Technical Report

Investigations and Monitoring Group

Economic Impact Analysis of options for the flow regime and allocation of water from the Hurunui River

Environment Canterbury

Your regional council

Economic Impact Analysis of options for the flow regime and allocation of water from the Hurunui River

Report No. U04/85

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Prepared For: Environment Canterbury

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Executive Summary

Background

Environment Canterbury (ECan) are in the process of identifying the most effective management regime for protecting the instream values of the Hurunui River while providing for the present and future needs of people for water in the Hurunui Catchment.
ECan wished to:

- explore the economic effects of the proposed regime to better protect Hurunui River instream values on existing users of Hurunui water;
- explore the economic effects of increasing the "A" permit allocation from 7.5 cumecs to 10 cumecs, both under the existing and Mosley regime, having regard to the costs and benefits to present and potential irrigators and to the region and nation;
- explore in a general sense, the economic feasibility of providing storage to increase reliability of supply.

This documents reports the results of analysis of reliability of supply under two river flow regimes, the existing and that proposed by Dr Mosley at two different A permit allocations, 7.5 and 10 cumecs. It reports the impact on individual land uses and the District / Region as a whole.

The impacts are on three sets of irrigators, those existing irrigators that extract water from the main stem of the Hurunui River (Existing others), those that have water supplied to them through the Balmoral Irrigation Scheme (BIS) and those that could take advantage of new irrigation capability under an expanded allocation block (New irrigators) .

Irrigation Reliability

Three different measures of reliability were analysed.

1. The frequency of events occurring and the average duration of each event.
   The frequency data is reported in whole numbers (1) or as decimals (0.1 or 0.01). Whole numbers report the number of times that an event will occur in a single year (2 means twice a year), single point decimal numbers represent the number of years out of ten in which an event will occur (0.6 means six years out of ten), double point decimal numbers represent the number of years out of one hundred in which the event will occur (0.03 means three years out of one hundred, or once in 33 years). It should be noted that the occurrence figures have been rounded to the nearest figure for presentation. Average duration reports the average length of restrictions of consecutive days.

2. The severity of partial restrictions expressed as a % of full flow. The percentage reported in the proportion of full flow available for use on average.

3. The incidence of restriction free years and the total days lost in the worst year as an indication of the variability between years.

These are reported in Summary Table 1.

Summary Table 1: Irrigation Reliability Description

Reliability Analysis			Existing		Balmoral	Mosley	
		Periods	**7.5**	**10**		**7.5**	**10**
Full Restrictions	Frequency	2 – 15	0	0	0.1	0.2	0.2
		15 – 30	0	0	0.03	0.1	0.1
		>30	0	0	0	0.03	0.03
	Duration (No of days)	2 – 15	0	0	9	4	4
		15 – 30	0	0	21	26	26
		>30	0	0	0	46	46
Partial Restrictions	Frequency	2 – 15	2	3	0.5	2	2
		15 – 30	0.3	0.5	0.06	0.3	0.5
		>30	0.1	0.3	0	0	0
	Duration (No of days)	2 – 15	7	7	6	5	5
		15 – 30	22	20	22	20	21
		>30	43	42	0	0	0
Partial Severity			65%	62%	42%	44%	49%
Full Restrictions	Years with Nil Events (31 years Total)		31	31	27	23	23
Total days lost in worst year. (not consecutive)			0	0	21	46	46
Partial Restrictions	Years with Nil Events (31 years Total)		18	1	16	3	1
Total days lost in worst year. (not consecutive)			89	113	27	53	66

Conclusions that can be drawn from the reliability modelling are:

- All options offer inferior reliability to the BIS irrigators with increased incidence of both full and partial restrictions.
- Existing other irrigators suffer a greater reduction in reliability at the Existing 10 scenario but little change through moving to either of the Mosley regimes. The Mosley regimes increase the incidence of full restrictions but reduce the frequency and duration of partial restrictions for these irrigators.
- The Mosley scenarios are only marginally different in terms of reliability between the 7.5 and 10 cumec options.

Economic Impacts

The conclusions that can be made from the economic impact analysis are:

- None of the economic impacts are sufficient to influence or change land use choice.
- The existing other irrigators show very little variance in financial performance between scenarios. On a whole farm basis they are worse off under Existing 10 but achieve very similar results to present under either the Mosley regimes.
- The financial impact on the BIS irrigators is magnified due to their delivery and application systems. Existing 10 has the greatest negative impact on financial performance while the two Mosley scenarios have similar impacts with Mosley 7.5 being the preferred of the two.

- At a District or Regional level the majority of the negative impacts are felt by the Balmoral irrigators but the increased surplus from new irrigators could lift the total net Cash Farm Surplus from $9.9 m at present to $13.08 or $13.80 under the two 10 cumec “A” permit options, an increase of $3.15 and $3.87m respectively. Therefore from a District / Regional perspective the Mosley 10 regime is the most attractive.

Storage Cost / Benefit

The costs involved in providing storage under an A permit block of 10 cumecs are not matched by the benefits gained on farm. The net return to storage ranges from -$3.4m to -$11m depending on the dam cost adopted. This is because the benefits are only marginal in terms of improving output from already irrigated properties while the cost is significant. The gap between costs and benefits is too large to indicate that sensitivity analysis would improve the situation.

The costs involved in providing storage under a B permit block of 11.3 cumecs are matched by the benefits gained on farm at the lower end of the range of dam costs modelled but are negative for the higher cost options (-$1.5m and -$13.7m respectively). Even when positive the net benefit is only marginal and probably not sufficient to make the proposition attractive for investment. However sensitivity analysis around the key variables of dam cost, secondary distribution system cost and land use returns may find a position where the investment was more attractive.

The preceding results would indicate that combing the two storage requirements would not provide a positive cost benefit because of the large negative return from the A storage proposition. The negative return is greater than the positive achieved at the lower end of the B storage cost options. However, there may be merit in combing the two storage facilities if significant economies of scale can be achieved in dam construction costs and the BIS distribution system can be used to deliver the water at a much lower capital cost than that modelled. If these two conditions can be achieved, the option merits further investigation.

Summary

The proposed flow regimes have an unequal spread of impacts between existing and new irrigators with differing preferences according to the perspective of the parties affected.

The BIS scheme irrigators are worse off than at present in all scenarios with the least impact being from Mosley 7.5.

The existing other irrigators have little change in overall reliability and economic impact under either of the Mosley regimes therefore should have little preference between them.

The addition of new irrigation capability under the expanded 10 cumec options mean that the net impact of new output would be a positive increase in total economic activity from a District and Regional point of view. The losses experienced by BIS irrigators are more than offset by the gains from new irrigation.

The benefits of providing increased reliability of supply to either the A or B permit blocks do not appear to be sufficient to cover the costs. Sensitivity analysis at a low dam construction and distribution cost could make the B permit option viable.

Table of Contents

Executive Summary....................1
- Background....................1
- Irrigation Reliability....................1
- Economic Impacts....................2
- Storage Cost / Benefit....................3
- Summary....................3

1 Introduction....................7
- 1.1 Purpose....................8
- 1.2 Report Structure....................9

2 Modelling of Flow Regime Impacts....................10
- 2.1 Scenarios....................10
- 2.2 Irrigation Reliability Analysis....................10
- 2.3 Modelling Results....................12
  - 2.3.1 Conclusions....................14

3 Economic Impacts....................15
- 3.1 Irrigated Area and Land Use....................15
- 3.2 Farm Models....................16
- 3.3 Agronomic Modelling....................17
- 3.4 Results....................19
  - 3.4.1 Agronomic Impacts....................19
  - 3.4.2 Financial Impacts by land use.....................19
  - 3.4.3 Financial Impacts – District / Region....................20
  - 3.4.4 Conclusions....................21

4 Storage Cost / Benefit....................22
- 4.1 A Permit Storage....................22
- 4.2 B Permit Storage....................23
- 4.3 Combined A and B Permit Storage....................24

5 Other Matters....................25
- 5.1 Mitigation....................25
  - 5.1.1 Water sharing / Rostering....................25
  - 5.1.2 Water Transfer....................25
  - 5.1.3 On Farm Water Storage....................25
  - 5.1.4 Alternative Water Sources....................25
- 5.2 Capital Value Loss / Loss of Future Options....................26

Appendix 1 Example Farm Financial Models....................27

1 Introduction

Environment Canterbury (ECan) are in the process of identifying the most effective management regime for protecting the instream values of the Hurunui River while providing for the present and future needs of people for water in the Hurunui Catchment.

As part of that process Dr Mosley (Mosley[1]) has reported on the in stream values of the river and has recommended the adoption of a flow management regime for the river which is different to that currently in place. Mosley recommends a minimum flow regime that is higher in all months than that used at present but does not require flow sharing at flows above the minimum, as is required at present. The comparison between the existing and the recommended flow regimes is shown in Table 1. It should be noted that the dominant abstractor from the main stem of the river is Amuri Irrigation Company Limited who are the owners of the Balmoral Irrigation Scheme (BIS). They have different consent conditions from other consent holders in the river (effectively a 2 cumec higher minimum flow but no flow sharing).

Table 1: Existing minimum flow regime on the Hurunui River and recommended minimum flow regime to maintain instream values (cumecs).

	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Sharing regime for flows above the minimum flow
Existing regime	10	11	13	17	16	11.5	10	10	10	10	10	10	Yes 1:1
Amuri Consent	12	13	15	19	18	13.5	12	12	12	12	12	12	No
Mosley's recommended	15	15	20	20	20	20	15	12	15	15	15	15	No

Lincoln Environmental (LE[2]) has reported on:

- The effects of the proposed regimes on existing abstractive users of Hurunui water.
- The appropriate size of an A permit allocation.
- Assessed the ability of the river to meet potential future demands within the catchment assuming an A permit allocation on a run of river basis and a B permit allocation for storage.
- The effect of the total A plus B permit takes on floods and freshes in the Hurunui River.

LE report in the Executive Summary that (abridged):

The maximum authorised abstraction rate for all surface water bodies in the Hurunui catchment is 10.454 cumecs of which 0.794 cumecs is pumped from hydraulically connected groundwater. The total consented take from the main stem of the Hurunui River is 7.545 cumecs. As the current A permit block size is 7.5 cumecs the A permits are currently fully allocated. Nearly all of the water is taken for the purpose of irrigation. The largest take (5 cumecs) is by the Amuri Irrigation Co Ltd for the Balmoral Irrigation Scheme.

[1] Mosley 2002: Hurunui River – Instream values and flow regime. Report No R02/1. Environment Canterbury.

[2] Lincoln Environmental 2004: The Effects of alternative Hurunui allocation regimes on abstractive users. Report No U04/9. Environment Canterbury.

A calculation of the potential irrigated area, including land currently occupied by the Balmoral and Medbury forests, indicates that potential peak demand from the catchment would be approximately 21.3 cumecs.

There is enough water available from the Hurunui River under the proposed allocation regime to meet the future demand although water restrictions, particularly in late summer and autumn, mean that water storage would be required to ensure good supply reliability.

The Hurunui River is fundamentally unreliable for abstractive users in late summer and autumn but the block size is not the most critical factor contributing to this. Reliability is predominantly driven by the hydrological characteristics of the catchment and the minimum flows. It therefore is reasonable to recommend increasing the A permit block size to 10 cumecs. Increasing the A permit block size from 7.5 to 10 cumecs will only further decrease existing users reliability slightly. However it will make further water available to new users.

The consent conditions under which the Balmoral Irrigation Scheme operates are inherently more reliable than both the existing regime and the proposed regime. A change to the proposed regime will more significantly affect the reliability of this take than the other existing users.

In order to meet a 10 cumec A permit irrigation demand 100 percent of the time some storage would be required. Storage volumes of 50 MCM are needed to meet full demand in all years, or 30 MCM to meet full demand nine years in ten, or 15 MCM needed to meet full demand four years in five.

In order to meet an additional 11.3 cumec B permit irrigation demand 100 percent of the time more significant storage would be required in most years. Storage volumes of 90 MCM are needed to meet full demand in all years, or 65 MCM to meet full demand nine years in 10, or 48 MCM needed to meet full demand four years in 5.

1.1 Purpose

ECan wishes to:

- explore the economic effects of the proposed regime to better protect Hurunui River instream values on existing users of Hurunui water;
- explore the economic effects of increasing the "A" permit allocation from 7.5 cumecs to 10 cumecs, both under the existing and Mosley regime, having regard to the costs and benefits to present and potential irrigators and to the region and nation;
- explore in a general sense, the economic feasibility of providing storage to increase reliability of supply.

The tasks required of this report were to:

1. Assess the dollar costs and benefits to Balmoral irrigation scheme irrigators, other present irrigators from the Hurunui main stem as a result of changing the flow management regime from that at present to that proposed by Mosley.
2. Assess the dollar costs and benefits of raising the "A" permit allocation from 7.5 to 10 cumecs for both the existing and Mosley regimes, as set out in Table 1.
3. Assess the overall dollar costs and benefits from changing the existing regime with a 7.5 allocation limit to the Mosley regime with a 10 cumec "A" permit allocation limit, to present irrigators, to the region and the nation.
4. Based on the storage volumes of 30MCM calculated by LE to provide 90% reliability of supply to a 10 cumec "A" permit allocation irrigation area, assess the dollar costs and benefits given an assumed high, medium and low level of cost of storage.

5. Based on the storage volumes of 95MCM calculated by LE to provide 90% reliability of supply to 21.3 cumec “A” +”B” permit allocation irrigation area, assess the dollar costs and benefits given an assumed high, medium and low level of cost of storage.

This report only calculates the economic impact on existing (and potential future) abstractive users of water. It does not calculate other market (ie other than irrigation) or non market (recreational or environmental) uses of the water and therefore should be considered as a partial analysis which is specific to abstractive irrigation use.

1.2 Report Structure

Section 2 reports the modelling of the flow regime scenarios and describes their impact on irrigation reliability.

Section 3 reports the modelling of the economic impacts of the scenarios on individual farm businesses and the Region.

Section 4 considers the costs and benefits of providing storage to improve reliability to A permit holders and the combined A and B permit holders.

Section 5 discusses some other matters that should be considered such as mitigation options and other economic impacts.

2 Modelling of Flow Regime Impacts

LE provided the daily time series of results from their demand and scheduling module for each of five flow regime scenarios. This time series was for 31 irrigation seasons starting in 1972/73 and ending in 2002/03. These scenarios were then interrogated to create a description of reliability of water for irrigation that could be used to determine the impact on farming systems of any restrictions that occur.

2.1 Scenarios

LE modelled five scenarios; these are described in Table 2 as to the core elements of their flow regimes and the abstractors who have an interest in each regime.

The abstractors are described as;

Existing Other - which includes all those irrigation abstractors who source their water from the main stem of the river independently of BIS,

BIS - is those irrigators supplied by the Balmoral Irrigation Scheme.

New Irrigators - are those irrigators that may have a future interest in taking up A permit water if the A allocation block was lifted from 7.5 to 10 cumecs.

Table 2: Scenario descriptions.

Scenario	Name	Minimum Flow Regime	A Allocation Block (Cumecs)	Flow Sharing above Minimum	Affected Abstractors
1	Existing 7.5	Existing	7.5	Yes	Existing Other
2	Existing 10	Existing	10	Yes	Existing Other BIS New Irrigators
3	Balmoral	Amuri	7.5	No	BIS
4	Mosley 7.5	Mosley	7.5	No	Existing Other BIS
5	Mosley 10	Mosley	10	No	Existing Other BIS New Irrigators

2.2 Irrigation Reliability Analysis

The LE irrigation demand and scheduling model produces outputs of irrigation demand (i.e. how much water is actually needed on any given day) and actual take (i.e. how much water was actually taken on any given day). The outputs are presented as a daily time-series of the combined demand or take.

Lincoln Environmental[3] identified that *"In its broadest sense, reliability of supply of irrigation water describes the restrictions and water availability an enterprise can expect and the subsequent effect of these restrictions on farm profit. It has aspects of timeliness, steadiness, variability, predictability and is related to user expectations. There are four aspects needed to accurately describe restrictions.*

[3] Lincoln Environmental: Reliability of Supply for Irrigation in Canterbury. Report No 4465/1, Prepared for Environment Canterbury (June 2001)

- ***Severity*** *or the amount of restriction.*
- ***Frequency*** *or how many times a year that restrictions can be expected and how many years in which they will occur.*
- ***Duration*** *or how long the restrictions last for.*
- ***Timing*** *or when in the production season that the restrictions occur."*

(1) Severity
Of importance when determining the reliability of supply is the magnitude of the supply restriction and the duration over which a continuous restriction (either partial or full restriction) occurs. For example, the effects of continuous full restrictions over 5 days (say) may or may not be similar to the effects of continuous 50% restrictions over 10 days. Therefore, results have been presented in terms of continuous days of both partial and full restrictions.

(2) Frequency
The frequency or occurrence of events has been calculated and reported in two ways. The first of these is the calculation and the presentation of information on the occurrence of events over the period of record of 31 irrigation seasons. These have been reported as the total number of events that occur during the 31 year period. Further analysis of the occurrence of full and partial events on an annual basis during those 31 irrigation seasons has been carried out. This analysis of annual events has been converted into a calculation of how frequently events occurred as either the number of times per year that they occur or the number of times that they occur in a ten-year period. In this way we are able to describe the frequency of occurrence as a probability which describes the likelihood of an event occurring.

(3) Duration
The duration or length of a continuous event can have a large influence on the impact that the event will have on agricultural production systems. Obviously events of shorter duration will have a minimal impact on production systems as the ability to irrigate after the event can overcome any small soil moisture deficits quickly. However the longer that the event continues, the less likely it is that irrigation can rectify the soil moisture deficits before negative plant growth impacts occur.

The analysis that has been carried out in this assessment has divided the duration of events into four categories.

- **1 day or less** – these events are considered to have no negative impact on farm output and have been ignored from a practical and agronomic impact point of view.
- **2 to 15 days (short events)** – these events are considered to have low impact on whole of season production as soil moisture levels can be lifted relatively quickly within existing irrigation system return periods.
- **16 – 30 days (medium events)** – these events have a significant impact on agricultural and horticultural output as the subsequent delays associated in completing the irrigation rotation will mean that soils will have been at or below plant wilting point for long periods of time.
- **>30 days (long events)** – these events are considered to be drought like in that they will result in failure of the production system and possibly plant death.

The average length of events in each of the duration categories has been calculated.

(4) Timing
The impact of timing of events is partly covered by the fact that the Lincoln Environmental model matches water supply and demand. Therefore it only reports restrictions in water availability at a time of year when water is in demand because of climatic conditions. However the timing of some of the longer duration events is important if an event occurs in the middle or towards the end of the production season when there is little or no hope of subsequent rain or irrigation to improve the situation or minimise the impact.

Through this analysis the Lincoln Environmental simulation of irrigation reliability occurrence has been converted into a description of irrigation reliability which is then able to be analysed for its impact on agricultural production systems.

2.3 Modelling Results

Table 3 reports three different measures of reliability.

1. The frequency of events occurring and the average duration of each event.

   The frequency data is reported in whole numbers (1) or as decimals (0.1 or 0.01). Whole numbers report the number of times that an event will occur in a single year (2 means twice a year), single point decimal numbers represent the number of years out of ten in which an event will occur (0.6 means six years out of ten), double point decimal numbers represent the number of years out of one hundred in which the event will occur (0.03 means three years out of one hundred, or once in 33 years). It should be noted that the occurrence figures have been rounded to the nearest figure for presentation. Average duration reports the average length of restrictions of consecutive days.

2. The severity of partial restrictions expressed as a % of full flow. The percentage reported is the proportion of full flow available for use on average.

3. The incidence of restriction free years and the total days lost in the worst year as an indication of the variability between years.

Table 3: Irrigation Reliability Description

Reliability Analysis			**Existing**		**Balmoral**	**Mosley**	
		Periods	**7.5**	**10**		**7.5**	**10**
Full Restrictions	Frequency	2 - 15	0	0	0.1	0.2	0.2
		15 - 30	0	0	0.03	0.1	0.1
		>30	0	0	0	0.03	0.03
	Duration (No of days)	2 - 15	0	0	9	4	4
		15 - 30	0	0	21	26	26
		>30	0	0	0	46	46
Partial Restrictions	Frequency	2 - 15	2	3	0.5	2	2
		15 - 30	0.3	0.5	0.06	0.3	0.5
		>30	0.1	0.3	0	0	0
	Duration (No of days)	2 - 15	7	7	6	5	5
		15 - 30	22	20	22	20	21
		>30	43	42	0	0	0
Partial Severity			65%	62%	42%	44%	49%
Full Restrictions	Years with Nil Events (31 years Total)		31	31	27	23	23
Total days lost in worst year. (not consecutive)			0	0	21	46	46
Partial Restrictions	Years with Nil Events (31 years Total)		18	1	16	3	1
Total days lost in worst year. (not consecutive)			89	113	27	53	66

Scenario 1 (Existing 7.5) has:

- No days of full restrictions.
- Partial events occur with short events occurring twice a year at an average length of 7 days, medium events occurring 3 years in 10 for an average of 22 consecutive days and long events occurring 1 year in 10 for an average length of 43 days.
- Partial events average 65 % of full flow.
- Over half the years (18 out of 31) are restriction free while the worst year showed 89 days of partial restrictions in total.

Scenario 2 (Existing 10) has:

- No days of full restrictions.
- Partial events occur with short events occurring three times a year at an average length of 7 days, medium events occurring 5 years in 10 for an average of 20 consecutive days and long events occurring 3 years in 10 for an average length of 42 days.
- Partial events average 62 % of full flow.
- Only one year is restriction free while the worst year showed 113 days of partial restrictions in total.

Scenario 3 (Balmoral) has:

- Full restrictions short events occurring 1 year in 10 for an average of 9 consecutive days and medium events occurring 1 year in 30 for an average of 21 days.
- Partial events occur with short events occurring 1 year in 10 at an average length of 6 days, medium events occurring 2 years in 33 for an average of 22 consecutive days.
- Partial events average 42 % of full flow.
- The majority of the time is free of full restrictions while partial restrictions occur in about half of the seasons. The worst total season has 21 days and 27 days respectively.

Scenario 4 (Mosley 7.5) has:

- Full restriction short events occurring 2 years in 10 for an average of 4 consecutive days, medium events occurring 1 year in 10 for an average of 26 days and long events occurring 1 year in 33 for an average of 46 days.
- Partial events occur with short events occurring 2 years in 10 at an average length of 5 days and medium events occurring 3 years in 10 for an average of 20 consecutive days.
- Partial events average 44 % of full flow.
- Two thirds of the years are free of full restrictions while partial restrictions occur in most years. The worst total season has 46 days and 53 days respectively.

Scenario 5 (Mosley 10) has:

- Full restriction short events occurring 2 years in 10 for an average of 4 consecutive days, medium events occurring 1 year in 10 for an average of 26 days and long events occurring 1 year in 33 for an average of 46 days.
- Partial events occur with short events occurring 2 years in 10 at an average length of 5 days and medium events occurring 5 years in 10 for an average of 21 consecutive days.
- Partial events average 49 % of full flow.
- Two thirds of the years are free of full restrictions while partial restrictions occur in nearly all years. The worst total season has 46 days and 66 days respectively.

2.3.1 Conclusions

Conclusions that can be drawn from the reliability modelling are:

- All options offer inferior reliability to the BIS irrigators with increased incidence of both full and partial restrictions.
- Existing Other irrigators suffer a greater reduction in reliability at the Existing 10 scenario but little change through moving to either of the Mosley regimes. The Mosley regimes increase the incidence of full restrictions but reduce the frequency and duration of partial restrictions for these irrigators.
- The Mosley scenarios are only marginally different in terms of reliability between the 7.5 and 10 cumec options.

3 Economic Impacts

The economic impacts have been estimated by determining the reliability of irrigation water supply under each of the scenarios from Section 2. This reliability has then been converted into economic impacts on the different farm types in the area by estimation of the impact on pasture production. The individual farm impacts have been aggregated into total impacts according to the land use mix. The impacts of the individual scenarios are then able to be reported according to their impacts on different farm types and in total under each of the scenarios.

This methodology reports and models average impacts over the period of record (31 years), it does not report the impacts of individual events. The methodology used assumes that individual businesses are resilient enough to survive the severe events and have an appropriate capital structure to be able to cope with fluctuating revenue as a result of fluctuating availability of water. This is a fair assumption considering that existing reliability of water is variable as a result of the variable nature of river flows.

As a number of assumptions have had to be made during this exercise and farm performance has been modelled at average levels the data reported may not be useful in determining impacts for a specific farming operation at a specific location. The results are however useful in comparing the impacts of different flow regime options and combinations of options.

Therefore the results reported in this section should be regarded as useful in determining the order of magnitude of impacts of the different scenarios and therefore leading to choices of preferred options from an individual irrigator and wider community perspective. The results are presented as a tool to understand the nature of impacts of moving from one scenario choice to another rather than as exact estimates of the outcome of each individual scenario.

3.1 Irrigated Area and Land Use

The irrigated area has been taken from the LE report and the consents database. Land use for existing irrigators has been compiled from the consents database and consultation with irrigators. The land use mix for new irrigators under an expanded A block of 10 cumecs has been based on the land use mix of existing other irrigators as it is assumed that the new irrigation would mainly occur along the river margins as part of partial irrigation of existing properties. The land use mix of new irrigators under an expanded B block of 11.3 cumecs has been based on experience with other areas of community scheme development which has been modified to reflect the land, soils and climate in the area studied.

Table 4 reports the land use assumptions for the irrigation scenarios modelled as well as the land use assumptions used for the dryland for new irrigation under the A and B block scenarios. The B block scenario includes an assumption that land presently in forests could be converted to irrigated agriculture. Information on forest returns are not available for that area so it has been assumed that this area is in dryland agriculture. The assumption could mean that the net return from conversion to irrigated agriculture could be overstated if the current returns from forestry are greater than dryland agriculture.

Table 4: Irrigated area and Land Use (ha)

Irrigators	Total	Dairy	Sheep	Beef	Deer	Dairy Support
Existing Irrigators						
Existing Other		13%	50%	25%	8%	4%
	2,789	360	1,385	693	231	120
BIS		72%	10%	5%	2%	12%
	5,243	3,778	507	254	85	620
10 Cumec A Block						
New as Dryland			70%	20%	10%	
	4,980	-	3,486	996	498	-
New Irrigated		20%	50%	10%	5%	15%
	4,980	996	2,490	498	249	747
11.3 Cumec B Block						
New as Dryland		0%	70%	20%	10%	0%
	27,600	-	19,320	5,520	2,760	-
New Irrigated		40%	30%	10%	5%	15%
	27,600	11,040	8,280	2,760	1,380	4,140

3.2 Farm Models

The farm financial models created match the land use mix:

- Dairy.
- Sheep.
- Beef.
- Deer.
- Dairy support

The farm financial models created (Examples of the present land use models are shown in Appendix 1) include both income and farm working expenditure resulting in a Cash Farm Surplus (CFS) that is available for personal drawings, debt servicing, taxation, capital purchases and profit. The models have been based on the models used in the MAFPolicy Farm Monitoring[4] reports, where appropriate.

The basic models have been adapted to reflect the soils and climate characteristics of the area to give physical and financial performance parameters for the properties which reflect the nature of farming in the area at present. The sheep and deer farm models integrate a proportion of breeding units and finishing. These proportions are changed according to the scenario where appropriate. The Beef model is based on finishing beef only and the Dairy Support model is based on the sale of Dry Matter in the form of heifer grazing, silage and cow wintering. In reality many farms may have a mix of these land uses. Therefore the results should be considered as comparative impacts on the different land uses rather than on individual farms as such.

The models make the assumption that the impact of lost pasture production while result in less product to sell. In some cases farmers may choose to purchase feed to farm through feed deficits caused by irrigation restrictions. If they choose to do so it must be assumed that the feed can be purchased at a cost that allows the product to be sold at a marginal return above the cost of the extra feed. The approach adopted means that the results reported can be regarded as the most pessimistic impacts without allowing for any mitigation responses.

The financial parameters used in the modelling have been based on MAFPolicy[5] medium term predictions of outlook for New Zealand farm gate prices for produce. In this way the

[4] MAFPolicy : South Central Monitoring Report – July 2003.
[5] MAFPolicy : Situation and Outlook for New Zealand Agriculture and Forestry (May 2004)

economic impact calculation is based on the medium term average price expectations over the next five years for the individual, commodities. By adopting medium term averages the outcomes of the modelling cannot be influenced by individual commodities which may be on peaks or troughs in the commodity price cycle at the time of modelling. The price parameters used are shown in Table 5.

Table 5: Product Price Parameters.

Product	**Price Used**
Milksolids ($ / kg)	3.87
Sheep	
Breeding (Gross / SU)	67.04
Lamb Schedule ($ / kg)	3.57
Beef Schedule ($ / kg)	2.99
Deer	
Venison Schedule ($ / kg)	5.28
Breeding (Gross / SU)	90.00
Dairy Support ($ / kg DM)	
Heifer Grazing	0.12
Silage	0.15
Cow wintering	0.20

3.3 Agronomic Modelling

The financial models are driven by the results of the pasture growth models. All livestock models have been created so that the farm performance and output is driven by pasture growth models. The base used is the annual dry matter production for Winchmore, taken from the Lincoln University Farm Technical Manual, of 11,000 kg DM /ha/yr. The Balmoral Irrigation Scheme irrigators are modelled at a slightly lower base production level because of the losses that occur as a result of their irrigation distribution roster and their use of border dyke on farm application systems. The performance of each model is based on deduction of the growth lost from this standard amount (with a feed utilisation factor of 80 %) then being applied to the financial model to determine output.

The agronomic impacts have been estimated by calculating the lost growth that would occur as a result of irrigation restrictions for each scenario.

The formula for that calculation is: **Impact= D x GR x F**.

Where:
D = average days lost
GR= average daily growth rate
F = loss modification factor.

The average days lost (D) were calculated from the irrigation reliability analysis) by multiplying the frequency of restrictions by the average length of restriction.

The average growth rate (GR) was taken from the growth rate tables in the Farm Technical Manual[6] for the irrigated Winchmore site by multiplying the average daily rate by the number of days per month to get an average daily grow rate during the irrigation season of 37 kg DM /ha/day.

The loss modification factor (F) was derived to modify the total loss according to the duration of the event. This takes into account the fact that at the beginning of each restriction at least

[6] Lincoln University Farm Management Group 2003: Farm Technical Manual, P H Fleming Ed

half the irrigated area will be at 50 % water holding capacity. If we assume that the average plant available water (PAW) of the soils in the study area is 80mm then with average evapotranspiration during the irrigation season at 3 mm per day (Farm Technical Manual) this means that it will be approx 13 days until there is no more plant available water to support plant growth. Plant growth will start to diminish before this point is reached so loss of production is not expected to start until approximately 6 days into a restriction event and will not be total until approximately 14 days into the event. On the other hand full recovery of growth once irrigation is restarted is not instantaneous. The longer the event the more severe the impacts on growth recovery post the event.

This is further complicated by the nature of the operation of the water delivery system within the BIS distribution system. The system is designed to have a 15 day return with the ability to water 31 ha in 24 hours. Therefore a 200ha property will get approx 6 days water during the 15 day watering period.

Experience has shown the managers of the system that the river reduces rapidly (3 to 4 days) from full water availability to complete cut off therefore they have adopted an aggressive response to the onset of partial restrictions by immediately moving to 50 % restrictions on their irrigators.

Each irrigator is considered to have had their turn if they were irrigating at the time of cut off regardless of the number of days of their entitlement that they have received. Therefore at start up they go to the bottom of the queue and wait another 15 days before they start up again. This can mean that if the 200 ha farm given as the example above is only one day into its turn when irrigation ceases then the period without water for the majority of the farm will be much greater then the period of restriction.

Another important factor for the BIS irrigators is that their system is incapable of operating when there is only 2.5 cumecs of water in the river for it to take. In total these two factors mean that the impacts of partial and full restrictions are much more severe in terms of duration impacts for the BIS scheme irrigators than for the other irrigators.

Therefore it is necessary to modify the impacts according to the duration of the event and the irrigators affected to reflect the impact of speed of onset of restriction and the ability to recover full soil moisture rapidly. The modification factors used are shown in Table 6.

Table 6: Growth loss modification factors.

Event Duration	**Full Restrictions**	**Partial Restrictions**
Short events (2 – 15 days)		
BIS	0.2	0.4
Other Irrigators	0.2	0.15
Medium events (16–30 days)		
BIS	0.5	0.6
Other Irrigators	0.5	0.45
Long events (>30 days)		
BIS	0.7	0.8
Other Irrigators	0.7	0.6

It is important to point out that this method of calculation of the impacts represents the average impact over time as represented by modelling of a number of seasons. It does not report the range or extremes of impacts, either better or worse, that can occur in any one individual season. The purpose of this methodology is to estimate the impact over time for comparison of impacts between scenarios on long term business performance.

3.4 Results

3.4.1 Agronomic Impacts

The annual average loss of production for each scenario is shown in Table 7. The first column reports the total number of days growth lost, the second the growth lost reported in kg DM / ha and the third the percentage loss from optimum growth.

Table 7: Annual average loss of production

	Present			Existing 10			Mosley 7.5			Mosley 10		
	Days Total	Growth Kg DM / ha	Loss	Days	Growth Kg DM / ha	Loss	Days	Growth Kg DM / ha	Loss	Days	Growth Kg DM / ha	Loss
Other Irrigators	11	299	2.72%	22	555	5.05%	10	226	2.06%	15	334	3.04%
Balmoral	3	97	0.96%	22	891	8.78%	10	341	3.36%	15	514	5.06%

Points to note from Table 7 are:

- Other irrigators would have a significant reduction in output if they moved from the present scenario to Existing 10, would have a slight improvement at Mosley 7.5 and would be slightly worse off at Mosley 10.
- The Balmoral irrigators would have a significant reduction in output if they moved from the present scenario to Existing 10 with an almost 5% reduction in average output. Mosley 7.5 would show a 2.4% average reduction while Mosley 10 would see a 4.1% reduction in average output.

3.4.2 Financial Impacts by land use.

The financial impacts on the different land uses are reported as Cash Farm Surplus (that is the amount available for personal drawings, debt servicing, taxation, capital purchases and profit).The results are reported on a per hectare basis on a 200 ha property and the change in Cash Farm Surplus from the present for a 200 ha property in the next two tables. Table 8 reports the impacts on existing other irrigators; Table 9 reports the impacts on the Balmoral scheme irrigators.

Table 8: Financial Impacts for Existing Other Irrigators.

	Present		Existing 10			Mosley 7.5			Mosley 10		
	$ / ha	$ / 200 ha	$ / ha	$ / 200 ha	Change / 200ha	$ / ha	$ / 200 ha	Change / 200ha	$ / ha	$ / 200 ha	Change / 200ha
Dairy	1,684	336,877	1,636	327,208	- 9,669	1,698	339,645	2,768	1,678	335,561	- 1,316
Sheep	1,076	215,173	1,048	209,667	- 5,506	1,084	216,750	1,576	1,072	214,424	- 750
Beef	981	196,174	953	190,694	- 5,480	989	197,743	1,569	977	195,428	- 746
Deer	1,086	217,155	1,055	210,958	- 6,197	1,095	218,929	1,774	1,082	216,312	- 844
Dairy Support	728	145,664	694	138,853	- 6,811	738	147,614	1,950	724	144,737	- 927

The point to note for the other irrigators is that there is very little difference in the financial performance between scenarios on a per hectare basis. They are financially worse off under the Existing 10 scenario but marginally better off and worse off under the two Mosley scenarios. This would indicate that the present position would be the preferred position but that either of the Mosley scenarios are little different to the present scenario and either would be preferred to Existing 10.

The financial results reported for other irrigators are those that would be achieved by any new irrigators that were able to irrigate under the increased A and B irrigation block scenarios.

Table 9: Financial Impacts for Balmoral Irrigation Scheme Irrigators

	Present		Existing 10			Mosley 7.5			Mosley 10		
	$ / ha	$ / 200 ha	$ / ha	$ / 200 ha	Change / 200ha	$ / ha	$ / 200 ha	Change / 200ha	$ / ha	$ / 200 ha	Change / 200ha
Dairy	1,470	293,906	1,208	241,608	-52,298	1,358	271,565	-22,341	1,312	262,322	-31,584
Sheep	1,021	204,131	912	182,492	-21,640	981	196,205	- 7,926	960	191,927	-12,205
Beef	928	185,578	822	164,334	-21,244	889	177,862	- 7,716	868	173,639	-11,939
Deer	1,007	201,357	875	175,079	-26,277	957	191,303	-10,054	931	186,256	-15,101
Dairy Support	684	136,801	578	115,664	-21,137	652	130,312	- 6,488	629	125,702	-11,099

The most important point to note is that the financial impacts on the Balmoral scheme irrigators is magnified due to their delivery and application systems. The Existing 10 has the greatest negative impact on financial performance while the two Mosley scenarios have similar impacts with Mosley 7.5 being the preferred of the two.

3.4.3 Financial Impacts – District / Region

The major difference between the scenarios at a district level is that under the increased A allocation block scenarios (Existing 10 and Mosley 10) there is capacity for additional irrigation with the extra 2.5 cumecs of allocation available. LE has estimated that this will give the opportunity for an additional 4,980 ha of irrigation from the river. This means that the two increased allocation block scenarios will have additional output from this area of new irrigation. This output is reported as the net increase in Cash Farm Surplus as a result of the conversion from dryland to irrigated farming. The land use assumptions used as dryland and under irrigation are reported in Table 4. The new irrigators are assumed to have the same performance as the existing other irrigators therefore they utilise the same farm financial models.

The use of Cash Farm Surplus to report this increase is relevant as it is an indication of GDP and therefore is of interest from a District or a Regional level as an indicator of district or regional economic output.

Table 10 reports the Cash Farm Surplus from each irrigation group as well as the change in total Cash Farm Surplus compared with the present situation.

Table 10: District / Regional Financial Impacts ($m)

	Present	Existing 10		Mosley 7.5		Mosley 10	
	CFS	CFS	Change	CFS	Change	CFS	Change
Other	3.11	3.03	- 0.09	3.14	0.02	3.10	-0.01
Balmoral	6.81	5.67	- 1.15	6.34	- 0.48	6.13	- 0.68
New		4.38	4.38			4.57	4.57
Total	**9.93**	**13.08**	**3.15**	**9.48**	**- 0.45**	**13.80**	**3.87**

Table 10 shows that the majority of the negative impacts are felt by the Balmoral irrigators but that the increased surplus from the new irrigators could lift the total net performance from $9.9 m at present to $13.08 or $13.80 under the two 10 cumec “A” permit options, an increase of $3.15 and $3.87m respectively. Therefore, from a District / Regional perspective, the Mosley 10 regime is the most attractive.

As the additional CFS all comes from new irrigators it is important to acknowledge that there is considerable capital expenditure required to achieve the conversions to irrigated agriculture and the resulting increased surplus. Expenditure items include irrigation systems, plant and machinery, farm infrastructure and livestock. The additional 4,980 ha would have an average cost of $5,930 / ha which would result in an interest, or cost of capital, charge of $474 / ha at 8%. This would have a total cost of $2.36 m over the new irrigation area. This is approximately half of the increased CFS from new irrigation. Even if the cost of capital was included there would still be a positive net increase in CFS for both scenarios that include new irrigation.

3.4.4 Conclusions

The conclusions that can be made from the economic impact analysis are:

- None of the economic impacts are sufficient to influence or change land use choice.
- The existing other irrigators show very little variance in financial performance between scenarios. On a whole farm basis they are worse off under Existing 10 but achieve very similar results to present under either the Mosley regimes.
- The most important point to note is that the financial impact on the BIS irrigators is magnified due to their delivery and application systems. The Existing 10 has the greatest negative impact on financial performance while the two Mosley scenarios have similar impacts with Mosley 7.5 being the preferred of the two.
- At a District or Regional level the majority of the negative impacts are felt by the Balmoral irrigators but the increased surplus from new irrigators could lift the total net Cash Farm Surplus from $9.9 m at present to $13.08 or $13.80 under the two 10 cumec “A” permit options, an increase of $3.15 and $3.87m respectively. Therefore, from a District / Regional perspective, the Mosley 10 regime is the most attractive.

4 Storage Cost / Benefit

LE has calculated that under the Mosley 10 scenario the storage volume of water required to provide full reliability in 9 years out of 10 to a 10 cumec A permit block would be 30 million cubic meters (MCM). LE has calculated that there is a potential future area of irrigable land of 34,500 ha in the Hurunui catchment (including the Balmoral and Medbury forests) with an irrigable area of 22,510 ha. This would require a B permit block allocation of 11.3 cumecs that would be considerably less reliable than the A permit block. To provide the same level of reliability (full reliability in 9 years out of 10) to a B permit block would require 60MCM of storage.

The costs and benefits of providing the additional storage are:

Costs

- Capital
  - Storage Dam Construction
  - Land Loss
  - Secondary Distribution Systems
  - On Farm Development Costs
- Operational
  - Scheme Operation and Maintenance charges
  - Capital debt servicing

Benefits

- Net change in CFS (Total CFS with storage, minus Total CFS without storage.)

The analysis has been calculated at three levels of storage costs provided by AquaLinc[7]. The analysis compares the results against those that are achieved under the Mosley 10 scenario.

4.1 A Permit Storage

The major assumptions made in assessing the cost / benefit of providing A permit storage to achieve full reliability of supply 9 years out of 10 are:

- The dam would be attached to the Balmoral irrigation scheme and would utilise that distribution system to deliver the water into the scheme area.
- On farm benefits would accrue in terms of reduction in growth lost in most years.
- The severity of the reduction in the 1 year in 10 that restrictions would occur is not known but it is assumed to be mainly partial in nature and relatively short in duration.
- Land use would not change from the mix already modelled but production would intensify.

[7] I MacIndoe pers comm.

Table 11: A Permit Storage Costs and Benefits.

	Low Storage Cost	Medium Storage Cost	High Storage Cost
Dam Volume (MCM)	30	30	30
Dam Area (ha)	300	300	300
Construction cost ($ / CM)	0.50	1.00	3.00
Value of land Lost	1.35	1.35	1.35
Total Dam Cost	16.35	31.35	91.35
Secondary Distribution costs	-	-	-
On Farm Capital	29.5	29.5	29.5
Operation and Maintenance costs	.150	.150	.150
Off farm capital servicing costs	1.665	3.193	9.304
Total Annual Costs	1.815	3.343	9.454
Effective Annual Water Charge ($ / ha)	**365**	**671**	**1,898**
On farm capital servicing costs	2.362	2.362	2.362
Total on and off farm annual costs.	**4.178**	**5.706**	**11.817**
Net increase in CFS Total	**.814**	**.814**	**.814**
Net Return to Storage	**-3.364**	**-4.892**	**-11.003**

Table 11 indicates that the costs involved in providing storage are not matched by the benefits gained on farm. The net return from storage ranges from -$3.4m to -$11m. This is because the benefits are only marginal in terms of improving output from already irrigated properties while the cost is significant. The gap between costs and benefits is too large to indicate that sensitivity analysis would improve the situation.

4.2 B Permit Storage

The major assumptions made in assessing the cost / benefit of providing B permit storage to achieve full reliability of supply 9 years out of 10 are:

- Area of new irrigation is 22,510 ha.
- The dam would require its own distribution system to deliver the water into the scheme area. This system has been assumed at a cost of $2,500 / ha.
- The severity of the reduction in the 1 year in 10 that restrictions would occur is not known but it is assumed to be mainly partial in nature and relatively short in duration.
- Land use would be similar to that experienced in recent community irrigation scheme development and production would intensify. There is some suggestion that a B permit block could be used to divert water into the Waipara catchment to irrigate viticulture. If this were the case the potential returns from land would rise significantly as would the cost of the secondary distribution system.

Table 12: B Permit Storage Costs and Benefits ($m).

	Low Storage Cost	Medium Storage Cost	High Storage Cost
Dam Volume (MCM)	60	60	60
Dam Area (ha)	950	950	950
Construction cost ($ / CM)	0.50	1.00	3.00
Value of land Lost	4.275	4.275	4.275
Total Dam Cost	34.275	64.275	184.275
Secondary Distribution costs	56.272	56.272	56.272
On Farm Capital	158.508	158.508	158.508
Operation and Maintenance costs	1.375	1.375	1.375
Off farm capital servicing costs	9.222	12.278	24.500
Total Annual Costs	10.348	13.403	25.626
Effective Annual Water Charge ($ / ha)	**460**	**595**	**1.138**

On farm capital servicing costs	12.680	12.680	12.680
Total on and off farm annual costs.	**23.028**	**26.084**	**38.306**
Net increase in CFS Total	**24.590**	**24.590**	**24.590**
Net Return to Storage	**1.562**	**-1.494**	**-13.716**

Table 12 indicates that the costs involved in providing storage are matched by the benefits gained on farm at the lower end of the range of dam costs modelled but are negative for the higher cost options (-$1.5m and -$13.7m respectively). Even when positive the net benefit is only marginal and probably not sufficient to make the proposition attractive for investment. However, sensitivity analysis around the key variables of dam cost, secondary distribution system cost and land use returns may find a position where the investment was more attractive.

4.3 Combined A and B Permit Storage

The preceding analysis would indicate that combing the two storage requirements would not provide a positive cost benefit because of the large negative return from the A storage proposition. The negative return is greater than the positive achieved at the lower end of the B storage cost options. However there may be merit in combing the two storage facilities if significant economies of scale can be achieved in dam construction costs and the BIS distribution system can be used to deliver the water at a much lower capital cost than that modelled. If these two conditions can be achieved, the option merits further investigation.

5 Other Matters

5.1 Mitigation

The physical and economic impacts of the proposed flow regimes that have been modelled in this report do not included allowance for any mitigation of impacts which may occur. There are a number of mitigation activities which may reduce the potential impact of the proposed minimum flows to a greater or lesser degree.

5.1.1 Water sharing / Rostering

It may be possible to reduce irrigation water demand to avoid restrictions being put in place. This could happen by reducing the rate of water take which would reduce the rate of depletion of the river to maintain flows above the trigger level for restrictions. This could be carried out by the management of water sharing or water rostering systems from within the water users in the catchment. No analysis of the potential for this to improve reliability has been carried out.

5.1.2 Water Transfer

The transfer of water during periods of diminishing flows or partial restrictions, by commercial or non-commercial means, to the highest value users would have the impact of reducing the overall economic impacts of the proposed flow regimes. This would involve an agreement for low value users to forego the use of water and transfer their water share to higher value users. In this way it would serve to protect the higher value users who may or may not be able to compensate those who transfer the water. This would have the potential to minimise the degree of negative district impacts at farm gate level. This system would require some degree of water sharing or rostering on a catchment based level.

5.1.3 On Farm Water Storage

The creation of on-farm water storage as a means of providing water to allow irrigation during periods of restrictions is a proven successful mitigation technique. Water can be taken from the river during times of nil irrigation demand or high flow and stored in a pond or dam to be used when restriction are in force. The volume of water that would need to be stored to cover the long periods of full restrictions has been estimated and would require very large storage facilities. These facilities would be very expensive to form and would therefore not be cost effective. However smaller facilities that could store sufficient water to get through short restriction periods may be created economically. Accordingly water storage could be seen as a means of partially mitigating unreliability of supply rather than as a cost effective means of total mitigation.

5.1.4 Alternative Water Sources

Another means of mitigation that may be available to individual irrigators would be the opportunity to gain access to an alternative source of water which was not connected to the river flow rules. This may be from groundwater or from surface water that arises as a result of by wash from the BIS scheme. This would probably require some of the existing scheme irrigators at the lower end converting over to this source as a permanent source of irrigation water.

This option would incur additional costs of capital to set up and operate on an annual basis. However, these additional costs may be justified for high value land uses that achieve greater returns from higher reliability and by improving reliability to the rest of the scheme by reducing the amount of water required to be abstracted from the river.

5.2 Capital Value Loss / Loss of Future Options

Existing irrigators, particularly those within the BIS, who suffer the impacts shown in this report, risk the possibility of a decrease in the capital value of their properties. Potential purchasers of land in the area would view a lower level of irrigation water reliability as a negative aspect and would discount their purchase prices of farms accordingly.

Some future high value land use options will only be available to farmers with a high degree of irrigation water reliability. Therefore if the reliability levels offered to farmers as proposed are below those required by these high value options then farmers will not be given the opportunity to participate. Therefore another impact of the potential deterioration in water reliability offered by the proposed regimes is the potential loss of future options to further develop profitability.

Appendix 1 Example Farm Financial Models

		Dairy		**$ / Ha**	**Total**
REVENUE			per kgMS		
	973	Price	3.87	3,765	
Cattle net of Purchases			0.49	477	
Other			0		
GROSS FARM REVENUE				**4,241**	**848,266**
FARM WORKING EXPENSES					
Livestock Purchases			0.02	19	
Wages			0.48	467	
Animal Health			0.16	156	
Breeding			0.07	68	
Shed Expenses			0.05	49	
Electricity			0.15	146	
Feed			0.64	623	
Fertiliser			0.37	360	
Freight			0.02	19	
Seeds			0.02	19	
Shearing			-	-	
Weed and Pest			0.02	19	
Fuel			0.05	49	
Vehicle			0.07	68	
Repairs & Maint			0.16	156	
Rates			0.04	52	
Communication			0.01	15	
Insurance			0.03	36	
Acct, Legal,Cons			0.02	18	
Administration			0.03	40	
Other			0.04	53	
Irrigation	Off Farm				
	On Farm			125	
CASH FARM EXPENDITURE				**2,557**	**511,389**
CASH FARM SURPLUS				**1,684**	**336,877**

		SHEEP FINISHING			**$ / Ha**	**Total**
REVENUE						
Lamb Trading			255	3.57	910	
Ewe Breeding / Finisl			10.38	67.04	696	
Wool					90	
Other						
GROSS FARM REVENUE					**1,695**	**338,955**
FARM WORKING EXPENSES						
14.01	SU/Ha			per SU		
Livestock Purchases				0.05	1	
Wages				4.91	69	
Animal Health				3.55	50	
Breeding				0.12	2	
Shed Expenses				-	-	
Electricity				0.49	7	
Feed				2.41	34	
Fertiliser				7.82	110	
Freight				0.84	12	
Seeds				1.69	24	
Shearing				2.19	31	
Weed and Pest				1.72	24	
Fuel				1.77	25	
Vehicle				1.57	22	
Repairs & Maint				3.20	45	
Rates				1.02	11	
Communication				0.49	5	
Insurance				0.90	9	
Acct, Legal,Cons				0.90	10	
Administration				0.35	4	
Other				0.20	2	
Irrigation	Off Farm					
	On Farm				125	
CASH FARM EXPENDITURE					**619**	**123,782**
CASH FARM SURPLUS					**1,076**	**215,173**

		BEEF FINISHING		**$ / Ha**	**Total**
REVENUE		Kg C W	$/ Kg		
Beef		524.54	2.99	1,568	
GROSS FARM REVENUE				**1,568**	**313,675**
FARM WORKING EXPENSES					
14.01	SU/Ha		per SU		
Livestock Purchases				-	
Wages			4.91	69	
Animal Health			3.55	50	
Breeding			0.12	2	
Shed Expenses			-	-	
Electricity			0.49	7	
Feed			2.41	34	
Fertiliser			7.82	110	
Freight			0.84	12	
Seeds			1.69	24	
Shearing				-	
Weed and Pest			1.72	24	
Fuel			1.77	25	
Vehicle			1.57	22	
Repairs & Maint			3.20	45	
Rates				11	
Communication				5	
Insurance				9	
Acct, Legal,Cons				10	
Administration				4	
Other				2	
Irrigation	Off Farm				
	On Farm			125	
CASH FARM EXPENDITURE				**588**	**117,501**
CASH FARM SURPLUS				**981**	**196,174**

		DEER FINISHING		$ / Ha	Total			DAIRY SUPPORT		$ / Ha	Total
REVENUE		Kg C W	$/ Kg			**REVENUE**		9,631			
Venison	Trading	201.52	5.28	1,064		Heifer Grazing			0.12	462.266	
	Bree/ Fin	10.38	90.00	934		Silage			0.15	288.9163	
						Cow wintering			0.20	770.4434	
GROSS FARM REVENUE				**1,998**	**399,576**	**GROSS FARM REVENUE**				**1,522**	**304,325**
FARM WORKING EXPENSES						**FARM WORKING EXPENSES**					
14.01	SU/Ha		per SU						per Ha		
Livestock Purchases			14.60	205		Livestock Purchases					
Wages			3.22	45		Wages			35	35	
Animal Health			3.87	54		Animal Health			-	-	
Breeding			1.03	14		Breeding			-	-	
Shed Expenses			-	-		Shed Expenses			-	-	
Electricity			1.07	15		Electricity			9	9	
Feed			6.32	89		Feed	0.01		96.30543	96.30543	
Fertiliser			8.16	114		Fertiliser			280	280	
Freight			1.76	25		Freight			15	15	
Seeds			1.42	20		Seeds			50	50	
Shearing			-	-		Shearing			-	-	
Weed and Pest			0.43	6		Weed and Pest			31	31	
Fuel			2.15	30		Fuel			32	32	
Vehicle			1.72	24		Vehicle			21	21	
Repairs & Maint			4.30	60		Repairs & Maint			58	58	
Rates				23		Rates				11	
Communication				12		Communication				5	
Insurance				23		Insurance				9	
Acct, Legal,Cons				14		Acct, Legal,Cons				10	
Administration				4		Administration				4	
Other				10		Other				2	
Irrigation	Off Farm					Irrigation	Off Farm				
	On Farm			125			On Farm			125	
CASH FARM EXPENDITURE				**912**	**182,421**	**CASH FARM EXPENDITURE**				**793**	**158,661**
CASH FARM SURPLUS				**1,086**	**217,155**	**CASH FARM SURPLUS**				**728**	**145,664**

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Fax: (03) 365-3194

Customer services: (03) 353-9007
or: 0800 EC INFO (0800 324 636)

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