IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the Proposed Canterbury Land and Water Regional Plan

SUPPLEMENTARY EVIDENCE OF SHIRLEY ANN HAYWARD RESPONDING TO QUESTIONS FROM THE GROUP 2 HEARING

1. INTRODUCTION

1.1 My name is Shirley Ann Hayward and I have the qualifications and experience described in my Evidence in Chief dated 4 February 2013, although I note that tomorrow, on 19 June, I will commence employment with DairyNZ as a Water Quality Specialist. I repeat the confirmation given in that statement that I have read and agree to comply with the Code of Conduct for Expert Witnesses.

1.2 I have prepared this supplementary evidence in response to questions asked by the Hearing Commissioners in relation to my evidence in chief for the Group 2 hearing.

2. EFFECT OF REDUCED N LOSS ESTIMATES ON DR COOKE'S CATCHMENT MODEL PREDICTIONS

2.1 Commissioner van Voorthuysen asked what the implications were if Dr Cooke's catchment attenuation estimates were incorrect. In considering this question, I have reviewed the three scenarios modelled by Dr Cooke:

(a) 10% increase in N loss onall pastoral land use as permitted by the proposed plan;

(b) Environment Canterbury irrigation development estimates;

(c) AERU irrigation development estimates;

2.2 I have also considered the capped scenarios.

2.3 In my rebuttal evidence for the Group 2 hearings I considered that it was likely that Dr Cooke's high apparent attenuation rates were related to over-estimates of N inputs from agricultural land uses (paragraph 3.2). In particular, Table 2 in Dr Cooke's Group 2 hearing evidence reported average export coefficients for dairy farms of 67 kg N/ha/yr for the Ashburton catchment, 73 kg N/ha/yr for the Selwyn catchment which appear high and contrast with the low value of 33 kg N/ha/yr for the Rakaia catchment. Dr Cooke refers to Dr Dewes' evidence as the source of these values but I cannot find any reference for the basis of these values in Dr Dewes evidence. Furthermore, in Dr Cooke's modelling of future irrigation scenarios, a higher export coefficient value for new dairy farms of 90 kg N/ha/yr was used for the Ashburton and Selwyn catchments and 20 kg N/ha/yr for the Rakaia catchment. Based on a recent modelling exercise of dairy farms in the Sewlyn Waihora zone by DairyNZ[1], a value of 90 kg N/ha/yr appears at the upper end of the range given for dairy farms on light soils (67 – 90 kg N/ha/yr). If the farm export coeffients are overestimated, the model calibration method used by Dr Cooke will result in an overestimate of the catchment attenuation rates (under estimate of attenuation coefficient).

2.4 Another source of potential error in the estimates of N inputs is the values used for point source discharges. These appear to be taken directly from an Environment Canterbury report estimating N and P loads from point source discharges in the various zones in Canterbury[2]. This will over-estimate N loads from at least the Selwyn catchment because the value used by Dr Cooke for this catchment (Table 3) of 463,000 kg N/yr is an estimate of the total point-source load for the whole Selwyn Waihora zone, of which the Selwyn catchment is only a subset.

2.5 If the attenuation estimates are incorrect because the agricultural export coefficients (particularly for current and future dairy farms) are overestimated, then predicted N loads in the 3 scenarios will be less than that reported in Tables 4 and 5 of Dr Cooke's evidence. This is likely to be only a small

1. Howard, S., Romera, A., Doole, G.: Selwyn-Waihora nitrogen loss reductions and allocation systems. DairyNZ report.
2. Loe, B. 2012: Estimating nitrogen and phosphorus contributions to water from discharges that are consented and permitted activities under NRRP. Environment Canterbury report no R12/18.

reduction in the N loads predicted for the scenario of a 10% increase in pastoral N losses. The predicted increase in N loads in the future irrigation scenarios could be much lower than that reported by Dr Cooke. However, I cannot quantify by how much without re-running Dr Cooke's or a similar model.

2.6 In the exercise where Dr Cooke modeled a range of N caps for the Ashburton and Sewlyn catchments, a higher attenuation rate (lower baseline N input estimates) would reduce the predicted catchment wide N load reductions shown in Figure 4 and Table 6 of Dr Cooke's evidence. That is, the reduction in N load for the Ashburton and Selwyn catchments predicted by a cap of 20 kg N/ha/yr would be less than the 16 and 26% (respectively) predicted reduction for current land uses (Table 6 of Dr Cooke's evidence).This also means that the upper cap limit (40 kg N/ha/yr) modeled by Dr Cooke is not likely to result in reductions in N loads to the extent indicated in Figure 4 for current land uses.

3. CLARIFICATION OF QUESTION ASKED BY COMMISSIONER SHEPPARD

3.1 Commissioner Sheppard asked whether current levels of nitrogen loads are consistent with safeguarding the life supporting capacity of the water, soil and ecosystems for the catchments that were modelled by Dr Cooke. I stated that for the Selwyn catchment my analysis of the level of compliance with the outcomes in Table 1 indicated that the Selwyn catchment did not currently meet these outcomes and that holding nutrient levels at their current level '*won't necessarily safeguard the life supporting capacity of the river'*. On reflection, I wish to clarify my response, particularly in regard to whether the outcomes in Table 1 reflect thresholds at which the life supporting capacity is safeguarded.

3.2 In general I do not consider the numeric outcomes in Table 1a and 1b to be at the threshold of safeguarding the life-supporting capacity of waterways, and in most cases are above that threshold. The exception is possibly the QMCI criteria for urban streams which could be considered at the threshold of supporting life-supporting capacity (equates to a water quality classification of 'poor'[3]).

3. Stark JD, Maxted JR. 2007. A user guide for the Macroinvertebrate Community Index. Prepared for the Ministry for the Environment. Cawthron Report No. 1166.

3.3 My analysis of the Selwyn River in my Group 2 hearing evidence showed that the lower Selwyn River does not meet the water quality outcomes in Table 1a for filamentous algal growth, which is set at a threshold for avoiding nuisance growths that adversely affect aesthetic and recreational values periphyton (MfE 2000). On reflection this is not, in my opinion, a threshold of safe guarding the life supporting capacity of the river.

3.4 In summary, while the water quality outcomes in Table 1 are not met in all cases, I am of the view that for the three rivers modelled by Dr Cooke, the current nitrogen loads are consistent with safeguarding the life supporting capacity of the water and ecosystems in those rivers.

4. MATERIALITY OF IMPACTS OF THE FARMS THAT WERE UNDERGOING CONVERSION TO DAIRY FARMS PRIOR TO NOTIFICATION OF THE PLAN

4.1 Mr Griffiths outlined in his evidence for the Group 2 hearing the number of farms in each Canterbury Water Management zone that were in the process of converting to dairy farms at the time the proposed plan was notified. Commissioner van Voorthuysen asked Ms Campbell about the materiality of allowing these conversions to proceed.

4.2 Mr Cullen has provided details of the farms in each of the orange and red nutrient allocation zone and an estimate of the nitrogen leaching loss expected once the farms are fully converted. Ideally these farm nitrogen leaching losses could be compared to the total nitrogen load for each zone. However, I was unable to obtain estimates of total nitrogen loads for the nutrient allocation zones from Environment Canterbury, and therefore I am not able to quantify the effect of these new conversions on the current nutrient loads in each zone.

4.3 However as shown in Mr Cullen’s table, there are only between 1-3 new conversions occurring in each zone. Mr Cullen’s table shows that in most cases, modest stocking rates are anticipated and the predicted nitrogen losses are not excessive. Of the 27 farms undergoing conversions in the orange and red zones, only 2 are changing from dryland farms to irrigated dairy farms. The remaining 25 are changing from irrigated sheep or mixed farm systems to irrigated dairy farms, which means that nitrogen increases will be less than if all farms were converting from dryland to irrigated systems.

4.4 Given that there are only a small number of farms that are undergoing dairy conversions in each zone, and that most are converting from an already irrigated farm system, I do not consider that these farms will result in any material difference in the nutrient allocation status of the relevant zones. In addition, the industry-initiated measures outlined by Mr Ryan and Mr Cullen will likely ultimately result in reductions in nutrient loads in these zones.

5. USE OF SCHEDULE 5 WATER QUALITY STANDARDS

5.1 As discussed in paragraph 4.5 of my rebuttal statement for Group 2 hearings, the Schedule 5 water quality standards were developed as thresholds for determining the activity status of point source discharges to surface waters.

5.2 It is important to note that the water quality standards do not always have a direct relationship with the water quality outcomes set out in Table 1 when applying to individual water bodies. This means that for any given river or lake, compliance with the water quality standards does not necessarily mean that compliance with Table 1 will be assured. Conversely, non-compliance with Schedule 5 does not mean that the water quality outcomes in Table 1 will not be met. In my view it is necessary to carry out catchment or river specific analyses to determine relevant water quality thresholds (especially for nutrients) that do not prevent achievement of the outcomes. This is because of the high degree of variability in key attributes such as frequency of floods, water clarity, and substrate type that occurs within each of the broad river and lake management units which mean some waterways can assimilate more nutrients than others while achieving the same periphyton, phytoplankton or macrophyte outcomes.

5.3 Notwithstanding the limitations of the water quality standards and their relationship with the outcomes sought in Table1, there may be merit in their application to other activities such as land use or water takes (e.g., farming or large water abstraction).

5.4 Of the water quality standard parameters listed in Schedule 5, nutrients and *E. coli* have the most relevance to diffuse discharges from agricultural land uses (that are not addressed by specific rules addressing agrichemical use and effluent). Other parameters such as temperature, pH, colour and clarity are appropriate for point source discharges but have less relevance to diffuse agricultural discharges.

5.5 The availability of water quality data for rivers and streams across the region is patchy, with very little data available for some areas and only small and sporadic datasets available in other areas. Furthermore, detailed technical assessments may be required in some locations in order to determine the location of the receiving surface water body. This means that in some places it would not be possible for a landholder to know or easily ascertain whether they would be in compliance with a permitted activity condition requiring compliance with Schedule 5.

5.6 However, there is potential for water quality standards to be considered as part of a restricted discretionary or discretionary activity rule where the burden of proof already requires technical evaluation of the potential effects of the activity. In my view it is appropriate to do so in respect of nutrients for diffuse discharges. They are relevant to agricultural land uses. There is some data available for most catchments.

5.7 In some ways referring to the relevant water quality standards may be more meaningful and easier to evaluate than, for example, the requirement in rule 5.45 (of the s 42A report recommendation) where the exercise of discretion includes (amongst other things) consideration of '*3. The contribution of nutrients from the proposed activity to the nutrient allocation status of the management zone'.* This particular consideration is in my opinion near impossible to evaluate because of the lack of transparency in the derivation of the nutrient allocation status map. An alternative may be consideration of the activity on the achievability of the relevant water quality standards for nutrients in Schedule 5.

5.8 While I am of the view that nutrients are relevant to diffuse agricultural discharges, not all nutrients are relevant in all situations.

5.9 The nutrient standards for rivers in Schedule 5 were developed on the basis that an adequately protective nutrient standard was set for the nutrient that was likely to be most limiting on periphyton for each river type.[4] In the case of

4. Hayward, S., Meredith, A., Stevenson, M., 2009: Review of proposed NRRP water quality objectives and standards. Environment Canterbury report R09/16

upland, lake-fed, and spring-fed lower basin river types, both N and P were considered potentialy important for instream plant growth and therefore, both dissolved reactive phosphorus (DRP) and dissolved inorganic nitrogen (DIN) were set a levels that were considered likely to prevent excessive growths. Banks Peninsula streams are recognised as naturally enriched in phosphorus from the volcanic rock material, and therefore DIN was set for this river type based on avoiding excessive periphyton growth.

5.10 In lower alpine and hill-fed rivers, DRP standards were set at levels based on avoiding excessive periphyton growth while DIN were set at either the 50th percentile of existing data (alpine) or on the ANZECC water quality guidelines.[5] These DIN values are not 'effects-based' thresholds in that they are not based on protection of any particular values, but are set at levels that assumed some broad, unspecified level of protection. The nutrient standards for spring-fed plains streams were set at the 50th percentile of the dataset.

5.11 The nutrient standards (total P and total N) for lakes were set at the concentration that corresponded to the trophic level index set in the water quality outcomes tables based on nationally developed lake trophic designations.[6]

5.12 While DIN[7] standards are included in Schedule 5, nitrate concentrations are not included in the Schedule 5 water quality standards or the associated toxicant table. The omission of standards for avoiding potential toxicant effects of excessive nitrate concentrations was carried over from the NRRP water quality standards where nitrate were expressly omitted from the WQL17 toxicant table[8].

5.13 Given the broad, unspecified nature of the DIN standards for lower river types in including the spring-fed plains streams, a more appropriate nitrogen limit for these river types is the nitrate toxicity guidelines that have been recently updated by Dr Hickey of NIWA[9]. These guidelines represent the best up to date

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5. ANZECC (Australian and New Zealand Environment and Conservation Council), 2000: *Australian and New Zealand guidelines for fresh and marine waters.* Australian and New Zealand Environment Council, Melbourne.
6. Burns N, Bryers G, Bowman E. 2000. Protocol for Monitoring Trophic Levels of New Zealand Lakes and Reservoirs. Prepared for the Ministry for the Environment.
7. DIN = nitrate nitrogen + nitrite nitrogen + ammonia nitrogen)
8. NRRP water quality chapter decision report
9. Hickey, C. 2013: Updating nitrate toxicity effects on freshwater aquatic species. Report prepared for Ministry of Building, Innovation and Employment

understanding of toxicity risks to aquatic fauna, and as such they could be included in the toxicant table in Schedule 5 and applied to river types where other nitrogen guidelines have less relevance.

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