BEFORE THE	Canterbury Regional Council
IN THE MATTER OF	the Environment Canterbury (Temporary Commissioners and Improved Water Management) Act 2010
AND	
IN THE MATTER OF	Submission and Further Submission on Proposed Variation 1 to the Proposed Canterbury Land and Water Regional Plan (2014)

STATEMENT OF EVIDENCE OF ROGER HAYDN WILLIAMS ON BEHALF OF THE NORTH CANTERBURY PROVINCE OF FEDERATED FARMERS OF NEW ZEALAND

Dated 29 AUGUST 2014

QUALIFICATIONS AND EXPERIENCE

1 My full name is Dr Roger Haydn Williams.

2 I am the General Manager of Science (Sustainable Production) for Plant and Food Research. My role involves leading a group of 120 scientists and technical staff to undertake high quality science focussed on delivering impact to New Zealand's plant-based industries, with a particular focus on sustainable primary production.

3 Prior to joining Plant and Food Research in 2013, I worked as the Director of Research Development at the Foundation for Arable Research. While working at the Foundation for Arable Research, I was appointed one of the technical co-leads for the Matrix of Good Management project to provide technical leadership on behalf of the arable and horticultural sectors. This is a role that I continue to carry out while employed at Plant and Food Research.

4 My previous experience includes working as the Head of Science for the Royal Horticultural Society in the United Kingdom, as well as a number of research roles for the primary sector in the United Kingdom.

5 I hold a Doctor of Philosophy Degree from the University of Sheffield, and a Postgraduate Diploma in Public Leadership and Management from University of Warwick.

6 I am a member of the British Society for Plant Pathology (BSPP) and currently act as the Company Secretary.

7 I am a member of the Board of the Precision Agriculture Association of New Zealand (PAANZ).

8 I have authored numerous articles and peer reviewed publications.

9 Although this is not a Court hearing, I have read the Environment Court's Code of Conduct for Expert Witnesses, and I agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my area of expertise, except where I state I am relying on what I have been told by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

10 I am familiar with the Proposed Variation 1 to the Proposed Canterbury Land and Water Regional Plan (the Variation) to which these proceedings relate.

SCOPE OF EVIDENCE

11 In my evidence I have been asked to provide a summary of the Matrix of Good Management project.

MATRIX OF GOOD MANAGEMENT

12 The Matrix of Good Management (MGM) project is a collaborative initiative between Environment Canterbury, Crown Research Institutes (AgResearch, Plant and Food Research and Landcare Research), primary sector organisations (DairyNZ, Deer Industry New Zealand, NZPork, Beef + Lamb New Zealand, Horticulture NZ and the Foundation for Arable Research) and is overseen by a cross-sectoral governance stakeholder group.

13 The project aims to take a consensus approach, involving primary industry sectors, research institutes and Environment Canterbury to quantifying the typical nitrate nitrogen (N) and phosphorous (P) losses that are expected to occur from the range of farming systems, soils and climates across Canterbury when managed to Good Management Practice (GMP). This presents significant social, political and technical challenges but has the potential to deliver robust, credible and transparent benchmarks that will be invaluable in managing farmland to minimise N and P losses on the basis of outputs rather than nutrient inputs.

Background

14 Although there is widespread support for the implementation of good management practices across primary industries[1], there are no commonly agreed definitions of GMP, nor a good understanding of the nutrient losses that occur with farms operating at GMP. This information is essential to assess the nutrient losses from different land uses under good management practices which can be used to support the development of effective resource management policy.

15 For any particular GMP there will be a range of estimated nutrient losses and these losses will vary with differing land uses, different soil types and within different climate

[1] Land and Water Forum 2012. Third Report of the Land and Water Forum. Managing Water Quality and Allocating Water

zones. In the MGM project each sector defines GMPs, which are then compared across sectors and modelled to estimate nutrient losses.

Funding & Governance

16 Core funding for the MGM project is provided by Environment Canterbury, AgResearch, Plant and Food Research, Ministry for the Environment and Ministry for Primary Industries. In addition, the key primary sector industries (DairyNZ, Foundation for Arable Research, HorticultureNZ, DeerNZ, NZ Pork and Beef + Lamb NZ) are investing in the project through financial contributions and in-kind resourcing. Given the potential for the project to be adapted and applied in other parts of the country there are a number of regional councils that are also contributing financially to the project.

Key project components

17 The project commenced in 2013 and involves:

1. Each agricultural sector defining GMP through engagement with farmers and other rural professionals working in that sector;
2. A consensus approach to establishing GMP across sectors;
3. Defining the main farm systems using data collected from actual farms across the region;
4. Using OVERSEER® to model expected nutrient losses from these farm systems, assuming they operate at the defined GMP, across the diversity of soils and climates in Canterbury;
5. Developing methods for grouping similar farm systems, soil and climate combinations together.

Industry approaches to defining good management practice

18 An important element of the design of the MGM project is the central role played by each of the primary sectors involved (dairy, sheep and beef, horticulture, arable, deer and outdoor pigs) in defining GMP. Although each sector is represented within the

project structure by appropriately experienced staff, a highly consultative approach involving farmers and other rural professionals is being taken by each sector.

19 While existing conceptual definitions of GMP have provided a useful starting point for discussion[2], the aim within the MGM project is to describe the practical farming actions that are considered to constitute GMP. In other words, each sector is aiming to articulate the reasonable management actions that farmers could be expected to take when managing a tidy and efficient farm.

20 Each sector has taken an iterative approach to defining GMP, generally involving workshop sessions with groups of farmers and rural professionals. Draft lists of tangible GMP measures arising from these discussions have been the subject of further discussion and refinement within industry sectors.

21 Whilst this process is not yet complete, sufficiently well-developed menus of GMP have been produced to enable the grouping together of sector GMPs on the basis of areas of farm management decision-making such as nutrient planning. Grouping in this way may be helpful in comparing GMP across sectors for the purpose of evaluating equivalence.

Characterising farming systems

22 Another aspect of the MGM project is to determine the relevant farm systems to include in the matrix. Various methods are being used for this but common across all industries is the importance of current farm data. All industries have collected information on farm systems and farm management from a sample of the farms in Canterbury. For the smaller sectors (deer, outdoor pigs) this has been by invitation. For others, a random sample of farms has been selected and the owners/managers invited to participate (horticulture, arable, beef and sheep) or data from a large industry database of OVERSEER® files have been used (dairy, courtesy of Ravensdown Fertiliser Co-operative). Data being collected from the farms are detailed enough to establish descriptions of farm systems in either Farmax Pro (Webby *et al.*, 1995), Farmax Dairy Pro (Bryant *et al.*, 2010) or APSIM (Keating *et al.*, 2003) models and to calculate their nutrient losses using the OVERSEER® model (Wheeler *et al.*, 2006; Cichota *et al.*, 2012). Farmax is not being used to describe typical farm systems

[2] ibid

for the dairy industry, but a cluster analysis will be conducted using the Ravensdown database, including OVERSEER® output, to describe farm systems, management and accompanying nutrient losses.

23 Currently all industries are in the process of verifying the data. In meetings with farmers and other relevant industry players the data has been 'sense-checked' to ensure the farm systems and management are relevant to the industry in Canterbury, and true outliers and gaps are identified. The final sample set will be assessed to ensure that it covers the relevant range of soils, climates and topography for each land use in Canterbury. When all areas with a relevant presence of a particular industry are covered by farms in the sample, it will be assumed the sample is sufficiently spatially representative of the region. Where substantial gaps are identified, either across the region or across farm systems, the industries involved will endeavour to collect more data to address these gaps.

Characterising the variation in climate and soils within Canterbury

24 Within Canterbury there is considerable variation in the key environmental conditions that influence nutrient losses from farms. Annual rainfall on the agricultural land varies from 430 mm/yr in the eastern McKenzie Basin to 5500 mm/yr close to the Main Divide, elevation ranges from sea level to 2360 m above sea level, soils range from very poorly drained to well drained with estimates of Profile Available Water (to 1 m depth) that range from 45 to 235 mm. Development of the MGM requires that this continuum of variability is categorised into climate zones and soil types that still capture the main characteristics of the resulting variation in nutrient losses.

25 The primary sources of information for climate and soil respectively are the NIWA Virtual Climate Station Network (Tait *et al.*, 2006) and S-map (Lilburne *et al.*, 2012a). There are a possible 1491 virtual stations in the agricultural parts of Canterbury and over 650 S-map siblings. Many of these will be very similar to each other. A clustering exercise will be undertaken to group the climate stations and soil types into a more manageable set. A simulation approach will then be used to simulate nutrient losses, for example from a single urine patch or wheat crop using APSIM across all of the climate stations under a few key dryland and irrigated soils over a period of 30 climate years. A similar analysis will be undertaken on the soils, allowing both climate stations

and soils to be clustered into groups. The final number of clusters will reflect the practical requirements of the MGM as well as the variation in the modelled results. Not all clusters will be relevant to all farm systems. This will be determined using AgriBaseTM (a database of farm type, ownership, location and management in New Zealand) and information from the industry groups.

Modelling Nutrient Losses

26 Ultimately the MGM will provide values of expected N and P losses for farms managed under agreed GMP. This will require a model to be used to assess the nutrient losses because no feasible systems exist that measure losses at the whole farm scale (Vogeler & Snow, 2012; Lilburne *et al.*, 2012b).

27 OVERSEER® works at the whole-farm scale, is widely used in New Zealand, is freely available and was accepted by the industry representatives on the MGM project as the best tool available to assess nutrient losses for the purposes of the project (Williams *et al.*, 2012).

28 The modelling work to produce the nutrient losses needed for the MGM has been conceptualised in three stages, as shown in Figure 1. The work will begin by utilising the collation of realistic farm management information (described in section 22 – 23 above headed '*Characterising farming systems*'). This will provide detailed farm-level information that will allow models to be constructed for 312 existing farms in Canterbury, representative of the participating industries. The first stage is modelling the nutrient losses for these farms, using OVERSEER®, to provide estimates of the likely current levels of nutrient losses.

29 Stage Two in the modelling involves estimating the likely nutrient losses from those farms when they are managed under the agreed GMPs (described in section 18 - 21 above headed '*Industry approaches to defining good management practice*'). For some farms, it is possible that nutrient losses under GMP will be the same as those under current management.

30 While minor changes to the farm management can be modelled in OVERSEER® alone, more substantial changes must be supported by external information about how these changes will affect the biophysical production system. In these cases other models will be used, such as APSIM (Keating *et al.*, 2003) and Farmax (www.farmax.co.nz) to calculate the effect of management changes on farm inputs (e.g. fertiliser, supplements) and production outputs. That information will be combined with that collected for Stage One to construct an OVERSEER® representation of the farm under GMP. Comparison of the nutrient losses calculated under Stages One and Two will indicate, very generally, the likely changes in nutrient losses between current management and GMP.

31 Stage Three will expand the farming systems modelled in Stage Two to a more comprehensive set of representative farm systems and then to extend the range across the relevant clusters of soils and climates in Canterbury (described in section 24 - 25 above headed '*Characterising the variation in climate and soils within Canterbury*'). A variety of methods will be used to expand the farm systems from Stage Two. These methods (Figure 1) will include APSIM, Farmax, a Linear Program and other statistical methods. The result will be a set of farm systems that are considered representative for Canterbury across the region's soil types and climate zones and that are then assessed for nutrient losses using OVERSEER®.

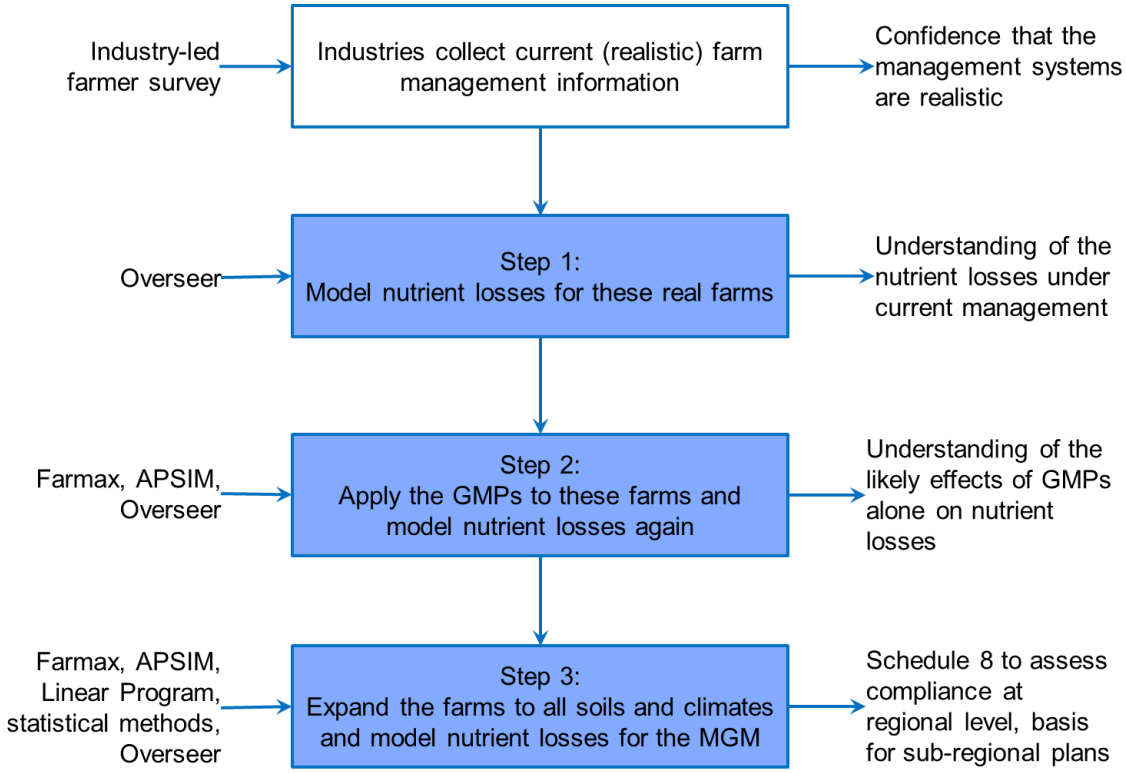

Figure 1. Modelling schematic showing the steps from collection of the farm systems data to the generation of the expected values of N and P loss for Canterbury farms managed under GMP that will populate the MGM.

SUMMARY

32 The Matrix of Good Management is an important project that has the potential to deliver robust, credible and transparent benchmarks that will be invaluable in managing farmland to minimise N and P losses on the basis of outputs rather than nutrient inputs.

Dr R H Williams

29 August 2014

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