BEFORE THE HEARING COMMISSIONERS

IN THE MATTER	of the Resource Management Act 1991 ("**the Act**")
AND	
IN THE MATTER	of the Resource Management Act 1991 and the Environment Canterbury (Temporary Commissioners and Improved Water Management) Act 2010

STATEMENT OF EVIDENCE BY STUART JOHN FORD FOR HORTICULTURE NEW ZEALAND

25 SEPTEMBER 2015

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1. QUALIFICATIONS AND EXPERIENCE

1.1 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.

1.2 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.

1.3 I have spent over thirty years as a consultant in the primary industries, with the last fifteen years specialising in agricultural and resource economics and business analysis

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

1.5 As part of my work I have been extensively involved in the calculation of nutrient discharges through the use of OVERSEER and the economic assessment of mitigation strategies that farmers can use to reduce their discharges and runoff. Some relevant pieces of work include "The Impact of Water Related Management Changes" which was written for the (then) Ministry of Agriculture and Forestry and "Selwyn Te Waihora Nutrient Performance and Financial Analysis" which was prepared for ECan and Irrigation NZ. I have calculated the total load allowable under the Rangitata Diversion Race Management Limited's (RDRML) short term consent.

1.6 I have prepared and presented evidence for Central Plains Water and Horticulture NZ on variation 1 and for RDRML and Horticulture NZ on variation 2.

1.7 Some particular pieces of work which I have carried out for the Horticultural sector are "Nutrient Performance and Financial Analysis of Lower Waikato Horticulture Growers" which was prepared for the Ministry of Primary Industries and Horticulture New Zealand, "Nutrient Performance and Financial Analysis of Horticultural Systems in the Horizons Region" which was prepared for Horticulture New Zealand and "Nutrient Performance and Financial Analysis of Horticultural Systems on the Waimea Plains of Tasman District"

which was prepared for Horticulture NZ and the Tasman District Council.

1.8 In each case I developed example grower rotations across a range of growers which were then modelled in OVERSEER and then a range of mitigation techniques were modelled across the representative models. At the same time budgets were created for each model and the impact of the mitigations was tested to determine the financial impact of each mitigation.

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

1.10 I have been asked by Horticulture New Zealand ("**Horticulture NZ**") to provide this evidence.

1.11 In preparing my evidence I have reviewed:

1.11.1. ECan: Proposed Variation 3 to the Proposed Canterbury Land and Water Regional Plan – Section 15 Waitaki and Coastal Canterbury.

1.11.2. ECan: Proposed Variation 3 to the Proposed Canterbury Land and Water Regional Plan Section 32 Evaluation Report.

1.11.3. ECan: South Canterbury Coastal Streams limit setting process. Predicting consequences of future scenarios: Overview Report. Report No R15/29.

1.11.4. Lilburne L: South Canterbury Coastal Streams limit setting process: Estimating nitrogen loss under rural land use and informing nitrogen allocation options.

1.11.5. Harris S: Technical report to support water quality and quantity limit setting in South Canterbury Coastal Streams: Economic Assessment.

1.11.6. Lilburne et al (2013): Estimating nitrate nitrogen leaching rates under rural land uses in Canterbury. Report No R14/19 for ECan. (Lookup Table Report)

1.11.7. Snow V et al (2008): Steady state nitrate leaching: Predictions for selected Canterbury Plains soil types, climates and farm systems. Report No R08/65 for ECan. (The Lookup Report)

1.11.8. Green S, Clothier B (2008): Nitrate leaching under various land uses in Canterbury.

1.11.9. Green S, Clothier B (2009): Nitrate leaching under various land uses in Canterbury.

1.12 I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's Practice Note 2014. 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.

2. CONTEXT AND SCOPE OF MY EVIDENCE

2.1 My evidence is given in support of the submission by the Horticulture NZ in relation to Variation 3 to the Proposed Land and Water Regional Plan ("**Variation 3**"). In particular I will be providing evidence regarding the work I have done that provides an overall analysis of the implications of Variation 3 to the horticultural sector in the region.

2.2 In the evidence that follows I consider the following matters:

2.2.1. The nature of horticultural land in the region;

2.2.2. My analysis of the economic impact on the horticultural sector of Variation 3;

2.2.3. My conclusions and recommendations.

2.3 By way of a high level overall summary it is my evidence that there is a vast difference between the N leaching results which have been used by the Council in modelling the scenarios to be considered by the ZIP and the NARG and the results gained from Overseer analysis. This difference means that the majority of land users are already over the maximum cap and will be forced to reduce the intensity of their operations.

3. THE NATURE OF HORTICULTURAL LAND IN THE REGION

3.1 My evidence relates to horticultural growers. This is a definition of growers that range from intensive market garden operations which have a combination of a wide number of

crops which include leafy greens, brassicas, root crops and cucurbits through to the more traditional arable farmer who includes a relatively small area of process crop or root vegetables in their rotation. This definition also includes berry fruit and Pipfruit growers.

3.2 All of these horticultural crops are grown on relatively deep soils which has a major impact on limiting the amount of N leaching which occurs in their operations at present.

4. LIMITATIONS IN THE LOOKUP TABLE

4.1 It is extremely disappointing to find that the Council has chosen to use the Lookup Table Report in adopting the N leaching values used to explore the various options open to the community in setting the values that were eventually derived.

4.2 The Lookup Table Report does not carry out adequate analysis across the full range of land use options open to the Horticultural sector. More importantly it does not calculate the N leaching results using OVERSEER.

Theoretical nature of the Lookup Table

4.3 The purpose of the Lookup table report was to provide a range of Nitrogen loss factors that could be used across a range of land uses and soil types in a known location. At the time that it was initiated (2007) it was felt that it was impossible to model the results accurately so it was decided to base the analysis on what could be modelled and then create relationships to fill in the other land uses and soil types. The relationships were created at a series of workshops which incorporated the scientific knowledge at the time. In the majority of instances the relationships were created as a consensus of opinions of those attending the meetings.

4.4 The Lookup Table report was updated when the version of OVERSEER (Version 6) was made available in the middle of 2013. Despite Version 6 of OVERSEER having an extensive range of vegetable and horticultural crops available to be modelled and an increased ability to model arable operations with a higher degree of accuracy neither the vegetable models nor arable model were updated to include the results of OVERSEER modelling.

4.5 Therefore the modelling which was carried out on the Arable model was carried out by the use of LUCI09 model and the vegetable modelling was carried out using the SPASMO model. Some of the information that makes up the results that you can get from modelling in OVERSEER is informed by the same science that is used in the LUCI 09 and SPASMO results, but how comparable the two modelling results are, is unproven.

4.6 A review of the reports by Plant and Food into their SPASMO modelling which created the N leaching values for vegetable growing indicate that in the case of the 2008 report they modelled a continuous rotation of a single crop lettuce. For their subsequent report (2009) they again modelled a continuous sequence this time using a brassica crop.

4.7 In both of their modelling exercises they applied a single dressing of 150 kg N / ha of Urea to the surface of the crop at sowing and then allowed it to be washed through by irrigation and rainfall.

4.8 While the adoption of this modelling technique may have been adequate to demonstrate the sort of results and interrelationships that occur between the soil types for this class of land use it does not necessarily reflect the results that we could expect from the growers operations. This is because the range of crops grown is far more diverse than that able to be modelled and that both the rate of application, frequency of application and means of incorporation of fertiliser used in the modelling is different than that practiced by growers.

4.9 This creates a difficulty in that the creation of the N leaching factors have been undertaken by a separate means to those derived by OVERSEER. However the performance of growers operations have to be reported in an OVERSEER format. How comparable the results are has not been tested so it is impossible to make a definitive statement on their applicability to the actual situation.

4.10 I also have concerns about the way that the relationships that have been created between the limited number of farming systems that are actually modelled and the vast array of farm types that are listed in the Lookup Table report were then developed as there is no explanation of the various relationships developed by the experts. In the update report it states that "these results were then extrapolated following a similar set of rules and trends as were used in the previous

version of the lookup table". I am not sure what this means by a "similar" set of rules and trends. Does this means that a whole new set of relationships were created that were similar to the ones that were developed by the experts or what? On what basis were they developed? To me this does not indicate a very scientific methodology in developing the relationships and therefore the resultant tables of results.

4.11 I conclude that the method used to calculate the N leaching performance of growers is very theoretical in nature and do not indicate a very robust method of allocation. This is particularly so in light of the fact that there is the capability within OVERSEER to actually model the majority of the potential land uses and soil types.

Non-horticultural modelling

4.12 I would also like to comment on the non-horticultural modelling used in the Lookup Table Report because it brings into question the whole validity of the process used by the Council.

4.13 The Lookup Table Report was updated when the version of OVERSEER (Version 6) was made available in the middle of 2013.

4.14 The Version 6 update of the OVERSEER files was done using the Good Management Practice (GMP) rules (so the modelling assumed good management practice was already occurring).

4.15 In the case of irrigation it adopted the "method only" approach. By selecting "method only" OVERSEER automatically calculates the irrigation amount required to maintain soil moisture content. This calculation underestimates the amount of irrigation required and therefore underestimates the amount of drainage which will occur (while providing an estimate of likely N losses based on those assumptions around moisture and drainage).

4.16 In some work carried out for Central Plains Water I compared this "method only" approach against the alternative which was to enter the actual amount of irrigation applied. Over 20 irrigated farms we found that the method only approach of specifying the irrigation method under estimated the amount of leaching by 35%.

4.17 The farm systems used were those used in the original Snow report which was produced in 2008. These are farm systems, which were actually developed in 2007, are therefore not reflective of the current state of the systems used in Dairy farming in Canterbury. Since they were developed the Dairy farming systems have become much more intensive in terms of stocking rate and output and utilise much higher amounts of fertilisers and bought in supplementary feed from off the farm. All of these intensification activities have lifted the baseline N leaching results considerably.

4.18 A review of the Lookup Table Report indicates that the only land uses that were actually modelled in OVERSEER to make up the core data for the Lookup tables were Dairy at 3, 4 and 5 cows /ha with cows wintered on and off the farm and Sheep under both dryland and irrigated farming systems. The remaining systems were extrapolated from this very limited set of Overseer results.

4.19 The Beef irrigation factor was taken as the "base" for the other models to be compared too. It was assumed that the N leaching for this base model was the same as the 3 dairy cow winter - on model.

4.20 For the remaining land uses, N leaching performance was extrapolated off the available data from the limited number of OVERSEER models run. For example, the Dairy Support figures were taken as the "base" plus 25%. This means that the Dairy Support figures are the same as those used in the low stocking rate dairy farm which winters its cows on the farm plus 25%. Given that Dairy Support represents a range of activities that include selling silage onto a dairy farm, the grazing of young stock and the wintering of dairy cows. Each of these activities have entirely different N leaching results with the wintering of Dairy cows being by far the highest in N leaching capacity.

4.21 The degree of leaching is dependent on a number of factors including the intensity of the operation, the mix of activities and the different mitigation strategies that it is possible to adopt. It is difficult to see how the results gained from adopting the base model plus 25% is a fair estimation of the N leaching factor which occurs under Dairy Support.

The Lookup Table – summary of concerns

4.22 My main concerns about the accuracy and applicability of the use of the Lookup Table Report to inform the load factors In the South Canterbury Coastal Streams zone total are:

4.22.1. The narrow base of OVERSEER models (and the number of modelled farming systems) actually used;

4.22.2. The use of extrapolation factors across other land uses and soil types with little or no explanation of the factors that were used in determining the relationships, particularly the lack of any scientific explanation for the choices made;

4.22.3. The apparently very outdated assumptions made in the setup of the OVERSEER land use models;

4.22.4. The comparability of the LUCI09 and SPASMO results with OVERSEER.

4.23 It is most disappointing that the Council choose to use the Lookup Table Report in its Variation 3 discussions. Since the release of Version 6.0 there have been multiple releases of versions of OVERSEER each has seen an improvement in the scope and accuracy of our ability to model the farming systems that apply. In my opinion the Council would have been better to use actual modelled results of the full range of farming systems to inform their discussions. As I discuss later in my evidence if they had adopted this approach they would have come to vastly different conclusions.

5. OVERSEER ISSUES

5.1 The Foundation for Arable Research carried out an independent review of the use of OVERSEER in the arable sector, which incorporated consideration of the horticultural sector. It came up with the following conclusion:

> *OVERSEER® is the best tool currently available for estimating N leaching losses from the root zone across the diversity and complexity of farming systems in New Zealand. This review sets out a pathway for improving its fitness for this purpose in the arable sector (see recommendations). It also highlights that the new challenges facing OVERSEER® place demands on the development team and model owners that need to be acknowledged and resourced appropriately.*

5.2 The review came up with the following recommendations which are relevant to the horticultural sector:

5.2.1. OVERSEER® crop model estimates of N leaching should be evaluated against measurements of N leaching to identify whether there are any systematic errors in predictions.

5.2.2. OVERSEER® crop model estimates of N leaching should be evaluated against predictions of long term leaching produced by established, detailed research models e.g. APSIM.

5.2.3. The testing outlined in recommendations (1) and (2) is likely to identify and justify areas for further development of OVERSEER® to improve N leaching predictions.

5.3 OVERSEER is not what I would call being in a "steady state" as yet. I believe that it is a work in progress rather than an accurate modelling tool at present. I expect that as it improves by the rectifying of its current modelling errors and includes more sophisticated ways of more accurately calculating the N leaching performance of the various land uses we will gain much greater confidence in the results which it generates. Nevertheless it is the only freely available modelling tool available to us at present and therefore it is the best available tool.

5.4 Horticulture New Zealand is part of a team that is currently funding a research programme that is designed to determine which of two options to model N leaching results is the best for horticultural operators. They are comparing the operation and results of OVERSEER and an Australian modelling tool which has had the necessary changes made to make it relevant for New Zealand soils and climatic conditions called APSIM.

5.5 Limitations to the use in OVERSEER for Horticultural operations were identified in my work on modelling grower rotations in the Lower Waikato region and included:

5.5.1. The crops that can be modelled;

5.5.2. Working in monthly time steps;

5.5.3. Incorporating side dressings;

5.5.4. Limited range of irrigation options.

6. THE RESULTS OF OVERSEER MODELLING VERSUS THE LOOKUP TABLE RESULTS

6.1 Plant and Food Research has carried out OVERSEER modelling (September 2015 Overseer version 6.2) for Horticulture New Zealand on five properties in Canterbury which represent the range of vegetable growers from intensive market gardeners on deep (poorly drained) soils which are all of the Templeton soil type to arable farmers who incorporate some vegetable crops into their rotation. The results of this modelling are shown in Table 1.

Table 1: N leaching values taken from The Lookup Table Report (kg N / ha)

Farm Number	N leaching across the rotation kg / ha	Rotation
1	31	Cereals, seed, greenfeed, potatoes
2	37	Cereals, seed, greenfeed, potatoes
3	19	Pasture, cereals, potatoes
4	21	Cereals, seed, greenfeed, onions, potatoes
5	37	Cereals, seed, potatoes
Average	**29**	

6.2 As part of preparing this brief of evidence I have carried out some limited OVERSEER modelling on some properties within the Wainono sub zone. The information contained in Table 22 incorporates the average figure for the arable rotations and the results which I achieved in my modelling. In Table 22 they are compared to the figures used in the Lookup Table Report which were used by ECan to inform this decision making process.

Table 2: Comparison between N leaching values used in the Lookup Table Report and taken from Plant and Food results and own modelling. (kg N / ha)

Crop	N leaching Lookup Table Report	N Leaching Actual	% Change
Arable (seasonal grazing)	3	29	967
Dairy (4 cows winter off)	13	24	185
Vegetables	8	17 to 24	250

6.3 What this table demonstrates is that the actual values which have been obtained from OVERSEER modelling are considerably higher than the values that have been used in the Lookup Table Report. This is not surprising considering that the Arable values in the Lookup Table Report have been derived by an alternative and not very comprehensive method and the vegetable value has also been derived by an alternative and not very accurate method.

6.4 In the case of Dairy farming the difference can be explained by modelling of the current farming practice rather than one which is nine years old and the fact that the latest version of Overseer doesn't allow the use of "method only" in the choice of irrigation applications.

6.5 What this means is that the majority of land uses in place now and potentially to be used in the future are already leaching more Nitrogen than the plan allows for in terms of the flexibility cap and the maximum allowance cap. This is considerably different than the assumptions used by the Council which are caused by the use of the highly theoretical Lookup Table Report rather than calculating actual numbers.

6.6 This puts us into the situation as discussed in the SCCS Limit Setting Report (Section 6.7.2 and 6.8 Page 108) where the report states:

> **6.7.2 OVERSEER® version changes with potential consequences for assessment of environmental effects**
> *OVERSEER® versions that produce non-uniform (i.e. differing degree of change across farms and scenarios within the catchment) and large changes to N loss estimates (i.e. some land use types change significantly more than others) could potentially have consequences for the assessment of environmental effects presented in this report (i.e., assessments that informed the SCCS community limit setting process). This is because the relative (i.e., proportional) difference in N loss between current and future land use scenarios would change with the new OVERSEER® version compared to the old version. This could alter the assessment of environmental effects for some scenarios for the reasons explained in section 4 above, and could thus potentially alter the basis on which limit-setting decisions have been made.*
>
> *A second type of OVERSEER® version change that may fall into this section is where the version significantly changes land users ability to meet N discharge allowance thresholds such as the flexibility caps or maximum caps (set in kg/ha/yr) described in section 4.2.*
>
> **6.8 Finding solutions**
> *The planning solutions to the issues identified above are not yet clear but are being progressed by Environment Canterbury and discussed*

amongst stakeholders at the time of writing. From a technical perspective there is a need to find solutions to these issues that will:

i) Address OVERSEER® version changes that have no environmental consequences as efficiently as possible so that users are not penalised by any unintended effects of the updated version.

ii) Provide opportunity to review MGM numbers and OVERSEER® version changes (when available) to identify any potential consequences for the assessment of environmental effects that informed the community limit setting decisions and, depending on the outcome of that review, make adjustments to the limit numbers and or the planning framework to preserve the recorded intent of the ZCSP.

6.7 It is obvious to Horticulture NZ that we are already in the situation where the relative differences in N loss between current and future land uses are considerably different than that assumed by the Council. It definitely alters land users ability to meet the N discharge flexibility and maximum caps.

6.8 Therefore it is essential that we review the planning solutions that the report states are being progressed. The ability to review the MGM numbers is problematic as the project is already a year overdue and it has just been announced that it has been delayed for a further six months. I believe that the people running that project are finding it very difficult to deliver what has been promised and whether they will be able to deliver anything which is a practical solution is in question.

6.9 It is my opinion that we are already in the situation that the assessment of environmental effects that informed the community limit setting process is compromised. This is not as a result of the change in Overseer values but as a result of the Council choosing the highly theoretical Lookup Table Values to inform the process rather than using actual Overseer values.

7. EXAMPLES OF THE IMPACT ON ACTUAL GROWERS

7.1 In this section of my evidence I include some examples to illustrate the impact on growers and their ability to meet the baseline calculation, the flexibility cap and the maximum cap. They are all situated within the Waihao – Wainono sub zone on soils that are classified as being poorly drained. As I understand it this requires that they are subject to the potential of a flexibility cap of 17 kg N / ha, if augmentation occurs, and a maximum cap of 20 kg / ha.

Berry fruit

7.2 My first example is of a berry fruit grower who farms approximately 65 ha of mixed berries. His N leaching as determined by the Lookup Table Report is 6 kg / ha. How this has been obtained it is not clear from the Lookup Table Report, it was definitely not modelled. However it is not possible to model Berry fruit in OVERSEER, so presumably it is acceptable to assume that this is an appropriate number to use as the baseline figure.

7.3 This particular grower is coming towards the end of his working life and believes that it is unlikely that the operation will be sold as a berry fruit operation. So theoretically this grower has lots of room between his baseline figure and the flexibility cap (of potentially 17 kg N / ha). By my calculation there is very little that the property would be able to be converted to because there are very few options that will keep below the 17 kg N / ha cap. So the only alternative is to sell it with limited development opportunity which will obviously result in a much lower price.

7.4 So we have an example of a very low emitter (theoretically) who will suffer financially because of the means of allocation of the N leaching total load.

Pipfruit

7.5 My second example is a Pipfruit growing operation. Despite having the ability to model Pipfruit in OVERSEER the Lookup Table Report has not included Pipfruit in its analysis. Therefore their operation has not been modelled at all in the reporting process.

7.6 I have previously modelled Pipfruit on the same soil type as we are assessing here and have found that on average it has an N leaching of 24 kg N / ha. This is obviously above the maximum cap of 20. So in order to maintain their highly efficient Pipfruit operation they will be forced to buy extra land which they will be forced to farm at a very low N leaching figure to try and balance the higher output from their existing operation. This will cause a deterioration of their total return and return on capital.

Yams

7.7 My third example is of a vegetable grower who has a total of 176 ha on which he annually grows approximately 30 ha of yams. Despite vegetables being analysed as leaching 8 kg N /ha in the lookup Table Report, Overseer analysis shows that they leach 25 kg N / ha in a dryland situation. At present his baseline figure over the whole operation is 7 kg N / ha because of the relatively low intensity with which he farms the rest of his property.

7.8 The grower has plans to at least double the area in yams and develop irrigation to allow him to consistently provide for the markets requirements in terms of the size and quality of his product. Carrying out both of these expansion options is likely to mean that his property will exceed the maximum cap. Therefore, this grower will be forced to either scale back his plans to expand or scale back his operation further on the remainder of his property or buy more land to reduce the total amount of leaching on land under his control. Again this option will result in a much lower potential gross revenue and return on capital.

Potatoes

7.9 My fourth example is a potato grower who farms 365 ha of land. Currently he grows approximately 100 ha of potatoes on leased land off his property. He uses his land to produce silage to sell to Dairy farmers. He therefore has a very low baseline figure on his property of 4 kg N / ha.

7.10 It is most likely that because of the relatively high N leaching which occurs with potatoes that this grower will not be able to lease land on which to grow potatoes. That will force him to grow it on his own land. Therefore this grower will be forced to adopt a rotation similar to the ones that I have listed in Table 1. These are all above the maximum leaching cap which is proposed. Therefore he will be forced to manage how much he can afford to adopt as arable land against his existing land use to stay below the maximum cap.

7.11 An alternative land use would be to convert to Dairy farming which according to the Lookup Table Report would have an N leaching figure of 13 kg N / ha. When we model it in the latest version of Overseer we find that it has an N leaching

figure of 24 kg N / ha. So again we find that he is restricted by the maximum allowable cap.

7.12 The purpose of showing you these examples is to point out some of the problems with the modelling which has been carried out.

7.13 The first point is that the majority of horticulture growers have just not been considered in the analysis provided for consideration by the ZIP or NARG.

7.14 The second point is that the growers N leaching has been seriously underestimated because of the theoretical means in which their N leaching has been determined. This has meant that the majority of land uses used in the scenarios considered have been based around the low emitters (horticultural growers) being in the fortunate position of being able to intensify further until they meet the flexibility cap. What we find in practice when their N leaching is determined by the use of Overseer is that the majority of them are already constrained by the maximum cap and will be forced to scale back the intensity of their operation to meet the maximum cap.

7.15 This is not a situation which has been modelled in any of the Scenarios put up for consideration by the ZIP or the NARG groups.

7.16 Therefore, I conclude that the scenarios that were considered by the ZIP and the NARG were highly theoretical constructs which had no basis in reality. Therefore the conclusions which both of those groups came to were seriously misinformed and therefore are wrong.

8. THE POTENTIAL LOSS OF LAND USE FLEXIBILITY

8.1 In the case of Horticultural growers the maximum cap set for the heavy soils is relatively much lower than those set for the lighter soils. By my calculations these maximum caps will be restrictive to all land uses. The class of land which most of these operations are carried out on is highly productive and is suitable, subsequent to some modification, to convert to any other production land use. I would also point out that because of the soil's deep nature it is very good at retaining the majority of N which leaches through below the root zone.

8.2 Therefore, efficiency measure of Productive capacity compared to N leaching is much higher for these heavy soils than the lighter soils.

8.3 As the relative profitability of the various land uses changes in the future there will be real economic pressure for the land use to change. As the rules stand at present it will not be possible to make the changes because the property has too low a maximum cap to be able to make the change to a higher N leaching land use. Even though it could do so at a much lower N leaching figure than lighter soils.

8.4 This will create financial hardship for the individual who will be stuck with the land with the highest adaptive ability but the lowest maximum cap figure. Therefore, there will be little if any demand to purchase the land by higher returning and higher leaching land uses. Consequently, the value of the land will drop according to the returns that can be made by the land uses which are possible within the relatively low maximum cap figures.

8.5 There will also be a negative impact on the total economic output possible from within the Catchment because the land uses will be forced to remain at the lower economic land use because they have a low (but highly efficient) N leaching allowance.

8.6 As this situation has not occurred in New Zealand it is not possible for me to quantify the financial impacts on individuals or the economy as a whole.

8.7 I believe that there are two possible solutions. The first is the adoption of a trading mechanism for N leaching. The second is the allocation of the maximum cap figure at a level which advantages the relative efficiency of productivity compared to the potential for N leaching. Both of these options are highly dependent on the rules under which they operate which would have to be designed with extreme caution.

9. COMMENTARY ON THE RELIABILITY OF IRRIGATION WATER

9.1 The irrigated crops that I refer to in my evidence include the full range of vegetable crops which are grown in the catchment. In the rotation there are different times for planting and harvest. Irrigation demand depends on the time of planting and the time that a crop is in the ground. Crops have different water demands at different times of the year

with the highest occurring in the summer months of December through to March. However water demand can occur outside this time period.

9.2 These crops require irrigation of some sort during the periods when they are grown that coincide with the periods when evapotranspiration exceed the available soil moisture. The irrigation is for two purposes. The first is to maintain the yield of the crop and the second is to maintain the quality parameters of the crop. Both elements are equally important in terms of the effect that they have on the economics of growing the crop. Without the yield component they are uneconomic to grow and without achieving the quality parameters they are uneconomic to grow. The availability of highly reliable Irrigation water is essential to the continued viability of growing these crops in the Canterbury Region.

9.3 For example in the case of growing onions there is the important element of the grading criteria for the size of the onions. There could be up to double the value depending on the size grades that onions fit into. The objective is to get as many as possible into the desired range. This is set up by drilling but is maintained by irrigation. If irrigation is missed during a crucial growth period the crop will fail to meet the size requirement.

9.4 For potatoes quality parameters are first influenced by the size of tubers that are grown but then quality is also influenced by the shape and the look of potatoes for the fresh market. For process potatoes there is a range of other attributes that are tested for to ensure that the processed product achieves the desired standards which are essential to meet the requirements of the processed product. All of these characteristics have a large influence on the price paid for the crop.

9.5 Unfortunately the cost of growing them is virtually the same if they meet the quality standards or not. Therefore any downgrading of quantity of yield and / or the quality of the crop can put the grower into the situation of making a loss on the growing of the crop.

9.6 The economics of growing carrots depends on achieving relatively high yields while also meeting tight specifications as to carrot size. Missing one or two irrigations could mean that the specifications for the crop fall outside those required. At

this point there is virtually no alternative use other than stock feed for the crop.

9.7 All of these crops have a dependence on irrigation for both yield and to meet stringent quality specifications. The amount of irrigation may not be large but it is absolutely vital to the continued growing of them as it is the difference between a profit and a loss. Therefore consideration of the need for reliability of access to irrigation water needs to be given to these horticultural crops.

9.8 There are three major types of efficiency of water use. The first is **Technical Efficiency** which determines the rate at which resources, capital, labour are converted into goods. More goods produced for a given set of resources equates to higher technical efficiency. The next is **Allocative Efficiency** in which resources are optimally allocated to the production of different sets of goods in such a way that the welfare of society is maximised. The third is **Dynamic Efficiency** which allows use patterns to evolve over time.

9.9 Because of the nature of the crop rotations and the need to move areas cropped and irrigators from location to location they sometimes will not be as technically efficient as we would expect from say a centre pivot irrigator. Nevertheless many of the irrigation applications on horticultural crops are of a lower volume, and are generally applied more regularly than that for pastoral agriculture and therefore achieve a higher technical efficiency than most pastoral farming irrigation practices.

9.10 Horticulture is also very efficient when it comes to allocative efficiency. This relates to the value generated from the use of the water resource. This is generally measured as dollars generated per cubic meter of water used ($ / m3). The combination of high Gross returns and the relatively low total amount of irrigation water used mean that Horticulture achieves measures three to eight times that of alternative uses of the water.

9.11 I would also point out that pastoral agriculture is not solely dependent on irrigation and has alternative means of providing for the feed to produce the gains made from irrigation. These range from purchasing or making hay and silage to introducing a range of alternative purchased feed sources such as molasses, grain meal, maize silage, palm kernel etc.

9.12 In terms of establishing priority to horticultural use I believe that there is good justification for horticultural use to be granted priority status at times of water shortages or low flows over all other users. The times when water is essential to crops coincide with times when water shortages occur. If water was shut off to those crops the growers could suffer a complete loss of revenue or at the least their revenue would be lower than their costs of production.

9.13 At present, as proposed, horticultural irrigators would need to cease irrigating along with pastoral irrigators once trigger levels are reached. As already explained the pastoral irrigators have alternative means to provide for the feed that they would lose. This would mean that the only people who would suffer financially would be the horticulturalists. Considering the high returns to horticulture per unit of water consumed this would cause considerable losses. I therefore believe that the horticulturalists should receive priority in terms of access to irrigation water over the pastoral uses. This would require pastoral users to lose access to water before horticulturists in times of water restrictions.

9.14 In my view the current proposed rule structure disadvantages horticultural land use as it treats Horticultural irrigation rights the same as irrigation rights from all other land uses when it is obvious that their reliance on irrigation is much higher than other uses and their return to irrigation is much greater. I believe that there is no justification for this treatment of horticulture and believe that there is a strong imperative to have horticulture elevated to a position of priority.

10. CONCLUSIONS AND RECOMMENDATIONS

10.1 The method used to calculate the N leaching performance in The Lookup Table is very theoretical in nature and does not indicate a robust method of allocation. This is particularly so in light of the fact that there is the capability within OVERSEER to actually model the majority of the potential land uses.

10.2 The use of OVERSEER as the reporting tool at present requires a degree of caution because of concerns about the accuracy of results produced for horticultural and arable operations.

10.3 Comparison of the results used in The Lookup Table Report and actual OVERSEER runs indicate that there is a vast

difference in the results obtained with the results being from twice to ten times those used by the Council.

10.4 The majority of land uses in place now and potentially to be used in the future are already leaching more Nitrogen than the plan allows for in terms of the flexibility cap and the maximum allowance cap. This is considerably different than the assumptions used by the Council which are caused by the use of the highly theoretical Lookup Table Report rather than calculating actual numbers.

10.5 It is obvious to Horticulture NZ that we are already in the situation where the relative differences in N loss between current and future land uses are considerably different than that assumed by the Council. It definitely alters land users ability to meet the N discharge flexibility and maximum caps.

10.6 Therefore it is essential that we review the planning solutions that the report states are being progressed.

10.7 What we find in practice when their N leaching is determined by the use of Overseer is that the majority of them are already constrained by the maximum cap and will be forced to scale back the intensity of their operation to meet the maximum cap.

10.8 The scenarios that were considered by the ZIP and the NARG were highly theoretical constructs which had no basis in reality. Therefore the conclusions which both of those groups came to were seriously misinformed and therefore are wrong and therefore I consider that they should be reconsidered.

Stuart John Ford
25 September 2015