New Zealand Greenhouse Gas Inventory
Approval for change to emission factor, parameter or methodology

Reviewer	Tom Misselbrook
Date of review	08/11/2015

Inventory sector[1]	Agriculture
Name of EF, variable or category	EF3 for sheep, beef and deer
Current value of emission factor, variable or methodology Tier	Urine 0.01 Dung 0.0025
Suggested value of emission factor, variable or methodology Tier	Disaggregate by livestock type and land slope class: Beef and Deer, low slope Urine 0.0099 Dung 0.0021 Beef and Deer, medium and high slope Urine 0.0032 Dung 0.0006 Sheep, low slope Urine 0.0055 Dung 0.0011 Sheep, medium and high slope Urine 0.0016 Dung 0.0011
Use from year (start year)	**1990**
Recommend that a change to the new value or methodology is approved	Yes (Although further work to refine the revised estimate is recommended – see below)

Please comment on whether the supporting review or report sufficiently covers the following topics and provides adequate justification for a change.

	Yes/no	**Comment**
Is the need for a change well documented?	Yes	There is clear evidence from Kelliher et al. (2014) for the use of a lower EF3 on hill slope land than on lowland. Combining these revised EF with survey data on the distribution of livestock types and observational data on excreta distribution across the different slope

[1] Energy, Industrial Processes, Solvents, Agriculture, LUCF, Waste

		classes results in a substantial change to the estimate of N2O emissions from this source. A more detailed approach is therefore justified.
Is the proposed change scientifically defensible?	Yes	The hypothesis of a tighter N cycle, resulting in lower N2O emissions, for medium and high compared to low slope areas because of limited fertility and soil moisture has a sound underlying theoretical basis which is supported by the empirical evidence presented. However, the proposed revised values for EF3, while representing the best currently available evidence, are based on relatively few observations – the sheep urine lowland EF is based on just 4 observations and Kelliher et al. (2014) note that the lowland EF for urine for dairy, beef and sheep were not significantly different. Similarly, those for dairy, beef and sheep dung for lowland were not significantly different. It is unclear why the observations for lowland and hill 'low slope' were not combined for sheep urine and dung to increase the number of observations. The EF values for beef urine (low and medium slope) are also based on only 4 observations each. Kelliher et al. (2014) also note that the EF for medium slope sheep and beef urine were not significantly different. More observations for beef and sheep across the different slope classifications would therefore be good to provide more robust estimates for the disaggregated EF. The urine and dung allocations to the different slope classes are also based on relatively few data. Observations are from 2 sites and relate to dung rather than urine. Observations are for sheep and are assumed to apply equally to cattle and deer. Again, further data for sheep and beef across more sites are recommended to provide more robust disaggregation parameters. The model for nutrient allocation (Table 5

		in the Saggar et al. 2015 paper) is perhaps a bit arbitrary in the choice of break-points for example and does (as acknowledged) result in step changes. Would it be possible to fit a continuous function to the data?
Has any documentation been peer-reviewed or published?	Yes	The effect of land slope on EF3 is described by Kelliher et al. (*Environmental Pollution* - 2014) and the derivation of proposed revised EF3 values and the more detailed approach to estimate emissions from this source are described by Saggar et al. (*Agriculture Ecosystems and Environment* – 2015). These are peer-reviewed journals well respected by the scientific establishment. Kelliher et al. cite the source of the experimental data from which their table of EF vs. land slope was derived – these data were derived using accepted field experimental techniques.
Is the proposed methodology, EF or variable consistent with IPCC GPG?	Yes	IPCC GPG clearly states that parties should use a more detailed approach including empirically-derived or modelled EF where observational/experimental evidence exists and where country-specific activity data allow for scaling up. A conservative approach has been taken e.g. in the selection of the higher values for slope EF and use of beef rather than sheep as proxy for deer.
Is any new EF, variable or methodology comparable with any other countries?	No	Other countries are moving to disaggregated EF3 according to excreta type (i.e. Dung and Urine) but I have no knowledge of any other country disaggregating EF3 according to land slope classification. As stated by Saggar et al. (2015), this more detailed approach could be appropriate for a number of countries where grazing is an important emission source and lowland and upland situations exist, so this may be a model example for other countries to follow.
Is the level of uncertainty reported?	No	This is a major weakness of the current reports. As mentioned above, some of the EF and other required parameters are based on few observations.

		Uncertainties in these need to be quantified and a sensitivity analysis conducted to assess which parameters have the most influence on the emission estimate and might benefit from additional measurements.
Is there a comparison with IPCC default emission factors, variables or Tier 1 methodology	Yes	A time series of the effect of the proposed revisions from 1990 to 2012 is provided.