IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of submissions and further submissions by Rangitata Diversion Race Management Limited to the proposed Canterbury Land & Water Regional Plan (pL&WRP)

STATEMENT OF EVIDENCE OF ANDREW WEBSTER MACFARLANE

(HEARING 3)

INTRODUCTION

1. My name is Andrew Webster Macfarlane.
2. I graduated from Lincoln College in 1981 with a Bachelor of Agricultural Science degree. I have 32 years' experience as a Farm Management Consultant, 31 of which have been in private practice. I am a registered farm management consultant, Life Member of the New Zealand Institute of Primary Industry Management and am a past New Zealand President of that Institute.
3. I am a director of Ag Research, ANZCO, a Lincoln University Councillor and Chairman of Deer Industry NZ.
4. I have been farming on my own account, with both border-dyke and spray irrigation, for 24 years. My home property was awarded the "Ballance Farm Environment Award" (for setting a high standard in environmentally sustainable farming) in 2003, and our second farm, in which our family has a major equity share, recently won the dairy farm award, energy excellence award, and integrated management award in the 2013 finals. Our family farming interests include dairy, dairy support, sheep/beef/deer and arable farming.
5. My advisory work, through my company Macfarlane Rural Business ("**MRB**"), involves crop and animal systems, the impact of soil fertility and water availability on them, and the financial analysis of such systems. I have been advising farmers on the development and management of their on farm and off farm irrigation systems for 29 years. In recent years a significant amount of my time has been involved in assisting farmers: (many of whom are in the RDR scheme area):

(a) re-develop existing irrigated areas (both spray and border-dyke) to enhance efficiency of resource use and hence profitability;

(b) develop sound design and management practices for proposed water use, both individual and group schemes;

(c) manage production and financial risk around water enhancement schemes, both group and individual and

(d) implement farm systems that optimise production relative to nutrient leakage from that system.

6. In preparing this evidence, I acknowledge that I have read the Code of Conduct for Expert Witnesses in the Environment Court Consolidated Practice Note (2011). I confirm that I have complied with the Code of Conduct in preparing this evidence.

SCOPE OF EVIDENCE

7. The push to improve reliability of water supply has been a key driver to irrigation investment in the Ashburton District.

   As a result, I have observed that productivity per mm of water has increased dramatically, alongside improvements in other associated environmental and resource use efficiency metrics.

   The 70,000ha RDR scheme (existing footprint, with potential to go to 94,500 ha) has been the leader in those improvements as its farmer shareholders have responded to commercial drivers for improved water reliability.

   The purpose of my evidence is to outline the impact of a potential decline in water reliability.

8. The scope of my evidence is:

   a. summary of current water reliability for existing consented takes;

   b. rationale for the economic and environmental drivers to improving reliability;

   c. assessment of the impact of a reduction in reliability

CURRENT RELIABILITY

9. Over the past 20 years, but particularly in the past five years, the optimal degree of reliability sought by irrigators in the Ashburton District has increased into the band between 95% and 100% reliability. By definition, a reliability of 90% means that plant demand cannot be met one year or 1 day in 10, and 95% reliability means plant demand cannot be met on a one in 20 year or 1 in 20 day occurrence.

   The movement in desired reliability is a response to:

   a. Farmers observed evidence of a strong correlation between increasing reliability, decreasing water volume used (that is, irrigating “just in time” rather than “just in case”), and enhanced resource use efficiency. [1] The “just in time” behaviour is enabled by having water stored as a buffer available for use if rain does not occur or evapotranspiration increases. I will explain the reasons behind this behaviour change later in my evaluation.

   b. Heavier capitalisation of farms, both in type of land use, non irrigation capital and irrigation capital. For example, heavy investment in plant, drying facilities, management, bees and other inputs to grow carrot seed (half the global requirement) cannot be compromised by lack of water at flowering.

   c. A high extraction or capital cost for additional water (12.5 c/m^3 – 25c/m^3) depending on source, with stored water, either in dams or extracted via wells from underground storage, at the top end of that.

      Hence any efficiencies that can either save water of prevent purchase of additional water have tended to be pursued

OUTCOMES

10. The use of "deficit irrigation" for greater control of soil moisture timing to enhance environmental management opportunities. The result is better utilisation of rainfall and minimised nutrient leaching. Deficit irrigation is the practice of irrigating to maintain a slight soil moisture deficit capable of leaving room to absorb small rainfall events (typically up to 10 mm, but up to 25mm on high moisture capacity soils.)

11. Lower absolute water use (m^3/ha/yr), more accurate water placement, and better predictability of when to apply that water has reduced water drainage,

[1] Macfarlane presentation to MAF seminar "Financing Pathways for Rural Water Infrastructure" MRB study for Environment Canterbury and the CWMS study "On-farm Impact of Variation in Reliability".

which in turn, has reduced nutrient leaching. Key enablers to that outcome include low application, fast return period systems, variable rate irrigation (more recently), and remote moisture and temperature sensing technology.

Resource use efficiency has been further enhanced via higher pasture and crop yields, and greater confidence to reduce inputs per unit of target yield.

MRB have analysed these trends through Overseer 6 to model outcomes. A summary is written below

12. Farmers on the RDR schemes (Mayfield Hinds Irrigation Limited, Valetta Irrigation Limited, Ashburton Lyndhurst Irrigation Limited), have demonstrated clearly that there are water efficiency, productivity, and environmental gains from improving reliability above the 92% reliability inherent in the "run of river" take. They have voluntarily invested in on farm storage, and now in "in scheme" storage (Carew ponds in Mayfield Hinds. 6.1 M3 storage at a cost of $14M) in order to increase reliability. As a result, water use per hectare has reduced, pasture and crop productivity has increased, electricity consumption, which has increased as spray irrigation replaced flood, is now decreasing as the schemes pressurise their water conveyance system by piping, and nutrient leaching has declined. Typically, best practice farm output of wheat, milk and meat per millimetre of applied water, has more than tripled in the past decade. Sections 13, 14, 15 demonstrate the progress in these metrics over the past 30 years. I have calculated these metrics based on my experience with farmers, and on my own properties, over that period of time.

13. Top 20% output of meat, milk and wheat (kg product/ha)

	mm water used	Meat & Wool	Milk Solids	Wheat
1980's flood	950	340	900	7000
1990's flood	750	420	1100	8000
2000 boom	600	645	1400	9000
2010 pivot	500	800	1711	13000

14. Output per mm water (kg produce/mmwater)

	Meat & Wool	Milk Solids	Wheat
1980's flood	0.36	0.95	7.4
1990's flood	0.56	1.46	10.7
2000 boom	1.08	2.33	15.0
2012 pivot	1.6	2.4	26.0

15. Output/kgN leached (kg output/kgN)

	Meat & Wool	Milk Solids	Wheat
1990's flood	8.4	15.7	160
2013 pivot	40	68	650

16. The net result is that farmers with systems such as that described now typically switch off water application further in advance of a rain, and commence longer after the rain. That behaviour is consistent with my earlier “just in time”, not “just in case” comment.

The key benefit to the farmer is that he or she is more efficient in energy and nutrient use. Both those inputs are high cost.

The environmental benefit is lower leaching of nutrients carried to groundwater through “just in case” watering, even though such excess water does have a dilution factor. The electricity saving dominos into reduced need for new generation capability.

In my experience, such farmer behaviour has now become mainstream. That means more than 50% of irrigated farmers in the Mid Central Canterbury think from that perspective, with uptake occurring at a fast rate as visible and financial evidence of gains, backed by publicity around policy, and transparency around input use and outcomes from the use of telemetry and associated technology increases.

POSSIBLE COSTS AND BENEFITS FROM ENHANCED RELIABILITY AND THE COST OF REDUCED RELIABILITY

17. MRB has, over the past decade completed a number of extensive exercises analysing costs and returns from enhanced reliability and additional storage creating that reliability.[2] I note that the absolute costs and returns fluctuated over that decade but the marginal return on marginal capital has not moved significantly.

18. In 2010, MRB were commissioned by Geoff Henley, facilitating the Canterbury Water Management Study on behalf of Environment Canterbury, to analyse the farm gate economic impact of a change in water reliability.

We applied the reliability scenarios to four farm models:

a) 100% irrigated dairy

2. “On farm impact of variation in reliability”, March 2011, a report for Environment Canterbury by MRB[2]

b) 50% irrigated dairy support

c) 50% irrigated mixed livestock and arable

d) 100% irrigated arable and process crops

In that work, we examined the impact of a 15% change in reliability (that is, a range from 80% to 95%) was examined.

All examples were tested using Aqualinc to model years of higher and lower reliability, from which plant available water could be applied to biological models (Udder, Farmax, wheat etc) and then run through whole farm budgets.

19. Key price parameters used include:

Milk	$6/kg MS
Maize silage	22c/kgDM
Barley	$830/ton
Pasture silage	15c/kgDM
Cow grazing	$23/hd/wk
Heifer grazing	$9.50/hd/wk
Feed wheat	$400/t
Milling wheat	$450/t
Potatoes	$220/t
Grass seed	$2.10/kg
Clover seed	$5.40/kg
Carrot seed	$32/kg
Lamb	$6.10/kg (summer)
Lamb	$6.50/kg (winter)

For more detail, the report summary is attached to my evidence.

20. Key metrics determined from a 15% difference in reliability included:

	80%	95%	Units
Non dairy pasture production	8275	10598	kgDM/ha
Dairy pasture production	10429	12957	kgDM/ha
Milling wheat yield	8.2	9.5	t/ha
Feed wheat yield	11.6	12.0	t/ha
Process peas	8.0	8.0	t/ha
Grass seed	1.96	2.2	t/ha
Clover seed	800	900	t/ha
Potatoes	62	65	t/ha

Milk output	1113kg/ha	1287kg/ha

21. Summary of analysis

Assuming no short term opportunity to change land use capital to improve reliability, the change in marginal EBIT/ha is $430 for a 15% change in reliability.

Assuming land use alters over time to optimise the level of reliability, the change in EBIT is $830/ha for a 15% change in reliability. Such an optimisation of land use involves investment of additional capital to optimise returns.

As a result, the marginal increase in return on marginal capital invested is 10.4%. That is, the higher return per hectare ($830) is diluted by the additional capital.

Where the capital is already invested, the loss of reliability reduces the return on capital by 59%, from 5.73% to 3.4%.

This return on capital can be calculated per 1% change in reliability at:

a) Where additional capital investment is discretionary, return on capital reduces by 0.7% per 1% change in reliability

b) Where that capital is already invested, and reliability drops, a decline in Return on Capital of 3.9% occurs in relative return per 1% change in reliability.

22. Return per unit of water volume

Using the above analysis and work, MRB have completed for the various Canterbury irrigation entities, and in particular, the paper on reliability for Environment Canterbury, which was informed by Aqualinc analysis of irrigation demand, I estimate that on average, farmers are using an additional 45m^3/ha water per 1% of reliability gained.

On that basis, the above return of $825/ha EBIT for 15% difference in reliability equates to $1.22/$m^3$ of water.

That relationship will vary a little depending on where on the reliability curve the calculation is made but is a good estimate.

RELATIONSHIP TO RDR CONSENT ON ASHBURTON RIVER

23. I understand that RDR potentially loses 0.9m^3/sec from the Ashburton River take due to the planned increase in minimum flow. If not offset with savings from a reduced Ashburton District Council stock water take, then a significant decrease on reliability of irrigation water supply to RDR users occurs.

    The evidence of Mr de Joux documents an average loss of irrigation season reliability (8 months) in the Ashburton take of 12%, rising to 30.5% in drier years such as 2005.

    As a proportion of total water supply, that represents an average of 1.6% (assuming the Ashburton River take is 13.27% of the total RDR take), with 4% in drier years.

24. My experience and evidence of previous RDR related hearings, is that farmers behaviour is driven off 1 in 10 year events. That is, events occurring less often will be "tolerated" to the extent that they will not change farm system policy. Events occurring more often than 1 in 10 years will change behaviour and farm system policy.

    On that basis, I believe the economic loss from a permanently reduced reliability as described above will be $220/ha, or 2.77% return on total farm capital.

    If the RDR schemes, under a piped scenario can irrigate 78,000 ha without further storage, then the total on farm impact equates to $17,160,000 p.a.

    That impact is dramatically more than estimated by Harris Consulting in the report: "Ashburton River: Economic Impact of Changes to Flow Regime and Allocation"

25. Described another way, to replace the lost water in the form of storage for those dry years requires:

4700 l/sec x 30.5%	=	1433 l/sec
	=	124000m^3/day
Over 130 irrigation days	=	16,100,000m^3

At a cost of $4.50/m^3 for new storage, a capital cost of $72.5M is incurred.

Over 78000ha, that is another $1076/ha to add to existing average debt across the scheme of $17,000/ha.

26. At 9% interest and principal, the resulting $97/ha is a lower cost than the $220/ha from loss of reliability, but would further stretch balance sheets already tightened by investments in on farm storage, spray irrigation, in scheme storage, and pressurisation already completed or committed to.

    I estimate the total capital investment in RDR farms (on and off farm) over the past 10 years, and committed for the next three years, to be $1.996 billion, or $28,000 per hectare over 70,000 hectare.

27. Investment on that scale is based on confidence in the reliability of the water being utilized by the new infrastructure, and confidence in ability to service the debt incurred in the development phase.

    The enormous scale of the investment to date, and the confidence required to achieve that, is a tribute to the manner in which reliability of water supply has been guarded and enhanced to date.

    Any action which undermines that clearly successful philosophy will have implications for future confidence to invest, not only on existing infrastructure, but new infrastructure on the fringe of the schemes.

CONCLUSION

Using Mr de Joux's base data, in combination with my on farm data suggests it is critical that reliability is not reduced from the Ashburton River. If that reliability is reduced, an impact on both EBIT generation and capital values would occur.

Fortunately, a win win solution is obvious with a reduction in the now severely underutilised Ashburton District Council stock water take able to substitute for the lower RDR cut off point.

The opportunity cost of lost on farm income, lost debt servicing ability, or alternate new storage, is a very high price to pay for that stock water.

13 May 2013