

Overseer Model Update to 6.5.13

Full Impact Assessment

2026-05-14

Introduction

This release introduces two major new features and resolves two identified modelling issues within Overseer. These updates improve the representation of real farming practices, strengthen the consistency of nutrient and emission calculations, and increase transparency in model outputs.

Following this release, some users may observe small changes in modelled nitrogen (N) losses, phosphorus (P) losses, or greenhouse gas (GHG) emissions. These differences reflect improvements to model representation and calculation methods rather than changes in farm performance or management practices.

1. Chemical mitigation of methane for dairy effluent systems — full release

Chemical mitigation of effluent methane in dairy systems is now fully released in Overseer.

Background

This mitigation approach was previously available as a beta implementation within Overseer. The beta status reflected that peer review and confirmation of the final parameter set were still in progress.

This mitigation approach uses acidifying agents and ferric salts to reduce methane emissions from dairy effluent ponds by suppressing methanogenesis. Commercial systems implementing this approach are available in New Zealand, including EcoPond™ systems.

What has changed

- The previous beta implementation has now been replaced by the fully released model.
- The release incorporates updated input parameters aligned with the latest application specifications and methodology.

What remains unchanged

The underlying scientific approach and environmental outcomes remain consistent with the beta implementation, including:

- 96% reduction in methane emissions from effluent ponds,

- modelling aligned with the Agricultural Inventory Model (AIM) methodology implemented within Overseer,
- representation of additional nutrient inputs associated with the treatment system, including sulphur (S), magnesium (Mg), and sodium (Na),
- potential impacts on phosphorus (P) losses where applicable.

Impact for users

- No action is required for existing analyses already using this mitigation approach.
- Results are expected to remain effectively unchanged, apart from minor numerical differences associated with parameter refinement.

A full peer-reviewed technical document describing the implementation and scientific basis of this mitigation approach is available within the Overseer knowledge base.

2. Flexible milking strategies — new functionality

Overseer now supports flexible milking strategies, allowing dairy systems to be represented more accurately where milking frequency changes throughout the season.

New functionality

Users can now model:

- once-a-day (OAD) milking,
- twice-a-day (TAD) milking,
- 3-in-2 milking,
- 10-in-7 milking,
- systems that transition between strategies during the season (for example, moving from 10-in-7 to OAD).

Why this change was introduced

Many dairy farms adopt different milking frequencies at different stages of lactation. Previously, modelling these changes was challenging.

Following consultation with DairyNZ, the updated approach allows seasonal changes in milking frequency to be represented explicitly.

Modelling improvements

As part of the flexible milking strategy implementation, Overseer now calculates excreta transfer factors monthly rather than using a single annual average.

Previously, the model calculated annual average transfer factors representing:

- the proportion of excreta deposited onto lanes and races, and

- the proportion collected by the effluent system.

These annual values were then applied uniformly throughout the year.

The updated model now calculates transfer factors separately for each month, allowing seasonal variation in milking frequency and animal movement patterns to be represented more accurately. For example, farms using once-a-day milking during calving and twice-a-day milking later in the season can now be modelled explicitly rather than averaged into a single annual value.

This improves the representation of nutrient redistribution and associated emissions throughout the production season.

Impact for users

- Existing analyses using milking strategies have been automatically migrated.
- No user action is required.
- Some analyses may show small changes in nutrient losses or GHG emissions due to the improved temporal representation of excreta transfer.

3. Bug fix — once-a-day milking during calving and drying-off

An issue affecting the interpretation of milking strategies has been corrected.

Previous behaviour

Previously, selecting once-a-day milking during the calving period and/or drying-off period was incorrectly interpreted as once-a-day milking for the entire milking season.

Corrected behaviour

The selected milking strategy is now applied only to the intended periods within the season.

Impact for users

Some analyses may show a small increase in phosphorus (P) losses following this correction. These changes reflect the corrected interpretation of seasonal milking practices rather than changes in farm performance.

4. Bug fix — excreta collected on wintering pads and greenhouse gas emissions

An issue affecting greenhouse gas emissions calculations for wintering pads and shelters has been corrected.

Previous behaviour

Previously, excreta collected by the effluent system while animals were on wintering pads or shelters was unintentionally counted twice in GHG emissions calculations.

Corrected behaviour

Collected excreta is now counted once only, as intended.

Impact for users

- Analyses that include wintering pads or shelters may show a small reduction in reported GHG emissions following this correction.
- This change reflects a correction to the calculation method rather than any change in farm management.

Summary

This release delivers several important improvements to Overseer, including:

- the full release of modelling the technology for chemical mitigation of effluent methane,
- support for flexible seasonal milking strategies,
- improved monthly representation of excreta transfer processes,
- corrections to milking strategy interpretation, and
- corrections to GHG calculations associated with wintering pads and shelters.

Any resulting changes in model outputs are expected to be small and reflect improved model representation and calculation accuracy.

Impact on farm results

The impact of the change has been evaluated across 186,940 analyses from the file: Release-6.5.13_Impact_2026-05-14_0941.csv, which was extracted from the 'fm_20260511' database (table 'public.mt_doc_upgraderunresult') for the run titled 'Full Upgrade Run (6.5.13) - 13/05/26 (1/1)'.

The analysis is predominantly focused on dairy cattle systems, constituting 65% of the data in this file. Additionally, the file incorporates analyses of mixed livestock (24%), non-dairy animals (10%), and crop/horticultural production (2%).

This assessment is conducted using all farm system analyses within the OverseerFM database. This includes Year Ends, Predictive and Scenario analyses many of which will be based upon real, feasible farm systems; some of the analyses, however, may be exploratory or infeasible. The assessment is conducted to explain the magnitude of change from a model update.

General statistics

The global statistics of the variations in N loss, P loss and GHG emissions are summarised in the following table; only analyses that include strictly positive results for N, P, and GHG emissions were retained.

##	NLossPercentage	PLossPercentage	GHGPercentage
##	Min. : -7.6923	Min. : -20.0000	Min. : -28.83848
##	1st Qu.: 0.0000	1st Qu.: 0.0000	1st Qu.: 0.00000
##	Median : 0.0000	Median : 0.0000	Median : 0.00000
##	Mean : 0.0325	Mean : 0.4249	Mean : -0.04167
##	3rd Qu.: 0.0000	3rd Qu.: 0.0000	3rd Qu.: 0.00000
##	Max. : 14.2857	Max. : 50.0000	Max. : 1.14078
##	NA's : 19	NA's : 19	NA's : 19

On average (NA's removed) for 166,962 farms, the impact is 0% for N loss, 0.4% for P loss and 0% for GHG emissions. However, the dataset includes some outliers that exhibit significant positive and negative variations from these averages.

Analysis statistics

The number of analyses with GHG results:

- Total number of tested analyses 186,940
- Total number of tested analyses with N loss results (before model update): 167,046
- Total number of tested analyses with N loss results (after model update): 167,052

- Total number of tested analyses without N loss results after update: 19
- Total number of tested analyses with N loss results after update (no results before): 25
- Total number of tested analyses with N loss results before and after: 167,027

Resolved Errors Following Update

- Total number of tested analyses with N loss results after update (no results before): 25

Message Before	Count
Minimum pasture production on a pastoral block is 200 kg DM/ha/year for Effluent. Check animal numbers, block area or the amount of supplements or crops fed	3
NA	22

Errors After Update

- Total number of tested analyses without N loss results after update: 19.

Message After	Count
Dairy animals are fed in the milking shed but no supplements or crops are been fed to these animals, or the feed from crops already exceeds animal requirements for the month of March	4
For Dairy in May, ME supplied in feed fed in the shed, on pads and as crops exceeded animal ME requirements by 120%. The feed was predominately fed on the wintering pad/animal shelter. Check supplement rates and supplement utilisation, or crop yield and distribution of crops to animals. Go to the 'Animal Reports' tab to see how much feed your animals require.	4
For Dairy in May, ME supplied in feed fed in the shed, on pads and as crops exceeded animal ME requirements by 136%. The feed was predominately fed from crops. Check crop yield, distribution of crops to animals or consider increasing grazing time on fodder crop if this message persists. Go to the 'Animal Reports' tab to see how much feed your animals require.	3
Dairy animals are not getting enough Ca from their feed for the month May. Please check how animals are allocated to crops and whether they should have alternate feed sources.	2
For Dairy in May, ME supplied in feed fed in the shed, on pads and as crops exceeded animal ME requirements by 130%. The feed was predominately fed from crops. Check crop yield, distribution of crops to animals or consider increasing grazing time on fodder crop if this message persists. Go to the 'Animal Reports' tab to see how much feed your animals require.	2

Message After	Count
Dairy animals are fed in the milking shed but no supplements or crops are been fed to these animals, or the feed from crops already exceeds animal requirements for the month of April	1
For Dairy grazing in August, ME supplied in feed fed in the shed, on pads and as crops exceeded animal ME requirements by 315%. The feed was predominately fed from crops. Check crop yield, distribution of crops to animals or consider increasing grazing time on fodder crop if this message persists. Go to the 'Animal Reports' tab to see how much feed your animals require.	1
For Dairy in May, ME supplied in feed fed in the shed, on pads and as crops exceeded animal ME requirements by 143%. The feed was predominately fed from crops. Check crop yield, distribution of crops to animals or consider increasing grazing time on fodder crop if this message persists. Go to the 'Animal Reports' tab to see how much feed your animals require.	1
For Dairy replacements in August, ME supplied in feed fed in the shed, on pads and as crops exceeded animal ME requirements by 138%. The feed was predominately fed from crops. Check crop yield, distribution of crops to animals or consider increasing grazing time on fodder crop if this message persists. Go to the 'Animal Reports' tab to see how much feed your animals require.	1

Observations

The bug fix correcting the misinterpretation of milking strategies updates the monthly metabolisable energy (ME) requirement calculations for dairy milking herds. As a result, feeding-balance errors were triggered in 19 out of 166,962 analyses, while 25 out of 166,962 previously affected analyses were resolved.

This issue reflects a threshold effect in the feeding-balance validation logic: small changes in feed demand caused some analyses to cross the overfeeding threshold in either direction. Consequently, some analyses triggered a feeding error, while others no longer did. In all cases, the affected analyses were already very close to the overfeeding threshold prior to the correction.

Graphs of variations

This section compares each plotted output before and after the 6.5.13 model update. The x-axis generally shows the value before the update, and the y-axis shows the value after the update. Points close to the 1:1 reference line indicate little or no change. The terminology used in these plots is summarised in the glossary at the end of this document.

In the following graphs, the variation in farm results is defined as the following ratio:

$$\text{Variation} = \frac{\text{Value}_{\text{After}} - \text{Value}_{\text{Before}}}{\text{Value}_{\text{Before}}}$$

The *Value* could be the N loss, P loss or the GHG emissions value.

N loss variation

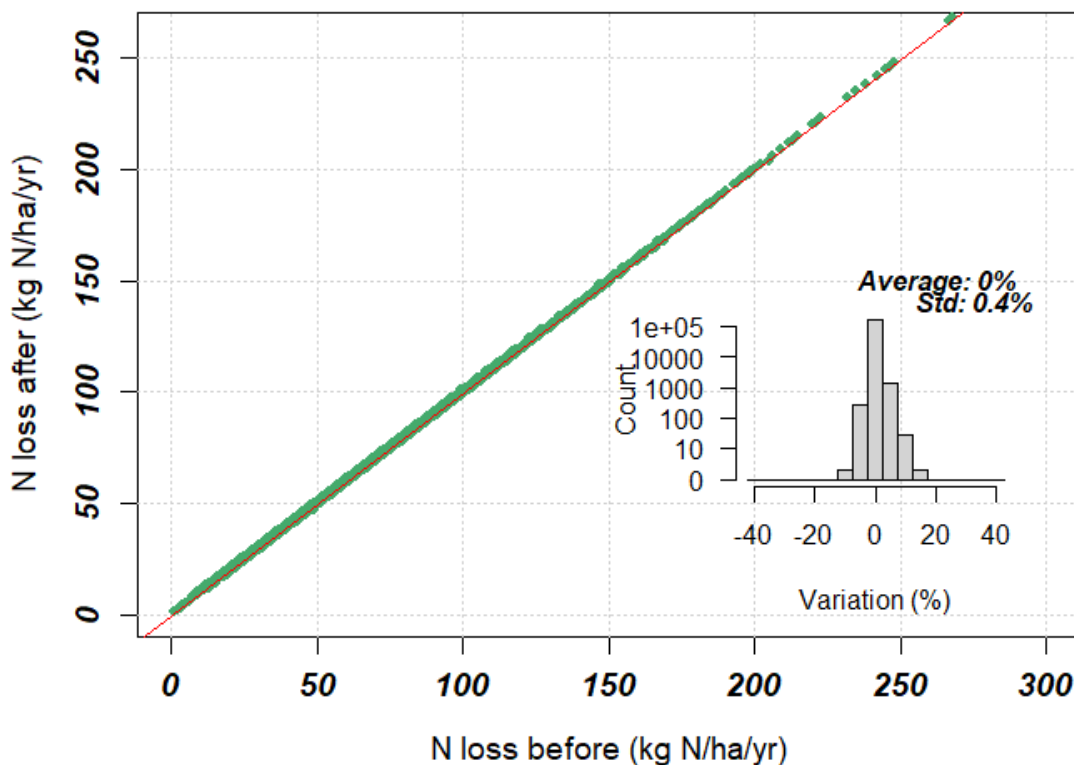


Figure 1: Total N loss variation

Plotted term: NLossPerHa means total modelled nitrogen loss per hectare, expressed as kg N/ha/year. In this figure, each point compares NLossPerHa before and after the model update.

The mean variation is 0%, with maximum/minimum variations of 14.3%/-7.7%.

Out of 166,856 analyses:

- 183 (0.1%) show a positive or negative variation greater than 5%,
- 6 (0.0036%) show a positive or negative variation greater than 10%,
- 0 (0%) show a positive or negative variation greater than 20%.

Distribution of N loss variation by range

Variation Range	< -100%	-100% to -75%	-75% to -50%	-50% to -25%	-25% to -15%	-15% to -5%	-5% to -0.05%	-0.05% to 0.05%	0.05% to 5%	5% to 15%	15% to 25%	25% to 50%	50% to 75%	75% to 100%	> 100%
Number	0	0	0	0	0	33	1206	162890	2567	160	0	0	0	0	0
Frequency (%)	0	0	0	0	0	0	0.7	97.6	1.5	0.1	0	0	0	0	0

N loss variation magnitude

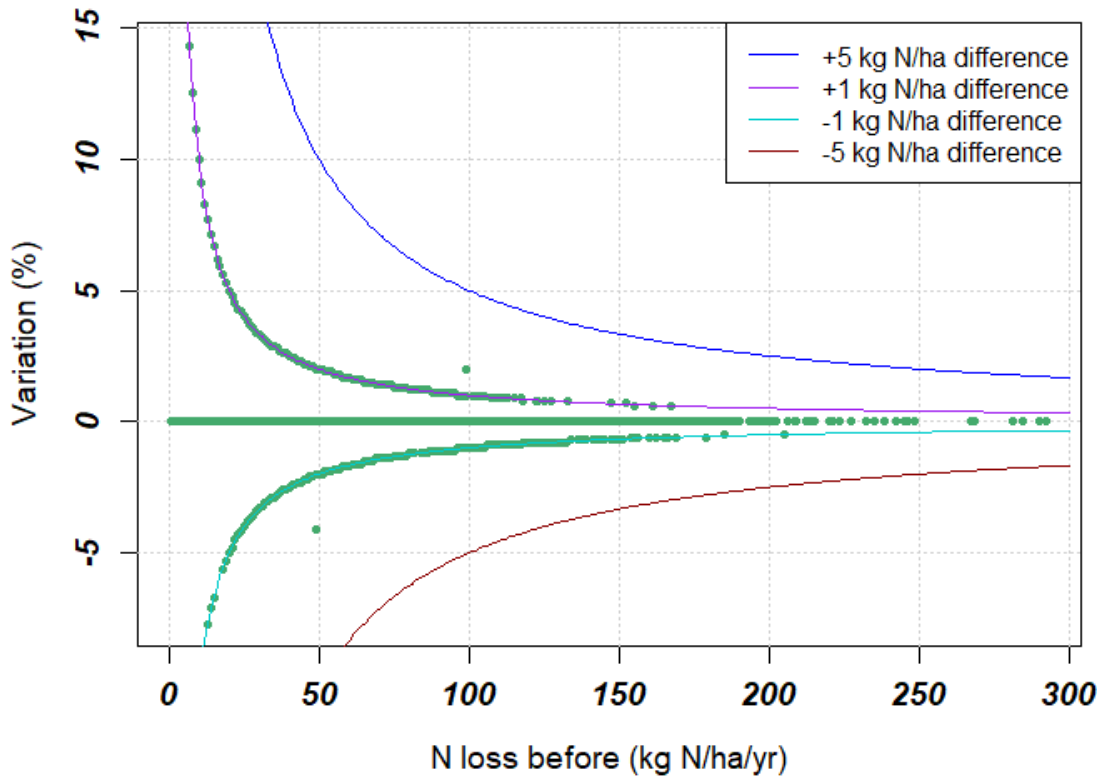


Figure 2: Total N loss variation magnitude

How to read this graph: The x-axis is baseline NLossPerHa before the update and the y-axis is percentage variation. The curved reference lines show what fixed absolute changes, such as +/-1 kg N/ha/year, look like when expressed as a percentage of the baseline value.

The new release has a minimal impact on modelled N loss outcomes.

As shown in Figure 2, percentage variation is inversely related to the baseline N loss level. This reflects the fact that the absolute change in N loss remains consistently small across the analysis population. Consequently, analyses with low baseline N losses can exhibit relatively larger percentage changes despite only minor absolute differences.

The reference curves demonstrate that the observed variation is effectively bounded within approximately ± 1 kg N/ha/yr across all analyses. This indicates that even analyses showing percentage variations greater than 5% correspond to very small absolute changes in N loss.

Consistent with this, the distribution summary shows that:

- 97.6% of analyses changed by less than $\pm 0.05\%$,
- 99.1% changed by less than $\pm 5\%$, and
- no analyses changed by more than $\pm 20\%$.

Overall, the release has a minimal impact on N loss predictions, with changes remaining around ± 1 kg N/ha/yr regardless of baseline N loss level.

Largest positive N loss variation

This section highlights the most positive significant changes in N loss, focusing on changes that exceed 5% and a difference of more than 1 kg N/ha in N loss before and after. The analysis aims to identify analyses in which the recent update had an impact on N loss, both in terms of percentage change and absolute value.

In total, 0 (0%) analyses meet these criteria.

Largest negative N loss variation

This section highlights the most significant negative changes in N loss, focusing on changes that exceed -5% and an absolute difference of more than 1 kg N/ha in N loss before and after. The analysis aims to identify analyses in which the recent update had an impact on N loss, both in terms of percentage change and absolute value.

In total, 0 (0%) analyses meet these criteria.

P loss variation

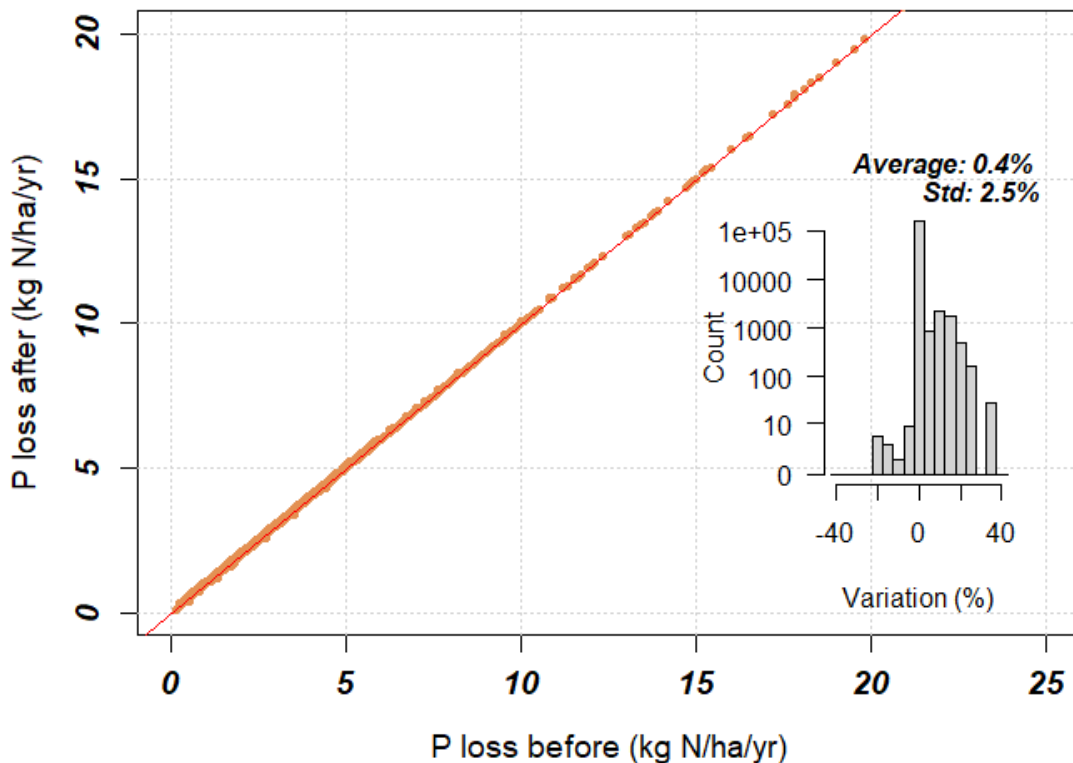


Figure 3: Total P loss variation

Plotted term: PLossPerHa means total modelled phosphorus loss per hectare, expressed as kg P/ha/year. This figure compares PLossPerHa before and after the model update.

The mean variation is 0.4%, with maximum/minimum variations of 50%/-20%.

Out of 166,856 analyses:

- 5191 (3.1%) show a positive or negative variation greater than 5%,
- and 4018 (2.4%) show a positive or negative variation greater than 10%,
- and 206 (0.1%) show a positive or negative variation greater than 20%.

P loss variation magnitude

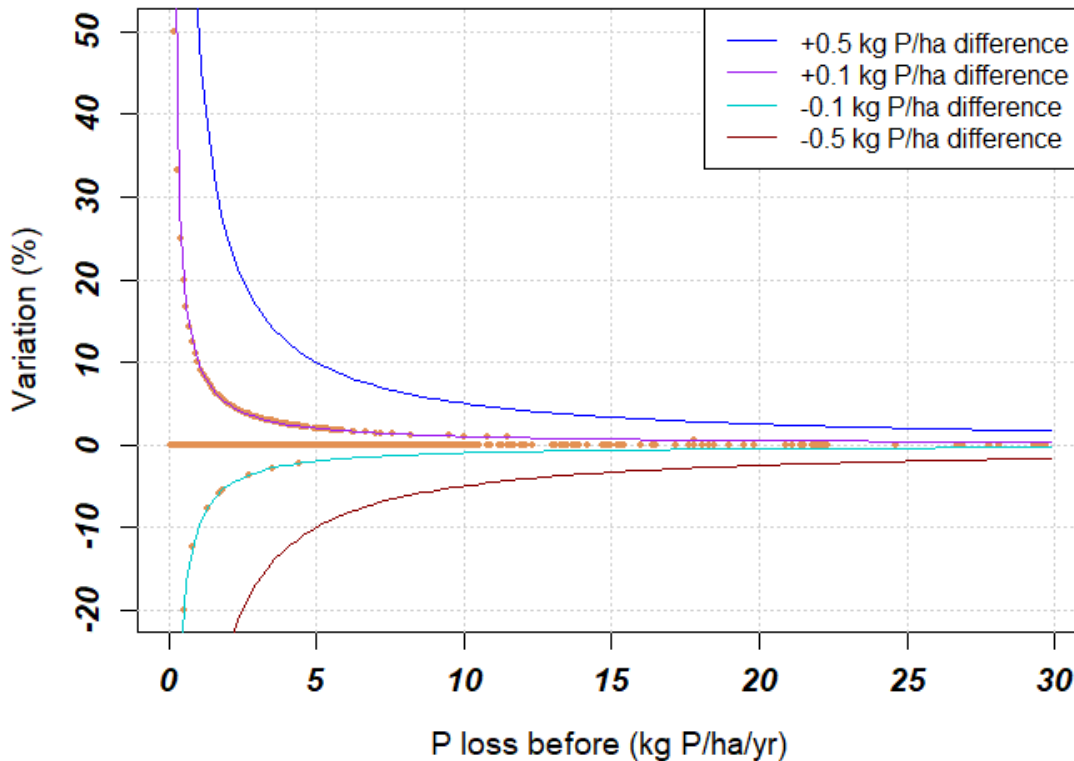


Figure 4: Total P loss variation magnitude

How to read this graph: The x-axis is baseline PLossPerHa before the update and the y-axis is percentage variation. The reference curves show fixed absolute changes, such as +/-0.1 kg P/ha/year, expressed relative to the baseline P loss.

Distribution of P loss variation by range

Variation Range	< -100%	-100% to -75%	-75% to -50%	-50% to -25%	-25% to -15%	-15% to -5%	-5% to -0.05%	-0.05% to 0.05%	0.05% to 5%	5% to 15%	15% to 25%	25% to 50%	50% to 75%	75% to 100%	> 100%
Number	0	0	0	0	5	7	7	161093	565	3446	1694	39	0	0	0
Frequency (%)	0	0	0	0	0	0	0	96.5	0.3	2.1	1	0	0	0	0

The new release has a minimal impact on modelled P loss results, 96.5% fall within the $\pm 0.05\%$ variation band, and no analyses exceed $\pm 50\%$ variation.

As shown in Figure 4, percentage variation is inversely related to the baseline P loss level. This reflects the fact that the absolute change in P loss remains consistently very small across the analysis population. Consequently, analyses with low baseline P losses can exhibit relatively larger percentage variations despite only minor absolute differences.

The reference curves indicate that the observed variation is effectively bounded within approximately ± 0.1 kg P/ha/yr for the vast majority of analyses. Most data points cluster tightly around the ± 0.1 kg P/ha reference curves, confirming that the release produces only very small absolute changes in either direction.

Although a small number of analyses show percentage variations above 15%, these cases correspond to very low baseline P losses and therefore remain small in absolute terms.

Overall, the release has a minimal impact on P loss predictions, with changes generally remaining within approximately ± 0.1 kg P/ha/yr regardless of baseline P loss level.

Largest P loss variation

This section highlights the most positive significant changes in P loss, focusing on changes that exceed 5% and a difference of more than 0.1 kg P/ha in P loss before and after. The analysis aims to identify analyses in which the recent update had an impact on P loss, both in terms of percentage change and absolute value.

In total, 1717 (1%) analyses meet these criteria.

GHG emission variation

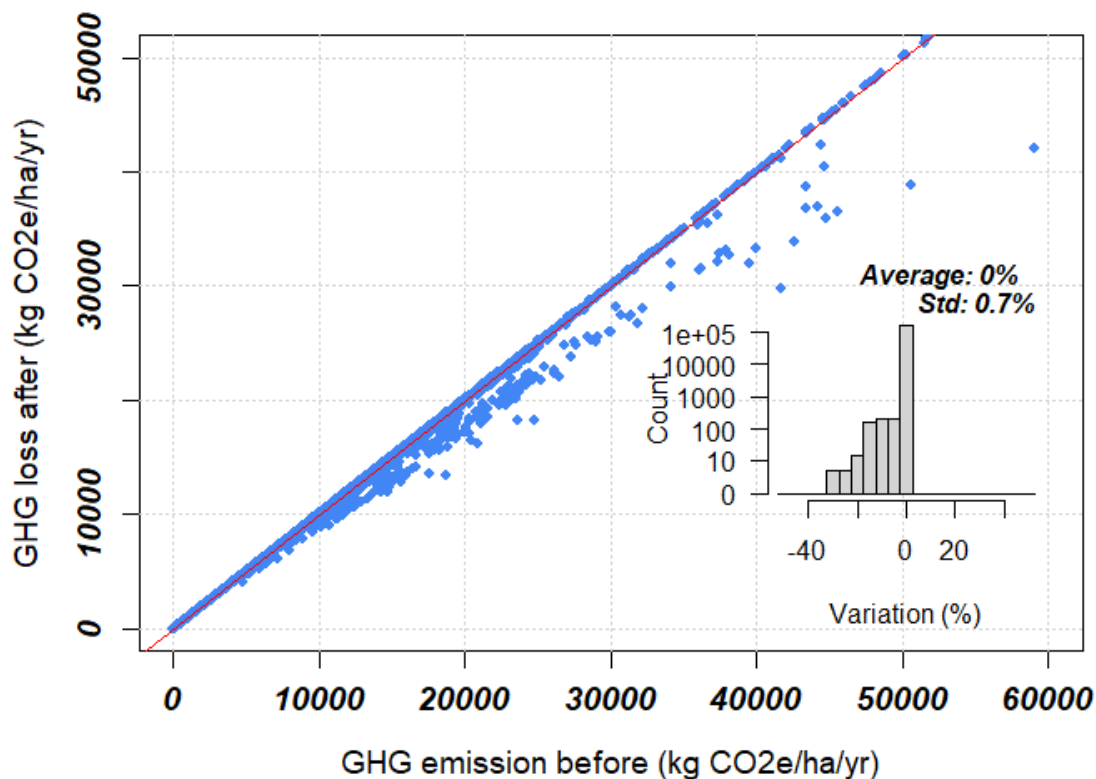


Figure 5: Total GHG emissions variation

Plotted term: GHGPerHa means total modelled greenhouse gas emissions per hectare, expressed as kg CO₂-e/ha/year. It aggregates methane, nitrous oxide, carbon dioxide, and embodied CO₂-equivalent emissions.

The mean variation is 0%, with maximum/minimum variations of 1.1%/-28.8%.

Out of 166856 analyses:

- 440 (0.3%) show a positive or negative variation greater than 5%,
- and 259 (0.16%) show a positive or negative variation greater than 10%,
- and 10 (0.01%) show a positive or negative variation greater than 20%.

Distribution of GHG emission variation by range

Variation Range	< -100%	-100% to -75%	-75% to -50%	-50% to -25%	-25% to -15%	-15% to -5%	-5% to -0.05%	-0.05% to 0.05%	0.05% to 5%	5% to 15%	15% to 25%	25% to 50%	50% to 75%	75% to 100%	> 100%
Number	0	0	0	5	61	374	21134	138323	6959	0	0	0	0	0	0
Frequency (%)	0	0	0	0	0	0.2	12.7	82.9	4.2	0	0	0	0	0	0

GHG emissions variation magnitude

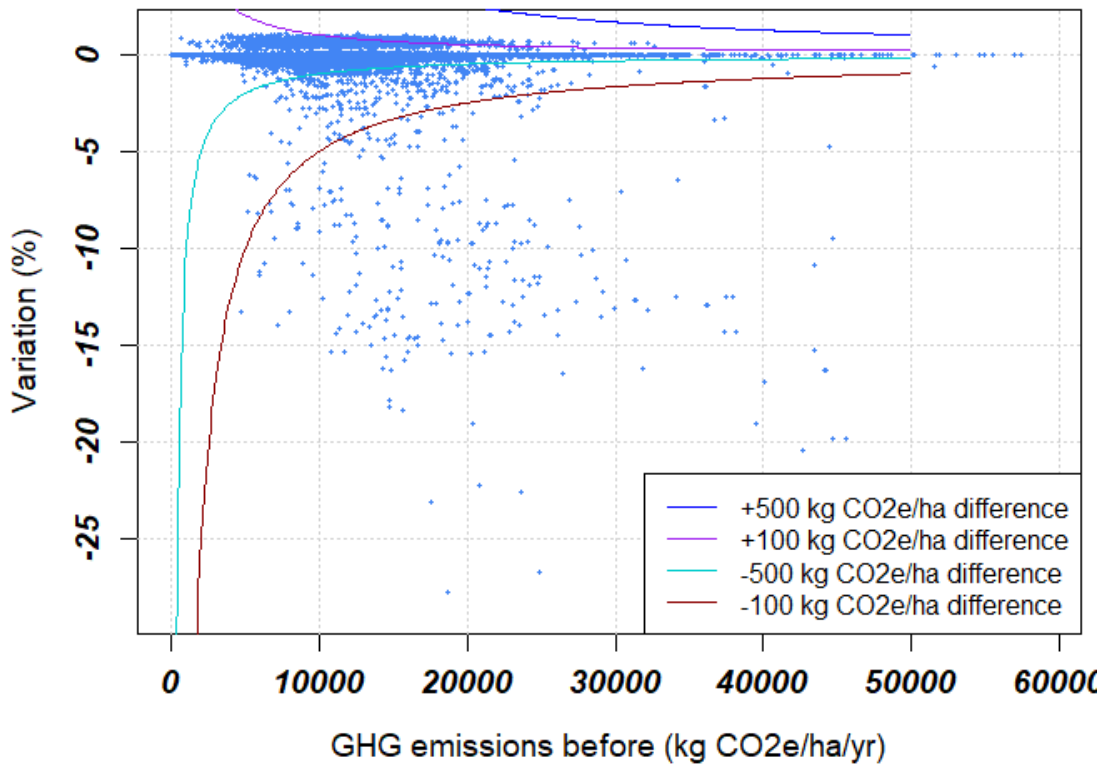


Figure 6: Total GHG emissions variation magnitude

How to read this graph: The x-axis is baseline GHGPerHa before the update and the y-axis is percentage variation. Negative values indicate lower modelled GHG emissions after the update; in this release, the main negative shift is linked to the wintering pad and shelter excreta correction.

The majority of GHG emission changes remain within approximately ± 100 kg CO₂e/ha. However, 0.26% of analyses show a negative variation greater than 5%, reflecting the targeted impact of the wintering pad correction.

Overall, the new release has a mixed but limited impact on modelled GHG emissions. Out of all analyses:

- 82.9% fall within the $\pm 0.05\%$ variation band,
- 12.7% show a small negative variation between -5% and -0.05%,
- 4.2% show a small positive variation between 0.05% and 5%,
- 0.3% show an absolute variation greater than 5%,
- 0.2% exceed 10%, and
- only 10 analyses (<0.01%) exceed 20%.

As illustrated in Figure 6, the distribution is asymmetric with a predominantly negative shift in a subset of analyses. Most variations remain close to zero and within the ± 100 kg CO₂e/ha reference curves. However, some analyses show larger negative changes extending below the -100 kg CO₂e/ha reference curve.

These larger negative variations are attributable to the correction of the bug related to wintering pads and shelters, which previously caused excreta collected by the effluent system to be counted twice in GHG calculations. The correction therefore produces the expected reduction in emissions for the affected systems.

The smaller positive variations observed in some analyses are consistent with the introduction of monthly excreta transfer factors associated with the flexible milking strategy implementation, which produces minor upward adjustments in certain cases.

Overall, the release has a minimal impact on GHG emissions for the vast majority of analyses. The more noticeable variations are limited to specific systems directly affected by the wintering pad correction and reflect an intended correction to the calculation methodology rather than uncontrolled model behaviour.

Largest GHG emissions variation

This section highlights the most positive significant changes in GHG emissions, focusing on changes that exceed 10% and a difference of more than 125 kg CO₂e/ha in GHG emissions before and after. The analysis aims to identify analyses in which the recent update had an impact on GHG emissions, both in terms of percentage change and absolute value.

In total, 257 (0.2%) analyses meet these criteria, the top 30 is the following (one analysis per farm):

Farm Type	Region	GHG /ha (Before)	GHG /ha (After)	% Change
Dairy	Southland	59112	42065	-28.8
Dairy	Canterbury	41675	29714	-28.7
Dairy	Otago	18658	13478	-27.8
Dairy	Canterbury	24827	18168	-26.8
Dairy	Southland	17545	13491	-23.1
Dairy	Otago	20393	16496	-19.1
Dairy	Canterbury	15627	12759	-18.4
Dairy	Southland	14694	12020	-18.2
Dairy	Canterbury	26476	22106	-16.5
Dairy	Southland	14830	12406	-16.3
Dairy	Canterbury	31874	26706	-16.2
Dairy	Otago	14530	12257	-15.6
Dairy	Southland	18869	15950	-15.5
Dairy	Southland	20264	17118	-15.5
Dairy	Southland	15917	13466	-15.4
Dairy	EastCoastNorthIsland	11659	9861	-15.4
Dairy	Southland	10712	9057	-15.4
Dairy	Southland	16682	14182	-15.0
Dairy	Southland	13485	11459	-15.0
Dairy	WaikatoCoromandel	18270	15568	-14.8
Dairy	Southland	15924	13591	-14.7
Dairy	WaikatoCoromandel	26099	22322	-14.5
Dairy	Canterbury	21615	18471	-14.5
Dairy	Southland	21508	18382	-14.5
Dairy	Canterbury	38172	32722	-14.3
Dairy	Northland	22814	19547	-14.3
Dairy	Otago	12408	10638	-14.3
Dairy	WaikatoCoromandel	7157	6153	-14.0
Dairy	WaikatoCoromandel	18220	15680	-13.9
Dairy	Otago	15637	13505	-13.6

Observations:

All affected farms include wintering pads or feed pads. The reduction in reported GHG emissions is directly proportional to the time animals spend in these structures: the more time spent, the greater the correction.

CH₄ emissions

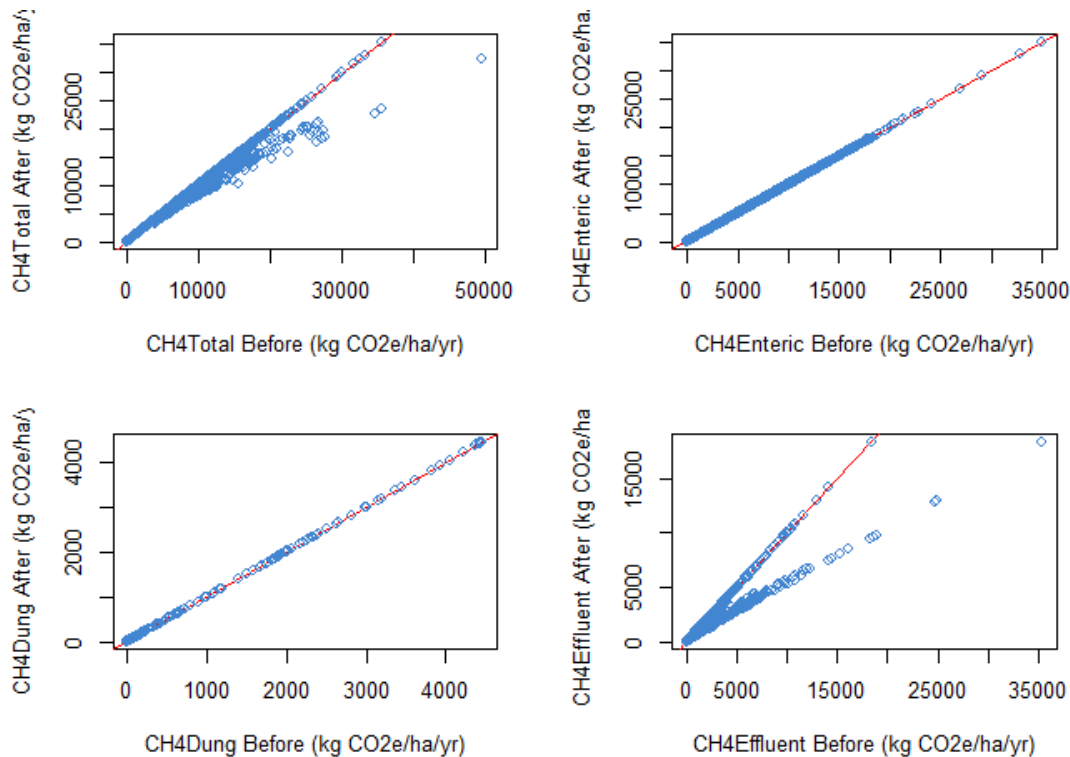


Figure 7: CH₄ emissions variation

Plotted terms: CH₄Total is total methane emissions; CH₄Enteric is enteric methane; CH₄Dung is methane from dung; and CH₄Effluent is methane associated with excreta managed through the effluent system. The main change is expected in CH₄Effluent and therefore CH₄Total.

The bug double-counted excreta collected from wintering pads and shelters in GHG emissions calculations. The correction eliminates this duplication, resulting in a measurable reduction in Total CH₄ emissions, as clearly observed in Figure 7. The scatter plots confirm that:

- *CH₄Effluent* and *Total CH₄ emissions (CH₄Total)* are systematically lower after the fix, directly reflecting the correction for effluents collected on structures.
- *Enteric (CH₄Enteric)* and *Dung (CH₄Dung)* emissions remain unchanged, as they are unaffected by the effluent calculation error.

This variation in total CH₄ emissions is therefore exclusively linked to the correction of the double-counting error in effluent-related emissions.

N2O emissions

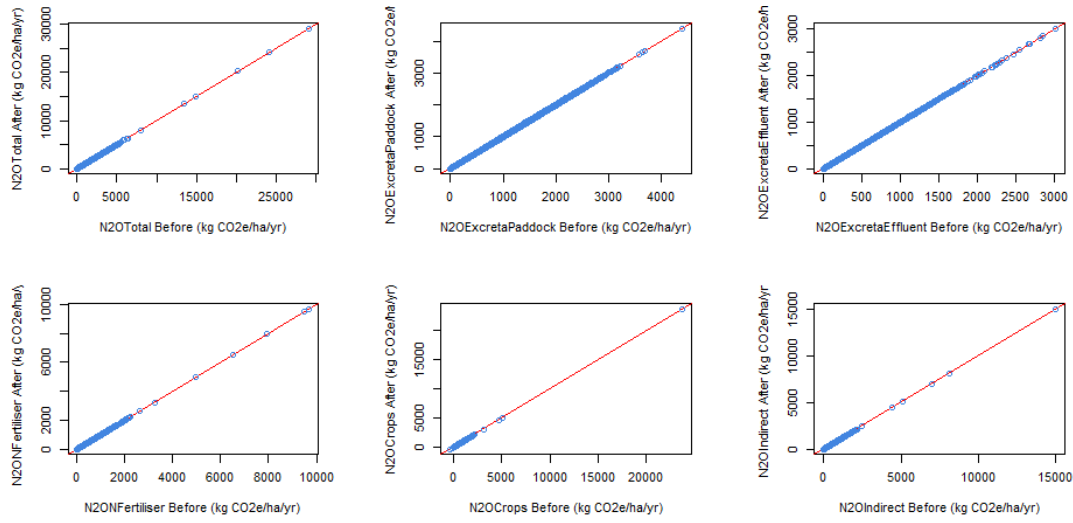


Figure 8: N2O emissions variation

Plotted terms: N2OTotal aggregates nitrous oxide emissions. The component plots separate emissions from excreta deposited on paddocks, effluent-related excreta, nitrogen fertiliser, crop-related sources, and indirect N2O associated with volatilisation and leaching pathways.

No systematic variation was observed.

CO2 emissions

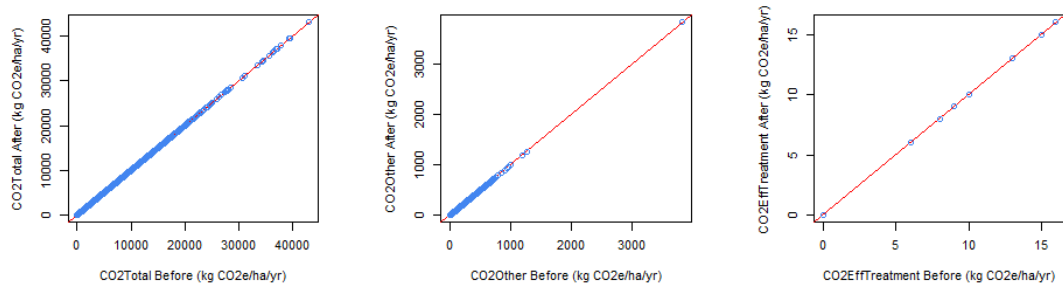


Figure 9: Some CO2 emissions variation

Plotted terms: CO2Total is total carbon dioxide and embodied CO2-equivalent emissions. CO2Other is the aggregate of minor Other CO2 sources shown in the CO2 report, including animal health, refrigerants, plastics, re-grassing, parasite control, chemical sprays, other chemicals, effluent treatments, and residual other CO2 items. CO2EffTreatment is the CO2-equivalent emissions associated with effluent treatment.

No material impact was detected.

NCE¹ and N surplus²

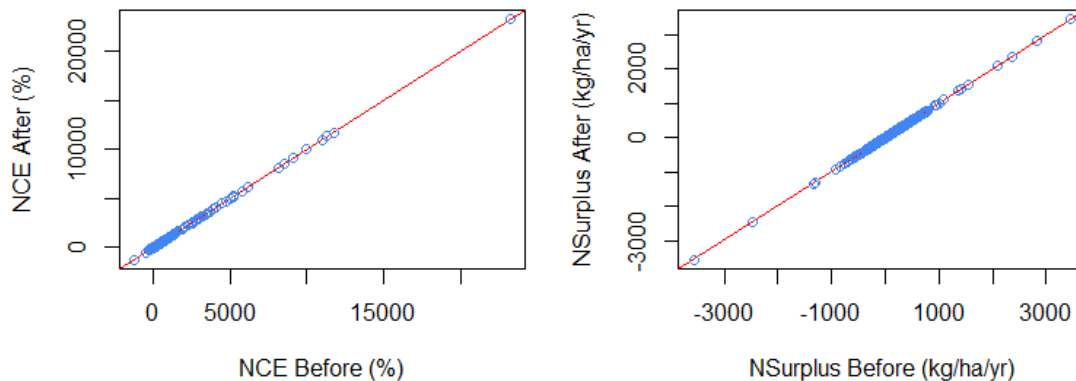


Figure 10: NCE and N Surplus

Plotted terms: NCE is Nitrogen Conversion Efficiency: nitrogen removed in products as a percentage of nitrogen inputs used for production. NSurplus is nitrogen inputs used for production minus nitrogen removed in products.

No systematic variation was observed.

¹ NCE = Nitrogen Conversion Efficiency and is calculated as the percentage of the estimated nitrogen removed in products relative to the estimated nitrogen inputs used for production.

² N Surplus is the estimated nitrogen surplus, calculated as the difference between the estimated nitrogen inputs used for production (e.g. fertiliser, imported feed, irrigation water, clover fixation) and the estimated nitrogen removed in products (e.g. milk, meat, wool, crops).

Nitrogen budget

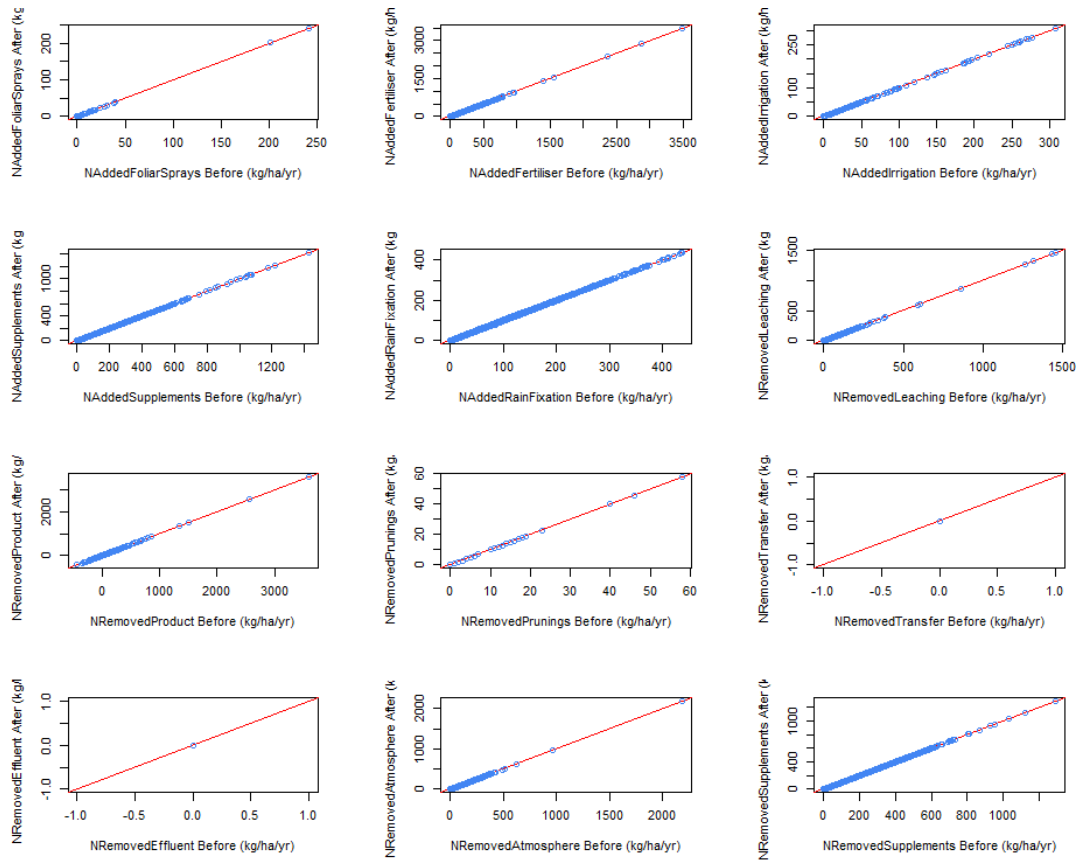


Figure 11: Nitrogen budget categories

Plotted terms: The nitrogen budget plots group nitrogen added to the system, nitrogen removed from the system, and transfers or losses through pathways such as fertiliser, irrigation, supplements, rainfall/fixation, products, leaching, atmosphere, effluent, animal transfer, and supplement removal.

Results remain effectively unchanged.

Nitrogen Pools

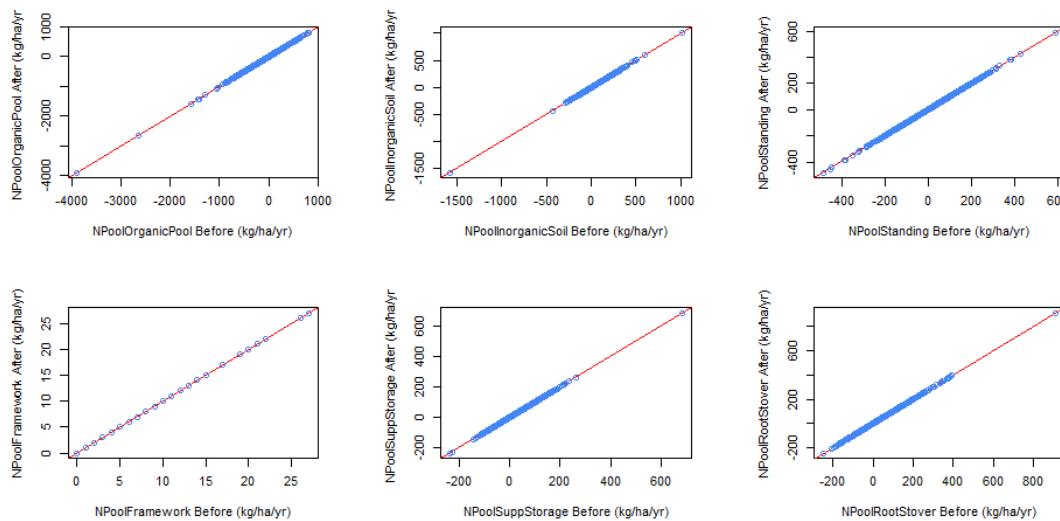


Figure 12: Nitrogen pools

Plotted terms: The nitrogen pool plots show changes in nitrogen held in different storage pools, including the organic pool, inorganic plant-available soil pool, standing plant material, perennial crop framework, stored supplements, and root or stover residues.

No material impact was detected.

Conclusions

This impact analysis evaluated the effect of the Overseer 6.5.13 release across the full analyses dataset, covering two new features (technology for chemical mitigation of effluent methane such as EcoPond™ Generation 2, and flexible milking strategies) and two bug fixes (once-a-day milking interpretation and excreta double-counting on wintering pads).

N loss is minimally affected by the new release. The vast majority of analyses (97.6%) fall within the $\pm 0.05\%$ variation band, and the absolute change is consistently bounded within ± 1 kg N/ha across the population. The small percentage variations observed in low-baseline analyses are a mathematical artefact of a small absolute difference, not a material change in modelled outcomes.

P loss is equally stable, with 96.5% of analyses falling within the $\pm 0.05\%$ variation band. Absolute changes remain very small, generally within approximately ± 0.1 kg P/ha across the population. Although some analyses show relatively larger percentage variations, these correspond to systems with very low baseline P losses and therefore remain small in absolute terms.

GHG emissions show a broader distribution than N and P loss, but the pattern is well understood and expected. The majority of analyses remain within a narrow band, while a subset — exclusively farms with wintering pads or feed pads — show a measurable



reduction in emissions directly attributable to the correction of the double-counting bug. This reduction is proportional to the time animals spend on these structures and represents an improvement in model accuracy rather than a change in farm performance. The small positive variations observed in a minority of analyses are consistent with the introduction of monthly excreta transfer factors. N₂O, CO₂, N budget, N pools, NCE, and N surplus show no material impact.

Overall, the new release delivers targeted improvements to model accuracy and representational fidelity, with minimal unintended impact on farm results. Any changes observed by users are expected, explainable, and reflect corrections and enhancements rather than model instability.

Appendix: Glossary of plotted terms

This glossary defines the variables plotted in the impact assessment graphs. Definitions are intended to support interpretation of the figures and do not replace the detailed technical manuals.

Variable	Definition
NLossPerHa	Total modelled nitrogen loss per hectare, expressed as kg N/ha/year. This includes nitrogen lost to water and relevant loss pathways aggregated in the model output.
PLossPerHa	Total modelled phosphorus loss per hectare, expressed as kg P/ha/year.
GHGPerHa	Total modelled greenhouse gas emissions per hectare, expressed as kg CO ₂ -e/ha/year. This aggregates methane, nitrous oxide, carbon dioxide, and embodied emissions reported in CO ₂ -equivalent units.
CH4Total	Total methane emissions, expressed as CO ₂ -equivalent per hectare/year. This includes enteric methane, dung-related methane, and effluent-related methane.
CH4Enteric	Methane emissions from enteric fermentation by animals. Enteric methane as being calculated from dry matter intake and an enteric methane emission factor.
CH4Dung	Methane emissions from dung/manure decomposition, excluding the effluent-system component where this is reported separately.
CH4Effluent	Methane emissions associated with dung/excreta managed through the effluent system, including effluent storage and treatment pathways.
N2OTotal	Total nitrous oxide emissions, expressed as CO ₂ -equivalent per hectare/year in the impact plots. This includes direct and indirect N ₂ O sources.
N2OExcretaPaddock	Nitrous oxide emissions from animal excreta deposited directly onto paddocks or pasture.
N2OExcretaEffluent	Nitrous oxide emissions associated with effluent, including emissions from effluent management and/or land-applied effluent.
N2ONFertiliser	Nitrous oxide emissions from nitrogen fertiliser inputs added to soil.
N2OCrops	Nitrous oxide emissions associated with crop residues, cultivation, or crop-related nitrogen inputs.
N2OIndirect	Indirect nitrous oxide emissions associated with nitrogen lost from the farm through volatilisation and leaching pathways.
CO2Total	Total carbon dioxide and embodied carbon dioxide emissions, expressed as CO ₂ -equivalent per hectare/year in the impact plots.
CO2Other	Aggregate CO ₂ -equivalent emissions from minor "Other" CO ₂ sources, including animal health products, refrigerant losses, plastics, re-grassing, parasite control products, chemical sprays, other farm chemicals, effluent treatments, and residual other CO ₂ items.
CO2EffTreatment	Carbon dioxide or embodied CO ₂ -equivalent emissions associated with effluent treatment.
NCE	Nitrogen Conversion Efficiency: the percentage of estimated nitrogen removed in products relative to the estimated nitrogen inputs used for production.
NSurplus	Nitrogen surplus: estimated nitrogen inputs used for production minus estimated nitrogen removed in products. Inputs include sources such as fertiliser, imported feed, irrigation water, and clover fixation; removals include products such as milk, meat, wool, and crops.
NAddedFoliarSprays	Nitrogen added in foliar sprays, mainly relevant to fruit crop blocks where sprays are included in the nutrient budget.
NAddedFertiliser	Nitrogen added as fertiliser, lime-associated inputs where relevant, organic material, imported effluents, and related fertiliser-type nutrient inputs. For N specifically, this primarily represents fertiliser and organic/effluent N additions.
NAddedIrrigation	Nitrogen added in irrigation water.
NAddedSupplements	Nitrogen imported onto the farm in supplements, including brought-in supplements, stored supplements fed out, farm-grown supplements fed on the block, crops fed, and animal health supplements where included.
NAddedRainFixation	Nitrogen added through rainfall deposition and biological nitrogen fixation, especially clover or other N-fixing sources.
NRemovedLeaching	Nitrogen removed from the root zone or farm system through leaching, including urine-patch and background leaching where aggregated.
NRemovedProduct	Nitrogen removed in products sold or exported from the farm system, such as milk, meat/liveweight, wool, velvet, crops, fruit, or other products.
NRemovedPrunings	Nitrogen removed in prunings, mainly relevant to fruit crop blocks.
NRemovedTransfer	Net nitrogen transfer by animals between blocks or structures, such as nutrients consumed on one block and deposited elsewhere via excreta, including transfers involving pads, lanes, races, farm dairies, and wintering pads.
NRemovedEffluent	Nitrogen removed from the farm in exported effluent.
NRemovedAtmosphere	Nitrogen lost to the atmosphere, including volatilisation and denitrification losses. Denitrification includes nitrous oxide emissions.
NRemovedSupplements	Nitrogen removed as supplements, fodder crops, crop residues, or similar material removed from a block or exported from the farm.
NPoolOrganicPool	Change in nitrogen held in the organic pool, including net immobilisation/mineralisation into soil organic matter and, where relevant, accumulation in effluent storage ponds.
NPoolInorganicSoil	Change in the plant-available inorganic soil nitrogen pool, representing the inorganic/mineral N pool balance after additions, removals, and transformations.
NPoolStanding	Change in nitrogen held in standing plant material between the beginning and end of the reporting year.
NPoolFramework	Nitrogen accumulated in perennial crop framework, especially above- and below-ground fruit crop framework growth.
NPoolSuppStorage	Change in nitrogen held in stored supplements, reflecting changes in supplement storage over the reporting period.
NPoolRootStover	Change in nitrogen held in root and stover residues between the beginning and end of the reporting year.