy influences, other than environmental flow rules (first introduced in 1998).

Figure 4: Actual announced allocations - initial and final allocations



[4] Drier seasonal conditions in the late 1990's resulted in lower storage levels in some years, and hence, less water available for allocation. The major policy influence was the introduction of MDBC Cap in 1995. Cap implementation in NSW involved the full recognition of 'sleeper and dozer' licenses in allocation announcements. Previously, under utilisation of licences acted to markedly inflate allocation announcements to regular water users.

3. *Environmental flows*

3.1 Environmental issues[5]

River regulation and water extractions have contributed to a decline in the health of the Lachlan River. Natural stream flows are usually highest from June to October and lowest in late summer. Regulation has changed this seasonal nature by capturing winter and early spring flows for release during summer. The average annual flow has been reduced at Oxley (at the end of the controlled system) from 234,000 ML/year under natural conditions to 120,000 ML/year currently. The catchment has experienced algal blooms, a decline in native fish species and an increase in exotic species, increasing river salinity and dryland salinity, a loss of native vegetation and declines in the health of wetlands.

River regulation has adversely affected native biota (particularly fish) and wetland ecosystems. Water released from the bottom of Wyangala and Carcoar dams is colder than natural flows, particularly in summer. There is evidence that these cold water releases have affected fish in the river. Water bird breeding in the Great Cumbung Swamp, Booligal Wetland and various other wetlands along the lower reaches of the river and fish migration and spawning events have been triggered by natural floods or freshes; but, regulation of flows may have caused more rapid recession of water levels and failure of breeding. Habitat maintenance of these areas is of environmental importance.

Salinity, in particular, represents a threat to agricultural productivity in the Lachlan if current trends are not reversed. Waterlogging and salinity in Jemalong Irrigation District, which is a significant irrigation scheme, has become a major problem, along with the disposal of water draining from irrigated land. These issues are currently being addressed through Land and Water Management Plans. Phosphorus concentrations generally increase as you move downstream and greatly increase during high flows as a result of stream bank and gully erosion due to land and riparian vegetation clearing. There have been substantial algal blooms in the lower section of the Lachlan River, including Lakes Brewster and Cargelligo.

3.2 Environmental flow rules

The Lachlan River Management Committee (LRMC) developed a set of flow rules for the 2000-01 season. These rules were designed to share water between users and the environment to improve river health by making provision for environmental water requirements, town water supplies, basic rights to stock and domestic water and identifying water availability for other extractive water uses, such as irrigation and other industries, thereby providing some level of water security to irrigators. The three individual flow rules adopted by the LRMC have been implemented as an integrated package, and consequently, should be viewed as simply attributes of the 2000-01 flow rules. A brief description of the flow rules is provided below[6].

[5] This section draws on material contained in EPA (1996) "Proposed Interim Environmental Objectives for NSW Waters".

[6] The description provided draws on unpublished information by the DLWC Central West Region titled "Preliminary Draft Water Sharing Plan for the Lachlan Regulated River, 22/6/2001".

Rule 1: Translucent Releases

The translucent release rules have been designed to deliver flows to the effluents and wetlands in the lower system in a way which mimics natural flows. Translucent releases are to be made from Wyangala Dam during the June to November period to attain, in combination with tributary inflows, flows at Lake Brewster of 3,500 to 8,000 ML/day, depending on the storage level of the dam. The options looked at by the committee and used in this analysis involve variations in this translucent period. Water provided under this rule is classified as **Environmental Health Water**. In the Lachlan, this rule has been put in place to ensure that, to some degree, natural flow and variability is restored downstream of Wyangala Dam.

The volume of water that can be released under the translucency rule is limited to 350 GL. The actual amount released each year depends upon the storage level of Wyangala Dam.

Rule 2: Environmental Contingency Allowance

A 20 GL High Security Environmental Contingency Allowance (ECA) was established for management of critical environmental events such as: protection of bird breeding, native fish requirements and other threatened species; salinity dilution; and algal mitigation. Water provided under this rule can be classified as **Supplementary Environmental Water**.

In more recent options, the committee has added the concept of a Water Quality Allowance (WQA) to be used for problems such as blue green algae and high salinity levels, which might be addressed through dilution flows. The rules regarding the operation of the ECA and the WQA vary between the options considered in this analysis. Generally, the ECA will be eliminated during years when the 1st July allocation announcement plus percentage carryover for the Valley is below 50% and is not re-instated until allocation announcements plus percentage carryover for the Valley exceed 75%. The management of the ECA is specified as a number of sub rules relating to the treatment of unused ECA between seasons, and the use of ECA to supplement translucent releases.

Rule 3: Off Allocation

Off allocation water that might become available to irrigators is limited to 30,000 ML per annum. The remainder of these types of flows is reserved for the environment. Off allocation is only made available if Lakes Cargelligo and Brewster are guaranteed of filling and flows are in excess of the requirements for the environmental flow rules. Off allocation water is made available as a percentage of an individual irrigators entitlement and, when used, is not debited toward their annual allocation use.

4. Methodology

4.1 An economic framework

The implementation of environmental flow policies involves a re-allocation of resources. Such decisions are commonly assessed in a benefit-cost framework. The economic efficiency of different allocation policies can be assessed by comparing the social benefits and costs associated with each policy. There are however, a number of difficulties associated with adopting the standard benefit cost analysis framework when considering issues, which are likely to yield environmental benefits, like increased allocations to the environment. The major difficulty relates to the appropriate valuation of environmental benefits (particularly those in the non-use category) so that they can be incorporated into a benefit-cost framework.

To overcome some of the conceptual arguments regarding valuation, a variation on the standard benefit cost framework can be adopted through the use of an 'opportunity cost' or 'threshold value' approach. The threshold value approach avoids the need to directly place monetary values on environmental goods. The approach is based upon estimating the 'opportunity costs' which would be the consequence of a particular resource decision. In the case of environmental flows, the agricultural costs represent these opportunity costs. To gain a picture of the economic efficiency of environmental flows, these agricultural costs can be directly compared to the environmental outcomes (often quantified in non-monetary terms) which are expected from the proposal.

There are, however, further difficulties in applying a threshold value approach to community planning processes like the NSW water reforms. These relate principally to the broader interests of the community beyond economic efficiency. WMCs also consider whether water management changes are 'fair and reasonable', incorporating notions of equity between water users. Of key concern to many stakeholders is how the impacts of water management changes are distributed amongst different users. These users may be defined on a range of criteria including a geographic basis (eg. users in a specific part of a catchment) or a particular subset of users defined on water usage (eg. more active irrigators) or property or entitlement sizes (eg. small users).

The evaluation of agricultural impacts therefore requires analysis at two levels. First, at a broader regional scale, agricultural impacts can be assessed, and subsequently used, in a threshold value approach to determine the overall economic efficiency of options. Second, impacts on a more disaggregated basis can be assessed to provide WMCs with distributional information on how subsets of the population might be affected. The first issue is addressed through wider regional effects of changes in irrigated production[7], being undertaken by DLWC that also complements this study. NSW Agriculture has undertaken economic assessments at the farm level. The on-farm impacts provide distributional information and are the focus of this study.

[7] NSW Agriculture has also previously undertaken some regional analysis of agricultural impacts. See NSW Agriculture, 1996 and 1998.

4.2 Overview of approach

There is a broad range of techniques available for assessing the farm level impacts of water policy reforms. These techniques range from simple budgeting methods to formal optimisation models. The applicability and appropriateness of any of these techniques depends ultimately on the context of the analysis, the problem being addressed and the nature of the farming systems under consideration.

This study used a representative farm modelling approach to evaluate the on-farm impacts of environmental flows. A standard whole farm budgeting framework was adopted to consider changes in water availability and associated farm adjustment responses. This framework is used to assess the impacts that reduced water availability has on the profitability of representative irrigation farms involved in broadacre agricultural production. The impacts of environmental flows were estimated across a range of different years utilising historical weather data and simulated hydrology data.

A critical component of the approach is the selection of representative farm types. The socio-economic sub-committee of the LRMC identified six representative farm types to depict the main farming systems in 5 principal production zones (see Figure 1) moving from east to west in the Lachlan Valley. It is recognised that these representative farms do not represent the full diversity of surface water use in the region, however, they do represent the predominant broadacre irrigation farming systems relying on surface water in the catchment.

Representative farm models were developed to capture the nature of these six irrigation-farming systems identified. The models are set out as whole farm budgets and explicitly model irrigation requirements and water availability over a 97-year simulation period. Irrigation requirements are driven by fluctuations in rainfall availability with monthly crop evapo-transpiration requirements fixed. DLWC hydrology simulation information (from IQQM Model) is used to represent irrigation water availability over the same period. The economic models are solved on the basis of annual allocation availability under different environmental flow scenarios, expressed as a percentage of licensed entitlement. Figure 5 shows a schematic of the structure of the model.

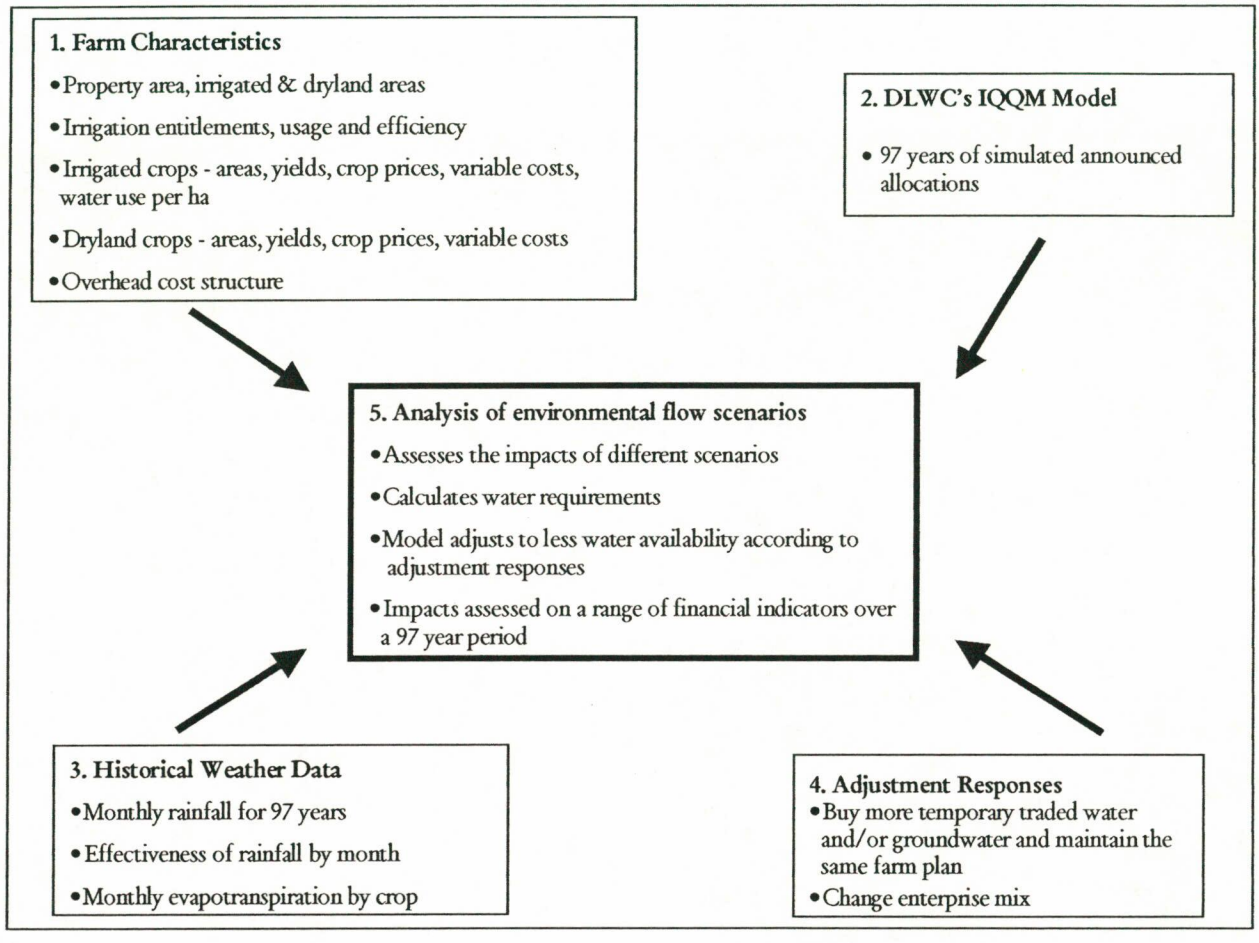
Impacts of environmental flows on farm profitability are assessed in terms of whole farm gross margin and net farm income. Definitions of these profitability indicators are as follows:

- Whole farm gross margin – sum of individual enterprise gross margins (enterprise income less enterprise variable costs) received from all farm enterprises;
- Net farm income – whole farm gross margin less overhead costs (overhead costs include depreciation, administration, permanent labour and rates but exclude finance costs like interest and rent on leases);

Effects on whole farm gross margin and net farm income essentially measure the impacts on the income generation capacity of the representative farms. Whole farm gross margin aggregates the contribution of each farm activity and gives an indication of returns prior to the consideration of overheads or fixed costs of the farm. Net farm income is a measure of farm profit and measures the return to the operator for their labour and management and the return to all capital invested in the farm whether it is borrowed or not. Because net farm income excludes finance costs, comparisons of results are not complicated by differences in the level of indebtedness peculiar to

particular farms. More details of the major components of the modelling approach (as outlined in Figure 5) are provided below. Full details of data used in the solution process including farm details, evapo-transpiration requirements, effectiveness of rainfall and irrigation efficiencies etc, are presented in Appendices 1 - 2.

Figure 5: Outline of Model Structure



4.3 Model structure

4.3.1 Farm characteristics

NSW Agriculture developed whole farm models to represent the key characteristics of irrigation farming in 5 principal production zones moving from east to west in the catchment. Data on the key features of representative farms were collected using a local consensus data (LCD) approach. The LCD technique is a way of quickly obtaining data on the structure of farming for a particular farming system in a particular locality. In general terms, the approach involves a meeting between a small group of experienced farmers and officers of the Department of Agriculture to discuss all the practices which have a bearing on the costs and returns of a 'typical' farm in the area of interest. As discussion proceeds, a consensus of opinion or agreement is reached on the size and

nature of the 'typical farm' and on relevant aspects of farm production. These relate to crop areas and yields, prices, management practices, water use, variable costs and overhead costs, and as a consequence, net farm income. The information provided is cross-checked against existing sources for consistency.

It is important to note that the approach is not statistically based, and as a consequence, is not truly representative of farms on the basis of any single characteristic. However, the approach does draw on available statistical data (farm size, irrigation allocations, crop areas etc) as a way of putting bounds around what might be considered as typical farms by participants. Ultimately, the figures reported through this technique are not average figures, but typical figures for farmers represented by the group. This has both advantages and disadvantages. An advantage is that typical figures for a targeted group can be more representative than average figures, which are commonly distorted by various sources of sampling error arising from variability in the survey population. A significant disadvantage is that figures derived cannot be simply aggregated up for use in a regional analysis. A more detailed discussion on the technique and its relative advantages and disadvantages can be found in Jayasuriya, Catt & Young (1999).

The LCD meetings were conducted in July-August 1999 in various parts of the catchment. The LCD groups consisted of practicing farmers of the area, as nominated by the socio-economic sub committee of the LRMC and NSW Agriculture staff. The range of irrigated farming systems identified by the socio-economic sub committee and later endorsed by the various LCD groups in relevant zones, are shown in Table 1. The highlighted enterprises shown are those farm types selected for representative farm modelling. The main physical characteristics of these representative farms in terms of property sizes, water entitlement and usage, breakdown of irrigated and dryland enterprise and financial characteristics are given in Table 2.

Table 1: Enterprises in different zones of the Lachlan Valley

Zone	Number of Licences	Enterprises	Number of Farms
Zone 1	307	**lucerne, and fat lamb production** sweet corn combined with lucerne & mixed farming horticulture (fresh vegetables / vines)	120 20 5
Zone 2	412	**lucerne, grazing & winter crops** (mixed farms) orchards dairy	150 15 10
Zone 3	320	**grazing / winter crops (small & large farms 50% each)** graziers / water traders summer crops	100 50 10
Zone 4	340	graziers / water traders **cotton & summer crops** horticulture (citrus / vines / fresh vegetables)	100 30 10
Zone 5	1	lucerne & mixed farming **summer crops** (maize) grazing / winter crops	45 30 30

Table 2: Description of representative farms used in the analysis

	Zone 1	Zone 2	Zone 3 Small Farm	Zone 3 Large Farm	Zone 4	Zone 5
Key physical characteristics						
Total farm size (Ha)	304	800	1000	5000	7500	2000
Area set up for irrigation (Ha)	152	320	200	200	1300	750
Water entitlement (ML)	600	1000	972	972	4000[8]	1400
Estimated Av. Water use[9]	471	531	743	525	4937	1373
Irrigated enterprises (Ha)						
Irrigated Wheat	15	40	75	20	60	50
Irrigated Oats			25	20		
Irrigated Canola	19	20				50
Irrigated Cotton					250	
Irrigated Maize					180	100
Irrigated Lucerne Hay	76	80	50			
Irrigated Perennial Pasture					60	100
Irrigated Annual Pasture		20	50	160		50
Dryland enterprises (Ha)						
Wheat	61	160	200	1000	300	300
Barley						100
Oats				200		100
Canola	19	160	100	300		250
Lucerne Hay (establishment)	19	20				
Improved / Perennial Pasture	95	280	400	2000	5900	800
Fallow / developing / non-arable		20	100	1300	750	200
Number of Sheep	700	1500	1200	3200	3000	1700
Number of Cattle		50	40	200	50	150
Farm labour (Weeks)						
Owner / Manager & Family	50	50	50	100	100	50
Permanent Labour		48	48	48	48	48
Casual Labour	25	25		48		10
Average farm performance[10]						
Whole Farm Gross Margin	92,828	162,062	111,868	231,127	443,529	159,943
Total Operating Overheads	54,446	99,153	60,253	140,629	204,946	120,197
Net Farm Income	38,383	62,909	51,615	90,498	238,584	39,747
Business Return	-4,167	8,209	13,515	7,998	165,234	-3,953
Total Assets	1,315,700	2,285,500	1,541,500	3,490,000	4,038,606	3,507,500
Total Liabilities	230,000	400,000	220,000	500,000	750,000	450,000

[8] Average water use exceeds the surface water entitlement because this representative farm also holds a 2,000 ML groundwater base entitlement and a 2,000 ML conjunctive use entitlement.Surface water supplies are utilised initially by the farm with groundwater used only to supplement surface water availability.

[9] Calculated through model runs for the 97-year (full simulation period) monthly average rainfall.

[10] Simulated farm performance based on 97-year monthly average rainfall.

A brief description of each of the farms is provided below.

i) **Zone 1 –Lucerne and fat lamb production.** This is seen as the 'traditional' type mixed farm of the Cowra to Forbes region, representing approximately 120 irrigators. The farm type has an average area of 300 Ha (range 150 to 600 Ha), with 600 ML (range 150 to 1,000 ML) water entitlement. Average water use is about 80%. The farm is run by the owner/manager, with employment of casual labour during peak demand periods adding up to about a half time employee. Lucerne is the main focus of irrigation, and used for hay and/or fattening stock, depending on market conditions and the availability of water. Sale of hay (or hay products) is the major contributor to income. Winter crops, largely wheat and canola are grown, with some irrigation when necessary and available. A cereal crop for feed (grazing and grain) is also generally part of the farm program. From a gazing perspective, this type of farm was the only one not to include cattle, with the focus on fat lamb production.

ii) **Zone 2 – Lucerne, grazing and winter Crops** (mixed farming). – This farm type is also included as a 'traditional' Lachlan farm, most common between Eugowra and Condobolin. It is estimated to represent about 150 irrigators, with an average area of 800 Ha (range 600 to 1,400 Ha) and 1,000 ML (range 600 to 1,800 ML) water entitlement. Average water use is about 50% of entitlement. This type of farm is seen as a typical family farm, often run by a father and son team, with the use of casual labour during peak demand periods adding up to about a further half time employee. Lucerne is again the main focus of irrigation, and used for hay and/or fattening stock, depending on market conditions and the availability of water. Winter (wheat & canola) cropping, both irrigated and dryland, plays a larger role than the zone 1 type farm. Irrigated annual pasture also plays an important role for stock feed, particularly in the dry years - this is especially important for some with Stud enterprises.

iii) **Zone 3 – Grazing/winter crops ("small" farm type).** – This type is classified as "small", as it generally includes ownership of a single 'river' property which includes an area laid out to irrigation. Again, it is seen as a 'traditional' Lachlan farm, with a focus on fat lamb production, and winter crops. Farms of this type are typically found between Forbes and Lake Cargelligo, including the Jemalong Irrigation District, and represent about 65 irrigators. Farm size averages 1,000 Ha (range 400 to 5,000 Ha) with 972 ML (range 400 to 8,000 ML) water entitlement. Average water use is about 80% of entitlement. This type of farm is also seen as a typical family farm, often run by a father and son team (two labour units). Irrigation is primarily used for fodder and pastures crops (including lucerne), with returns from sale of hay being an important component. Wheat, and probably a growing use of Canola, are important parts of the farm rotation, both irrigated and dryland.

iv) **Zone 3 – Grazing/winter crops ("large" farm).** – This type is classified as "large", as it includes ownership of a significant 'off-river' dryland block, as well as the 'river' block with irrigation. The main focus of this farm is dryland winter crops, although in the past it may have been primarily a grazing property. Again, farms of this type are typically found between Forbes and Lake Cargelligo, and represent about 65 irrigators. Farm size averages 5,000 Ha, with a 1,000 Ha 'river block', similar to the "small" farm in (iii) above and dryland being 4,000 Ha (overall range 2,000 to 20,000 Ha). Generally water

entitlements are again 972 ML, with a range of 400 to 8,000 ML. Irrigation is an important adjunct to this farm type, being particularly important in dry periods. With this emphasis on reliability rather than use, average water use is about 50% of entitlement. The farm requires two family labour units, as well as two full time employees. Irrigation is primarily used for pastures, which might be an important part of a stud enterprise.

v) **Zone 4 - Cotton and summer crops.** – This type of farm represents the industry that has been providing the largest growth in the Lachlan Valley over the last decade. Due to the climatic requirements of current cotton varieties, it is located west of Lake Cargelligo, mostly based around Hillston. It is estimated to represent about 30 farms to date, and is the only type in this study to include groundwater as a significant part of irrigation. Farm size averages 7,500 Ha, with a range of 2,000 to 50,000 Ha, reflecting the historically large grazing properties on which irrigation has been developed. Surface water entitlements average 4,000 ML, with 2,000 ML base plus 2,000 ML conjunctive groundwater licences. To represent the variation in irrigation systems of the area, this farm has 100 Ha under spray irrigation, with 1,000 Ha landformed for flood irrigation, and a further 200 Ha being developed. Whilst cotton is the main irrigation crop, maize, cereals and lucerne based pasture are important part of irrigation rotations. There is potential for other summer crops. A merino based 3,000 sheep flock and a 50 cow cattle enterprise make up the stocking component, mostly run on the dryland area. Labour units include two family members and a full time employee.

vi) **Zone 5 – Summer crops (maize).** – This type of farm is seen as the main intensive irrigation type of the Jemalong Irrigation District (Zone 5), although it also represents farms outside the district, but generally between Forbes and Lake Cargelligo. It is estimated to represent about 30 farms. Maize has been the most common summer crop, but the search is on for profitable enterprises, which might complement this. Because of the fixed costs of Irrigation District, the cost per ML of water increases with lower use. This provides an additional incentive for the search for profitable summer crops, which remains elusive. Wheat, canola and pastures (lucerne, medic and sub clover) are part of the irrigation rotation. Dryland cereals and pasture also make a major contribution. From the grazing perspective, there is a strong emphasis on cattle combined with a traditional merino flock. Farm size averages 2,000 Ha (range 600 to 5,000 Ha) with 1,400 ML water entitlement (range 800 to 2,600 ML). Average water use is about 95% of entitlement. Labour units include the owner/manager, a full time employee, and some casual labour at the busy times.

4.3.2 DLWC Hydrology Model

The DLWC IQQM model simulates the operation of the Lachlan system by calculating the monthly announced allocation percentages and total allocation diversions for each year of a 97 year simulation period from 1901 to 1997. The model is set to represent, as closely as possible, all the factors affecting water use as they were in 1993-94. These factors include dams and water storages then in place, the water allocation rules, amount of land being irrigated, the year by year planting decisions made by farmers etc. The model is simulated with the actual rainfall, evaporation and water inflow for the period 1901 to 1997 to obtain the simulated hydrology output. This hydrology simulation approach has been used in other issues including the analysis of river flow objectives (EPA, 1996; NSW Agriculture, 1996 & 1998; DLWC, 1998) and the Snowy Water Inquiry, 1998.

Hydrology simulation information from DLWC's IQQM model was used to represent the allocations that irrigators were expected to receive under different environmental flow scenarios through time (see Appendix 3). The economic modelling uses this hydrology data as input into the extent of irrigated crops grown in each of the representative farms. However, the historically conservative nature of allocation announcements by DLWC (as discussed in Section 2) suggests that farmers would be unlikely to base their farm plans solely on announced allocations at the beginning of the season (August). The extent that irrigators would upwardly revise allocation announcements depends on irrigators' attitude to risk, which is likely to be individual specific. For the purposes of the analyses, it was assumed that irrigators would plan to receive an allocation, which approximated that of the January announcement in each year of the simulation period. As a consequence, the study is assuming that irrigators are well informed about the usual increase in allocation announcements and that they base their crop planting decisions on higher water availability than that is actually announced at the start of the irrigation season[11].

4.3.3 Historical weather data

The irrigation requirements of different crops for each representative farms is simulated over a 97 year period based on historical weather data in the Lachlan Catchment. Depending on the location of the representative farm, the monthly rainfall is obtained from four different rainfall stations in the catchment namely Cowra, Forbes, Lake Cargelligo and Hillston. The effectiveness of rainfall data provides information on the contribution that rainfall makes to meet crop evapo-transpiration requirements. The data is provided on a monthly basis. The crop evapo-transpiration data was sourced from Jemalong Land and Water Management Planning evaluations and other NSW Agriculture reports (NSW Agriculture, 1996 and 1998). These are provided by crop and by month and are fixed during the simulation.

[11] Most farmers would be well aware of the tendency for actual announced allocations to increase through the year. For example, according to **historical** announced allocations (see Figure 4), the average increase in allocations over the season between 1982 and 2001 was 41 per cent (excluding two dry years and years when the maximum of 120% allocation was announced at the start of the irrigation season). The **simulated** hydrology for the base case C71A (see Appendix 3) shows a 29 per cent increase from August to January on average across the full simulation period.

4.3.4 Adjustment responses considered

The types of adjustment responses taken by farmers in response to lower water availability will have a significant bearing on the magnitude of effects. Some responses can be undertaken in the short term (temporary trade in water, change enterprise mix) while other responses require a longer-term time frame (investment in irrigation infrastructure to improve irrigation efficiency). The focus of this study is on the shorter-term responses that farmers can make to lower water availability. The responses considered are described below.

Adjustment response 1: Buy/sell water in the temporary market

The purchase of surface water was supported by the LCD groups who indicated that a number of irrigators trade in the temporary water market. The purchase of water can be assessed within the modelling framework through the simulation of annual water demands based on climatic conditions. When water demand exceeds availability in a particular year, the model purchases the deficit on the temporary transfer market and maintains the original enterprise levels. The price at which the model purchases surface water is determined by an aggregate surface water demand function for the Lachlan Valley[12]. The price of water varies annually depending on the announced allocations for the surface water users. The price ranged from $15 to $80 with an average of $23 per ML across the 97-year period. These prices are consistent with the views of members of the LCD group who discussed the possibility of buying surface water for around $20/ML. The model also assumes that any surplus water could be sold at the same price as determined above. For the Zone 4 representative farm, in addition to the above, supplementation with groundwater is possible too.

Adjustment response 2: Change enterprise mix

The purchase of additional surface water to offset reductions in water supplies may not be the most feasible adjustment response for some irrigators. Only some water users access temporary traded water, and there are also restrictions in place for the transfer of water between license holders. An alternative response for some irrigators may involve making changes to enterprise mix and crop rotations to accommodate water shortages resulting from environmental flow policies. This adjustment response is incorporated into the analysis by progressively reducing low priority irrigated enterprises, as identified by the LCD group, and replacing sacrificed irrigated enterprises with dryland alternatives to partially offset the loss of income. The priority of the farm enterprises is determined on the basis of the gross margin per ML of water use. For all representative farms, dryland barley is included as a replacement crop.

Consideration of both responses together

Sometimes it is not rational to buy water under adjustment response 1, when the marginal value of water (the value of agricultural production with an additional ML of water) is lower than the

[12] The function is derived through the application of NSW Agriculture's regional linear programming models, which attempt to represent surface irrigated agriculture across the same five irrigation zones in the Lachlan Valley. An existing economic model of the Jemalong area was initially compiled by Randall Jones and Anthea M'cClintock, formerly of the Economic Services Unit of NSW Agriculture. The larger LP model of the Lachlan was extended by Randall Jones, Jason Crean and Margot Fagan and has been further revised by Rohan Jayasuriya and Jason Crean. Ian Smith, Irrigation Officer, Forbes has provided substantial technical input.

market price of water. Under such circumstances it becomes more profitable to cut back low value enterprises as under the adjustment response 2. Similarly, sometimes it is not rational to cut back enterprises under adjustment response 2, when the marginal value of water is higher than the market price of water and when additional water is available to the farm on the temporary transfer market. This problem is unavoidable in an approach where the two adjustment responses are considered as two mutually exclusive events in a simulation period.

To avoid these problems, this study adopts an approach to choose between the two adjustment options based on their relative financial merits. The model makes a rational decision (whether to buy water or cut back enterprises) based on an overall goal of maximising farm returns. Under this approach, the marginal value of water is the driving force that determines which adjustment response should be adopted. Consequently, each year the model determines whether the farm should purchase temporary trade water, use groundwater if available, or change enterprise mix to make the best use of the available water. The model is based on linear programming techniques and attempts to maximise farm gross margin (M) according to the objective:

$$M = \sum_{j=1}^{n} (c_j - a_{ij}.x_j.p_i), \qquad (j = 1,.....n)$$

Where:

c_j denotes all the revenue from activities j;
x_j is the magnitude of activity j;
a_{ij} is the amount of resource i used per unit of activity j;
p_i is the cost of resource i; and
n is the number of j activities.

subject to: $\sum_{j=1}^{n} a_{ij}.x_j \le a_i \quad (i = 1,.....,m)$

The model attempts to maximise farm returns from irrigated agriculture in the light of land and water resource constraints and enterprise costs (part of which are directly associated with the cost of water) and returns. Consequently, the models are useful in looking at optimal responses to changes in variables such as water availability and price.

5. Assessment of environmental flow rules

NSW Agriculture was requested to evaluate a range of environmental flow management options developed by the LRMC. The initial request was to analyse five options and the results of this analysis were previously presented to the Committee and are discussed in section 5.3. The LRMC also requested the evaluation of a further two options (E73A and E131). The following discussion focuses on the evaluation of these two management options against base case conditions. The evaluation of the environmental flow rules is undertaken as an ex-ante analysis. A simulation approach is taken to evaluate the impact of flow rules over a range of climatic years from 1900/01 to 1996/97.

5.1 Evaluation of E73A and E131 environmental flow rules

The base case, E73A and E131 environmental flow rules are described in the form of hydrology data which specifics the availability of water to irrigators across different climatic years. Water availability is represented in the form of allocation announcements, which express the quantity of water available as a proportion of entitlement. For the purposes of this analysis, any access to off allocation flows is incorporated within the allocation data provided for each option. Simulated January announced allocations are used in this analysis, so any off allocation flows made available between August and January are reflected in the hydrology data (see Appendix 3).

The environmental flow rules E73A and E131 reflect specific cases of the flow rule categories outlined in Section 3 which included translucent releases, environmental contingency allowances and off allocation. One of the key differences between the environmental flow rules and the base case examined here is access to off allocation flows. Under the base case, off allocation access represents around 7 per cent of total water availability, while under the flow rules this falls to 3 and 0 per cent under E73A and E131, respectively. The hydrology data gave an average January announced allocation of 97.0 per cent under the base case and 73.1 and 68.3 per cent for E73A and E131 rules, respectively. The hydrology data also indicated that there was lower variability in terms of allocation availability for the two management options with lower standard deviations compared to the base case.

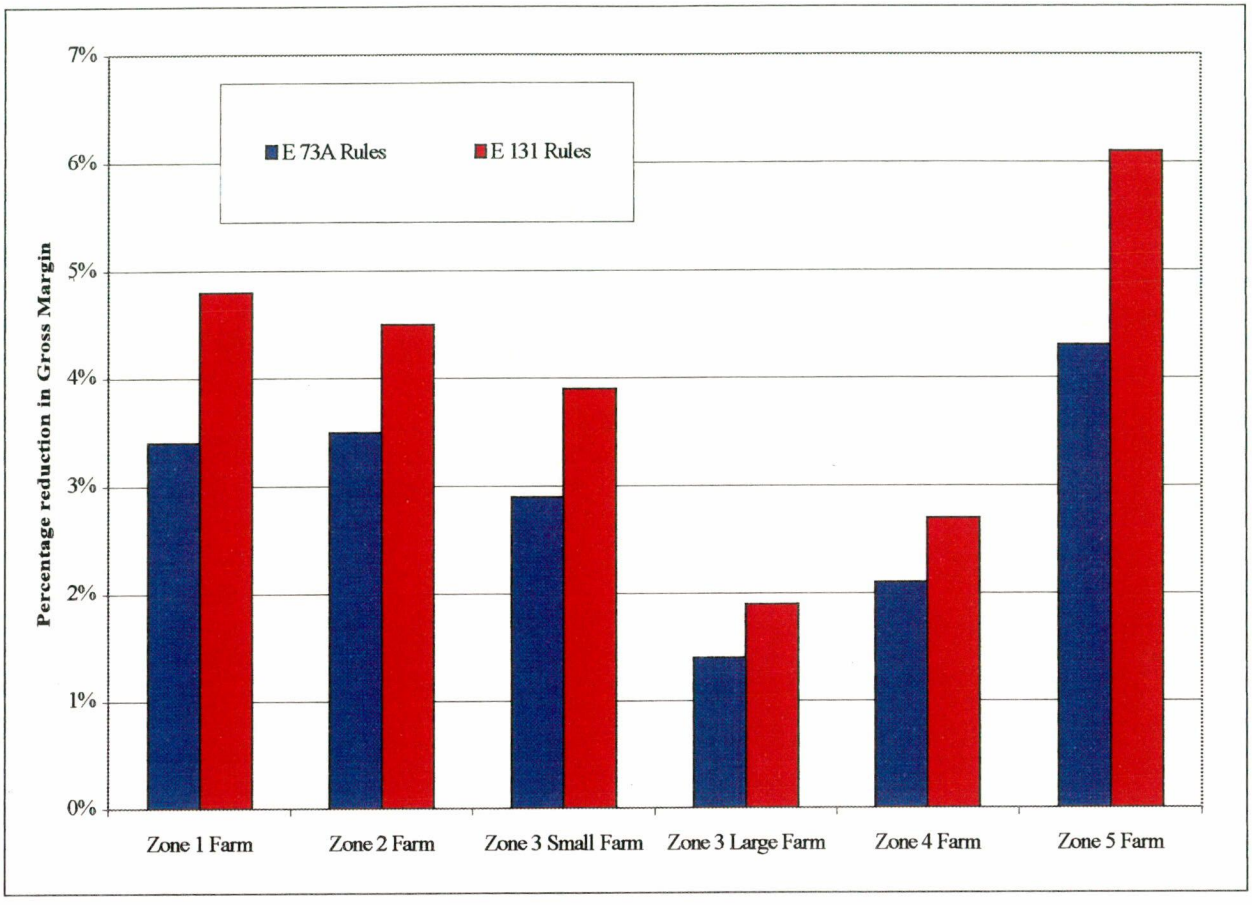
On the basis of the hydrology data provided, the agricultural impacts associated with the introduction of environmental flow rules are estimated across the six representative farms. The results of the analysis are reported in Table 3 and the impacts are shown graphically in Figure 6.

The results show that the introduction of LRMC's E73A environmental flow rules resulted in a decrease in whole farm gross margin of between 1 and 4 per cent and a decrease in net farm income of between 4 and 22 per cent across the six representative farms. In comparison, the introduction of E131 environmental flow rules resulted in a decrease in whole farm gross margin of between 2 and 6 per cent and a decrease in net farm income of between 5 and 32 per cent across all farms. Consequently, we can conclude that the introduction of E131 environmental flow rules will have marginally higher impacts on farms in the Lachlan catchment than E73A environmental flow rules.

Table 3: Results of LRMC's E73A and E131 flow rules analysis

	C 71A Base Case average January allocation 97.0 %		**E 73A Rules** Average January allocation 73.1 %				**E 131 Rules** average January allocation 68.3%			
	Mean ($)	SD ($)	Mean ($)	SD ($)	Impact ($)	Impact %	Mean ($)	SD ($)	Impact ($)	Impact %
Zone 1 Farm										
Gross Margin	88,021	12,753	85,039	14,462	-2,983	-3.4	83,779	15,349	-4,242	-4.8
Net Farm Income	33,576	12,753	30,593	14,462	-2,983	-8.9	29,334	15,349	-4,242	-12.6
Zone 2 Farm										
Gross Margin	159,854	15,281	154,336	14,407	-5,518	-3.5	152,736	15,113	-7,119	-4.5
Net Farm Income	60,702	15,281	55,183	14,407	-5,518	-9.1	53,583	15,113	-7,119	-11.7
Zone 3 Small Farm										
Gross Margin	110,921	8,369	107,669	6,891	-3,252	-2.9	106,577	7,439	-4,344	-3.9
Net Farm Income	50,668	8,369	47,416	6,891	-3,252	-6.4	46,324	7,439	-4,344	-8.6
Zone 3 Large Farm										
Gross Margin	230,119	9,985	226,873	9,983	-3,246	-1.4	225,788	10,944	-4,331	-1.9
Net Farm Income	89,490	9,985	86,244	9,983	-3,246	-3.6	85,159	10,944	-4,331	-4.8
Zone 4 Farm										
Gross Margin	431,923	25,232	422,974	28,344	-8,949	-2.1	420,166	31,785	-11,756	-2.7
Net Farm Income	226,977	25,232	218,028	28,344	-8,949	-3.9	215,221	31,785	-11,756	-5.2
Zone 5 Farm										
Gross Margin	149,233	23,748	142,787	27,730	-6,446	-4.3	140,068	30,189	-9,164	-6.1
Net Farm Income	29,036	23,748	22,590	27,730	-6,446	-22.2	19,872	30,189	-9,164	-31.6

Figure 6: LRMC's E73A and E131 flow rules – Impact on Farm Gross Margin



Further analysis was undertaken to determine whether the agricultural impacts of environmental flows were statistically significant. The analysis found that the impacts of E131 environmental flow rules across the 97 year simulation period were found to be statistically significant at a 95 per cent confidence level for all the representative farms (all t-statistics above the critical value of 1.65). That means agricultural returns under situations of E131 environmental flows are consistently lower than without such flows for all farms. Impacts of E73A flow rules were found to be significant at a 95 per cent confidence level for five out of the six farms. The Zone 1 representative farm impacts became significant at 90 per cent confidence level. This is due to the relative high variation in farm returns for this representative farm.

The whole farm gross margin impacts from the LRMC rules (over the full range of climatic years) can be compared to the indicative flow rules developed by government agencies. NSW Agriculture conducted a regional analysis of the agricultural impacts on indicative flow rules in 1998. The impacts of indicative flow rules on regional gross margin were found to be between 4-5 per cent. The analysis of LRMC's E73A environmental flow rules shows lower impacts than the indicative flow rules for all the representative farms. The analysis of E131 environmental flow rules shows equal or lower impacts than the indicative flow rules for all but one of the representative farms (the farm in Zone 5 - Jemalong that has a high level of license activation). This suggests some progress in option development in reducing the negative effects of environmental flows on farm incomes.

The results also show that environmental flows are unlikely to have uniform impacts across farms in the catchment. This is due to a variety of farm specific factors including the current level of license activation, the profitability of existing land uses and the current financial position of the farm.

5.2 Impact of E73A and E131 environmental flow rules in Dry Years

The LRMC expressed interest in finding out the nature of agricultural impacts of environmental flow rules in dry years. This issue was addressed in this study by drawing on information already available from the main analysis which provides a time series of results for the base case and environmental flows over 97 climatic years. Given the availability of these results, essentially all that is required is a set of criteria to define dry years.

In some studies, dry years are defined through reference to historical rainfall conditions. A potential problem with this approach to irrigation issues in large inland catchments is the geographical separation of the main irrigated regions from the actual storages from which irrigation supplies are released. Using historical rainfall availability as an indicator of a dry year could indicate those years where dry seasonal conditions exist in the region but may also coincide with relatively abundant irrigation supplies. To overcome this problem, other approaches were considered.

A dry year from an irrigation perspective is probably best viewed in terms of the availability of irrigation supplies. A dry year was defined as any year, which reported a January allocation of less than 70 per cent for the base case. This definition yielded 26 dry years out of the total simulation period. The hydrology data alone illustrates that the proportional reductions to allocation resulting from environmental flow policies are larger in drier years relative to average years. The average January announced allocation is 35.0 per cent under the base case and 23.1 and 18.3 per cent respectively under E73A and E131 rules for the 26 dry years assessed. The impacts of E73A and E131 environmental flow rules in dry years are reported in Table 4.

The impact of E73A and E131 environmental flow rules was found to be much more significant in dry years. The impact of environmental flows on farm returns increased from between $3,000-$11,800 in an average year to between $7,000-$23,300 in a dry year. The representative farm in Zone 4 had access to groundwater and was the least affected in both absolute and percentage terms. As expected, the groundwater supplementation acted to offset the impact of reduced surface water access in dry years.

The higher impacts of environmental flows in dry years felt by most of the farms is a product of both a larger reduction in allocations during dry years and the higher marginal value of water derived from irrigated agriculture during periods of resource scarcity. The agricultural impacts of environmental flows are further increased in dry years because of the higher marginal value of water derived from irrigated agriculture during periods of resource scarcity. That is, the allocation of water away from irrigated agriculture will have a higher per unit cost during times of resource scarcity as higher returning enterprises are sacrificed from production. These impacts may have been even higher in the absence of measures implemented by the LRMC specifically to mitigate the effects of environmental flows in drier years.

Table 4: Results of LRMC's E73A and E131 flow rules analysis in Dry Years

	C 71A Base Case average January allocation 35.0 %	**E 73A Rules** average January allocation 23.1 %			**E 131 Rules** average January allocation 18.3%		
	Mean ($)	Mean ($)	Impact ($)	Impact %	Mean ($)	Impact ($)	Impact %
Zone 1 Farm							
Gross Margin	73,824	66,780	-7,044	-9.5	63,589	-10,235	-13.9
Net Farm Income	19,378	12,334	-7,044	-36.4	9,144	-10,235	-52.8
Zone 2 Farm							
Gross Margin	147,866	136,376	-11,490	-7.8	132,339	-15,527	-10.5
Net Farm Income	48,713	37,223	-11,490	-23.6	33,186	-15,527	-31.9
Zone 3 Small Farm							
Gross Margin	105,419	99,947	-5,472	-5.2	97,069	-8,350	-7.9
Net Farm Income	45,167	39,694	-5,472	-12.1	36,816	-8,350	-18.5
Zone 3 Large Farm							
Gross Margin	220,993	215,167	-5,826	-2.6	212,471	-8,521	-3.9
Net Farm Income	80,364	74,538	-5,826	-7.2	71,843	-8,521	-10.6
Zone 4 Farm							
Gross Margin	406,688	393,937	-12,752	-3.1	386,226	-20,462	-5.0
Net Farm Income	201,742	188,991	-12,752	-6.3	181,281	-20,462	-10.1
Zone 5 Farm							
Gross Margin	120,299	104,303	-15,996	-13.3	97,018	-23,280	-19.4
Net Farm Income	102	-15,894	-15,996	NA*	-23,178	-23,280	NA*

* Percentages are large because initial Net Farm Income for base case is very low. It is reasonable to expect some farms make a loss in dry years.

5.3 Assessment of previous options

NSW Agriculture was previously requested to evaluate five options and the results of this analysis are shown in Appendix 4. The hydrology data provided by DLWC (see Appendix 3) for this analysis showed only a marginal difference between the options in terms of average allocation availability. The average January allocations ranged from 68.3 to 69.6 per cent across the options. The hydrology data also indicated that there was no significant difference between the options in terms of allocation variability with standard deviations found to be the same across the options. Consequently, for the purposes of the analysis only the management options reporting the highest average value (E98) and the lowest average value (E116) were assessed.

It is important to note that the results of this analysis are not directly comparable with that of the main analysis. This is due to the change in the IQQM model as it was being periodically updated. As a consequence the hydrology received for the base case (C71) was different than for the current situation.

6. Summary

The extent of trade-offs associated with establishing environmental allocations is a significant issue in the Lachlan Catchment. There are important river health issues in the catchment as well as a large irrigation industry dependent upon secure irrigation supplies. The agricultural trade-offs incurred through the introduction of environmental flows requires analysis at two levels. First, at a broader regional scale, to determine the overall economic efficiency of options. Second, at a more disaggregated level to provide WMCs with distributional information on how subsets of the population might be affected. The on-farm impacts provide this distributional information and are the focus of this study.

A representative farm approach was used to assess the financial impacts on agriculture from the implementation of the environmental flows proposed by the LRMC. Six representative farms were developed for the analysis to reflect the typical farming systems in 5 principal production zones moving from east to west in the catchment. The impacts have been determined by quantifying the difference in farm returns between a base case (without environmental flows) and environmental flow scenarios. The evaluation of the impact of environmental flows was undertaken with climatic and hydrology simulation data to reflect the impacts over a range of climatic years from 1900/01 to 1996/97.

The results from the analysis show that the introduction of LRMC's E73A environmental flow rules resulted in a decrease in whole farm gross margin of between 1 and 4 per cent and a decrease in net farm income of between 4 and 22 per cent across the six representative farms. In comparison, the introduction of E131 environmental flow rules resulted in a decrease in whole farm gross margin of between 2 and 6 per cent and a decrease in net farm income of between 5 and 32 per cent across all farms. Consequently, we can conclude that the introduction of E131 environmental flow rules will have marginally higher impacts on farms in the Lachlan catchment than E73A environmental flow rules.

The agricultural returns under situations of E131 environmental flows are consistently lower than without such flows for all farms, while the same under E73A flow rules could be inferred for the case of most of the representative farms.

The whole farm gross margin impacts from the LRMC rules (over the full range of climatic years) were also compared to the indicative flow rules developed by government agencies (impact of indicative rules on average regional gross margin was previously found to be 4.2 per cent). This analysis showed that the rules developed by LRMC generated lower impacts for most of the farms.

The impact of E73A and E131 environmental flow rules was found to be much more significant in dry years. The impact of environmental flows on farm returns increased from between $3,000-$11,800 in an average year to between $7,000-$23,300 in a dry year. The higher impacts of environmental flows in dry years is a product of both a larger reduction in allocations during dry years and the higher marginal value of water derived from irrigated agriculture during periods of resource scarcity. These impacts may have been even higher in the absence of measures implemented by the LRMC specifically to mitigate the effects of environmental flows in drier years.

The representative farms used in this study provide a representation of the predominant broadacre irrigation farming systems relying on surface water in the catchment. In this context, the study provides the LRMC with some indication as to how environmental flows may affect typical broadacre farms within the central irrigation areas of the Lachlan Valley. Obviously these representative farms do not represent the full diversity of farms in the region so some care should be exercised in generalising the results of this study. Ultimately, the impacts of environmental flows on any one farm will reflect a variety of farm specific factors including the current level of license activation, the productivity of existing land uses, the adjustment responses adopted to reduced water availability and the current financial position of the farm. Nevertheless, the results of this study should provide the LRMC with some indications on the likely impacts to be felt by broadcare farms in the catchment from the implementation of environmental flow policies.

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Appendix 1: Representative farm data

1.1 – Zone 1 Farm

Lucerne / Grazing / Winter Crops - 120 Farmers

As in zone 2 but smaller farms

1. Physical farm characteristics

Farm areas					
Total farm area	Ha	304	range 150-600		
Area set up for irrigation	Ha	152			
Area normally irrigated	Ha	110	range 38-130		
Dryland area	Ha	194			
Beef cattle number	no.				
Sheep number	no.	700			
Water supplies					
Regulated water					
- irrigation entitlement	ML	600	range 150-1000	475.0	
- access to off allocation	ML				
Unregulated water					
- licenced area	Ha			51.3	
Groundwater supplies				40.5	
- irrigation entitlement	ML				
Closest rainfall site	location	Cowra - SCS		566.8	Total water use
		or ?: ARS / AirPort / PostOffice			
Farm labour					
- owner/manager	no. of weeks	50			
- family	no. of weeks				
- permanent labour	no. of weeks				
- casual	no. of weeks	25			

Farm "plan" showing rotation

Irrigated 152 ha	Dryland 152 ha
PP-L1	Canola - 19 ha
PP-L2	W
PP-L3	W
PP-L4	PP-L
PP-L5	PP-L
C	PP-N
W	PP-N
W - 19 ha	PP-N

2. Irrigation characteristics

		Area	Irrigation eff			
Irrigation by layout and method		Ha	%			
- land formed - flood (LFF)						
- land formed - spray (LFS)						
- non landformed - flood (NLFF)						
- non landformed - spray (NLFS)		152	80			
- other						
Irrigation infra-structure						
River pump details						
- capacity	Ml/hour					
- running cost	$/hour					
Ground water pump details						
- capacity	Ml/hour					
- running cost	$/hour					
On-farm storage						
- surface area	square metres					
- depth	metres					
On-farm recycling system	Y/N					
Scheme details						
- name	name					
- usage charge	$/ML					
- fixed charge	$					
Water resource cost			usage	pumping cost	fixed cost	
- regulated supplies	$/ML	**47.20**	3.80	43.40	3.07	
- unregulated supplies	$/ML					
- groundwater supplies	$/ML					

Note : Water Use from model given below is for 97 year average monthly rainfall data and therefore all Gross Margin figures here are based on these average data.

3. Irrigated enterprises

		Area	expected water use MI/ha	water use from model MI/ha	Pump/Delivery Cost $/MI	Yield tonnes/ha	Price $/tonne	V.Costs $/ha	Gross Margin $/ha	Total GM
Winter crops										
- Short Fallow - Wheat										$0
- Long Fallow - Wheat		15	2.70	1.48	47.20	5	$145.00	$383.22	$341.78	$5,127
- Barley										$0
- Oats										$0
- Canola		19	2.70	1.50	47.20	2	$320.00	$433.98	$206.02	$3,914
- Chickpeas										$0
- Fababeans										$0
- Lupins										$0
										$0
Summer crops										$0
- Cotton										$0
- Sorghum										$0
- Rice										$0
- Soybeans										$0
- Maize										$0
- Sunflowers										$0
										$0
Pasture	(LSM's/ha or an indication of stocking rate)									$0
- Lucerne hay		76	6.25	5.53	47.20	12.50	140	$1,184.18	$565.82	$43,002
-Summer pasture (perennial based)										$0
- Spring										$0
- Summer										$0
- Autumn										$0
- Winter										$0
-Winter pasture (subclover based)										$0
- Spring										$0
- Summer										$0
- Autumn										$0
- Winter										$0
- Other crops										$0
Total Water Use (ML)		110 Ha	566.8 ML	471.2 ML						
Irrigated Gross Margin										$52,044

1.1 – Zone 1 Farm *Continued*

4. Dryland enterprises

Winter crops		Area	Yield	V.Costs	Gross Margin	Total GM
- Short Fallow - Wheat						$0
- Long Fallow - Wheat		61	2.50	$165.38	$197.12	$12,024
- Barley						$0
- Oats						$0
- Canola		19	1.50	$350.14	$129.86	$2,467
- Chickpeas						$0
- Fababeans						$0
- Lupins						$0
						$0
Summer crops						$0
- Cotton						$0
- Sorghum						$0
- Soybeans						$0
- Maize						$0
- Sunflowers						$0
						$0
Pasture	(LSM's/ha or an indication of stocking rate)					$0
- Lucerne hay -establishment		19	4.00	$165.04	$314.96	$5,984
- Improved pasture		95	link Sheep2>	$209.74	$213.78	$20,309
- Spring						
- Summer						$0
- Autumn						$0
- Winter						$0
- Unimproved pasture (native)						$0
- Spring						$0
- Summer						$0
- Autumn						$0
- Winter						$0
- Other crops						$0
Dryland Gross Margin		194	Ha			$40,785

5. Overhead cost structure

Administration expenses			
- accounting	1400		
- bank charges	1800		
- insurance (farm & Vehicles)	2100		
- super & workers compensation	2100	15%	
- telephone	800	of wages	
- stationary	550		
Labour (permanent & casual)	14000		
Fuel and oil (farm vehicles)	2800		
Electricity (not including pumping costs)	1200		
Repairs and maintenance			
- plant and equipment	2800		
- structures	1200		
Depreciation		RATE	
- plant and equipment	17524	6.8%	
- structures			
Rates			
- Stocking charges (PPB)	300		
- Land	1230		
- Water	1842		
Other operating overheads (Rego & License)	2800		
Total operating overheads	$ 54,445.6		

ASSETS	Age	Current Value	Expected Life
Farm		1000000	
PLANT :			
Tractor - 150 hp			
Tractor - 100 hp		45000	
Tractor - 75 hp		15000	
Tractor - MF 35		6000	
Tractor with Loader - 50 hp			
Header			
Mover / Conditioner		23000	
Rake		5000	
Rake		3000	
Baler		15000	
Sprayer		5000	
Bale Loader or Wagon		20000	
Augers		8000	
Field Bins		4000	
Plough		5000	
Scarifier		2200	
Combine		4000	
Harrows - Two		5000	
Motor Bike		2500	
Truck		15000	
Ute			
Travelling Irrigator Plant		50000	
STRUCTURES			
Sundries		25000	
		257700	

6. Profit and Financial analysis

OTHER FARM INCOME (eg timber)	$	-	
TOTAL FARM GROSS MARGIN	$	92,828	
TOTAL OPERATING OVERHEADS	$	54,446	
NET FARM INCOME	$	38,383	
Less operators labour	$	24,000	
OPERATING RETURN (A)	$	14,383	
Less			P component
- OD interest paid		$1,050	
- HP / Lease interest paid		$4,750	$8,272
- Term Loan interest		$12,750	$5,313
BUSINESS RETURN (B)	$	(4,167)	
TOTAL ASSETS (C)			
- liquid assets	$	35,000	
- value of land and improvements	$	1,000,000	
- value of plant and equipment	$	257,700	
- value of sheep	$	23,000	
- value of cattle	$	-	
Sub Total	$	1,315,700	
TOTAL LIABILITIES	$	230,000	
EQUITY (D)	$	1,085,700	
EQUITY RATIO D/C X 100		82.5%	
RETURN ON TOTAL ASSETS (A) / (C) x 100		1.1%	
RETURN ON EQUITY (B) / (D) x 100		-0.4%	
OFF-FARM INCOME	$	15,000	
Approx. Taxable Farm Profit or Loss	$	19,833	
NET CASH RESULT (after tax)	$	34,805	
DECISION TREES :-			

Livestock	Number	Value/hd	
Rams -	20	$100	2000
Ewes -	700	$30	21000
Bulls -		$1,000	0
Cows -		$450	0

Liquid assets such as		
Bank Deposits - Off farm investment	25,000	super
Shares / Equity	10000	

LIABILITIES		Rate	Term
OD Bank	30000	10.5%	1
HP / Lease	50000	9.5%	5
Mortgage	150000	8.5%	15
Bank lending equity	82%		

1.2 – Zone 2 Farm

Lucerne / Grazing / Winter Crops - 150 Farmers

As in zone 1 but larger farms

1. Physical farm characteristics

Farm areas			
Total farm area	Ha	800	
Area set up for irrigation	Ha	320	
Area normally irrigated	Ha	160	range 160-180
Dryland area	Ha	640	
Beef cattle number	no.	50	45 Vealers
Sheep number	no.	1500	Lambs 1500
Water supplies			
Regulated water			
- irrigation entitlement	ML	1000	range 600-1800
- access to off allocation	ML		
Unregulated water			
- licenced area	Ha		
Groundwater supplies			
- irrigation entitlement	ML		
Closest rainfall site	location	Forbes-Camp St	
		or ? Bethany Park/Airport Aws/Muddy Water/3	
Farm labour			
- owner/manager	no. of weeks	50	
- family	no. of weeks		
- permanent labour	no. of weeks	48	
- casual	no. of weeks	25	

Farm "plan" showing rotation

	Irrigated 160	setup 160ha	Dryland 480 ha
60.0	AP-S	AP-S	
	PP-L2	PP-L1	PP-L 280 ha
680.0	PP-L3		
	PP-L4		
	PP-L5		
84.0	C		W or C 320 ha
108.0	W		
	W - 20 ha		
932.0	Total water use		

2. Irrigation characteristics

		Area	Irrigation eff
Irrigation by layout and method		Ha	%
- land formed - flood (LFF)		160	75
- land formed - spray (LFS)			
- non landformed - flood (NLFF)			
- non landformed - spray (NLFS)			
- other			
Irrigation infra-structure			
River pump details			
- capacity	Ml/hour		
- running cost	$/hour		
Ground water pump details			
- capacity	Ml/hour		
- running cost	$/hour		
On-farm storage			
- surface area	square metres		
- depth	metres		
On-farm recycling system	Y/N		
Scheme details			
- name	name		
- usage charge	$/ML		
- fixed charge	$		

Water resource cost			usage	pumping cost	fixed cost
- regulated supplies	$/ML	**14.96**	3.80	11.16	3.07
- unregulated supplies	$/ML				
- groundwater supplies	$/ML				

Note : Water Use from model given below is for 97 year average monthly rainfall data and therefore all Gross Margin figures here are based on these average data.

3. Irrigated enterprises

		Area	expected wate	water use from	Pump/Deliver	Yield	Price	V.Costs	Gross Margir	Total GM
		Ha	use Ml/ha	model Ml/ha	Cost $/Ml	tonnes/ha	$/tonne	$/ha	$/ha	
Winter crops										
- Short Fallow - Wheat										$0
- Long Fallow - Wheat		40	2.7	1.70	14.96	5	$145.00	$338.85	$386.15	$15,446
- Barley										$0
- Oats										$0
- Canola		20	4.2	1.63	14.96	2	$320.00	$387.78	$252.22	$5,044
- Chickpeas										$0
- Fababeans										$0
- Lupins										$0
										$0
Summer crops										$0
- Cotton										$0
- Sorghum										$0
- Rice										$0
- Soybeans										$0
- Maize										$0
- Sunflowers										$0
										$0
Pasture	(LSM's/ha or an indication of stocking rate)									$0
- Lucerne hay		80	8.5	4.85	14.96	9.63	$148.57	$991.08	$438.92	$35,114
- Perennial pasture (Lucerne)										$0
- Spring										$0
- Summer										$0
- Autumn										$0
- Winter										$0
- Annual pasture (sub clover)		20	3	2.12	14.96	link Cattle Budgets		$334.85	$627.88	$12,558
- Spring										$0
- Summer	Gross Margin									$0
- Autumn	$/DSE									$0
- Winter										$0
- Other crops										$0
Total Water Use (ML)		160 Ha	932.0 ML	531.3 ML						
Irrigated Gross Margin										$68,162

1.2 – Zone 2 Farm *Continued*

4. Dryland enterprises

			Area	Yield	V.Costs	Gross Margir	Total GM
Winter crops							
- Short Fallow - Wheat							$0
- Long Fallow - Wheat			160	2.2	$160.03	$158.97	$25,436
- Barley							$0
- Oats							$0
- Canola			160	1.5	$350.14	$129.86	$20,778
- Chickpeas							$0
- Fababeans							$0
- Lupins							$0
							$0
Summer crops							$0
- Cotton							$0
- Sorghum							$0
- Soybeans							$0
- Maize							$0
- Sunflowers							$0
							$0
Pasture	(LSM's/ha or an indication of stocking rate)						$0
- Lucerne hay -establishment			20	4.00	$165.04	$314.96	$6,299
- Perennial pasture (Lucerne)		$14.43	280	link Sheep2X	$160.50	$147.81	$41,387
- Spring		Gross Margin					$0
- Summer		$/DSE					$0
- Autumn							$0
- Winter							$0
- Annual pasture (sub clover)							$0
- Spring							$0
- Summer							$0
- Autumn							$0
- Winter							$0
- Other crops (Fallow)			20				$0
Dryland Gross Margin			640	Ha			$93,900

5. Overhead cost structure

Administration expenses			
- accounting	2000		
- bank charges	1800		
- insurance (farm & Vehicles)	3000		
- super & workers compensation	5497	15%	
- telephone	800	of wages	
- stationary	550		
Labour (permanent & casual)	36646	Station Hand Gd 3	
Fuel and oil (farm vehicles)	5200		
Electricity (not including pumping costs)	1200		
Repairs and maintenance			
- plant and equipment	5000		
- structures	2000		
Depreciation		RATE	
- plant and equipment	28390	6.8%	
- structures			
Rates			
- Stocking charges (PPB)	300		
- Land	2500		
- Water	3070		
Other operating overheads (Rego & License)	1200		
Total operating overheads	$ 99,153		

ASSETS	Age	Current Value	Expected Life
Farm		1750000	
PLANT			
Tractor - 150 hp		60000	
Tractor - 100 hp		45000	
Tractor - 75 hp			
Tractor - MF 35			
Tractor with Loader - 50 hp		25000	
Header		50000	
Mower / Conditioner -Two		46000	
Rake - Two		10000	
Rake - Two		6000	
Baler		15000	
Sprayer		15000	
Bale Loader or Wagon		20000	
Augers		8000	
Field Bins - Two		8000	
Plough		10000	
Scarifier		5000	
Combine		15000	
Harrows - Two		12000	
Motor Bike		5000	
Truck		15000	
Ute - Two		17500	
Travelling Irrigator Plant			
STRUCTURES			
Sundries		30000	
		417500	

6. Profit and Financial analysis

OTHER FARM INCOME (eg timber)	$ -		
TOTAL FARM GROSS MARGIN	$ 162,062		
TOTAL OPERATING OVERHEADS	$ 99,153		
NET FARM INCOME	$ 62,909		
Less operators labour	$ 24,000		
OPERATING RETURN (A)	$ 38,909		
Less		P component	
- OD interest paid	$ 2,800		
- HP / Lease interest paid	$ 6,650	$11,581	
- Term Loan interest	$ 21,250	$8,855	
BUSINESS RETURN (B)	$ 8,209		
TOTAL ASSETS (C)			
- liquid assets	$ 45,000		
- value of land and improvements	$ 1,750,000		
- value of plant and equipment	$ 417,500		
- value of sheep	$ 49,500		
- value of cattle	$ 23,500		
Sub Total	$ 2,285,500		
TOTAL LIABILITIES	$ 400,000		
EQUITY (D)	$ 1,885,500		
EQUITY RATIO D/C X 100	82.5%		
RETURN ON TOTAL ASSETS (A) / (C) x 100	1.7%		
RETURN ON EQUITY (B) / (D) x 100	0.4%		
OFF-FARM INCOME	$ 25,000		
Approx. Taxable Farm Profit or Loss	$ 32,209		
NET CASH RESULT (after tax)	$ 58,721		
DECISION TREES :-			

Livestock	Number	Value/hd	
Rams -	45	$100	4500
Ewes -	1500	$30	45000
Bulls -	1	$1,000	1000
Cows -	50	$450	22500
Liquid assets such as			
Bank Deposits - Off farm investment			25,000 super
Shares / Equity			20000

LIABILITIES		Rate	Term
OD Bank	80000	10.5%	1
HP / Lease	70000	9.5%	5
Mortgage	250000	8.5%	15
Bank lending equity	81%		

1.3 – Zone 3 Small Farm

Grazing / Winter Crops - 130 Farmers - Type 1 - Small (50% of Farmers) Zone 3 - 100 farmers

Zone 5 - 30 farmers

1. Physical farm characteristics

Farm areas			
Total farm area	Ha	1000	range 400-5000
Area set up for irrigation	Ha	200	range 40-2000
Area normally irrigated	Ha	200	one watering on some pasture
Dryland area	Ha	800	
Beef cattle number	no.	40	cows
Sheep number	no.	1200	First X ewes
Water supplies			
Regulated water			
- irrigation entitlement	ML	972	range 400-8000
- access to off allocation	ML		
Unregulated water			
- licenced area	Ha		
Groundwater supplies			
- irrigation entitlement	ML		
Closest rainfall site	location	Condobolin	rain 15-16 inches or 8-30 cm
Farm labour			
- owner/manager	no. of weeks	50	
- family	no. of weeks		
- permanent labour	no. of weeks	48	
- casual	no. of weeks		
		2 people	

Farm "plan" showing rotation (clockwise)

50%LF & 50%Graded

	Irrigated 200 H	Dryland 800 ha	
	O -25 ha unde	Fallow -100 ha	W
75.0	W (C ?)		
425.0	W	PP-Legume	W
	W (undersown?)		
225.0	L establishme	PP-Legume	Canola B undersown
	L (3 yrs)		
150.0	AP-S (4 yrs)	PP-Legume	PP-Legume
	AP-S (4 yrs)		

875.0 Total water use

Merino - lambing March / April X D
22-23 Micron 22.5 Micron - 6 Kg yield 65%

Age	# Ewes	
2.5	|	2% mortality
3.5	|	1.5 % joining
4.5	|	100 % selling
5.5	|	
Total	1200	

Sheer July / Aug

2. Irrigation characteristics

Irrigation by layout and method	Area Ha	Irrigation eff %
- land formed - flood (LFF)	100	80
- land formed - spray (LFS)		
- non landformed - flood (NLFF)	100	60
- non landformed - spray (NLFS)		
- other		

Irrigation infra-structure					
River pump details					
- capacity	Ml/hour	0.5	12ML/day		
- running cost	$/hour	6	$12 / ML		
Ground water pump details					
- capacity	Ml/hour				
- running cost	$/hour				
On-farm storage					
- surface area	square metres				
- depth	metres				
On-farm recycling system	Y/N	N	high cost of recycling		
Scheme details					
- name	name	JID			
- usage charge	$/ML				
- fixed charge	$	10 to 20			
Water resource cost			usage	pumping cost	fixed cost
- regulated supplies	$/ML	**13.10**	3.80	9.30	3.07
- unregulated supplies	$/ML				
- groundwater supplies	$/ML				

Note : Water Use from model given below is for 97 year average monthly rainfall data and therefore all Gross Margin figures here are based on these average data.

3. Irrigated enterprises

		Area	expected wate	water use from	Pump/Delivery	Yield	Price	V.Costs	Gross Margin	Total GM
		Ha	use Ml/ha	model Ml/ha	Cost $/Ml	tonnes/ha	$/tonne	$/ha	$/ha	
Winter crops										
- Short Fallow - Wheat										$0
- Long Fallow - Wheat		75	3.00	2.92	13.10	4	$145.00	$434.35	$145.65	$10,924
- Barley										$0
- Oats	undersowing co	25	3.00	2.92	13.10	2.50	$120.00	$172.94	$127.06	$3,177
- Canola	to cattle									$0
- Chickpeas	25 DSE/ha for 3 months									$0
- Fababeans	Autumn lambing									$0
- Lupins										$0
										$0
Summer crops										$0
- Cotton										$0
- Sorghum										$0
- Rice										$0
- Soybeans										$0
- Maize										$0
- Sunflowers										$0
										$0
Pasture	(LSM's/ha or an indication of stocking rate)									$0
- Lucerne hay		50	8.50	6.46	13.10	11.00	$128.00	$1,003.12	$404.88	$20,244
- Perennial pasture (Lucerne)	3 DSE per Ac									$0
- Spring	7.5 DSE/ha									$0
- Summer										$0
- Autumn										$0
- Winter										$0
- Annual pasture (sub clover)	4 DSE per Ac	50	3.00	2.55	13.10	link Cattle Budgets		$198.01	$106.37	$5,318
- Spring	Spring lambing									$0
- Summer	fat lambs sold									$0
- Autumn	Sept/Oct 18-20Kg									$0
- Winter										$0
- Other crops										$0
Total Water Use (ML)		200 Ha	875.0 ML	742.6 ML						
Irrigated Gross Margin										$39,663

1.3 – Zone 3 Small Farm *Continued*

4. Dryland enterprises

			Area	Yield		V.Costs	Gross Margin	Total GM
Winter crops								
- Wheat after pasture (River Block)				100	2	$231.11	$58.89	$5,889
- Wheat into stubble (River Block)				100	2	$138.49	$141.51	$14,151
- Barley								$0
- Oats								$0
- Canola		undersowing cost to sheep		100	1.2	$301.32	$82.68	$8,268
- Chickpeas								$0
- Fababeans								$0
- Lupins								$0
								$0
Summer crops								$0
- Cotton								$0
- Sorghum								$0
- Soybeans								$0
- Maize								$0
- Sunflowers								$0
								$0
Pasture	(LSM's/ha or an indication of stocking rate)							$0
- Lucerne hay								$0
- Perennial pasture (Lucerne)	4 DSE/Ha			400 link Sheep2X Bu		$73.56	$109.74	$43,897
- Spring	1600 ewes equivalent all up							$0
- Summer	12 - 16 DSE for 40 cows							$0
- Autumn								$0
- Winter								$0
- Annual pasture (sub clover)								$0
- Spring								$0
- Summer								$0
- Autumn								$0
- Winter								$0
- Other crops (Fallow)				100				$0
Dryland Gross Margin				800 Ha				$72,205

5. Overhead cost structure

Administration expenses			
- accounting	1400		
- bank charges	1800		
- insurance (farm & Vehicles)	2100		
- super & workers compensation	3397	15%	
- telephone	800	of wages	
- stationary	550		
Labour (permanent & casual)	22646	Station Hand Gd 3	
Fuel and oil (farm vehicles)	2800		
Electricity (not including pumping costs)	1200		
Repairs and maintenance			
- plant and equipment	2800		
- structures	1200		
Depreciation		RATE:	
- plant and equipment	14246	6.8%	
- structures			
Rates			
- Stocking charges (PPB)	300		
- Land	1230	$ 1.30 / Ac	
- Water	2984		
Other operating overheads (Rego & License)	800		
Total operating overheads	$ 60,253		

350 + 250 Layout
400 dry
250 improovement

ASSETS		Age	Current Value	Expected Life
Farm			1250000	
PLANT				
Tractor - 150 hp -JD		10	25000	
Tip truck - Bedford		35	2000	
Slasher		10	5000	
Fergie		40	3000	
80 hp MF 65 C front loader		30	10000	
Header - NH1550		25	20000	
Group		10	5000	
Workshop Equipment			10000	
Pump 8" 50 hp - Perkins		20	5000	
Vehicle - Falcon CiLi		4	12000	
Boom Sprayer		15	5000	
Harrows		10	5000	
Augers	2	30	5000	
Field Bins	3 @ 18 tons	20	3000	
Plough				
Scarifier - 211 Inter		15	5000	
Combine - 28mm Sheaner		15	10000	
Motor Bike	4WD	2	6500	
Motor Bike	2W - Yamaha 200	2	1000	
Truck - Inter		25	40000	
Ute - Hilux 2.8D 4WD		7	15000	
Off-sets 28 plate - 3.5 Inter		15	7000	
STRUCTURES				
Sundries			10000	
			209500	

6. Profit and Financial analysis

OTHER FARM INCOME (eg timber)	$ -		
TOTAL FARM GROSS MARGIN	$ 111,868		
TOTAL OPERATING OVERHEADS	$ 60,253		
NET FARM INCOME	$ 51,615		
Less operators labour	$ 24,000	to 30000	
OPERATING RETURN (A)	$ 27,615		
Less		P component	
- OD interest paid	$ 3,500		
- HP / Lease interest paid	$ 3,800	$6,617	
- Term Loan interest	$ 6,800	$2,834	
BUSINESS RETURN (B)	$ 13,515		
TOTAL ASSETS (C)			
- liquid assets	$ 25,000		
- value of land and improvements	$ 1,250,000		
- value of plant and equipment	$ 209,500		
- value of sheep	$ 38,000		
- value of cattle	$ 19,000		
Sub Total	$ 1,541,500		
TOTAL LIABILITIES	$ 220,000		
EQUITY (D)	$ 1,321,500		
EQUITY RATIO D/C X 100	85.7%	80	
RETURN ON TOTAL ASSETS (A) / (C) x 100	1.8%		
RETURN ON EQUITY (B) / (D) x 100	1.0%		
OFF-FARM INCOME	$ 18,000		
Approx. Taxable Farm Profit or Loss	$ 37,515		
NET CASH RESULT (after tax)	$ 52,807		
DECISION TREES :-			

Livestock	Number	Value/hd	
Rams -	20	$100	2000
Ewes -	1200	$30	36000
Bulls -	1	$1,000	1000
Cows -	40	$450	18000

Liquid assets such as
Bank Deposits - Off farm investment 25,000 super
Shares / Equity

LIABILITIES		Rate	Term
OD Bank	100000	10.5%	1
HP / Lease	40000	9.5%	5
Mortgage	80000	8.5%	15

1.4 – Zone 3 Large Farm

Grazing / Winter Crops - 130 Farmers - Type 2 - Large (50% of Farmers)

Zone 3 - 100 farmers
Zone 5 - 30 farmers

1. Physical farm characteristics

Farm areas			
Total farm area	Ha	5000	range 2000-20000
Area set up for irrigation	Ha	200	range 40-2000
Area normally irrigated	Ha	200	one watering on some pasture
Dryland area	Ha	4800	
Beef cattle number	no.	200	cows - range 100-1200, mostly on dryland (finished on irrigation)
Sheep number	no.	2000	M ewes on dryland
		1200	1X ewes on irrigated
Water supplies			
Regulated water			
- irrigation entitlement	ML	972	range 400-8000
- access to off allocation	ML		
Unregulated water			
- licenced area	Ha		
Groundwater supplies			
- irrigation entitlement	ML		
Closest rainfall site	location	Condobolin	rain 15-16 inches or 8-30 cm
Farm labour			
- owner/manager	no. of weeks	50	
- family	no. of weeks	50	
- permanent labour	no. of weeks	48	
- casual	no. of weeks	48	
		4 people	

Farm "plan" showing rotation (clockwise)

50%LF & 50%Graded

	Irrigated 200	Dryland 800 ha		
60.0	W -20 ha	Fallow -100 ha	W	
60.0	O (undersown)			
90.0	AP-S	PP-Legume	W	
390.0	AP-S			
	AP-S	PP-Legume	Canola	B undersown
	AP-S			
	AP-S	PP-Legume	PP-Legume	
	AP-S			
	AP-S			
	AP-S			

600.0 Total water use

4000 ha Dryland	F- 400 ha	W	W	C - 200 ha undersown	
				O -200 ha undersown	Home Timber
	PP - Legume	PP - Legume	PP - Legume	PP - Legume	Native veg Hill

200 Cows & 2000 Ewes

Merino - lambing March / April X D
22-23 Micron 22.5 Micron - 6 Kg yield 65%

Age	# Ewes	
2.5	|	2% mortality
3.5	|	1.5 % joining
4.5	|	100 % selling
5.5	|	
Total	1200	

Sheer July / Aug

2. Irrigation characteristics

		Area	Irrigation eff
Irrigation by layout and method		Ha	%
- land formed - flood (LFF)		100	80
- land formed - spray (LFS)			
- non landformed - flood (NLFF)		100	60
- non landformed - spray (NLFS)			
- other			
Irrigation infra-structure			
River pump details			
- capacity	Ml/hour	0.5	12ML/day
- running cost	$/hour	6	$12 / ML
Ground water pump details			
- capacity	Ml/hour		
- running cost	$/hour		
On-farm storage			
- surface area	square metres		
- depth	metres		
On-farm recycling system	Y/N	N	high cost of recycling
Scheme details			
- name	name	JID	
- usage charge	$/ML		
- fixed charge	$		

Water resource cost			usage	pumping cost	fixed cost
- regulated supplies	$/ML	**13.10**	3.80	9.30	3.07
- unregulated supplies	$/ML				
- groundwater supplies	$/ML				

Note : Water Use from model given below is for 97 year average monthly rainfall data and therefore all Gross Margin figures here are based on these average data.

3. Irrigated enterprises

	Area	expected water use MI/ha	water use from model MI/ha	Pump/Delivery Cost $/MI	Yield tonnes/ha	Price $/tonne	V.Costs $/ha	Gross Margin $/ha	Total GM
	Ha								
Winter crops									
- Short Fallow - Wheat									$0
- Long Fallow - Wheat	20	3.00	2.92	13.10	4	$145.00	$434.35	$145.65	$2,913
- Barley									$0
- Oats	20	3.00	2.92	13.10	2.50	$120.00	$172.94	$127.06	$2,541
- Canola									$0
- Chickpeas									$0
- Fababeans									$0
- Lupins									$0
									$0
Summer crops									$0
- Cotton									$0
- Sorghum									$0
- Rice									$0
- Soybeans									$0
- Maize									$0
- Sunflowers									$0
									$0
Pasture	(LSM's/ha or an indication of stocking rate)								$0
- Lucerne hay									$0
- Perennial pasture									$0
- Spring									$0
- Summer									$0
- Autumn									$0
- Winter									$0
- Annual pasture (sub clover)	30	3.00	2.55	13.10	link Cattle Budgets		$495.94	$2,033.14	$60,994
- Annual pasture (sub clover)	130	3.00	2.55	13.10	link Sheep2X Budgets		$229.23	$258.81	$33,645
- Summer									$0
- Autumn									$0
- Winter									$0
- Other crops									$0
Total Water Use (ML)	200 Ha	600.0 ML	524.5 ML						
Irrigated Gross Margin									$100,093

1.4 – Zone 3 Large Farm *Continued*

4. Dryland enterprises

			Area	Yield	V.Costs	Gross Margin	Total GM
Winter crops							
- Wheat after pasture (River Block)			100	2	$231.11	$58.89	$5,889
- Wheat into stubble (River Block)			100	2	$138.49	$141.51	$14,151
- Wheat after pasture (Dry Block)			400	1.5	$199.76	$10.24	$4,094
- Wheat into stubble (Dry Block)			400	1.5	$130.84	$86.66	$34,662
- Oats		undersowing cost to sheepM	200	1.8	$78.82	$137.18	$27,435
- Canola (River Block)		undersowing cost to sheep2X	100	1.2	$301.32	$82.68	$8,268
- Canola (Dry Block)		undersowing cost to sheepM	200	1.0	$238.69	$81.31	$16,263
- Lupins							$0
							$0
Summer crops							$0
- Cotton							$0
- Sorghum							$0
- Soybeans							$0
- Maize							$0
- Sunflowers							$0
							$0
Pasture	(LSM's/ha or an indication of stocking rate)						$0
- Lucerne hay							$0
- Perennial pasture (Legume Mix)				2000 link SheepM	$19.66	$10.14	$20,271
- Spring							$0
- Summer							$0
- Autumn							$0
- Winter							$0
- Annual pasture (sub clover)							$0
- Spring							$0
- Summer							$0
- Autumn							$0
- Winter							$0
- Other crops (Fallow)				500			$0
- Horne, Timber, Native Veg, Hill				800			
Dryland Gross Margin				4800 Ha			$131,033

5. Overhead cost structure

Administration expenses			
- accounting	2500		
- bank charges	1800		
- insurance (farm & Vehicles)	2100		
- super & workers compensation	7429	15%	
- telephone	900	of wages	
- stationary	550		
Labour (permanent & casual)	49526	Station Hand Gd 3	
Fuel and oil (farm vehicles)	2800		
Electricity (not including pumping costs)	1200		
Repairs and maintenance			
- plant and equipment	2800		
- structures	1200		
Depreciation		RATE	
- plant and equipment	50490	6.8%	
- structures			
Rates			
- Stocking charges (PPB)	300		
- Land	13250	$ 1.00 / Ac	
- Water	2984		
Other operating overheads (Rego & License)	800		
Total operating overheads	$ 140,629		

350 + 250 Layout			
400 dry			
250 improovement			
$ 1m + 250K improovements			

ASSETS		Age	Current Value	Expected Life
Farm			2500000	
PLANT :				
Tractor - 300 hp - 4WD Case		2	150000	
Tip truck - Bedford		35	10000	
Slasher		10	5000	
Fergie		40	3000	
80 hp MF 65 C front loader		30	10000	
Header - 30' Case 2180		3	190000	
Group		10	5000	
Workshop Equipment			10000	
Pump 8" 50 hp - Perkins		20	5000	
Vehicle - Landcruiser		4	41000	
Compu Sprayer		15	18000	
Harrows		10	5000	
Augers	2	30	10000	
Field Bins	5 @ 30 tons	20	10000	
Chisel Plough			20000	
Scarifier - 211 Inter		15	5000	
Combine - 28mm Sheaner		15	10000	
Motor Bike	4WD	2	6500	
Motor Bike	2W - Yamaha 200	2	1000	
Truck - Inter		15	50000	
Ute - Nissan 4.2D		1	38000	
Off-sets 60 plate - 3.5 Inter		15	30000	
AirSeeder - Flexicod			100000	
STRUCTURES				
Sundries			10000	
			742500	

6. Profit and Financial analysis

OTHER FARM INCOME (eg timber)	$	-	
TOTAL FARM GROSS MARGIN	$	231,127	
TOTAL OPERATING OVERHEADS	$	140,629	
NET FARM INCOME	$	90,498	
Less operators labour	$	48,000	
OPERATING RETURN (A)	$	42,498	
Less			P component
- OD interest paid	$	7,000	
- HP / Lease interest paid	$	19,000	$33,087
- Term Loan interest	$	8,500	$3,542
BUSINESS RETURN (B)	$	7,998	
TOTAL ASSETS (C)			
- liquid assets	$	50,000	
- value of land and improvements	$	2,500,000	
- value of plant and equipment	$	742,500	
- value of sheep	$	103,500	
- value of cattle	$	94,000	
Sub Total	$	3,490,000	
TOTAL LIABILITIES	$	500,000	
EQUITY (D)	$	2,990,000	
EQUITY RATIO D/C X 100		85.7%	85
RETURN ON TOTAL ASSETS (A) / (C) x 100		1.2%	
RETURN ON EQUITY (B) / (D) x 100		0.3%	
OFF-FARM INCOME	$	18,000	
Approx. Taxable Farm Profit or Loss	$	55,998	
NET CASH RESULT (after tax)	$	76,659	
DECISION TREES :-			

Livestock	Number	Value/hd	
Rams -	75	$100	7500
Ewes -	3200	$30	96000
Bulls -	4	$1,000	4000
Cows -	200	$450	90000

Liquid assets such as		
Bank Deposits - Off farm investment	50,000	super
Shares / Equity		

LIABILITIES		Rate	Term
OD Bank	200000	10.5%	1
HP / Lease	200000	9.5%	5
Mortgage	100000	8.5%	15

1.5 – Zone 4 Farm

Cotton / Maize + Summer Crops - 30 Farmers

1. Physical farm characteristics

Farm areas			
Total farm area	Ha	7500	range 2000-50000
Area set up for irrigation	Ha	1300	600 ha Flood, 500 ha Spray, 200 ha to develop
Area normally irrigated	Ha	550	450 ha Flood, 100 ha Spray
Dryland area	Ha	6950	
Beef cattle number	no	50	50 cows & 1 bull
Sheep number	no	3075	3000 sheep & 75 rams
		1000	Self replacing merino
Water supplies		1000	merino to 1X (from m flock)
Regulated water			
- irrigation entitlement	ML	4000	with 2000 ML conjunctive with GW
- access to off allocation	ML		
Unregulated water - licenced area	Ha		
Groundwater supplies			
- conjunctive use entitlement	ML	2000	
- base entitlement	ML	2000	
Total Water availablity	ML	6000	
Closest rainfall site	location	Hillston	
Farm labour			
- owner/manager	no. of weeks	50	
- family	no. of weeks	50	
- pernament labour	no. of weeks	48	
- casual	no. of weeks		

Farm "plan" showing rotation

1300 ha set up		6200 ha dryland
flood irrigated - 450 ha	180.0	- Long Fallow - Wheat
	1500.6	- Cotton - Conventional
	374.9	- Cotton - GM -spray irrigated
	1800.0	- Maize - Flood
	360.0	- Perennial pasture (Lucerne)
150 ha		3000 sheep : 2000 Merino Ew (1000M & 1000 BL)
spray irrigated - 100 ha		2.5 % rams
		50 cows - 350 kg @ $ 1.10
		- 85% replacement
		01 bull
400 ha		
To develop 200 ha		

2. Irrigation characteristics

Irrigation by layout and method	Area Ha	Irrigation eff %
- land formed - flood (LFF)		80
- land formed - spray (LFS)		
- non landformed - flood (NLFF)		65
- non landformed - spray (NLFS)		90
- other		

4215.5 ML Total water use

Irrigation infra-structure				
River pump details				
- capacity	Ml/hour	1.875	45ML/day - 20" pump and a backup 12" pump as well	
- running cost	$/hour	14.06	$7.50	per ML
Ground water pump details				
- capacity	Ml/hour	0.625	15ML/day	
- running cost	$/hour	$13.75	$22.00	per ML
On-farm storage				
- surface area	square metres			
- depth	metres			
On-farm recycling system	Y/N	Y	25% re-cycle possibility ?	
Scheme details				
- usage charge	$/ML			
- fixed charge	$			

Water resource cost			usage	pumping cost	fixed cost
- regulated supplies	$/ML	**11.24**	3.80	7.44	3.07
- unregulated supplies	$/ML				
- groundwater supplies	$/ML	**22.30**	0.30	22.00	0.61
- spray irrigation costs (extra)	$/ML	**21.00**		21.00	

Sheep --> 23 Micron Wool - 6 Kg
Lambing -- > 80% M
100% -- Griffith Sale Yard - $ 60
2% mortality
Maize stubble --> finished on Lucerne

Oats - 20 ha every 2 years
water if necessary

Note : Water Use from model given below is for 97 year average monthly rainfall data and therefore all Gross Margin figures here are based on these average data.

3. Irrigated enterprises

	Area Ha	expected wate use Ml/ha	water use from model Ml/ha	Pump/Delivery Cost $/Ml	Yield tonnes/ha	Price $/tonne	V.Costs $/ha	Gross Margin $/ha	Total GM
Winter crops									
- Short Fallow - Wheat									$0
- Long Fallow - Wheat	60.0	3.0	3.1	11.24	3.5	145.00	$424.75	$82.75	$4,965
- Barley									$0
- Oats									$0
- Canola									$0
- Chickpeas									$0
- Fababeans									$0
- Lupins									$0
									$0
Summer crops									$0
- Cotton - Conventional	187.5	8.0	11.3	11.24	6.60 Lint	450.00	$2,287.57	$945.75	$177,328
					2.38 Seed	110.00			$0
- Cotton - GM -spray irrigated	62.5	6.0	10.0	32.24	6.60 Lint	450.00	$2,309.43	$923.88	$57,743
					2.38 Seed	110.00			$0
- Maize - Flood	180.0	10.0	8.0	11.24	10.00	160.00	$859.91	$740.09	$133,216
- Maize - Spray									$0
									$0
Pasture	(LSM's/ha or an indication of stocking rate)								$0
- Lucerne hay									$0
- Perennial pasture (Lucerne)	60.0				11.00	On farm Use - cost transferred to livestock			$0
Self replacing Merino 21-22 Micron	15	6.0	9.6	11.24	link SheepM Budgets		$1,154.54	$855.95	$12,839
First X Lambs	33	6.0	9.6	11.24	link Sheep1X Budgets		$664.28	$1,076.37	$35,520
Cattle	12	6.0	9.6	11.24	link Cattle Budgets		$966.50	$685.31	$8,224
									$0
- Annual pasture (sub clover)									$0
- Spring									$0
- Summer									$0
- Autumn									$0
- Winter									$0
- Other crops									$0
Total Water Use (ML)	550 Ha	4215.5 ML	4936.6 ML						
Irrigated Gross Margin									$429,835

1.5 – Zone 4 Farm *Continued*

4. Dryland enterprises

		Area	Yield	V.Costs	Gross Margin	Total GM
Winter crops						
- Short Fallow - Wheat						$0
- Long Fallow - Wheat After Pasture		150	1.5	$215.86	$1.64	$246
- Long Fallow - Wheat After Stubble	undersowing cost to cattle	150	1.5	$127.84	$89.66	$13,448
- Oats						$0
- Canola						$0
- Chickpeas						$0
- Fababeans						$0
- Lupins						$0
						$0
Summer crops						$0
- Cotton						$0
- Sorghum						$0
- Soybeans						$0
- Maize						$0
- Sunflowers						$0
						$0
Pasture	(LSM's/ha or an indication of stocking rate)					$0
- Lucerne hay						$0
- Perennial (native) pasture	maintennance costs to overheads-Weed con		5900 for cattle & sheep			$0
- Spring						$0
- Summer						$0
- Autumn						$0
- Winter						$0
- Annual pasture (sub clover)						$0
- Spring						$0
- Summer						$0
- Autumn						$0
- Winter						$0
- Other crops (Fallow + to develop)			750			$0
Dryland Gross Margin			6950 Ha			$13,694

600 ha laid out flood 200 lasered @ 800/Ac = 400,000
400 @ 400/Ac = 400,000
100 ha spray = 350,000
3000 ML river = 100,000
3000 Ml GW
6200 dryland = 620,000
Improovements = 230,000
Another = 900,000

5. Overhead cost structure

Administration expenses			
- accounting	5000		
- bank charges	1800		
- insurance (farm & Vehicles)	10000		
- super & workers compensation	3724	15%	
- telephone	3000	of wages	
- stationary	3000		
Labour (permanent & casual)	24825	Rural Tradesperson	
Fuel and oil (farm vehicles)	12000		
Electricity (not including pumping costs)	5000		
Repairs and maintenance			
- plant and equipment	5000	50% GM ?	
- structures	11000	8 - 14.5 K	
Dryland maintenance	10000	RATE	
Depreciation - plant and equipment	48797	6.8%	
Landforming - 50 ha @ $750	37500		
Rates			
- Stocking charges (PPB)	300		
- Land	8000	rates 10K PPB 1K	
- Water (both surface and GW)	13500		
Other operating overheads - (Rego & License)	2500		
Total operating overheads	$ 204,946		

6. Profit and Financial analysis

OTHER FARM INCOME (eg timber)	$ -		
(agistment from good seasons included in off farm income)			
TOTAL FARM GROSS MARGIN	$ 443,529		
TOTAL OPERATING OVERHEADS	$ 204,946		
NET FARM INCOME	$ 238,584		
Less operators labour	$ 48,000		
OPERATING RETURN (A)	$ 190,584		
Less		P component	
- OD interest paid	$ 9,750	includes OD + Crop terms	
- HP / Lease interest paid	$ 24,000	$51,137	
- Term Loan interest	$ 29,100	$9,669	
BUSINESS RETURN (B)	$ 165,234		
TOTAL ASSETS (C)			
- liquid assets	$ 200,000		
- value of land and improvements	$ 3,000,000		
- value of plant and equipment	$ 717,606		
- value of sheep	$ 97,500		
- value of cattle	$ 23,500		
Sub Total	$ 4,038,606		
TOTAL LIABILITIES	$ 750,000		
EQUITY (D)	$ 3,288,606		
EQUITY RATIO D/C X 100	81.4%		
RETURN ON TOTAL ASSETS (A) / (C) x 100	4.7%		
RETURN ON EQUITY (B) / (D) x 100	5.0%		
OFF-FARM INCOME (including agistment)	$ 25,000		
Approx. Taxable Farm Profit or Loss	$ 213,234		
NET CASH RESULT (after tax)	$ 146,078		
DECISION TREES :-			

ASSETS	Age	Current Value	Expected Life
Farm		3000000	
PLANT :			
Tractor - Case MX 270	1	145000	
Tractor - Case 7110 / bucket	4	70000	
Fordson 5000		7000	
Fiat 1000		7000	
Header NHTR 87	7	125000	
Bins - Vennings	4	20000	
Augers - 9" 33'	4	2800	
Augers - 7" 44'	12	1800	
Chaser Bin - 8t	4	8000	
Truck - Inter Acco 1830	15	15000	
Grouper	15	7500	
Air Seeder - Commor Shea	12	15000	
Chiesel plough - Shearer 25'	5	20000	
4WD Motor Bike	2	6	
Motor Bike	2	1000	
Mulcher - Melway	8	10000	
Ripper - Agro plough 19 type	8	10000	
Discs - grizzly 21	4	20000	
Lister / fertiliser - Twin Rivers	2	25000	
Tanks		8000	
Cultivator - toolbar - 8m	5	8000	
Boom Spray - Hardi	10	3500	
Planter - 8 row JD	2	30000	
Bed Shaper		5000	
Cultivator - Rolling 8 row	1	25000	
Rotabuck	5	2000	
Syphons (2800)		10000	
Grader Board - KB		10000	
Ute - Cruiser	2	30000	
Hilux	1	25000	
Hilux	7	6000	
Commodore	2	20000	
STRUCTURES			
Workshop Sundries		25000	
		717606	

Livestock	Number	Value/hd	
Rams -	75	$100	7500
Ewes -	3000	$30	90000
Bulls -	1	$1,000	1000
Cows -	50	$450	22500

Liquid assets such as
Bank Deposits - Off farm house 150,000 plus super
Shares / Equity 50000

LIABILITIES		Rate	Term
OD Bank	150000	11.50%	1
HP / Lease	300000	8%	5
Mortgage	300000	9.70%	15
Crop Terms	200000	8%	
		10.5%	
		9.5%	
		8.5%	

Drawings - 2 families - $ 45 K
Developing - $ 100 - 450 K

1.6 – Zone 5 Farm

Summer Crops - 25 Farmers

Zone 5 - 15 farmers

Zone 3 - 10 farmers

1. Physical farm characteristics

Farm areas			
Total farm area	Ha	2000	range 600-5000
Area set up for irrigation	Ha	750	range 320-1900 / developing on average 10 ha/pa
Area normally irrigated	Ha	350	plus Pasture if water available
Dryland area	Ha	1750	
Beef cattle number	no.	150	150 Angus Cows & 4 Bulls
Sheep number	no.	1700	link to LSM ? M.Ewes 900 ha (including non-arable 300)
Water supplies			
Regulated water			
- irrigation entitlement	ML	1400	range 800-2600
- access to off allocation	ML	0	0%
Unregulated water			
- licenced area	Ha		
Groundwater supplies			
- irrigation entitlement	ML		
Closest rainfall site	location	Jemalong Weir	
		or ?	Condobolin
Farm labour			
- owner/manager	no. of weeks	50	
- family	no. of weeks		
- permanent labour	no. of weeks	48	
- casual	no. of weeks	10	

Farm "plan" showing rotation

	normally irrigat	setup for irrigation	dryland 1200 ha		non arable
	350 ha	400 ha			50 ha
150.0	W - 50 ha	W - 50 ha	O - 100 ha	W	W
210.0	C	W			
200.0	AP (seed;hay;	C	C	B	C
	M	PP-Luc/Medic			
800.0	M	PP-Luc/Medic	AP	AP	F
	PP-Luc/Medic	AP-Sub			Spray AP
270.0	PP-Luc/Medic	AP-Sub	AP	AP	AP
		devt			

1630.0 Total water use

Dryland Rotation:

C(200ha)-W(100ha)- B(100ha) and W(200ha) undersown to AP(3 yrs)

AP = lucerne with annual pasture

oats not undersown - more likely wheat - more like 50 Ha specialty pdk

- grazed & stripped

2. Irrigation characteristics

		Area	Irrigation eff
Irrigation by layout and method		Ha	%
- land formed - flood (LFF)		500	80
- land formed - spray (LFS)			
- non landformed - flood (NLFF)		250	65
- non landformed - spray (NLFS)			
- other			
Irrigation infra-structure			
River pump details			
- capacity	Ml/hour		
- running cost	$/hour		
Ground water pump details			
- capacity	Ml/hour		
- running cost	$/hour		
On-farm storage			
- surface area	square metres		
- depth	metres		
On-farm recycling system	Y/N		
Scheme details			
- name	name	JID	
- usage charge	$/ML		
- fixed charge	$		

Water resource cost			Govt usage	JIL useage	Govt Fixded	JIL Fixed	
- regulated supplies	$/ML	10.57	3.80	6.77	3.07	6.50	
- unregulated supplies	$/ML		4.62	5.95	3.09	6.50	from JIL Feb 2001
- groundwater supplies	$/ML						

Note : Water Use from model given below is for 97 year average monthly rainfall data and therefore all Gross Margin figures here are based on these average data.

3. Irrigated enterprises

		Area	expected wate	water use from	Pump/Delivery	Yield	Price	V.Costs	Gross Margin	Total GM
		Ha	use Ml/ha	model Ml/ha	Cost $/Ml	tonnes/ha	$/tonne	$/ha	$/ha	
Winter crops										
- Short Fallow - Wheat										$0
- Long Fallow - Wheat		50	3.0	2.9	10.57	5.0	140.00	$439.40	$260.60	$13,030
- Barley										$0
- Oats										$0
- Canola		50	4.2	2.8	10.57	2.4	300.00	$394.49	$325.51	$16,275
- Chickpeas										$0
- Fababeans										$0
- Lupins										$0
										$0
Summer crops										$0
- Cotton										$0
- Sorghum										$0
- Rice										$0
- Soybeans										$0
- Maize		100	8.0	7.8	10.57	10.0	160.00	$895.62	$704.38	$70,438
- Sunflowers										$0
										$0
Pasture	(LSM's/ha or an indication of stocking rate)									$0
- Lucerne hay										
- Lucerne / Medic Pasture	PP - L / M	100	2.7	1.8	10.57	link Cattle & sheep budgets - 50% each		$696.17	$99.18	$9,918
- Spring	2.4 t/ha hay									$0
- Summer	3 dse / 6 months									$0
- Autumn										$0
- Winter										$0
- Annual pasture (sub clover)	AP - HW	50	4.0	2.5	10.57	link Cattle Budgets		$473.81	$103.99	$5,200
- Spring	HW-500 kg/ha @ $3.20									$0
- Summer	L- 500-750 kg/ha									$0
- Autumn	Feb-Aug 5dse/ha									$0
- Winter										$0
- Other crops										$0
Total Water Use (ML)		350 Ha	1630.0 ML	1372.6 ML						
Irrigated Gross Margin										$114,861

1.6 – Zone 5 Farm *Continued*

4. Dryland enterprises

			Area	Yield	V.Costs	Gross Margin	Total GM
Winter crops							$0
- Short Fallow - Wheat							$0
- Long Fallow - Wheat		undersowing cost to sheep		300	2.0 $231.11	$58.89	$17,666
- Barley				100	1.8 $145.13	$70.87	$7,087
- Oats				100	1.8 On farm Use - cost $205/ha transferred to c		
- Canola				250	1.0 $238.69	$81.31	$20,329
- Chickpeas							$0
- Fababeans							$0
- Lupins							$0
							$0
Summer crops							$0
- Cotton							$0
- Sorghum							$0
- Soybeans							$0
- Maize							$0
- Sunflowers							$0
							$0
Pasture	(LSM's/ha or an indication of stocking rate)						$0
- Lucerne hay -establishment							$0
- Perennial pasture							$0
- Spring							$0
- Summer							$0
- Autumn							$0
- Winter							$0
- Annual pasture (sub clover)	4 dse / ha	Only establishment costs - undersowing + fe		600	link Sheep Budgets		$0
sub pasture (on land laid out for irrigation)		no maintenance cost		100	link Sheep Budgets		$0
legume pasture (lucerne + medic)				100	link Sheep Budgets		$0
- Autumn							$0
- Winter							$0
- Other crops - Fallow				100			$0
- being developed / non-arable				100			
Dryland Gross Margin				1750	Ha		$45,082

5. Overhead cost structure

Administration expenses			
- accounting	1400		
- bank charges	1800		
- insurance (farm & Vehicles)	2100		
- super & workers compensation	4564	15%	
- telephone	800	of wages	
- stationary	550		
Labour (permanent & casual)	30425	Rural Tradesperson	
Fuel and oil (farm vehicles)	2800		
Electricity (not including pumping costs)	1200		
Repairs and maintenance			
- plant and equipment	2800		
- structures	4000	24500	
Depreciation		RATE:	
- plant and equipment	39780	6.8%	
Landforming - 25ha @ $490	12250		
Rates			
- Stocking charges (PPB)	300		
- Land	1230	4.16 / ha	
- Water	13398		
Other operating overheads - (Rego & License)	800		
Total operating overheads	$ 120,197		

500 ha lasered @ $2500/ha
500 ha irrigable @ $1000/ha
1500 ha dryland @ $600/ha

ASSETS	Age	Current Value	Expected Life
Farm		2650000	
PLANT :			
J.D. Tractor on HP - 300s	2	110000	
Header on Lease - NHTR 87	3	150000	
Air seeder on HP	2	80000	
Gestner Tool Bar & Tools		20000	
Planter - JD, Kinze		10000	
Gas gear on Lister rig		16000	
Rotabuck - countrywide		6000	
Grissly off sets 64 disc		22000	
Harrows 12 m		2000	
Slasher		1000	
Ford 5000 c Front loader		12000	
Case 120 Hp	5	50000	
Chaser Bin		20000	
Field Bins x 2		6000	
Augers x 2 (45' x 30')		8000	
4 W Bike	2	5000	
4 WD Ute	2	15000	
4 WD Ute	5	8000	
Lift pump x 2		12000	
Truck - Inter -unreg		5000	
Grouper		12000	
STRUCTURES			
Sundries		15000	
		585000	

6. Profit and Financial analysis

OTHER FARM INCOME (eg timber)	$ -		
TOTAL FARM GROSS MARGIN	$ 159,943		
TOTAL OPERATING OVERHEADS	$ 120,197		
NET FARM INCOME	$ 39,747		
Less operators labour	$ 24,000		
OPERATING RETURN (A)	$ 15,747		
Less		P component	
- OD interest paid	$ 5,250		
- HP / Lease interest paid	$ 11,400	$19,852	
- Term Loan interest	$ 15,300	$6,376	
BUSINESS RETURN (B)	$ (3,953)		
TOTAL ASSETS (C)			
- liquid assets	$ 145,000		
- value of land and improvements	$ 2,660,000		
- value of plant and equipment	$ 585,000		
- value of sheep	$ 56,000		
- value of cattle	$ 71,500		
Sub Total	$ 3,507,500		
TOTAL LIABILITIES	$ 450,000		
EQUITY (D)	$ 3,057,500		
EQUITY RATIO D/C X 100	87.2%	85	
RETURN ON TOTAL ASSETS (A) / (C) x 100	0.4%		
RETURN ON EQUITY (B) / (D) x 100	-0.1%		
OFF-FARM INCOME	$ 15,000		
Approx. Taxable Farm Profit or Loss	$ 20,047		
NET CASH RESULT (after tax)	$ 32,339		
DECISION TREES :-			

Livestock	Number	Value/hd	
Rams -	50	$100	5000
Ewes -	1700	$30	51000
Bulls -	4	$1,000	4000
Cows -	150	$450	67500

Liquid assets such as
Bank Deposits - Off farm investment 25,000 super
Shares / Equity / house 120,000

LIABILITIES		Rate	Term
OD Bank	150,000	10.5%	1
HP / Lease	120,000	9.5%	5
Mortgage / Term Loan	180,000	8.5%	15

$ 50 K Drawings
permanent labour $ 28 - 30 K / pa
casual 11.80 / hr
earthworks maintenance $ 10 K
lasering 50 ha @ 490 / ha

Appendix 2: Data used in the hydrology calculations

Hydrology - Lachlan Valley

Zone 4-1 Hillston

Irrigation Water Requirement By Crop and Livestock (ML/ha)

Month	Rainfall mm	Riverflow	Farmstorage	Groundwate Total Water Available	Asparagus	Tomatoes	Sweet corn	Oats	Wheat	Cotton conventional	Cotton GM - Spray	Maize Flood	Maize Spray	Lucerne hay	Lucerne pasture	Perennial pasture	Sub-clover	Livestock 1	Livestock 2	Livestock 3
July	31.3				0	0	0	0	0.824	0	0	0	0	0	0	0	0			
August	30.5				0	0	0	0.129	0.420	0	0	0	0	0	0	0	0			
September	26.3				0	0	0	0.535	1.007	0	0	0	0	0	0.382	0	0			
October	35.9				0	0	0	0.638	1.186	0.161	0.143	0	0	0.626	1.398	0.345	0			
November	28.8				0	0.35	0.322	0.084	0.480	1.130	1.004	0.855	0.760	0.547	1.180	0.297	0			
December	30.5				0.755	1.62	1.392	0	0	2.472	2.197	2.134	1.897	1.167	1.859	0.786	0			
January	30.9				0.954	2.01	1.907	0	0	3.007	2.673	2.919	2.595	1.182	1.932	0.794	0			
February	26.3				0.933	1.03	1.296	0	0	2.699	2.399	2.061	1.832	0.871	1.461	0.583	0.558			
March	31.3				0.496	0	0	0	0	1.469	1.323	0	0	0.796	1.389	0.490	0.796			
April	27.1				0	0	0	0	0	0.313	0.278	0	0	0	0	0	0.000			
May	31.2				0	0	0	0	0	0	0	0	0	0	0	0	0			
June	32.8				0	0	0	0	0	0	0	0	0	0	0	0	0			
Allocation	70%				3.178	5.004	4.916	1.386	3.117	11.269	10.017	7.969	7.084	5.188	9.601	3.294	1.354	0	0	0

Hydrology model inputs - Note : given below is 97 year average monthly rainfall data and therefore hydrology calculations on this page are based on these average data

	Jan alloc	Irrigation Diversions (ML) Zone 1	Zone 2	Zone 3	Zone 4	Rainfall Jemalong	Cowra Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Aug alloc	Forbes Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Aug alloc	Lake Cargelligo Jan	Feb
Year t hydrolo	69.6%	29869	19276	39191	97546	64265	59.1	44.6	49.5	45.2	49.4	60.8	52.3	50.9	51.7	57.1	51.8	57.2	58.9	44.7	49.0	43.7	48.7	50.3	69.6%	51.9	42.5	44.8	39.9	43.0	43.1	45.3	43.2	41.3	50.2	42.1	45.8	51.6	42.8	44.0	39.3	42.3	42.9	69.6%	39.7	34.2

Rainfall (ML/ha)

Month	Effective rainfall	Rainfall 25% Percentile Cowra	Forbes	Lake C.	Hillston	Effective Expected Rainfall Zone 1	Zone 2	Zone 3	Zone 4	Jemalong	Effective Actual Rainfall Zone 1	Zone 2	Zone 3	Zone 4	Jemalong
July	80%	26.25	23	14.5	13	0.210	0.184	0.116	0.104	0.116	0.418	0.362	0.289	0.251	0.289
August	80%	32.25	25.5	19.5	15.25	0.258	0.204	0.156	0.122	0.155	0.407	0.346	0.266	0.244	0.266
September	70%	26	17.5	16	13.25	0.182	0.123	0.105	0.093	0.105	0.362	0.289	0.217	0.184	0.217
October	70%	29	23.25	16	13.25	0.203	0.163	0.105	0.093	0.105	0.399	0.351	0.287	0.252	0.287
November	70%	22	13.25	8	6	0.154	0.093	0.056	0.042	0.056	0.363	0.295	0.233	0.186	0.233
December	50%	21	15.25	11	8	0.105	0.076	0.055	0.040	0.055	0.286	0.229	0.186	0.152	0.186
January	50%	25.25	20	9	7	0.126	0.100	0.045	0.035	0.045	0.295	0.258	0.199	0.155	0.199
February	50%	12	11	6	3	0.060	0.055	0.030	0.015	0.030	0.224	0.214	0.172	0.131	0.172
March	70%	14	13	5.25	5	0.098	0.091	0.037	0.035	0.037	0.343	0.308	0.256	0.219	0.256
April	70%	15	14	8.25	6	0.105	0.098	0.058	0.042	0.058	0.306	0.275	0.223	0.190	0.223
May	70%	23	18	14.25	12	0.161	0.126	0.100	0.084	0.100	0.341	0.296	0.263	0.219	0.263
June	80%	25	24	16.25	13.25	0.200	0.192	0.130	0.106	0.130	0.402	0.343	0.299	0.263	0.299
Total						1.862	1.504	0.992	0.811	0.992	4.146	3.566	2.890	2.445	2.890

Irrigation Efficiency

	Light	Heavy
NLF	70%	65%
LF	80%	80%
Spray	90%	75%
Trickle	90%	90%

Crop Evapo-transpiration requirements (ML/ha)

Zone 1

Month	Asparagus	Tomatoes	Sweet corn	Oats	Wine-grapes	Wheat	Canola	Maize	Lucerne seed	Lucerne hay	Lucerne pasture	Perennial pasture	Sub-clover
July				0.5		0.25	0.2						
August				0.67		0.51	0.46						
September				0.8		0.79	0.79		0.44	0.33	0.33	0.248	
October				0.4	0.42	0.91	1.04		0.93	0.9	0.9	0.675	
November		0.64	0.62	0.8	0.79	0.43	0.26	0.62	1.52	0.8	0.8	0.600	
December	0.89	1.58	1.4		1.05			1.4	1.45	1.22	1.22	0.915	
January	1.09	1.9	1.82		1.09			1.82	1.49	1.24	1.24	0.930	
February	0.97	1.06	1.26		0.95			1.26	1.4	0.92	0.92	0.690	0.67
March	0.74				0.74				1.21	0.98	0.98	0.735	0.98
April					0.42								0.27
May				0.11	0.18	0.04	0.04						
June				0.26		0.11	0.13						
Total	3.69	5.17	5.1	3.54	5.64	3.04	2.92	5.1	8.44	6.39	6.39	4.7925	1.92

Zone 2

Month	Apples	Wheat	Canola	Maize	Lucerne seed	Lucerne hay	Lucerne pasture	Perennial pasture	Sub-clover
July		0.25	0.2						
August		0.51	0.46						
September		0.79	0.79		0.52	0.52	0.39	0.293	
October	0.54	0.91	1.04		1.05	1.05	1.03	0.773	
November	1.21	0.43	0.26	0.68	1.67	1.67	0.88	0.660	
December	2.12			1.69	1.76	1.76	1.49	1.118	
January	2.39			2.23	1.81	1.81	1.53	1.148	
February	2.21			1.63	1.82	1.82	1.19	0.893	0.88
March	1.59				1.55	1.55	1.26	0.945	1.26
April	0.89								0.35
May		0.04	0.04						
June		0.11	0.13						
Total	10.95	3.04	2.92	6.23	10.18	10.18	7.77	5.8275	2.49

Zone 3

Month	Wheat	Canola	Maize	Lucerne hay	Lucerne pasture	Perennial pasture	Sub-clover
July	0.27	0.22					
August	0.58	0.53					
September	0.99	0.99		0.65	0.49	0.368	
October	1.2	1.38		1.39	1.37	1.028	
November	0.57	0.35	0.87	2.15	1.13	0.848	
December			1.86	1.93	1.64	1.230	
January			2.49	2.03	1.7	1.275	
February			1.78	1.98	1.3	0.975	0.96
March				1.69	1.33	0.998	1.38
April							0.35
May	0.04	0.04					
June	0.11	0.13					
Total	3.76	3.64	7	11.82	8.96	6.72	2.69

Zone 4

Month	Wheat	Canola	Cotton	Maize	Sorghum	Lucerne hay	Lucerne pasture	Perennial pasture	Sub-clover
July	0.27	0.22							
August	0.58	0.53							
September	0.99	0.99				0.65	0.49	0.368	
October	1.2	1.38	0.380		0.6	1.39	1.37	1.028	
November	0.57	0.35	1.090	0.67	1.23	2.15	1.13	0.848	
December			2.130	1.85	1.14	1.93	1.64	1.230	
January			2.560	2.49	1.22	2.03	1.7	1.275	
February			2.290	1.78	1.44	1.98	1.3	0.975	0.96
March			1.410			1.69	1.33	0.998	1.38
April			0.440						0.35
May	0.04	0.04							
June	0.11	0.13							
Total	3.76	3.64	10.3	7	5.63	11.82	8.96	6.72	2.69

Zone 5 - Jemalong

Month	Wheat	Canola	Maize	Lucerne seed	Lucerne hay	Lucerne pasture	Perennial pasture	Sub-clover
July	0.27	0.22						
August	0.58	0.53						
September	0.99	0.99		0.65	0.65	0.49	0.368	
October	1.2	1.38		1.39	1.39	1.37	1.028	
November	0.57	0.35	0.87	2.15	2.15	1.13	0.848	
December			1.86	1.93	1.93	1.64	1.230	
January			2.49	2.03	2.03	1.7	1.275	
February			1.78	1.98	1.98	1.3	0.975	0.96
March				1.69	1.69	1.33	0.998	1.38
April								0.35
May	0.04	0.04						
June	0.11	0.13						
Total	3.76	3.64	7	11.82	11.82	8.96	6.72	2.69

Appendix 3: Hydrology Data from DLWC's IQQM Model

August and January Simulated Allocation Percentages (* indicates where total off-allocations from August to January added)

	C 71 Base Case		E 98 Rules		E 113 Rules		E 112 Rules		E 91 Rules		E 116 Rules		C 71A Base Case		E 73A Rules		E 131 Rules	
	August	January	August	January	August	January	August	January	August	January	August	January	August	January *	August	January *	August	January
	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc
Year	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1901	120	119	100	100	100	100	100	100	100	100	100	100	120	127	100	104	100	100
1902	63	115	70	80	64	76	64	77	68	78	61	76	67	120	67	80	59	68
1903	5	4	0	0	0	0	0	0	0	0	0	0	5	7	0	2	0	0
1904	5	53	6	27	7	29	12	33	2	25	0	21	7	59	1	25	2	25
1905	24	29	18	18	18	18	21	21	17	17	18	18	26	31	18	19	17	17
1906	35	50	25	29	26	29	24	27	25	29	25	27	40	61	25	31	33	37
1907	13	100	6	61	5	61	6	62	4	61	4	61	13	106	5	64	6	63
1908	29	35	22	21	22	21	21	21	23	22	23	22	28	38	25	28	22	22
1909	4	35	7	22	10	25	10	25	8	22	10	25	4	38	10	26	6	21
1910	35	70	22	34	20	31	22	34	21	33	22	34	33	72	21	35	24	38
1911	41	66	32	36	31	35	30	34	29	33	28	33	42	73	28	35	30	34
1912	58	100	47	59	46	56	46	56	47	58	47	59	60	106	46	62	47	59
1913	47	109	34	57	33	55	33	55	33	57	33	57	49	115	35	59	31	56
1914	50	50	18	18	18	18	17	17	18	18	17	17	55	58	16	18	16	16
1915	20	19	23	22	22	21	22	21	23	22	23	22	20	22	24	26	23	23
1916	45	85	31	51	32	53	32	52	32	52	32	52	45	99	31	56	34	54
1917	90	119	55	100	54	100	55	100	56	100	55	100	92	136	54	105	57	100
1918	120	119	100	100	100	100	100	100	100	100	100	100	120	124	100	104	100	100
1919	109	119	100	100	100	100	98	100	100	100	98	100	111	126	100	100	100	100
1920	20	19	8	7	2	1	0	0	6	5	0	0	20	23	7	10	0	0
1921	2	50	2	33	2	31	1	30	2	33	1	30	3	60	2	37	2	33
1922	68	103	64	86	61	83	60	80	64	85	59	80	72	113	66	92	65	86
1923	66	98	48	55	49	57	49	55	49	55	46	53	70	118	49	60	44	53
1924	77	119	58	100	58	100	56	100	57	100	55	100	82	124	54	103	54	100
1925	65	119	78	97	73	93	69	93	75	88	69	93	70	126	78	98	68	79
1926	120	119	100	100	100	100	100	100	100	100	100	100	120	132	100	104	100	100
1927	120	119	100	100	100	100	100	100	100	100	100	100	120	125	100	103	100	100
1928	40	45	50	50	45	45	45	45	50	50	42	42	45	49	49	52	45	45
1929	120	119	100	100	100	100	100	100	100	100	100	100	120	125	100	102	100	100
1930	30	29	15	14	12	11	12	11	13	12	11	10	30	32	9	11	6	6
1931	1	53	0	25	0	28	2	31	0	18	0	27	0	66	0	31	0	21
1932	120	119	100	100	100	100	100	100	100	100	100	100	120	124	100	103	100	100
1933	114	119	100	100	100	100	100	100	100	100	100	100	115	127	100	103	100	100
1934	48	78	31	35	28	31	22	25	31	35	20	22	53	93	32	39	27	31
1935	50	119	39	100	39	100	38	100	39	100	38	100	55	127	37	104	38	100
1936	106	119	91	93	92	93	88	90	82	85	88	90	110	125	91	98	79	82
1937	117	119	73	82	74	80	73	79	68	74	72	77	118	126	76	88	64	74
1938	30	39	0	0	0	0	0	0	0	0	0	0	35	42	0	2	0	0
1939	1	35	0	22	0	21	0	23	0	21	0	21	1	39	1	24	0	18
1940	11	70	13	42	13	42	14	42	13	42	13	42	13	81	14	46	12	43
1941	5	4	4	3	5	4	5	4	5	4	7	6	5	12	10	11	6	6
1942	0	0	8	7	8	7	9	9	9	9	12	11	0	3	13	16	8	8
1943	5	63	18	42	19	45	17	43	18	40	18	45	6	83	20	51	23	48
1944	120	119	100	100	100	100	100	100	100	100	100	100	120	128	100	103	100	100
1945	50	50	53	52	50	50	49	48	51	50	45	45	55	58	55	57	52	52
1946	4	20	0	0	0	0	0	0	0	1	0	1	2	24	0	3	0	0
1947	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	0	0
1948	0	41	0	42	0	45	0	44	0	42	0	47	0	43	0	47	0	42
1949	77	113	96	100	93	100	94	100	93	100	93	97	76	119	97	103	95	100
1950	50	119	45	100	43	100	43	100	45	97	41	99	50	131	50	104	44	98

Appendix 3 - Hydrology Data Continued

	C 71 Base Case		E 98 Rules		E 113 Rules		E 112 Rules		E 91 Rules		E 116 Rules		C 71A Base Case		E 73A Rules		E 131 Rules	
	August	January	August	January	August	January	August	January	August	January	August	January	August	January *	August	January *	August	January
	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc	alloc
Year	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
1951	120	119	100	100	100	100	100	100	100	100	100	100	120	136	100	105	100	100
1952	120	119	100	100	100	100	100	100	100	100	100	100	120	138	100	105	100	100
1953	120	119	100	100	100	100	100	100	100	100	100	100	120	126	100	103	100	100
1954	104	119	100	100	100	100	100	100	100	100	100	100	104	124	100	101	100	100
1955	50	70	54	53	49	48	47	46	49	48	45	45	55	85	57	60	48	48
1956	81	119	67	100	66	100	67	100	56	100	65	100	82	132	66	104	56	100
1957	120	119	100	100	100	100	100	100	100	100	100	100	120	127	100	103	100	100
1958	70	70	85	85	78	77	73	72	81	80	73	72	75	79	82	85	76	76
1959	13	113	12	59	9	62	8	62	13	61	7	62	12	127	12	71	7	57
1960	120	119	100	100	100	100	100	100	100	100	100	100	120	140	100	105	100	100
1961	118	119	100	100	100	100	100	100	100	100	100	100	118	132	100	104	100	100
1962	116	119	100	100	100	100	100	100	100	100	100	100	116	131	100	104	100	100
1963	116	119	100	100	100	100	100	100	100	100	100	100	120	135	100	104	100	100
1964	120	119	100	100	100	100	100	100	100	100	100	100	120	131	100	104	100	100
1965	120	119	100	100	100	100	100	100	100	100	100	100	120	125	100	102	100	100
1966	45	54	54	53	47	46	48	47	50	50	45	45	45	60	52	55	47	47
1967	0	108	1	76	0	75	1	79	0	65	0	74	0	115	0	79	0	64
1968	49	70	52	59	50	57	52	61	43	52	47	55	54	75	52	62	44	53
1969	59	108	50	68	50	69	49	68	49	68	51	69	64	126	48	70	57	74
1970	120	119	100	100	100	100	100	100	100	100	98	100	120	133	93	104	100	100
1971	100	119	100	100	100	100	97	100	100	100	97	100	100	126	100	102	100	100
1972	109	119	100	100	100	100	100	100	100	100	100	100	109	128	100	103	100	100
1973	105	105	100	100	100	100	100	100	100	100	100	100	105	114	100	104	100	100
1974	49	119	52	100	47	100	44	100	49	100	44	100	54	127	52	104	48	100
1975	120	119	100	100	100	100	100	100	100	100	100	100	120	130	100	104	100	100
1976	120	119	100	100	100	100	100	100	100	100	100	100	120	128	100	103	100	100
1977	120	119	100	100	100	100	100	100	100	100	100	100	120	127	100	104	100	100
1978	109	119	100	100	100	100	100	100	100	100	100	100	112	130	100	104	100	100
1979	120	119	100	100	100	100	100	100	100	100	100	100	120	126	100	103	100	100
1980	70	70	80	79	74	74	70	70	80	79	70	70	75	81	79	80	73	73
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
1982	2	30	6	23	4	21	4	21	6	23	4	21	3	43	7	26	6	21
1983	0	0	2	1	3	2	3	2	2	1	2	1	0	2	4	6	0	0
1984	0	26	0	22	0	31	0	31	0	18	0	32	0	36	0	34	0	15
1985	109	119	100	100	100	100	100	100	100	100	100	100	109	125	100	104	100	100
1986	56	119	65	93	60	91	60	84	66	93	57	85	61	130	65	91	59	85
1987	53	119	36	100	35	100	31	100	36	100	32	100	55	126	33	104	29	100
1988	89	119	69	79	64	74	67	77	65	76	63	74	92	129	68	85	70	83
1989	87	119	31	88	30	86	32	87	32	89	31	86	88	125	32	89	32	90
1990	120	119	100	100	100	100	100	100	100	100	100	100	120	128	100	104	100	100
1991	120	119	100	100	100	100	100	100	100	100	100	100	120	131	100	104	100	100
1992	86	119	87	100	81	100	81	100	84	100	79	100	86	130	83	104	76	100
1993	113	119	93	100	84	100	83	100	88	100	82	100	113	129	85	104	79	100
1994	118	119	100	100	100	100	100	100	100	100	100	100	118	127	100	103	100	100
1995	80	79	91	91	84	84	81	80	89	88	81	80	80	89	89	93	85	85
1996	52	119	41	99	37	95	36	95	39	98	36	93	55	134	40	103	38	99
1997	101	119	71	100	67	100	68	100	69	100	64	100	108	125	74	103	74	100
Mean	67.4%	**88.3%**	57.8%	**69.6%**	56.6%	**68.9%**	56.3%	**68.8%**	56.9%	**68.7%**	55.7%	**68.3%**	68.8%	**97.0%**	57.6%	**73.1%**	56.1%	**68.3%**
Std dev	45%	40%	39%	36%	39%	36%	39%	36%	39%	36%	39%	36%	45%	42%	39%	36%	39%	36%

Appendix 4: Results of LRMC's E98 and E116 (previous) flow rules analysis

	C 71 Base Case average January allocation 88.3 %		E 98 Rules average January allocation 69.6 %				E 116 Rules average January allocation 68.3%			
	Mean ($)	SD ($)	Mean ($)	SD ($)	Impact ($)	Impact %	Mean ($)	SD ($)	Impact ($)	Impact %
Zone 1 Farm										
Gross Margin	86,890	13,355	83,946	15,257	-2,944	-3.4	83,589	15,480	-3,301	-3.8
Net Farm Income	32,445	13,355	29,501	15,257	-2,944	-9.1	29,143	15,480	-3,301	-10.2
Zone 2 Farm										
Gross Margin	158,070	15,092	152,786	14,731	-5,284	-3.3	152,302	14,772	-5,768	-3.6
Net Farm Income	58,917	15,092	53,633	14,731	-5,284	-9.0	53,149	14,772	-5,768	-9.8
Zone 3 Small Farm										
Gross Margin	109,854	8,127	106,895	7,155	-2,959	-2.7	106,580	7,232	-3,274	-3.0
Net Farm Income	49,601	8,127	46,642	7,155	-2,959	-6.0	46,327	7,232	-3,274	-6.6
Zone 3 Large Farm										
Gross Margin	228,794	10,242	225,915	10,580	-2,879	-1.3	225,901	10,772	-2,893	-1.3
Net Farm Income	88,165	10,242	85,286	10,580	-2,879	-3.3	85,272	10,772	-2,893	-3.3
Zone 4 Farm										
Gross Margin	429,397	27,751	421,298	30,824	-8,098	-1.9	421,036	31,407	-8,361	-1.9
Net Farm Income	224,451	27,751	216,353	30,824	-8,098	-3.6	216,090	31,407	-8,361	-3.7
Zone 5 Farm										
Gross Margin	147,009	25,319	140,568	29,766	-6,440	-4.4	139,734	29,865	-7,274	-4.9
Net Farm Income	26,812	25,319	20,372	29,766	-6,440	-24.0	19,538	29,865	-7,274	-27.1

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