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Karen Wilson
Team Leader Science, Strategy and Design
Environment Southland
By Email

Dear Karen,

Re: DairyNZ Feedback to ES: Science Stakeholder Review, Limit-setting

Thank you for the opportunity to provide technical feedback, as part of the Science Stakeholder Group, on the science reports developed to inform limit-setting in Southland to date and listed in Appendix 1. We commend ES for its initiative in establishing the Science Stakeholder Group, and the well-run question and answer sessions to explain the approach taken, highlight assumptions and gaps and to agree to work with science stakeholders to reduce modelling uncertainties as far as possible.

As previously discussed, we would appreciate a written response to this feedback in due course. DairyNZ gives permission for this feedback to be circulated to other stakeholders.

Key early messages from Contaminant Loads Modelling for ES Executive, September 2020

We note the messages communicated in this document to the council executive.
DairyNZ has appreciated the recent opportunity to discuss communication of these early findings (particularly timing) to dairy farmers as part of a broader conversation on communication and engagement with farmers. The challenge is to build understanding and engagement with farmers in a way that empowers farmers to participate and bring their voice into the limit-setting process rather than in a way that is overwhelming.

We support ES's approach of giving the community a 'heads up' of changes coming, rather than presenting the extent of these changes as a done deal, particularly while the technical review by members of the Science Stakeholder Group has been in process.

We suggest that the matter of timeframes for achieving freshwater objectives is one that needs broad community input. The transition time for change is a key consideration that affects the individuals making that change, as well as the broader Southland community. It is important that these individuals and communities are given an opportunity to be part of the discussion on what is an appropriate timeframe for change.

Contaminant Limits- Regional modelling framework- Nutrient Reductions

There are multiple drivers of periphyton biomass in rivers which presents many challenges when trying to predict periphyton growth in response to nutrient concentrations. We note that there have been a number of recent attempts to model and determine drivers of periphyton biomass using both national and regional data sets (e.g. Larned et al 2015 and Kilroy et al 2019). This work has often concluded that it is difficult to tease out strong relationships, that there are large uncertainties and they have recommended using data sets from different spatial scales than what were used (i.e. if the authors used regional data sets, they recommended national data sets).

In light of this, we acknowledge the difficulties in trying to define nutrient thresholds given the uncertainty and multiple drivers of periphyton biomass.

Consequently, we do not wish to debate the fundamental mechanics of this modelling approach. Instead we would like to see additional analysis conducted to help quantify the modelling error and additional relevant sense checking of the modelled outputs with measured data.

The biggest concern we have is what the modelling results from Snelder (2020) with respect to periphyton freshwater objectives is suggesting compared to measured data presented by Wilson and Norton (2020). Specifically, the Snelder report predicts that 22 out of the 29 monitoring sites exceed the national bottom line for periphyton. But based on the work of Wilson and Norton (2020), only two site exceeds the national bottom line if the Waiau at Tuatapere is excluded due to the influence of Didymo. This suggests the modelling approach used by Snelder (2000) is conservative.

An additional point to highlight is that the attenuation coefficient (factor) used in catchment load modelling can affect the relative efficiency of mitigations. High attenuation means that a high portion of the load generated within a sub-catchment won’t reach the outlet, but load reductions achieved through mitigations will be similarly attenuated. When attenuation factors vary significantly across sub-catchments, they will impact the optimal distribution of load reductions across sub-catchments. In other words, it might be more effective to strive for higher load reductions in sub-catchments with lower attenuation. Obviously this will also depend on the magnitude of the loads generated within each sub-catchment, but the point is to make clear what role attenuation will play when mitigation scenarios will be evaluated against each other. The catchment modelling report does state that uncertainty needs to be borne in mind when using the models for decision making.

The report states that at some of the water quality monitoring sites, no measured flows were available. For those sites, modelled flows have been used to estimate the N and P loads. Since the estimated loads directly impact the attenuation coefficients, it would be useful to have the report list the sites for which no measured flows were available.

Therefore, we make the following recommendations for additional analysis that can enhance the Regional Forum’s discussions:

1) Some insight in the implications of uncertainty around attenuation could be covered in the forthcoming scenario modelling report. Additionally, it would be useful to have the report list the sites for which no measured flows were available.

2) Conduct a sensitivity analysis of the nutrient-periphyton model using the periphyton and water chemistry data collected by Environment Southland. A sensitivity analysis will show how the variable the results could be, based on the data inputs.

3) Re-do the Snelder (2020) analysis by removing periphyton estimates for lowland soft bottom streams. Soft bottom streams are regarded as not having suitable substrate to support nuisance levels of periphyton. We have not read any justification in relevant reports that highlight nuisance periphyton issues in soft bottomed waterways.

4) Repeat the analysis by considering a 30% exceedance risk criteria[1] (the work in Snelder (2020) considered a 20% exceedance risk criteria). We understand that the nutrient criteria for the 30% exceedance risk criteria based on another Snelder report that developed the method used in Snelder (2020) are on average 2.7 times higher than the 20% exceedance risk criteria.

5) Present a summary table showing:
- the current periphyton state for sites with monthly periphyton sampling sites and sites where there is just annual data (and assume that these annual sites are broadly representative of maximum accrual);
- Current state for nitrogen and phosphorus for each site with periphyton data
- The predicted nitrogen and phosphorus limit ranges for the different periphyton attribute states depending on the current periphyton state.

6) Clarify the language of 'nitrogen criteria'. We understand that these criteria are effectively guidance values. They are not necessarily tipping points nor are they necessarily reductions to achieve periphyton objectives. There is a risk that this could become confusing during the inevitable conversation about reducing nutrient levels to achieve periphyton outcomes.

7) Utilize the 2018 Ministry for Environment guidance on the periphyton attribute whereby hard-bottom rivers meeting the relevant periphyton objective, current nutrient state should be an acceptable limit.

8) Once the above recommendations have been completed, quantify the uncertainty within all data sets and provide a document that can explain the uncertainty within the results and conclusions can be strongly made and what conclusions are less certain and the implications this can have on planning frameworks. For example, when there are high degrees of uncertainty a more adaptive planning framework may be warranted.

We acknowledge the *National Policy Statement for Freshwater Management 2020* (NPS) directive on dealing with uncertainty in limit-setting. Namely, that the presence of uncertainty is not a reason not to act. However, we also agree with the statement in 'Key early messages for ES executive, *'The estimated nutrient and sediment load reductions should not be viewed as automatically appropriate limits for regional planning without further consideration.'*

Deriving average N & P loads from a diverse range of studies
Dr Graeme Doole has provided some comments following a technical review of the methodology applied in the *Nitrogen and phosphorus losses to water from agricultural land uses in Murihuku* report by Rodway (2020). ES and DairyNZ are currently working together to address data gaps identified during recent conversations. The following comments will no longer be relevant providing these data gaps are resolved.

[1] Exceedance risk criteria: The probability that sites exceed the periphyton criteria.

Technical review of the document of Rodway (2020)
Dr Graeme Doole (Principal Economist, DairyNZ)

Thank for the opportunity to provide feedback on the report of Rodway (2020), entitled Nitrogen and phosphorus losses to water from agricultural land uses in Murihuku.

In my professional opinion, the methodology that has been applied to the dairy sector in this report should not be used to inform the Southland Regional Forum and freshwater objective and limit setting process in Southland.

Average values of nitrogen (N) and phosphorus (P) loss have been computed from a range of studies. These studies are Kaye-Blake et al. (2013), Muirhead (2013), Ledgard et al. (2014), Moran et al. (2017), Bright et al. (2018), and Srinivasan et al. (2020).

The methods used to estimate N and P loss across all of these studies are very diverse. Kaye-Blake et al. (2013) use synthetic scenarios and an old Overseer version in a single year, while Ledgard (2014) collated losses from various sources measured across 2005-13. Moran et al. (2017) based models on representative farms using a 2015 version of Overseer. Overseer loss estimates from Srinivasan et al. (2020) rely on a more limited number of farm typologies and a different version of Overseer again, while the N loss model of Bright et al. (2018) has an unclear relationship with Overseer. The nutrient losses computed from these studies are not directly comparable, given the different methodologies—including both the process of estimation, generation of case-study farms, and model versions—that have been used to estimate them.

Taking the mean value from a set of such diverse studies is invalid statistically given that the studies are not directly comparable. Even if such studies were able to be compared, it would be standard to weight them according to their relative precision (Cooper et al., 2019), rather than weighting them equally as has been done in this Rodway (2020). The key source of uncertainty here is the different models, including several versions of OVERSEER, that have been used to estimate N and P loss across the set of analyses (see Section 2, Rodway (2020)). This is particularly an issue because the most recent version of Overseer is that which is judged most appropriate by the developers of the software.

The implication of using the average values from Rodway (2020) is that they provide a distorted picture of the baseline dairy losses of N and P across the region. This has two major effects:

1. It will affect estimated nutrient loads at the sub-catchment and catchment scales. This will distort the quality of information pertaining to groundwater lags, attenuation, and the benefits of mitigation for water-quality outcomes.
2. A change in the estimate of baseline losses affects how much nitrogen a dairy farm has to abate and the actions it takes to do so. Thus, such a change affects the abatement-cost curves for these businesses. The use of mean values that are inconsistent with existing abatement-cost curves makes it necessary to identify appropriate relationships, creating additional work.

It is particularly important to avoid such distortion in the average nutrient losses given the significance of dairy production to the Southland economy (Dorigo and Ballingal, 2020) and the size of the reductions in nitrogen loss that are being discussed. An additional motivation to ensure these means are credibly determined is that they are being relied upon to efficiently describe losses from a large number of farms.

In my view, the preferable and standard approach would be to employ losses of N and P from a single study that uses a consistent methodology. In my assessment, that utilised by Moran et al. (2017) is likely the best source of information for dairy farms in the region. It utilises older estimates of N and P loss, given the use of an OVERSEER version from 2015. Yet, the abatement-cost curves employed within the Southland Economic Model are all consistent with these baseline levels of nutrient loss. Their use would avoid having to re-estimate abatement-cost curves for the different dairy farms studied therein, making the economic impacts of nutrient losses much easier to assess in the Southland region.

Once again, DairyNZ appreciates the opportunity to review the technical reports provided, and to work with ES to reduce uncertainty where possible. Alternatively, to acknowledge and quantify this uncertainty, and to provide for it in the planning framework as a new plan change is developed for the Southland Region.

Please do not hesitate to get in contact should you wish to discuss any of the matters raised in this feedback.

Many thanks

Charlotte Wright
Senior Policy Advisor
DairyNZ

Appendix 1

Reports reviewed

- Wilson, K. & Norton, N. *Key early messages from contaminant loads modelling for ES executive*
- Cox, T., Kerr, T., Snelder, T. Rodway, E., Wilson, K. 2020. *Southland Region Catchment Nutrient Models.*
- Plew, D. 2020. *Models for Evaluating Impacts of Nutrient & Sediment Loads to Southland Estuaries*
- Snelder, T. 2020 *Assessment of Nutrient Load Reductions to Achieve Freshwater Objectives in the Rivers, Lakes and Estuaries of Southland*
- Norton, N., Wilson, K., Roberts, K., Ward, N., Rodway, E., O'Connell-Milne, S., DeSilva, N., Hodson, R., Greer, M. 2019. *Current Environmental State and the "Gap" to Draft Freshwater Objectives for Southland.*
- Norton, N. & Wilson, K. 2019. *Developing Draft Freshwater Objectives for Southland*
- Wilson, K., McLachlan, S., & Norton, N. 2019. *Community values for Southlands FMUs*
- Rodway, 2020. *Nitrogen & Phosphorus Losses to Water from Agricultural Land Uses in Murihiku.* In draft.

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- Cooper, H., Hedges, L.V., and Valentine, J.C. (eds.) (2019). The handbook of research synthesis and meta-analysis, Russell Sage, New York.
- Dorigo, E., and Ballingal, J. (2020). Dairy's economic contribution, Sense Partners, Wellington.
- Kaye-Blake, W., Schilling, C., Monaghan, R., Vibart, R., Dennis, S. and Post, E., 2014. The economic impacts of nutrient policy options in Southland, AERU, Lincoln University.
- Ledgard, G., 2014. An inventory of nitrogen and phosphorous losses from rural land uses in the Southland region. Nutrient management for the farm, catchment, and community. Occasional Report, Environment Southland, Invercargill.
- Moran, E., Pearson, L., Couldrey, M. and Eyre, K. (2017) (edited 2019). The Southland economic project: agriculture and forestry (No. 2017-02), Environment Southland Technical report, Invercargill.
- Muirhead, R.W. (2013). Science summary and Overseer® analysis of the Waituna catchment. AgResearch Internal report RE500/2013/074, Invermay.
- Rodway, E. (2020). Nitrogen and phosphorus losses to water from agricultural land uses in Murihuku, Environment Southland, Invercargill.
- Srinivasan, M.S., Muirhead, R.W., Singh, S.K., Monaghan, R.M., Stenger, R., Close, M.E., Manderson, A., Drewry, J.J., Smith, L.C., Selbie, D. and Hodson, R. (2020). Development of a national-scale framework to characterise transfers of N, P and Escherichia coli from land to water, New Zealand Journal of Agricultural Research 63, 1-28.