Memorandum to HortNZ

1 Background

This memorandum is written in response to a request from HortNZ to:

1) The action for freshwater discussion document, includes a Vegetable growing case study, based on the Hawkes Bay survey you did for HortNZ. I would like you to comment on the appropriateness of the use of your survey data.

2) Please make some comments from your knowledge and experience on the impact of irrigation of horticulture on water quality, in particular low-intensity horticulture. Your comments can be based on and refer to previous Overseer modelling and reports for HortNZ and others. We are particularly looking to see if there is any relevant information that can be used to differentiate the risks associated with irrigation of fruit etc from irrigation in general.

   - Leaching concentrations and loads for irrigated versus non irrigated horticulture
   - Irrigation techniques used in Horticulture (drip, fertigation etc) and the risks associated with increased loads.
   - Irrigation and improvements in yield, and uptake of fertiliser
   - Leaching rates of fruit crops

3) Can you please look at the analysis you did for Waikato into the costs of expansion by offsetting the land area and provide more of a national view, or perhaps compare it with some other regions, so we can provide a range.

2 Vegetable growing case study.

In the Action for Healthy Waterways document at Section 10.3 Impact Scenarios are described in order to provide an indication of how proposals may impact. In Scenario 3 Commercial vegetable grower on fertile flat land, an example is given of a 45 ha commercial vegetable-growing operation, with 30 hectares on their own property, and 15 hectares of land leased from other landowners within their catchment. They grow squash, peas, sweetcorn, lettuces and beans on mostly flat fertile land.

It then goes on to detail the costs of reducing sediment, reviewing the farm plan, providing more accurate irrigation management and upgrading the telemetry of their water take over the next ten years at a total cost of $92,000 or annualized to $9,200 per year.

We would comment that one of the costs given is that of installing ten silt traps including annual maintenance costing a total of $17,500 for the whole ten years. Andrew Barbers report " Erosion & Sediment Control Guidelines for Vegetable Production" is quoted as the source of the costing. We can see from Table 1 Cost and effectiveness of various mitigation measures in that report that the cost of establishment of silt traps is given as between $750 and $1,300 per ha and that annual maintenance is $75 per ha per year. We do not know what assumptions have been made as to the total area that is serviced by the ten silt traps that would cost in total only $17,500 over ten years but would comment that if it was the total 45 ha the cost spread over the ten years would be between $67,500 and $92,200 and if it was in fact this sum it would add another between $5,000 and $7,475 to the annual cost as calculated in the report.

The report then goes on to comment that the $9,200 per year equates to one percent of total income and a reduction in Earnings Before Interest and Tax (EBIT), incorrectly described as profit in the report, from $397,440 to $388,240. The source of the information is given as "Hawkes Bay Horticultural Nutrient and Financial Benchmarking Results. Prepared for: Horticulture New Zealand and Hawke's Bay Regional Council by The AgriBusiness Group May 2016".

While the information used is correct the manner in which it has been used is in our view incorrect and it is misleading in its conclusions.

For example:

- If a third of the area utilised is in affect leased that would reduce the annual average EBIT from the $8,832 to $7,999 based on the facts used to determine the average EBIT result.
- It is a pointless exercise to express a change in expenditure compared with the Gross Revenue of an operation and to try and portray it as an affordable item because it is a relatively small value when compared to the total Gross Revenue.
- The true impact of a change in expenditure should be measured against the true profit which is best described as that sum available to the owners of the business after all costs have been deducted. In the example given there would no doubt be considerable debt to service, repayment of capital and then tax to be paid on the remainder to come off the EBIT result that was used in the example. If the comparison were to be made against this figure then it would have a far greater impact than that portrayed in the report.

The example given of the impact on a commercial vegetable producer is factually incorrect in the way that it has used the financial information and is completely misleading in the way it compares the impact against the Gross Revenue and the EBIT result rather than the true business profit.

This would lead us to believe that either the example has been set up to portray a low level impact purposely or the person that constructed the example had insufficient knowledge of either the practical nature or the economics of the commercial vegetable production sector to enable them to compile an accurate estimate.

3 Horticultural Irrigation

3.1 Leaching concentrations and loads for irrigated versus non irrigated horticulture.

It is difficult to answer this question because apart for some areas in the center of the North Island / Bay of Plenty and in Southland the vast majority of horticulture has the capacity to irrigate the crops when it is required therefore we do not have the information that can be used to compare the leaching information between irrigated and non irrigated horticulture.

Where Horticultural crops are grown on relatively deep, high moisture retention soils in areas with relatively reliable rainfall then they are not likely to be irrigated. Where they are grown on relatively light soils or are grown in areas where the rainfall is unreliable then they require the addition of irrigation to ensure both the quality and quantity of the crop grown.

The contribution that irrigation makes to the leaching performance of horticultural crops is as a result of causing an excess of moisture to filter through the soil profile taking with it any excess Nitrogen (N). If there isn't sufficient moisture added to the soil profile to cause the excess filtering through the soil profile or there isn't an excess of N that can be carried through the soil profile then the crops N leaching figure will be low.

There is a considerable difference between the performance of the permanent fruit crops and vegetable production in their N leaching performance with the former being generally much lower than the latter. That is because the use of applied N in the fruit industry is much lower than in the vegetable sector and the use of irrigation is generally much lower in the volume of application because of the delivery systems, predominantly drip or sprinkler systems, being much more efficient and directed in their delivery of water to the plants. The vegetable sector uses much more N and irrigation right throughout the life of their crops because they are relatively inefficient in their N use, particularly in the earlier stages of their growth and the irrigation systems are much less efficient and targeted in their water delivery being either spray or center pivot systems.

3.2 Irrigation techniques used in Horticulture.

The main separation between the grouping of irrigation techniques in horticulture is determined by the nature of the crop being grown between permanent crops and rotational crops.

3.2.1 Permanent crops (drips, micro sprinklers).

Permanent crops by their nature are fixed to the one location and do not move or change. That means that the irrigation system which is used on them can also be permanent and so it can be set up to deliver the moisture exactly to the point that it is required and that is directly into or onto the root zone of the plant. This means that the directed application of the moisture means that both the application area and the volume of moisture applied can be managed so that exactly the amount of moisture that is required by the plant is able to be applied. The other big advantage of the permanent irrigation systems is that because they are in place permanently they are able to apply moisture permanently and so they deliver moisture at much lower volumes of application per hour than other systems.

That means that the total water application efficiency of these systems is very high and the chances of these systems causing a large amount of moisture travelling through the soil profile is very low.

The resultant N leaching achieved in the permanent crops is relatively low when compared with other crop types.

3.2.2 Rotational crops (spray and center pivot).

Rotational crops are crops that are grown for a short term, less than a year, and are changed from year to year therefore their irrigation systems have to be able to allow the cultivation of the ground and the planting, tending and harvesting of the crops. This is achieved by establishing either spray or center pivot irrigation systems both of which are travelling irrigation systems which move across the area and irrigate them as they move.

These systems are much less efficient in the delivery of moisture to the plants because they irrigate the whole area which they cover and because they are designed to deliver sufficient moisture to maintain the plant until they are able to return. Obviously the longer the return period the more moisture that is delivered to the one spot in any application. That is why the spray irrigation systems that have a longer return period deliver more moisture at the one time than the center pivot systems which have a relatively short return time.

In general, the more moisture delivered at any one time the more potential there is for more moisture to filter through the soil profile depending on the depth and water holding capacity of the soil.

The irrigation systems used in the rotational crops have the potential to cause much more N leaching than the permanent systems.

3.3 Irrigation and improvements in yield and uptake of fertiliser.

My commentary on this issue is based on personal observation and not any published studies or research reports.

Over the last ten years the environmental performance of horticulturalists has risen tremendously. This has been influenced by the dual drivers of knowledge improvement and responses to constrained economics of their production system. The latter driver has been achieved by adopting much better production techniques which have resulted in yield increases while at the same time reducing the amount of fertiliser that they have applied and using water much more efficiently.

Adopting advanced irrigation practices have been part of this drive to improve the efficiency of their production systems. This has seen the adoption of irrigation scheduling techniques which include the measurement of the amount of moisture resident in the soil and matching that with weather forecasting which has allowed them to accurately make decisions on both the amount of irrigation required and the timing of that application.

Upgrading the irrigation infrastructure has been a big part of this improvement with the wide spread adoption of more efficient application systems to allow a lower amount of moisture to be applied throughout the life of the crop and at the same time maximising the yield. This has been achieved by keeping the fertiliser applied available within the root zone of the plants where it can be taken up by the plant and contribute to the yield enhancement rather than being washed through the soil profile as was happening with the previous irrigation practices.

3.4 Leaching rates of fruit crops

As has already been explained the N leaching performance of fruit crops is much lower than other horticultural crops because of the relatively deep nature of the soils which they are grow on, the fact that much lower applications of N are made to them and the efficiency of their irrigation systems in delivery just the amount of moisture which is required to their root systems.

In some work The AgriBusiness Group did benchmarking the performance of horticultural crops in the Hawkes Bay we found that on the Pipfruit Orchards which were surveyed (8) the average N leaching as modeled in Overseer was 13 kg N/ha/year (7 to 26) and for the Kiwifruit Orchards (2) the average N leaching was 25.

In some earlier work which we carried out in 2015[1] we modeled three different fruit crops on the Waimea Plains in the Tasman District. Considerable caution should be taken in interpreting the results of this work because the modeling was carried out in Overseer version 6.1.3 and we noted

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[1] The AgriBusiness Group (2015): Nutrient Performance and Financial Analysis of Horticultural Systems in the Waimea Catchment

at that time that there were considerable challenges with the accurate modeling of these crops in Overseer at that time. The results of that work are shown in Table 1.

Table 1: Overseer results on each of the dominant soil types.

	Ranzau	Waimea
Pipfruit	24	19
Vineyard	6	6
Kiwifruit	44	37

In a report written for Environment BoP Crop and Food reported on nitrogen losses as modeled using SPASMO from Kiwifruit orchards across the Bay of Plenty across a range of sites, soil types and irrigation practices and reported that the results ranged from 1 to 18.

In the report written for Environment BoP written by Perrin Ag[2] in 2018 they modeled two Kiwifruit Orchards with N leaching rates of 23 and 19 respectively using Overseer version 6.3.0.

In a report written for Winegrowers NZ in 2017 [3]Crop and Food modeled a range of vineyards across the main wine growing regions (6) of NZ across a range of soil types (89) and they found that the average N losses / ha / yr were 8 with a range from 1 to 14.

4 The costs of expansion by offsetting the land use.

The following information should be treated with some caution because the data that drives the models is sourced from a range of different reports which mean that the N leaching results have been derived from different versions of Overseer and the financial data is derived from different time scales as well. The information should be regarded as representing the range of values rather than being an accurate reflection of what the current information indicates.

4.1 Waikato / Auckland

In my evidence to the commissioners hearing PC1 in the Waikato Region I presented quite a detailed analysis of the cost to the growers if they were able to offset any new growth in land use within the rules that were proposed in PC 1.

While the creation of an offset is a technically feasible alternative that would allow for a new area of CVP land to be achieved the financial impact of such an activity has not been considered by the Officers in their analysis.

If we consider the provision of providing for an offset in three ways:

- De-intensifying the productive system.

[2] PerrinAg (2018): Economic and contaminant loss impacts on farm and orchard systems of mitigation bundles to address sediment and other freshwater contaminants in the Rangitāiki and Kaituna-Pongakawa-Waitahanui Water Management Areas
[3] Clothier B, Green S : The leaching and runoff of nutrients from vineyards

- An enterprise off set whereby additional productive land is purchased and it is converted to low leaching land use.
- An on farm offset whereby an existing land uses high leaching activity is replaced with CVP production.

A brief explanation of how each option has been modelled is as follows.

Deintensification is modelled as the new CVP producer buying a new dairy farm and operating it at its existing leaching value which means that there is a much higher proportion of the low leaching crop which is barley.

The enterprise example models a new CVP producer buying an existing dairy farm and planting as much of it as is required in Forestry to ensure that the N leaching value is the same as the existing use.

The on-farm offset models a new CVP producer leasing land off a dairy farmer (the feed cropping block) and the dairy farmer winter grazing their cows elsewhere and the loss of some milksolids production.

Table 2: The cost of maintaining the current CVP gross margin in various offset scenarios-Waikato

	Deintensification	Enterprise	On farm
Additional area required per ha of CVP area.	1.74	1.05	-
Additional cost to maintain existing gross margin.	9,115	6,280	5,653*
Change in average crop revenue to maintain the existing gross margin.	+ 50%	+ 30%	+ 16%

* includes the existing lease cost of $2,000 per ha.

The additional areas of land that would be required in each off the offset scenarios are 1.74 ha of additional land for every 1 ha of CVP land in the deintensification scenario and an additional 1.05 ha of land for every 1 ha of CVP land in the enterprise scenario. In the on farm scenario there is sufficient spare nutrients from the crop area to allow for an additional 29.8 ha of dairy land to also be involved in the lease.

The additional cost to maintain the existing gross margin in the deintensification and enterprise scenario reflect the cost to the CVP grower of having to buy additional land to use as an offset. In the case of the on farm scenario this figure has been calculated from the point of view of a lessor and reflects the amount that they would have to receive, at the minimum to compensate them for the lost productivity of their land.

The final row is an approximation of how much the returns for each crop would have to rise to compensate the growers for the additional costs and maintain their existing gross margins. This is on the assumption that the CVP growers were price setters and that the market would respond by paying that price ie: that demand was inelastic. Neither of those two assumptions is true because CVP growers are price takers and demand for their product is very elastic according to the price of the produce on offer. We can see that just to maintain their present returns that the price of vegetables would have to increase by between 16 and 50 %.

In relation to the on-farm scenario what this would mean would be that the commercial vegetable grower might only be accommodated within the dairy farm for 3 years of the 20 year consent of the dairy farm. While it would be technically possible for this to occur, a dairy farmer could apply to consent and submit their FEP and nutrient model to accommodate vegetable growing, it would mean that the farmer would need to anticipate the desire of growers to come onto their land and obtain a (discretionary) consent to provide for that.

None of these scenarios are realistic in terms of offering new CVP growers the opportunity to offset their production.

4.2 Horizons

Data is taken from a report carried out for Horizons in October 2017 titled “Farm Scale Economic Impact Analysis of One Plan Intensive Land Use Provisions”.

Table 3: The cost of maintaining the current CVP gross margin in various offset scenarios-Horizons

	Deintensification	Enterprise	On farm
Additional area required per ha of CVP area.	1.22	0.74	-
Additional cost to maintain existing gross margin.	5,339	4,508	5,991
Change in average crop revenue to maintain the existing gross margin.	27%	23%	31%

4.3 Canterbury

Data is taken from the report written for ECan in February 2019 titled “Overseer nutrient modelling of commercial vegetable production.”

Table 4: The cost of maintaining the current CVP gross margin in various offset scenarios-Horizons

	Deintensification	Enterprise	On farm
Additional area required per ha of CVP area.	0.54	0.38	-
Additional cost to maintain existing gross margin.	4,009	3,646	5,886
Change in average crop revenue to maintain the existing gross margin.	20%	19%	30%

4.4 Summary

Apart from the Waikato/ Auckland data where the offsetting costs are much higher because of the relatively high cost of land the majority of offsetting options mean that the additional value required to maintain the existing Gross Margin is between $4,000 and $6,000 per ha which would require the gross revenue, hence the value of the produce, to increase by between 20 to 30 %.