OVERSEER Nutrient Budget review

For: Environment Southland – Aerodrome Farm Ltd

Prepared by: Nicky Watt, CNMA

Introduction

1. Regarding the consent application for Aerodrome Farm Ltd, I have reviewed the following OVERSEER ® Nutrient Budget (OVERSEER) files:
   a) New Block
   b) Ovr-Aerodrome Farm Ltd proposal -15-18 readjcownos-copy 3- copy1
   c) Ovr-Aerodrome Farm Ltd current 2015-18/19 – copy2 adinos

2. Along with the files I have reviewed the following accompany report:
   - Farm Scenario Plan -A plan to cover the Current 3 Year Averaged Farm System and the Proposed Farm System Nutrient Budgets after an adjacent property purchase -Prepared by Mark Crawford

3. I have completed a robustness check on the files for sensibility based on data available and checked to ensure the modelling aligns with the OVERSEER Best Practice Data Input Standards for v6.3.0.The 'New Block' has the farms location as 'By nearest town' where the proposed models have 'By Region'. Changing to 'By region' increases the N loss in the New Block from 29 kgN/ha (1387 kg) to 31 kgN/ha (1481 kg). The current and proposed blocks have not had their soils updated to the latest version (all v6.2.2) however updating these did not have an effect on N loss. The new block has not been identified in the Proposed model. To be able to make comparisons of the change in farm systems the new block needs to be shown in the blocking.

4. It must be assumed that the information provided in the OVERSEER files that the current farming system as modelled is a viable farming system, using actual stock and fertiliser inputs. Therefore, the actual and proposed scenario is also assumed to be appropriate for the location and climate.

5. A 'sensibility test' has been undertaken on the Aerodrome Farm Ltd nutrient budgets with the following five output screens from OVERSEER forming the basis of the determination of the robustness of the nutrient budget:
   a) Is the nutrient loss consistent with what you would expect for an operation of this type and soils in this location?
   b) Does the summary of inputs and outputs make sense? Especially clover fixation and change in block pools?
   c) Check the 'Other values' block reports for rainfall, drainage, and PAW
   d) Select the Scenario reports other values and check the production and stocking rate
   e) Select the pasture production in the scenario report and check pasture growth.

6. Answers to each of these five points will be provided further in this report and then a final determination of the robustness of the nutrient loss to water will be provided at the end of this report.

OVERSEER AUDIT

Appropriateness of the Overseer inputs

1. The three XML files stated in paragraph 1 of this report have been reviewed for consistency between the files and appropriateness of the inputs regarding the farming systems and the Overseer Best Practice Data Input Standard (BPDIS).

2. I concur that there is no deviation from the BPDIS.

3. The New Block model has a total area of 47.8 ha (47.7 ha effective) and the Current model has a total area of 266.8 ha (250.6 ha effective) and the Proposed model has a total area of 314.6 ha (298.3 ha effective) which consists of the Current overseer models for the existing dairy farm and the New Block. There is decrease in the peak stocking rate from Current model at 3.2 cows/ha to 3.0 in the Proposed model.

4. Reviewing the NZ Dairy statistics against the Current and Proposed models, shows the average milk solids production on this property (424 kgMS/cow currently and 454 kgMS/cow proposed) is greater than the Southland regional average of 408 kg MS/cow. The stocking rate at 3.2 and 3.0 cows/ha is higher for the Current and Proposed models, respectively, when compared to the Southland average for the 2017/2018 season of 2.64 cows/ha. The Proposed model per cow production is 6.6% higher than the Current model and the per hectare production is proposed to increase from 1302 kgMS/ha to 1357 kgMS/ha (a 4% increase). Lactation length has remained the same.

Table 1: Summary of Production and stocking rate

	New Block[1]	Current[2]	Proposed[3]
Total Ha	47.8	266.8	314.6
Effective Area (ha)	47.7	250.6	298.3
KgMS	-	326180	390000
MS kg/ha grazed	-	1302	1357
MS kg MS/cow	-	424	454
Dairy RSU	-	6881	8006
Lactation Length	-	284	284
Cows/ha	-	3.2	3.0
Cows October	-	780	870
Cows June	-	4	4
Cows July	-	137	140
Replacement RSU	-	47	54
Sheep RSU	660	-	-
Beef RSU	-	119	54
N lost kg/ha/yr	29	50	47

[1]New Block
[2]Current model
[3]Ovr-Aerodrome Farm Ltd proposal -15-18 readjcownos-copy3-copy1 -Proposed Dairy Farm

5. The total crop area for the New Block model was 15.6 ha and 8 ha in the Current model and 7.2 ha in the Proposed model (see table 2 below).

Table 2: Crop Details

	New Block	Current	Proposed
Dairy Fodder Ha	-	8	7.2
Dairy Fodder Yield (tDM/ha)	-	25-28	
Dairy Oats Ha	-	-	4.6 (part FB rotation)
Dairy Kale Yield (tDM/ha)	12	-	1
New Block Potato rotation	7.8	-	-
New Block Potato Yield (tDM/ha)	50	-	-
New Block Swede rotation Ha	7.8	-	-
Sheep Swede Yield (tDM/ha)	13.5	-	-

6. Supplements imported have changed to meet cow demand (see Table 3). Pasture silage has been made where there was a surplus of pasture.

Table 3: Supplements imported and Harvested

	New Block	Current	Current +NB	Proposed
Supplements Imported (tDM)	0	384	384	383
Supplements Imported (tDM/ha)	0	1.53	1.29	1.28
Total Area (ha)	47.8	266.8	314.6	314.6
Effective Area (ha)	47.7	250.6	298.3	298.3
Peak Cows/ha	-	3.2	3.0	3.0
N Fertiliser applied (kgN/ha)	28	204	177	195
Pasture Growth Dairy with Effluent (TDM/ha)	-	17.16	16.50	16.97
Pasture Growth Dairy (TDM/ha)	-	17.16	16.50	16.97
Pasture Growth Sheep Dryland (TDM/ha)	12.95	-	-	-
Silage Harvested to storage (tDM) -Dairy	-	68	68	122
Silage Harvested for feeding on swede (tDM) - Sheep	24	-	24	-

7. The Proposed Overseer model shows the pasture production as 16.97 tDM/ha for non-effluent/effluent land. If the Current and New Block pasture production figures are combined the pasture production is 16.5 tDM/ha. The N used in the Proposed model was 195 kgN/ha and the average N applied to Current and New Block models is 177 kgN/ha. The supplement used in the Current + New Block Models was 1.29 tDM/ha and the Proposed is predicting using 1.28 tDM/ha. Based on this information, the Proposed models increase in pasture harvested is justified by the increase in N fertilizer applied, increase in per cow and per hectare milk production, similar supplement imported per ha and reduction in stocking rate (see Tables 1 & 3 above).

8. The Current Model N loss was 50 kgN/ha. The N loss of the New Block Model was 29 kgN/ha. The Proposed Model shows a N Loss of 47 kgN/ha and it is unknow what the change in N loss is for the New Block as it was not clearly identified (See table 4a below). When the New Block Model was included in the calculations for Current and Proposed (as in Table 4b below) the Current + NB N loss was 47 kgN/ha which is the same as the proposed model. The Current Model P loss was 0.8 kgP/ha and the P loss of the New Block Model was 0.3 kgP/ha. The Proposed Model shows a P Loss of 0.7 kgN/ha and it is unknow what the change in P loss is for the New Block as it was not clearly identified (See table 4a below). When the New Block Model was included in the calculations for Current and Proposed (as in Table 4b below) the Current + NB N loss and the proposed model were the same at 0.7 kgP/ha. It must be assumed that the information provided in the Current Model farming system

is modelled as a viable farming system, using actual stock and fertiliser inputs. Therefore, the Proposed scenario is also assumed to be appropriate for the location and climate.

Overseer Outputs

Table 4a: OVERSEER outputs

Overseer v6.3.0	New Block	Current	Proposed
N lost to water kg/ha/yr	29	50	47
Total N lost kg/farm	1387	13280	14714
P lost kg/ha/yr	0.3	0.8	0.7
Total P lost kg/farm	15	211	225
Other sources – N	14	519	600
Other sources – P	4	123	141

Table 4b: Adding new Block to current compared to proposed

Overseer v6.3.0	Current + NB	Proposed + NB
N lost to water kg/ha/yr	47	47
Total N lost kg/farm	14667	14714
P lost kg/ha/yr	0.7	0.7
Total P lost kg/farm	226	225

Change in block pools

9. Overall there is no significant difference in the change in block pool values between the Current and the Proposed scenario for N. Only change in block pool values for P is in the Proposed Model (P levels being maintained).

10. It appears N is potentially being immobilized; this is observed with a positive value in the Organic pool for N. This value remains reasonably constant in Current and Proposed models. The reverse is the case for the New Block due to the low amount of N fertilizer applied.

11. Slightly above maintenance P was applied to the New Block and Current Models and at maintenance requirements for the Proposed model which is seen by the respective slight increase and decrease in Inorganic Soil Pool levels.

Table 5: Change in block pool (N)

	New Block	Current	Proposed
Plant Material	7	4	2
Organic Pool	-16	91	90
Inorganic Material	0	0	0
Inorganic Soil Pool	9	2	2

Table 6: Change in block pool (P)

	New Block	Current	Proposed
Plant Material	1	0	0
Organic Pool	0	10	11
Inorganic Material	2	4	4
Inorganic Soil Pool	28	25	1

Rain/clover N Fixation

12. The Biological fixation for the combined Current and New Block Models compared to the Proposed Model at 88 or a 15% increase in fixation (see table 7 below).

13. Average N added to the proposed scenario is 9% more than the average of 177kg N/ha/yr for the New Block and Current Models combined.

14. The increase in biological fixation is mostly due to the decrease in N applied from Effluent to the Proposed model (see Table 8 below). This is deemed to be an acceptable variance and within the limitations of the model due to the proposed increase in area effluent will be applied and decrease in stocking rate.

Table 7: Biological fixation

	New Block	Current	Current+NB	Proposed
Biological Fixation	71	75	74	88
Average N applied to whole farm kg/ha/yr	28	204	177	195

15. It is not known if the decrease in N applied and increase in biological fixation will be able to maintain the pasture production modelled.

Pasture Production

16. The effluent N inputs will decrease from the Current Model to the Proposed Model by 19.4% due to the increase in area effluent will be applied (see table 8 below).

17. Fertiliser inputs of N are the same for effluent and non-effluent area in the Current Model. The N applied to the effluent blocks in the Proposed Model are 23 kgN/ha less than the non-effluent areas.

18. Pond solids are applied to the non-tiled, non-effluent areas only in both Current and Proposed Models (except Otwy_3a Non-Effluent block which has no solids applied). Liquid effluent is only applied to the effluent block in all models using a low application method.

19. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr. Average growth data for Edendale, from Dairy NZ data sheets, showed 13.3 tDM/ha (adding 195 kgN/ha of nitrogen at a 10:1 response will give pasture growth of 15.3 tDM/ha). The pasture production on this property, for dryland, is higher than the long-term growth. The annual pasture growth for the Current Model at 17.16 tDM/ha is 17% and 11% higher than the Southland average and Edendale respectively. The New Block Model at 12.95 tDM/ha is than the Edendale and Southland long term pasture growth.

20. The proposed pasture production is very similar to the Current Model pasture production.

21. The animal distribution is modelled the same in all scenarios.

Table 8: Pasture production and N inputs (fertiliser and effluent)

	New Block	Current	Proposed
Effluent Area (ha)*	-	112	152
Pasture Growth (tDM/ha/yr)			
Effluent		17.16	16.97
Non-Effluent	12.95	17.16	16.97
N Fertiliser inputs (kg/ha/yr)			
Effluent		225	201
Non-Effluent	28	225	224
N Effluent Inputs (kg/ha/yr)			
Effluent		94	56
Non-effluent (includes solids)		0 or 15**	0 or 16**
Total N Inputs (kgN/ha/yr)			
Effluent		319	257
Non-Effluent	28	225 or 240	224 or 240

**Effluent area is area that receives liquid effluent*

***Solids added to all the non-tiled blocks except to Otwy_3a Non-Effluent block (no tiles)*

Mitigations Modelled

22. As described in the Farm Scenario Plan of the Aerodrome Farm Ltd summarized on page 30, there are several mitigation measures to mitigate N loss that have been included in the proposed scenario. The below table details if the mitigation measures have been included in the proposed scenario and if they are accurately modelled.

Table 9: Mitigation option for proposed

Contain all increased stock within landholding (added dry cows and replacements to Piobiare (support block)	Can't check this as do not have the support block model
Effluent Mitigation (Increased Effluent area and targeted applications) – Avoid liquid applications in September/April and May to tiled areas, N reduced to Effluent areas (Dec/Jan)	Yes. Effluent area has increased from 112 ha in Current Model to 152 ha in Proposed Model. N Fertiliser is 201 kgN/ha on the effluent areas versus 224 kgN/ha on the non-effluent area or 37 kgN/ha to 25 kgN/ha for December and January. Liquid effluent is not applied to tiled areas April to September.
After cropping regime (Only dry cows on crop over spring and catch crop added)	Yes. Only dry cows on crop and forage oats added after crop grazed by milking cows in the Autumn.
Installation of wetland (a planned area captures an additional 57ha)	Yes, wetland area added, model indicates 76 ha as the catchment area not 57 ha indicated (19 ha in Current Model)
Calving Pad (reduce risk of pugging in spring and autumn)	Yes, calving pad added with stock on it for 100% of the cows in July and 29% in August.

23. Most of the mitigation measures are robust, however there are a few areas in the modelling that may need to be addressed.

24. It is important that these mitigation measures are measured and monitored as if they are not adhered to the N loss reductions proposed may not occur.

CONCLUDING COMMENTS

Determination of the robustness of the nutrient loss to water

25. The questions below were described at Paragraph five of this report. Whilst these have been answered throughput this report, this section summarizes the answer to each question to make an overall conclusion about the robustness of the nutrient budgets.

Is the N loss consistent with what you would expect for an operation of this type and soils in this location?

26. Based on my experience, the N loss estimates are reasonably consistent with an operation of this scale and soil types present.

Does the summary of inputs and outputs make sense? Especially clover fixation and change in block pools?

27. Overall there is no significant difference in the change in block pool values between the Current and the proposed scenario for N. Only change in block pool values for P is in the Proposed Model (P levels being maintained).

28. There is a 15% increase in biological fixation in the Proposed model and a 9% increase in N Fertiliser applied. The increase in biological fixation is mostly due to the decrease in N applied from Effluent in the Proposed model. This is deemed to be an acceptable variance and within the limitations of the model due to the proposed increase in area effluent will be applied and decrease in stocking rate. Clover and pasture inputs are similar for Current and Proposed Models.

29. It is not apparent from reviewing the Overseer technical manuals or the nutrient budgets if the difference in pasture production and N fertiliser use accounts for all the increase in biological fixation.

Check the 'Other values' block reports for rainfall, drainage, and PAW

30. The rainfall and soil information have been entered based on protocols for the location and soil type selected.

Production and stocking rate

31. Based on my experience as well as reviewing NZ Dairy statistics for the Current and Proposed stocking rate is higher than the Southland Region average in the 2017/2018 season. The Current and Proposed Models milk production per cow is higher than the Southland Region average in the 2017/2018 season

32. The average milk solids production per cow on this property for the Current Model is 424 kg MS/cow/year which is higher than the Southland regional

average of 408kg MS/cow. The target of 454 kgMS/cow is a 6.6% increase over the Current Model and if not achieved is likely to result in a lowered N loss.

33. The stocking rate at 3.0 cows/ha for the Current + New Block Models and 3.0 cows/ha for the proposed model are higher than the Southland average for the 2017/2018 season of 2.64 cows/ha.

34. It is assumed that since the Current Model is based on year end information that it represents viable production and stocking rate.

Select the pasture production in the scenario report and check pasture growth.

35. A detailed explanation of the pasture production has been outlined in the above sections.

36. The Proposed model pasture production of 16.97 tDM/ha is higher than the Current and New Block models pasture production figures of 16.5 tDM/ha. The N used in the Proposed model was higher at 195 kgN/ha compared to the average N applied to Current and New Block models of 177 kgN/ha. The supplement used in the Current + New Block Models was 1.29 tDM/ha and the Proposed model is predicting using 1.28 tDM/ha. Based on this information, the Proposed models increase in pasture harvested id justified by the increase in N fertilizer applied, increase in per cow and per hectare milk production, similar supplement imported per ha and reduction in stocking.

37. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr. Average growth data for Edendale, from Dairy NZ data sheets, showed 13.3 tDM/ha (adding 195 kgN/ha of nitrogen at a 10:1 response will give pasture growth of 15.3 tDM/ha). The pasture production on this property, for dryland, is higher than the long-term growth. The annual pasture growth for the Current Model at 17.16 tDM/ha is 17% and 11% higher than the Southland average and Edendale respectively. The New Block Model at 12.95 tDM/ha is than the Edendale and Southland long term pasture growth.

38. I have assumed an adequate level of robustness around the Current Model of actual Overseer Modelling as it is based on an actual farming system, and with that, I have assumed actual stock and fertilizer inputs used.

39. The data input protocols have been followed for all scenarios with no deviations. This leads to a high level of robustness for the relevant input data for example, climate, soils, and pasture type.

40. Based on the concerns raised regarding some of the inputs and outputs in the Overseer models, I consider that the robustness of the nutrient loss estimates for the Proposed scenario are **medium,** this is due to the robustness of the nutrient loss estimates for the actual scenarios is **medium**.

41. The area of concern in all the New Block model is: The 'New Block' has the farms location as 'By nearest town' where the proposed models have 'By

Region'. Changing to 'By region' increases the N loss in the New Block from 29 kgN/ha (1387 kg) to 31 kgN/ha (1481 kg).

42. The area of concern in the current and proposed models is: The current and proposed blocks have not had their soils updated to the latest version (all v6.2.2) however updating these did not influence N loss.

43. The area of concern in the proposed model is: The new block has not been identified in the proposed model. To be able to make comparisons of the change in farm systems the new block needs to be shown in the blocking. Also, the wetland area of 76ha is in the Proposed model and the report indicates 57 ha (minor issue and does change the N loss/ha only total N)

44. It is vital that the proposed changes to the future farm system are effectively measured and monitored as if these are not adhered to then the reductions in N loss proposed may not occur.

References:

New Zealand Dairy Statistics 2017/2018. Produced by LIC and DairyNZ 2018.
https://www.dairynz.co.nz/media/5790451/nz-dairy-statistics-2017-18.pdf
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Smith. L. C. 2012. Proceedings of the New Zealand Grassland Association 74: 147-152 (2012) *Long Term pasture growth patterns for Southland New Zealand: 1978-2012*. www.grassland.org.nz/publications/nzgrassland_publication_2284.pdf

https://www.dairynz.co.nz/media/5790163/average-pasture-growth-data-south-island-2018.pdf (Edendale)