

IN THE MATTER

of the Resource Management Act 1991

AND

IN THE MATTER

of appeals lodged against proposed Plan Change 2
to the Manawatu-Whanganui One Plan

**JOINT WITNESS STATEMENT OF FARM SYSTEM AND PLANNING
EXPERTS**

7 October 2022

INTRODUCTION

1. This joint expert witness statement relates to the appeals lodged against proposed Plan Change 2 (**PC2**) of the Manawatu-Whanganui One Plan which focuses on existing intensive farming land use activities within targeted water catchments in the region.
2. This joint witness statement follows two earlier workshops in June 2002 and August 2022, which resulted in joint witness statements being produced by the experts, dated 28 June 2022 and 25 August, 2022 respectively.
3. At the first workshop held on June 28, 2022, participants explored the possibility of developing a risk assessment methodology as a way to assess the risk of nitrogen leaching loss from intensive farming land uses.
4. At the second workshop held on August 25, 2022, the farm systems experts reconvened to discuss and seek to reach agreement on how to assess and potentially quantify risk and how to present that in a 'scored' format (including whether it is qualitative or quantitative).
5. It was agreed that the experts would reconvene in a third conferencing workshop to continue discussions around the risk assessment tool – its content and form – and how it might work within the context of PC2.
6. The expert conferencing was held on 7 October 2022 at Te Ao Nui Building, Palmerston North with some members joining via video / teleconference.
7. The workshop was facilitated by Michelle Rush.
8. Farm system experts attending the conference were:
 - (a) Ian McNab (**IM**) for Manawatu-Whanganui Regional Council (**Horizons**);
 - (b) David Horne (**DH**) for Horizons;
 - (c) Dr Anne-Maree Jolly (**AJ**) for Horizons;
 - (d) Andrew Barber (**AB**) for Potatoes New Zealand and Horticulture New Zealand;
 - (e) Stuart Ford (**SF**) for Horticulture New Zealand (via AVL);
 - (f) Gavin Marshall (**GM**) for Federated Farmers (via AVL);
 - (g) Dr Paul Le Miere (**PL**) for Federated Farmers (via AVL);

(h) Dr Brent Clothier (**BC**) (Plant and Food) as an invited participant by Horizons.

8.2 The planning experts in attendance were:

- (a) Christine Foster (**CF**) for Horizons;
- (b) Greg Carlyon (**GC**) for Ngāti Turanga and Wellington Fish and Game Council;
- (c) Sue Ruston (**SR**) for Horticulture New Zealand (via AVL);
- (d) Gerard Willis (**GW**) for Federated Farmers (via AVL).

8.3 Observing the conference was:

- (a) Nouman Kyamanywa, Rural Advisor, Horizons.

CODE OF CONDUCT

- 9. This joint statement is prepared in accordance with section 4.7 of the Environment Court Practice Note 2014 (the “**Practice Note**”)
- 10. We confirm that we have read the Practice Note, and in particular Appendix 3 – Protocol for Expert Witness Conferences, and agree to abide by it.

PURPOSE AND SCOPE OF CONFERENCING

- 11. The purpose of expert conferencing was to identify, discuss, and highlight points of agreement and disagreement on the possibility of developing a risk matrix approach to managing the impacts of intensive farming land use on catchment water quality in the Manawatu-Whanganui region.
- 12. The scope of the issues covered at the conference included:
 - (a) Discussion and decisions on recommendations from working groups;
 - (b) Presentation (format) of risk assessment methodology;
 - (c) Place of biophysical factors within the assessment methodology; and
 - (d) Applying the risk assessment framework in practice.

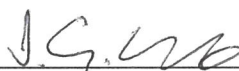
AGREED ISSUES

- 13. Refer to Annexure A.

DISAGREEMENT AND REASONS

14. Refer to Annexure A.

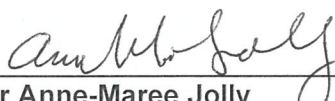
Date: 7 October 2022



Ian McNab



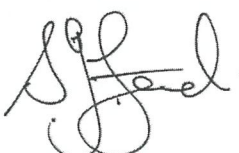
David Horne



Dr Anne-Maree Jolly



Andrew Barber



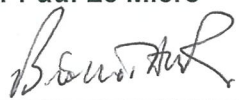
Stuart Ford



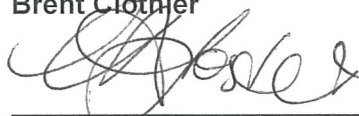
Gavin Marshall



Dr Paul Le Miere



Brent Clothier



Christine Foster



Greg Carlyon

SC Ruston

Sue Ruston



Gerard Willis

ANNEXURE A

In the matter of Proposed Plan Change 2

Expert conferencing – Intensive Farming Risk Matrix (7 October 2022)

Issue	Statements	Agreed Position	Disagreements, with reasons
Note: For some areas of discussion, the planning experts did not feel qualified to contribute to the agreed position. The Farm Systems experts – AJ, BC, AB, DH, IM, GM, PL, SF – are referred to as FS in places.			
Topic 1 – Discussion and decisions on recommendations from working groups			
Report back from stock management working group	See PowerPoint presentation and background papers from DH at Attachment 1 . Note: Statements in this presentation were DH's opinion only and not necessarily agreed by participants.	All FS agreed with the incorporation of the following edge of field technologies: wetlands and bioreactors. All FS also agreed to the incorporation of plantain as an in-field technology. All FS agreed that the use of dung beetles is promising, however, there is not enough evidence or confidence that they have a significant effect on nitrogen. CF says that under the decisions version of PC2, the benefits of dung beetles for P sediment and pathogens can be examined through the controlled activity and discretionary activity consents. DH, IM, GM and PL agreed that the Nitrogen Risk Scorecard (NRS) could be adapted to assess irrigated sheep and beef farms.	

Issue	Statements	Agreed Position	Disagreements, with reasons
		DH, AJ and IM agreed that, given that arable farms in the region are a mix of enterprises, they could be evaluated using a combination of NRS (for the pastoral component) and the Vegetable Risk Scorecard for the cropped area. All FS agreed that there are no further gaps in the stock management table.	
Topic 2 – Presentation of Vegetable Risk Scorecard			
Presentation of vegetable risk scorecard from AJ	See drafted vegetable scorecard as attached to JWS dated 25 August 2022.	AJ, AB, BC and SF agree that the six most significant factors for the vegetable risk scorecard are: Annual application rate, application rate per application, nitrogen budget/balance, soil testing, application method, and management between crops. AJ, AB, BC and SF agree that if the vegetable risk scorecard was adopted, it can show a 35% reduction in N loss risk. Note: AB and SF will be consulting on the vegetable risk scorecard with commercial vegetable growers (Action Point).	
Topic 3 – Presentation (format) of risk assessment methodology			
Points based scoring		All agreed that scores could drive the assessment and the overall score then indicates the consenting pathway. All agreed that colours could be used as a visual guide to show users where they should make their changes.	

Issue		Statements	Agreed Position	Disagreements, with reasons
Do you agree that you can aggregate nitrogen risk factors as a cumulative nitrogen leaching loss risk for the farm?			All FS agree that you can aggregate nitrogen risk factors as a cumulative nitrogen leaching loss risk for the farm. This recognises that the scorecard has been adjusted to reflect the minimum standards prescribed by the Plan for effluent management. The same principle should apply to all other practices where there is a rule.	
Topic 4 – Place of biophysical factors				
Option 1 – Biophysical data to be included in risk assessment approach		Report back from DH of working group meeting (DH, AJ, AB and GM). See PowerPoint presentation from DH at Attachment 1 . Note: Statements in this presentation were DH's opinion only and not necessarily agreed by participants.		
Option 2 – Biophysical data to be excluded from risk management approach but included later in the consenting process		Report back from GW. Presentation from PL with Fonterra data – PL will circulate pending consent from Fonterra.		
Topic 5 – Applying the risk assessment framework in practice for the PC2 consenting pathways				
Pathways	Can the One Plan Threshold or Reduction be represented as a risk threshold or risk band?	Can the Risk Assessment Framework Calculate or Estimate a 20% or 35% Reduction in Risk?	Including Biophysical Factors (Soil type/Vulnerability to N leaching and rainfall)	Excluding Biophysical Factors
Achieve Table 14.2 limits	DH thinks you can explore adapting Table 14.2 by using the 10-year row and inputting risk scores from model farms. Further work to be done (Action Point)	Further work required (DH)	Potentially – subject to further work.	Potentially – subject to further work.

CVG reduce by 35% from 2012/2013 baseline	6 most significant practices to assess against (5 relate to N, 1 relates to crop management)	Yes	Soil type – N leaching vulnerability index from Manaaki whenua. Rainfall – uniform, not high for priority catchment areas.	Yes, can be done.
Dairy specific pathway (reduce to the lesser of 80% of the 2012/2013 baseline or 75th percentile for the sub-catchment)	6 groups of factors comprising ~35 sub-factors	Yes	Both soil type and rainfall could technically be included – some different views about how this could be done in a timely manner.	
All other pastoral reduce by 20% from 2012/2013 baseline	5 groups of factors	Yes	Both soil type and rainfall could technically be included – some different views about how this could be done in a timely manner.	

Note: For all land uses, there is a question about whether there is reliable data available to determine the risk scorecard score at the 2012/2013 baseline.

Issue	Statements	Agreed Position	Disagreements, with reasons
Commercial vegetables	Discussion of whether biophysical factors should be included in the risk scorecard for PC2.	AB, BC, AJ and SF agree that rainfall is a neutral factor for the Horowhenua catchments in this region. AB, BC, AJ and SF agree that these factors could be investigated when consulting on the risk scorecard with growers – talk to Horizons, PNZ and Hort NZ (Action Point). AJ proposes, and all others agree, that a modelling exercise be undertaken to investigate the influence of soil type on N leaching risk and how this might be incorporated (Action Point).	AB, BC and SF do not think including soil type will make a difference – the practices are more significant in influencing N loss. AJ would include soil type because there is enough variability in Horowhenua to influence risk profiles on different properties.

Issue	Statements	Agreed Position	Disagreements, with reasons
Dairy and other intensive pastoral pathway	Discussion of whether biophysical factors should be included in the risk scorecard for PC2. Do you need to include biophysical factors to get an adequate N risk score?	DH suggests, and all others agree, that there can be some work to identify a way to score the biophysical factors. This could then be compared with the existing risk scorecard (without biophysical factors) to see if there is a significant difference (e.g. if the same farms are in the 75th percentile) - might need more thinking of what the comparison would be (e.g. does it matter if the people in the 75th percentile are different? How do we identify them?). Need to talk to Horizons (Action Point - CF).	PL does not think they should be included as the most change will be influenced by land use practices. PL and GW expressed concern about including these factors in an accurate and meaningful way in the time constraints of this process. Note: These views are subject to the findings of further work agreed.
General discussion of including/excluding biophysical factors in the risk scorecard		All FS agreed that if biophysical factors are going to be included in the pastoral risk scorecard, they should also be included in the vegetable scorecard if relevant.	

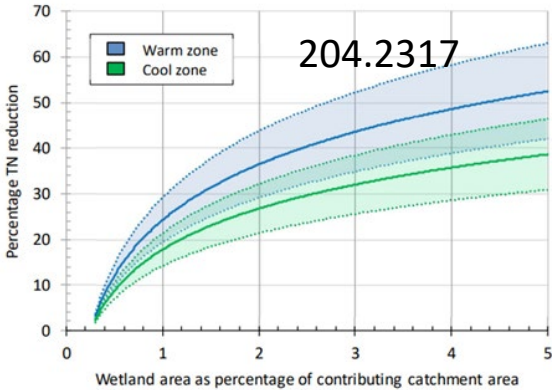
Attachment 1

25/8/22

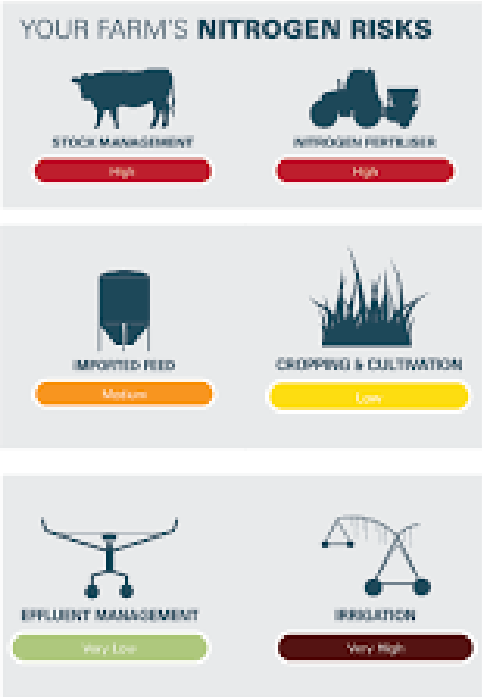
Factor	Information required to be able to assess risk reduction	Risk category / band or score	Performance against agreed criteria
Plantain in diet	% of plantain in diet by ^{pastoral} over - summer / autumn	0-10 = 0 10-20 = -10% dm enter 20-30 = -20% dm enter >30 = -30% dm enter	Needs <u>Plan</u> more work on scoring good reliability. good truth
Wetlands	- Wetlands as a % of overall area - Wetland as a % of the pastoral area that drains into it.	Action - get data from NIWA Paul research be conservative	
Edge-of-field mitigation / new Emerging technologies (Plantain)	- bioreactor ~~wetlands~~ as a % of overall farmed area - Bioreactor as a % of the pastoral area that drains into it.	Action - Dave to get data	
Bioreactor			
Dung beetles	- Proof they've done it - It in place a 4 season package	Action - Andrew info for scoring	

Incorporating edge of field techniques

1. Wetlands



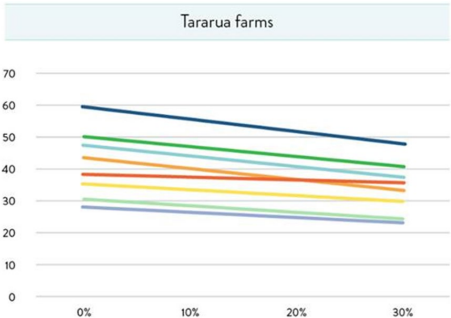
Percentage of Catchment area	Reduction in score
0.5	5
1	12.5
2	18
3	21
4	24.5
5	26



As these mitigations remove N directly from drainage water the (final) score can be modified



2. Plantain



% Plantain	Weighting (% of farm N-loss reduction))
0 - 9	0
10 - 19	-6%
20 - 29	-12%
30 - 39	-18%
40 - 49	-24%
50 - 59	-30%

3. Bioreactors

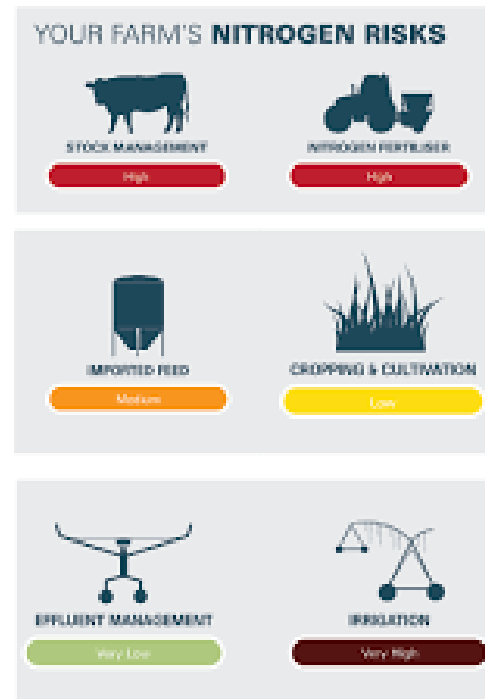
- It was agreed that the N.R.S. (Fonterra tool) could be used to assess irrigated sheep and beef farms
- It was agreed that, given that arable farms in the region are a mix of enterprises, they could be evaluated using a combination of N.R.S (for the pastoral component) and the Vegetable Risk Scorecard for the cropped area.

Including environment/physical features

1. Climate

2. Soil type

As these features impact directly on N content in drainage water, they can set the context for the risks associated with management.



As these mitigations remove N directly from drainage water the (final) score can be modified



1. Wetlands

2. Plantain

3. Bioreactors



EVALUATION OF FONTERRA'S N SCORECARD FACTORS ON OVERSEER NITROGEN STATISTICS

Prepared for
Gavin Marshall and Matthew Randal
Fonterra Limited

By
Neville Jopson
AbacusBio Limited

1 November 2019

DISCLAIMER

Every effort has been made to ensure the accuracy of the investigations, and the content and information within this document. However AbacusBio Limited expressly disclaims any and all liabilities contingent or otherwise that may arise from the use of the information or recommendations of this report.

AbacusBio Limited
PO Box 5585
Dunedin
New Zealand

Phone: +64 (03) 477 6375
Fax: +64 (03) 477 6376
Email: name@abacusbio.co.nz
Website: www.abacusbio.com

Conclusions

Overall, the N Scorecard is providing very useful feedback to farmers on their farm management practices. The moderate accuracy of prediction of Overseer N-Loss to water from the Scorecard sub-factors is encouraging, given that major environmental data which affects nitrogen loss to water is not included in the Scorecard. There are a small number of factors that dominate in the prediction of

- To identify pastoral farms with the greatest leaching losses, and therefore those farmers who will need to make the greatest reductions, will require a scorecard which;
 - has an aggregate score
 - includes environment/physical factors (climate and soil)
- Without these it will not be possible to deliver (anything like) the PC2 outcomes.
- Without environmental factors, an assessment of pastoral farms will generate a very flat distribution (which will therefore be of little use).
- It will have perverse outcomes –e.g. a farm on silt loam under 900 mm of rainfall (Rangitikei) having a similar score to a farm on a coarse textured soil with 1400 mm of rainfall
- Relatedly, PC2 is predicated on a farmer with a leaching loss of 45 kg N/ha reducing N leaching by 9 kg N/ha and a farmer with a loss of 65 kg N/ha reducing losses by 13 kg N/ha.
- It will not be possible to identify a 75th percentile.

Current

Reduce N fertilizer

+ Improve FDE management

N-leaching Risk Matrix

128 ha 340 cows; 426 kg MS/cow; 11 t DM/ha eaten; 160t DM supplement.

Stock Management				
SR	cows/ha	su	su/ha	Points
	2.8	8	22.4	30
Pasture eaten		12-14 tDM/ha		10
Wintering off		40-60%		30%
Sub-total				28

Cropping & Cultivation		
% of total grazed area	10-15%	70
Grazing season	Summer + Winter	0
Fertiliser applied		30
Sub-total		100

Nitrogen Fertiliser		
N-use	175-200kgN/ha	60
NUE (kgMS/kgN)	7 - 11 kgMS/kgN	20
Timing	May-Jun	40
Application rate	70kg urea/ha	
Sub-total		120

Imported feed			
Total N/ha	Maize 8%CP; CP 16%N		80
Average N%	1.28%N		3
Pasture eaten	12-14 tDM/ha		10
Conversion efficiency			0
Sub-total			83

Effluent management		
Storage		0
Application depth	10 - 20mm	10
Application area		20
sub-total		30

Sub-totals:	
Stock	28
Crop	100
N-fert	120
Feed	83
Effluent	30
Total	361

Mitigated Farm

Stock Management				
SR	cows/ha	su	su/ha	Points
	2.8	8	22.4	30
Pasture eaten		12-14 tDM/ha		10
Wintering off		40-60%		30%
			Sub-total	28

Cropping & Cultivation		
% of total grazed area	10-15%	70
Grazing season	Summer + Winter	0
Fertiliser applied		30
Sub-total		100

Nitrogen Fertiliser			
N-use	100-150kg		30
NUE (kgMS/kgN)	7 - 11 kgMS/kgN		20
Timing	May-Jun		40
Application rate	23kg		-20
Sub-total			70

Imported feed			
Total N/ha	Maize 8%CP; CP 16%N		80
Average N%	1.28%N		3
Pasture eaten	12-14 tDM/ha		10
Conversion efficiency			0
Sub-total			83

Effluent management		
Storage		0
Application depth	10 - 20mm	10
Application area		10
sub-total		20

Sub-totals:		
Stock	28	
Crop	100	
N-fert	70	
Feed	83 Points reduced	60
Effluent	20 Reduction %	17%
Total	301	83%

Mitigated Farm

Stock Management				
SR	cows/ha	su	su/ha	Points
	2.8	8	22.4	30
Pasture eaten		12-14 tDM/ha		10
Wintering off		40-60%		30%
			Sub-total	28

Cropping & Cultivation		
% of total grazed area	10-15%	70
Grazing season	Summer + Winter	0
Fertiliser applied		30
Sub-total		100

Nitrogen Fertiliser			
N-use	100-150kg		30
NUE (kgMS/kgN)	7 - 11 kgMS/kgN		20
Timing	May-Jun		40
Application rate	23kg		-20
Sub-total			70

Imported feed			
Total N/ha	Maize 8%CP; CP 16%N		80
Average N%	1.28%N		3
Pasture eaten	12-14 tDM/ha		10
Conversion efficiency			0
Sub-total			83

Effluent management		
Storage		0
Application depth	10 - 20mm	0
Application area		0
sub-total		0

Sub-totals:	
Stock	28
Crop	100
N-fert	70
Feed	83 Points reduced 80
Effluent	0 Reduction % 22%
Total	281 93%

	Overseer value (kg N/ha)	N.R.S	Percentage reduction in Overseer value (%)	Percentage reduction in N.R.S
Current farm	43	361	-	-
Reduce N fertilizer rate	37	301	14	17
Reduce N fertilizer + improve FDE management	35	281	19	22

Aligning with PC2 (for dairy)

- Use the modified N.R.S. to generate an analogue of Year 10 for Table 14.2 (we have the 'standard/model' farm data).
- Assess farmers in the target catchments with the modified N.R.S.
- Identify the 75th percentile value
- Farmers can meet the Year 10 score in the re-worked Table 14.2.
- Farmers reduce to the lesser of 80% of the baseline or the 75th percentile for the sub-catchment

Incorporating Wetlands into Nitrogen Risk Scorecard

Paul Le Miere

The following reference was used

<https://niwa.co.nz/sites/niwa.co.nz/files/CW%20Technical%20Guidelines-Final.1%2020.5.21%2Bnote.pdf>

Looking at the report while the reductions can be quite decent (>50%) for N – the wetland has to be designed properly.

Therefore I suggest that we be conservative and for most wetlands, not specifically designed this way, apply a 50% reduction of the possible mitigation.

Eg – go off this graph

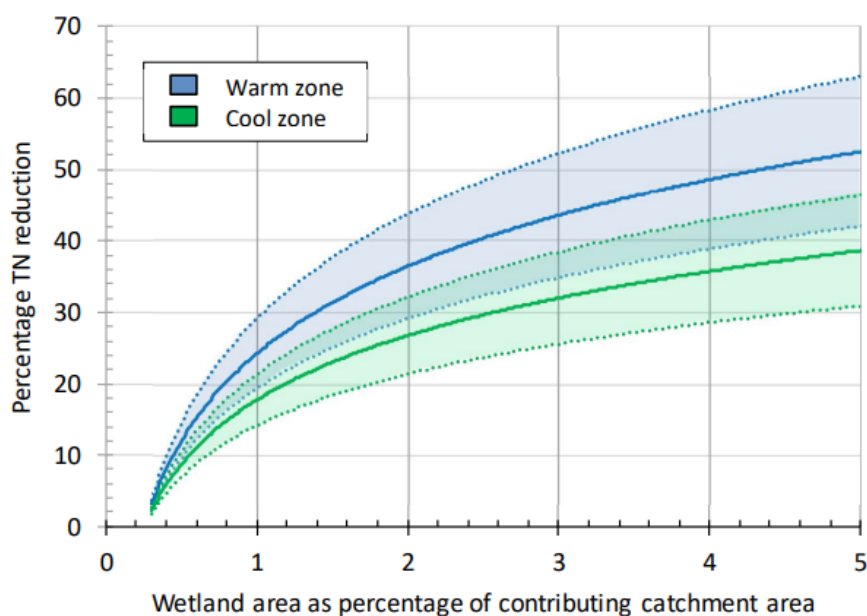


Figure 6: Long-term median annual TN reduction performance expectations. Performance is for appropriately constructed wetlands receiving run-off and drainage from pastoral farmland for warm (median annual temperature >12°C) and cool (median annual temperature 8-12°C) climatic zones and with catchment rainfall within New Zealand norms. Solid lines show expected medians for each zone; shaded areas show range of performance expected.

And using the warm zone area (I presume Horizons is warm zone ?) – thus the lookup table would be something like this:

warm zone			
% N score reduction			
midrange			
<u>% of</u>			
<u>catchment</u>			
<u>area</u>	<u>TN reduction</u>	<u>50% reduction</u>	
0.5	10	5	
1	25	12.5	
2	36	18	
3	42	21	
4	49	24.5	
5	52	26	

So if a wetland was 2% of the catchment that drains into it and that area was 50% of the farm you would get a modifier of 9% reduction of your total N score.

Eg wetland =2% of contributing catchment = score of 18 (50% of 36) times 0.5 (the 50% of farm) = 9%.

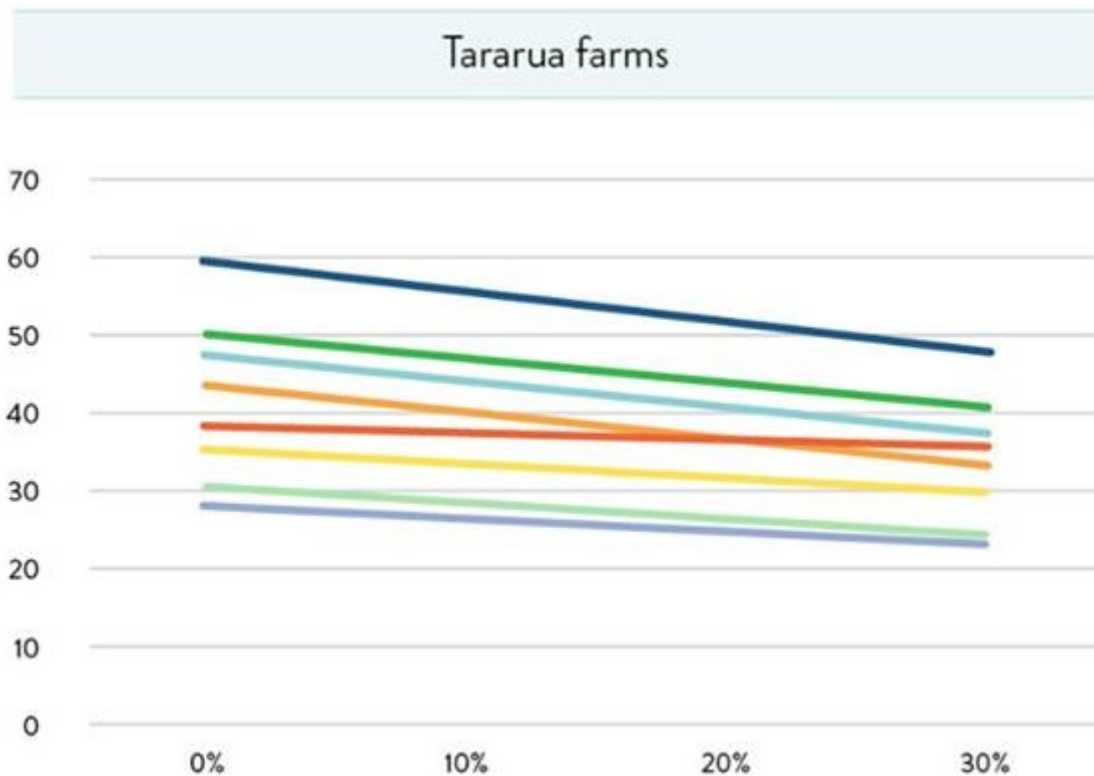
If the wetland has been specifically designed as per the guidelines then we could use the full % reduction ?

Paul Le Miere

PC2 Risk Approach – 3rd Workshop

Plantain N-leaching Mitigation:

From DairyNZ/Massey Overseer modelling of 8 farm systems, based on in-field lysimeters measurements:



Peter Kemp advised me “Dairy 4 research continues to show a linear relationship between percentage plantain leaves in the diet and decreased N concentration in the cow’s urine.”

	0%	10%	% reduction	20%	% reduction	30%	% reduction
1	47.4	44.1	7.0%	40.8	13.9%	37.5	20.9%
2	43.6	39.9	8.5%	36.3	16.8%	32.9	24.5%
3	30.5	28.3	7.3%	26.2	14.2%	24.4	20.1%
4	35.5	33.4	5.8%	31.5	11.2%	29.8	16.1%
5	28.3	26.5	6.3%	24.8	12.4%	23.1	18.3%
6	50.0	47.0	6.0%	44.0	12.0%	41.1	17.8%
7	59.9	55.6	7.2%	51.7	13.7%	48.0	19.9%
8	38.4	37.4	2.6%	36.5	5.0%	35.7	6.9%
Average	41.7	39.0	6.3%	36.5	12.4%	34.1	18.1%

Using these numbers we can extrapolate the N-leaching reductions to 40 & 50% plantain in the diet.

% Plantain	Weighting (% of farm N-loss reduction))
0 - 9	0
10 - 19	-6%
20 – 29	-12%
30 - 39	-18%
40 - 49	-24%
50 - 59	-30%

Regional Councils accept the Visual Assessment method to estimate of the amount of plantain in a paddock using the DairyNZ method which Horizons has ground-truthed with CME staff. The council CMW staff are comfortable using this method to estimate total farm plantain content as a percentage of the diet for auditing purposes.

TITLE: Summary of dung beetle papers – PC2. Risk Scorecard
AUTHOR: Andrew Barber
DATE: 30/8/22
PURPOSE OF THE PAPER: Summarise dung beetle N risk scorecard evidence
SUMMARY: 1. Dung beetles bring a multitude of ecosystem services to pastoral farming systems. 2. NZ research showed up to an 80% reduction in surface run-off following dung beetle activity, and up to 97% reduction in sediment loss. Sediment was used as the indicator for other overland contaminants (e. coli, N, P). 3. Reduced overland flow improves the performance by reducing the load on other mitigation measures including wetlands, and vegetated buffers. 4. Nutrients returned to the soil that would otherwise be tied up in dung deposits and unavailable to pasture. Dung burial at full carry capacity occurs within 48 hours. 5. Reduced nitrogen loss in livestock dung 6. 80% of the stream contamination occurs on first order streams before reaching those streams that are big enough to fence (McDowell). Therefore, other mitigation measures are required. 7. Industry and council support is needed to drive practice change. Dung beetles are an inexpensive, multi contaminant mitigation tool, with no on-going costs, while also increasing production.

The website www.dungbeetles.co.nz has a wealth of information, including scientific articles. Including timelapse video <https://youtu.be/f-YTcuXMgeg>

Reduced overland flow

Dung beetle activity resulted in significant reductions of 49% and 81% in mean surface runoff volume, depending on simulated rainfall intensity. The presence of dung beetles resulted in a 97% reduction in mean sediment amount in runoff.

Forgie et al (2018) Newly released non-native dung beetle species provide enhanced ecosystem services in New Zealand pastures

Soil health, soil structure and subsoil chemistry

Double, 2008. Meat & Livestock Australia.

Dung burial resulted in elevated levels of nitrate, ammonia, phosphate, sulphur and soil carbon in the subsoil 20–45 cm below dung pads. Soil organic matter, soil pH and EC were also elevated. These

effects were dramatic, particularly in the vicinity of the beetle tunnels, and have persisted for more than 2 years.

Earthworm numbers and biomass increased in soil where the dung had been buried by beetles, being found throughout the soil profile.

Catchment scale effects

Dymond et al., Mapping of Escherichia coli Sources Connected to Waterways in the Ruamahanga Catchment, <https://pubs.acs.org/doi/10.1021/acs.est.5b05167>

E. coli used as an indicator of contaminant flow. Permits the assessment of catchment-wide mitigation and best management practice. Introduction of dung beetles would minimise sources connected to waterways by overland flow and would reduce total E. coli sources by approximately 35%.

Benefits

Increasing pasture production, reducing fertiliser costs and improving water use efficiency. The general public will also benefit through reduced water pollution and elevated levels of carbon storage in soil organic matter (reducing greenhouse gasses).

Abundant beetle populations can be expected within 10 years of introducing beetles to suitable habitats.

A very good summary. USA experience of introduced beetles since the 1970's.

Dung Beetle Benefits in the Pasture Ecosystem <https://attra.ncat.org/htmlpub/dung-beetle-benefits-in-the-pasture-ecosystem/>

Dung beetles are just one small part of the pasture ecosystem, but they are too important to ignore. To summarise the dung beetle benefits:

- Nutrients returned to the soil that would otherwise be tied up in dung deposits and unavailable to pasture grasses
- Reduced nitrogen loss in livestock dung
- Increased pasture yields resulting from the incorporation of organic matter into the soil, with an increase in soil friability, aeration, and water-holding capacity
- Prevention of pasture surface pollution
- Increased effective grazing of pasture areas covered by dung

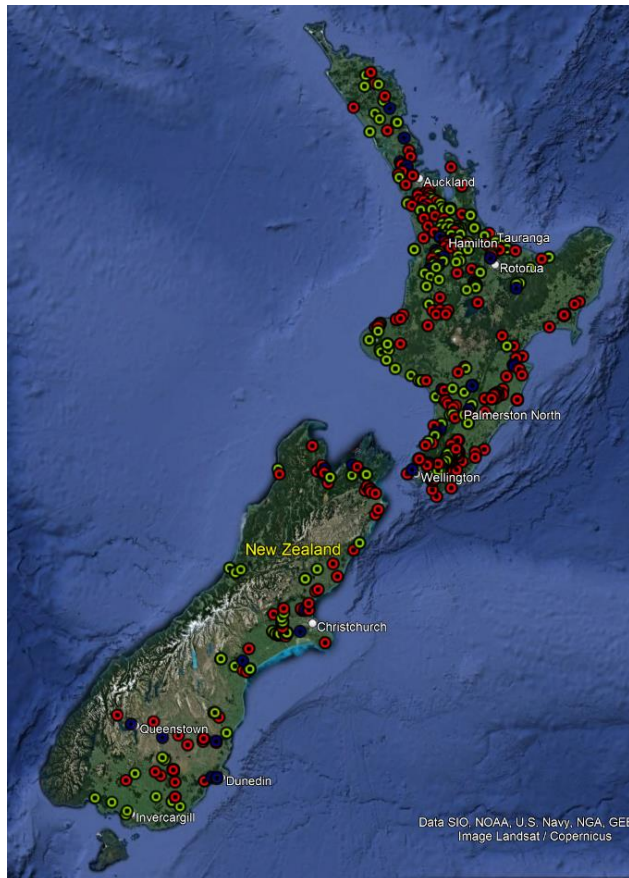
NZ Leaching study

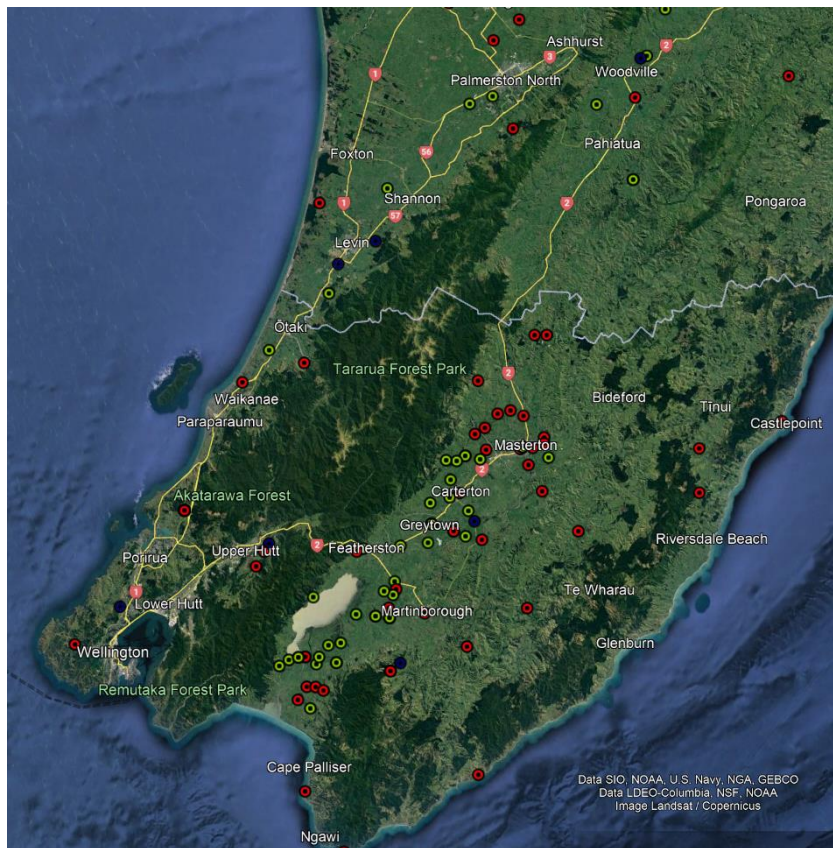
Tunnelling by dung beetles did not increase leaching. Dung beetles significantly lowered e. coli levels in the soil surface layer.

E. coli concentrations in surface soil from the lysimeter cores treated with dung and dung beetles, and untreated control soil were significantly lower than those in soil treated with dung only.

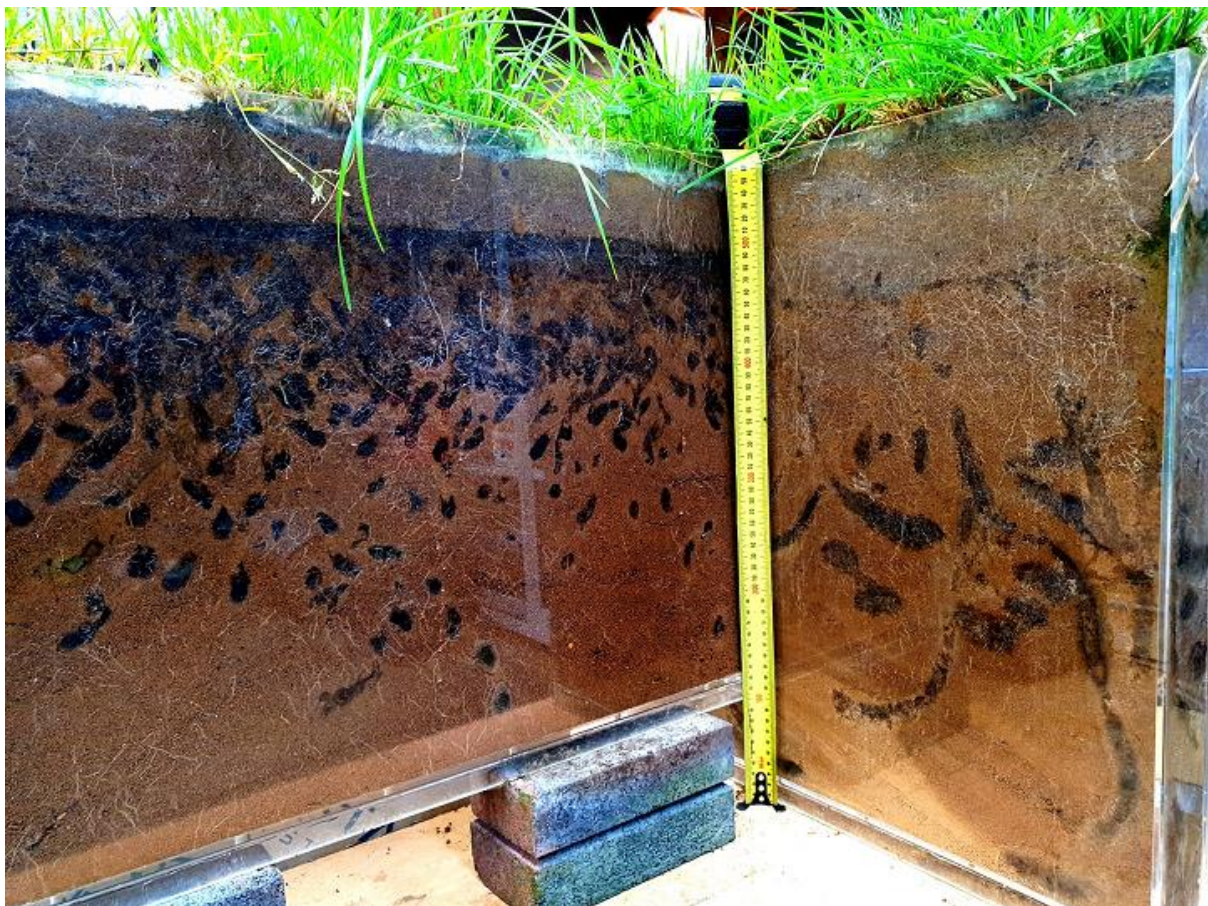
E. coli levels in the surface layer (0-3 cm) of the soil treated with dung + dung beetles were significantly lower than those in soils treated with dung only and were similar to those of untreated soil.

Release sites





Soil profile. Two dung beetle species, active at different depths.



ADDENDUM Email reply 4/9/22**From:** Andrew Barber <andrew@agrilink.co.nz>**Sent:** Sunday, 4 September 2022 10:36 pm**To:** 'David Horne' <D.J.Horne@massey.ac.nz>; 'Paul Le Miere' <plemiere@fedfarm.org.nz>; 'Ian McNab' <Ian.McNab@horizons.govt.nz>; 'Gavin.Marshall@rabobank.com' <Gavin.Marshall@rabobank.com>; 'Nouman Kyamanywa' <Nouman.Kyamanywa@horizons.govt.nz>**Cc:** 'GBailey@crlaw.co.nz' <GBailey@crlaw.co.nz>; 'Michelle Rush' <rush.m@xtra.co.nz>**Subject:** RE: More 'expert conferencing'

Hi

My first thoughts on scoring.

The absolute number doesn't matter, but rather the relativity between mitigations and practices.

With regards to dung beetles.

To try and get a sense of the relativity I have compared them to wetlands.

Both mitigations have multiple contaminant benefits.

Both treat overland flow.

Dung beetles have a synergistic effect on wetlands (and riparian plantings) by reducing the volume of flow into them.

Wetlands rely on having as long a detention time as possible to achieve their benefits.

Dung beetles reduce overland flow by between 49% and 81% (previously circulated Forgie et al., 2018). Halving the volume, doubles the detention time. Improving wetland performance both through greater efficiency and lower discharge volumes.

Thought needs to be given to scoring based on the percentage of the farm covered by a mitigation.

Wetlands might capture say 10% of farm flows, versus dung beetles cover 100% of the grazed area.

Many mitigations like riparian planting, wetlands, and dung beetles take a few years to establish.

While the best time was to start 10 years ago, the second-best time is now. These longer-term practices need incentivising.

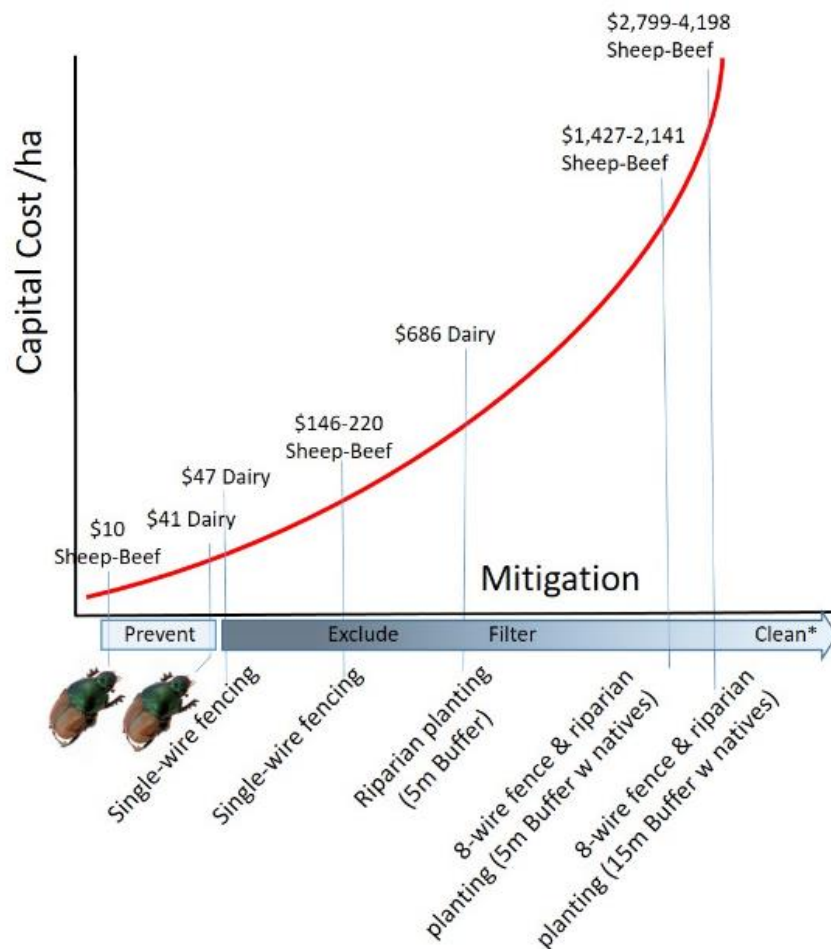
We need a mixture of mitigations that are within field, edge of field, and catchment scale.

Thinking in terms of soil loss, you need both erosion control (minimise soil movement in paddock) and sediment control (minimise the soil leaving a paddock).

From the McDowell paper that I circulated previously

"Previous research on the implementation of on-farm contaminant mitigation strategies has found that the cost effectiveness of strategies decreases the farther away mitigation occurs from the source (McDowell, 2014). For instance, using the metric of dollar per kilogram P per hectare per year saved, the mitigation of P losses can be nearly cost-neutral by changing fertilizer practices but upward of US\$400 per kg P ha⁻¹ yr⁻¹ if mitigated via a wetland. We therefore hypothesize that focusing on contaminant delivery to headwaters, which are not currently required to be fenced (i.e., narrow, shallow, or sloping streams), may be more cost-effective than trying to mitigate delivery or their impact farther downstream."

Dung beetles are as close to the contaminant source as you can get.



Verifiable evidence of action.
Release photographs and invoices.

Dung beetles might be scored similar to wetlands. Assuming wetlands have a score that is scaled based on the percentage of catchment, dung beetles might be at the upper end of that. Reflecting their synergistic relationship with other mitigations, they cover the whole farm, and that they are close to the source of the problem as a preventative rather than a cleaning mitigation.

Both mitigations would score much higher in a P, e.coli, or sediment risk index. But their impact on N can be scored and acknowledged, therefore incentivising on the ground action which is the only thing that the environment cares about.

Best regards
Andrew

Additional research papers collated by Andrew Barber can be found through the link below:

https://cooperrapley-my.sharepoint.com/:f/g/personal/gbailey_crlaw_co_nz/EIJoWhYhn3FCrG-AzwDqxGcBNNHNIUczv3sufvfN4r2xOA?e=cdmxFR

