BEFORE INDEPENDENT HEARING COMMISIONERS

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER Proposed Waikato Regional Plan Change 1: Waikato and Waipa River Catchment

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STATEMENT OF PRIMARY EVIDENCE OF DR BRUCE SYDNEY THORROLD FOR DAIRYNZ LIMITED SUBMITTER 74050

3 MAY2019

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Qualifications and experience

1. My full name is Bruce Sydney Thorrold. I am employed at DairyNZ as Strategy and Investment Leader, responsible for investment into and oversight of research projects relating to farm systems and nutrient management.

2. I hold a Bachelor of Agricultural Science (Hons.1) (1984) majoring in Agronomy, and a Ph.D. in Soil Science (1994) from Lincoln University. In my role at DairyNZ I have had oversight of relevant projects including Pastoral21 (Steering Group Chair) and Forages For Reduced Nitrate Leaching (Governance Group Member) and I am a member of the Owl Farm Governance Group. Prior to that I was a Senior Scientist at Dexcel and AgResearch, where I led research programmes including catchment studies at Whatawhata Research Centre, Best Practise Dairy Catchments, Prototype Farms, Oteramika Catchment Study and Lake Taupo. I spent 5 years deeply involved in the science, farmer-regional council negotiations and policy development for Waikato Regional Council Plan Change 5 – the Lake Taupo Variation.

Code of Conduct

3. I have read the Environment Court's Code of Conduct for Expert Witnesses contained in Practice Note 2014 and agree to comply with it.

Scope of Evidence

4. My evidence pertains to Proposed Waikato Regional Plan Change 1 – Waikato and Waipa River catchments and covers research undertaken to reduce nitrate leaching, and whether the results can be applied to every dairy farm in the Waikato River catchment now.

5. In summary my evidence is that

    a) Dairy farmers have invested in research that has proven farm systems options that reduce nitrogen (N) leaching, and there are new options in the research pipeline.

    b) The Pastoral21 Future Farm system has shown a reduction in N leached of 43% through a combination of lower N inputs and off-pasture infrastructure. However, it is my opinion that the

widespread and rapid adoption of this system is not feasible or desirable.

Two decades of research investment by dairy farmers is now delivering implementable solutions.

6. Over the last two decades DairyNZ and its predecessors have extensively researched the Nitrogen cycle, understanding the processes that drive N leaching and testing new management systems and technologies that would reduce N leaching while maintaining profit and productivity. This research has been funded by dairy farmers and the government and done in close collaboration with Crown Research Institutes (CRI) and university researchers.

7. The Pastoral21 (P21) research programme (a government-pastoral sector research partnership) has tested the science at farm system scale and found that our understanding of the whole system is sufficient for us to design and implement systems that produce large differences in N leaching. These systems were built on our understanding of

    a) the way that increasing total N inputs into the farm increases leaching, and

    b) the N leaching reductions from having cows spending time off-pasture (with urine capture and re-cycling) at critical times of year.

8. The results of P21 experiments are consistent with the Overseer model outputs, and farmers implementing the mitigation options used in P21 will see changes in their N leaching calculations in Overseer.

9. In addition to these farm systems solutions, the P21 programme and subsequent research have also developed further options for reducing N loss that are yet to be tested at farm system level. These include

    a) Using the herb plantain in mixed pastures.

    b) Breeding cows for lower urinary N output (LowN livestock)

    c) The use of fodder beet and cover crops for wintering.

d) The building of constructed wetlands to intercept all four contaminants in drainage.

e) The use of N-cycle inhibition compounds applied directly to urine patches (the Spikey tool developed by Pastoral Robotics Ltd).

10. Previous experience with the N inhibitor dicyandiamide and early work with off-pasture systems have shown the importance of full system scale testing to ensure that promising results at plot and paddock scale still apply at the full system level. Dexcel research tested a TightN Prototype Farm and found that plot scale results were not able to be replicated at system level due to poor (at the time) understanding of the underlying processes and the way that different seasonal weather patterns influenced performance in the Waikato compared with Canterbury. Further research and testing into the mitigation options discussed above at the farm scale are required for these options to be integrated into Overseer. The staged approach in PC1 allows for the future integration of these options and will enable farmers to meet their regulatory obligations in the long term.

Pastoral21 Future Farm

11. The P21 Future Farm research has shown large reductions (43%) in N leaching in the Waikato with a combination of reduced N inputs and use of off-pasture options during the autumn (Shepherd et al, 2017). This was achieved with a reduction in both production and profit (Table1). In Table 1 Operating Profit includes all cash costs, staff and depreciation but excludes debt servicing.

Table 1 Summary of trial design and results over 5 years for Pastoral21 Waikato Current and Future Farms. From Clark et al 2019.

	Current	Future
Stocking rate (cows/ha)	3.2	2.6
Cow genetic merit BW ($/5t feed)	90	170
N fertiliser (kg N/ha/yr)	150	50
Stand-off	No	Yes
Bought in feed	Yes	No
Production (kg MS/ha/yr)	1200	1153
Pasture grown (t DM/yr)	17.0	15.5
Gross revenue ($/ha/yr)	7714	7363
Operating expenses ($/ha/yr)	5628	5556
Operating profit ($/ha/yr)	2086	1807

12. On the basis of the P21 results, it has been suggested that dairy farmers in the Waikato should now implement the Future Farm system and make greater reductions in N leaching than PC1 requires for the next 10 years. It is my opinion that the wide and

rapid scaling up of the P21 Future Farm system through the Waikato is not the optimum pathway to the Healthy Rivers vision as it is infeasible in that timeframe, would negatively impact farm profitability and limit future choices.

13. To support my opinion, I will

    a) explain the basis of the Pastoral21 results,

    b) discuss the barriers to their rapid and widespread adoption and the importance of the staged approach and

    c) outline some future options that dairy farmers will have to meet the long-term nutrient targets.

14. Reducing N inputs (fertiliser and feed) lowered pasture grown and feed supply in the Future Farm. The research team was able to partially offset the effect of the lower feed supply on milksolids production by

    a) Reducing total feed demand (through a lower stocking rate), and

    b) Increasing per cow feed intake, production and efficiency by

        (i) higher feed allowances per cow supported by high pasture management skill and

        (ii) selecting an elite herd of cows with genetic merit approximately 8 years ahead of the average of the national herd

15. Research has shown that breeding has increased the feed intake potential of elite cows, without increasing their liveweight and maintenance cost. This leads to elite cows being more profitable per tonne feed supplied as fewer cows are required to consume the feed supply leading to increased milksolids production and lower costs (Macdonald et al 2005).

16. Reduced milksolids production in the Future Farm lowered income, and the capital ($73/ha/yr depreciation) and operating ($247/ha/yr) cost of the off-pasture system increased costs (Clark et al 2019). The research team was able to partially off-set the effects of these extra costs on profitability by

    a) Lower per cow costs (e.g. wages, animal health) due to lower stocking rate, and

b) Less feed and fertiliser purchased.

It is not feasible for dairy farmers to implement the P21 Future Farm system at scale and speed

17. It is not~~n't~~ possible for all farms to replicate the Future Farm system immediately as farmers cannot simply create the elite genetic merit herd that the Future Farm used. There is at least 8 years of breeding to increase the genetic merit (Breeding Worth, BW) of the herds on all farms to the same level as the Future Farm. The losses in profit from shifting from the Current to the Future Farm **without elite genetics** are greater than the P21 result.

18. The P21 Future Farm was designed and named to reflect the Future scenario. Because the Future Farm captured the benefit of future genetic gain, its profitability overstates the situation of a farm converting today to lower feed inputs and lower stocking rate. The genetic merit differences in Table 1 would be expected to lead to a $240/ha/yr difference in profit. This is calculated from the BW difference per cow of $80 (per 5t feed) multiplied by the 15t feed grown in the Future Farm. If farmers were to replicate the Future Farm system with today's cows this would be expected to reduce the profitability of the Future System by a further $240/ha to be $519/ha less than the Current Farm.

19. This amount of profit loss ($519 divided by $2086 = 25%) is well aligned with the cost abatement curves presented in Dr ~~Graeme~~ Doole's evidence for a 40% reduction in N leaching. It is not correct to extrapolate from the Future Farm that a 43% leaching reduction can be widely achieved for only a 13% reduction in profit. It is the costs represented in the abatement curves that farmers will face today – in the longer term genetic gain will increase profitability at the lower input levels. But that is profitability that farmers will need to offset cost increases, invest on other actions to improve water quality and maintain dairy farming's international competitiveness

20. Maintaining high pasture utilisation and quality is central to the performance of pasture based dairy systems. Higher pasture management skills are required for lower stocking rates and the use of off-pasture systems. With the rapid expansion of dairying there has been a dilution of pasture management skills. The Owl Farm Demonstration at St Peter's School was set up by the dairy sector to help lead our response to the Healthy Rivers Vision and Strategy. At Owl Farm it took 3 years to take an average performing farm into the top quartile for profit through a focus on pasture management with reduced feed inputs. This was with a full-time supervisor committed to improved pasture management and a dedicated farm manager. On the other approximately

2,550 farms in the Waikato the support for change is likely to be lower, and it will take longer to build skills and implement these changes.

21. Approximately half the N leaching gains in the Future Farm came from the off-pasture facility (Beukes et al, 2017). High debt levels in the dairy sector and increasing capital requirements for the banking sector are going to limit capital availability for many dairy farmers. This will limit the ability of farmers to invest in the off-pasture systems.

There are other good reasons to support a gradual transition

22. Farmers cannot afford to invest scarce capital in infrastructure that is adequate in the short-term but does not meet long-term needs.

23. While the benefits for N leaching are well understood, the implications of infrastructure for animal welfare and greenhouse gas (GHG) emissions are also important. Standards for animal care continue to increase, and facilities that were previously acceptable are unlikely to meet future standards for lying times and animal comfort. There is evidence that building infrastructure can lead to pollution swapping whereby leaching is reduced but GHG emissions increase. To reduce N leaching and improve cow comfort the Owl Farm Governance Group has been investigating building a composting barn. These plans were put on hold when the group received Overseer results that predicted that nitrous oxide emissions from the barn would lead to a large (60%) increase in total GHG emissions from the farm.

24. Until there is greater clarity on concerns such as pollution swapping and the treatment of GHG emissions at farm level, farmers should be very cautious about investing scarce capital into infrastructure. Imposing a greater N reduction target on farmers than PC1 proposes risks compelling them into infrastructure which may be poorly designed for the long-term. This is especially the case for farmers who already have low N inputs but high leaching losses due to being in high rainfall areas.

A gradual transition allows time for better management options to be proven

25. Research continues into other options for reducing N leaching with better profit and production outcomes than Pastoral21 achieved. Options such as plantain and LowN livestock are in the research pipeline (DairyNZ 2019). These options can substitute for infrastructure in reducing N leaching losses, and are expected to be able to do this with minimal capital investment and a decrease in operating costs. Requiring farmers to make large reductions quickly will drive mitigation decisions towards infrastructure and

limit the benefits of the new technologies as they are not completely additive to infrastructure.

26. The staged approach is an important component of PC1 as it allows for the development and comprehensive proving of new technologies and strategies. This includes the incorporation of the new options into Overseer.

27. In summary, dairy farmers have invested in research that has proven farm systems options that reduce N leaching, and there are new options in the research pipeline. The Pastoral21 Future Farm system has shown a reduction in N leached of 43% through a combination of lower inputs and off-pasture systems. However, it is my opinion that the widespread and rapid adoption of this system is not feasible or desirable because:

    a) Farmers cannot simply create the Future Farm elite cow herd – this herd is 8 years of breeding ahead of the industry average.
    b) The Future Farm economic performance depended on a high level of pasture management skill which isn't widespread in the sector. It will take time to build skills across the sector and successfully implement these changes on commercial farms.
    c) The limited availability of capital will constrain the rate at which farmers are able to invest in off-pasture systems.
    d) The gains in N leaching came at a large cost to farm profitability – with an estimated 25% reduction in Operating profit (before debt servicing).

28. These factors all support the gradual transition proposed in PC1. The desirability of this approach is further reinforced by:

    a) Risks to farmers from rapid adoption of off-pasture systems whose future suitability for animal welfare and GHG management aren't clear.
    b) The continuing delivery of new and better mitigation options for reducing N leaching in ways that maintain farm profitability.

3 May 2019

Bruce Thorrold

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