BEFORE THE ENVIRONMENT COURT	**ENV-2021-WLG-000020**
AT WELLINGTON	**ENV-2021-WLG-000021**
I MUA I TE KŌTI TAIAO	**ENV-2021-WLG-000022**
I TE WHANGANUI-Ā-TARA ROHE	**ENV-2021-WLG-000023**

IN THE MATTER	of the Resource Management Act 1991 (**RMA** or **the Act**)
AND	
IN THE MATTER	of appeals under Clause 14(1) of the First Schedule of the Act in relation to a decision of Manawatū-Whanganui Regional Council on Proposed Plan Change 2 to the Horizons One Plan
BETWEEN	**TE RUNANGA O RAUKAWA** **Appellant**
	ANDREW DAY **Appellant**
	WELLINGTON FISH AND GAME COUNCIL **Appellant**
	NGĀTI TURANGA **Appellant**
AND	**MANAWATŪ-WHANGANUI REGIONAL COUNCIL** **Respondent**

STATEMENT OF EVIDENCE OF STUART FORD (COMMERCIAL VEGETABLE GROWING SYSTEMS AND ECONOMICS) ON BEHALF OF HORTICULTURE NEW ZEALAND

13 OCTOBER 2023

HOLM | MAJUREY

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INTRODUCTION

Qualifications and experience

1. My full name is Stuart John Ford. I am a Director of The AgriBusiness Group and work as an agricultural and resource economist based in Christchurch. I have a Diploma in Agriculture and Bachelor of Agricultural Commerce from Lincoln University and have undertaken post graduate studies in Agricultural and Resource Economics at Massey University.

2. I am a member of the New Zealand Agriculture and Resource Economics Society and the Australian Agriculture and Resource Economics Society. I am also a member of the New Zealand Institute of Primary Industry Management.

3. I have spent 40 years as a consultant in the agricultural industry, with the last 25 years specialising in agricultural and resource economics and business analysis.

4. I have extensive experience in the use of Overseer in the pastoral, arable and horticultural sectors throughout New Zealand and have undertaken training in the use of APSIM.

5. I have undertaken analysis of the nutrient (using Overseer) and financial performance of Commercial Vegetable Growing (**CVG**) operations in South Auckland / Northern Waikato, Hawkes Bay, Manawatu, Tasman, Canterbury and Southland for Horticulture New Zealand.

6. I have undertaken a wide range of economic impact and cost benefit assessments of proposed statutory planning proposals.

7. I have prepared and presented evidence to District and Regional Council Hearings Panels as well as the Environment Court and Special Hearing Panels on Conservation Orders.

Code of Conduct

8. I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's Practice Note dated 1 January 2023. I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I

state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Involvement in project

9. I have been retained by Horticulture New Zealand (**HortNZ**) to provide evidence on the economic and resource use impacts of PC2 on the CVG within the Horizons region.

10. I prepared the report "Nutrient Performance and Financial Analysis of Horticultural Systems in the Horizons Region" for HortNZ in 2014 and subsequently was the author of "Farm Scale Economic Impact Analysis of One Plan Intensive Land Use Provisions" for Horizons in 2017.

11. I took part in expert witness conferencing that was carried out before the Commissioners heard Plan Change 2 (**PC2**) submissions on;

    (a) The 21st and 22nd of July 2020 in respect to "Farming and Growing management practices; Farm systems modelling and farm scale economics";

    (b) The 27th of July 2020 in respect to Farm Scale Economics;

    (c) The 12th of August 2020 in respect to Farming and Growing management practices; and

    (d) the 19th of August 2020 in respect to Macro Economics.

12. I gave evidence for HortNZ in the original One Plan hearings.

13. I then took part in the expert witness conferencing of farm systems experts in the Environment Court appeal process on the 25th of August 2022, then in the mediation that took place on the 12th of December 2022 and then was involved in the mediation specific to the Commercial Vegetable Production (**CVP**) sector on the 10th of February 2023.

14. Subsequent to the formal mediation sessions, I have been involved in further refining the Nitrogen Risk Assessment Tool (**NRAT**) for the

CVP sector as included in the Council's suggested version of PC2 before the Court.

15. In preparing my evidence I have reviewed the following documents and evidence:

(a) Parminter T (2018); A Comparison of Changes to Nitrogen Loss Allowances on Dairying in the Upper Manawatu River Catchment;

(b) Collins H (2018); Social Impact Assessment of Plan Change 2;

(c) Hanly Dr J, Hedley Prof M, Horne Assoc Prof (2018); Sensitivity of values in Table 14.2 of the 'One Plan' to a change in the version of OVERSEER®;

(d) Horticulture New Zealand (2019). Submission on Horizons One Plan – Proposed Plan Change 2, Existing intensive farming land uses;

(e) Bloomer D, Posthuma L, O'Brien G (2020): Modelled Loss of Nutrients from Vegetable Growing Scenarios in Horowhenua. Report prepared for Pattle Delamore Partners;

(f) The Evidence in Chief of Mr Barber, Ms Sands, Mr Horne, Ms Jolly and Mr Snelder.

Scope of evidence

16. In my evidence I cover the following topics:

(a) The economics and margins of growing CVP;

(b) Crop rotations and why they are important;

(c) Overseer modelling undertaken to support water quality modelling that informed the percentage reductions that were based on specific provisions and the subsequent risk tool which is based on the same methodology as Overseer and should achieve a similar outcome;

(d) The appropriate use of overseer; and

(e) The CVG Nitrogen Risk assessment tool and the appropriateness of the Biophysical table values.

OVERVIEW

17. It is my understanding that the purpose of this hearing is to settle on an appropriate alternative to the use of Overseer in PC2. Overseer was the default tool that was used in the notified version of PC2. The notified version used Overseer to set the values in Table 14-2, which in turn set target values that growers must meet and therefore set their individual consenting pathways.

18. The Cumulative Nitrogen Leaching Maximums in Table 14.2 have come from modelling different intensities of dairy farming systems, and these do not correlate well to CVG, given the causes of N leaching differ considerably between the two land uses.

19. The fact that Overseer was not a stable modelling tool when it was used to create the values in Table 14-2 in the One Plan meant that when subsequent versions of Overseer were used to replicate the values in Table 14-2 the values changed significantly. The changes were positive in that the values increased, in some cases quite significantly, and accordingly it made it difficult for both farmers and growers to meet the consenting thresholds.

20. The second determinant on the appropriate use of Overseer was when the Government carried out its review of Overseer[1] and came out with a recommendation that Overseer "*is unlikely to be a reliable tool for predicting either relative or absolute nutrient loss estimates from farms*[2]". Rather the Government was of the opinion that Councils "*should use wording that will provide for maximum future flexibility for assessing nutrient loss from a range of tools that may become available*".

21. While we accepted in the various rounds of expert conferencing that Table 14-2 was still relevant for use in PC2, there was a

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[1] See: The Government response to the findings of the Overseer peer review report (2021); and Responding to the Overseer Model Redevelopment Review – A guide for Councils (2023).

[2] Ministry for the Environment and the Ministry for Primary Industries, 2021. *Overseer whole-model review: Assessment of the model approach*.

requirement to recommend an alternative that could be used in PC2 as another pathway alongside Table 14-2.

22. I was involved in the conference which sought to adapt the Fonterra Risk Score Card into an appropriate tool and more so in the development of the Nitrogen Risk Assessment Tool (**NRAT**) specifically for the CVG sector.

THE ECONOMICS AND MARGINS OF GROWING CVP

23. PC2 as proposed had the potential to negatively impact the production of fresh vegetables and, thus, the supply and the price of vegetables. It is my opinion that PC2 had the potential to lead to constraints on the supply of fresh vegetables through constraining the application of nitrogen, which is essential to achieve marketable yields.

24. In a report that was completed for HortNZ, Deloitte[3] identified that:

(a) The Pukekohe hub of vegetable production, which straddled both Auckland Council and the Waikato Regional Council boundaries, was experiencing increased negative pressure to keep up with the ever-increasing demand for fruit and vegetables from loss of highly productive land, increased legislation which is aimed at diminishing our ability to grow the crops at an economically maximum level of production and a loss of growers due to the increasing loss of margin in growing the crop.

(b) The growing of fruit and vegetables had a positive impact on the four capitals of Treasury's Living Standards Framework of Natural, Social, Financial and Human Capital.

(c) Under Deloitte's Base Case scenario by 2043 Auckland's population will have increased by 37%, based on 2018 predictions, which will result in the demand for fruit and

[3] Deloitte (2018): New Zealand's food story: The Pukekohe hub.

vegetables increasing by 33% and the growth of the production sector to meet that demand will be by 39%.

(d) Under Deloitte's Rigid constrained scenario which is described as "land scarcity is further constrained by land use restrictions" their modelling using the Deloitte Access Economics regional general equilibrium model, predicts that there will be, compared to the Base Case scenario, an annual economic loss of $1.1b, a loss of 4,500 FTE's, a decrease in production of 55% and a resultant rise in prices of 58%.

25. Although the Deloitte report is a theoretical exercise in predicting a likely future scenario it is robust enough to indicate that there is a need to start the conversation on food security around providing for the nation's future requirements for fruit and vegetables to at least maintain the current level of wellness within the population.

26. Following on from the Deloitte report HortNZ commissioned Dr Cristina Cleghorn of Otago University to investigate the health system impacts of the predicted increase in vegetable prices over time.[4]

27. In her report Dr Cleghorn modelled two scenarios where the price of vegetables increases each year for the next 23 years, firstly by 2% a year and secondly by 2.5% a year to match the expected price increase.

28. The 2% and 2.5% cumulative increase in New Zealand vegetable prices from 2020 to 2042 is predicted to result in a decrease in daily vegetable intake of 69 grams and 94 grams by 2042.

29. The 2% cumulative increase is predicted to result in a 58,300 reduction in Health Adjusted Life Years (**HALY**) and $490 million in costs to the health system. The 2.5% price increase produced overall HALY losses that were 25% greater and costs to the health system

[4] Cleghorn C (2020): The health and health system cost impacts of increasing vegetables prices over time.

that were 24% greater than the 2% cumulative price increase at 72,800 and $610 million.

30. Dr Cleghorn came to the conclusion from her modelling that:[5]

> *These small cumulative increases in the price of vegetables are likely to cause an important decrease in vegetable consumption in NZ over the next two decades. This is likely to lead to modest health loss to the NZ population and costs to the health system over time.*

31. A recently completed report for Auckland Council and HortNZ by PerrinAg[6] added to the reliability of the data being used by the Auckland Council to populate their Fresh Water Management Tool for the CVP and the kiwifruit sectors for the losses of the four contaminants. The report investigated the economic costs of a range of mitigation options in which they used financial data for the CVP sector, which was gained from the growers.

32. It is my opinion that this data can be used to demonstrate the economics and the margins from growing for the Horowhenua area because the growing systems are the same and the produce is sold, substantially, into the same market which is dominated by the two big retailers. What we see in **Table *1*** is a range of rotations, which each include a specific mix of crops that are commonly grown and a weighted average of the returns from those rotations. These demonstrate the annual revenue, annual growing expenses which result in the average Gross Margin which then has annual overheads deducted from it to show the annual profit achieved.

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[5] Ibid.

[6] Muller, C. and Inness, M. 2023. Horticulture Typology Modelling for the FWMT: a technical modelling report. A report prepared for Auckland Council and Horticulture New Zealand.

Table 1: The makeup of the profitability of a range of rotations commonly used in the Waikato Region ($/ha/year).

	Rotation 1	Rotation 2	Rotation 3	Rotation 4	Rotation 5	Weighted average
Average annual revenue	33,980	31,589	106,740	30,136	25,361	34,335
Average annual expenses	20,588	20,172	48,540	14,669	18,334	19,951
Average annual gross margins	**13,392**	**11,417**	**58,200**	**15,467**	**7,027**	**14,384**
Average annual overheads	11,004	10,972	11,225	10,037	10,401	10,645
Average annual profit	**2,388**	**445**	**46,975**	**5,430**	**-3,374**	**3,740**

33. What we can interpret from the data in **Table 1** is that the margins which the crops are grown on are, on average, very slim with the weighted average data indicating that the average annual profit of the weighted rotations is only approximately 10% of the revenue.

34. That is why over the last decade the growing of the crops has substantially congregated into the hands of a few large growing entities that are very efficient in the growing and packaging and in the marketing of their crops either through their own brands or by the brands of the duopoly of supermarket retailers that control the sale of approximately 80% of the produce in Aotearoa.

35. However, the data in **Table 1** also shows the market for vegetables is in fact very dynamic and responds very quickly to supply and demand. That is why we are, at the time of writing, experiencing extreme prices for vegetables as a result of the dual impacts of Covid limiting the productive capacity of the sector and then the impact of the two recent cyclones severely reducing the supply of vegetables.

36. The research of Dr Cleghorn indicates that the current high price of vegetables forces many consumers to seek alternatives to vegetables that do not offer the same health benefits.

37. PC 2 had the potential to lead to the same scenario of a lack of supply and so a large increase in the cost of vegetables and therefore impacts on human health.

CROP ROTATIONS AND WHY THEY ARE IMPORTANT

38. CVG is identified as an intensive farming land use (**IFLU**) in the One Plan.

39. The nature of CVG is that the crops that are grown are part of a rotation. This is a practice which is carried out for a number of reasons including:

(a) To spread the financial risk of growing just the one crop;

(b) To spread the risk of pests and diseases building up from the growing of the one crop repeatedly; and

(c) Providing for restorative crops that are designed to bring the growing environment back into the desired state after a number of years of the growing of depletive crops.

40. This adoption of a rotation enables the growers to ensure that their systems are sustainable in the long term for both economic and environmental considerations.

41. The most up to date and the most comprehensive analysis of the range of crop rotations grown can be found in the Hokio 1a Targeted Water Management Sub Zone (**TWMSZ**)in the Horowhenua area is represented in the "Modelled Loss of Nutrients from Vegetable Growing Scenarios in Horowhenua – May 2020" (Bloomer[7]) report.

42. In the Bloomer report they identify three major types of crop rotations;

(a) An onion / potato rotation,

(b) A brassica dominant rotation, and;

(c) An intensive fresh vegetable rotation.

43. The onion / potato rotation used follows the following pattern:

Potato > Potato > Onion > Onion > Ryegrass > Ryegrass > Ryegrass > Beetroot.

44. The brassica dominant rotation is designed to ensure that brassicas are available for sale all year round. This means that smaller areas of the crop are planted twice weekly. Bloomer found when he talked

[7] Bloomer D, Posthuma L, O'Brien G (2020): Modelled Loss of Nutrients from Vegetable Growing Scenarios in Horowhenua. Report prepared for Pattle Delamore Partners

to the growers that to represent their system in Overseer would require modelling 36 different blocks in order to correctly represent the complexity of their operations. Bloomer chose to represent 12 of these variations in his Overseer modelling. The general theme of these 12 variations followed the following pattern:

> *Cauliflower / Broccoli / lettuce > Broccoli / lettuce > cabbage / Onion > cabbage / cauliflower > cabbage / broccoli > onion / cauliflower > celery / cabbage > cauliflower / potato > pumpkin / cauliflower > cauliflower / leek.*

45. The intensive fresh vegetables rotation is described in the Bloomer report as "*the most complex with numerous crops and multiple sowings and plantings to meet daily market demands*." And that "*To model this in detail in OverseerFM we would need to create hundreds of blocks of 0.1 – 1.0 ha each. Once plantings were clumped into months and some other rationalisation was done, 38 different blocks representing different crops and rotations were identified and modelled*."

46. The range of crops represented in the Bloomer modelling include; Beetroot, Cabbage, Celeriac, Celery, Coriander, Fennel, Ryegrass, Kale, Leek, Lettuce, Maize, Melon, Oats, Parsley, Pumpkin, Radish, Red Cabbage, Shanghai, Spinach, Spring Onion, White PakChoi and Wongbok.

47. In my 2014 report I modelled what I call a 'Waimarino rotation', which is representative of the types of rotations grown in the Ohakune area. These include crops such as carrots and winter greens which are grown on quite extensive rotations which include a significant proportion of pasture as a restorative crop in the rotation. These crops are grown across the free draining deep soils found in the area and are grown on a mixture of grower owned land and leased land from pastoral famers. These operations are not part of a IFLU area. I have re-run the Waimarino rotation described in the 2014 report, in Overseer version 6.3 at an estimated leaching rate of 35 kg/ha/yr for this rotation to inform water quality modelling. As discussed in Ms Homes evidence I would expect this rotation to quite easily meet the relevant cumulative leaching maximums in Table 14-2.

48. The other sort of rotation which I model in both my 2014 and 2017 reports is part of what I call a "cash cropping" arable rotation. It includes potatoes and onions grown as part of a mixed arable rotation incorporating crops such as barley and a significant proportion of pasture. I have re-run the rotation described in the 2014 report, in Overseer version 6.3 at an estimated leaching rate of 31 kg/ha/yr for this rotation to inform water quality modelling. As discussed in Ms Homes evidence I would expect this rotation to easily meet the relevant cumulative leaching maximums in Table 14-2.

49. This rotation is carried out on both owned and leased land across the Rangitikei area on the deeper soils. Most of these rotations are grown outside of a TWMSZ.

50. All of the area of CVG which is grown in Horowhenua is grown on flat land with deep soils that have a relatively high Plant Available Water (**PAW**) which means that they can store, and therefore not leach, large volumes of water which contains Nitrogen.

51. These soils are all in the Land Use Class (**LUC**) 1 and 2. The core characteristics of LUC Class 1 and 2 are that they are all soils with a deep profile having a rooting depth of 70 cm to 1 m plus which means that they are ideally suited to growing horticultural crops. They are all classified as having a low N leaching vulnerability.

52. The climate in Horowhenua is also ideal for the growing of horticultural crops with a relatively high proportion of sunlight hours and a relatively even supply of rainfall which means that there is only an occasional requirement for irrigation to maintain the soil moisture within the ideal range to maximise plant growth.

53. Horowhenua is close to an abundant source of labour which is required to grow and harvest the majority of the horticultural crops which are grown in the area. It is also relatively close to the combined markets of both Wellington and Palmerston North which means that delivery of the produce grown in the area can be carried out in an efficient manner in terms of both timeliness and cost.

54. The area defined by the Horowhenua TWMSZ is an ideal location to grow CVG due to its soil types, climatic factors and location. That is in fact the reason why some of the most productive horticultural growers in the country are situated there.

OVERSEER MODELLING UNDERTAKEN TO SUPPORT WATER QUALITY MODELLING

55. It is my opinion that the Bloomer Overseer modelling (which has been externally peer reviewed by Plant and Food Research) was by far the best possible and most accurate representation of Overseer modelling that was available to us for use in both determining a properties status in terms of either meeting or exceeding the cumulative leaching maximums in Table 14-2 and the likely percentage changes possible as a result of adopting the various mitigations which we agreed upon in the expert conferencing.

56. The Bloomer modelling reported that for the Potato / Onion rotation that when the yields modelled were the accurate grower yields that the N leaching values for the total rotation were below the cumulative leaching maximums values listed in Table 14-2.

57. For the Brassica dominant rotation the pre 2018 model had an N leaching value of 109 kg N / ha / annum and the post 2019 (which is used to represent the adoption of the majority of GMP's and BMP's) has an N leaching value of 99 kg N / ha / annum. This rotation doesn't meet the target value in Table 14-2.

58. For the intensive fresh vegetable rotation the pre 2018 model had an N leaching value of 98 kg N / ha / annum and the post 2019 (which is used to represent the adoption of the majority of GMP's and BMP's and in this case also has a considerable amount of what I refer to as system change which incorporates a substantial change in the total crop mix which includes a substantial amount of pasture added into the rotation and a consequential reduction in the area cropped) has an N leaching value of 61 kg N / ha / annum. This rotation doesn't meet the target value in Table 14-2.

59. In paragraph 64 of her Evidence Dr Jolly refers to "CVG systems" when referring to the three representative crop rotations modelled by Bloomer et al 2020 and uses the term "rotations" when referring to her modelling of the 62 partial crop combinations she modelled.

The term "crop rotation" is defined in the PC2 decision and includes the planting of different crops in sequence over multiple years. With this definition, it is clear that what Dr Jolly has modelled are partial rotations.

60. When undertaking her partial rotation modelling discussed in her 2020 Section 42a report Dr Jolly predicts individual crop N leaching values ranging from 22 kg N / ha / annum to 226 kg N / ha / annum. In the same report, Dr Jolly then reports the percentage of N reductions possible from what she refers to as her Original, which represents grower practice at the reference year (2014) and the results from modelling of adoption of both GMP and BMP. She reports that she would expect individual crops to achieve reductions of between 36 – 94% for GMP and 55 – 94% for BMP.

61. In her evidence before the Environment Court Dr Jolly has updated her section 42 A analysis for the latest version of Overseer 6.5.1 which includes a complete update of the crop model. As well as re-running the models in the updated Overseer Version, Dr Jolly has also changed the way GMPs and BMPs are represented in her Overseer modelling. The result of these updates is that she estimates that with the implementation of the CVG NRAT could result in reductions in N loss per hectare of 70%.

62. I believe that it is very important to note that Dr Jolly is reporting a very limited proportion of the results from individual crops which represent the total number of crops grown in the CVG sector in the Horowhenua TWMSZ (38 vegetable crops are grown in the Horowhenua District) and hasn't attempted to represent a total whole property rotation N leaching result.

63. While Dr Jolly's results are interesting, I do not believe that they are able to give us an insight into what is happening on individual properties and don't believe that they are able to offer us any guidance in determining what would be an appropriate setting in a planning context.

64. If we assess the list of GMP's and BMP's that were agreed at the expert conferencing as being appropriate to be used in a toolbox of appropriate measures for the CVG sector the vast majority of

them describe practices that cannot directly be modelled in Overseer. Some such as the grassing of buffer strips and planting catch crops during fallow periods are able to be directly modelled. The vast majority of the remainder require the modeller to make some sort of assumption as to the impact of the practice of the models input parameters and then input them appropriately into the model.

65. The biggest impact is applying the appropriate amount of N fertiliser which both will enable the crop to achieve the desired level of productivity and which takes into account the residual amount of N still available in the soil. Although we have a significant amount of knowledge about the first factor we are left as to being unable to estimate the second factor as in Overseer the residual amount of N that is available in the soil is driven by Overseer making an assumption as to the amount and therefore it is not possible for the modeller to alter that assumption with a more accurate estimate.

66. It means that for some of the most important variable factors which would influence the outcome of the modelling the modeller is stuck with a fixed assumption rather than being able to influence the result by having the opportunity to enter a variable array of values.

67. it is my opinion that considering the Governments view that Overseer is unlikely to be a reliable tool for predicting either relative or absolute nutrient loss estimates from farms, the fact that Overseer is unable to be used to accurately model the full range of crops grown in a CVG system and the fact that what Dr Jolly has modelled is not a total CVG rotation we can have little confidence that the actual growers will be able to achieve the 70% reduction which she reports.

68. My contention that Dr Jolly's estimate is unreliable is supported by the result of the expert conferencing which agreed that Overseer may have some value in comparing the direction of travel, ie: having a deteriorating or improving amount of N leaching, of a CVG operation but is not accurate enough to report the actual value.

69. Overseer is also not able to model the full range of mitigation practices which are available to growers in order to reduce the amount of Nitrogen that is leached below the root zone.

70. That is the reason why, in the expert conferencing, we were tasked with developing an alternative tool which could be used by the CVG sector in order for them to contribute their share of the required reductions in N leaching into the water ways.

71. What we did was to take the key drivers of N leaching as represented in Overseer and the main ways that it is practical to reduce them and converted them into a risk assessment tool.

THE APPROPRIATE USE OF OVERSEER

72. It is my opinion that the Overseer model is an appropriate model to be used in determining the direction of travel for both an individual operation and on a wider scale at the catchment level.

73. I am of the opinion that Overseer is not appropriate to be used as a means of determining hard numbers that are used in regulation without provision of an alternative pathway.

74. That is why I am supportive of the approach recommended by Horizons which is to retain Table 14-2 which can be used by the general horticultural crop growers and those that incorporate a significant amount of pasture in their rotation, like the potato and onion growers that are represented by that rotation in the Bloomer report, but to offer an alternative pathway which is available to the CVG sector which relies on the NRAT for CVG.

CVG NITROGEN RISK ASSESSMENT TOOL

75. I note that both Dr Jolly and Mr Barber have given you evidence on the detail about the formulation, trialling and further refinement which has resulted in the development of the CVG NRAT which is proposed to be adopted in PC2.

76. The management practices which make up the CVG NRAT represent the two major influences on the potential for N leaching:

(a) Nitrogen Fertiliser application factors; and

(b) Soil Health factors.

These two factors reflect the outcome of modelling of N leaching in Overseer, Agricultural Production Systems SIMulator (APSIM) and Soil Plant Atmosphere Systems Model (SPASMO) and reflect the major practice drivers that each of those modelling tools have found.

77. I would like to point out that the values that are used in the NRAT to score the individuals score in each of those factors have been chosen to reflect the degree of the outcome on the ultimate level of N leaching and therefore reflect the risk. They are not purely scientifically driven but are based on the known science. They are also based on the known difference between practices which in itself mean that they offer a grower the opportunity to adopt an individual practice or multiple practices in order to lower their risk of N leaching and both provide mitigation from their current practices and in order to access the controlled activity consent pathway.

78. It is my opinion that the scores have been set at a level that would encourage a grower to adopt the neutral or negative scores. There is an element of offering them a substantial "carrot" in order to encourage the adoption of what are substantial mitigation practices along with the "stick" of not adopting them and therefore having to go through a more complicated and expensive consent regime.

79. It is not an exact science, but I am of the opinion that the NRAT will achieve the objectives of Horizons in formulating PC2 within the CVG sector by reducing the amount of N leaching below the root horizon.

80. I like to describe the results that it is possible to gain from the use of the NRAT as qualitative rather than quantitative.

81. Although I wasn't involved in creating the numerical risk framework which is used by growers to determine their consenting status according to the two biophysical influences of rainfall and the Profile Available Water of their soils I was somewhat perturbed by the fact that the values used were created by a simple mathematical adjustment to the pastoral risk framework. I note that in his evidence in chief that Mr Barber has trialled it with growers in the Horowhenua

and reports that he is of the opinion that the values used are satisfactory for the purpose and achieve the desired results.

CONCLUSIONS AND RECOMENDATIONS

82. While we accepted in the various rounds of expert conferencing that Table 14-2 was still relevant for use in PC2 there was a requirement to recommend an alternative that could be used in PC2 as another pathway alongside Table 14-2. That is why we developed the NRAT specifically for the CVG sector.

83. The nature of CVG is that the crops that are grown are part of a rotation. This is a practice which is carried out for a number of reasons including:

    (a) To spread the financial risk of growing just the one crop;

    (b) To spread the risk of pests and diseases building up from the growing of the one crop repeatedly; and

    (c) Providing for restorative crops that are designed to bring the growing environment back into the desired state after a number of years of the growing of depletive crops.

84. This adoption of a rotation enables the growers to ensure that their systems are sustainable in the long term for both economic and environmental considerations.

85. In the Bloomer report they identify three major types of crop rotations;

    (a) An onion / potato rotation,

    (b) A brassica dominant rotation, and;

    (c) An intensive fresh vegetable rotation.

86. The Bloomer modelling found that for the Potato / Onion rotation the N leaching values for the total rotation were below the cumulative leaching maximums values listed in Table 14-2 but for the Brassica and intensive fresh vegetables rotation neither were able to meet the leaching maximum values listed in Table 14-2.

87. It is my opinion that considering the Governments view that OverseerFM is unlikely to be a reliable tool for predicting either relative or absolute nutrient loss estimates from farms, the fact that Overseer is unable to be used to accurately model the full range of crops grown in a CVG system and the fact that what Dr Jolly has modelled is not a total CVG rotation we can have little confidence that the actual growers will be able to achieve the 70% reduction which she reports.

88. My contention that Dr Jolly's estimate is unreliable is supported by the result of the expert conferencing which agreed that Overseer may have some value in comparing the direction of travel, ie: having a deteriorating or improving amount of N leaching, of a CVG operation but is not accurate enough to report the actual value.

89. I am supportive of the approach recommended by Horizons which is to retain Table 14-2 which can be used by the general horticultural crop growers and those that incorporate a significant amount of pasture in their rotation, like the potato and onion growers that are represented by that rotation in the Bloomer report, but to offer an alternative pathway which is available to the CVG sector which relies on the NRAT for CVG.

90. I am of the opinion that the NRAT will achieve the objectives of Horizons in formulating PC2 within the CVG sector by reducing the amount of N leaching below the root horizon.

91. This is supported by the results of Mr Barbers trailing of the NRAT that the values are satisfactory for the purpose and achieve the desired results.

Stuart Ford

13 October 2023