IN THE MATTER OF:	Clauses 6 and 8 of Schedule 1 – Resource Management Act 1991 – Submissions on publicly notified plan change and variation – Proposed Plan Change 1 and Variation 1 to Waikato Regional Plan – Waikato and Waipa River Catchments
And:	**Wairakei Pastoral Ltd** Submitter
And:	**Waikato Regional Council** Local Authority

REBUTTAL EVIDENCE OF JONATHAN WILLIAMSON

Block 1 Hearing Topics

Dated: 26 February 2019

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SUMMARY AND CONCLUSIONS

Dr Canning for Auckland / Waikato Fish and Game Council ID 74085

1 Dr Canning discusses the timing for achievement of freshwater objectives in sub-catchments that have groundwater flow lags. While I partially agree with him that it will take some "time" for management objectives to be met in some sub-catchments, I disagree with the inference with respect to N load. The inference I took from this para was that what goes into the system, will come out in similar proportion. This is incorrect because it does not take account of the (likely) powerful effect of denitrification occurring under reducing conditions in old groundwater. Paras 17-36 of my Evidence in Chief (EIC) explain the scientific background to this.

Dr Mueller for Beef + Lamb New Zealand Ltd ID 73369

2 Dr Mueller addresses the importance of considering spatial and temporal scale variability. I support this statement and paras 16, 29.2 and 34 of my EIC describe why spatial scale is important.

3 Dr Mueller discusses the NRP and I agree with her starting premise, that the NRP approach may not achieve water quality outcomes, but disagree with her reasoning relating to nitrogen load to come, for reasons discussed in my EIC paras 17 to 36. I agree with her later reasoning regarding the need to account for the differing physical characteristics of sub-catchments and attenuation.

4 Dr Mueller discusses a different approach to achieving the Vision & Strategy involving management at the sub-catchment level. I support this approach as it reflects the differing physical characteristics of the landscape and therefore differing vulnerabilities from an N discharge perspective, as discussed in my EIC paras 29 to 36.

5 Dr Mueller states: "there are also variations across the catchment with regards to factors such as attenuation which have an impact on nitrogen concentrations in receiving water bodies that have not been accounted for in the management approach suggested by PC1. This statement is consistent with my EIC paras 29 to 36.

Dr Cox for Beef + Lamb New Zealand Ltd ID 73369

6 I am in general agreement with the evidence presented by Dr Cox.

7 Dr Cox discusses nitrogen attenuation factors and considers the use of different nitrogen attenuation factors ("apparent" and "ultimate") in models used to support the HRWO planning process to be both ambiguous and unsettling. The HRWO models assume a significant load to come, which I disagree with as discussed in my EIC paras 17 to 36. I discuss in my EIC denitrification can be significant in catchments where old groundwater discharges, hence the "ultimate" attenuation factors that were applied in the models supporting PC1 in the Upper Waikato are likely to be gross under estimates (i.e. the attenuation factor should be higher).

8 Dr Cox explains that any model platform used to support mitigation decision making in the future should be capable incorporating time-of-travel lags and dynamic basin exports. I agree with this statement and in Block 2 evidence will discuss the Ruahuwai Decision Support Tool, which was developed with this premise in mind.

9 Dr Cox explains that any future modelling should incorporate seasonality. This is a logical statement if the objective is to understand hydrological cause and effect of land management practices. I agree with Dr Cox's explanation that: "Export coefficients, attenuation rates and river flow rates (dilution) are all known to vary seasonally in nature."

Dr Depree for DairyNZ ID 74050

10 Dr Depree states that the PC1 models are "fit for purpose" for a range of tasks which he describes. I disagree that the models are fit for purpose for the reasons discussed above, being:

10.1 The "ultimate" attenuation factors do not appear to be robust and are likely to underestimate the actual rates of attenuation in the Upper Waikato where old groundwater is prevalent; and

10.2 The PC1 models are steady state, hence they do not consider seasonal or daily induced effects responsible for a significant component of catchment water quality issues.

11 Dr Depree seemingly accepts the PC1 premise of N load to come. I disagree with that premise as discussed in my EIC paras 17-36.

Ms Holmes for Horticulture New Zealand (HortNZ) ID 73801

12 I am in general agreement with the evidence of Ms. Holmes.

13 Ms Holmes discusses that "…the severity of the effects really depends on the vulnerability of the receiving environment (which is different between each sub-catchment)." This is consistent with the discussion of variability in N risk across the landscape in paras 29-36 of my EIC.

14 Ms Holmes discusses the proposed FEP protocol and why it is unclear how compliance will be measured for constituents other than N. She goes onto say that there is variability in significance and type of effects from different land uses, and how scale of enterprise can affect the level of reported discharge due to land use averaging within large enterprises. I support this discussion and consider that the different attenuation rates from different land parcels within the landscape are another factor that should be considered, as discussed in paras 29-36 of my EIC.

15 Ms. Holmes proposes an alternative approach to managing contaminants loads, which I do not support only insofar as her alternative approach is based on unattenuated loads. As indicated in my EIC para 29.2 "The hydrogeological functionality of the landscape varies; hence the same land use activity on different parts of the landscape will have a different impact on the receiving environment. For example, dairying on a lowland terrace in reasonably close proximity to a river will have a much greater impact on river water quality than the same land use either at greater distance from the river or at a higher elevation within the catchment. Therefore, management strategies can apply varying levels of stringency to reflect such spatial variability across sub-catchments". Therefore, to optimise land use utility, while still meeting agreed freshwater objectives, management must be focussed on attenuated discharges not unattenuated losses (at a sub-soil level). For example, WPL are proposing Limits and Targets (TN and TP) for PC1 that are based on observed and predicted in river (stream) loads. These are identified in the EIC of Dr Neale.

Dr Cooper for Waikato Regional Council (WRC) ID 72890

16 Dr Cooper discusses the apparent influence of nitrogen load to come in the HRWO models. In my opinion, there are two problems with this statement and therefore the points being made do not appear to be well founded:

16.1 The HRWO model does not adequately model N lags, rather it applies blanket coefficients across broad scale areas that serve to decrease the N load according to the proportionality between OVERSEER loses and measured discharges within river reaches; and

16.2 The assumptions made in the model regarding the N load to come are incorrect, as discussed in paras 17-36 of my EIC.

17 I note however that few of these reports were peer reviewed by external parties (outside the organisation producing them). In my view, peer review is now happening under the PC1 evidence and rebuttal submission process.

Ms Addenbrooke for Miraka Ltd ID 73492

18 Ms Addenbrooke explains: “Freshwater Management/Sub-catchment Units will enable more equitable and effective introduction of changes to achieve water quality improvements”. She explains how this will be achieved through an overlay of spatial dataset that include mean annual precipitation bands, river classes linking homogenous reaches and their watersheds, bio-physical bands and socio-cultural factors.

19 While I agree with the general direction of her evidence on this point, management at sub-catchment scale needs to also recognise that the N discharge risk of land parcels varies across the landscape, as discussed in my EIC paras 17 to 36.

REBUTTAL EVIDENCE OF JONATHAN WILLIAMSON

Block 1 Hearing Topics

1 My name is **Jonathan (Jon) Williamson**. I have the qualifications and experience recorded in my statement of evidence filed in relation to the Block 1 Hearing Topics.

2 My rebuttal evidence has been prepared in accordance with the Code of Conduct for expert witnesses as set out in Section 7 of the Environment Court of New Zealand Practice Note 2014.

3 Relevant to my expertise, I wish to rebut the evidence of the following expert witnesses:

Name	Submitter
Dr Canning	Auckland / Waikato Fish and Game Council ID 74085
Dr Mueller Dr Cox	Beef + Lamb New Zealand Ltd ID 73369
Dr Depree	DairyNZ ID 74050
Ms Holmes	Horticulture New Zealand (HortNZ) ID 73801
Ms Addenbrooke	Miraka Ltd ID 73492
Dr Cooper	Waikato Regional Council (WRC) ID 72890

Dr Canning for Auckland / Waikato Fish and Game Council ID 74085

4 In para 3.38 Dr Canning discusses the timing for achievement of freshwater objectives in sub-catchments that have groundwater flow lags. While I partially agree with him that it will take some "time" for management objectives to be met in some sub-catchments, I disagree with the inference with respect to N load. The inference I took from this para was that what goes into the system, will come out in similar proportion. This is incorrect, because it does not take account of the (likely) powerful effect of denitrification occurring under reducing conditions in old groundwater. Paras 17-36 of my Evidence in Chief (**EIC**) explain the scientific background to this.

Dr Mueller for Beef + Lamb New Zealand Ltd ID 73369

5 Dr Mueller addresses the importance of considering spatial and temporal scale variability in para 19 of her evidence, where she notes that: "On a spatial scale, nutrient levels vary at different locations within the same catchment, so both N and P should be limited. Spatial and seasonal variations will need to be accounted for." I support this statement and paras 16, 29.2 and 34 of my EIC describe why spatial scale is important.

6 In para 20, Dr Mueller discusses the NRP and indicates that:

> This approach may not be sufficient to achieve water quality targets for a range of factors. These factors include the nitrogen load already accumulated in the ground water system. This load means that due to historic land use activities, a currently undetermined amount of nitrogen will enter surface waters through groundwater regardless of load reductions on land. A further factor is that the approach does not distinguish between land use types or capability of land resources, and does not account for attenuation, topography, or soil types.

7 I agree with Dr Mueller's starting premise, that the NRP approach may not achieve water quality outcomes, but disagree with her reasoning relating to N load to come, for the reasons discussed in my EIC paras 17 to 36. I agree with her later reasoning regarding the need to account for the differing physical characteristics of sub-catchments and attenuation.

8 In para 22, Dr Mueller discusses additional ways to achieve the Vision and Strategy including:

> … monitoring and management of sub-catchment groups. Management approaches could include a spatial framework based on sub-catchment groups; integrated contaminant management focusing on nutrients, sediment and microbial contaminants; a focus on critical source areas at a property scale; and the consideration of a wide range of edge-of-field management options. This could also involve optimisation of the natural capital of the land, and the inclusion of ecosystem services to monitor and incentivise land management practices for effective improvements in water quality outcomes.

9 I support this approach as it reflects the differing physical characteristics of the landscape and therefore differing vulnerabilities from an N discharge perspective, as discussed in my EIC paras 29 to 36.

10 In para 62, Dr Mueller states: "there are also variations across the catchment with regards to factors such as attenuation which have an impact on nitrogen concentrations in receiving water bodies that have not been accounted for in the management approach suggested by PC1". This statement is consistent with my EIC, paras 29 to 36.

Dr Cox for Beef + Lamb New Zealand Ltd ID 73369

11 I am in general agreement with the evidence presented by Dr Cox. Dr Cox presents theory and modelling relating to nutrient transport at sub-catchment scale, specifically as it relates to modelling calibration, uncertainty, and application, and also transparency in model reporting

12 Dr Cox discusses N attenuation factors and considers the use of different N attenuation factors ("apparent" and "ultimate") in models used to support the HRWO planning process and considers them both to be ambiguous and unsettling. Specifically, Dr Cox makes the point in para 43:

> This limitation of the model does raise concerns about model over-simplification and uncertainties associated with basin attenuation.

13 As discussed in my EIC paras 17 to 36, denitrification can be significant in sub-catchments where old groundwater discharges, hence the "ultimate" attenuation factors that were applied in the models supporting PC1 in the Upper Waikato are likely to be significant under estimates (i.e. the attenuation factor should be higher).

14 In para 50 Dr Cox explains that any model platform used to support mitigation decision making in the future should be capable of incorporating time-of-travel lags and dynamic basin exports. I agree with this statement and in my Block 2 evidence I will discuss the Ruahuwai Decision Support Tool (**RDST**), which was developed with this premise in mind.

15 I support Dr Cox in para 140 where he states:

> I find the discussion of apparent vs. ultimate attenuation rates unsettling. The importance of this distinction appears to have been somewhat glossed over in the published reports. The calibration performed to parameterise the NIWA model was complicated by the fact that they used a synoptic set of observed in stream concentration data to parameterise exports and attenuation associated with the same time period. In reality, a significant portion of the observed nutrient mass in the c. 2012 data set originated in exports that occurred years, even decades, earlier. Since land use in the basin has changed dramatically over the past decade, this assumption introduces significant error.

16 In para 144, Dr Cox states, "… I recommend that both the NIWA catchment model and the supporting economics optimisation model, and all supporting data and parameterisation work, be made publicly available. Transparency is decidedly lacking in the Healthy Rivers modelling performed to-date." I would agree with this insofar as it is applicable to the supporting technical reports I reviewed (as listed in Appendix B of my EIC).

17 In para 145, Dr Cox explains that any future modelling should incorporate seasonality. This is a logical statement if the objective is to understand the hydrological cause and effect of land management practices. I agree with Dr Cox's explanation that: "Export coefficients, attenuation rates and river flow rates (dilution) are all known to vary seasonally in nature".

Dr Depree for DairyNZ ID 74050

18 In para 3.2a, Dr Depree states that he is not a modeller. However, in para 3.2d Dr Depree states that the PC1 models are "fit for purpose" for the range of tasks that he describes. I disagree that the models are fit for purpose for the reasons discussed already and as follows:

18.1 The "ultimate" attenuation factors do not appear to be robust and are likely to underestimate the actual rates of attenuation in the Upper Waikato where old groundwater is prevalent; and

18.2 The PC1 models are steady state, hence they do not consider seasonal nor storm induced effects.

19 In paras 3.4f and 6.12, Dr Depree seemingly accepts the PC1 premise of N load to come. I disagree with that premise as discussed in my EIC paras 17-36.

Ms Holmes for Horticulture New Zealand (HortNZ) ID 73801

20 I am in general agreement with the evidence of Ms. Holmes and would like to highlight key points I agree with.

21 In para 40g Ms Holmes states, "… the severity of the effects really depends on the vulnerability of the receiving environment (which is different between each sub-

catchment)." This is consistent with the discussion of variability in N risk across the landscape in paras 29-36 of my EIC.

22 In paras 46-52 Ms Holmes discusses the proposed FEP protocol and why she considers that it is unclear how compliance will be measured for constituents other than N. She goes on to note that there is variability in significance and type of effects from different land uses, and how the scale of an enterprise can affect the level of reported discharge due to land use averaging within large enterprises. I support this discussion and consider that the different attenuation rates from different land parcels within the landscape is another factor that should be considered, as discussed in paras 29-36 of my EIC.

23 However, I do not support the alternative approach (as currently proposed) to managing contaminants loads described in paras 53-59 of her EIC as it is premised on managing unattenuated loads (see para 54). As indicated in my EIC para 29.2:

> The hydrogeological functionality of the landscape varies; hence the same land use activity on different parts of the landscape will have a different impact on the receiving environment. For example, dairying on a lowland terrace in reasonably close proximity to a river will have a much greater impact on river water quality than the same land use either at greater distance from the river or at a higher elevation within the catchment. Therefore, management strategies can apply varying levels of stringency to reflect such spatial variability across sub-catchments.

24 Therefore, to optimise land use utility, while still meeting agreed freshwater objectives, management must be focussed on attenuated discharges not unattenuated losses (at a sub-soil level). For example, WPL are proposing Limits and Targets (TP and TN) for PC1 that are based on observed and predicted in river (stream) loads. These are identified in the EIC of Dr Neale.

Dr Cooper for Waikato Regional Council (WRC) ID 72890

25 In para 16 Dr Cooper, mentions that: "The model structure, inputs, assumptions and strengths and weaknesses have been detailed in the relevant peer-reviewed reports". The reference is a hyperlink that takes the reader to the WRC documents library.

26 I note however, that few of these reports were peer reviewed by external parties (outside the organisation producing them). In my view, peer review is now happening under the PC1 evidence and rebuttal process.

27 In paras 28 and 31 Dr Cooper, discusses the N load to come and indicates: "the simulation modelled the effect that groundwater lags (the N load-to-come) will have in 'frustrating' attempts to reduce future surface water N concentrations below the current state" [para 28] and "nitrogen legacies evident in groundwater in the upper catchment make it difficult to maintain or improve all water-quality outcomes at a number of monitoring sites in this location" [para 31].

28 In my opinion, there are two problems with these statements and the points being made do not therefore appear to be well founded:

28.1 The model does not adequately model N lags, rather it applies blanket coefficients across broad scale areas that serve to decrease the N load according to the proportionality between OVERSEER losses and measured discharges within river reaches; and

28.2 The assumptions made in the model regarding the N load to come associated with old groundwater are incorrect, as discussed in paras 17-36 of my EIC.

Ms Addenbrooke for Miraka Ltd ID 73492

29 In para 5.4 Ms Addenbrooke explains: "Freshwater Management/Sub-catchment Units will enable more equitable and effective introduction of changes to achieve water quality improvements". She adds in para 5.5 that this will be achieved through an overlay of spatial dataset that includes mean annual precipitation bands, river classes linking homogenous reaches and their watersheds, bio-physical bands and socio-cultural factors.

30 While I agree with the general direction of her evidence on this point, management at sub-catchment scale needs to also recognise that the N discharge risk of land parcels varies across the landscape, as discussed in my EIC paras 17 to 36.

Jonathan Williamson

Managing Director, Williamson Water & Land Advisory

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