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

Statement of evidence of Stuart John Ford

Block 1 Hearing Topics

Dated: 15 February 2019

STATEMENT OF EVIDENCE OF STUART JOHN FORD

Block 1 Hearing Topics

SUMMARY AND CONCLUSIONS

Summary of evidence

1 The objectives in PC1 are generally suitable for achieving sustainable management, subject to the amendments recommended by Mr Mckay. However, the policies, methods, and rules in PC1 are unlikely (as notified) to achieve the objectives or give effect to the NPS-FM or the Vision and Strategy. More importantly, the s 32 evaluation and the economic modelling that underpins that evaluation does not support the methods and rules included in PC1 for maintaining or improving freshwater quality.

2 My evidence therefore provides an overview of matters that will be directly relevant for the topics in Block 2. In particular, the s 32 evaluation framework has failed to test (in a meaningful and robust way) such alternatives as:

2.1 Adopting an allocation mechanism via transfer rules for nutrient discharges; and

2.2 The opportunity to adopt land use change while not exceeding the NPS-FM derived freshwater quality objectives for the river.[1]

3 These alternatives all offer superior economic and employment growth whilst maintaining or improving the environmental performance of the river system.

4 There is considerable uncertainty as to the accuracy of the HRWO modelling because of:

4.1 The accuracy of the data which populated the model;

4.2 The way that the mitigation scenarios were set up and the fact that the range of mitigations were limited before the model reverted to deintensification of land use change;

4.3 The limited range of scenarios that were modelled.

---

[1] I understand that Dr Neale has recommended (in his evidence) a number of amendments to the freshwater objectives in Table 3.11-1 to ensure that they are scientifically robust and defensible.

5 The various options available to the CSG were not adequately put through a s 32 evaluation framework that estimated in a quantifiable way the costs and benefits of the effects of each alternative on the environment, economic, social and cultural considerations.

6 In fact, the integrated assessment was completed after the CSG had made their recommendations to WRC.

7 It is difficult to determine exactly how the results of the scenarios that were run through the HWRO model influenced the CSG in their decision-making, because there is no clear relationship between the results as presented and the final form of PC 1.

8 However, it is my opinion that the enormity of the sums presented as the cost of each option would have had a significant effect on the members of the CSG, and would have caused them to be reluctant to adopt any of the other scenarios as presented.

9 It is, therefore, my opinion that reporting the scenarios as being hugely costly has led to us getting a version of PC 1 that is restrictive on land use change when there is no apparent connection between that outcome and the modelling that has been carried out.

10 It is my opinion that the s 32 evaluation as reported is inadequate because it did not fully assess the full range of options which were open to it - because it didn't consider the opportunity to allow for land use change while still maintaining water objectives.

Conclusions

11 There is considerable uncertainty as to the accuracy of the HRWO modelling which puts into contention the accuracy of the decisions made by the CSG and ultimately by WRC

12 Alternatives which all offer superior economic and employment growth whilst maintaining or improving the environmental performance of the river system were not (in reality) evaluated in a s 32 evaluation framework.

13 The various options available to the CSG were not adequately put through a s 32 evaluation framework that estimated in a quantifiable way the costs and benefits of the effects of each alternative on the environmental, economic, social and cultural considerations.

14 The economic component of the evaluation of the full range of alternatives has therefore been inadequate, and this has resulted in PC 1 (as notified) being far from economically efficient.

15 Adopting the amendments to the PC1 provisions as requested in the submissions made by WPL will greatly enhance the potential for PC1 to be economically efficient while at the same time maintaining or (where necessary) improving freshwater quality to meet the aspirations in the NPS-FM and the Vision and Strategy.

EVIDENCE

Block 1 Hearing Topics

1 My name is **Stuart John Ford**. I have the qualifications and experience recorded in my curriculum vitae **attached** to this statement of evidence as **Appendix 1**. Key aspects of my recent expert experience relevant to this Hearing include:

1.1 I have prior experience related to analysing the economic impact of proposed plan changes which all entailed both economic and nutrient management advice in:

(a) Auckland: preparing and presenting evidence on various parts of the Proposed Auckland Unitary Plan.

(b) Canterbury: preparing and presenting evidence for Central Plains Water Limited on Plan Change 1 Selwyn Te Waihora, Rangitata Diversion Race Management Limited on Plan Change 2 Hinds Plains, and Horticulture New Zealand on Plan Change 4 South Canterbury Coastal Streams.

(c) Hawkes Bay: preparing and presenting evidence for Horticulture New Zealand on the proposed changes to the Tukituki Catchment provisions.

1.2 I was initially involved in development of a suite of OVERSEER models that represented the various land uses being developed across the Wairakei Pastoral Ltd (**WPL**) since its initial development and that were used as a reference point for the APSIM modellers who created similar models for WPL using APSIM.

1.3 I reviewed the Proposed Waikato Regional Plan Change 1 (**PC1**) and Variation 1 to Proposed Waikato Regional Plan Change 1 – Waikato and Waipa River Catchments (**Var1**) documents, including a large number of the background modelling reports, that were completed for the Collaborative Stakeholder Group (**CSG**), that relate to economics (including the Section 32 Evaluation Report), OVERSEER modelling, land use, social assessments, and some of the relevant ecological reports.

1.4 I then worked with the WPL expert team to formulate the company's submission and to respond to other submitters (via further submissions) and the Var1 process.

1.5 I have reviewed the results of the Ruahuwai decision support tool (**RDST**) modelling commissioned by WPL in relation to a group of 10 relevant sub-catchments in the Upper Waikato, and created an economic model of the alternative scenario which results from that model. I am therefore able to offer an opinion on the effectiveness and efficiency of the use of the models in managing the water quality in the river.

1.6 My areas of expertise in this process are agricultural economics, land use, OVERSEER, the use of a Nitrogen Reference Point (**NRP**), the range of mitigation options available, the development and use of Farm Environment Plans (**FEPs**), and allocation mechanisms.

2 I have been engaged to prepare this evidence in support of the submissions and further submissions made by WPL on PC1 and Var1.

3 Relevant to my qualifications and experience, my evidence focuses on:

3.1 The proposed objectives included in PC1 and whether they are suitable for promoting sustainable management.

3.2 My review of the Section 42A Report and the resultant amendments to PC 1.

3.3 My conclusions.

4 In preparing my evidence I have also reviewed the background documents listed in the bibliography attached to my evidence, that underpin the Section 32 Evaluation Report.

5 My 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.

STATUTORY FRAMEWORK

6 From my understanding of the statutory framework under the Resource Management Act 1991 (**RMA**) there is a strong balancing theme that seeks to enable people and communities to provide for their social, economic and cultural well-being – while ensuring that environmental bottom lines are met. For example:

6.1 Economic well-being and the efficient use of natural and physical resources (including freshwater) are key elements in s 5(2) and s 7(b) of the RMA.

6.2 Efficient allocation of freshwater (including its assimilative capacity) and enabling communities to provide for their economic well-being (Objective A4) are features of the National Policy Statement for Freshwater Management 2014 (**NPS-FM**) as amended.

6.3 Economic well-being is also a feature of Objectives (b), (c), and (d) of the Vision and Strategy for the Waikato River, while the regional significance and importance of primary production in terms of its contribution to economic well-being is emphasised by Policy 4.4 in the operative Waikato Regional Policy Statement (**WRPS**).

7 These matters are all directly relevant because PC1 is required to achieve sustainable management, and to give effect to the NPS-FM and the Vision and Strategy. Additionally, s 32 of the RMA imposes further tests that PC1 must satisfy:

7.1 The objectives in PC1 must be the most appropriate (or suitable) way to achieve sustainable management.

7.2 The policies, methods, and rules in PC1 must be the most appropriate way to achieve the objectives and must be:

(a) Reasonably practicable; and

(b) Efficient and effective.

8 WRC must also have regard to costs and benefits when evaluating the above matters, including, whether PC1 will provide economic growth and employment opportunities or reduce them.

9 As noted above, my evidence focuses on whether the objectives in PC1 are suitable for achieving sustainable management, and my later evidence, for the Block 2 Hearing Topics (in particular), will focus on whether the policies, methods, and rules in PC1 meet the other s 32 tests. My preliminary conclusion, however, based on my analysis of the Section 32 Evaluation Report and related background documents is that the other provisions in PC1 are unlikely to achieve the proposed objectives. For example, the Section 42A Report notes (para 635) that during the critical period 2016-2026 the PC1 objectives will not be achieved in 50% of Priority 2 sub-catchments and in 75% of Priority 3 sub-catchments.

10 It is also doubtful whether the PC1 objectives will be implemented in all Priority 1 sub-catchments given the short lead-in time (2022-2026) for implementation of FEPs.

11 In other words, actions are unlikely to be in place or implemented in these sub-catchments (by 2026) to maintain or improve freshwater quality or achieve any necessary reductions in diffuse contaminant discharges.

NPS-FM and its 2017 update

12 As stated in the Section 42A Report (para 32), Waikato Regional Council (**WRC**) must give effect to the NSP-FM. I am of the opinion that WRC has not adequately addressed in PC 1 the economic requirements of Objective 4 and the requirement of Policy A7 to give consideration to how they can:

> … enable communities to provide for their economic wellbeing, including productive economic opportunities, in sustainably managing freshwater quality, within limits.

13 While I believe that PC 1 has been influenced significantly by allowing for communities to provide for their economic well-being in terms of the speed chosen in achieving the Vision and Strategy, I do not believe that the WRC has adequately considered the full range of the productive economic opportunities that can be used to achieve these considerations.

14 From an economic perspective the aim is to achieve efficiency - that is to achieve the maximum possible outcome within the constraints of whatever policy is being developed.

15 In the case of PC 1 it is my opinion that the failure to include an adequate allocation mechanism for the discharge of nutrients and the failure to provide for a trading regime for nutrients (e.g. via transfer rules) mean that the resultant plan is suboptimal in terms of meeting economic efficiency. Nowhere in the Section 32 Evaluation Report are these options considered.

16 The inclusion of restrictions on the potential for land use change mean that PC 1 is also suboptimal in terms of achieving economic efficiency, and it is my opinion that the alternative options to these provisions were not adequately considered in both the CSG process and in the Section 32 Report.

17 I will deal with these matters later in my evidence for the Block 2 Hearing Topics.

Section 32 evaluation

18 Later in my evidence I discuss my interpretation of the adequacy of the s 32 evaluation in relation to how it was carried out for PC 1 in

terms of choosing the most appropriate option and the way that it carried out the efficiency and effectiveness evaluations. Noting that it is my opinion that the efficiency and effectiveness evaluations were inadequate because they were only carried out on the selected option that was deemed to be the most appropriate.

19 The s 32 analysis includes a requirement to take into account the proposed polices and rules and in doing so identify and assess the environmental, economic social and cultural effects and, in particular, address whether the policies and rules will provide for or reduce the opportunities for economic growth and employment.

20 It is my opinion that the s 32 evaluation is wholly inadequate - because it did not fully assess the other options which were open to WRC and because it did not consider the opportunity to allow for land use change, while still meeting the freshwater quality objectives in Table 3.11-1. Land use change certainly allows for economic growth and employment and is (in my view) an appropriate option to select where environmental bottom lines are met.

21 It is therefore disappointing that WRC did not evaluate the opportunity at all or quantify the impacts to evaluate which is the best option in terms of achieving the maximum beneficial effect on the environment or the economy, along with the social and cultural framework.

22 The failure to evaluate the NRP is also a s 32 matter in terms of whether it is the most appropriate method for achieving the PC1 objectives, and in terms of the efficiency and effectiveness (in particular) of requiring that everyone above the 75th percentile must reduce their nitrogen (**N**) discharges is yet another major inadequacy of PC 1. It is my opinion that this choice is not an efficient method for reducing overall N discharges and could lead to a suboptimal outcome for the catchment. It is not obvious as to exactly what environmental outcomes are going to be achieved by this method during the plan period. If it had been evaluated appropriately (including comparison of its effects with alternatives), I believe this would have resulted in an alternative method that could achieve superior environmental outcomes at a lower cost.

23 I will deal with this matter in more detail later in my evidence for the Block 2 and 3 Hearing Topics.

MfE work programmes

24 I note that the work program recently launched by the Ministers for the Environment and Primary Industries titled the *Essential Freshwater* work program had a related Cabinet Paper that notes

that "introducing limits means that decisions on how to allocate the rights to use resources are unavoidable – not making a decision is actually a decision for the status quo".[2]

25 It is my opinion that PC 1 has erred in not allocating any rights to the resources (i.e. the capacity of water to assimilate diffuse contaminant discharges) that it intends to reduce from entering into the river. Allocating these resources at property, enterprise, or sub-catchment level is the most efficient way of achieving the desired outcome. The failure to allocate them means that there is a suboptimal outcome for the river and it means that there could (in practice) be very little control over the outcomes.

26 Regardless of whether decision-makers can have regard to such statements, it does foreshadow the Government's thinking on the issue and therefore it is my opinion that WRC as a regulatory authority should have regard to such statements.

Waikato River Vision and Strategy

27 Like the NPS-FM, PC1 is also required to give effect to the Vision and Strategy. I note that providing for economic well-being is also an important requirement of Objectives (b), (c), (d), and (j) for the Waikato River in Section 2.5.2 of the WRPS.

28 I also note that balancing economic and environmental considerations is a strong theme that emerges from the WRPS – including (as noted above) the requirement under WRPS, Policy 4.4 to have regard to "Regionally significant industry and **primary production**" (my emphasis).

29 Again, I do not consider that PC1 meets these requirements in terms of how the policies, methods, and rules have been developed and I will deal with these matters later in my evidence for the Block 2 Hearing Topics in terms of their effectiveness and efficiency.

WATER QUALITY AND ECOSYSTEM HEALTH

30 The Section 42A Report under the heading B1 Overall direction for PC1 Analysis and Recommendations (when discussing the 80 year targets and timeframes at para 113 – 118) rightly points out the differing views on an appropriate speed of achieving the freshwater quality objectives in Table 3.11-1 between those that believe that it

---

[2] Cabinet Paper: Restoring our freshwater and waterways (CAB-18-MIN-0296), para 88.

is best achieved by tackling it now and those that believe that it is best achieved by tackling it towards the end of the required time frame.

31 In an economic sense what these differing views are alluding to is the time cost of money. What submitters are basing their opinion on is their individual perspective of the time cost of money. Some believe that they are achieving their maximum economic returns now, and that achieving the freshwater objectives now would reduce their returns - so the longer that they can continue to carry on their current farming practices would be preferable. On the other hand there are other submitters who have a very different view about regulatory costs and would prefer to implement actions designed to achieve the PC1 freshwater objectives more quickly than currently provided for under PC1 as notified.

32 In the end the CSG decided on setting targets that are effectively a straight line between where we are now and where we want to be in 80 years' time. It is disappointing to me that the competing demands in terms of the speed of achievement were not mapped out in terms of the potential mitigation pathways that are available to achieve the vision so that they could have been put into an economic framework and reported as a Net Present Value which accounts for the cost of money over the time period. In this way the CSG would have been able to choose the most economically efficient pathway, that is the one that is able to meet the PC1 freshwater objectives (both short-term and long-term) with the lowest cost.

33 The CSG's decision to choose a straight-line pathway has not therefore been tested, therefore we do not have a measure of its economic efficiency. In my opinion it is a suboptimal choice.

34 In relation to time, I also note that:

34.1 Mr Williamson in his evidence considers that the period 2016-2026 (reflected in PC1 Objective 3) is the most critical for meeting freshwater objectives.

34.2 Emerging Government policy (noted above) indicates that more urgent short and long-term timeframes (5 and 30 years) may be appropriate.

34.3 The NPS-FM (Appendix 6) arguably sets more ambitious timeframes for achieving swimability than PC1 and encourages WRC to meet this objective by 2040 rather than by 2096.

34.4 It is unlikely (as noted above) that PC1 Objective 3 (short-term freshwater objectives) will be achieved in all sub-catchments by 2026 (see the Section 42A Report, p 125).

35 These matters are important considerations that are relevant to the economic analysis required under the RMA, NPS-FM, and the Vision and Strategy provisions identified above. They go to the heart of good plan change design, and whether PC1 currently gives effect to these matters.

Good farming practice

36 At para 134 of the Section 42A Report the Officers comment on moving towards an explicit requirement for the adoption of Good Farming Practice (**GFP**), formerly known as Good Management Practice (**GMP**). I have considerable experience with the adoption of GMP from my work in Canterbury. I will deal with these matters later in my evidence for the Block 3 Hearing Topics.

TOPIC B 3 SCIENCE AND ECONOMICS

41 In the Section 42A Report (para 276) the Officers contend that:

> Ahead of evidence being presented, the Officers consider the science and economic analysis and modelling to be both comprehensive and adequate to enable the RMA requirements in s32 to be fulfilled.

42 Yet when you read the minute prepared by the Facilitators of the expert conferencing to the Commissioners "Memorandum from facilitators to Waikato Regional Council's PC1 hearing panel: expert conferencing" you will note that it identified a significant number of issues, (Economics 13, Science 12) which are listed in the memorandum, which the experts thought it would be worthwhile considering.

43 In the memorandum the Facilitators conclude:

> It seems to us that the underlying issues discussed at the Forum are of such fundamental significance that it is unlikely in the available time (and at this time of year) that useful progress would be made.

44 It is very hard to reconcile the Facilitators suggestion that the issues identified were of such a fundamental significance to an understanding of the degree of confidence that the experts could have in the results of the economic model (relied on by the CSG

and WRC), with the Officers contention that the modelling was both comprehensive and adequate.

45 With regard to fulfilling the s 32 evaluation requirements under the RMA, I cannot agree that the WRC modelling meets the statutory requirements in terms of choosing the most appropriate objectives and the adequacy of its assessment of the efficiency and effectiveness of the other PC1 provisions.

46 For example, in the section on Making Reductions in the Section 32 Report (E.3) it identified 6 options and chose Option 6 (the PC1 provisions as later notified) as being appropriate - but there is no real comparison with the other alternative options. Therefore, it is impossible to be able to analyse why Option 6 is the most appropriate as is required under the RMA. The report then only considers this option (Option 6) in a s 32 framework for evaluating its efficiency and effectiveness so there is no means of comparing how it performed against the other possible alternatives within this framework and no way of evaluating if it is really the best.

47 In the section on Restricting land use change (E.4), the report only considers two options and very quickly rejects one, namely controls on changes in land use, and declares that the moratorium option is the most appropriate. It then goes on to carry out a s 32 efficiency and effectiveness analysis on the moratorium option alone. The analysis is therefore very weak in that it did not evaluate the full possible range of options and did not examine the efficiency and effectiveness requirements appropriately.

48 For these reasons, I do not consider that the report meets the statutory requirements for a section 32 evaluation – primarily, because of the weakness in applying the statutory tests to the preferred option alone rather than all of them. Therefore, there is no way of determining which is the most appropriate option.

49 In other words, it is apparent that the selection of the preferred option was carried out on grounds other than those detailed in the RMA, but the rationale for those choices are not made explicit, and then only the preferred option is run through the s 32 economic analysis alone.

50 I will deal with these matters in more detail later in my evidence for the Block 2 Hearing Topics – specifically in relation to the policies, methods, and rules for managing diffuse discharges and restricting land use change.

Topic B 3.3.1 Economic Impact of PC 1

51 In the s Section 42A Report (para 285) the Officers say that:

> The significant costs to some parts of the community of achieving the Vision and Strategy are recognised, but the achievement of the Vision and Strategy, and the NPS-FM, are mandatory. How best to do this was the key consideration for the CSG, informed by the TLG and the modelling undertaken.

52 As I have already pointed out above, the analysis of the alternatives in PC 1 is very weak and in some cases non-existent. It is the choice of the methods that causes concern, and particularly the failure to properly evaluate the full range of effects in making the choices.

53 In the following section I make comment on the adequacy of the economic and science modelling and come to the conclusion that there is a high degree of uncertainty in the results of the Healthy Rivers Wai Ora (**HRWO**) model – as a result, this puts into consideration the quality of decisions made by the CSG, the Technical Leaders Group (**TLG**), and ultimately by WRC.

Topic B 3.3.2 Economic Modelling

54 In my following evidence on the Economic Modelling topic I review the background documents listed in the bibliography attached to my evidence and:

54.1 Offer a comment on the nature of the model chosen; then

54.2 Make some comments on the impact of the data that populates it; then

54.3 Discuss the result of the range of mitigations tested; and then

54.4 Discuss how the information generated from the model influenced the final form of PC 1.

55 The **nature of the model** used is based on optimisation by mathematical programming. The HRWO model is an optimisation model that relies on the diverse relationships between land use, land management, contaminant loss, mitigation activity, pollutant attenuation, groundwater flows of nitrogen, and links between loads and concentrations.

56 In the report **General principles underlying the development of the Healthy Rivers Wai Ora (HRWO) economic model** the authors comment that:

> … it is critical to recognise that while best efforts have been made to collect the most meaningful information for a model of this kind, there remain critical uncertainties given our limited capacity to address the complexity of the problem in its complete entirety.

57 This comment leads me to the conclusion that there are critical uncertainties in being able to interpret the results of such a model if the information used in populating it creates uncertainty.

58 The most important constraints within the HRWO model mean that certain freshwater objectives are set at alternative locations within the catchment, and the model is tasked with determining how land use and land management will have to change within different parts of the catchment to meet these at least cost, given the set of input data being employed. Therefore, if the targets for freshwater quality in Table 3.11-1 are wrong, then the solution calculated is wrong. I refer to the evidence of Dr Neale as to the accuracy of the freshwater objectives used in the modelling and conclude that there is considerable uncertainty as to the accuracy of the modelling results.

59 Another constraint noted in the report **Model structure for the economic model utilised within the Healthy Rivers Wai Ora process - an overview of the model structure** is that:

> … the non-linearity of the model potentially challenges the identification of global optima through the use of non-linear programming, given that non-convexity can lead to the existence of multiple local optima.

60 This means that land use conversion is possible, but (mostly) only the options for de-intensification are simulated. This may mean that an optimal financial solution that creates a small amount of very high intensity land use and a large amount of low density is not possible within the model used.

61 The impact of the validity of the data used in the modelling is first demonstrated by the land use assumption made in order to represent the current state. As reported in NIWA 2015 the land use data used in populating the model was based on the CLUES Model Land use classification map that was created in 2012. It is my understanding that there has been a considerable amount of land use change since that data was produced therefore the results generated by the HWRO model will not represent the results that could be gained from any more recent modelling of the land use.

62 The data that populates the model for Dairy farms was provided by DairyNZ. The physical and financial data that was provided from

approximately 410 dairy farms so it would be considered to be an accurate representation of the Dairy industry in the Waikato but it was only representative of a single season that being the year 2012-13, and so only represents the performance of the dairy industry in that season rather than as a long term average result. The payout for milk solids was adjusted to reflect a long-term average price.

63 The OVERSEER files that were created to represent those farms were created using the "Dairy Industry Protocol". The protocol was issued by the Dairy industry and it gave detailed instructions about what options were to be used in entering the data into OVERSEER. The entering of data into OVERSEER is governed by the document "Best practice data input standards" which details the various ways or forms that data can be inputted into OVERSEER and it ranks them in terms of the most accurate results.

64 The Dairy Industry Protocol suggests some options for the input of data that were designed to ease the data entry process rather than achieving the most accurate possible results. Previous work that I have been involved in for both Central Plains Water and the Rangitata Diversion Race Management Limited suggested that using the Dairy Industry Protocol underestimates the actual N leaching by up to 45% compared to the results that can be achieved if the data is inputted by the recommended means.

65 The data which represents the Sheep and Beef industry was supplied by Beef and Lamb NZ (**B+LNZ**) which was supplied from their economic service survey which indicates that it is a fair representation of their members farms - but it was data from two actual years, so the financial impacts reported are for those two years not a long term average in terms of physical and financial performance. This factor which influences the results was picked up very late in the HRWO modelling process, after the decision had been made by the CSG. The modelling was re run using long term average data that showed that the impact on sheep and beef farms was much greater than originally reported. This refinement was therefore modelled when it was too late to influence the PC1 notification decision.

66 In summary the impact as to the uncertainty as to the accuracy of the data included in the CSG/WRC model, as to the land area used, the N leaching and phosphorus (**P**) emissions in the dairy industry, and the financial and physical performance of the sheep and beef industry, cause there to be considerable uncertainty as to the accuracy and reliability of the results generated.

67 The range of mitigations used in the model is as described in **Description of mitigation options defined within the economic**

model for Healthy Rivers Wai Ora Project. This document advised that the mitigation options can be broadly described as management changes designed to de-intensify the current farm system first, followed by an infrastructure change which allowed restricted grazing.

68 Stage 1 which is the deintensification stage follows a standardised sequence, where mitigation measures are applied:

68.1 If the farm has an existing feed pad or standoff pad the use of this is optimised as the first step.

68.2 Autumn N fertiliser applications are reduced and then removed as a second step.

68.3 Spring N fertiliser applications are reduced and then removed as a third step.

68.4 Imported supplements are then reduced (up to a 20% reduction from the base) as a fourth step.

68.5 The stocking rate is then reduced (up to 20% reduction of cow numbers from the base) as a fifth step.

69 In Stage 2 restricted grazing on standoff pads is incorporated into each of the scenarios modelled in Stage 1.

70 It is my experience that the range of mitigations which are used in the modelling are both limited, compared to the total range of mitigation options available to an individual farmer, and are very structured in their implementation. It is also my experience that all farmers that are faced with applying some form of mitigation utilise their own marginal abatement cost curve in their decision making. This means that they adopt mitigation according to the one that comes at the lowest cost to them first and then adopt the next mitigation technique until they are able to meet their required reduction in nutrient discharges.

71 This means that the results of the modelling are strongly influenced by the fact that the total array of mitigation options open to the farmers are artificially restricted, and that the structured approach to mitigation adoption means that the costs to them of mitigation are higher than they would normally be. These considerations cause there to be further uncertainty as to the accuracy of the results of the modelling.

72 This uncertainty as to the accuracy of the modelling approach is further exacerbated by the fact that in the modelling, if the adoption

of the mitigation options was not sufficient to meet the water quality objectives, then the third option was for land use change that converted the land from dairy or sheep and beef farming to forestry. This is the mitigation option that has the highest cost.

73 The use of this high cost mitigation option instead of the array of lower cost mitigation techniques which are available to farmers means that the total cost of the modelling expressed will be much higher than it would be if a more diverse array of mitigation options were able to be modelled.

74 In summary, the considerable amount of inaccuracy in the data used to populate the model and the way that data is treated in the modelling create a considerable amount of uncertainty as to the accuracy of the results produced.

75 I am therefore unable to reconcile my analysis as to the degree of uncertainty in the modelling with the Officer's statement in the Section 42A Report (para 277) where they state:

> … the Officers consider the science and economic analysis and modelling to be both comprehensive and adequate to enable the RMA requirements in s32 to be fulfilled." and "A significant amount of scientific and economic data and modelling was used in the development of the objectives, policies, water quality targets/limits and rule framework within PC1.

76 It is my opinion that the Officers are confusing the quantity of the information, rather than focusing on the quality of the data and the range of scenarios modeled in their assessment.

77 There is an obvious correlation between data quality and model outputs, and the use of poor or uncertain data will impact on the quality and reliability of the model outputs.

78 These modelling parameters were then put through two rounds of modelling which had an influence on the decisions that were made by the CSG and subsequently influenced the design of PC1 as notified by WRC.

79 The first round entailed running four scenarios:

79.1 Scenario 1 was a substantial improvement in water quality for swimming, taking food, and healthy biodiversity.

79.2 Scenario 2 was no further degradation and improving sites to at least minimum acceptable standard for all attributes.

79.3 Scenario 3 was some general improvement in water quality for swimming, taking food, and healthy biodiversity.

79.4 Scenario 4 was no further degradation in spite of lags.

80 The second round was designed to evaluate what extent of change is required to achieve 10, 25, 50, 75, and 100% steps from the current state towards Scenario 1. A step of *x*% towards Scenario 1 means that all limits defined across the catchment move x% from their current state to that state defined under Scenario 1.

81 The results of the HRWO model were then used to compile the report **Economic Impacts of the Healthy Rivers Initiative - Freshwater Management Unit, Regional and National Assessment** which used input/output analysis to create multipliers which were then applied to the results of the HRWO model to create both regional and national flow on effects. The use of input / output analysis to carry out an assessment like this is quite adequate in my opinion. However, it is based on the results from the HRWO modelling and so in my opinion the uncertainties that are inherent in those results again flow into this work.

82 The HRWO modelling was then used in the report **Regional and national level economic impacts of the proposed Waikato Regional Plan Change 1 - Waikato and Waipa River Catchments** This report includes analysis of the policy mix along with the development of various proportions of Iwi land from low to high. Again it is based on the results from the HRWO modelling and so in my opinion the uncertainties that are inherent in those results also flow into this work.

83 The results of the HRWO model and the Regional and National level assessments were then used in an integrated assessment in an attempt to try and integrate all of the assessments, economic, environmental and social, into an overall assessment. It attempted to compare the four scenarios in a quite detailed way. Each assessment is reported in a wheel diagram with elements rated on a score from -5 to +5. In my opinion it is very difficult to use a value judgement to assign a quantitative score. I am also of the opinion that there is too much potential for bias in the assessments as it can sometimes depend on who you chose to do the assessing as much as anything else.

84 I am not sure of the value of the exercise or how it influenced the CSG's decision-making. I do however note that some of this integrated assessment work was completed after the CSG had made their recommendations to WRC.

85 It is difficult to determine exactly how the results of these scenarios influenced the CSG in their decision-making because there is no clear relationship between the results as presented and the final form of PC 1. However, it is plain to me that the enormity of the sums presented as the cost of each option, would have had a significant effect on the members of the CSG and would have caused them to be reluctant to adopt any of the other scenarios as presented.

86 Therefore, it is my opinion that this reporting of the scenarios as being hugely costly has led to a version of PC 1 which is restrictive on land use change when there is no apparent connection between that outcome and the modelling that has been carried out.

TOPIC B 4 OBJECTIVES

87 I have already noted in my evidence (above) that the long-term freshwater quality objective (2096) in **Objective 1** may now be out of sync with both the NPS-FM 2017 amendments and emerging Government policy.

88 **Objectives 2 and 4** are important in my view in underlying the importance of economic well-being and ensuring that economic and environmental considerations are appropriately balanced to achieve sustainable outcomes. But this will not be achieved if the policies, methods, and rules in PC1 are based on economic modeling that is (as described above) at best uncertain – and at worst inadequate in providing a sound justification for what is effectively a land use change moratorium. Additionally, Objective 4 is also important in providing the basis for GFP and adaptive management approaches to be used successfully in FEPs to implement PC1.

89 Again, as noted in my evidence (above) **Objective 3** will be problematic in practice if the notified policies, methods, and rules will not achieve implementation of this objective in all sub-catchments by 2026. In my view, this objective is sound (based on Mr Williamson's evidence) and the issue points to a need to amend other provisions in PC1 (as requested by the WPL submissions) to ensure that it will be achieved.

TOPIC B 5 FMUS, SUB-CATCHMENTS AND TABLES 3.11-1 AND 3.11-2

B 5.4.5 Staging and sub-catchment priority

90 Other experts have dealt with the amendments required to Table 3.11-1 in their evidence. But I would like to comment on the general structure of PC1 that compels farmers and landowners to wait until the priority dates spelled out in the rules to apply for resource

consent. In my view, this is not efficient because it will delay investment in achieving the critical short-term freshwater objectives.

91 While it may not be appropriate to compel everyone to apply for consent earlier, it would be much more sensible to adopt a similar "voluntary" approach to that used in relation to climate change regulation under the Climate Change Response Act 2002 (as amended). For the industries and sectors regulated under that Act, the Act provided for both mandatory dates by which industries were required to participate in the Emissions Trading Scheme (**ETS**) and also allowed industry participants to voluntarily join the ETS much earlier if they wished to do so. Adopting a similar "voluntary" ability to be consented earlier than the PC1 priority dates would help to improve likely compliance with Objective 3 and increase the level of implementation.

CONCLUSIONS

92 I am of the opinion that WRC has not adequately addressed in the PC 1 provisions the economic requirements of Objective 4 and the requirement of Policy A7 of the NPS-FM and its 2017 update to give consideration to enabling communities to provide for their economic well-being (including the full range of productive economic opportunities) through the failure to include an adequate allocation mechanism via transfer rules for the discharge of nutrients and the inclusion of restrictions on the potential for land use change.

93 The economic component of the evaluation of the full range of alternatives has therefore been inadequate, and this has resulted in PC 1 (as notified) being far from economically efficient. Unless the plan provisions (including policies, methods, and rules (and the related maps, schedules, and tables)) are amended as requested in the submissions made by WPL, the potential for PC1 to be economically efficient while maintaining or improving freshwater quality is unlikely to be achieved.

94 The CSG's decision to choose a straight-line pathway has not been tested in terms of its economic effect, therefore we do not have a measure of its economic efficiency. In my opinion it is a suboptimal choice.

95 The impact as to the uncertainty as to the accuracy of the data included in the HRWO model as to the land area used, the N leaching and P emissions in the dairy industry and the financial and physical performance of the sheep and beef industry, cause there to be further uncertainty as to the accuracy and reliability of the results generated.

96 There is an obvious correlation between data quality and model outputs, and the use of poor or uncertain data will impact on the quality and reliability of the model outputs.

97 It is difficult to determine exactly how the results of the scenarios run through the HWRO model influenced the CSG in their decision-making because there is no clear relationship between the results as presented and the final form of PC 1. However, it is plain to me that the enormity of the sums presented as the cost of each option would have had a significant effect on the members of the CSG and would have caused them to be reluctant to adopt any of the other scenarios as presented.

98 Therefore it is my opinion that this reporting of the scenarios as being hugely costly has led to us getting a version of PC 1 which is restrictive on land use change, when there is no apparent direct connection between that outcome and the modelling that has been carried out.

Stuart John Ford

Agricultural and Resource Economist

15 February 2019

BIBLIOGRAPHY

Documents Reviewed

Cochrane W, Roskruge M (2016): Healthy Rivers Project - Comment on Employment and Vibrant Resilient Communities Indicators.

DairyNZ: New Zealand Dairy Industry Audited Nitrogen Management Scheme. Section B: A protocol for the use of the OVERSEER model to measure, model and audit nitrogen information from New Zealand dairy farms.

Doole G, Eliot S, McDonald G (2015): Economic evaluation of scenarios for water-quality improvement in the Waikato and Waipa River catchments. Assessment of first set of scenarios.

Doole G, Eliot S, McDonald G (2015): Economic evaluation of scenarios for water-quality improvement in the Waikato and Waipa River catchments. Assessment of second set of scenarios.

Doole G, (2015): Description of mitigation options defined within the economic model for Healthy Rivers Wai Ora Project. - Description of options and sensitivity analysis.

Doole G, Eliot S, McDonald G (2015): General principles underlying the development of the Healthy Rivers Wai Ora (HRWO) economic model.

Doole G (2016): Model structure for the economic model utilised within the Healthy Rivers Wai Ora process.

Doole G, Quinn J, Wilcock B, Hudson N (2016): Simulation of the proposed policy mix for the Healthy Rivers Wai Ora process.

Market Economics (2016): Economic Impacts of the Healthy Rivers Initiative - Freshwater Management Unit, Regional and National Assessment.

McDonald G, Doole G (2016): Regional- and national-level economic impacts of the proposed Waikato Regional Plan Change No. 1—Waikato and Waipa River Catchments.

NIWA (2015): Review of historical land use and nitrogen leaching: Waikato and Waipa River catchments.

NIWA (2015): Modelling E. coli in the Waikato and Waipa River Catchments - Development of a catchment-scale microbial model.

Olubode F (2015): Sheep and beef data adjusted for average schedule price and expenditure.

OVERSEER (2018): Best Practice Data Input Standards.

Perrin Ag (2015): Land use conversion costs for Healthy Rivers Wai Ora Project.

SCION (2015): Identifying Complementarities for the Dairy and Forestry Industries in the Central North Island.

Technical Leaders Group for the Healthy Rivers/Wai Ora project: Integrated Assessment Baseline and Scenarios.

Wadhwa S, Elliot S (2015): Refined classification of land characteristics to assist economic modelling.

Waikato Regional Council: Proposed Waikato Regional Plan Change 1 - Waikato and Waipa River Catchments.

Waikato Regional Council: Proposed Waikato Regional Plan Change 1 - Waikato and Waipa River Catchments. Section 32 Evaluation Report.

Waikato Regional Council: Proposed Waikato Regional Plan Change 1 - Waikato and Waipa River Catchments. Section 42A Report.

Wedderburn L, Coffin A (2016): Integrated Assessment for Healthy Rivers Wai Ora: The Baseline Information.

Wedderburn L, Coffin A (2016): Integrated Assessment One: Assessment of Scenarios from modelling round one.

Wedderburn L, Coffin A (2016): Integrated Assessment Two: Achieving water quality for swimming, taking food and healthy biodiversity. Assessment of Scenario 1 steps 10%, 25% and 50% from case 1 of modelling round two.

APPENDIX 1

Curriculum vitae

CURRICULUM VITAE

Full name: **STUART JOHN FORD**

Present position: Consultant

Present employer: The AgriBusiness Group
(Director and Shareholder)

Work address: PO Box 85016
Lincoln University
Lincoln 7647
New Zealand

Contact details:

mobile	0274 346 515
work	03 304 8015
e mail	stuart@agribusinessgroup.com
web	www.agribusinessgroup.com

Academic qualifications:

Diploma in Agriculture Lincoln University (1974)

Bachelor of Agricultural Commerce (Valuation and Farm Management) Lincoln University (1979)

Extra Mural studies, Advanced Diploma in Business Studies (Agribusiness) Massey University: Advanced Primary Industry Accounting
Agribusiness Organisation and Management
Agricultural Economics
Natural Resource and Environmental Economics
Project Evaluation

Number of years a practising consultant: 37

Society membership:

Senior Member New Zealand Institute of Primary Industry Management.
Australia and New Zealand Agricultural Resource Economics Society.
International Farm Management Association.

Professional skills / specialty:

- Economic and Financial evaluation and feasibility studies.
- Systems modelling and analysis of production and financial parameters.
- Information Management in Agribusiness.
- Resource management and resource economic evaluations.
- Policy analysis and interpretation.

Policy Work Related to Water

Costs and Benefits of the Ashburton District Council Stockwater race network. (2008)

Scoping the context of water efficiency. (2008)

Economic evaluation of the value of irrigation water to agriculture in the Waikato region. (2007)

Impacts of Loss of Security of Supply of electricity to irrigators on the central plains of Canterbury. (May 2005)

Property Rights in Water Allocation (2005)

Impact of Water Allocation on Reliability and Regional Output 2004

Water in Agriculture (2004)

Land Use Change Projections in NZ and Implications for Water (2003)

Regional Economic Impact Analysis of References of the Proposed Regional Plan : Water for Otago (June 2001)

Economic Efficiency of Water Allocation - MAF Technical Paper No:2001/7

MAFPolicy Water Enhancement Projects: Study Five – Economic and Social Assessment of Community Irrigation Projects: A multi objective framework.

Irrigation Scheme Development – Issues to consider when promoting a water resource scheme. MAF Technical Paper (Sept 2001)

Options for efficiency gains through trading within a community irrigation scheme.

Nutrient Management
Selwyn te Waihora Nutrient Performance and Financial Analysis – ECan and Irrigation NZ.

Nutrient Performance and Financial Analysis of Lower Waikato Horticulture Growers - HortNZ

Nutrient Performance and Financial Analysis of Horticultural Systems in the Horizons Region – HortNZ

Nutrient Performance and Financial Analysis of Horticultural Systems on the Waimea Plains – HortNZ

Report on the Nutrient losses and Financial Performance of Horticultural properties in Southland. – Environment Southland.

Nutrient Performance and Financial Analysis of Horticultural Systems on the Waimea Plains – HortNZ

Hawkes Bay Horticultural Nutrient and Financial Benchmarking Results of Horticultural Growers – HortNZ and Hawkes Bay Regional Council

Calculation of the Total Nutrient Loading for the Central Plains Irrigation Scheme; Used in evidence on Variation 1 of the LWRP. – Central Plains Water Ltd.

Calculation of the Total Nutrient Load for the Rangitata Diversion Race Schemes; Used in the calculation of their short term resource consent. – RDRML

Derivation of the Actual Reductions Possible to Achieve Water Quality Limits in Variation 2 of the Hinds Plains. - RDRML

Irrigation Scheme Analysis
On farm modelling carried out for Wairarapa Economic Impact report. (2014)

Economic Assessment of Higher Reliability Water – Waimakariri Irrigation ltd (2013)

Affordability and Regional Economics for the Manuherikia Catchment Scheme (2012).

Financial Performance of Tarras Water Ltd (2011)

Affordability of NOIC Stage II Water (2011)

Returns to irrigation development in the Waitaki District (2010)

Economic impacts of the Hurunui Irrigation scheme. (2010)

Hunter Downs Irrigation Scheme Affordability Analysis (2010)

The impact of irrigation reliability on Waimakariri Irrigators (2010)

Analysis of the Benefits of an Addition to the Morven – Glenavy Irrigation Scheme. (2009)

Hunter Downs Irrigation – Assessment of Environmental Effects (2008)

Economic Impact of the Opuha Dam (2008)

Waitaki Water (2003)

Irrigation Impact Report – the physical and financial impacts of conversion from dryland to irrigated farming. (2004) Available at ; www.ritso.co.nz

A financial decision making framework for irrigation conversion (2004)
Available at ; www.ritso.co.nz

Economic and Social Impacts of the Downlands Irrigation Scheme (Nov 2001)

Project Aqua – Economic Impact Analysis. (Feb 2001)

Central Plains Water Enhancement – Economic and Social Impacts of Proposed Irrigation Schemes. (Nov 2000)

River Analysis

Economic Impacts of alternative minimum flow regimes on the Waiau River. (2010)

Economic impact of the Flaxbourne Community Irrigation Groups application. (2009)

Economic and Social Impacts beyond the farm gate of granting consent applications to take water in the Rakaia Selwyn Zone (2009)

Economic Impacts of alternative minimum flow regimes on the Ashburton / Hakatere River. (Oct 2002 updated 2008)

Economic Impacts of alternative minimum flow regimes on the Hurunui River. (2007)

Economic Impacts of the Draft Waitaki Allocation Plan. (June 2005)

Economic Impacts of alternative minimum flow regimes on the Waipara River. (June 2005)

Economic Impacts of alternative minimum flow regimes on the Ashley River. (Oct 2002)

Rangitata River Conservation Order : Economic Impact Analysis (Oct 2001)