IN THE MATTER OF	The Resource Management Act 1991
AND	
IN THE MATTER OF	Lake Rotorua Nutrient Management – **PROPOSED PLAN CHANGE 10** to the Bay of Plenty Regional Water and Land Plan

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STATEMENT OF EVIDENCE OF LEE ANTONY MATHESON
ON BEHALF OF THE BAY OF PLENTY REGIONAL COUNCIL

Evidence topics: Meeting nutrient loss targets on dairy farms in the Lake Rotorua catchment; Rotorua NDA impact analysis and subsequent update; Methodology for creation of NDA reference files and stocking rate table

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Contents:

Qualifications and experience

1 My full name is **LEE ANTONY MATHESON**. I am a Director and Shareholder of Perrin Ag Consultants Limited, an advisory and consultancy business providing a range of services to the pastoral agricultural sector, and have been an employee of the company since August 2006, becoming a director in April 2008.

2 Prior to this I was employed by the ANZ Bank and The National Bank of New Zealand as an interest rate trader.

3 My area of expertise is financial analysis and modelling, profitable nutrient management and farm business management. In addition to the provision of project-based agribusiness advisory, I also hold direct executive management authority for a number of dry stock and dairy farming operations (c. 4,700ha) in the greater Rotorua region.

4 I have been extensively involved in completing analysis on the economic impact of nutrient limits on pastoral farming business in a number of catchments within the North Island of New Zealand, evaluating the extent of potential farm system change required to meet nutrient limits and working with farmers to identify appropriate mitigations to reduce diffuse and point-source nutrient losses from their farm systems.

5 I have the following qualifications: Bachelor of Applied Science (Rural Valuation and Management) with First Class Honours (Plant Science) and an Advanced Certificate in Sustainable Nutrient Management in New Zealand Agriculture from Massey University. I am a Registered Member of the New Zealand Institute of Primary Industry Management. I also hold a Diploma in Financial Services from the Australian Financial Markets Association and have completed the OneFarm Governance Advisory Training Programme.

6 Since the introduction of nutrient limits within the Rotorua Lakes catchments, starting with Rule 11, I have worked with farmers, industry good organisations and regional government in both projects and individual engagements that:

(i) Estimated historic and current root-zone nutrient losses from farm systems;

(ii) Identified the likely individual and sector impact of proposed nutrient limits on the operating performance of affected farming operations;

(iii) Identified the potential capacity of existing farm systems to reduce nutrient losses while minimising negative economic impact;

(iv) Modelled least cost farm system changes (dairy and non-dairy) and calculated their subsequent impacts on farm nutrient losses;

(v) Provided technical support for proposed frameworks within the relevant rules designed to manage the basis risk associated with the ongoing evolution of the OVERSEER® software used to predict root zone nitrogen losses

7 Our firm is also one of the approved Land Use Advisory service providers for the Bay of Plenty Regional Council. I have also provided expert advice to the Rotorua Land Technical Advisory Group (Land TAG), the Stakeholder Advisory Group (StAG) and the Lake Rotorua Incentives Board (LRIB).

8 I have presented evidence at three consent hearings for proposed land use change within nutrient limited Rotorua lakes and have written two reports on the expected farm gate economic impact from reducing nitrogen losses from pastoral farming systems in the Lake Rotorua catchment.

9 I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014 and I agree to comply with it. I confirm that the issues addressed in this statement of evidence are within my area of expertise, except where I state I am relying on the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from my expressed opinion.

Scope of Evidence and Summary

10 My evidence concerns two main areas of interest. The first is the impact that meeting nutrient loss targets will have on affected farm businesses (Part I). The second is methodology and output behind the creation of the sector reference files proposed in PC10 to manage the basis risk associated with OVERSEER® version change on the nominal nitrogen discharge allowances (NDA) allocated to farm properties within the Lake Rotorua catchment (Part II).

11 I summarise my conclusions for Part 1 (*Economic impact on farmers of meeting proposed nutrient limits*) at paragraph 21 below. My conclusions for Part II (*Methodology and output of the sector reference files)* are summarised at paragraph 57 to 59. My overall conclusions are set out in paragraph 60 to 66.

PART I. ***Economic impact on farmers of meeting proposed nutrient limits***

12 Reducing nitrogen losses in existing pastoral farms essentially requires changes that reduces the cycling of N that occurs in pastoral systems, particularly N that is "lost" from the system through biological inefficiency.

13 Some of these applicable mitigation strategies can result in an accompanying improvement in farm financial performance, but invariably it appears to be farm systems that have lower levels of productivity that have the greatest capacity to reduce whole system N losses while maintaining <u>or</u> increasing underlying profitability. However, where farms already utilise N efficiently, system changes to reduce N losses typically result in losses in farm profitability.

14 Earlier work commissioned by the Bay of Plenty Regional Council (BOPRC) and the Lake Rotorua Primary Producers Collective in 2012 (Farmer Solutions Project) had identified that farmers within the Lake Rotorua catchment had the capacity to significantly reduce nitrogen losses from their farm systems utilising both land management and land use change options. This was estimated to come at a significant cost to those farm systems, although targeting productivity gains as a means to offset "costs" was deliberately excluded from the analysis. This analysis had also not directly considered the extent of N loss savings required when considering farmer capacity to reduce N losses; rather it had looked at how much N loss might be achieved if farmers had sufficient "incentive" to change.

15 In 2014, Perrin Ag Consultants were engaged by the BOPRC to analyse the financial implications, as measured by operating profit (earnings before interest and tax, EBIT) of the draft NDA levels proposed by the BOPRC and the Stakeholder Advisory Group (StAG) at an individual farm level (Rotorua NDA Impact Analysis: Phase 1 Project, 2014, www.rotorualakes.co.nz/vdb/document/736).

16 The terms of reference specifically required the use of EBIT as the measure of financial impact, primarily because operating profit provides an excellent indicator of the financial resilience of a <u>farm system</u> to N loss restrictions. Changes in operating profit will clearly have differing implications for farm businesses, based on their individual balance sheet configuration and the extent of commitments on their business that fall outside of the operating profit measure. Expanding the financial analysis to an NPAT (net profit after tax) level would have been useful in providing stakeholders and the wider community

about the impact of proposed limits might have on individual [existing] businesses and therefore short[er]-term transition costs. However, when looking at the medium to longer term financial impact of N limits on farming systems within the catchment, irrespective of current or future ownership, EBIT is a preferable measure to consider.

17 This analysis was completed using a range of hypothetical and real farm case studies that were deemed to be illustrative of farms within the Lake Rotorua catchment. The case study farms were modelled in Farmax and Overseer® software to determine how operating profitability changed as farmers made realistic decisions to optimise their farm systems in a restrictive N loss environment. This included productivity gains considered realistic in the best professional judgement of the authors.

18 The draft report was externally peer reviewed by five nominees of both of the commissioning entities (BOPRC & StAG), the two main pastoral farming sector industry good bodies (DairyNZ, Beef+Lamb NZ) and Federated Farmers. The feedback and input from the review process was addressed (where this fell within the original terms of reference) within the released version of the report.

19 The analysis from this study was then reviewed in January 2016 (Update of the NDA Impact Analysis, 2016) in the context of the NDA allocation methodology proposed in the draft plan change and potential changes in medium term outlook for farm output and input prices and updated to Overseer v.6.2.0.

20 The basis for this review was two-fold. It was considered important to ascertain whether or not the extent of mitigations originally considered for "typical" farm systems in the Lake Rotorua catchment were sufficient to meet the draft "sector range" allocation framework. In addition, in light of the extreme volatility in milk price experienced by the dairy sector since the initial study, as well as cyclically high prices for red meat and wool, it made sense to review the product pricing assumptions used to assess the economic impact of farmers actively altering farm systems to lower diffuse nutrient losses.

Conclusions Part 1

21 In summary, the main findings from this combined body of work were:

(i) Farming under a restricted nitrogen loss regime, like that proposed for the Lake Rotorua catchment, is likely to have differing financial impacts across farms and farm systems.

(ii) The ability to lift farm productivity in response to the need to mitigate N losses is a key factor in the extent of any [negative] financial impact on farm systems. As a result, N efficient/highly productive farm systems are more likely to be [negatively] impacted by a reduction in allowable farm gate N losses.

(iii) Dairy farms will likely need to rely on a combination of lower annualised stocking rates, improved per cow milk solids production and replacing high N feed and high N loss feed with low protein alternatives to reduce N losses. Most of the case studies experienced some degree of decline in operating profit (EBIT) in reaching the proposed limits.

(iv) Dry stock farms should firstly eliminate the use of N fertiliser where it is deemed to be unprofitable and then eliminate/reduce winter cropping to lower N losses. After that maximising meat, wool and feed sold off farm from the available feed and/or shifting feed used for livestock maintenance into more N efficient livestock classes are key strategies. However, the extent to which these changes resulted in profit increasing, decreasing or remaining unchanged relied heavily on the relative profitability of the various enterprises and their mix in the system. This is because of the variability in both N losses and profitability from the numerous livestock farming systems utilised within non-dairy pastoral farming operations. Beef cattle tend to result in higher N leaching than sheep or deer, breeding operations tend to result in higher relative N leaching than finishing systems and dairy support activity tends to result in higher leaching than most other livestock systems. All have differing levels of profitability, which can vary significantly from year to year depending on underlying market conditions. As a result, the complexity of non-dairy pastoral farming systems makes identifying the definitive financial impact of N limits on the sector extremely difficult.

(v) It is important to recognise how the changes in the prices of inputs and outputs associated with a mitigation strategy can alter the perceived and actual financial impacts of meeting N loss targets. When output prices are low, the financial impact of lowering production reduces. For example, the financial impact of implementing mitigations that lower milk production is, on a marginal basis, lessened when milk prices are low i.e. the opportunity cost is reduced. Likewise, when input prices are high, reducing their [inefficient] use improves the cost structure of the business. This can regularly be observed in the normal functioning of the various farming sectors; low milk prices resulted in farmers reducing costly feed inputs, resulting in lowered milk production, but improved profitability and when urea prices exceeded $800/t, fertiliser N use on farms reduced significantly The converse obviously applies. Increasing sheep:cattle ratios to lower N losses has a negative financial impact when beef prices are high and lamb/wool prices are low. The requirement to lower N losses is not, in of itself, the sole determinant of a farm business's financial health, but it will potentially limit the ability of a farm system to change in response to changes in market prices in order to maximise profitability.

(vi) The combination of OVERSEER® version change and the sector range allocation subsequently notified in PC10 is likely to require some dairy and dairy support farms to make system/land use changes beyond that extent originally envisaged by BOPRC and StAG back in 2014 based on the N loss reduction limits analysed in the original NDA Impact Analysis study. This is consistent with the average dairy farm sector reduction having been set at 35.3% (see http://www.boprc.govt.nz/media/508998/n-lake-rotorua-nutrient-management-plan-change-10-version-4-for-notification-29-february-2016-copy.pdf) versus an analysed reduction of 25% in the 2014 Perrin Ag report.

PART II. Methodology and output of the sector reference files

22 The rationale behind the use of reference files to manage the impact of OVERSEER version change on nitrogen discharge allocations is covered by the evidence of Park.

23 Perrin Ag Consultants Ltd was engaged by the BOPRC in 2015 to create dairy and drystock sector reference files for the purposes of managing OVERSEER version change on the PC10 nitrogen discharge allowances.

24 As described in the evidence of MacCormick, a number of iterations of reference files were developed by Perrin Ag between August 2015 and December 2016 in response to managing bugs in the OVERSEER software and submissions to PC10.

25 Initially the reference files were designed to represent the average per ha 2032 discharge of the range in N losses associated with each sector as determined by the dual range allocation method. On this basis, the models, whilst utilising a hypothetical

block set-up that was representative of the geo-physical characteristics of the Rotorua catchment (see below), were intended to be both physically and financially feasible – to some extent providing a "proof-of-concept" of viable farming enterprises operating within the limits of an the relevant sector average 2032 NDA.

26 After initial submissions on PC10 were received, new reference files were designed to be representative of the "average" benchmarked dairy and dry stock farming systems as they would have been during the Rule 11 benchmarking period (2001-2004), both in terms of farm system and average per hectare N discharge. The primary objective of this change was to create reference files that tracked the average benchmarked sector losses through OVERSEER versions as closely as possible.

27 In all cases, the reference files were created using the same basic methodology. Full methodology, model parameters and output is presented in three reports: "Methodology for creation of NDA reference files and stocking rate table" (Perrin Ag, August 2015), "Methodology for and output from revision of NDA reference files and stocking rate table" (Perrin Ag, February 2016), "Methodology for and output from further revision of NDA reference files" (Perrin Ag, December 2016).

Original reference files – sector average 2032 NDA

28 Reference files for two 100ha hypothetical properties- a drystock farm and a dairy farm, were created in a stand-alone version of Overseer 6.2.0, provided by AgResearch.

29 The block set-up in each of the files consisted of blocks totalling 100ha of effective area, comprising the soil, rainfall and slope combinations that proportionally represents the benchmarking data within the catchment. Geophysical data for these blocks was supplied by the BOPRC.

30 These discrete management blocks were each allocated to one of 12 broader geophysical zones for the purposes of allocating pasture growth potential and subsequently relative productivity.

31 Baseline status quo models of representative dairy and dry stock farming operations for all of these geophysical zones had previously been developed in Farmax, based on actual farming enterprises within these same zones, for the farm level component of the recently completed Rotorua N-reduction economic impacts project that is referred to in Parsons *et al* (2015). As a result, validated potential pasture growth curves existed for

all of the relevant geophysical zones that had dairy activity. In combination with the validated potential drystock pasture growth curves for five geophysical zones, pasture growth potential for the balance of the geophysical zones had been calculated, through interpolations based on the observed relativity between actual pasture growth due to soil type, rainfall, slope class and soil fertility (assuming dairy land typically had a higher average level of fertility versus drystock land).

32 An average potential pasture growth curve was then able to be estimated for both the dairy and drystock sectors, weighted by the relative proportionality of each geophysical zone among each sector in the catchment.

33 Pasture growth potential was then used to determine the level of relative productivity between blocks required to be utilised in the OVERSEER model.

34 Feasible Farmax models were then created for both the sector reference files, utilising their respective weighted average pasture growth curves to set the pasture productivity limit. The modelled systems were designed to:

(i) reflect a requirement to minimise the less-well understood and complex functionality within OVERSEER; and

(ii) represent systems that were deemed likely to be economically viable for an average efficient farmer in 2032.

35 Both factors require a degree of professional judgement and the author readily accepts that different systems could be designed by others that could equally achieve the targeted mid-points of the allocation range, depending on the specific interpretation of these two “constraints”.

36 Cost and revenue assumptions used for forecasting the financial performance of the farm systems in Farmax were primarily based off the relevant industry databases (DairyBase, B+LNZES surveys) and medium term revenue expectations

37 The feasible files were then replicated in Overseer in order to generate nitrogen losses. A number of iterations of stock classes, stock performance levels, N fertiliser usage and the area of silage harvest and fed back out were undertaken in order to create viable farm systems that come close to the desired sector range mid-points. These averages were 64.53 kg N/ha for the dairy sector and 25.59 kg N/ha for the drystock sector (OVERSEER Version 6.2.0).

38 With the pasture growth potential essentially forming a fixed constraint to the models, it was not necessarily possible to achieve the exact range mid-point.

39 For the dairy file, annual nitrogen leaching was estimated in Overseer 6.2.0 at 6,469kg N, versus the "target" of 6,453kg N - a variance of +0.25%. Annual profitability was calculated in Farmax (at a $5.50/kg MS milk price) at $1,286/ha.

40 For the drystock file, annual nitrogen leaching was estimated in Overseer 6.2.0 at 2,624kg N, versus the "target" of 2,559kg N - a variance of +3.2%. Annual profitability was calculated in Farmax at $234/ha.

<u>Revised reference files – sector benchmark average</u>

41 For the post-notification revision of the reference files, the immediate previous versions of reference files were migrated to OVERSEER Version 6.2.3 by BOPRC staff and the block setup (designed to be representative of the geo-physical make-up of the Lake Rotorua catchment) modified by BOPRC to account for a bug identified in OVERSEER Version 6.2.2 regarding the treatment of dairy effluent when applied to less than 100% of an OVERSEER block and a requirement to include cropping activity in the new reference files.

42 BOPRC staff then supplied Perrin Ag with sector average farm input data extracted from all the 2001-2004 benchmark files held on file by the BOPRC to provide the basis for the development of the reference files and key input parameters.

43 For the dairy sector this related to all of the dairy OVERSEER® files they had on record (21 farms representing 89 % of the dairy area). For the drystock sector the data was extracted from 12 large drystock properties geographically spread throughout the Lake Rotorua Catchment (12 farms representing 41 % of the drystock area).

44 Feasible 100ha Farmax models once again created for each of the dairy and dry stock sector reference files, utilising, as a starting point, the same weighted average pasture growth curves used to create the original reference files and the specific farm input data supplied by the BOPRC. However, the modelled systems were ultimately to be designed to:

(i) reflect the farm system components and performance levels of the average dairy and dry stock farm during the Rule 11 benchmarking period;

(ii) be structured in the same way as the typical benchmarking file i.e. utilise the same data input fields as used for benchmarking;

(iii) generate N losses that were in line with the average farm area discharges from the benchmarking period as expressed in OVERSEER 6.2.3. These were 95.86kg N/ha/year for the dairy sector and 34.67kg N/ha/year for the dry stock sector.

45 The "average" farm system inputs, as with the geo-physical characteristics assigned to the OVERSEER blocks, represented an average of a series of individual farms, rather than a specific farm system that had the average or median sector N loss. As a consequence, the farm systems modelled wouldn't necessarily provide good examples of how an individual farm system would actually have been configured. However, in the event such a farm system existed, this would be how it would [have been] operate[d] to be physically feasible.

46 This time, economic feasibility was not assessed, as the required farm system inputs were pre-determined on the basis of historic averages, not commercial combinations of livestock, imported feed and fertiliser inputs.

47 These files were again replicated in OVERSEER 6.2.3 in order to generate nitrogen losses. In line with paragraph 44(ii) above, age and mature weight parameters were used to model livestock performance, rather than opening and closing live weights.

48 All of the initial representative farm systems failed to fully utilise all of the pasture assumed to be growing on the hypothetical farms when modelled in Farmax. It was determined that the potential pasture growth rates used, which had been interpolated from recent actual performance of farm systems within the catchment, were not representative [too high] of actual pasture growth potential in 2001-2004. As a result, after a number of approaches were considered and modelled, it was decided to proportionally lower the pasture growth potential in Farmax (using the "Adjust Pasture Growth" functionality) to establish the lowest level of pasture growth required to ensure forecast average pasture cover remained within the bounds of normality and observed practice once the farm system model that generated the appropriate level of N loss was achieved.

49 A number of iterations of proportional reductions in stock classes were subsequently undertaken in Farmax and OVERSEER to generate farm systems that came close to

their desired sector average N losses. Other key input parameters (crop areas, fertiliser and feed inputs) were left unchanged from the BOPRC supplied data

50 Annual nitrogen leaching for the revised dairy sector file is estimated in Overseer 6.2.3 at 9,545kg N, versus the “target” of 9,586kg N - a variance of +0.4%.

51 Annual nitrogen leaching for the revised drystock sector file is estimated in Overseer 6.2.3 at 3,424kg N, versus the “target” of 3,467kg N - a variance of 43kg N or-1.2%.

Discussion

52 After accounting for [known] differences in file structure of the original [2032 average loss] reference files, beta testing by the BOPRC in 2015 (summarised in Mr MacCormick’s evidence) made it apparent that variation between the [future] farm systems modelled for the reference file and the historic farm systems represented in the benchmark data was resulting in variation in how N losses from the respective files tracked each other through version change.

53 With benchmark data anchoring the sector range allocation framework, the impact of not addressing this residual “error” in the relativity between reference and benchmark N losses could, depending on the nature of a given science change or modelling bug, potentially result in either the temporary erosion of N reduction targets or the temporary erosion of a farmer’s NDA. Neither outcome is likely to be desirable in the interests of water quality, equity and certainty for farmers.

54 In both the original and the revised [sector benchmark average] reference file concept, the models represent “average” Rotorua dairy and dry stock farms in a geophysical sense. The revised reference file construction takes that concept a step further and attempts to represent “average” benchmarked Rotorua farms in farm system sense as well.

55 There is a risk in trying to incorporate or utilise all possible farm system components and stock types in a reference file on the basis that this would create a nonsensical and unfeasible system. Doing so, in our opinion, would also start to erode the basic premise that OVERSEER (and indeed most models) needs to adhere to being the use of “actual and reasonable inputs”. We continue to subscribe to this view.

56 The revised “benchmark” reference files, as created, could be considered a further step towards this catch-all model and a progression away from a realistic farm system. However, we are still comfortable with the changes to the reference file approach for the following reasons:

(i) The farm system input parameter data used to develop the underlying Farmax models is derived from real data, albeit at a catchment scale rather than an individual farm level. This also mirrors the use of catchment level geophysical input parameters in the modelling.

(ii) The recreated Farmax files for the each of the sector models still forecast appropriate average pasture covers over the year and the associated supplementary feed and nitrogen fertiliser usage is sensible and reflects local practice as regards timing and quantum.

(iii) All of the individual livestock policies modelled are realistic and reflective of average district practice.

Conclusion – Part II

57 The basis for the use of a reference file within the allocation framework is an attempt to anchor the relativity over time of permitted N losses allocated to properties, both within and between sectors, without the necessity of having to continually reassess allocations.

58 It has been possible to develop feasible farm models to use as reference files; models representative of catchment-wide sector benchmark average farm systems that generate N losses in OVERSEER 6.2.3 closely in-line with actual sector average N losses from the benchmarking period and also potential “future” (2032) systems than generate N losses in line with average sector NDAs.

59 Since undertaking the report research I have had the opportunity to read the evidence of Mr MacCormick dated January 2017,(including in particular paragraphs 45-58), and to discuss the application and outcome of the proposed new reference files with him. As a consequence of this it is my opinion that the revised “sector benchmark average” files will deliver improved relativity with benchmarked N losses through OVERSEER version change, and that they will therefore provide a better option for use in the framework than those originally developed in August 2015.

Conclusion - overall

60 The N loss restrictions placed on farm properties in the Lake Rotorua catchment through the sector range allocation proposed in PC10 will, in my opinion, have a variable impact on the [operating] profitability of farm businesses.

61 Most of the dairy farm systems (based on the case studies), irrespective of their relative productivity, are likely to have their financial performance (EBIT) negatively affected to some degree by the proposed N limits

62 However, it is extremely difficult to definitively identify the broad profit impact of these proposed N limits on non-dairy pastoral farms. It would appear that [predominantly] dairy support farms are most likely to experience reduced operating profit as a result of the PC10 allocation. In comparison, mixed sheep, beef and/or deer farm systems will, on average, have a greater capacity to reduce N losses before profitability is negatively affected.

63 Based on the sheep, beef and deer case studies examined, this higher level of financial resilience appears to be due to a greater potential for productivity gains identified within the non-dairy farm systems, a lower required sector reduction (17.2%) and greater flexibility within the mix of livestock production systems available to these farms.

64 However, it is apparent that the N loss limits proposed under PC10 will potentially limit the ability of a farm system to change in response to changes in market prices in order to maximise profitability. This includes changing land use to a more intensive and higher value activity.

65 Given the likely economic impacts of the PC10 N loss allocation on farm businesses, delivering certainty around allocation is critical to allow farmers to make medium to long term decisions within their businesses, particularly as regards capital investment and major farm system design.

66 On the basis that such N loss limits are to be allocated using the proposed sector range approach, which is anchored by historic [benchmarked] sector N losses, the use of a “sector benchmark average” reference file appears to provide the best option for maintaining the relativity (and certainty) of allocation both between sectors and within sectors as OVERSEER changes through time.

Appendices

Reports –

Rotorua NDA Impact Analysis: Phase 1 Project, 2014, www.rotorualakes.co.nz/vdb/document/736

Update of the NDA Impact Analysis, 2016

"Methodology for creation of NDA reference files and stocking rate table" (Perrin Ag, August 2015),

"Methodology for and output from revision of NDA reference files and stocking rate table" (Perrin Ag, February 2016),

"Methodology for and output from further revision of NDA reference files" (Perrin Ag, December 2016).

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