

**From:** [Alister Metherell](#)  
**To:** [Plan Hearings](#)  
**Subject:** Re: Proposed Plan Change 7 to the Canterbury Land and Water Regional Plan - Webpage updates  
**Date:** Friday, 17 July 2020 11:44:24 am  
**Attachments:** [LWRP PC7 hearings - Melbury Ltd Sub Id 172 - Evidence of Dr Alister Metherell 17 July 2020.pdf](#)

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Please find attached my Evidence for the LWRP PC7 hearing for Melbury Ltd (submitter Id 172)

Kind regards

Dr Alister Metherell

On Thu, 16 Jul 2020 at 14:33, Plan Hearings <[planhearings@ecan.govt.nz](mailto:planhearings@ecan.govt.nz)> wrote:

Tena koe

There have been a number of documents added to the website for [Proposed Plan Change 7 to the Canterbury Land and Water Regional Plan](#), additional documents are regularly added to the webpages for the Plan Changes.

The following documents have been added under the “Council Documents” tab:

- [Memo on Consolidated Officer Recommendations on PC7 10 July 2020](#)
- [Consolidated Officer Recommendations on PC7 10 July 2020 \(PDF\)](#)
- [Consolidated Officer Recommendations on PC7 10 July 2020 \(word\)](#)
- [Memorandum of Counsel on behalf of Canterbury Regional Council regarding the Explanatory Note - Orari FMU Land Use Attributes](#)

The following document has been added under the “Independent Hearing Commissioner Documents” tab:

- [Decision 2 of the Hearing Commissioners](#)

The following documents have been added under the “Additional information released by Council” tab:

- [GIS information of Officer recommendations to amend the proposed PC7 planning maps of 'Indigenous Freshwater Species Habitat'](#)
- [Well data used to generate Figures 2-6, 2-8 and 2-9 in the Nitrate Management report \(Kreleger and Etheridge, 2019\) \(CCC wells.csv\)](#)
- [Well data used to generate Figures 2-6, 2-8 and 2-9 in the Nitrate Management report \(Kreleger and Etheridge, 2019\) \(CCC\\_wells\\_all\\_nitrate.csv\)](#)
- [Data referred to in Figure 6-3 of the Waimakariri Land and Water Solutions Programme \(Etheridge and Hanson, 2019\) \(SC vs depth inland vert grad area.xlsx\)](#)
- [Memo - Data that provides the Environment Canterbury Soil Types Layer on Canterbury Maps](#)
- [Orari FMU Land Use Attributes](#)

Statements of evidence-in-chief are being uploaded under the “Submitters Documents” tab and will be uploaded over the course of the next week.

Should you have any questions, please do not hesitate to get in touch with me.

Nga mihi

Tavisha

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**Plan Hearings**

Environment Canterbury

planhearings@ecan.govt.nz

PO Box 345, Christchurch 8140

Customer Services: 0800 324 636

24 Hours: 0800 76 55 88

**ecan.govt.nz**



**IN THE MATTER** of the Resource Management Act 1991 (RMA)

**AND**

**IN THE MATTER** of Canterbury Land and Water Regional Plan: Plan Change 7

**AND**

**IN THE MATTER** of submissions by Melbury Ltd (Submitter Id. 172)

Statement of Evidence of Dr Alister Metherell

17 July 2020

## 1. INTRODUCTION

- 1.1. My full name is Dr Alister Keith Metherell. I have a B. Ag. Sc (1st class Honours) from Lincoln College, University of Canterbury, a Graduate Diploma in Applied Computing from Lincoln University, and a Doctor of Philosophy degree in Agronomy, from Colorado State University.
- 1.2. I have previously been employed by the Ministry of Agriculture and Fisheries and AgResearch as a scientist with a particular focus on soil fertility, nutrient cycling and modelling fertiliser requirements, including major contributions to the development of the Overseer® model. Since 2004 I have been employed by Ravensdown Limited in a role focused on science related to soils and fertiliser and modelling nutrient cycling and fertiliser requirements. I have been responsible for the integration of Overseer® within Ravensdown's IT systems, and have provided advice to Ravensdown staff in the use and interpretation of Overseer®. I have also provided considerable feedback to the Overseer® development team about bugs in the software and suggested improvements to it. In 2012 I was invited to be a member of the Expert Working Group for the Foundation for Arable Research Review of the Overseer® model. I was an inaugural member of the Overseer® Users Advisory Group during the time the group met from 2014 until 2016.
- 1.3. At various times in my career I have provided formal and informal advice to the Canterbury Regional Council (Council) to assist in policy development. In my role at Ravensdown during 2015-2017 I had a great deal of involvement in providing data and expertise for the Matrix of Good Management project, testing the Farm Portal and in preparing evidence for Plan Change 5 in relation to the Schedule 28 modelling proxies. Subsequent to the Plan Change 5 appeals, in 2019 I was invited to be a member of the Good Management Practice (GMP) Technical Working Group, brought together by the Council, which has reviewed the fertiliser and irrigation proxies. In 2017 was also invited by the Council to contribute to a study to estimate the uncertainty in Overseer® modelling in the Waimakariri Zone.
- 1.4. Over my career I have been greatly involved in the development and implementation of decision support models for fertiliser advice and nutrient cycling. This began with the implementation and improvement of MAF's computerised fertiliser advisory service (CFAS) and the development of fertiliser advice models for arable crops in the 1980's. This was followed by a PhD on "Simulation of Soil Organic Matter Dynamics and Nutrient Cycling in Agroecosystems" which included redevelopment of the internationally used CENTURY Soil Organic Matter model. I then worked on AgResearch's Outlook, AgResearch PKS Lime and Overseer® 3 models. In 2018 I was invited to review parts of the Parliamentary Commissioner for the Environment's report on the Overseer® model.

- 1.5. My research interests include soil science, especially soil organic matter, soil fertility, and fertilisers; trace element requirements for pastures and livestock; simulation modelling; decision support systems; precision agriculture and sustainable land management. I am either the senior author or a contributing author of 27 refereed Scientific Journal or Conference papers, a further 61 scientific or extension conference papers, 4 book chapters, 2 technical manuals and 11 research reports.
- 1.6. I am a Director of Melbury Limited, a family company, which owned a 309ha farm (approximately 280ha effective) at North Loburn. The farm which has been in family ownership for over 100 years has recently been sold. The farm had been leased to third parties since 1992, but I retained a strong interest in its viability as an agricultural enterprise. The farm is currently a dryland operation with a mix of sheep, beef, dairy grazing and cropping with the mix of enterprises in any one year depending on market and climate factors.
- 1.7. The Loburn Irrigation Company had proposed purchasing 5ha of land from Melbury Limited to build a storage pond. A Memorandum of Understanding was signed in 2019 whereby, in exchange for the sale of farm land, Melbury Limited would purchase shares in the irrigation company to provide sufficient water to irrigate about 30ha. As the farm is in an Orange Nutrient Allocation Zone, under the planning regime of Plan Change 5, this addition of less than 50ha irrigation would be a Permitted Activity. (see section 6.4 for the implications of Plan Change 7 on this proposal).
- 1.8. Through both my professional and personal interest I have taken a strong interest in the development of the Waimakariri Land and Water Solutions Programme and Plan Change 7. Over the last 10 years I have attended some of the public meetings, read a number of background documents available through the Council website and provided feedback to the Zone Implementation committee.
- 1.9. This evidence is a personal submission and does not necessarily reflect the views of Ravensdown. I am not an independent expert witness, but as our family farm has been sold I now have no on-going personal financial interests in the Waimakariri District. However, my evidence does reflect the expertise that I have gained over my 40 years of professional experience.

## 2. SCOPE OF EVIDENCE

- 2.1. In this brief of evidence I will cover
- i) my concerns with the use of GMP N loss rates in Plan Change 7
  - ii) my concerns with the use of GMP N loss rates in the modelling leading to the policies which Plan Change 7 aims to implement,
  - ii) the impact of uncertainty in the policy development
  - iii) changes to the winter grazing thresholds, and
  - iv) changes eliminating policy related to the Orange Nutrient Allocation Zone for the area north of the Ashley River.
- 2.2. I believe that because of the major focus of the primary sector groups on the very large impact of the proposals relating to the Nitrate Priority Area in the submissions and evidence presented for Plan Change 7, there has relatively little attention paid to other aspects of the Plan Change 7, especially the changes related to the elimination of the Orange Nutrient Allocation Zone.

## 3. GMP N LOSS RATES

- 3.1. Plan Change 7 has continued to use the GMP N loss rates as calculated by the Farm Portal and Schedule 28 modelling proxies which have been declared erroneous by the Council. The Council Good Management Practice Technical Working Group, of which I was a member, concluded that the Nitrogen (N) Fertiliser Proxy currently implemented in the Farm Portal is not fit for purpose to calculate Good Management Practice (GMP) N Loss Rates from Overseer® model output files and recommended that the fertiliser proxy be disabled in the Farm Portal. The Technical Working Group also recognised that there were technical issues with the P fertiliser proxies. The Technical Working Group also recommended that the irrigation proxy be disabled in the Farm Portal and replaced by a revised lookup table for on-farm GMP assessment. These recommendations were endorsed by the Implementation Working Group and presented to a Council meeting on 16 May 2019. The Implementation Working Group recommended to Council that Plan Change 7 should be delayed until the issues were resolved stating *“It would not be responsible to notify Plan Change 7, given the Technical Working Group's advice has significant implications for catchment models used to assess effects and determine appropriate reduction regimes.”*
- 3.2. The Council Chair in a letter to the chair of the GMP Implementation Working Group dated 8 July 2019 stated
- “Council agrees with the Working Group that the nitrogen fertiliser proxies can contribute to nitrogen loss rate figures that are erroneous. We have considered your recommendation and propose to proceed as follows:*
- *Council is required to retain a Farm Portal that reflects the requirements of*

*Schedule 28 of the LWRP. Disabling the proxies would only be possible via a plan change to amend Schedule 28 of the LWRP. The nitrogen fertiliser proxies in the Farm Portal cannot therefore be 'disabled'.*

- However, the LWRP does already contain an 'alternative pathway' rule framework (see below) that allows an application for consent to be made and an 'Equivalent GMP Loss Rate' to be calculated, in circumstances when the Farm Portal generates an erroneous loss rate number.*
- As is already allowed for, in such cases the N proxy is not used (i.e. it is 'disabled' for that case) – as recommended by the Working Group."*

- 3.3. Plan Change 7 was the opportunity to make that change. However Plan Change 7 has not removed or modified the irrigation and fertiliser proxies. Instead it has made extensive use of GMP loss rate calculations including the proxies in the proposed rules and in the modelling underlying the basis for the Plan Change. This has compromised a substantial part of the basis of the Plan Change, especially in relation to the proposed N reduction targets in the Nitrogen Priority Area of the Waimakariri Zone.
- 3.4. In particular the catchment modelling based on Overseer®, used Overseer® files modified by the Schedule 28 proxies, and then included a step to estimate the difference between Current Management Practice to Good Management Practice. Given the use of the flawed proxies this aspect of the model was given a relatively high degree of uncertainty, hence inflating the overall confidence levels in the model results. If it was not for this inflated uncertainty, the 95th and 99th percentile confidence intervals presented for Christchurch aquifer nitrate concentrations in the interzone modelling report (Etheridge et al, 2018a)<sup>1</sup> would be lower.
- 3.5. I am extremely concerned that Plan Change 7 includes any reference at all to GMP loss rates in any of its rules. It is my submission that all references (they are too numerous for me to list individually) to GMP loss rates be removed from the Plan and be replaced by Baseline Loss rates OR that the Plan Change adds a clause to specifically remove the Schedule 28 fertiliser proxies and modify the irrigation proxy in line with the Technical Working Group recommendations.

#### 4. UNCERTAINTY

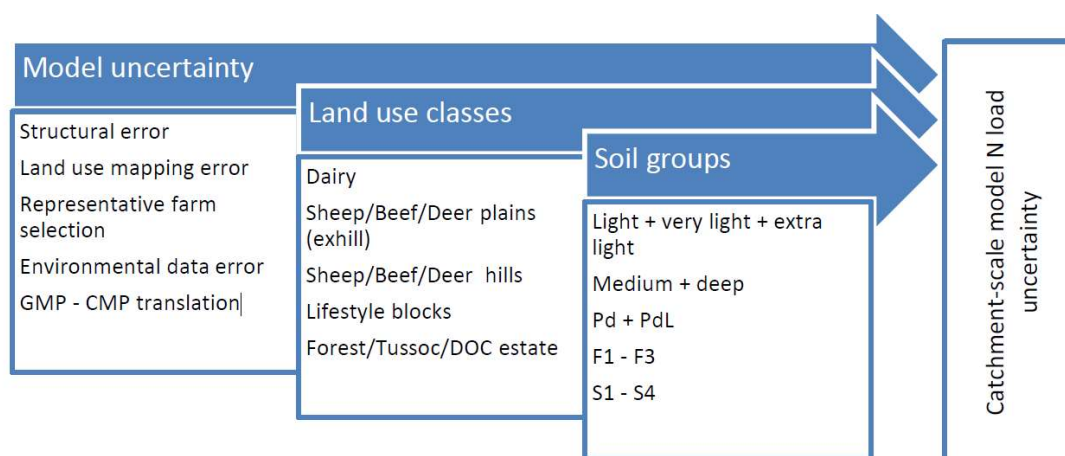
- 4.1. I agree with the evidence of Dr Michael Freeman where he states (paragraph 108) that *"PC7PC (Plan change 7 part C) is dependent on highly complex modelling processes that are dependent on a series of scientific, planning and behavioural assumptions. The interrelated development of policy responses adds to this*

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<sup>1</sup> Etheridge, Z., Hanson, M., Harris, S. (2018a) Nitrate assessment for the interzone source area catchment. Environment Canterbury Report. <https://www.ecan.govt.nz/document/download?uri=3437270>

*complexity. This combines to produce a high level of uncertainty that the specific proposed policy response will result in the achievement of all the various objectives and outcomes specified in PC7PC over the proposed 60-year timeframe”.*

- 4.2. As noted above I was a member of the expert panel which assessed the uncertainty in the nitrogen load estimates for the catchment scale modelling of N loss to water (Etheridge *et al*, 2018b) <sup>2</sup>. In the absence of a numerical uncertainty analysis for the use of the Overseer® model to predict N leaching losses in a catchment we used a formal expert judgement elicitation framework to approximately quantify uncertainty around catchment-scale modelled N loss rates for the Waimakariri Zone. We identified 5 components of uncertainty in the modelling system: structural error, land use mapping error, representative farm selection error and environmental error. The extent of bias and uncertainty in each was estimated for various combinations of landuse and soils (Figure 1).



**Figure 1** Elaboration of modelled N load uncertainty

- 4.3. Structural error includes uncertainty associated with the ability of the Overseer® model to predict N leaching losses for different land use classes on each group of soils, such as the use of mean annual synthetic daily time series climate data, instead of actual long term climate records, or almost total lack of Overseer® validation data for most land uses apart from dairy farms and the very limited validation data for light soil groups. The report on Overseer® by the Parliamentary Commissioner for the Environment (2018)<sup>3</sup> highlighted many issues relating to uncertainty and lack of documentation and transparency in key aspects of the Overseer® model.

<sup>2</sup> Etheridge, Z., Fietje L., Metherell A., Lilburne L., Mojsilovich O., Robson M., Steel K., Hanson M. 2018b. Collaborative expert judgement analysis of uncertainty associated with catchment-scale nitrogen load modelling with OVERSEER®. In: Farm environmental planning – Science, policy and practice. (Eds L. D. Currie and C. L. Christensen). [http://flrc.massey.ac.nz/workshops/18/Manuscripts/Paper\\_Etheridge\\_2018.pdf](http://flrc.massey.ac.nz/workshops/18/Manuscripts/Paper_Etheridge_2018.pdf)

<sup>3</sup> Parliamentary Commissioner for the Environment 2018. Overseer and regulatory oversight: Models, uncertainty and cleaning up our waterways.

- 4.4. GMP-CMP (Current Management Practice) translation refers to the fact that the representative farm Overseer® files used the catchment model were created using the GMP modelling proxies from Schedule 28 of Plan Change 5. The study then needed to estimate a correction for what N losses might be on real farms. Given that the nitrogen fertiliser and irrigation proxies have been shown to be erroneous this added an additional and unnecessary level of uncertainty to the overall analysis.
- 4.5. The analysis of uncertainty in root zone N losses summarised in Etheridge *et al* (2018b) is only one part of the overall catchment model uncertainty. The overall catchment outcome with particular reference to the possible interzone movement of nitrate to the Christchurch aquifer is presented in Etheridge *et al* (2018a). However it is noteworthy that the catchment analysis did not include any estimate of nitrate attenuation in groundwater and hence no estimate of uncertainty in that estimate. This analysis shows that under current land management there is likely to be a small increase in median equilibrium nitrate concentrations in comparison to current measured nitrate concentrations (Table 1). This analysis also shows that there is a very high level of uncertainty in the projected equilibrium nitrate -N concentrations with the 95% confidence interval spanning a range from very low to about 9 mg/l (Table 1). All these concentrations are below the drinking water limit of 11.3 mg/L, even under the highly conservative 99% confidence model results.

Table 1. Christchurch aquifer projected equilibrium and measured nitrate concentrations (data extracted from Etheridge *et al* (2018a))

	Modelled Current Practice Equilibrium Nitrate-N (mg/L)				Current measured Nitrate-N (mg/L)
Statistics	5 <sup>th</sup> percentile	Median	95 <sup>th</sup> percentile	99 <sup>th</sup> percentile	Median
Shallow aquifer	0.3	3.4	7.5	9.1	2.5
Mid aquifer	0.6	3.8	7.1	8.6	2.4
Deep aquifer	1.8	4.5	7.0	8.1	0.3

- 4.6. Given the very high level of uncertainty in the projected values it is not appropriate to set in place policies which are increasingly restrictive on land management without having an adaptive management framework based on on-going research and monitoring.

## 5. WINTER GRAZING THRESHOLDS

- 5.1. In the PC5 submissions and hearings there was considerable debate about the appropriate level for area or the percentage of a farm used for winter grazing as a permitted activity. As a result of evidence presented the threshold was changed and a region wide threshold of 10% of the farm area for farms between 10 and 1000ha was adopted as being a level at which typical farm management practices would remain as permitted activities.
- 5.2. However within months of PC5 being made operative on 1 February 2019, Plan Change 7 seeks to change that rule for the Waimakariri Zone, reducing the percentage of the farm area to 5%. Firstly, this makes a mockery of the planning process, and secondly is not justified as the change was apparently based on a concern that small holdings (ie. Lifestyle blocks) would suddenly become hotspots of winter grazing as farmers transferred operations from their farms to other blocks of land in the district. This is a most unlikely scenario for either farmers or small holders. The actual impact of a reduction in the winter grazing area per farm is that farmers will seek to maximise crop yields through the use of more fertiliser and higher yielding crops such as fodder beet instead of brassicas, thus creating more intense hotspots on the individual farms and a higher risk of nitrate leaching.
- 5.3. The definition of Winter Grazing should take into account how Winter Grazing is actually managed as there is no differentiation between 24/7 and restricted grazing in conjunction with pastoral blocks which can have a markedly different nutrient loss impact.

## 6. ORANGE ZONE

- 6.1. The area of the Waimakariri Zone north of the Ashley River is classified as an Orange Nutrient Allocation Zone, which in the region wide rule 5.54 (introduced under Plan Change 5) the use of land for a farming activity is a permitted activity provided
  - i) the area of the property irrigated with water is less than 50 hectares; and
  - ii) the area of the property used for winter grazing is less than:
    - a) 10 hectares, for any property less than 100 hectares in area; or
    - b) 10% of the area of the property, for any property between 100 hectares and 1000 hectares in area; or
    - c) 100 hectares, for any property greater than 1000 hectares in area.
- 6.2. Plan Change 7 has not changed the designation of the Ashley / Rakahuri FMU from an Orange Zone, but has stealthily changed the thresholds for permitted activities to be equivalent to those of Red Zones with no increase in irrigated area above 10ha. There is no justification for this change and none was presented in the ZIPA.

In fact a recent Council report states: “Modelling results for the Ashley River/Rakahuri catchment suggest that nitrate concentrations are unlikely to change significantly under the GMP, PC5PA and Current Pathways scenarios for most watercourses” (Kreleger and Etheridge, 2019)<sup>4</sup>, where PC5PA is Plan Change 5, Permitted Activities with full uptake of permitted activity rules for winter grazing and irrigation. It is extremely unlikely that there would be full uptake of permitted activity rules as there is a very limited supply of water available for irrigation and a significant proportion of the area is in small holdings which are very unlikely to have winter crops for cattle grazing. Nitrate levels in the Ashley River are currently low and have a decreasing trend (Kreleger and Etheridge, 2019). Hence further restrictions on permitted farming activities in the Ashley / Rakahuri FMU are not justified. There is nothing in the objectives of the Waimakariri Water Zone Committee ( <https://www.ecan.govt.nz/your-region/your-environment/water/whats-happening-in-my-water-zone/waimakariri-water-zone/waimakariri-land-water-solutions-programme/> ) that justify the effective re-designation of the Orange Zone.

- 6.3. The most significant environmental issue in the Ashley River / Rakahuri as noted in the Section 32 report (page 13) is the toxic cyanobacteria *Phormidium*. The Section 32 report (page 279) states “The Ashley River/Rakahuri currently experiences cyanobacteria and algal blooms, where increased nitrogen losses could intensify nuisance growths.” However, McAllister et al (2017)<sup>5</sup> in a survey of Canterbury rivers found that *Phormidium* cover was greatest under low to intermediate accrual dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP) concentrations. Accrual nutrients had a strong, negative effect on cover at concentrations > 0.2 mg L<sup>-1</sup>DIN and 0.014 mg L<sup>-1</sup>DRP. Similarly, McAllister et al (2018)<sup>6</sup> in mesocosm experiments found that increasing nitrate concentrations did not affect *Phormidium* expansion and detachment. Hence policies to manage nutrients in the Ashley Rakahuri FMU are very unlikely to result in any reduction in toxic cyanobacterial blooms.
- 6.4. Objective 6 of the Waimakariri Zone Committee is to have irrigation water with a reliability of 95% available in the zone. Currently the reliability of the Loburn Irrigation Company water supply can be compromised by low flow levels in the Ashley River. As the scheme currently has no storage, low flows will immediately result in cessation of irrigation. The proposed change in thresholds for permitted activities in the Orange Zone had an immediate impact on Melbury Ltd and its agreement with the Loburn Irrigation Company (see 1.7 above). The rule changes

<sup>4</sup> Kreleger and Etheridge, May 2019. Waimakariri Land and Water Solutions Programme Options and Solutions Assessment Nitrate Management Report No. R19/68

<sup>5</sup> McAllister, T. G., S. A. Wood, J. Atalah, and I. Hawes. 2018. Spatiotemporal dynamics of *Phormidium* cover and anatoxin concentrations in eight New Zealand rivers with contrasting nutrient and flow regimes. *Science of the Total Environment* 612:71–80

<sup>6</sup> McAllister T, Wood S, Greenwood M, Broghammer F, & Hawes I (2018) The effects of velocity and nitrate on *Phormidium* accrual cycles: a stream mesocosm experiment, *Freshwater Science*. 2018. 37(3):496–509

introduced in Plan Change 7, resulted in the proposed irrigation of 30ha of Melbury Limited land no longer being a permitted activity. Whilst the addition of 30ha well managed irrigation would have little impact on the nitrate leaching footprint of the 309ha property the requirement to be in a consenting regime and having to meet an erroneous GMP N loss target meant that Melbury Ltd was not prepared to formalise the proposed agreement. Whilst the Loburn Irrigation Company subsequently purchased land from Melbury Ltd, an outcome of Plan Change 7 was to put in jeopardy a proposal to increase the reliability of irrigation in the Waimakariri District.

A handwritten signature in black ink, appearing to read 'Alister Metherell', written in a cursive style.

Dr Alister Metherell