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Memorandum

To	Matt Dodson
From	Linda Lilburne, Ognjen Mojsilovic, Heather North, Melissa Robson
Date	20 Feb 2017
Subject	Land use modelling for the Waimakariri land and water solutions programme

This memorandum briefly explains the process used to generate land use layers and associated rates of N loss below the root zone for the Waimakariri Zone (WZ).

Overview

A spatial modelling approach was used to classify and combine spatial information on land use and management practices, climate, soil type, and a table of expected nitrogen losses for each farm type, climate and soil category. This was done by developing a series of GIS (geographic information system) models by first combining various data sources to map land use, then overlaying this land use map with soil and climate layers, before finally using the nitrogen lookup table to determine the corresponding nitrogen and drainage losses for each polygon in the WZ area. The approach follows that used in the Selwyn Waihora (Robson 2014) and South Canterbury Coastal Streams (Lilburne 2015) limit setting processes and by the Matrix for Good Management (MGM) (Robson et al. 2015).

Soil & Climate

Soil data were obtained primarily from S-map[1] and supplemented by the modified Land Resource Inventory[2] where S-map coverage was incomplete. Soils were classified according to the rules developed by the MGM project (Lilburne & Webb 2015). These rules are based on the water holding capacity of the soil, its drainage class, slope and presence of an impeded layer. The climate layer was clipped from the MGM climate layer (Lilburne & Webb 2015) that is derived from a cluster analysis based on NIWA layers of mean long term rainfall, temperature and potential evapo-transpiration.

Land use

The land use/management layer used in the modelling was based on a land use layer generated according to the methods described in Hill et al. (2012). This approach uses AgriBase™ data (AsureQuality 2016) as the primary source of data, supplemented by the Land Cover Database, Department of Conservation (DOC) conservation estate boundary information, an irrigation layer (Aqualinc 2015), and topographic data.

[1] S-map: http://smap.landcareresearch.co.nz
[2] http://ecansoils.landcareresearch.co.nz

AgriBase™ is the only comprehensive source of property-scale land use data that is available for the region. This dataset is currently supplied to Environment Canterbury every 6 months. Agribase data supplied in April 2016 was used in this project. The AgriBase™ dataset is compiled from a voluntary 5-yearly survey of rural landowners who specify the type and area of all land uses, including crop type and area, type and number of stock.

The DOC estate boundary was obtained from koordinates.com. All conservation land was assumed to be native forest/scrublands/tussock (as there appeared to be no significant grazing concessions in the area). A GIS layer of irrigation was acquired (Aqualinc 2015).

Combining Agribase™, LCDB, the irrigation layer, the DOC estate boundaries, and topographic data as described by Hill et al. (2012) resulted in a draft 'baseline' land use layer (LUWQ), where each farm enterprise has a single numeric code (lu_scen) indicating its main land use, even where there are other, more minor, activities also carried out within the farm.

The draft land use layer was then updated in ascending order of precedence, by ECan's dairy effluent consents database, land use identification from ECan's lifestyle layer, and farm type corrections provided from ECan field work and local farmers.

At the conclusion of these steps a base layer representing current landuse (as at 2016) was generated (Figure 1). This was then used as a base from which to generate land use layers for various scenarios.The land cover database (LCDB4v1), provided by Landcare Research (2015), was used to separate the small amount of land where there was no useful Agribase™ information into unknown agricultural vs non-agricultural land. LCDB is a land cover layer derived from satellite imagery that represents land cover as at 2012/13. An additional class (golf courses) was sourced from topographic data from Land Information New Zealand.

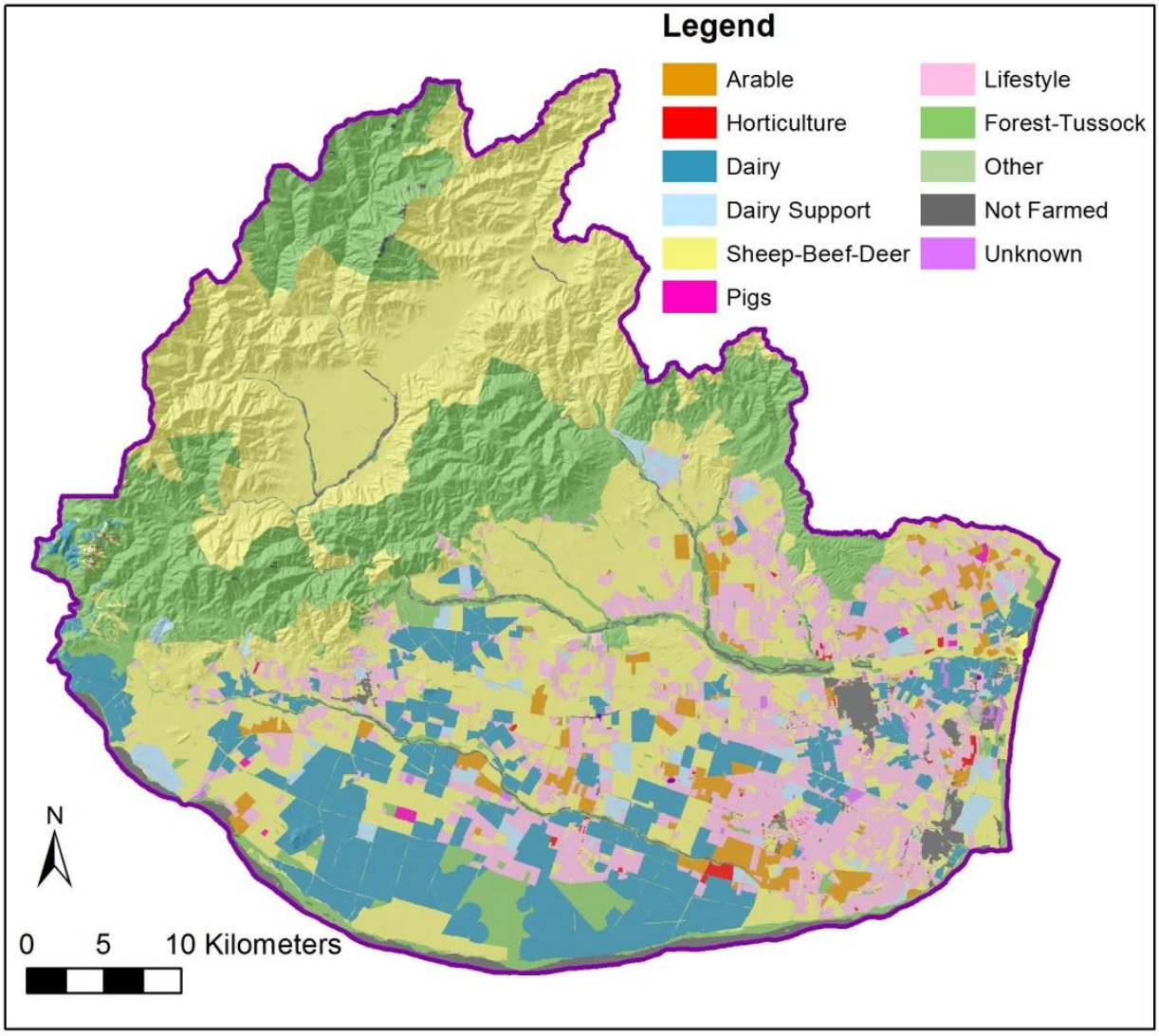

Figure 1 Land use in 2015 ('Current State')

Land use scenarios

A set of scenarios (Table 1) have been developed for the Waimakariri land and water solutions programme. Nitrogen losses below the root zone were estimated for each scenario and subsequently used to make predictions of nitrogen concentration in surface and groundwater.

Table 1: Scenarios used in the Waimakariri Zone modelling

Current State	Land use reflecting farm types in 2015 under good management practice (GMP)
Hindcast	Reflects farm types and nitrate losses from the 1980s
Current pathways	Current landuse and nitrate losses under GMP + the Eyrewell farm is fully developed into irrigated dairy
Alternative pathways: new irrigation	An additional 500 ha of irrigation in the Lees Valley, 3,500 ha in the Loburn area and 8,750 ha on the plains.

N loss rates

A lookup table of nitrate loss rates for the Waimakariri area was derived using a combination of values from the MGM (Robson et al. 2015) and the earlier nitrate lookup table known as the look up table (LUT) Patch (Lilburne et al. 2013) for farm types not covered by MGM (horticulture, forestry, pigs). The MGM values are based on the latest version at the time of preparation of the Overseer Nutrient Budget model (OVERSEER®), in this case version 6.2.2.

Some additional adjustments were made as follows:

- Dryland sheep, beef and deer stocking rates on high producing land were adjusted to better reflect the local situation, using Statistics NZ survey data (2012) for the district. This was done by reconciling the catchment-wide stock numbers from the modelled land use layer to a stock count estimated by projecting the district data from the 2012 Statistics NZ Agricultural Survey to 2016. After converting to revised stock units, the initial sum of sheep, beef and deer numbers, estimated from the Statistics NZ data, was approximately 60% of the sum assumed by the MGM farms chosen for use in modelling the sheep, beef and deer land use.
- N losses from sheep, beef and deer on semi-improved and unimproved land were derived from the MGM regression equations in Snow et al. (2015).
- Average productivity LIC statistics for the district, using milk solids per cow as a metric, were used to determine the ratio of MGM dairy farm types assumed in modelling N losses.
- A stocking rate of 4 RSU/ha was used for lifestyle blocks based on catchment-wide stock units estimated from Statistics NZ data.
- Agricultural farms were separated into effective and ineffective areas where the latter were added to the mask of non agricultural land and assigned low N loss rates.

Two GIS layers are generated for each scenario: nitrate losses (kg/ha), and drainage (mm of water) below the root zone. Masked areas (including urban and non agricultural land) and rural areas with unknown land use are assigned default values of 2 and 21 kg/ha respectively. Dairy loss rates were not available for all climate zones and soils so the N loss rates for the nearest equivalent climate zone/soil were used. Figure 2 shows the estimated N losses below the root zone under the current land use.

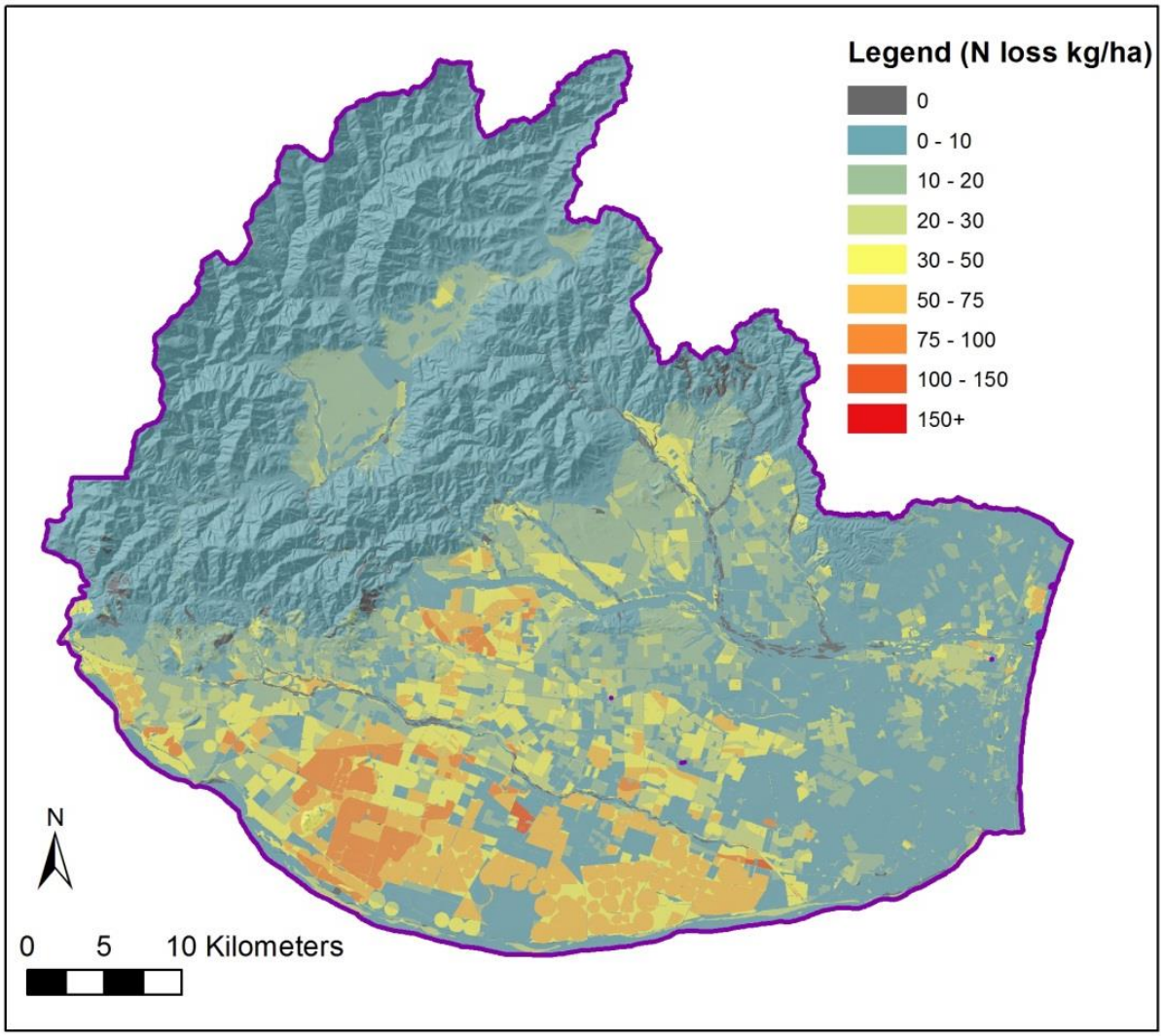

Figure 2 N losses below the root zone under land use in the 'Current State' scenario

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