Further submission pursuant to Memorandum no. 4 by Lachlan McKenzie: submitter 53. This is in support of the original submission.

The summary of evidence and outcome sought.

Tackle N and P, with adaptive management.

Maintaining the current in-lake nutrient loads, which are known to meet community objectives for water quality. This approach is founded on certain algal-nutrient relationships, exhibited by the lake today, with less uncertainty than the framework based on modelling. A multi-pronged approach is proposed, managed through sub-catchments targeting specific "hot spots" for both N and P:

- Actions to achieve the 642 TN target;
- Actions on the land targeting particulate P,
- Within Catchment actions mitigating N and P, Water cress, detention bunds etc.
- Phased reduction in alum dosing over time, as it is replaced by adoption of on-land mitigation.

Because of groundwater lags, maintaining the current N load will still require nitrogen mitigation on the land. The catchment will still need to identify actions to achieve approximately 10-12% reduction

Expected impacts compared to current approach

- Full compliance with the NPS
- Greater certainty of environmental outcome
- Immediate and maintained environmental outcome
- Reduced economic impact
- Reduced social impact

Comments on the Section 42 A report:

I completely refute the assertion in 186 and 187 that PC10 will have limited economic impact.

The detail in the Parsons, Doole and Romera, report shows clearly that none of their modelled Dairy farms can get down to the proposed NDA without buying in Nitrogen allowance. Only by modelling the addition of N trading are they able to mitigate the devastating micro and Macro impacts. Nitrogen trading in the Parson, Doole report masked the true economic impact as it is uncertain whether trading will be workable, allowed or if indeed it is bankable at an individual farm level.

The following is a report presented to Rotorua District council on the bankability of N trading

Bankability of Dairy

	Pre rules	Move to Beef	Move to Forestry
Dairy	$/Ha	$/Ha	$/Ha
land value	35000	15000	2500
Stock	4500	2000	0
Shares	4600	0	0
Capital sales		7100	9100
Total assets	44100	17000	2500
Debt	22000	14900	12900
equity	22100	2100	-10400
% Equity	50%	12%	-416%
		With Nitrogen Trading	
NDA 35			
N Loss	55	25	3
N sales Kg/Ha		10	32
N $400		4000	12800
equity post sales		6100	2400
N $160		1600	5120
Equity post sale		3800	-5280

Bankability of Sheep and beef farms

	Pre Rules	Move to Forestry
	$/Ha	$/ha
land value	15000	2500
Stock	1700	0
Shares	0	0
Capital sales		1700
Total	16700	2500
Debt	5000	3300
equity	11700	-300
% Equity pre sales	70%	-10%
Trading Nitrogen		
NDA 12		
N Loss	25	3
N sales Kg/Ha	0	9
N $400		3600
equity post sales		3300
N $160		1600
Equity post sales		1300

The tables above show moving from Dairy to Forestry even with $400/kg Nitrogen trade equity goes from $22100/ha to -$5280. For a 100Ha Dairy farm with trading a loss of $2,738,000.

A sample of Individual Farm model information from the Parson, Doole report

geophysical zone	scenario	standoff	ha	Eff ha	EBIT $3.75	EBIT $4.20	N loss	P loss	kg MS/ha	SR
Al1	1	no	219	219	1325	1366	77	1.5	1042	3.00
Al1	3	no	219	219	1192	1233	62	1.5	1041	3.00
Al1	4	no	219	219	1214	1255	62	1.5	1042	3.00
Al1	5	no	219	219	1220	1260	62	1.5	1042	3.00
Al1	6.1	no	219	219	1182	1222	62	1.5	1027	3.00
Al1	6.2	no	219	219	1142	1183	62	1.5	1013	3.00
Al1	6.3	no	219	219	1109	1148	56	1.5	972	2.9
Al1	6.4	no	219	219	1079	1119	55	1.5	964	2.9
Al1	7	no	219	208	1108	1148	53	1.4	978	2.9
Po1Ha	1	no	219	219	2602	2650	78	1.4	1041	2.3
Po1Ha	2	no	219	219	2585	2633	77	1.4	1041	2.3
Po1Ha	3	no	219	219	2545	2593	68	1.4	1093	2.3
Po1Ha	4	no	219	219	2564	2613	68	1.4	1040	2.3
Po1Ha	6.1	no	219	219	2532	2581	67	1.4	1030	2.3
Po1Ha	6.3	no	219	219	2496	2544	66	1.4	1021	2.3
Po1Ha	7	no	219	208	2624	2673	63	1.3	1040	2.3

None of the Dairy farms can get down to the NDA of 32-40 without trading. Only sheep and beef that can get to 12 are on recent soils.
Doole model says some sell NDA to other farmers. Previous slides show banks will not lend to many

Capital loss to district of just dairy land change

- If PC 10 creates a shift of 5000ha to go from Dairy to trees
- Capital value Dairy approx. $35000/ha
- Capital value forestry $2500/Ha
- $32500 X 5000Ha =$162.5m capital loss to our community
- Is it fair for BOPRC to take $162.5m off 26 farmers???

As can be seen by the tables above Land use change has significant financial effect on individual affected parties and the wider community. The analysis shows that if all 5000 Ha of dairy converts to pines this creates a capital loss of $162m to the district. The ongoing cost to the community will be in excess of $70m a year.

In Taupo there has been limited trading and what has been done and can only be justified when dairy product prices are high.

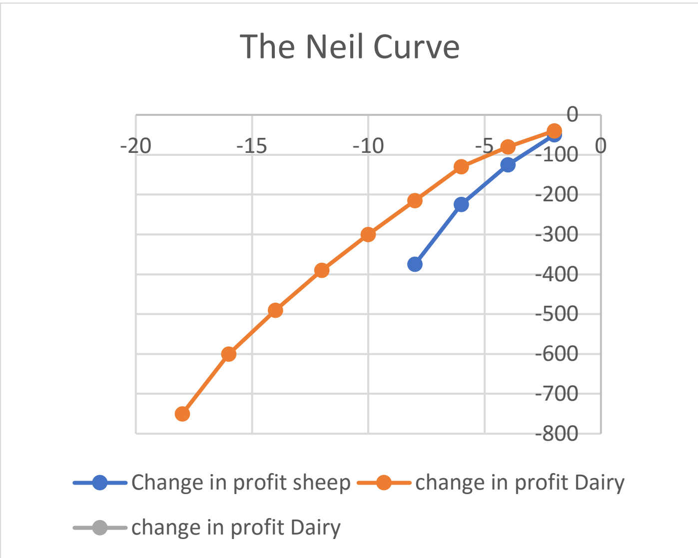
Without knowing the principles, the incentive fund is working too, the presumed ad hoc nature of the effect of the incentive fund actions will have unknown consequences on the landscape nature, economic mix of the catchment and environment.

The 42 A report (5.3.8) claim that the on-farm consent process is very simple and straight forward, the reality of farmer experience of dealing with council approved contractors is anything but. The NDA and NMP process are complicated, prescriptive, tick box exercise that is stifling innovation as well as creating significant ongoing compliance costs to individual landowners and Council. There is significant discrepancy between economic experts on the effect of PC10 rules and reality. Each report commissioned has used different methodology but none have considered the net effect after debt and Taxation at the individual property level.

The effect of N restrictions at the individual farm level.

Under pastoral farming in New Zealand financial losses generally get larger per Kg Nitrogen mitigated as the level of mitigation increases. (see below)

This relationship between profit and Nitrogen mitigation is commonly called the Neal curve (named after Mark Neal of DairyNZ who first used this formalism).



An example of cost curves delineating the relationship between the abatement of nitrogen and the associated change in farm profit.

Quotes;

"When Implemented at a large scale, land use change is associated with significant economic and social upheaval."[1]

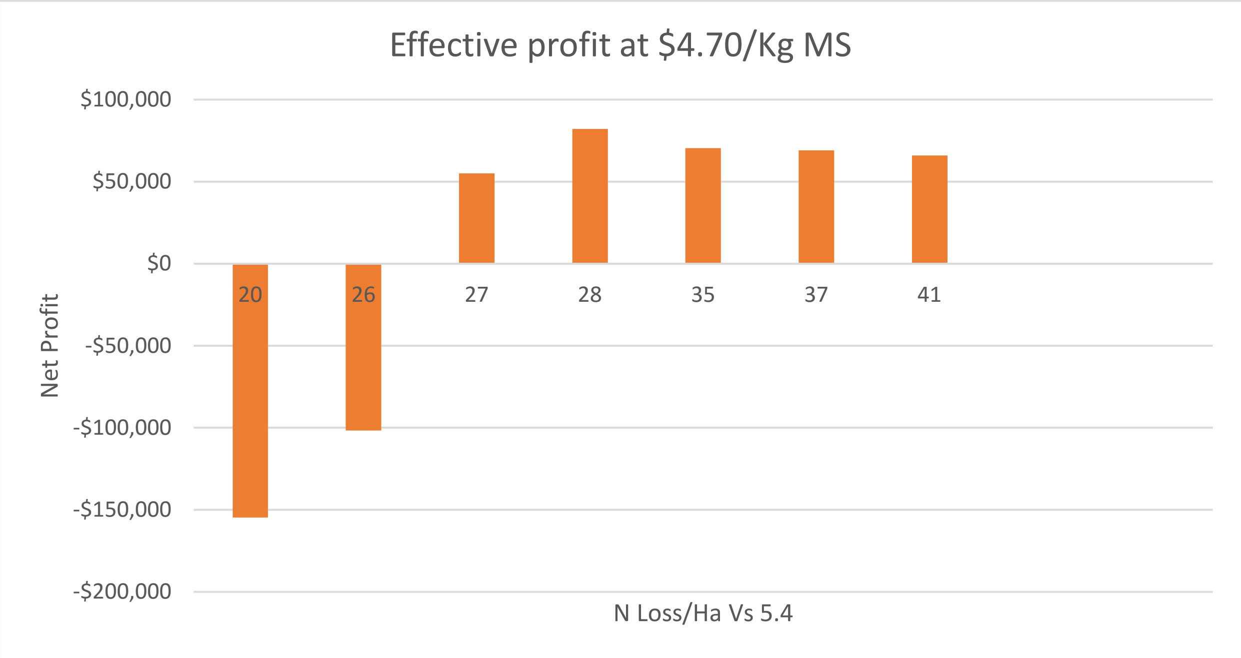
"Various case studies conducted over hundreds of farms show that reductions in leaching above 5-10% are likely to reduce farm income" [1]

"Indeed, there currently appears to be no transformative practices or systems available that have the potential for wide adoption, alongside being capable of greatly reducing the environmental footprint of pastoral farming in New Zealand" [1]

[1]Quotes from paper by Graeme Doole, Professor in Environmental Economics at the Department of Economics in the Waikato Management School at the University of Waikato.

Below are the results of a **real farm example** from within the Lake Rotorua catchment. Each bar graph represents a different farming system using the resources and debt of the farm, modelling both productivity and profit.

Case study 2



The financial losses are greater for each Kg Nitrogen mitigation required[3] once resources are used efficiently.

There is appears to have been no work done on understand where individual farms in the catchment are on the response curve, so there is limited understanding of the ever-increasing financial impact as the NDA's are reduced.

It is claimed [S 42A (186)] that some farms may be able to achieve the necessary Nitrogen reduction without loss in farm profit. There is no individual property evidence to support this claim or how many farms this may apply to. It is also claimed some farmers can have a win: win, implying that reducing Nitrogen losses will lead to increased profit. This is true in the example above **if** the farm moves from the system leaching 41 down to 28. The issue is this farmer is around the 28 Kg N/Ha (V 5.4) mark now so any further reductions will start to have an immediate impact on profit unless new technology comes along.

[3] The Neil curve

The more efficient the farmer the greater the effect of restrictions as they are already using good practices and implementing many mitigating practices. Resource use efficient farmers are penalised more than inefficient farmers.

It is noted in appendix 4 S32 report that the rules will have varying impacts. I agree

Without significant changes to PC10 the impacts on half the farms is likely to be devastating.

Decision sought: That there is a full economic assessment of the true private and public impact of these rules compared to alternative target loads of P and N. The assessment needs to look at profit effect after debt, Tax and personal income at the property level. This assessment to sit alongside the science review looking at the most effective methods and nutrients to maintain the TLI < 4.2

There is insufficient agreed evidence to show that PC10 is the most efficient and effective way to achieve the community goal of a TLI 4.2.

Overseer issues:
Overseer must be the point of compliance not the NMP.
Incentives for innovation are only effective if recognised by Overseer thus the latest version must be used. There is a desire to encourage innovation within the pastoral sector. (S32 report 10.2.4)

The use of Overseer 5.4 in the Taupo experience has resulted in the dis-incentivising of innovation. The opposite result to what is wanted.
Rules are requiring the use of Overseer need to track progress using a 3-year rolling average for Dairy and more for Drystock. Given multiyear variations it is unreasonable to plan for a period greater than 5 years ahead. Overseer should be used to assess relative changes, rather than absolute values so the focus should shift to “moving in the right direction”. Uncertainty must be addressed in the rules not left until later implementation. Effective farmer engagement and mutual trust are as important as the NDA itself.

Nitrogen management Plans 5.3.8

Staff claim that NMP are a key element of PC10 yet were never agreed to at STAG nor in any public forum. It is claimed, that the NMP’s are not prescriptive but the actions of council consultants and staff preparing them is completely at odds with this claim.

Overseer is used to develop the property NDA and the farm NMP so must be point of compliance, not the nutrient management plan (NMP). To ensure the objective of adaptive management and innovation has any chance of being achieved the point of compliance must be the outcome figure from Overseer.

By example, The IRD uses the annual accounts to determine the profit and hence tax liability (the outcome) as the point of compliance, not the cashflow (NMP) used to generate the profit.

Decision sought: Delete all reference to the NMP being the point of compliance.

Not all Nitrogen is equal, Attenuation:

When the ROTAN model was first run with Overseer 5.4 it was claimed that there was no Nitrogen removal (Called Attenuation) along the flow path from the Nitrogen leaving the root zone (As predicted by Overseer) and the N reaching the lake as the figures balanced.

My comment at the time was that this claim of no attenuation cannot be correct, there is always some attenuation in New Zealand catchments.

However, with updates of Overseer to V 6.2.2 (increases farm losses by an average 88%) it is demonstrated that there must be attenuation between the losses at the root zone and the loads reaching the lake. Now estimated at an average of 42%. (Predicting nitrogen inputs to Lake Rotorua using ROTAN-annual, Oct 2016)

This report also shows there is significant variation in attenuation between sub-catchments:

- Sub catchment estimates (pg 26): Ngongotaha 85%, Waitete 58%, Awahou 42%, Hamurama 14%

The variation in attenuation has significant baring on the effectiveness of the rules in PC10 and for the incentive fund. The percentage attenuation in a sub-catchment alters the effectiveness of any action/mitigation taken.

By way of example:

Two different parcels of land in different sub-catchments with different attenuation rates;

Block **A** is in a sub-catchment that has 20% attenuation therefore 80 % of Nitrogen losses reach the lake.

And Block **B** is in a sub-catchment with 80% attenuation therefore only 20 % of Nitrogen losses reach the lake.

Thus, if the incentive fund or farmer mitigation is carried out on each block that leads to a reduction of N loss as per Overseer of say 1000 Kg this has the flowing impact on the lake:

- Block **A**, Reduces N loss from land by 1000 Kg (Overseer 6.2.2) this gives an 800 Kg N reduction at the lake.

- Block **B**, Reduces N loss from the land by 1000Kg but this only gives a 200Kg N reduction at the lake as most was loss through attenuation in the flow path anyway.

This reinforces the need to manage nutrient losses by sub-catchments and to understand the effectiveness of mitigations within their spacial setting.

The effectiveness of the incentive fund, Farmers mitigations and the gorse fund will vary significantly depending on the sub catchments characteristics.

We need the best return per Dollar Invested

A better approach to safeguarding Lake Rotorua

I have consistently maintained that managing phosphorus with less focus on nitrogen would be a better approach to improving Lake Rotorua from a social and economic perspective. The science now suggests that this is also a more certain approach from an environmental perspective.

1. The science (Lake data) has changed – so should our approach

- Water quality in Lake Rotorua has shown an improving trend since 2003.
- The TLI in 2012 was the lowest on record and the 3-year rolling average was its lowest ever in 2014.
- Availability of phosphorus (P) is controlling algal growth in the lake.

The focus must shift from how to improve water quality, to how to maintain it while delivering on other community values. As the lake is now P-limited, nitrogen reductions would not improve water quality. The more critical question is how to substitute catchment mitigation of P for alum dosing over time.

2. There are a range of management options available – pick the best rather than the hardest

- Several nutrient scenarios have been modelled for maintaining Lake Rotorua's water quality.[1] -The Hamilton report on Alum dosing
- These include continued alum dosing and controls on catchment inputs of N and P. [1]
- Managing N alone was not predicted to achieve the required TLI (see chart, figure 26).[1]

The greatest improvement in TLI was predicted to occur from maintaining current N loads from the catchment (642 TN/yr, rather than the 435TN/yr target) and driving P down even further through both mitigations on the land and continued alum dosing.

"Driving the reduction in TLI3 simulated by those scenarios including P mitigation and/or alum dosing is a shift in the simulated system from co-limitation of phytoplankton by N and P to a highly P-limited state. Some evidence of a shift of this nature was apparent in the record of field observations from Lake Rotorua after 2010, specifically very low DRP concentrations and a relatively high concentration of nitrate in surface waters for much of the subsequent period."[1]

1 ERI report 49 Feb 2015

The figure above is figure 26 of the Hamilton report[1], modelling scenarios looking at the combined effects of different nutrient loads from the catchment, P mitigation and alum dosing on the TLI. This is based on the lake data 2009 to 2012. The coloured dots represent different modelled nutrient loads and what TLI is predicted from each scenario.

- Represents the TLI that would be reached each year with a Nitrogen load of 435
- Represents the TLI with a Nitrogen load of 730 + P mitigation + Alum
- Represents the TLI with estimated current Nitrogen load 642 + P mitigation plus Alum max

----- The target TLI

Further expert witness evidence of Prof. Hamilton and Dr Tom Stephens show that a 320 Tonne reduction in Anthropogenic TN-loads proposed by PC 10 without a reduction in TP load "will likely degrade water quality further by promoting potentially toxic cyanobacteria dominance."

Comment on Alum

Alum is a natural element that is used to treat urban water supplies throughout the world. It enters Lake Rotorua naturally yet a measured, controlled and monitored application is being treated suspiciously.

A Sediment survey in Lake Rotorua [4] looking at potential aluminium and phosphorus accumulation in Lake Rotorua basin concluded:

- Sediment survey data do not support the hypothesis that Al accumulated in the main basin of Lake Rotorua.
- It is suggested here, that long-to medium-term catchment and in lake dynamics had more influence on the net change in sediment P concentrations than alum.

[4] McIntosh (2012) & Abell et al (2012)

- The alum mass balance corroborates these findings: there is a compelling probability that very little alum was deposited into the main basin.
- The mass balance approach indicates, however, that alum may have reduced water column P and internal loading to some extent, but this reduction alone cannot explain the recent substantial improvement in water quality.

I completely reject simplistic the claim Alum dosing is not a long-term solution. [S 42 A- 2.3.1.(16)] The above reports and expert witness comments show Alum could and should be **part** of the long-term solutions for the lake.

The solutions:

Tackle N and P, with adaptive management.

Maintaining the current in-lake nutrient loads, which are known to meet community objectives for water quality. This approach is founded on certain algal-nutrient relationships, exhibited by the lake today, with less uncertainty than the framework based on modelling. I recognise that alum dosing carries some risk. Accordingly, I propose a multi-pronged approach managed through sub-catchments targeting specific "hot spots" for both N and P:

- Nitrogen reductions on land to achieve the 642 TN target;
- Action on the land targeting particulate P,
- Within Catchment actions mitigating N and P, Water cress, detention bunds etc.
- Phased reduction in alum dosing over time, as it is replaced by adoption of on-land mitigation.

Because of groundwater lags, maintaining the current N load will still require nitrogen mitigation on the land. The catchment will still need to identify actions to achieve approximately 10-12% reduction in nitrogen loading in stream to maintain the current N load in the lake. This will be most effective if targeted "hot spot" is the focus. The dollars will go further with a focused and targeted approach.

The nitrogen-focused (single nutrient) approach to maintaining water quality targets are highly uncertain – they have only been modelled. Whereas, achieving current N and P loads undeniably achieves community water quality goals of a TLI of 4.2 or less.

In addition, analysis demonstrates that the P-driven reduction in algal biomass within Lake Rotorua has naturally reduced the N-loads reaching Lake Rotoiti. Safe-guarding Lake Rotorua through continued dual nutrient management of current loads, will therefore protect Rotoiti. Keep in mind, the Kaituna River also currently receives higher quality water from Rotorua than anywhere on its length. This proposed dual-nutrient approach will maintain this, whilst protecting water quality in Lake Rotorua and Lake Rotoiti.

3. Expected impacts compared to current approach

- Full compliance with the NPS
- Greater certainty of environmental outcome
- Immediate and maintained environmental outcome
- Reduced economic impact
- Reduced social impact