

IN THE MATTER

the Resource Management Act
1991

AND

IN THE MATTER

of various resource consent
applications to irrigate land in the
Upper Waitaki Catchment

EVIDENCE OF GREGORY IAN RYDER
ON BEHALF OF MACKENZIE WATER RESEARCH LIMITED

1. INTRODUCTION

1.1 My full name is Gregory Ian Ryder. I am a water quality scientist and aquatic ecologist and hold BSc (1st Class Honours) (1984) and PhD (1989) degrees in Zoology from the University of Otago.

1.2 I am a member of the following professional societies:

New Zealand Freshwater Sciences Society;

New Zealand Water and Wastes Association; and

Royal Society of New Zealand.

1.3 I am a Director of Ryder Consulting Limited, an environmental consulting practice with offices in Christchurch, Dunedin and Tauranga. Prior to this I have held positions at the Otago Regional Council and the University of Otago.

1.4 For approximately 24 years, I have been associated with a wide variety of studies on freshwater ecology and water quality throughout the South Island. My university degrees focused on aspects of freshwater macroinvertebrate ecology with emphasis on ecosystem interactions and the effects of fine sediment deposition. For a brief period I was a regional council officer dealing with major discharge consents to water before becoming a consultant dealing primarily with water issues in coastal and freshwater environments. As a consultant, I have undertaken a wide range of investigations associated with the effects of human activities on aquatic environments.

1.5 In 1993, I acted as a technical editor for the Ministry of the Environment in the preparation of its 1994 publication, "Water Quality Guidelines No. 2: Guidelines for the Management of Water Colour and Clarity". I designed, and for a number of years ran, Environment Southland's State of Environment freshwater monitoring program. I have assisted both Environment Southland and Otago Regional Council in developing their

respective regional water plans. I have been project manager for major studies on South Island river ecosystems. Regional councils and government departments have engaged me to peer review environmental studies and resource consent applications, and I have held the position of an independent commissioner on a number of resource consent hearings associated with marine farming, water abstraction and wastewater discharges.

1.6 I have considerable experience with water abstraction for hydro-electric, irrigation and drinking water supply schemes, and have been contracted by owners, regional councils and government departments to provide ecological assessments on a number of existing and proposed schemes, large and small, throughout New Zealand. I am currently assisting Environment Southland in reviewing its SOE surface water monitoring data in relation to land use practices.

1.7 I am familiar with the upper Waitaki Basin and have undertaken a number of surface water ecological surveys in relation to point and non-point source activities. I have recently visited three large farms in the McKenzie Basin (Glen Eyrie Downs, Killermont Station and Ohau Downs) and have undertaken ecological assessments of these farms in relation to proposed land use changes associated with irrigation.

1.8 I was initially engaged by McKenzie Water Research Limited (MWRL) to undertake a peer review of the aquatic ecological and water quality assessments of Dr Brian Coffey. I have subsequently reviewed aspects of the Water Quality Study (WQS) prepared by GDH (GHD 2009) and have read the evidence of Dr Bright, Dr Coffey, Mr Kyle, Mr Ian McIndoe and Dr Melissa Robson.

1.9 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note (31 March 2005). I have read and agree to comply with that Code. Except where I state that I am relying upon the specified evidence of another person, my evidence in this statement is within my area of expertise. I have not omitted to consider material facts known to me that

might alter or detract from the opinions which I express.

2. SCOPE OF EVIDENCE

2.1 I have been asked to provide an opinion on the approach adopted in the WQS in relation to assessing effects on surface waterways, the robustness of the work undertaken by Dr Coffey in relation to describing the existing ecology of surface waterways of the McKenzie Basin and his assessment of ecological effects from increased irrigation on these waterways with the adoption of the mitigation 'toolkit' of the WQS, as described in the evidence of Dr Robson.

2.2 I also give my own opinion on the status of aquatic communities of the McKenzie Basin and how they may be affected under proposals to increase the area of land irrigated, but subject to recommended mitigation measures outlined in the WQS, as set out in the evidence of Dr Robson.

2.3 The details of the land use changes sought with increased irrigation in the McKenzie Basin have been described by others at this hearing (refs) but in brief involve an increase in irrigated land from approximately 8,159 hectares to 36,526 hectares. The bulk of the irrigated land subject of the WQS work is situated in the Lake Benmore catchment downstream of lakes Tekapo, Pukaki and Ohau.

3. EXISTING ECOLOGICAL AND WATER QUALITY STATUS OF UPPER WAITAKI LAKES AND RIVERS

3.1 Dr Coffey has surveyed key streams within existing and proposed irrigation land that flow into Lake Benmore. His focus has been on describing the benthic communities (that is macroinvertebrates, macrophytes and periphyton) as well as describing their physical character and how that may be influencing the biology of these streams. He has also reviewed information relating to fisheries values and water quality. Streams within the area have received considerable recent attention from the Department of Conservation due to the presence of several species of non-migratory galaxiids, some of which have limited geographical distribution and habitat

requirements.

- 3.2 Dr Coffey notes that his surveys were conducted in late summer following sustained dry weather conditions and stable flows. These are what I and many other freshwater ecologists frequently refer to as annual worst case conditions for stream ecosystems as they typically provide ideal conditions for maximum algae and plant growth coinciding with low flows, warm water conditions and compromised water quality (e.g., elevated nutrient concentrations and large diurnal swings in dissolved oxygen and pH). This combination of factors is usually unfavourable to aquatic biota that thrive in alpine and upland streams with stony beds. Consequently I consider Dr Coffey's survey timing and his methodology in general to be appropriate for providing an overview of environmental conditions in these streams.
- 3.3 My only concern with the survey methodology is the lack of quantitative periphyton data in a form that is directly compatible with the model output predictions of nutrient levels presented in the WQS work (i.e., periphyton growth expressed as chlorophyll *a*). This presents some difficulties in assessing the existing state of streams relative to the predicted changes under irrigation, and ECan plan standards, but can be remedied with additional targeted pre-irrigation monitoring over the summer/autumn period. I understand that the draft consent conditions presented in Mr Kyle's evidence makes provision for periphyton monitoring, an approach I concur with.
- 3.4 For lake characterisation, emphasis has been on determining the trophic level of Lake Benmore and its various arms. I consider this to be an acceptable approach given that potential effects from an increase in the nutrient status of lake inflows are largely to do with increased plant and phytoplankton growth, with resulting flow-on effects to other components of the lake ecosystem, depending on the magnitude and duration of the nutrient influx. The approach is also broadly compatible with that used by ECan scientists (e.g., Hayward *et al.* 2009).
- 3.5 Other potential changes in the water quality of lake inflows, including
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inputs of faecal bacteria, oxygen demanding substances and sediment, are possible, as when land use is intensified to support greater numbers of farm animals, increases in the concentrations of these contaminants are frequently observed. However, as has already be presented in the evidence of Dr Robson and others, MWRL has adopted an integrated approach to managing losses of nutrients from irrigated land, and a number of options provided in the mitigation 'toolbox' contained within the WQS will, by default, have a significant effect on minimising potential inputs of all contaminants to Lake Benmore (as well as its surface and groundwater inflows).

- 3.6 Dr Coffey has noted that the present overall instream habitat quality of Twizel River, Mary Burn, Stony River, Wairepo Creek, Quailburn and Omarama Creek is degraded in the lower reaches relative to upstream sites.
- 3.7 Dr Coffey has attributed these degraded conditions to land use but is unable to determine the contribution from existing irrigation practices. I have viewed first hand a number of tributaries within the McKenzie Basin (Ahuriri River, Omarara Stream, Six Mile Creek, Wairepo Creek, Mary Burn, Serpentine Creek) and have surveyed some of these. My overall impression is that they support benthic and fish communities typical of streams flowing through extensively farmed land that have little protection of riparian margins. I consider this lack of protection strongly influences the make-up of stream communities. These effects are probably historic in nature and likely to have been occurring for many years.
- 3.8 Dr Coffey has noted the relatively high diversity of the bird and fish communities within the McKenzie Basin. He notes that a "*further significant deterioration of water quality ... would therefore be of concern*". I agree with this statement, but would also add that the physical character of these waterways, including channel character (sinuosity, depth, wetted width, bed material, bank stability), flow and riparian cover are likely to play equally important roles in supporting fisheries and associated riverine bird communities. Therefore, while emphasis in the WQS has been on minimising nutrient losses to surface waterways, protection and ultimately
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enhancement of the physical character of these waterways and their associated riparian margins, if undertaken, will in my opinion provide significant benefits to aquatic communities particularly their more desirable components.

- 3.9 The benefits of channel and riparian protection are likely to be greatest for smaller streams that flow through or are downstream of farm land.
- 3.10 Fish biodiversity, salmonid rearing habitat, angling and visual aesthetics are probably the key aspects of the McKenzie Basin rivers that should be considered in setting management objectives.
- 3.11 With respect to potential irrigation effects, managing nutrients inputs to reduce the potential for nuisance periphyton growths is probably the most important issue to consider, although as I have already noted above, associated effects from land use intensification, namely increased stock numbers and access to riparian and stream margins, is of equal importance in my opinion.
- 3.12 The water quality and habitat requirements of a number native fish species present within the McKenzie Basin are not well understood, but we can assume that where they are currently found in abundance is indicative of their preferred habitat requirements. I would expect that managing periphyton and macrophyte growths in these habitats, together with the stream physical characteristics as described above, will provide adequate protection of these species.

4. LAKE AND RIVER THRESHOLDS FOR NUTRIENTS

- 4.1 Lake and river thresholds for nutrients have been derived via inputs to the WQS by Dr Coffey and others. These included recommendations that nitrogen and phosphorus loads should be managed to ensure the trophic state of the Ahuriri Arm of Lake Benmore remains in an oligotrophic state, and managing stream periphyton growths to not exceed a 25% increase in the annual average maximum biomass at any stream node.
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- 4.2 The trophic status of the Northern Arm of Lake Benmore is currently microtrophic and in my opinion, a shift to an oligotrophic state would have no significant ecological, aesthetic or recreational effects. This assessment is consistent with that of Dr Coffey and is consistent with the trophic characteristics of lake types contained within Burns *et. al* (1999).
- 4.3 In terms of a permitted percentage increase in mean annual maximum periphyton biomass for streams, Dr Coffey has outlined his reasoning for allowing such a potential increase at paragraph 7.15 of his evidence. I agree with him where he states that adopting the Ministry for the Environment Guidelines (Biggs 2000) or Environment Canterbury Proposed Water Quality Guidelines (Environment Canterbury 2004) would permit no further increase in nutrient concentrations in the McKenzie Basin (paragraph 7.16). In my experience, the nutrient concentration aspects of these guidelines are highly restrictive and are frequently exceeded in stream environments subject to relatively little human influence and containing good quality macroinvertebrate communities and support robust fish populations.
- 4.4 Predicting periphyton biomass in streams based on theoretical nutrient inputs is likely to be subject to some error as there are a number of other factors influencing the accrual of biomass, for example flood frequency, water clarity, temperature, riparian cover, bed material and invertebrate grazing pressure. These variables are difficult to account for without undertaken site specific studies over a long period.
- 4.5 In addition to this, some mitigation toolbox measures, in particular greater riparian protection, is likely to result in greater cover and consequently less opportunity for macrophyte and periphyton growth despite a potential increase in nutrient concentration.
- 4.6 A complicating issue is the presence of *Didymo* in some McKenzie Basin streams. *Didymo* is capable of very high biomass even in low nutrient river systems (e.g., the Hawea River that drains oligotrophic Lake Hawea). I recommend that that the 25% maximum increase in annual mean
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maximum periphyton biomass excludes Didymo. This approach would account for the potential spread of Didymo to other rivers in the McKenzie Basin, regardless of their existing or future nutrient status, and is consistent with Hayward *et al.* (2009).

- 4.7 I agree with Dr Coffey where he states that a 25% increase in annual mean maximum periphyton biomass would probably not be noticeable to the casual observer. His studies have revealed that the benthic ecology of many streams is already compromised in that they reflect enriched or modified habitat conditions. My own observations of several streams in the McKenzie Basin is that they are already significantly modified by surrounding land use practices and are by no means in a 'natural state'.

5. MONITORING AND FUTURE MANAGEMENT

- 5.1 I note that the current land use including existing irrigation operations is being treated as the baseline from which any potential effect has been assessed. This approach is appropriate in my opinion, but only if there is good baseline data against which to make assessments. In this respect I recommend that monitoring of the existing environment be continued in order to further develop the baseline dataset. For example, monitoring periphyton biomass at stream nodes over the November-April period would provide good quantitative information for pre/post irrigation comparative purposes and assessments against national guidelines and ECan plan standards.
- 5.2 Given the adoption of a baseline position, the monitoring programme needs to be tailored to measure the concentrations and loadings of nutrients, and assess periphyton biomass, at the various node points used in the WQS. Establishing a monitoring programme sooner than later will allow a more robust baseline to be established and enable a wider range of environmental conditions to be considered under the baseline situation.
- 5.3 Given the scale of the land use change under irrigation in the McKenzie Basin, and the potential for environmental change to surface waters should
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mitigation measures not be implemented in an appropriate manner, I recommend independent verification of the monitoring programme and mitigation measures at the catchment, sub-catchment and farm levels. The regional authority is the most appropriate agency to undertake this role.

5.4 I agree with the approach to farm scale and catchment scale monitoring and the corrective action programme as detailed in the evidence of Drs Bright and Robson, and these are reflected in the draft conditions presented by Mr Kyle.

6. CONCLUSIONS

6.1 Assessments within the WQS including those of Dr Coffey have focused on the effects of increased irrigation on nutrient inputs to ground and surface waters. I agree that nutrients are likely to be the primary contaminants of concern when addressing the effects of irrigation and associated land use intensification on waterways. However, other contaminants are produced under irrigation and intensive farming systems, and these will vary depending on the nature of the farming operation.

6.2 Controlling inputs of other contaminants to waterways will be addressed, by default, via farm management plans designed to control nutrient inputs. The effectiveness of these mitigation methods will be dependant on how well they are implemented, monitored and amended in response to monitoring information.

6.3 The WQS has been undertaken on a scale and with a level effort that to my knowledge has not been previously attempted in the South Island. The predictions of modelling outputs appear relatively robust, however appropriate monitoring will be required over time to ensure predicted effects and environmental responses are correct. The use of the mitigation toolbox approach outlined in the WQS and summarised in the evidence of Dr Robson is in my opinion a sound approach to avoiding significant adverse effects on water quality and aquatic communities.

6.4 In my opinion it is also critical that farm management plans are tailored for

individual farms within specific catchments, and that these be monitored and refined in response to environmental effects. The degree of adoption of on farm management practices (as recommended in the toolbox) and level of monitoring required both on spatial and temporal scales should not be underestimated. It is crucial that these processes be adopted and enforced on a catchment-wide basis in order to ensure environmental effects are acceptable.

6.5 Finally, it will also be important to adaptively manage the management of farm systems within the McKenzie Basin should monitoring indicate that mitigation options are not adequately reducing the effects of irrigation on receiving water environments. In this respect I agree with the comments from Dr Bright that corrective action programmes applicable at farm-scale and at catchment scale are also required.

6.6 Mr Kyle in his planning evidence concisely summaries the adaptive management approach where he says that *“if the results of monitoring indicate that farming regimes are leading towards adverse effects that, left unaddressed, may become significant, these findings can then be used to require the consent holders to adapt their farm management practices”*. This latter statement is the sharp end of the knife and the adaptive management approach must be enforced in order for environmental effects to be maintained within acceptable levels. I am confident that the conditions recommended by Mr Kyle would provide the necessary level of enforcement.

7. REFERENCES

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