Technical note

Project:	TANK Plan Change 9
To:	Mary-Anne Baker
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Date:	14-4-2021
Subject:	**LAND USE CHANGE**
Reviewed by:	

1. Purpose of this technical note

To provide supporting evidence for the proposed change of approach to the thresholds for land use change to trigger regulatory management action within TANK catchments.

2. Technical assessment

The need for a threshold for land use change

Intensification of land use represents a risk to water quality, particularly in relation to increased N losses.

There is a wide range of N losses within any land use category. The range in losses are due to both inherent biophysical factors such as soils and climate and variable factors such as management.

While management changes can mitigate or reduce nutrient losses within a farm system, changes in land use within areas with similar climate and soils represent a risk of a step change in nutrient loss. Where such changes may occur there is a need to establish a threshold for action, where the likely impact on water quality and potential mitigations at a property scale can be assessed further.

Use of models to set thresholds for regulating for land use change

There are challenges in using models to identify when thresholds of nutrient loss have been crossed. In its current form the rules may be unimplementable, particularly in situations where enforcement action is required. It is a complex and difficult framework to clearly communicate to farmers. It would also involve a high time cost to determine who needs consent and to request and interpret nutrient budget analyses. It also relies on farmers understanding and self-reporting their need for consent.

The use of absolute N loss numbers from models to determine compliance is problematic. Several reports have outlined reasons against this approach when using Overseer within policy. Willis 2018 is a particularly good summary. Overseer Ltd does not support the use of modelled output numbers in that way. This is due to the modelled outputs not necessarily representing the exact amount of N leached from the property and the difficulty dealing with Overseer version changes when absolute

*numbers are used. Use of absolute numbers as a "pass or fail test" also creates significant risks when compliance and enforcement are required and where it may be "difficult to justify and to enforce when legal tests of proof are applied" (*Willis 2018).

Threshold numbers in Table 2 of Schedule 29 of the TANK plan change are also less that the margin of uncertainty for any property N loss output from Overseer eg. A 100ha property leaching 25kgN/ha = 2500kgN @ ~ 30%[1] uncertainty is 750kgN/ha. A level of precision of the order outlined in the schedule is not possible.

A further layer of complexity in the use of absolute numbers is that models such as Overseer are updated and refined as research knowledge and technology improves. This issue of model version changes means the same farm system may have different model output numbers between different model versions.

Implementing a methodology to deal with updating these numbers as model version changes occur would require clear documentation on the origins, methodology and assumptions used to produce the numbers in the table. This is a well-documented issue of complexity with plans in other parts of the country. Those approaches require significant resourcing for nutrient accounting. An alternative methodology for setting a threshold for consent could avoid those pitfalls.

The Section 32 report considered some alternatives pp 138 – 141 and described a number of fundamental flaws in relation to each of them.

In the interim, new national provisions (the Resource Management (National Environmental Standards for Freshwater) Regulations 2020) were introduced as interim measures to prevent on-going land use change that resulted in increasing contaminant losses.

The national regulations presented a much less complex approach that referred to land use systems rather than adopting complex modelling solutions.

The following framework adopts a similar approach.

Recommended alternative approach

Schedule 29 could be replaced with a simpler and less confusing framework which avoids the use of absolute N loss numbers for compliance purposes and is clear to communicate to farmers when a trigger to require consent is reached.

This alternative approach is the grouping of landuse categories into similar bands of N loss to determine a change in the use of a property which has a substantial effect on N loss. A shift from any of these primary activities to a higher leaching activity category ie. a move up the table (shown below) to a higher N leaching band, would trigger the need for a consent.

A threshold increase of more than 10ha irrigated land would also trigger a need for consent. This is a simple and consistent approach for all farmers. It picks up the changes that present a significant step-change risk of increased N loss.

Landuse categories and levels are as follows:

Table 1.

Level	Landuse type*	Incorporating	N Leaching range / risk
1.	Commercial Vegetable growing	Vegetable growing for human consumption	High leaching
2.	Winter forage cropping	Forage crops for animal feed eg. Brassicas	
3.	Dairy or arable	Dairy cows, cereal cropping and bulb production	
4.	Sheep and/or beef	Sheep, Beef, Deer, goats	
5.	Horticulture	Perennial crops intended for food or beverage production for human consumption eg. kiwifruit, pipfruit, stone fruit, summer fruit/berries, grapes.	
6.	Other/ Forestry	Forestry	Low leaching

- *In addition, any change from non-irrigated to irrigated land.

RMA Landuse definitions are included in Appendix 1. for comparison.

The change to a threshold increase for new irrigation of 10ha per property is simple and consistent with the approach to other landuse change and NES 2020 approach.

The NES 2020 has adopted a similar approach with controls on intensification of more than 10ha of land changing from forestry to pastoral or pastoral use to dairy or an increase in irrigated area of more than 10ha. There are also controls on any increase to the maximum area in winter forage crop beyond that cropped in the reference years of 2014 to 2019. These intensification controls are in place until the end of 2024. The NES basis for assessing intensification is related to land use rather than modelled N losses.

The change in land use area especially in circumstances where there is crop rotation for productivity and disease control will consider the 10 hectares in relation to the total enterprise area. This allows for changes to the location of the cropped land from time to time, including the changes in leased areas.

An area (ha) threshold per property rather than a percentage threshold has been recommended particularly for winter forage cropping as a 10% change in land use across a catchment could result in a large increase in N load to water. As an example, a catchment covering 10,000ha could be permitted to collectively increase winter forage crop area by 1000ha. That could increase catchment N load by up to 60T depending on assumptions used.

Science behind representative loss rates

Monaghan et al. (2010) summarised the potential for nitrogen, phosphorous and sediment loss from different land uses in the Southland region. The data utilised to rank each land use according to their risk to water quality comes from around the country, including studies undertaken in Southland. This study, coupled with a previous review undertaken by Meneer et al. (2004) for the Bay of Plenty Regional Council, reveals a consistent risk ranking of contaminant losses from different land use types. Of the land use systems considered, the potential for causing nitrate leaching typically follows this order: vegetable cropping > cattle winter grazing > dairy farming > arable > mixed cropping > sheep/beef/deer farming > forestry. Within the sheep/beef/deer land use type, losses from sheep are generally the lowest.

(From Ledgard 2013)

Table 2.

Summary of researched N losses from different land uses in New Zealand covering a range of fertiliser N inputs.

Land use type	N leaching loss (kg N ha^{-1} yr^{-1})		References
	Range	Mean	
Market gardening	80–292	177	Williams et al. (2003); Francis et al. (1992 ; 2003).
Dairy pasture	15–115	65	Ledgard et al. (1999, 2000 and unpublished research); Roach et al. (2001); Steele et al. (1984); Monaghan et al. 2000); Silva et al. (1999).
Mixed cropping or arable farming	35–110	61	Francis et al. (1994; 1995); Adams and Pattinson (1985); Ludecke and Tham (1971).
Orcharding	50[a]	50[a]	Ledgard et al. (1992).
Sheep	6–66	21	Brock et al. (1990); Ruz-Jerez et al. (1995); Heng et al. (1991); Magesan et al. (1994, 1996); Burden (1980).
Forestry	3–28	3[b]	Parfitt et al. (1997, 2002, 2003); Magesan et al. (1998).

[a]Single study with Kiwifruit.

[b]Best estimate for undisturbed exotic forestry.

From Meneer et al. 2004

References to four articles that include consistent ranking of N loss rates across land-use categories are included in the reference list at the end of this document. A similar table and land-use N loss ranking is included in the section 32 report (table 6) from SOURCE model results.

Practicality of Implementation

In contrast with a modelled numerical output approach, all the landuse changes in the table above could potentially be detected via analysis of satellite imagery or through Agribase to provide initial

priorities for compliance checks. The rule could require registration of Landuse with Council (simple online form) before a certain date and/or provision of land use information upon request. This would be an easier, less costly alternative to create an initial base layer of information.

Greater clarity and simplicity aid effectiveness of implementation and compliance follow up and action when required.

Alternative approaches using Overseer or another approved model

Alternative approaches which use Overseer in a way that avoids use of absolute numbers and address version change issues are possible.
That would involve examining the farm system relativity between a baseline year and the present. Compared with the recommended alternative, this is a much less preferred approach to the first option. Reasons for this include:

- Greater complexity to understand and communicate.
- It would involve a large cost to resource, which would not be directly chargeable and would need to be funded through general rates or a targeted rate for the catchment.
- Administration costs would include nutrient accounting to update files and records as farm boundaries and ownership changes and as the model changes to incorporate new farm system activities.
- Many of the land uses on the Heretaunga Plains cannot use Overseer well eg grapes.
- It would tie a lot of resource to involvement with low risk, low leaching activities

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Appendix 1. RMA Landuse Definitions

a. **arable land use** means the use of land to grow any of the following crops for harvest: (a)grain cereal, legumes, or pulse grain:(b) herbage seed:(c) oilseed:(d) maize grain, maize silage, cereal silage, or mangels:(e) crops grown for seed multiplication:(f) a crop prescribed in regulations made under section 217M(1)(a)

b. **farm** means a farm where all or part of the farm is—
(a) arable land use; or(b)horticultural land use; or(c) pastoral land use; or
(d) other agricultural land use prescribed in regulations made under section 217M(1)(b); or (e) any combination of the above

c. **farm operator** means the person with ultimate responsibility for the operation of a farm.

d. **horticultural land use** means the use of land to grow food or beverage crops for human consumption (other than arable crops), or flowers for commercial supply.

e. **pastoral land use** means the use of land for the grazing of livestock.