Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Estimating nitrogen loss from land uses in the hill country of the South Canterbury Coastal Streams (SCCS) area

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1 Background

Environment Canterbury (ECan) and the Lower Waitaki Zone Committee (ZC) have been running a collaborative community process to help decide on water quality and quantity limits for the proposed South Canterbury Coastal Streams (SCCS) sub-chapter of the Land and Water Regional Plan (LWRP). This report has been prepared as part of that process. The report describes work undertaken to help provide estimates of nitrogen (N)-loss from the hill country in the SCCS area.

2 Aims

To estimate typical N-loss OVERSEER® predictions for a representative range of land uses on the South Canterbury hill country in order to provide estimates of N-loss for land use and soil combinations not already covered by the existing N-loss look-up tables (i.e. Lilburne *et al.,* 2013).

3 Methods

This study was focussed solely on the area of hill country in the SCCS area not covered by S-map[1] and which therefore was not covered by N-loss estimates provided in Lilburne *et al.,* (2013). The area not covered by S-map is shown in Figure 3-1 as the area under the soil classes defined as Hurunui (yellow), Kakahu (brown) and Class 7 (dark orange), these being the three 'hill country' soil classes defined for the purpose of this work (see later explanation). The remaining soil classes shown in Figure 3-1 are from S-map.

[1] S-map is the new national soils database provided on-line by Landcare Research Ltd http://smap.landcareresearch.co.nz/home

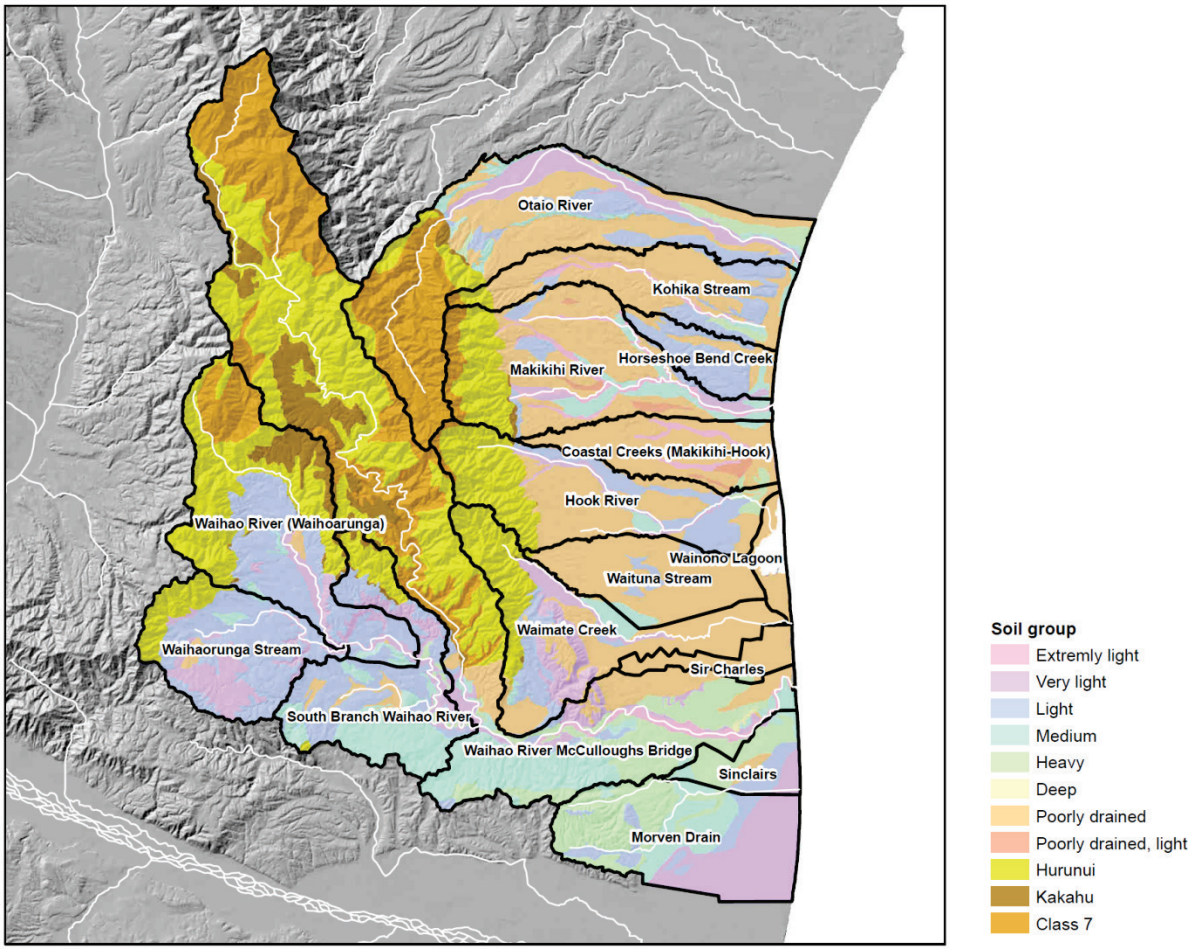

Figure 3-1: Soil classes defined for the SCCS area

Several key principles were followed during the method:

a. Avoiding duplication and building on work previously carried out;
b. Developing a consensus view;
c. Ground-truthing; and
d. Ensuring results are technically defensible.

3.1 Avoiding duplication and building on work previously carried out

Where information had been generated for other aspects of the project this was adopted and cross-referenced. This was particularly relevant to information on land use, soils and rainfall[2].

A number of OVERSEER® nutrient budgets have been prepared in the Upper Waihao catchment and surrounding area by Dan Laming[3] and Nicole Philips[4] and both have been generous in sharing the

[2] Spatial distribution and areas of current land use and soils was provided by Linda Lilburn and Trevor Webb of Landcare Research. Rainfall data was provided by Linda Lilburne. The derivation of all this data is described in Lilburne (2015)
[3] Account Manager, Ravensdown.
[4] Local farmer and Consultant with Irricon.

knowledge they have gained from this as well as reviewing budgets prepared specifically for this study.

Peter Bell, a farmer who owns property within the study area, provided a copy of his nutrient budget for his total farm system.

3.2 Developing a consensus view

Pivotal to the development of a consensus view is the need for full transparency of all information used.

Secondly and of equal importance is the need to involve all parties with an interest in the information used to inform decisions.

The use of virtual farms overcomes issues of confidentiality, enabling full transparency. It also overcomes one of the major challenges when using information from actual farms, namely the extent to which these represent other farms within the catchment.

Virtual farms can be sized and located to best represent the mix of land use, management practices, soils and climate within a catchment. They can incorporate feedback from interested parties and demonstrate sensitivity to various changes in inputs. This occurred at the meeting described in the next section.

Information on soils and land use was used to generate a virtual farm system which was confirmed in subsequent exchanges with Dan Laming and Nicole Philips.

3.3 Ground truthing

Local farmers and rural professionals were invited to a meeting at the Arno Hall on 12 March 2014. Invitees included those invited to a series of meetings held to inform discussion and decisions on the relative on-farm costs and effectiveness of various on-farm N-loss mitigation measures reported separately (Fietje 2014).

This group was also asked to recommend other farmers who may be interested and this resulted in invitations extended to a number of other farmers and rural professionals.

This meeting was helpful in ensuring inputs into OVERSEER® such as crop type and yields, stock type and ratios, production, relative pasture growth rates and fertiliser etc. was appropriate for the area represented.

A ground (vehicle) inspection of the Upper Waihao catchment was undertaken on 31 March 2014 with Meredith Macdonald[5].

The North Branch was inspected from two entry points, one from the Hakataramea Valley via Menzies Road (Figure 3-2), the other from Kaiwarua and Old Kaiwarua Roads providing access to the lower parts of the North Branch (Figure 3-3).

[5] Senior Planner, Environment Canterbury.

Figure 3-2: Upper North Branch Waihao Catchment

Figure 3-3: Lower North Branch Waihao Catchment

The South Branch was inspected from Meyers Pass Road travelling from the Hakataramea Valley, through to its intersection with Pentland Hills Road (Figure 3-4).

Figure 3-4: South Branch Waihao Catchment

This inspection enabled ground-truthing and familiarity with the soil and land use information used in the OVERSEER® model.

3.4 Ensuring results are technically defensible

Nutrient budgets were prepared using the on-line (internet) version 6.03 of OVERSEER®. At the time of preparing the budgets the OVERSEER® owners had published a set of input standards[6] which were followed, with the exception of soil parameters which were provided by Trevor Webb to ensure the Available Water Holding Capacity (AWHC) matched that expected for each of the three soils used (see Figure 3-1).

The nutrient budget was reviewed by Dan Laming and Nicole Philips and they together with Martin O'Connor provided valuable comment to ensure results were representative and repeatable.

[6] OVERSEER® Best Practice Data Input Standards Version 6.1 August 2013.

4 Results

The meeting held on 12th March was very helpful in achieving agreement on a number of key inputs for the representative virtual farm system. Key inputs agreed to are as follows:

- Stock ratio = 50/48/2 for sheep, cattle and deer
- Overall stocking rate using assumed ratios of soils = 5.4
- Calving % = 90, default growth rate
- Lambing % = 130
- Mean lambing date = 15 September
- Mean weaning of lambs = 7 December @ 29 kg mean weight
- Rear own replacements – 25% for cattle, 33% for ewes
- Wool production = 3.4 kg/RSU
- All stock sold finished (or as culls)

Sensitivity testing of the above demonstrated that N- loss results were fairly insensitive to many of the above inputs individually, largely because the N-loss numbers are so low.

The meeting identified three distinct 'groups' of soil and associated production ratios, namely:

- Soils on the lower slopes under 15°, able to be cultivated and with a production ratio of 1.0 and dry-matter production of ~ 7 tonnes/ha/annum;
- Soils on the hills, steeper than 15° with a production ratio of 0.6; and
- Soils on the steeper hills subject to erosion, with a production ratio of 0.2 to 0.3.

Following the meeting, advice was received from Linda Lilburne and Trevor Webb that the soils associated with each of the above groups could be represented by (see also Figure 3-1):

- Soils on the lower slopes under 15° – Kakahu
- Soils on the hills, steeper than 15° – Hurunui
- Soils on the steeper hills subject to erosion – Class 7

The above information was used to configure and populate blocks within OVERSEER®.

The OVERSEER® model calculated the AWHC for each of the above as:

- Kakahu – 98 mm
- Hurunui – 89 mm; and
- Class 7 – 91 mm

Following discussion with Trevor Webb and Linda Lilburne the following soil properties were inserted into the OVERSEER® model resulting in the AWHC shown in brackets:

- Kakahu (98 mm)

Order:	Brown
Topsoil texture:	Silt loam
Is Stony?	False
Lower profile texture	Medium
Non-standard layer:	--

- Hurunui (76 mm)

Order:	Brown
Topsoil texture:	Silt loam
Is Stony?	True
Lower profile texture	Medium
Non-standard layer:	Stony matrix (0.1-0.2 depth)

- Class 7 (55 mm)

Order:	Brown
Topsoil texture:	Silt loam
Is Stony?	True
Lower profile texture	Medium
Non-standard layer:	Stony (0.2-0.4 depth)

Given the range of rainfall found within the catchment, three model runs with different rainfall were completed for each of the above three soils, resulting in a total 9 model runs. This was extended to 12 model runs when the Kakahu soils were separately modelled for both pasture and crop (kale).

Table 4-1 sets out the results of the model runs completed using the above inputs.

Table 4-1: Estimates of N loss for the model farm using OVERSEER®

Soil	Cover	Rainfall mm/annum	N Loss kg N/ha/annum	Drainage mm/annum	Runoff mm/annum
Kakahu	Pasture	700	7.0	118	20
Kakahu	Pasture	800	8.7	168	28
Kakahu	Pasture	900	9.2	216	42
Kakahu	Kale	700	36.4	169	0
Kakahu	Kale	800	53.4	246	0
Kakahu	Kale	900	63.8	327	0
Hurunui	Pasture	700	5.2	96	67
Hurunui	Pasture	800	5.5	122	98
Hurunui	Pasture	900	5.9	151	131
Class 7	Pasture	700	4.3	111	66
Class 7	Pasture	800	4.5	140	97
Class 7	Pasture	900	4.7	174	130

5 Conclusions

Information from farmers, rural professionals and Landcare Research was used to generate a farm system representative of the land use and farm systems found within the Upper Waihao catchment. This information and the representative farm system were assumed to also be relevant for the hill country in other catchments in the SCCS area (see Figure 3-1).

The OVERSEER® model was used to generate estimates of N loss under two crop types, three soil types and three rainfall zones as set out in Table 4-1.

The results have thus provided estimates of N-loss for land use and soil combinations that were not already covered by the existing Canterbury N-loss look-up tables at the time (i.e., Lilburne *et al.,* 2013). The results have been incorporated into a revised "SCCS-customised" look-up table that is reported by Lilburne (2015).

The results have been used to help calculate estimates for the total catchment and sub-catchment N loads under current and future scenarios in the SCCS area, as reported by Lilburne (2015).

6 References

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7 Acknowledgements

My thanks goes to the farmers who gave willingly of their time and talents to attend the meeting held to ground-truth and provide information used to populate the nutrient and financial budgets. I particularly want to thank Peter Bell for his generosity in providing the nutrient budget prepared for his property.

I also want to acknowledge the contribution of Dan Laming and Martin O'Connor from Ravensdown for their helpful comments and review of information used to populate the nutrient budget.

Nicole Philips, consultant and farmer in an adjacent catchment to the west was immensely helpful in reviewing the budget and sharing her knowledge of local soils, climate and farm practices.

My thanks to Meredith Macdonald for accompanying me on a ground survey of both the North and South Catchments of the Upper Waihao.

Finally I want to thank Ned Norton for his guidance throughout the process and especially during the write-up and very helpful review comments. I also want to thank Ian Brown for his review comments.

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